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Trigger Point Theory as Aesthetic Activism

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Plymouth University

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**Trigger Point Theory as Aesthetic Activism:
A Transdisciplinary Approach to Environmental Restoration**

By Aviva A. Rahmani

A dissertation submitted in partial fulfillment for the degree of DOCTOR OF
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Supplemented by a DVD with Appendices and video

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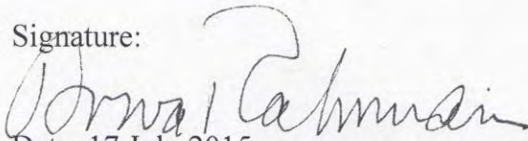
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AUTHOR'S DECLARATION

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Graduate Committee. Work submitted for this research degree at the Plymouth University has not formed part of any other degree either at Plymouth University or at another establishment. Relevant cultural and scientific conferences were attended at which the author presented her research; talks were given where her work was presented; she participated in several group exhibitions and several papers were prepared for publication (see resume on page 309).

ABSTRACT

**Trigger Point Theory as Aesthetic Activism:
A Transdisciplinary Approach to Environmental Restoration
Aviva A. Rahmani**

This dissertation presents a new approach to addressing environmental degradation based on transdisciplinary ecological art. Transdisciplinarity is defined here as merging art and science to discover new insights. Ecological art is defined as an aesthetic practice that promotes environmental resilience. This writing will describe why those approaches are essential to restoring resilient bioregionalism. It introduces the author's own heuristic perspectives and methodologies and demonstrates how they may be integrated with technology and science. The problems of accelerated loss of coastal (littoral) zone biodiversity, degraded water quality, and habitat fragmentation need critical attention. The author's research goal was to present a replicable set of guidelines for identifying small points of restoration for wetland *littoral zones* (the coastal region between terrestrial and marine life) based on a case study called *Ghost Nets*, scaled to a second case study, *Fish Story*. Her novel approach included establishing relevant parallels from quantum physics and acupuncture to energetic systems. Additional specific analogies were explored from visual arts, theatre, music, dance, and performance art, to discover a holistic and integrated point of view. Parallels and analogies were drawn by interrogating the two case studies.

An important aim of the study was to examine how certain restoration practices could be scaled up to the bioregional level and integrated with a special theory, Trigger Point Theory, to reinforce healthy ecosystems. This included an analysis of how restored upland ecotones and a different relationship to other species could contribute to restoration in the littoral zone. The analysis critiqued how anthropocentric considerations often fail to protect vulnerable water systems. The role of environmental justice for vulnerable human populations and ethical concerns for other animal species was included in that analysis. The author also claims that when artists work with Geographic Information Systems (GIS) mapping, that may propel a new transdiscourse and

eventually make heuristic information scientifically useful. Insight from the *Ghost Nets* case study informed data collections and GIS mapping for the Southern Gulf of Maine. Those insights and the mapping were used to analyze relationships between finfish abundance, eelgrass, and invasive, predatory green crabs. Conclusions were drawn that are relevant to coastal and fisheries management practices.

The author used performative approaches to contribute expert witnessing to her conclusions. Questionnaires were used to determine how much community awareness was accomplished with the case studies, and assess effects on future behavior. By combining art and science methodologies, the author revealed insights that could help small restored sites act as trigger points towards restoration of healthy bioregional systems more efficiently than would be possible through restoration science alone. In scaling up (applying small models to larger systems) and applying these practices for landscape ecology, the author assembled a set of recommendations for other researchers to implement these ideas in the future. Those recommendations included the formal engagement of ecological artists as equal partners on environmental restoration teams.

Keywords: Anthropocene, transdisciplinary, restoration, ecological art, environmental crisis, ecosystem, landscape ecology, modeling

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Introduction

The ultimate drivers of the Anthropocene ... if they continue unabated through this century, may well threaten the viability of contemporary civilization and perhaps even the future existence of Homo sapiens (Steffen et al. 2011).

Humanity faces accelerated, globalized environmental transformation and degradation, with insufficient time to adapt. Society appears conflicted between pressure to respond quickly and the need to be deliberative about adaptation to environmental change. In this Introduction, several terms will be briefly defined that will be discussed in more depth later in this writing.

Trigger Point Theory as aesthetic activism is a transdisciplinary idea model. It was conceived to address the threat referenced in the quote above as an approach to ecological restoration. The term ‘trigger point’ was appropriated from acupuncture as a means to locate and release the blocked flow of systemic energy (*Ch’i* in the human body). The transdisciplinary solutions I will propose, refer to resolving that blockage.

In this writing the term model refers to an analytic system that observes interactive patterns between *agents* (elements of a system). I will describe models are informed by sets of agents, including metaphors, heuristic practices (direct efforts to find surprising knowledge), a range of mapping methodologies, virtual conversations and the production of aesthetic artifacts. I contend that a model might be conceived to identify small areas capable of effecting bioregional environmental restoration, which I call trigger points.

I term the conflict between time required to adapt, and the rate of change, a *paradox of time*¹ (Geftner 2015), meaning, requirements for adaptation rates contract, even as need expands, generating a conflict between time demands. Psychologist Daniel Kahneman’s (2011) work describes how different time-based skills are required to assimilate the conflict between affect (fast thinking) and effect (slow thinking) in this paradox.

¹ The term in physics refers to how nuclear loops function, as in the arrow of time, which states that since an arrow in flight only occupies its own space, it is essentially at rest, erasing concepts of past and present.

My research will focus on how an artist's point of view might conflate fast and slow thinking and inform answers to this paradox in *littoral* (coastal) *zones*. There, agents are in complex interactions, with implications for bioregions. Some agents involved include, population density, sea level rise, storms caused by climate change, pollution, and the loss of biodiversity. The effects can be seen in the protection and availability of clean water for humans and other species. The integrity of the littoral system can be traced by monitoring the abundance of some taxa, such as native fish.

Conventionally, science has separated *restoration ecology*—the academic discipline that joins science and theory (Jordan, Gilpin & Aber eds. 1990)—from ecological restoration, which has emphasized the application of tools for ecosystem recovery (Society for Ecological Restoration 2004). In this writing, I will argue for an integration of those meanings (Falk, Palmer & Zedler eds. 2006) with enhanced heuristic tools.

Science tends to focus on quantifiable data to test falsification and exclude affect, which is more difficult to evaluate. But that can obscure viable, though unfamiliar solutions to complex problems. Artists can be equally limited by training that emphasizes visceral 'realities' couched in language that is often as arcane as that of science. Scientists and artists can resolve these conflicts and learn from the other by creating interdisciplinary teams with porous boundaries and common agendas. Interdisciplinarity and transdisciplinarity are somewhat fluid terms that privileges both content and process over form in evaluatory work (Klien 2008). I will investigate these challenges through the lens of two case studies from my own practice and the work of other artists.

A key premise of this writing is that the confluence between the points of view I will describe, could build a better *complex adaptive model* (CAM). A conventional CAM mathematically describes complex relationships between independent agents in adaptive transition. My premise determined choices for metaphors about complexity that would represent a range of points of view. The *butterfly effect*, is an example of a metaphor for chaos theory based on Ray Bradbury's story about how a very small event can precipitate substantial consequences. *Chronic Fatigue Syndrome* (CFS), a little understood immune system dysfunction with no known cure, characterized by physiological and neurological impairment, was chosen as a metaphor for how considered choices can leverage very small amounts of energy for survival.

My two case studies (*Ghost Nets* and *Fish Story*) and examples from other ecological artists I discuss are the macro- and micro-versions of a paradigmatic transdisciplinary CAM. Transdisciplinarity, as advanced by proponents like Basarab Nicolescu (Nicolescu 2002, 2010), on whose approach I will build, evolved from quantum physics and uniquely emphasized the role of *complexity science* (Brenner 2003). Complexity science concerns itself with how agencies interact adaptively and ultimately self-organize. Complexity science specifically addresses problems of ecosystem sustainability. I will, however, refer to *resilience* rather than sustainability, because the former presumes a greater capacity to absorb change without collapse.

Physicist and activist Vandana Shiva sees our present environmental situation as so dire that she describes it as an environmental war endangering all life in order to satisfy greed: a socio-political and philosophical problem inherent in the nature of capitalism. I agree with Shiva's contentions and will propose ways to identify 'trigger points' in systems (as loci of *environmental triage*) in that environmental war.

The means I will propose to locate this triage will be pragmatic but it will also attempt to solve a theoretical *thermodynamic* problem about the nature of change. In addition to my comparative analysis of case studies and examples, the pragmatic and theoretical problems were researched in workshops, with GIS mapping to establish some data analysis, and in the production of artifacts.

I will establish how systems and beliefs about landscapes might overlap, balance and reinforce each other, from landscape ecology, to Traditional Environmental Knowledge (TEK). I will compare the points of view of restorationists working in *nucleation*, which is the methodology of identifying and expanding small *refugia* (isolated areas where biodiversity has persisted), to those who are skeptical of restoration (Elliot 1982). Nucleation has been applied in particularly fragmented tropical systems of Brazil, Costa Rica, and other South American sites with histories of deforestation (Cole, Holl & Zahawi 2010; Reis, Bechara & Tres 2010; Corbin & Hull 2011).

I will specifically contrast mechanistic approaches, such as Richard Forman's (1995) view of the landscape as a *mosaic of patches* and holistic thinking, such as TEK.

In this writing holistic means, a point of view that is multi-dimensional, pluralistic, and inclusive, allowing for whole systems thinking. This definition is also an ecofeminist

point of view. Both Indigenous peoples and ecofeminists observe that separating experience into rigid categories, may render life experiences meaningless.

Performing ecology will be introduced as a methodology for restoration work, drawing from aesthetic theory and personal heuristic experience. I define performance art, on which performing ecology is based, as an event taking place and sustained over time, initiated by an artist, and ‘scored’ as a series of planned activities, not all of which may be self-evident. My conclusion will detail how performing ecology might be integrated with other systems, including classical symphonic structures. Performing ecology will be proposed as a redundant model for engineering Trigger Point Theory as aesthetic activism. People who might benefit from this research include restoration scientists, land managers, and other artists.

The ways metaphors, case studies (including the practice of performing ecology), models and correspondences between disciplines, can inform systems will be compared to agents of a CAM. A typical adaptive model uses mathematics and algorithms to describe how a *complex adaptive system (CAS)* will respond to change. A CAS can be defined as, ‘the interaction of a set of perhaps simple but numerous entities, components, or agents that interact and adapt on the basis of non-linear interactions ... to give rise to interesting and emergent phenomena.... between equilibrium and chaos’ (Niazi 2013). The rules to observe those interactions are often *Boolean*² though specific definitions of a CAS may vary between disciplines.

The CAM rules I will try to discover apply to targeting points for attention (triage and nucleation). In this dissertation, I first separate the agents of the CAM in each chapter, then reorganize them, giving equal weight to each agent system in interaction.

In considering approaches to large landscapes, I will argue, as many ecofeminist philosophers have, that humans have confused dominating nature with protecting systems upon which humans depend for survival. The overall premise of my thesis is that we can best design ecological models to address the environmental urgency and complexity of this era by subordinating short-term human needs to the long-term needs of other species.

² Boolean logic is basic to modeling mathematics, in which the premise “IF” is predicated on whether data is at an intersection (AND), at a union (OR), is in negation (NOT) or is exclusionary (XOR). It is also essential to semiotic thinking (see glossary for more information).

In this way, humans would have an equal but not dominant position. I argue for why *layering* such holistic changes in attitudes and behaviors with bioengineering solutions can effect resilience.

The term ‘art life’, a precursor to my phrase, ‘aesthetic activism’ (in the public sphere) or ‘performing ecology’ (in private), emerged in the 1970’s, concurrent with the emergence of feminist and environmental ethicist ideas. ‘Art life’, is often associated with the artist Allan Kaprow, a long term mentor of mine since graduate school, who advocated integrating philosophical and quotidian experiences (Kaprow 1993).

Metaphors and correspondences serve to bridge my theoretical and methodological approaches to problem solving amongst art, science, and communities. I will consider metaphors from physics, indigenous and holistic traditions including acupuncture, found objects, such as lost fishing nets (ghostnets), and the theatrical concept of the *fourth wall*, meaning, the potential space between the artist or artists and the participating audience, including, in this writing, the lives of other species.

I conceptualize the triage trigger points in this dissertation as *black swans*, unexpected events that change perceptions, contributing surprising layers of data to restoration work. As I will investigate, these black swans can represent innovative, creative systems-modeling designs.

The discussion of how black swans might function will include describing how artifacts, e.g. mapping, can efficiently focus and shift attention. It will also analyze heuristic practices in the performance art aspects of performing ecology, musical structures (symphonic opera), and idea models from ecological art. Artifact production, including mapping and performance art can also inform expert witnessing to identify trigger points for restoration. Visual artifacts can function as expert witnessing to contribute towards the development of innovative, creative systems for environmental restoration.

In Chapter four, I will detail how some fish species might serve as indicator taxa (Hilty & Merenlender 2000) for healthy water systems when their habitat is observed cartographically. Observing fish can illuminate how our wider relationships with wildlife might predict future human relationships to water.

I will refer to two case studies throughout this writing: *Ghost Nets*, a small, ongoing

restoration project located in the Gulf of Maine; and *Fish Story*, an adaptive management project for the Mississippi Water Basin (MWB). These case studies evolved from different methodologies. Designation of the *Ghost Nets* site resulted from a primarily art-based process. *Fish Story* emerged from extensive online discussions with scientists as part of the *Gulf to Gulf* project (2009–present).

The *Ghost Nets* site is comprised of an area slightly larger than one hectare. Located on a fishing island, it had been the former town dump. Previously degraded by timbering, shepherding, and quarry mining, it included land made from granite tailings and was slated for development of an ethanol plant. I purchased the site in 1990 and spent the next ten years restoring its wetlands systems. It has been subsequently monitored.

Fish Story (2012–2014) was an attempt to collaboratively identify a trigger point to remediate the bioregional problems of the MWB. I performed a series of live and virtual adaptive management experiments with small groups to address degradation in the MWB and dead zones in the Gulf of Mexico. My primary collaborators were Dr. James White, Director of the Institute for Arctic and Alpine Research at the University of Colorado at Boulder, and Dr. Eugene Turner at Louisiana State University, whose areas of specialization are, respectively, climate change and wetlands biology. Our goal was to understand relationships between agents in that complex system. Our experiments led to a conclusion that global warming might be mitigated with sufficient re-greening of the earth.

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Figure 1: The *Ghost Nets* site in context of the greater Gulf of Maine. *Ghost Nets* is seven kilometers from the mainland town of Rockland, Maine, on the southeast coast of Vinalhaven Island, in the Northern Atlantic. The island, known for rich fishing in its offshore waters, is three-and-a-half, by one-and-a-half kilometers. The coastal location receives high impact winds and storm surges (Rahmani2011).

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Figure 2: Placemark at the *Ghost Nets* site, located midway down the riparian zone to the salt marsh restoration in the southern section of the site on made land. Immediately west and east of the site, land has been fragmented by homes, but north and southeast, open land still provides some cover and forage for wildlife. The restored *Ghost Nets* site provided contiguous habitat corridors for wildlife (source: Google Earth 2014).



Figure 3: View of the *Ghost Nets* site shortly before it was abandoned by the quarrying industry in 1930 (photo courtesy of the Vinalhaven Historical Society).

The *Ghost Nets* site was chosen as a case study because the original site was degraded but seemed critically located. When I identified it in 1989, there was no remaining soil. Quarrying industry activities had buried the local topical fringing marsh. But its proximity to the Gulf of Maine placed it in a historically rich marine biosystem of complex littoral edges. The geomorphology had the potential to contain several microhabitat refugia. These included surface water and vernal pools created by the granite quarrying. It was near other rocky intertidal marshes and there was evidence that an estuary on the site might be *daylighted*, (the process of lifting away material that has impeded tidal flow). The location was therefore selected as a trigger point because of the confluence between marine and terrestrial habitats. The ten-year project (1990–2000) was divided into three phases. Each phase integrated poetic and metaphorical concepts with the physical labor of transforming the site while producing contemplative artifacts.

The *Fish Story* case study emerged after considering how *Ghost Nets* might represent a microcosmic example of Trigger Point Theory. It afforded an opportunity to explore the same ideas from a macrocosmic approach. White, Turner and I, researched the MWB in periodic *Gulf to Gulf* webcasts, to discover potential trigger point sites in the city of Memphis. I visited Memphis twice, first for reconnaissance and second, (with Turner) to enact a series of public events in May 2013 to determine a point of environmental triage.

The map in Figure 5 was created at the inception of *Fish Story* to analyze relationships between agents in the bioregion. The map illustrates how severe weather events impact Memphis. It also situates the city in relationship to other areas impacted by events caused by climate change, such as the area around the Far Rockaways in New York, which were impacted by Hurricane Sandy in 2012. Both cities have vulnerable littoral (coastal) zones. Memphis was chosen as a trigger point for the MWB because it is positioned at a confluence of agents. The goal of activities in Memphis was to locate one small point in the system where triage might precipitate a significant reversal of these large landscape patterns and be reflected in the health of endemic fish.

Image not available

Figure 4: Location of *Fish Story* (Memphis, at the centre of the indicated spheres) in the vast scale of the Mississippi Water Basin and in relation to the Gulf of Mexico (Rahmani 2014).

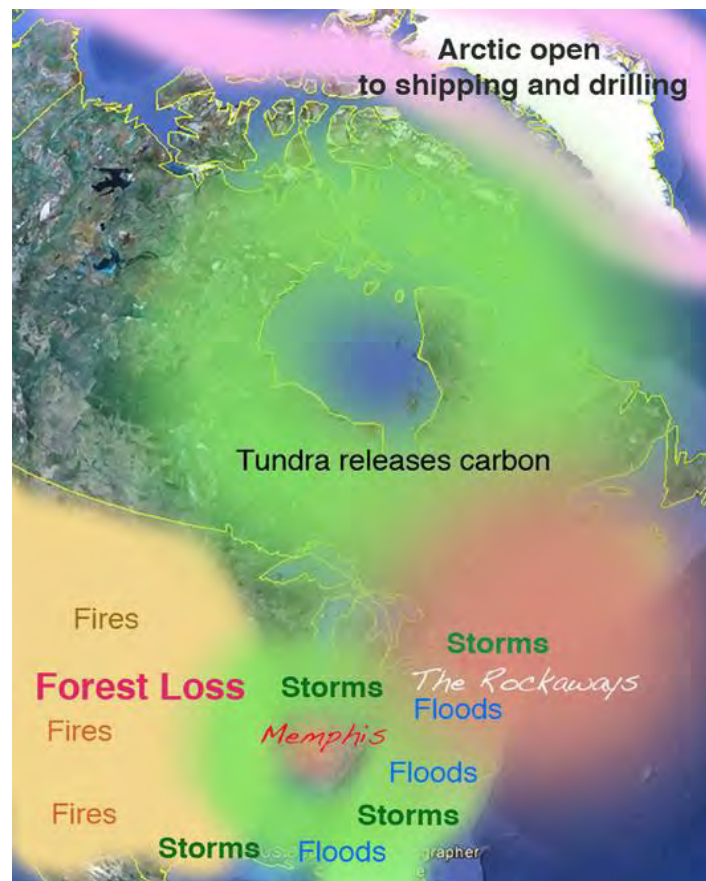


Figure 5: This map indicates the Far Rockaways, which had been heavily impacted by Hurricane Sandy, and Memphis; the two locations are equally but differently impacted by global dynamics (Rahmani 2013).

The current scale of environmental degradation is leading to what some refer to as ‘emergent’ or ‘novel’ (unprecedented, human-created) ecosystems (Hobbs et al. 2006). Is it possible to create a more resilient restoration model? Can we use limited resources to restore large, complex, degraded landscapes? Could Trigger Point Theory maximize the conservation of clean water?

These questions arose from observing systems failures in New Orleans after Hurricane Katrina. The implementation and monitoring of federal remediation and restoration projects, initiated, for example, by the Army Corps of Engineers, were and continue to be, subject to political pressures and budget cuts that compromise results. How then, can we preserve water systems for future generations and step back from the brink of environmental catastrophe at a time when many governments are eschewing conservation or restoration work?

In research to preserve water systems, scientists have paid attention to how abiotic and mechanical transformations impact water flow and the habitat restoration that has resulted. Often those impacts are defined by narrow metrics: for example, single-species or systemic functionality (Ruiz-Jaen & Aide 2005) or political pressure. Regulatory measures for human use are rarely compatible with conservation goals. This is because, as discussed in *The Wolf's Tooth* (Eisenberg 2010), we tend to focus on expediency at the expense of the ecosystem. In small areas, that can be seen in how the pragmatic value of large predators in unfragmented ecosystems is ignored. On the macro scale, political stalemates in the Everglades have been particularly disheartening.

The basic response, which employs engineering and technological solutions, is a type of social trap, where governmental mandates, planning-based paradigms, and vested interests often interact to inhibit the resolution of chronic environmental issues (Gunderson & Light 2006).

As I will argue, ecological art can be as rigorous a practice as pure mathematics for yielding new knowledge. My focus is primarily on the littoral zone and the role of ecological artists in the United States because that country represents: 1) vast, until recently, undeveloped expanses of land previously managed by Native Americans; 2)

relatively unimpeded industrial development and resource extraction—for example, for oil drilling or hydraulic fracturing (colloquially referred to as ‘fracking’); and 3) industrial factory farm practices.

Further, the country has had a recent record of political ambivalence about conservation at the federal level. Europe, by contrast, has largely eliminated wilderness areas, and many of the settled, even urban regions have been managed for millennia, integrating cultural and natural aspects of the landscape.

American ambivalence was evidenced in scientific papers submitted to the 2013 World Conference on Ecosystem Restoration in which modeling applied to large landscape problems generally focused on short-term gains, from game animals to human recreation (SER 2013). The irony of this approach is that it guarantees continued degradation of the very habitat it purports to be trying to rescue. Without long-term planning, systems will degrade.

The conflict between the scale of problems and capacity for timely response confronts our culture with ever more complex, chaotic situations. The collapse and paradox of time in the *Anthropocene Era*, this current period of geological time evidencing human activity with global ecosystem impact, is arguably analogous to the period of cultural transition from modernism to post-modernism (see Chapter three). It was during the past fifty years of that transition, that the international genre of ecological art emerged. Art writer Lucy Lippard, sees a role for art in communicating these transitions. Lippard wrote, ‘It is the artist’s job to teach us to see’ (Lippard 2007 p. 11). Science can require more time to verify insights.

1. Challenges

A primary challenge of this research is to discover how to determine whether integrating ecological art with restoration science can help solve this collapse and paradox of time with environmental restoration.

In the mid-twentieth century, a number of writers began applying principles of dynamic systems from physics, to the natural world. Methods ranged from highly mechanistic, to what might be seen as highly subjective. An example of the latter was physical chemist and philosopher Michael Polanyi’s work on what he termed ‘tacit

knowledge' (Polanyi 1966, 1967). Could a model be credible that systematically accesses the discursive, heuristic, and reflective experiences Polanyi included: knowledge that cannot be transmitted verbally and is often intuitive but has significant weight (Polanyi 1962)? In *The Structure of Scientific Revolutions*, Thomas Kuhn made an historical analysis of transitional process in scientific thinking (Kuhn 2012). Could metaphors referenced earlier in this section synergize a comparable transdisciplinary transition that conflates art, physics, and restoration science? I will argue that ecological art methodologies can use tacit knowledge to close gaps in understanding, reconcile conflicts, and access new knowledge about restoration work.

Renaissance artist Leonardo Da Vinci's work has been the most cited prototype for eliciting new knowledge from transdisciplinarity. He integrated art and science to study and find solutions to dynamic systems such as water flow, as can be seen in his portrayals of correspondences between systems.

The earth has a vegetative spirit in that its flesh is the soil, its bones are the configurations of the interlinked rocks of which mountains are composed, its tendons are the tufa, and its blood is the water in the veins; the lake of blood that lies within the heart is the oceanic sea, and its breathing is the increase and decrease of the blood during its pulsing, just as in the sea is the flux and reflux of the water (Da Vinci 1510).

Da Vinci's metaphorical observations about flux and reflux may have led to a number of his practical design solutions, such as a wheel to raise water.

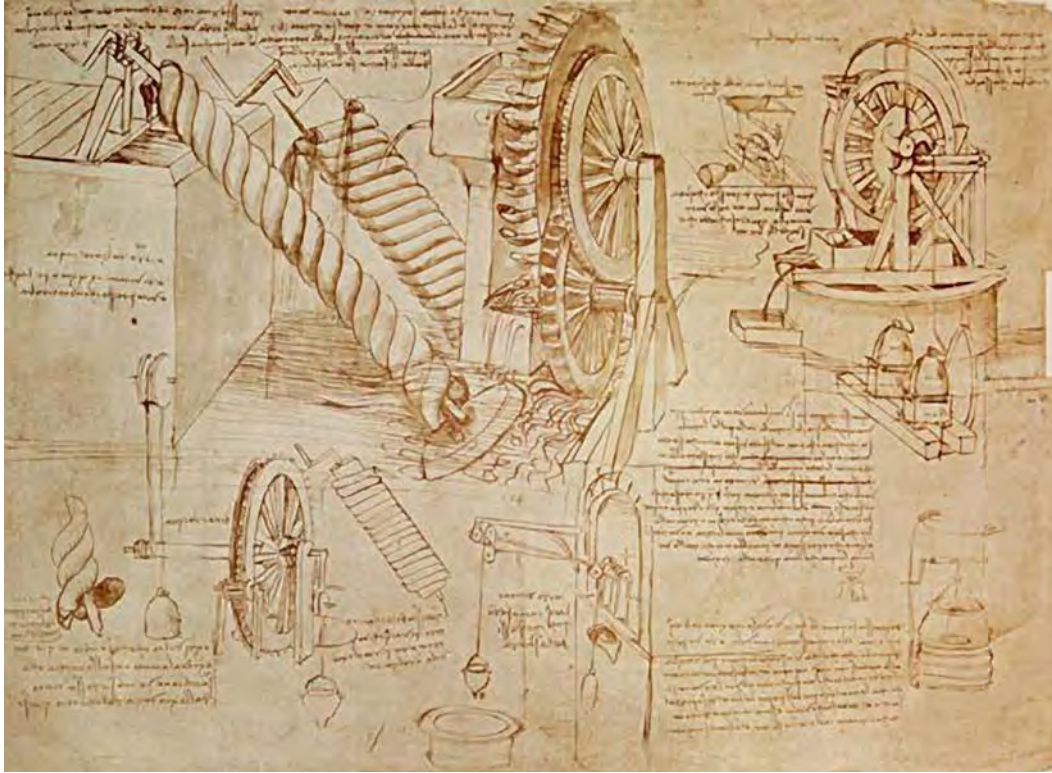


Figure 6: In this transdisciplinary drawing, Da Vinci realized a practical solution to his text on flux and reflux, detailing the design of a wheel that could raise water (Da Vinci 1510).

Since Da Vinci's time, knowledge production has become segregated into specialized and monetized silos, making it more difficult for artists to assume his mantle. In the last century, modernism seems to have disconnected artists and artmaking ever more extremely from pragmatism. However, as people have become more aware of environmental damage and the associated urgent issues we face, there is a new openness to innovative models.

Another goal of this research is to establish a basis for the inclusion of more ecological artists in restoration work. While integration of ecological art with biological science in restoration is increasing, it is still less common than integrating *social practice* art (work that focuses on human community events, engaging in personal interaction, often with the intent to address a political agenda). Some artists do work with scientists on environmental restoration projects, as I will discuss later. Other practitioners are pursuing transdisciplinary, independent research about environmental issues in art-science programs such as Z-Node at the University of Applied Arts in Zurich, Switzerland. However, the existing strategies for large landscape restoration rarely include artists in the planning and implementation process,

despite evidence that some ecological artists have extensive experience with restoration work and long-term planning. I argue that, given the opportunity, ecological artists could make substantial creative and pragmatic contributions to research and the success of large landscape restoration projects. The ecological artists I will reference will include the work of Aimee Morgana, Bernie Krauss, Eve Andree Laramée, Mierle Laderman Ukeles, Dominique Mazeaud; and my work on *Blue Rocks*, part of my *Ghost Nets* case study. These examples will show how artists have taken up Da Vinci's transdisciplinary mantle to discover new environmental approaches to systems knowledge.

Currently, few ecological artists are invited to participate in the planning stages or ecological restoration projects. That situation may reflect a very narrow understanding of potential contributions culture can make to science, as the feminist writer Sandra Harding has suggested (Harding 1986). However, artists often neglect problems of 'Quantifiable Quality Assessment' protocols essential to restoration scientists and funders because of ignorance of the existence, value, and necessity of those protocols, or because of a lack of access to funding. I attempt to address the consequences of that ignorance, such as the value of baseline quantitative studies.

I will discuss a falsifiable experiment based on quantifiable, correlative data, using Geographic Information Systems science (GISc). GISc is distinguished by its capacity to derive scientific data from layered statistical data, geolocated and organized in cartographic patterns. Discussions with the late Dr. Michele Dionne, former Director of the Wells National Estuarine Research Reserve, and my former external advisor for this dissertation, were paramount in designing this GISc work. The relationship of that GISc work will be examined as part of this new model for a systematic approach to environmental restoration.

The work of mathematician and science philosopher Michel Serres parallels the thinking of several ecofeminist writers I reference, who critique hierarchies in research methodologies. Collectively, they argue for a more horizontal point of view with other species. They have all used metaphorical thinking to critique contemporary science and contend that the siloization of knowledge stifles original insight.

...domination is never anything but the appropriation of legitimate death and

destruction (Serres 1974).

Until recently, metaphorical research has also been siloed, generally between semiotic and philosophical considerations: between use and meaning (Gardner & Winner 1979). The work of cognitive linguist George Lakoff, argued that metaphors determine behavior (Lakoff & Johnson 1980). Recent cognitive neuroscience research seems to support the premise that metaphors both illustrate and direct attention, while siloization supports less creativity than interdisciplinarity (Lacey, Stilla & Sathian 2012).

In my case study work, I discovered that many of the agents I observed and that determine the current state of ecosystems, can be presented as problems of physics, as Previdi et al. (2013) suggest in their analysis of Anthropocene climate change. That study suggested that physics-based modeling to find emergent order in chaos might also hold solutions to mitigate ecosystem collapse. If interactions between systems can be analyzed as patterned layers of physical interactions to discover confluences, might it also be possible to use concepts from physics to more easily identify targeted points of intervention?

...the second law of thermodynamics is a sort of meta-rule, which holds regardless of the specific dynamics of the systems we look at' (Maruyama, Nori & Vedrai 2008).

Now, I will describe how the second law of thermodynamics contextualizes some metaphors I reference, and consider their relationships to the Anthropocene. The metaphors I have chosen from physics represent principles about the dual nature of entropy, in which heat and the work of replacing information have equal energy. These descriptions may help explain how the metaphorical terms I use, such as the butterfly effect and black swans, represent the energetic nature of the ecosystems I will discuss.

The butterfly effect refers to the point in chaos theory, a response to what is known as *sensitivity to initial conditions*, where a small space-time anomaly may emerge and precipitate *self-organisation*, the emergence of new relationships between agents, towards an alternate equilibrium. This dynamic holds true despite other mechanics in physics.

Metaphors requiring more extensive clarification include, lost fishing drift nets called ghostnets, which represent the disorder of chaos; the fourth wall in theatre, which represents the point of contact that may initiate sensitivity to initial conditions. The flow of Ch'i in acupuncture; and CFS as an illness, are examples of self-organisation. Each of these metaphors represents different aspects of entropic change. I will discuss how discovering agent confluences between these metaphorical models may signify where to observe the early emergence of black swans.

Chapter logic	Physics concept	Metaphorical model	Restoration premise	Relevance to Trigger Point Theory as aesthetic activism rules for a CAM
1-How does an idea model work?	Entropy in Maxwell's Demon	Ghostnets	Systems thinking	Accept urgency to change with play
2-How could different point of view aid restoration?	Perturbation and disruption	Fourth wall	Interdisciplinarity and island biogeography	Accept urgency of time with reflection
3-How could art address degradation urgency?	Emergence	Black swans	Nucleation as triage	Ecological art as an entry point in chaos
4-Layering GIS and performative research	Self-organisation	Flow of Ch'i in acupuncture to heal from CFS	Ecotone contiguity and fractal iteration	Test limits of perception
5-Integrating science, art, and life into a transdisciplinary practice	Sensitivity to initial conditions	Butterfly effect	Adaptive management	Performing ecology to discover critical disruptions

Table I-1: Each chapter presents another agent system of a hypothetical CAM, with relationships to physics concepts, conceptual metaphors, and restoration science premises (Rahmani2013).

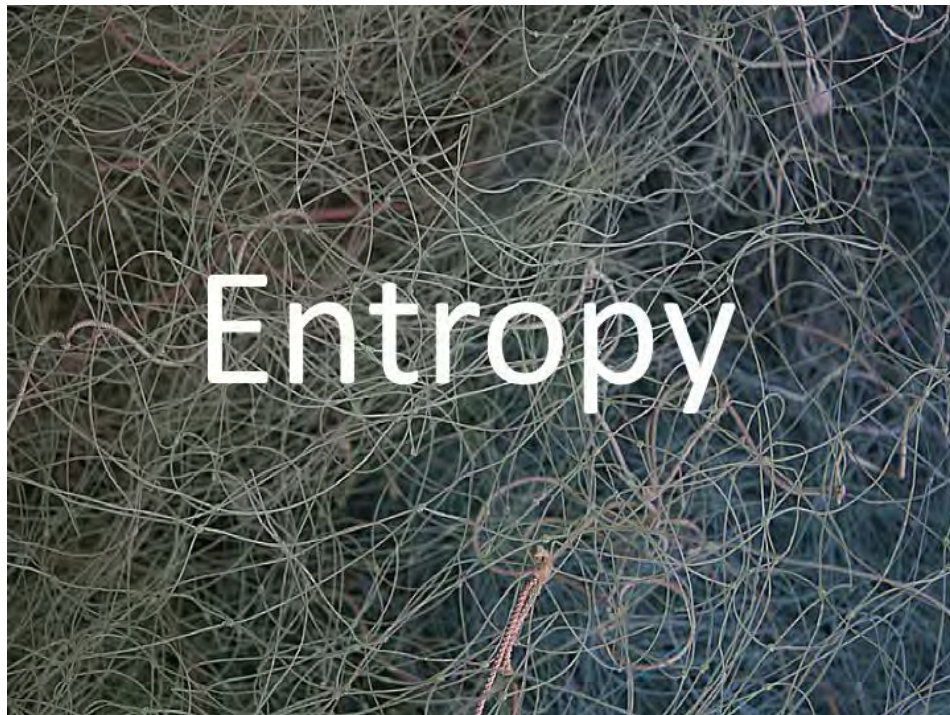


Figure 7: The ghostnets metaphor represents environmental entropic disorder; tangled driftnets are analogous to the chaotic nature of entropy (Rahmani 2014).

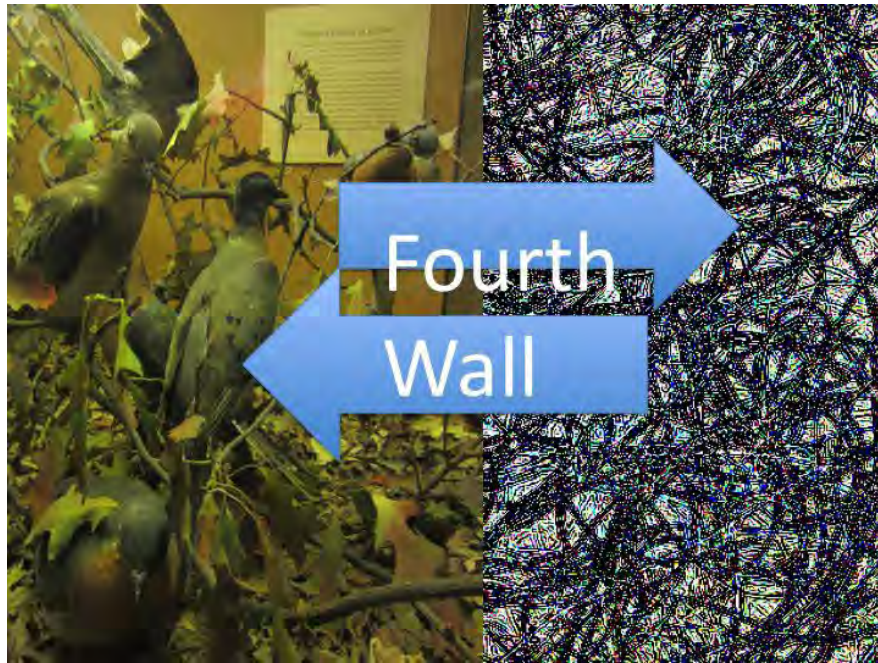


Figure 8: System interaction in the fourth wall. Although a boundary splits agents to the right and left, the nature of interaction erases that boundary, indicated by the arrows. To the left are extinct passenger pigeons at the Museum of Natural History, New York. Their extinction affected perception of ecological complexity in North America. To the right, an abstracted image of ghostnets, an example of the complexity that sent those birds into extinction. The arrows represent how interaction continues to become more complex (Rahmani 2014).



Figure 9: Metaphorical black swans can immediately alter perceptions of entropy when they appear in a system (Rahmani 2014).



Figure 10: Chronic Fatigue Syndrome requires an absolute reorganisation of every aspect of an entropic system in the patient (Rahmani 2014).

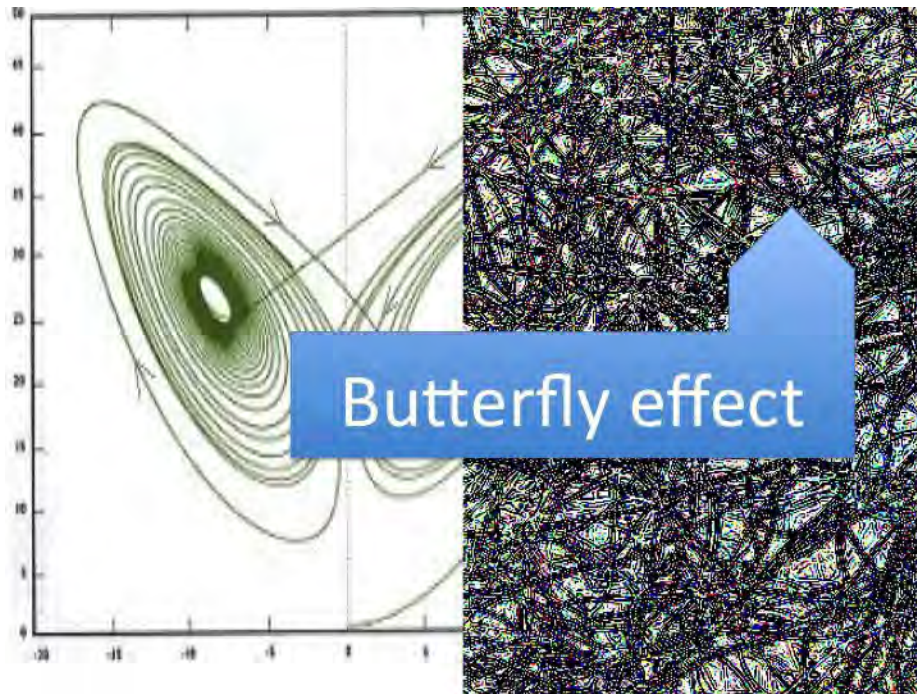


Figure 11: Butterfly effect: how a small event (such as a butterfly flapping its wings) can start a process of change that can have large effects on systems (Rahmani 2014).

2. Models, Metaphors, and Analogies

Several principles from thermodynamics about sensitivity to initial conditions underlie my arguments: *emergence*, (which in physics means how unpredictable changes occur in, and ultimately, organize themselves into complex systems), self-organisation, and self-similar patterns. These terms relate to how resilient *ecotones* (transitions between habitat edges), nuclear *scaling* (to apply nucleation to larger systems) and non-hierarchical relationships (particularly between species) function as agents in ecosystems.

Collectively, the interactions between these agents will be discussed as an aspect of the fourth wall, by which term I refer to the potential space between the artist or artists and the participating audience, in which I include the lives of other species.

These principles from complexity, chaos, and systems theory, frame my discussions about triggering self-organisation. I will identify possible black swans in my own ecological art projects as potential points of emergence in ecosystems. I will describe how those projects shift attention to new points of view, and how that shift in attention might introduce scaling solutions to systemic problems. These are systems of small events that could aggregate to become agents linked in complexity and create new self-organisation.

A corollary concept for such linkage is the mathematical aspect of chaos called *topological mixing*. This refers to the nature of boundaries, connection, and continuity in complex spatial relationships. Topological mixing is the abstract mathematical concept of how agents in a chaotic system interact to effect unpredictability. It is also relevant to the theory of *fractals*, developed by physicist Benoit Mandelbrot, who observed how nature replicates patterns (Mandelbrot 1982). Fractals define how forms emerge as detailed, self-similar, repeatable, and scalable patterns in nature (Mandelbrot 1982). Ecotones have fractal properties that connect habitat edges from one transition to another to create a matrix of habitat and function in nucleation, and effect succession. In reference to my premises about modeling, considering the self-similar, the fractal nature of ecotones builds engineering principles of iteration and leverage into strategic planning. In natural systems such iterations provide resilience (Holling & Gunderson 2002). Ecotone edge transitions provide the iterative *redundancy* for habitat resilience critical to water protection. That redundancy is comparable to how human engineering offsets failure by

embedding systems within themselves. The role of redundancy supports my arguments for layering aesthetic approaches into ecological restoration.

Physical chemist Ilya Prigogine critiqued how the second law of thermodynamics had classically occupied itself with microscopic and hypothetical (closed) systems that tend towards equilibrium (Prigogine & George 1983). Prigogine demonstrated the nature of ‘dissipative structures’: unstable systems that essentially thrive adaptively on self-organising disorder, generating adaptive evolution in macroscopic complexity. That led him to speculate on how physics might further inform the humanities. He wrote that complexity renders disciplinary boundaries ‘obsolete’ (1983), inviting consideration of a less hierarchal relationship to knowledge.

Prigogine’s reflections on the impact of physics on the humanities encouraged me to investigate the opposite conjecture in this research. Hypothetically, could ecological art clarify how small impacts on larger systems inform the physics of emergence? Could this emergence lead to self-organisation on the macro level in restoration work? Might complexity inform adaptive management when anthropogenic impacts add complexity to the responsive capacities of stakeholders? Is nucleation a means to catalyze regional restoration?

When nucleation activates small, localized refugia in degraded sites with seed rain (seeds that fall from plants to the earth) and plantings of saplings, the seed rain is distributed by small animals along *corridors*, pathways of animal movement between nesting, mating, foraging and watering sites. These processes contribute contiguity between landscape patches and ecotones to eventually knit bioregions together.

Nucleation can also be understood as a corollary aspect of *branching*, as a quality of topological mixing which refers to the multi-dimensionality of phenomena, in that a number of biological agencies interact to effect outcomes. This phenomenon is encountered in restoration work. Branching also describes non-hierarchal conceptual relationships such as those reflected by Prigogine and in some transdisciplinary and ecological art thinking. In Chapter four, I will discuss how branching was appropriated in critical art theory in descriptions of rhizomatic thinking, as defined by the philosopher Gilles Deleuze and the psychologist Felix Guattari as a non-linear means of thinking about complexity. In their comparison of the dynamics of capitalism and schizophrenia,

they provide the most complete explanation of this concept (Deleuze & Guattari 1972, 1987).

The complexity of ecotone relationships in the littoral zone requires untangling those complex relationships between agents of human behavior, urban planning, and ecosystem functions while being alert to emergence. As Apgar, Argumedo and Allen suggest (2009), this funneling and filtering of evidence requires the lateral transdisciplinary (branching) thinking suggested by Prigogine and also by Deleuze and Guattari.

The most critical problems humanity faces today are complex problems, characterized by high levels of uncertainty, multiple perspectives, and multiple interlinked processes from local to global scales.... Traditional research inquiries with specialized experts are unable to make the connections required to manage complexity. Transdisciplinary approaches can help different stakeholder groups to share and use their knowledge and experience for problem-focused inquiry. Facilitating transdisciplinarity requires good dialogue processes and the development of holistic frameworks (Apgar, Argumedo & Allen 2009).

In agreement with Apgar, Argumedo and Allen, my arguments in this writing will incorporate transdisciplinary values to resolve strategic adaptive management conflicts between natural systems and built human infrastructures, including social infrastructures. Transdisciplinarity may represent a generalized model in itself, or may be seen as a tool to analyze complexity. In this writing, I advocate for transdisciplinarity as a methodology to integrate a number of different points of view as independent agents in relationship to each other. The conceptual physics metaphorical model that best represents the relevant binary nature of entropic emergence in complexity is *Maxwell's Demon*.

3. Maxwell's Demon Model

In 1867, Maxwell's Demon was created as an idea model, or thought experiment by physicist and mathematician James Clerk Maxwell. He posited an imaginary intelligent being manipulating the distribution of atoms: phenomena too small to measure in a closed system, thereby acting to decrease entropy and contradicting the second law of

thermodynamics. Later physicists proved that the memory storage required for such an apparent feat of imposed order did not contradict the second law, because the work of memory storage also represented energy. Maxwell's Demon tested the theoretical statistical certainty of the second law for isolated, closed microsystems. It catalyzed several streams of new knowledge when it was shown that information could pass between the boundaries of a closed system in that separation of molecules (Shannon 1948)³ because in a closed system, entropy never decreases.⁴

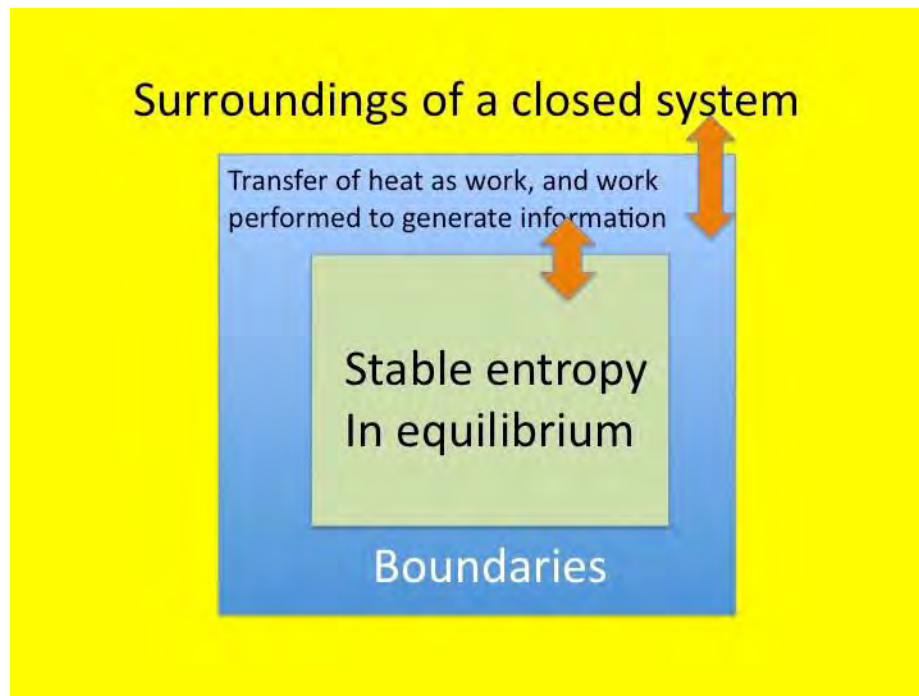


Figure 12: In the second law of thermodynamics, heat, both in the form of caloric energy and the work of creating data, can move between boundaries in systems. This schematic shows how that movement works in a closed system (Rahmani 2013).

I will reference Maxwell's Demon as an inspirational black swan, inducing butterfly effects of emergence in information science systems. I argue this model can also be applied to restoration work.

When the work of the 'demon' was shown to maintain steady entropy rather than disrupting the arrow of time, and that entropy increases as a function of time,

³ Claude E. Shannon was the original developer of information theory.

⁴ The progression called the 'arrow of time' preoccupied semiotic philosopher Jacques Derrida, who presented his thinking in a 1966 paper that was published in a later collection (Derrida 1978).

mathematicians and theoretical physicists began exploring the controversial concept of *dual entropy*, conflating heat and information. The demon's work to replace entropy being dissipated by his task included five stages:

1. establishing a novel boundary between molecules,
2. observing the pattern of their distribution,
3. discriminating information about that distribution,
4. memorizing data in order to reorganize the information, and
5. exercising erasure (of previous information) by establishing a new system.

The implications I found in my research on Maxwell's Demon and the stages the demon's work required, are that an intelligent agent (a black swan) can change a closed system without the use of great material force. I explore the further implications of this idea model in my metaphors and models. This may set the stage for exploring how art may function as an intelligent agent, that can lead to different sets of scientific questions about environmental adaptation and therefore, different sets of answers to the paradox of time.

4. The Acupuncture Metaphor

I will argue that the practice of acupuncture may correspond to strategies for managing land conservation and ecological restoration. Once effected, the restoration of vital energetic flow in successional habitat might be analogous to the restored flow of Ch'i in the human body. It would re-establish contiguity between ecotones, refugia and hydrology. As an idea model, this correspondence could be related to biogeographies. In which case, nucleation might function as trigger points and find a path from local, to regional impacts with self-organisation. I extrapolate from the function of acupuncture trigger points in the human body, to explain how *nucleation trigger points* (trigger points that effect nucleation) might heal depleted, degraded systems for ecosystem restoration.

Acupuncture is classically described as a means to restore equilibrium to the human body's internal system as part of a universal system to which humans must adapt for health (Tsuei & Lehman 1997). Practitioners are exhorted, 'If in curing the sick you do

not observe the records of heaven nor use the principle of earth, the result will be calamity'.⁵ Here, acupuncture represents adaptation to complexity.

Acupuncture contextualizes the human body in a cosmology of natural forces and references living systems in a number of ways. The entire system requires balancing paradoxical representations of light and dark (yin and yang), moist and dry, cold and hot, etc. The diagnosis of illness is related to a conceptual system of five elements: fire, water, metal, air (or gas), and wood, each requiring balance. Aspects of these elements might symbolize the relational parts of any ecosystem. Fire may be seen as comparable to global warming. Water might refer to fresh, brackish, and salt systems, while metal could reference geologic earth elements, including geographic features. Air could represent gravity or atmosphere and wood, vegetative material.

Acupuncture is introduced here as a provocative strategic model because it relies on correspondences between human physiology and biogeographic equilibrium. Those correspondences are based on thousands of years of observing complexity from an Oriental point of view.

5. The CFS Metaphor

CFS, is an energy-limiting immune system illness sometimes managed with acupuncture. The most characteristic symptom of CFS is the collapse to another (bedridden) state, with some neurological symptoms. Degraded habitats also often collapse to another state. In CFS, that can mean a loss of more than 50 percent of previous stamina for a minimum of six months with no external symptoms, apparent cause, cure, or correlation to indices of depression. Many patients learn to be hyper-vigilant about personal sensitivity to initial conditions: factors that will cause a physical relapse. In habitat, collapse may be inevitable but also unpredictable. Habitat collapse may also be invisible to casual, cursory observation when biological linkages, such as ecotones or animal corridors disappear.

As a metaphor, I intend CFS to represent how self-organisation might occur in ecosystems, as an adaptation to severe energetic restrictions. Could this analogy inspire interventionist models with art? Some pertinent qualities might include:

⁵ *Yellow Emperors Canon of Medicine* (Huangdi Neijing) approximately 475–206 B.C.

1. a reference back to how the work of Maxwell's Demon can reorganize dual entropy (energy and information) in systems with minimum physical force
2. referencing how acupuncture functions as a whole system to resolve blockage
3. how CFS requires patients with limited resources to choose between triage priorities.

I will pursue these relationships between Maxwell's Demon, acupuncture, CFS, sensitivity to initial conditions, and environmental triage in more depth. I argue that the means to manage CFS may also represent an activist model for ecosystem interventions.

CFS is treated symptomatically by physicians, because as of this writing, there is no known cure. Symptoms are treated proactively by patients, who learn to sensitize themselves to risk factors for collapse. This may be a useful model for the Anthropocene, when we may not be able to "cure" what we have done to ourselves and the rest of the earth, but may be able to mitigate and anticipate points of collapse.

I find analogous connections among restoration, CFS, and Maxwell's Demon, because all three require:

1. establishing new, fine-grained boundaries on the expenditure of energy (humans are imminently facing boundaries to protect natural resources) but not information;
2. detailed observations of the consequences of choosing to abrogate those boundaries, (such as protecting free tidal flow from built infrastructure);
3. discriminating between short- and long-term triage consequences of choices (such as energy use and built systems);
4. remembering discriminations regardless of the experiences of urgency, (such as prioritizing permeability over hard surfaces and subtle ecotone relationships under the pressure of built infrastructure in littoral zones); and
5. erasing the memory of a time when small amounts of energy could be expended without serious consequences (such as the precedent of profligate expenditures of fossil fuels and consumptions of other species).

Many CFS patients anecdotally report symptom relief, as I have, from acupuncture. When symptoms are relieved, it would, according to acupuncturists, mean an energetic

flow has been re-established. Although a virus component is suspected, the causes of CFS are unknown, and people report that their experiences of collapse are unpredictable.

That ignorance is unlike what we face in the Anthropocene. We know most causes of systems collapse in the Anthropocene. However, I argue that hyper-alert sensitivity, requiring continual and conscious engagement with boundary systems—in effect, triaging and weighting each small personal decision against finite resources—is a skill that humans might learn from by looking more closely at the requirements for living sustainably with CFS. These skills might also collectively apply to monitoring habitat resilience.

In a person with an immune dysfunction, such as CFS, continual strategic awareness can require responses as delicately tuned as the flap of a butterfly's wing. Flexible calibration of human choice combined with identifying and re-establishing systemic flow is what I propose as a model for intervention in ecosystem degradation.

6. The Fourth Wall Metaphor

Denis Diderot was the first to define the fourth wall (*Discours sur la poesie dramatique* 1758) as the psychological space that begins where the curtain separates performer and audience. It marked a profound advance in performative experience. Since Diderot, that space has been informed by ethical ideas conflating theatre and public art with social activism, evolving from literal to virtual curtains. Theatre can be an agent of profound psycho-social change. The fourth wall presumes a permeable boundary in an open system. That contrasts with the system that the Anthropocene represents, which might be seen as a manifestation of what is arguably a closed system. If my premise is accepted that the Anthropocene reflects a construct of anthropocentrism because it places humans at the apex and centre of a hierarchal pattern, I will argue that considering the implications of the fourth wall for adaptive management changes that point of view.

The fourth wall can be seen as a perceptual model for engaging with ecotones and the wildlife that inhabits them. The process of adaptive management can be quite complex in the Anthropocene, with intensely competing agendas between agents and stakeholders. Therefore, I will detail considering them with the performative implications of various dramatic relationships, *arena*, *proscenium* and *spectacle*. Respectively, these terms refer

to observing events in the round, in a framed context, and as part of a massive public event. These distinctions may help contextualize a nuanced discussion of audience engagement in adaptive management.

Environmentalists and landscape ecologists often refer to theatre as the metaphorical arena. The terms arena and proscenium both originate from theatre, but have different implications. In both cases, the audience experience depends on physical positioning. An arena stage is transparent. It is surrounded on all sides by the audience, with nothing hidden and very often, the audience response is equally visible. This presumes more equality than actually exists.

A proscenium stage is framed by wings and a backdrop which conceals some staging effects from the audience, who are collectively focused only on those framed actions. Aspects of the dramatic structure—the beginning, crisis, resolution, and denouement of the narrative conflicts—are hidden in the wings, behind the backdrop and curtain. Perceptions of physical actions on the stage are framed by what is called the proscenium arch, the structural shape of the theatre. Audience attention is where the human director intends focus. All observers see similar scenes. On the stage, individual performers drive the director's version of the narrative being shaped. This means the unfolding drama is more dramatically controlled, but the audience, usually experiencing the drama in some shadow, is removed from interaction and their mental engagement is private and hidden from each other.

Spectacle, in contrast to the arena or the proscenium fourth wall, concerns itself with scale and interaction between the audience and the initiator. As with the arena, all action is visible and the audience response is also. However, the audience is positioned so that the actions they observe, which might cause profound and cathartic impacts, are based on the scale of the event more than the resolution of conflict, as in classical theatre. The audience's own responses are generally visible to each other but dwarfed by scale.

In Chapter three, I will discuss how the work of several artists, might inform adaptive management through the metaphor of the fourth wall.

Image not available

Figure 13: Seals caught in and killed by drift nets (ghostnets) (source: https://en.wikipedia.org/wiki/Ghost_net).

7. Two Case Studies for a Complex Adaptive Idea Model

In establishing these metaphorical correspondences, my aim includes discovering how researchers might integrate holistic attribute tables into GIS analysis and find ways to add agents in adaptive management. However, layering disparate agents may also present some problems.

Maxwell's Demon provides lessons about idea models. However, the challenge in proposing interdisciplinary holistic correspondences is that historically, they can be seen as shallow or ineffective or can suffer from misleading false equivalencies. That was the criticism of pseudoscience from philosopher Karl Popper (1963). Popper argued that any theoretical construct must be falsifiable. That was the basis for charges of pseudoscience by physicist Peter Woit (2006) against populist physicist Frithoj Capra's book, *The Tao of Physics* (Capra 1975). Therefore, in Chapter four, I will discuss quantifiable aspects of my research in a falsifiable modeling experiment. That experiment was developed from data gathered after the completion of *Ghost Nets* but was inspired by information that emerged during the monitoring phase. In this writing, the experiment attempts to identify

nucleation trigger points where the butterfly effect, located by the application of attention, could influence a kind of systemic change for the entire Gulf of Maine, like the one I intended to accomplish locally with the *Ghost Nets* restoration.

Metaphorically, I regard that effort to identify where to apply attention as comparable to reorganising the chaos of a drift net after a season of use. Symbolically, I see it as the place where Maxwell's Demon begins to sort molecules. I anticipate finding that place as the point of sensitivity to initial conditions. When that point is discovered, it might also be seen as a fourth wall encounter between independent agents which might subsequently precipitate a butterfly effect. These abstract associations could inform the search for refugia where nucleation might effect succession by suggesting other points of view. However, as my arguments will demonstrate, these are more than fanciful suggestions.

Nucleation techniques in environmental restoration evolved from experiments with patch size, to test what scale would be required to establish biodiverse succession. As an approach, this theory draws heavily on principles of island *biogeography*, the study of how biotic and abiotic agencies function in ecosystems. Robert MacArthur and E. O. Wilson developed that theory to describe how populations migrate between 'islands'. Literally and figuratively, the traffic maximizes opportunities for biodiverse populations to colonize and stabilize habitat (MacArthur & Wilson 1967). Nucleation has a promising record of application to tropical forest systems by catalyzing succession from localized refugia, which function as island patches. Nucleation was pioneered in Brazil (Ruiz-Jaen & Aide 2005) and Costa Rica (Zahawi 2012). It is being cautiously applied in temperate zones (Corbin & Hull. 2011). Although it may take further decades of monitoring to assess final results, Ruiz-Jaen and Aide, Zahawi and others claim that nucleation, when compared to passive or plantation-style restoration,⁶ appears to be more efficient, economical, and results in greater biodiversity. In this writing I suggest that the nucleation system is a hypothetical approach to remediating marine system degradation. However, there is not yet evidence that it could work in the littoral zone.

⁶ Biologist Fernando Bechara has begun a long-term comparative study, but after three years, subtle variations in ecotone relationships seemed apparent from slides shown of unpublished work at the 2013 Global Society for Ecological Restoration Conference.

In all applications of nucleation, contiguity is challenging. For example, bioregional dispersal between refugia points might be too far apart to generate contiguous patch relationships. However, principles of the fourth wall, if applied to adaptive management, could engage the general public to extend the contiguity of these nuclear nodes. In my case studies, I will describe some techniques I used to do that.

However, the nature of tidal hydrology in marine and riparian zones systems adds complexity to littoral zone restoration. The dynamics are usually too fluid, literally and figuratively, to reliably insure success. Nonetheless, nucleation has been very successful in the restoration of coral reefs (Goreau & Hilbertz 2005), apparently because coral reefs are in themselves trigger points that support and attract rich biodiversity. In Chapter four, my claims about nucleation in the littoral zone will be furthered by GISc mapping and statistical analyses. I will consider how correlations between vegetation and finfish abundance despite the presence of an invasive species *C. maenas* (European Green crab), might be relevant to fisheries management.

As indicated earlier in my description of the fourth wall, parallels might be drawn from theatrical modalities to participatory public art and landscape scale strategic analyses. Virtual means could also efficiently and economically leverage and maximize adaptive management outreach, as I will show in the case study *Fish Story*. I claim that including indigenous peoples and ecofeminists, whose views about other species, echo each other, would be prudent. The work of economist Robert Costanza (Costanza 1991, 1996) and others, validates that resource depletion without appropriate valuation is short-sighted. Often, the TEK of Native American and other indigenous peoples can add useful dimensions. *Participatory mapping* (the process of producing maps of relational systems in communities) and adaptive management are accepted means to layer such disparate knowledge. However, when indigenous views or the needs of wildlife are included, they have often been marginalized by an emphasis on economic progress, putting the two approaches in conflict. I discuss how transdisciplinary TEK practices might provide instructive idea models about interactions with habitat and non-humans that is compatible with long-term environmental pragmatism, as is argued by Vandana Shiva, (Shiva 2002). An example of TEK practice I reference in Chapter five, the Medicine Wheel, can be

seen as a ritualized teaching about ecotones. Other TEK cultural practices effect forest wildlife management by selective culling and seasonally timed fire regimens.

Similarly, ideas about *speciesism* (attitudes of entitled dominance over other species) from ecofeminism, explore why wildlife and water need to be prioritized over short-term economic advantage in regional and urban strategic planning. Advocates of TEK and ecofeminism argue that we require different attitudes towards hierarchicalism in habitat and inhabitation. Many writers I cite emerged from the American feminist tradition whose slogan was, ‘the personal is political’ referring to how problems with childcare, labor inequities, and domestic violence are not experiences that require personal therapy so much as policy change. Ecofeminism conflated those personal choices with redefining our relationships to other animals.

Ecofeminist thinkers whose qualitative views blur boundaries between the personal and political and espouse indigenous agendas will be discussed. In addition to Vandana Shiva, Winona LaDuke, of Ojibwe and Anishinaabe descent, speaks out for other species as her ‘family’. Chapter five integrates this trope with individual land stewardship and restoration work as art life. I will examine how the Native American Medicine Wheel ceremony became a means to inform and organize habitat and ecotone monitoring for the *Ghost Nets* case study and how it might be used to address philosophical points as contemporary, practical choices for non- Indigenous peoples.

These qualitative elements inform a matrix that includes biofiltration and phytoremediation issues and ways other species function to protect water quality. In this light, *Fish Story* will be presented as a case study for how Trigger Point Theory as aesthetic activism might address speciesism, racism, and environmental justice at the scale of the Mississippi River Watershed Basin.

8. Chapter Analysis

In Chapter one I discuss some metaphors and conceptual models offered by several artists, particularly the abstract expressionist painter Jackson Pollock, and art life artist Allan Kaprow. Their philosophical approaches to activity will be compared with the activities of other ecological artists, such as Mierle Laderman Ukeles. I will consider the

shift in attitudes that presume the capacity to act, not for its own sake, but with the intention to intervene in environmental chaos and effect ecosystem restoration.

Chapter two will cover various points of view about large landscape systems and implementation of adaptive management for ecological restoration. I will explore how ideas borrowed from theatre and public art might inform strategic planning with adaptive management to achieve different understandings of problems in landscape ecology. I compare how ideas about the fourth wall and spectacle were addressed by the playwright and director Antonin Artaud and others. How might these ideas inform public environmental attitudes and a community model for adaptive management that includes animals?

The need for an attitudinal shift will be argued as both a philosophical and a practical necessity. I will provide historical and theoretical contextualization for premises in landscape ecology and contemporary art that are relative to Trigger Point Theory as aesthetic activism, beginning with a description of holistic approaches to global systems. My aim is to identify gaps and query whether hierarchal dominance patterns may be less resilient than systems rich in redundancies, as can be seen in the pluralism of certain indigenous peoples' ideologies and ecofeminist ethics.

By describing the process of restoration on the *Ghost Nets* site and comparing the results to criteria and methodologies of conventional restoration science, including nucleation, I will explore whether integrating premises from participatory art (the fourth wall), can maximize nucleation. I will also consider how endemic conditions are being impacted by *C. maenas*, an invasive crab species currently decimating North American littoral zone habitat. Lessons learned from *Ghost Nets* about large landscape analysis and adaptive management were considered in planning *Fish Story*, this will also be covered.

Chapter three considers the question: can art be a triage for urgency? Could transdisciplinarity provide new idea models for a resilient ecological restoration? Art discourse will be examined to show how artists became interested in physics and other sciences, leading to transdisciplinarity and new forms in art, such as land art. I examine how critics became collaborators with activist artists advocating for progressive and educative agendas and how some contemporary curators and institutions have partnered with land and ecological art projects towards that agenda.

I consider how artists are experimenting with systems in a trajectory in art criticism and curatorial writing. This began in response to the apolitical formalism of Clement Greenberg, and became more politicized leading to ecological art. This will be traced through the work of the late artist and educator Joseph Beuys, who chose to explore relationships between education and science as a transdisciplinary and activist practice. Those practices will be compared to the inception of ecological art in projects from several ecological artists, such as Helen Mayer Harrison and Newton Harrison, Dominique Mazeaud, and myself. These comparisons will be used to identify a set of criteria consistent with my thesis. The Ecoart Dialogue Collective will be discussed, to clarify how the definition of ecological art has evolved, and I will conclude with comments about the need to come to terms with quantifiable evidence to demonstrate the value of ecological art for scientists and land managers.

Chapter four discusses how mapmaking could determine restoration strategies. I ask, how do we define a map? This and other questions will be addressed by comparing performance scores, participatory mapping, GIS, and GISc to demonstrate how activism emerges as a 'score' from shifting perceptions. I also show how participatory mapping and schematics of vocal production analysis might inform adaptive management in the Mississippi Water Basin. I suggest small, carefully planned *ecoventions* (a term introduced by curator Amy Lipton to describe environmental interventions from ecological artists) with GISc might effect black swan and butterfly effects to catalyze change in degraded systems (for example, using GISc to pinpoint eelgrass beds for restoration). I will present evidence from my GISc maps and charts to show how analyzing data might identify locations that would support finfish in the Gulf of Maine.

Chapter five covers how I applied unconventional models, with acupuncture and indigenous ceremonies, as expert witnesses to inform *Ghost Nets*. This chapter will also review how my transdisciplinary art life practice might articulate a new conceptual approach to restoration triage: performing ecology to identify and activate trigger points as aesthetic activism in my two primary case studies. I detail how CFS and acupuncture provided, respectively, a metaphor and an analogic model for the kinds of difficult and complex strategic choices about sites and adaptive management that, I argue, are necessary in these urgent times. I explore aspects of the Native American Medicine

Wheel in *Ghost Nets* expressed as heuristic work onsite, walking concepts, and acoustic experiments based in *bel canto*, a classical operatic singing technique, to understand habitat conditions. Why, and how, webcasts and social media might be used to minimize travel during early stages of restoration planning will also be addressed.

Embodiment will be investigated as a research tool in workshops. In this writing, embodiment is defined as, techniques that engage the body as a matter of heuristics: for example, movement exercises with elements of vocalizing—that is, ‘feeling’ what is happening, as in performing ecology. Arguments will be presented for how the enhanced point of view of performing ecology results from layering artifacts and embodiment. That will be seen in the context of the metaphors and analogies I have presented. I explain how the result will be a more efficient analysis of large landscape problems and solutions. In addition, answers to qualitative, evaluatory questionnaires from both case studies will be analyzed for insight into the social practice aspect of this work. I show how individual limitations, such as CFS, could provoke strategic solutions for adaptation and ecological restoration, suggesting how my model could invite the participation of people with limited resources in restorations, effecting Trigger Point Theory as aesthetic activism.

In the conclusion, results from all five chapters will be assembled for evaluation. The use of metaphors, mappings, systems analysis, and heuristics in *Ghost Nets* and *Fish Story* will be recapitulated to clarify how a layered ecological art practice might trigger points of environmental triage. This will clarify how methodologies could be applied and developed by ecological biologists, restoration scientists, sociologists, philosophers, ethicists, land managers, ecological artists and people with TEK.

I also discuss how the different approach to adaptive management, which I have outlined, as an aspect of performing ecology, drawing on the ideas and examples presented, could inform restoration science. I argue for restoration scientists to engage more fully with ecological artists on projects and describe what research might be engaged in by other practitioners to test or advance the ideas I have described. I end with an analysis of how a lay audience might best apply my research.

Chapter 1

Models, Metaphors, and Analogies

In this chapter I discuss how metaphors might function as idea models for complex systems. Complex systems have performance characteristics outside the parameters of classical mechanics. The historical evolution of ecological systems theory as it has been expressed in food web modeling will be detailed. It illustrates how an idea model might function as a complex system.

Metaphors and the Boolean logic that underlies mathematical modeling are symbolic constructs that can explain relationships between discrete human experience and other elements. Metaphors can bridge the divide between the quantitative observation of complex systems and heuristic experience. Metaphors can contain experience by ‘naming, framing, and changing’ relationships (Steen 2008, 213–241). As George Lakoff noted, the poetic tropes of metaphors can have multiple meanings with powerful implications (Lakoff & Johnson 1980). Metaphors about complexity and uncertainty seek to explain subjective or intuitive observations, often by establishing a correspondence between contexts: for example, Robin Lakoff (1979, 203–251) affirmed that metaphors do more than synthesize experience and can actually frame experience in ways that are deterministic and predictive. I will argue that metaphors functioning as idea models have practical application to ecological restoration.

In this chapter I enlist metaphors to explore several independent agents: interspecies justice, expanded ecotone healing, scaling nucleation as triage, and ecological art as black swan interventions. These metaphors will be organized around thermodynamic ideas.

Physics explores the energetic building blocks of the natural world by grounding ideas about causality, change, and transformation in the natural world with mathematically and statistically quantifiable frames of reference. The physics terms presented earlier in the Introduction: sensitivity to initial conditions, resilience, disturbance, emergence (Batterman 2009), self-organisation, and nucleation will be discussed in greater detail in this chapter. They collectively represent energetic models (Folke et al. 2007) for the thermodynamics of transformation in transition from a closed, stable state, to an open and

arguably more resilient state. Examples from linear, closed systems (with limited capacity to absorb or release energy) and open systems (with permeable boundaries) will be discussed. Open systems are presumed to be more flexible and therefore more resilient to perturbation (Corsi, De Leeuw & Skidmore 2000).

Idea models about thermodynamics can have broad implications. They can help visualize the energy patterns of bioregions and show how change occurs between biological regimes. An example is emergence, the point when transitional chaos, which occurs when ecosystems degrade, can spontaneously 'self-organise' to another state. Self-organisation can result from a series of perturbations, small events that disrupt equilibrium in systems. Perturbations in water systems include, the introduction of invasive species or chemical pollution, the proliferation of marine dead zones from *eutrophication* (the discharge downstream of nitrates from excess fertilizers), and sea-level rise from global warming on the marine side, or built human infrastructures on the terrestrial side, all of which may affect delicate relationships between native species. When we perturb complex natural systems in these ways, we may degrade them to another state. The goal of environmental restoration can be stated as providing elements to trigger reorganisation in such degraded systems that doing so will lead to revitalized, ideally endemic (native), resilient biodiversity.

Any ecosystem depends on energy exchanges between living and non-living agencies (such as temperature). I am interested in how metaphors could contribute strategies to restore littoral zones, where terrestrial and marine life meet. There, complex systems and their species interact with, and are acted upon, by perturbations from diverse human agencies. That process can test resilience. Since this research presumes that biome health for humans depends on the vitality of other species (Callicott 1983; Jameson 2009; Katz 1996; Eaubonne 1974; Griffin 1978; Merchant 1980; Haraway 1990; Warren 1990; Plumwood 1991), the nature of that relationship between complexity and resilience has both abstract and literal implications.

Figure 14, below, is a schematic representation of how these metaphorical terms from physics might function in an idea model with application to restoration.

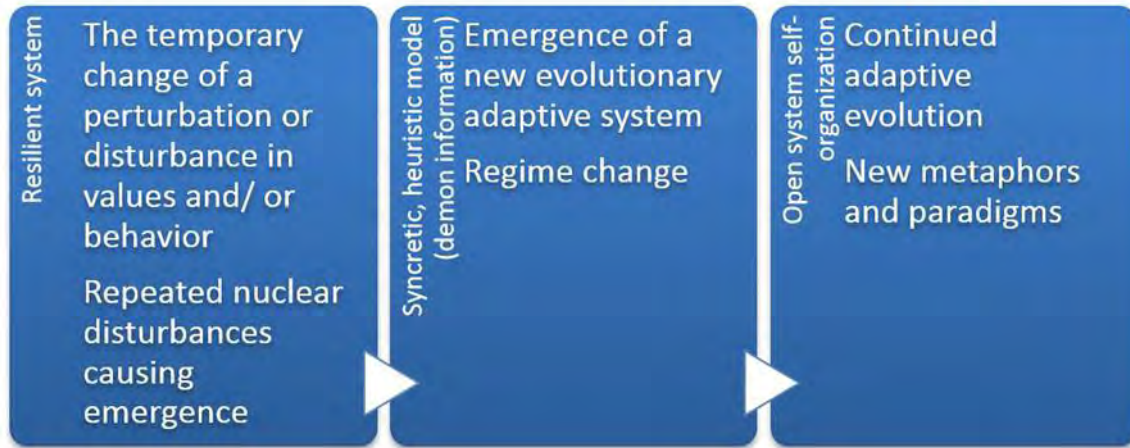


Figure 14: Schematic of how metaphors from physics might interact to effect ecological change in a perturbed open system, an abstraction of a complex adaptive system (Rahmani 2013).

Now, I will discuss each of these agents in sequence with the metaphors I associate with them and begin to develop each as themes in my arguments.

1. Interspecies justice. The design of resilient restoration solutions to environmental degradation might depend on reconsidering human relationships with other species. This approach would combine considerations of justice (environmental ethics) and pragmatism. It includes animals as partners in our survival rather than resources to exhaust for our short-term benefit.

Metaphors about interspecies justice and interdependence therefore, can have pragmatic implications. Some pivotal metaphors will be introduced in this chapter, while others will be developed in later chapters. Correspondences will be drawn between my premises and their practical applications.

If resilience depends upon recognizing and prioritizing relationships between humans, water and non-human species, the metaphor of lost fishing drift nets (ghostnets) symbolizes the opposite. Living connections that provide systemic resilience are lost as ghostnets ‘stripmine’ marine life and add plastic pollution to the sea.

The moral aspects of human dominance over, and commodification of, other species has been extensively discussed by philosophical ethicists (Callicott 1983, Jameson 2009, Katz 1996) and ecofeminists (Eaubonne 1974; Griffin 1978; Merchant 1980; Haraway 1990; Warren 1990; Plumwood 1991). Ecofeminists extended the dominance analogy to equivalence between domination of nature and gender domination. They saw

correspondences between indigenous peoples' views, cruelties towards other species, and a critique of Western science.

Costanza's writings on the economics of sustainable practices (1991, 1996; Costanza, Norton & Haskell eds. 1992; Costanza, Segura, & Martinex-Alier 1996; Costanza et al. 1997a; Costanza et al. 1997b; Prugh, Costanza & Daly 2000; Costanza, Graumlich & Steffen, eds. 2007) connected arguments for the morality of our choices about resource use to the financial consequences of behaviors that reduce sustainability. By putting price tags on losing natural resources, he challenged economists to factor in all 'costs' when ecosystems are depleted or destroyed. However, many large corporations continue to ignore that advice, for example in the practices of fossil fuel extractors.

In recent years, expert witnesses from unconventional sources, such as indigenous peoples (Nakashima et al. 2012, 27) and independent marine fishermen have contributed rules for complex adaptive modeling systems, blurring boundaries between hard science and other sources of insight. Costanza's valuations would be familiar to many traditional indigenous cultures that often have long histories of adaptation with scarce resources, such as the aboriginal peoples of Australia (Schelling 1971, 2006; Gladwell 2002; Taleb 2010) or the Native Americans of the Southwest. Metaphors from TEK often teach why it is necessary to prioritize wildlife over short-term human goals. Their pedagogy maintains, as Costanza implies and my own arguments assert, that human resilience depends on not only accommodating, but prioritizing other species in ecoregional planning.

2. Expanded ecotone healing. The preservation and restoration of landscape features may depend on reinforcing transitional edges and ecotones between those edges. Ecotones are the linkages between habitat edges. In this writing, they also represent how disruptions in sensitivity to initial conditions, including very small perturbations, can effect environmental self-organisation. Although most restoration scientists are concerned with these subtle transitions, I claim that resilient planning depends upon giving even greater attention to how ecotones function because the Anthropocene is a time of unusual numbers of perturbations.

Ecotones provide resilience, but habitat fragmentation can eliminate ecotones or create them by establishing new edges. However, natural systems often die from the edges

inwards when ecotones are disturbed. The point where a phase transition occurs, such as when perturbation leads to emergence, is referred to as, ‘life at the edge of chaos’. I will explore two metaphors that describe this.

The metaphors of the butterfly effect from chaos theory, and black swans, borrowed from physics and applied to economics to describe surprising and unpredictable events, describe phenomena that cannot be controlled but that have long-term implications. In this claim I will focus on how these metaphors are grounded in chaos theory as a dynamic system. The three mathematically dynamic properties of chaos theory relevant to my arguments are:

- A. sensitivity to initial conditions, as described by the butterfly effect;
- B. topological mixing, which refers to how agencies interact in a thermodynamic system to effect unpredictability;
- C. dense orbits, which refer to the proximity of points in space.

I will primarily concern myself with the first property. Sensitivity to initial conditions is generally observed in retrospect. In hindsight, we can more easily identify emergent properties that lead to self-organisation. All modeling is an effort to circumvent unpredictability. Modeling often accesses ‘expert witnesses’ to obtain data from unexpected sources in order to reduce that uncertainty. Modeling the implications of this property has been extensively applied in economics and gave rise to the term, black swans. As my research will show, corresponding predictive models and expert witnessing can also emerge from art and embodied experiences⁷. I will identify them as models of alternate systems.

In 1971, economist Thomas C. Schelling’s seminal social science work on ‘tipping points’ considered dynamics of change in neighbourhoods by using game theory to observe when, and how, demographics shift to segregation as individuals experience racial discomfort. Tipping points may alternately establish environmental triage or induce collapse to another state. Schelling’s observations were based on the premise that precipitating small events typical of those studied in chaos theory, such as flapping butterfly wings, can have significant eventual consequences. Schelling later applied these

⁷This premise evokes Michael Polanyi’s thesis on tacit knowledge (1962).

ideas to global warming (1997) by investigating how small, deliberate, strategic interventions might effect change.

His ideas were popularized in Malcolm Gladwell's commercially successful book, *The Tipping Point* (2002), which simplified chaos theory for the layperson. Gladwell also referenced financial essayist Nassim Taleb, whose work can be found in his book, *The Black Swan* (Taleb 2010). The application and contextualization of the black swan metaphor differs from the metaphor about how Ch'i flow is blocked in CFS and released by acupuncture. Black swans imply sudden and unpredictable change, as when humans introduce invasive species, or an artwork introduces a new perception of life. Acupuncture presumes predictable, underlying locational causes and effects that can be activated, as when nucleation is applied to degraded biosystems. Both are examples of how different experiences and theories of change in complexity theory from physics have infiltrated other fields.

Unlike Maxwell's Demon, neither tipping points nor black swans presume the existence of deliberate agency. Maxwell's Demon is a more complex and provocative model because it does presume agency. However, all of these can be seen as idea models with application to ecotones.

When metaphors are appropriated from other sources, as Taleb and then Gladwell did with black swans, they can inform our cultural understanding of how human behavior can change. I believe they can also imply how to re-knit small, nuclear ecotone patches into larger systems, buffer edges, and effect smooth transitions between areas to preserve resilience. This reknitting would represent deliberate perturbations.

3. Scaling nucleation trigger points as triage. Scaling refers to how small models can be applied to large systems. That is the same principle that makes nucleation successful. Theoretically, strategically planned, nuclear restoration interventions might be scaled up and globalized, even in urbanized areas. Here I argue for scaling up nucleation as an aspect of Trigger Point Theory and a cost-effective solution to large landscape degradation.

Introducing trigger points and triage presumes deliberate perturbation as strategic agency. The danger and promise of small perturbations is the emergence of a new state of equilibrium that effectively scales up interventions. I claim that proactively locating a

series of small restoration interventions, analogous to acupuncture points, can aid the restoration of large landscapes. I shall call, nucleation trigger points, to reference the terminology of acupuncture and conflate that terminology with the restoration technique.

Unlike acupuncture trigger points, which exist in a systematic matrix, triage implies imposing an improvised systematic intervention into a highly disorganized and unpredictable context. Triage is for medical intervention in catastrophic circumstances, such as war, which requires draconian choices about who is likely to survive with or without assistance. Examples of environmental triage might include the choice to relinquish an inhabited coastline, as was required on Staten Island after Hurricane Sandy; restrictive fishing regulations to protect cod stocks in the Gulf of Maine; or requiring domestic cats who might prey on birds to remain indoors.

In this research, the ‘patients’ requiring triage are earth’s ecosystems. The strategy of identifying possible nucleation trigger points for environmental triage could cause large impacts and do so by scaling up the impacts of deliberate perturbations.

The fourth wall metaphor implies significant relationships can occur at the edge of perception, in the literal space between the curtain and the audience. This is where gradations of psychological or relational interaction can elicit the most sensitive experiences. But that peripheral sensitivity is also critical to preserving habitat integrity. Therefore, the fourth wall may also be analogous to the way ecotones function in biogeography. I shall refer to the role of such sites as, the landscape as proscenium. This metaphor has locational as well as performative implications. It implies positioning the observer for a particular point of view is critical for siting nucleation trigger points. As I will show, locating these sites is a cultural and spatial process.

GPS and the algorithms of GIS science can layer statistical data about located experiences and observations. That process can lead to falsifiable insights about these locations. I claim that this multidimensional, proactive approach to siting restoration work may be more effective, and holistic (in the sense of taking the entire system into account) than opportunistic interventions and will detail my arguments for that claim.

4. Ecological art as intervention. This section considers ecological artists as agents of transdiscursive⁸ and strategic change. Some ecological art practices, including siting and

⁸ Transdiscursive work engages conversation across art and science.

developing community support for nucleation events, may contribute to bioregional analysis. I propose that ecological art can partner with science to conceptualize, gather, test, and frame data for intervention and implementation.

Ecological artists can use metaphors to strategically intervene in degradation and generate self-organisation. The unpredictable nature of self-organisation, however, means that this will always be a calculated risk when specific outcomes are desired.

Art can, by its very subjective character, intuit factors beyond what quantification alone might indicate. It is the integration of the intuitive and hard data that might function as demon information or black swans in closed systems. The caveat is that the artist must apply sophisticated knowledge at the point of sensitivity to initial conditions.

The work of the following three artists suggest alternate models of inquiry. Their projects each embody a metaphorical approach and contribute new insight for science in restoration work.

The work of Aimee Morgana challenges assumptions about animal-human connections by embodying a different relationship. She has taught an African grey parrot (*Psittacus erithacus*) named N’Kisi to speak like a human (with an English vocabulary of seven hundred words) as a conceptual art project. Tests of N’Kisi’s linguistic skills have been documented (Sheldrake 2003), including the parrot’s spontaneous query, “When are you going to write a book about me?” That question from N’Kisi suggests the potential animals may have to become our active partners in surviving the Anthropocene. This, of course, is contingent on our willingness to listen to their stories rather than presume they are our passive subjects.

Bernie Krause (1998, 2002), (Krause & Franklin 1996) is a composer who has recorded the loss of acoustic diversity in a wide range of habitats, including forest stands, since 1968. He has documented the often-invisible effects of trophic cascades (a relational progression of consequences between species) and has compiled four thousand hours of recordings from fifteen thousand species. His recordings document how, though an ecosystem may appear unchanged (much like a person with CFS), its graphical acoustic displays demonstrate through reduction in sound density, that the ecology has been degraded. Krauss was willing to listen attentively to the forest over a long period, not only as an appreciator of sound or as a naturalist, but systematically, with modern

technology. He provides another model for how observing nature can give us critical ecosystem information.

Composer David Dunn (2014), from the Acoustic Ecology Institute, has made recordings of pine bark beetles (family Scolytidae) colonizing aspens (*Populus tremuloides*) and pinyon pines (*Pinus edulis*). Several native species' populations have exploded following climate change conditions favorable to their breeding habits. Over seventy million trees in Arizona and New Mexico have been devastated by these insects. The beetles were previously unknown to make noise. However, Dunn documented how these beetles were drawn to specific prior conditions in the trees and then made specific sounds once they began devouring them. Dunn's work led scientists to new solutions to address the beetle infestations with disruptive acoustic signals.

These three examples illustrate how, when ecological artists assemble insight with unconventional strategies, novel methodologies and insights may arise to address degradation. I will now consider the need for these claims and arguments with additional examples. I will explore in detail how they could model other approaches to ecological restoration. I call this approach aesthetic activism, the other half of Trigger Point Theory as aesthetic activism.

The implications of biogeographic change have been concerns since humans began studying the natural world. Climate change and pollution however, have accelerated the pressures for evolutionary change and precipitated a state change (Barnosky et al. 2012). Camille Parmesan, for example, has written about how most species simply cannot adapt to the confluence of events caused by climate change (Parmesan 2006). The Anthropocene has catalyzed 'ecological novelty',⁹ a term describing characteristics of novel or emerging ecosystems (Hobbs et al. 2006). Examples include, massive extinctions of entire constellations of species at unprecedented rates and the loss of entire biomes to extractive industries, as with the fisheries' global effects on marine environments or the devastation of the Northwest boreal forest from exploitation of the tar sands in Canada. These crises are generating domino effects of rapid, ubiquitous, and alarming interactions. As global warming melts permafrost, for example, the release of

⁹The term 'ecological novelty' was introduced as the title of a 2011 conference in Monte Verita, Switzerland. Available at <<http://www.en2011.ethz.ch/>>.

carbon dioxide accelerates global warming even more quickly, causing sea level rise to also accelerate. This in turn, dramatically affects the land mass of indigenous societies, such as the Inuit peoples and island nations.

The accelerated environmental changes we confront—and will continue to see accelerate—are also creating unprecedented, globalized human suffering. Many scientists have written about the crisis faced by international agencies struggling to come to terms with the consequences of global resource neglect and mismanagement (IPCC 2007). The personal experience of many people in today's complex world is one of profound dislocation and appropriate dread in the face of overwhelming and unpredictable changes to familiar patterns. These emotions can add another level of complexity to restoration management. A fear-based description of our experience of Anthropocene reality has been critiqued as pathologizing our experience of nature. But it may be equally valid to consider how we have created an implicitly metaphorical relationship to a planet threatening human capacity to successfully adapt: a Frankenstein monster of our own creation, novel yet neutral in evolutionary terms. It may therefore be more accurate to say that humans have precipitated a pathological global experience for our species and many others. If we think humans capable of infecting nature with our greed and disregard, we may also consider healing metaphors from a variety of cultures as alternative worldviews.

The loss of vast natural systems and our inadequate responses call for innovative strategies. These conditions (Higgs 2003, Hobbs et al. 2006) may comprise the most effective arguments to consider novel interventions, such as art and the metaphors that emerge from art, to help counteract these losses.

1.1. Early Concepts

...the aim of a skillful performance is achieved by the observance of a set of rules which are not known as such to the person following them (Polanyi 1962).

In this section I discuss how my research has been informed by several scientists whose work explored plurality and inclusion to effect transitions in academic thinking. They include biologist Ludwig von Bertalanffy (1968), ecologist Eugene Odum (1953), polymath Michael Polanyi (1962, 1964, 1967, 1969), and physicist Thomas Kuhn (2012).

All but Kuhn addressed what is commonly called a holistic understanding of the world, sometimes also described as inter-disciplinary. I believe the basis for proposing art's inclusion as an expert witness for modeling solutions to environmental problems was foreshadowed in their writings.

1.1.1. The Holistic View

In this writing, a holistic view refers to a point of view that is multi-dimensional, pluralistic, and inclusive. Holistic thinking means taking into account the whole system from which the matter at hand might be considered. This is a worldview consistent with that of many indigenous peoples globally and members of the ecofeminist movement.

The basic critique of holistic thinking is that it may sacrifice depth for comprehensiveness. The general counter argument from systems theorists is that without a whole-system analysis, or holistic approach, we are subject to reductivism, which has privileged a Cartesian view of the world divided into increasingly smaller, disconnected parts. Each of those parts might be replicable and testable (falsifiable) but do not combine to present a coherent worldview. I argue that holistic systems thinking also leads us to different questions.

The biologist Ludwig von Bertalanffy was an early systems theorist, a discipline considered a precursor to modern ecology. He had an early transdisciplinary interest in relationships between the humanities and the sciences. His goal was to understand life by creating a holistic integration of disciplines describing what he termed a 'floating balance': disengaged from time, grounded in mathematics, and representing an open system (Bertalanffy 1968). His research contested how the second law of thermodynamics relates to open systems in the natural world and non-linear outcomes. That multi-dimensional view contrasts with 'closed' energy systems, in which the circulation of heat, energy, and matter remains constant.

A series of scientists have wrestled with how relationships are expressed in the food webs that link biosystems as expressions of energy flow. That history is relevant to my own arguments for including non-human agents and heuristic knowledge in models for human survival.

Biologist Eugene Odum built on the work of his father, Howard W. Odum, a holistic sociologist, and his brother, Howard T. Odum, an early ecologist who applied the principles of thermodynamics to the biological dynamics of the food web (Odum, H. T. 1994). Howard W. Odum is credited with developing ecology as systems thinking. Howard T. and Eugene Odum studied how any food web exists in a matrix of biogeographic relationships. Eugene Odum promoted the importance of ecology as a discrete discipline. He is known for organizing ecological principles into a metaphorical template for observation. His work outlined complex relationships between systems of knowledge and human behavior.

In calculating populations to assess abundance, Eugene Odum pointed out the complexity in the very measurements of abundance. Species natality, age distribution, and mortality, for example, can be highly variable both seasonally and in relation to other dynamics. The presence or absence of desirable physical circumstances or invasive predatory species will impact the representation. Therefore, the investigator's decisions about what attributes to quantify and how to justify these choices become of paramount interest. They become qualitative judgments that determine the content of databases to be included in modeling.

There were two problems in Eugene Odum's initial descriptions of food webs (Odum, E. 1953). First was his statement that all (ecosystems) tend towards equilibrium. Though arguably true in climax systems, in systems that have reached equilibrium, this premise has since been contested and falsified by biologist Michael Soulé and others (Soulé et al. 1995). The second, was that he conceptualized a pyramidal food web model with humans as the apex consumers. In the beginning of Eugene Odum's (1953) chapter, 'Energy in Ecological Systems', in the first edition of his textbook, he describes the tendency of all systems to progress towards thermodynamic stability. He equates that stability with resilience, and asserts this is essential to understanding food webs. I argue this assertion reflected Odum's longing for unrealistically deterministic equilibrium.

Towards the end of that same edition (1953, 489), he cautions against 'ecological detours' en route to 'the achievement of true dominance and the complete orderliness of man and his environment'. The paradoxical aspect of Eugene Odum's statement about resilience and orderliness is that it legitimated the resource degradation he increasingly

came to deplore in disclimax agricultural systems. For example, he admitted that factory farming required deliberately sustaining agricultural land use in perpetual disruption for humanity to exploit. Odum implies that this state of disclimax is a closed system that requires an unsustainably high level of hyper management to maintain. In that perception, Odum revealed how well he understood that equilibrium is *not* the natural state of nature.

Eugene Odum's aesthetic description of food web dynamics is one of the most interesting passages in his original textbook (1953). He outlines a space-time dimensionality of functions in ecotones. His description includes vertical zonation (avian use of air space and piscine use of water columns in the ocean, roots and nematodes in the soil going down), the horizontality of ecotones, multi-dimensionality of marine tidal rhythms, and a six-season breakdown of the year. In addition to the scientific implications of tying these elements together, from an artist's point of view he is describing a surround-sound, immersive experience of life that is very different from the world of Cartesian logic and very like contemporary installation art. It prepares the way for, but stops short of explicitly including the perceptual dimension that ecological art could bring to the table.

Others developed more horizontal models. James Lovelock and Lynn Margulis' view of the earth anthropomorphized a complete symbiotic biosphere, conceived of as Gaia¹⁰ (Lovelock 1967, 2009; Lovelock & Margolis 1974; Margolis 1970, 1995, 1998). Their view of food webs asserted that we ignore the fragile interdependence of a dynamic matrix of systemic relationships between species at our peril. Jennifer Dunne and Richard Williams argued that in modeled food webs, denial of those relationships would lead to trophic cascades (Dunne & Williams 2009). Later, with Lawrence Biever, Eugene Odum subscribed to a more horizontal view of energy transactions (Odum & Biever 1984), reflecting a shift to a less anthropocentric point of view (closer to the views of Lovelock and Margulis).

In a 1968 paper on the historical evolution of thinking about energy flow in ecosystems, Eugene Odum presented a schematic that emphasized relationships between

¹⁰This trajectory of thinking about the earth's surface can be traced to Seuss (1875) using the term 'biosphere' and Lynn Margulis (1970) on endosymbiotic theory, which contributed to the present-day discipline of biogeography.

assimilated (metabolized) energy, biomass calorie use, light and storage, based on the second law of thermodynamics. In that model, species interactions are less important than total energy traffic. He concluded presciently that human adaptation remained a ‘key problem’ for future researchers.

In other approaches to food webs, biologists Gary Polis and Donald Strong considered lateral relationships between consumers and donors (Polis & Strong 1996). Food web cycles were further analyzed for time and energy relationships between smaller habitat systems in large landscape biomes (Polis, Anderson & Holt 1997). Polis, along with ecologists Mary Power and Gary Huxel, analyzed these relationships as a means to identify tools to address the intensively managed ecosystems of the Anthropocene (Polis, Power & Huxel 2004). However, the food web is still often presented as a pyramid in which humans, if included, are apex predators and consumers disembodied from other biogeographic features.

1.2. Ecological Systems

Eugene Odum and von Bertalanffy described how open, natural systems tend to be resilient. Considering their work on correlations between physics and their theories can clarify my own arguments.

Michael Polanyi was a Hungarian physical chemist, philosopher and economist whose writings on personal knowledge (Polanyi 1962, 1964) took systems theory and complexity science further than von Bertalanffy. Polanyi is often associated with Kuhn’s work on paradigm shifts in the history of science. In *Personal Knowledge: Towards a Post-Critical Philosophy* Polanyi opens the preface by

...rejecting the ideal of scientific detachment. In the exact sciences, this false ideal is perhaps harmless. But we shall see that it exercises a destructive influence in biology, psychology, and sociology, and falsifies our whole outlook far beyond the domain of science. But the seeming contradiction is resolved by modifying the conception of knowing (Polanyi 1962).

Polanyi asserted the significance of complexity in tacit, heuristic knowledge. He stated

that all scientific progress evolves from ‘spontaneous order’ (another term for self-organisation; Polanyi 1962, 1967). As von Bertalanffy (1968), Polanyi deduced the role of psychological perception in holistic understanding.

As part of my fourth claim, the theme of art as a paradigm shift in thinking, often occurs in a collaborative, discursive environment, driving new knowledge. Kuhn’s history detailed how ‘paradigm shifts’ in science also emerge from discourse.

Kuhn described this process of change as a grand ‘puzzle’, constantly recreated (2012). He believed each generation deconstructs and reinvents efficacious arguments for new data for evolutionary reasons that are as much personally as intellectually driven. Kuhn drew the template for thinking about how new ideas emerge in science, describing how physics relinquished a Cartesian linearity for a more open system, subsequently leading to quantum mechanics and eventually to complexity theory. Kuhn describes the personal aspect of this paradigm change as a ‘conversion ... of allegiances’, attended by ‘resistance’ to what may be experienced as a ‘violation’ (2012).

Kuhn and Polanyi were often in communication. However, to the chagrin of Polanyi and his supporters Kuhn didn’t discuss Polanyi in his history. Although Kuhn did not reference the heuristic aspects of tacit knowledge and implicit embodiment Polanyi explored, I believe it is Polanyi’s pursuit of the heuristic limbic brain that art engages which may have inspired Kuhn’s work on paradigm shifts.

I argue that Polanyi’s work was an important piece of Kuhn’s puzzle, representing a greater paradigm shift than the transition from Newtonian to quantum physics that Kuhn decided to focus on (Kuhn 2012). Polanyi was equally grounded in physics, but his principle of embodied experience opens the door to validating personal heuristics. I argue that hard science has resisted heuristic far more firmly than the transition to quantum physics Kuhn traced. Therefore, it was easier for Kuhn to argue over physics than heuristics. That resistance to heuristics is also why, I will argue, most environmental restorationists have resisted the potential analytic contributions of ecological art.

These relationships among personal experience, scientific data, and the embodiment of knowledge just described, were also developed by Francisco Varela, a Chilean philosopher, neuroscientist, biologist, Buddhist, and student of fellow Chilean biologist and philosopher Humberto Maturana. Varela sought to establish a philosophical approach

to perception. His studies in optics and complexity led him to conclude that knowledge was best derived when it is embodied, corroborating Polanyi's thesis about tacit knowledge. Varela emphasized that physiological perception informs conscious experience. Together, Varela and Maturana developed a body of work that fostered the field of cognitive science and the theory of *autopoiesis* (Maturana & Varela 1980; Varela & Maturana 1979), about self-reproducing systems, to understand self-organisation in molecular feedback systems.

1.3. Metaphors as Models

Karl Popper (2009) contested the credibility of correlative or analogic assertions on the basis that until a theory can be tested in every possible manner, it remains pseudoscience. That was not to say it might not be proven at a later time. In 1963, Popper cited physicist Albert Einstein's theory of general relativity, among others, as an example of a pseudoscience comparable to astrology, until it was proven otherwise (i.e. falsifiable). This dispute over what is 'true science' has also been explored as a quantifiable problem by philosopher and cognitive scientist Paul Thargard (1988). Thargard argued that falsifiability depends on a simple 'accepted/rejected' computational coherence.

I will now consider five approaches grounded in conservative thinking about what separates science from pseudo-science, such as Thargard's criteria of testable correlations, empiricism, parsimony and relevance to other theories.

1. If physics has been proffered as a common language between disciplines, might metaphors corresponding to physics principles, correlate to testable experiments?
2. Can useful observations about ecosystem interactions be evoked from contemplating a metaphor?
3. In the case of appropriated metaphors, such as the lost drift nets (ghostnets), applied to restoration concerns in complex ecosystems, can we observe parsimony?
4. Can a quantifiable model be evoked from metaphors to discover new knowledge?

1.4. Outcomes and Insights

I argue that artworks can be black swans when they test our assumptions about the sensitivity to initial conditions. Unlike the progression of the butterfly effect, a black swan immediately changes all previous perceptions at a point of sensitivity to initial conditions. If artists can have a determinate effect, might we identify what in the process that produces art could have that result? If so, how? Consider art training. The classic admonition to young artists in life drawing is, 'forget the eyelashes'. This reference to paying more attention to the whole than the parts is an artist's first lesson in formalism. It is also a young draughtsman's implicit introduction to creative whole systems thinking, complexity and thinking in terms of rules, even though the goal is usually to break whatever rules might be discovered. The directive, 'forget the eyelashes' teaches a young artist to eschew closed, clichéd perceptual rules about systems. The new goal becomes to conceive of what appears on paper as part of a larger, open holistic view or system, extending past the bounded edges of the surface or frame. The new goal then is to see what impinges on consciousness beyond the surface. This permits the young artist to experience how whole systems appear.

Unlike scientists however, artists are not expected to understand the mathematically quantify relationships in their practice, or to verbalize energetic distinctions. Rather, each student artist trains to internalize accurate observations of the natural world. Each artist then makes a choice about where, how, and why to apply that training and what rules to challenge. Artists go on to observe and interpret ever more complex patterns, from what their eyes can discern, to theoretical observations about communications, neurolinguistics, and policy matters.

Art systems have, until now, eluded the constraints of falsification. Artists have addressed surprise and chaos as effective tools to deliberately provoke response and even chaos, often deliberately courting loss of control. Art embraces uncertainty, without judgment, as a delighted investigation of edges beyond conventional perceptions. The explicit hopes are often that self-organisation might emerge. The result is often the surprise of a bold, unique, unrepeatably mark or *tache*, the mark of the artist's tool, made upon a surface, culture, or environment. I argue that the *tache* may take many forms,

including the effects on the soul, heart, and emotions of the viewer, inviting artist and audience into an encounter with the fourth wall.

Contemporary art often presumes value in how a new body of work can effect broad change, which is often also true in science. However, unlike science, in which value is given to clear, transparent, logical representation of every step of the work, in art the process of arriving at an original vision is often selectively veiled to maximize the ‘mystery’ of impact, even when the art form is itself process-oriented. In art, as with science, there is a tension between the accelerated time of current concerns and the attenuated time it takes to produce thoughtful work. Validation of new ideas in art, as in science, advances by a consensus of peer review, which may take centuries to establish. But many artists now, as scientists, feel an urgent and desperate need for new avenues to reach mainstream consciousness and grapple with the environmental crises of our times. Artists are taught to lead with their intuitive (tacit knowledge) responses to empiricism and heuristics. Therefore, artists may be trained to more quickly embrace the surprise of the present. As a result, the work of an artist, compared to the work of people in other disciplines may bring culture more quickly to self-organisation.

Three artists who experimented with calculated complexity to change discursive paradigms are, painter Jackson Pollock, painter and happenings artist Allan Kaprow and feminist Mierle Ukeles Laderman.

Abstract expressionist painter Jackson Pollock, is known as an artist who embraced chance. He spoke of ‘acting upon’ the canvas. Inspired by the Tao Te Ching,¹¹ his methodology was also informed by systems theory (Halsall 2008).

¹¹ A key text of Taoism.

Image not available

Figure 15: Jackson Pollock at work on a canvas, illustrating his spatial engagement with the act of creating the painting and discovering self-organisation in the apparent chaos (photo by Hans Namuth 1950. source: https://en.wikipedia.org/wiki/File:Namuth_-_Pollock.jpg).

Allan Kaprow wrote an historic elegy to Pollock (1958) that became an occasion to predict a time when art would move off the canvas and into everyday life.

I am convinced that to grasp Pollock's impact properly, we must be acrobats, constantly shuttling between an identification with the hands and body that flung the paint and stood "in" the canvas and submission to the objective markings, allowing them to entangle and assault us. This instability is indeed far from the idea of a "complete" painting. The artist, the spectator, and the outer world are much too interchangeably involved here ... What we have, then, is art that tends to lose itself out of bounds... (Kaprow 1958).

Since then, art has colonized every aspect of daily life, including the management of data streams that might inform models and be part of a new system's self-organisation. Both Pollock and Kaprow conceived of the canvas surface as a proscenium to be acted upon rather than simply a window into a world. Pollock's paintings describe nothing if

not a model of the explosive release of entropic energy from an opened system in which his own body was the intrinsic and performative commencement of the mark, the tache on the surface. In oriental brushwork, a flung drop of ink, besides being a tache, is considered evidence of the calligrapher's passion, which emerges less from the technical mastery than the contemplative focus of the artist. In French Impressionist painting, the mark was also driven by artist's assertions of their understanding of color and light in the texture of brushwork. These notions of painting as action, surface as proscenium, and life as the consummate, open-system canvas represent an aesthetic philosophy of art as a system of behavior within a conceptual ecosystem. They affirm that art is comparable to any other system, albeit (and arguably) still dominated by certain values we ascribe to artmaking. Kaprow, an opera aficionado, recognized that not only all life might be a canvas and proscenium, but the performance, or 'Happening', as he dubbed the new vision, was operatic in the breadth of its drama, even in its most mundane aspects.

It was in that intersection between the mundane and the surprising that Kaprow's open structures for events took on meaning and mystery. In this context, the art actions of Pollock (Figure 15), Kaprow, their colleagues, and those who came after, may be seen as new information, replacing former caches of entropic art history with the work of a new order. In physics, this work might be expressed in how statistical mechanics measures the amount of uncertainty in entropy. This work of representing the exchange of matter as art was a new paradigm. It also mirrored what was emerging in the theatre world as the encounter with the fourth wall.

Ukeles took an entirely different approach to the tache in her project, *Touch Sanitation* (1977–80). Building on Kaprow's understanding that art must engage with life to push the frontier of the fourth wall, she set out to shake the hand of every maintenance worker in New York City and thank them individually for their labor. She made the correlation between the 'maintenance work' of child-raising and housework and that of maintaining public infrastructures. In addition to the actual effort, which took three years, she published a manifesto in *Artforum* (Ukeles 1979), creating an historical and professional frame of reference for how the personal becomes political. The response to her project included numerous individual letters of thanks from the individuals she encountered. She followed that work up by washing sidewalks and the floors of museums, elevating the

most menial tasks to a status equivalent to any other act of dedication and craftsmanship. “Maintenance is a drag; it takes all the fucking time” (Ukeles 1979).

Image not available

Figure 16: Ukeles washing sidewalk at the Wadsworth Museum, 1974, effecting a tache on the sidewalk (photo courtesy of Ronald Feldman Fine Arts, Inc.).

Shaking hands with another from a different class represented a spectrum of engagement, of conversation with another point of view that art writer Grant Kester (2013) has written about extensively. In this case, Ukeles’s practice dramatically changed both roles and perceptions of roles. Ukeles’s *bricolage* (the use of text to construct composite realities) put the then-male-dominated New York City art world on notice, confronting their presumptions about women artists as lower class servants. She took ownership of her tache on sidewalks and clean diapers. Her literal ‘mano a mano’ contact between herself—a self-described ‘privileged New York intellectual woman’—and a

working-class person ‘handling’ garbage embodied a metaphor about systems for earth stewardship.

1.5. Butterfly Wings, Ghostnets, and Acupuncture

Chaos: When the present determines the future, but the approximate present does not approximately determine the future.—Edward Lorenz (1963)

Arguably, the most colloquially familiar metaphor from chaos theory is the butterfly effect. It gives form to abstract ideas about perturbation and emergence by making an analogy to how the flap of a butterfly’s wing can effect momentous, emergent changes.

In 1961, mathematician and meteorologist Edward Lorenz formulated what he would call the butterfly effect, to describe chaos theory. This was occasioned when he noticed an anomaly in his weather pattern experiment (Lorenz 1960). Initially, his computer only calculated the weather pattern to three or four decimals. Lorenz’s data indicated however that by surpassing a certain decimal point of variability, a new pattern of order would emerge from chaos. Lorenz had anticipated that his weather data would be consistent. The anomaly revealed two surprises. The first being that the pattern was not consistent with what was then known about weather systems. The second was that it led to observing a new, more subtle pattern originating from the emergent anomaly (sensitivity to initial conditions), which determined that cause and effect could not be predicted, except possibly, in retrospect based on extreme computations. The details of Lorenz’s experiment were less important than how the mathematical anomaly challenged the modernist (Cartesian) view. In that view, the world can be seen as orderly and subject to reason on the one hand while chaos is seen as impenetrable disorder on the other. His discovery perfectly realized what Kuhn (2012) later detailed as an inevitable paradigm shift to accept two previously unthinkable ideas: 1) that chaos self-organizes; but 2) that it does so unpredictably.

In his accounts of this discovery, Lorenz appropriated and referenced the butterfly effect parable (1963): that one flutter of a butterfly’s wing ‘can cause a tornado one thousand miles away’. The idea originated in Ray Bradbury’s 1952, ‘A Sound of

Thunder'. In the story, a time traveler tramples a butterfly while ineptly trying to kill a *Tyrannosaurus rex*. This leads to consequences felt in 2055, with the election of a Fascist President of the United States, an awesome string of relationships between personal responsibility and global effects.

Lorenz's work would not have been possible without another idea model as significant as Maxwell's 'demon information' for catalyzing information theory. The *Turing machine*, imagined by Alan Turing in 1936, proposed an automatic machine that could read discrete symbols on a tape according to rules. That idea model led to the invention of the computer and the capacity for fine-grained quantifiability. Taken together, it can be argued that these three models (demon information, butterfly effect, and the Turing machine), provided the mechanical vision for how quantifiable data would revolutionize our times, contributing to both modeling and Geographic Information Systems science (GISc).

Complexity science concerns itself with unpredictable, uncertain outcomes of relationships between phenomena such as those shown by the butterfly effect. I reference such phenomena as agents and will investigate a series of such agents to develop an approach for designing a complex adaptive model with art. Intriguing mathematical research directions have explored uncertainty in chaos theory, and that research is relevant to environmental restoration modeling. Researchers who have applied fractals to ecotones, have analyzed the mathematically iterative appearance of patterns, with partially ordered sets (*posets*). Both techniques are concerned with tracking how incremental patterns occur in nature.

When drift nets were in use and seasonally retrieved in New England, they were routinely unsnarled in the winter (see Figure 17) for reuse by fishermen and their families the following season. As with any snarled tangle, this required identifying a series of points to begin tracking how the whole system would reorganize. Finding that trigger point of intervention seemed provocatively analogous to contradicting unpredictability in how the butterfly effect catalyzes change. It opened the possibility that acts of intervention in chaos by human agents, might create deliberate perturbations.



Figure 17: Drift nets in a bin, ready to be untangled (Rahmani 1990).

I argue that empathy for other species is one such triggering intervention. Marc Bekoff is among those arguing for empathy, not only for our large, charismatic megafauna, such as tigers and elephants, but for all animals, including the small baitfish upon which larger species depend (Bekoff 2008). In restoration, the significance of adding this empathetic, psychological layer to a complex situation has practical and ethical implications.

It has been said that scientists welcome surprising discoveries, such as those that might emerge from studying complexity. As Costanza's work made clear (Costanza 1991, 1996; Costanza et al. 1997a; Costanza et al. 1997b), the quantifiable consequences of closed economic systems include how they extract species indiscriminately from ecosystems. The ghostnets metaphor illustrates such a system. In the next section I will discuss how art might differ from science in presumptions about the surprise of unexpected events and expectations of uncertainty in the chaos ghostnets might represent. I shall analyze and contrast metaphors from complexity science with a number of the metaphors that emerged from the *Ghost Nets* case study.

How do you eat an elephant? One bite at a time. —Anonymous

Perseverance furthers. —Tao Te Ching

The two quotes above refer to what inspired me to initiate *Ghost Nets*: finding a manageable point of entry to grapple with what is now called the Anthropocene and then design a plan to follow through with that engagement. Pollock, Kaprow, Ukeles and others of their era who represented an abrupt turning point in art history also inspired me to engage with the natural world in ways that culminated in the expression of *Ghost Nets*.

At the commencement of *Ghost Nets*, I thought we were entering ‘the decade of (environmental) choice’ and announced that assumption and my solution—to begin ‘housekeeping’ the planet—in press releases. The story was picked up by media such as the *New York Daily Post*, creating an imaginary proscenium for a fourth wall with my audience.

Unlike metaphors enlisted to retroactively describe a theory of dynamic change, such as the butterfly effect in chaos theory, the lost ghostnets metaphor proactively inspired and determined each step forward in the *Ghost Nets* case study. *Ghost Nets* unfolded simultaneously as research and performance—in the sense of acting on life as described by Pollock and Kaprow. Unlike Ukeles, my attention was not on the humans at the site but on the animals, particularly the fish. In the following section I will detail how one artifact produced from my practice functioned as a script for restoration work.



Figure 18: *Bed of Nets* painted steel bed frame and drift nets (Rahmani 1992).

Bed of Nets was created as part of an installation at the beginning of the *Ghost Nets* project. When drift nets were declared illegal, they were abandoned at the town dump in my community. I retrieved some and composed them on an iron bed, whose frame I had painted white in my studio. Placing them on the bed was intended to imply how our most familiar habits and routines (what we ‘get in bed with’) may be as chokingly lethal as the plastic nets are for marine life. I sought to convey how we figuratively get in bed with dysfunctional relationships and then bear the fruits of death and destruction in our larger environment. Using actual drift nets in the installation allowed me to handle the physical material that contemplating a metaphor as an idea model could not. It was a tactile, heuristic experience of the death trap for marine life. In the context of my conceptual focus, it triggered associations about how familiar relationships might impede or support marine habitat health.

Bekoff captured the pathos of those death traps in the beginning of his abstract for a 2007 paper, published before the devastating British Petroleum spill in the Gulf of Mexico, as follows:

... in this general, strongly pro-animal, and somewhat utopian and personal essay, I argue that we owe aquatic animals respect and moral consideration just as we owe respect and moral consideration to all other animal beings, regardless of the taxonomic group to which they belong (Bekoff 2007).

He continued, speaking of drift nets:

... in 1990, about 42 million marine mammals and sea birds were caught in drift nets as squid and tuna were being harvested (Fox 1997). About 129,000 Olive Ridley turtles have died over the past 13 years because they suffocate in the nets of fishing boats not using mandatory turtle-excluder devices.... In 2003 the World Wildlife Fund reported that nearly 1,000 whales, dolphins, and porpoises drowned daily after becoming entangled in fishing nets and other equipment ... (Bekoff 2007).

In my studio, *Bed of Nets* was a constant *mnemonic* (memory device) reminder of complexity that was deep and personal during the years I was primarily bedridden with CFS. Incapacity slowed my process of site restoration and brought an even more heightened intensity to my observations of details in microhabitats and ecotones, species interactions on the site, and the bioregional context.

The piled-up, rescued drift nets I retrieved from the town dump seemed to embody a metaphorical layer about closed systems and the way people have entangled themselves in indestructible, but impossibly chaotic patterns of environmental behavior, such as Lefebvre (1974) explored. To me lost ghostnets were emblematic of the look and feel of a collapse of complex systems precipitated by thoughtless human behavior. The notion of intervention in a system (i.e., the retrieved drift nets) at a series of points is also analogous to the acupuncture metaphor.

This restoration strategy developed differently from an experimental design in the sciences that draws on Cartesian reasoning or conventional scientific logic. Instead, *Ghost Nets* was driven by concepts and tools from art, and an awareness of the unpredictability of both my own future and the site's successional evolution. But, it was

also quite similar to a conventional scientific experiment because I gave myself a series of tasks, in addition to the journal entries, that were ritually, consistently performed at periodic intervals, such as walking the site in the same pattern daily, despite CFS. Contextualizing my difficulties in performing those tasks with CFS was a microcosm of how difficult it is to restore degraded habitat with the limited resources we are likely to encounter in the Anthropocene. I believe that reflected an aspect of the personal struggle Kuhn (2012) refers to in the creation of new paradigms. CFS forced my process to slow to a speed more consistent with a natural rate of unsupported ecosystem recovery and allowed me to observe many more increments to that recovery. Rather than waiting to observe the entropy of the lost ghostnets and the CFS metaphorical systems leading to chaos, my plan was to pre-empt chaos and work with the limited energy and other vicissitudes of living with CFS.

I deliberately invited chaos into my working process and then waited to see how a new, self-organised order might emerge. I then determined next steps. This structural approach in my practice was grounded in the systemic precedents of Pollock and Kaprow, who experimented with chance.

The self-organisation I observed from my decision, based on the metaphors of lost driftnets and CFS relational chaos, involved how constraints on my stamina and resources, as well as those of others, limited and defined—but did not stop—a potential to heal environmental damage. Increasingly, I was prompted to work collaboratively, for example with Wendi Goldsmith of The Bioengineering Group and with Dr. Michele Dionne, director of Research at the Wells National Estuarine Research Reserve (Wells NERR). I came to see that a second important ‘rule’ for restoration would be, setting aside adequate time to develop relational solutions and to work with communities to support those solutions regardless of my personal limitations. Those rules for restoration—take more time and work with others—may seem self-evident, but can be neglected and were not obvious to me as an artist. Artists are routinely trained to work alone and as spontaneously as possible.

During my time working on *Ghost Nets*, I turned to acupuncture for relief from CFS and began studying literature on it. Acupuncture then became another model to identify the configurations of related microhabitats on the site. Thus, lost ghostnets and

acupuncture, the appropriated models for the *Ghost Nets* project case study, represented extreme ends of a natural systems spectrum. The purpose of those *appropriations*, (ideas borrowed from other sources), was to identify points of contemplative focus along a range of possibilities. Each point defined a potentially mindful, performative action that I could apply to *Ghost Nets*.

The performative structure of the project, although conceptually grounded in closed system metaphors, was intended as a study in an open system, connecting microhabitats of land and wetlands restoration to the larger biome, and to fisheries concerns in the wider Gulf of Maine. That open conceptualization held true, even though I interpreted the grounding metaphor of lost ghostnets as the representation of a closed system. The project's time-based sequential metaphorical structures were each conceived as open systems as well, progressively addressing an upland riparian zone, fringing marsh systems, and the open ocean.

1.6. Summary

In this chapter, I have presented how environmental restoration can be conceived of as an idea model for complexity. Historically, idea models have entered discourse as metaphors. They have driven advances in complexity science, information theory, and the development of computer systems. The success of idea model examples, such as Maxwell's Demon and the Turing machine, suggest that the apparently intractable problem of restoring resilience to large degraded landscapes might be approached as a problem in physics. The existing strategies of nucleation in landscape restoration combined with work on patterns of ecotone integrity and inspired by the acupuncture model imply that scaling from nucleation trigger points could effect environmental triage. This research develops a strategy to observe and activate small, deliberate perturbations in ecosystems, based on nucleation trigger points in littoral ecotones. A corollary premise is that understanding the role animals may play in sustaining ecotone systems that protect water, is supported by ecofeminist and indigenous contributions to environmental ethics. The CFS metaphor is an embodiment tool to apply these premises to ecological restoration. The Trigger Point Theory I am advancing, as a combination of demon information from art and nucleation from ecological restoration, still requires

quantification and falsification standards for application.

Artists such as Kaprow and Pollock provided a formal, conceptual system for engaging proactively, as demon information in a closed, familiar system. Ukeles and other artists presented novel strategies to discover new knowledge and activate different responses to ecosystem problems. These precedents indicate how ecological art could model a vision for resilient and complex systems to effect change in the Anthropocene. In Chapter two, I will explore the application of the fourth wall metaphor as another point of view to inform a CAM for large landscape restoration.

Chapter 2

Landscape as Proscenium

In this chapter, I ask how a metaphorical point of view might become a proscenium to see ecological restoration differently. My discussion will consider the fourth wall concept. How could it help strategic planners scale up nucleation trigger point restoration practices for landscape ecology? A number of approaches to environmental restoration will be reviewed, their strengths and weaknesses as approaches to degradation in the Anthropocene will be discussed, and a possible narrative about opportunities and needs for heuristic and aesthetic thinking will be explored. I will summarize how a metaphorical point of view may predict resilience.

I claim that the proscenium stage view and the fourth wall metaphor might help both artists and scientists design better large landscape restoration strategies. I assert that this approach is efficient and economical. I also discuss how participatory performance art can help define this new point of view about the environment and lead to more resilient interactive models for adaptive management.

How might scalable models based on nucleation trigger points both reflect, and be reinforced by, considering community values differently? In this writing, “community,” is broadly defined to include the needs of endemic wildlife, the views of indigenous peoples, ecofeminists and ecological artists in a fourth wall. Artists are often trained experts at understanding and interpreting heuristic systems in the fourth wall of the proscenium view. They can add that expertise to the successful scaling of nucleation trigger points with strategies and adaptive management. I will show that ecological artists who have studied ecosystems heuristically and connected their experiences to ethics and science (including GISc), may contribute to a new view of resiliency. The methodology for *Ghost Nets* will be compared to more traditional approaches to restoration to illustrate that argument.

The introduction of *C. maenas* to the East Coast around 1817, by way of ship ballasts, will be presented as an example of how, when the human community proceeded from an

anthropocentric point of view, the result was a failure to anticipate disastrous consequences.

2.1. The Fourth Wall: Conversations, Semiotics, and Spectacle

Skillful discourse is essential to both strategic planning and adaptive management. Words are the basic tools of discourse. Artists often use words to direct attention in unique ways.

Semiotics is used freely by artists to signal their audiences where to direct their attention. In Artaud's *The Theatre and its Double* (1958), a surrealist manifesto, he advocated a theatre of cruelty and extravagant spectacle. Artaud inspired generations of artists to use words to seek an idealistic 'truth' as a revolutionary change in consciousness. His text became a directive for some performance artists to deliver sensationalist experiences in the fourth wall between artist and audience, as a means to effect transformation. The New York based Living Theatre (1947–present), exhorts audiences to join them in celebratory rites, sometimes naked, with political agendas. Kaprow's early happenings and many feminist art performances from the seventies into the present have been inspired by the same ethic of shock combined with text.

The Brazilian educator, director, and politician, Augusto Boal interpreted spectacle as an invitation to 'play' with his audience and discover self-respect (Boal 1995). His theatre's website (<http://www.theatreoftheoppressed.org/en/index.php?useFlash=1>) proclaims that, 'the *Discipline* of our Game is our belief that we must re-establish the right of everyone to exist in dignity'.

Feminist ecological artists like Ukeles Laderman, connected the community of maintenance workers to the art world. She engaged people in a dignified participatory art process as part of her project, which included the bricolage of her manifesto. She did so at the spectacle scale. When ecological art segues fluidly between these experimental engagements, as Ukeles's did, it addresses how community systems function: in this case, making a statement about maintenance work elevated to community stewardship. In this chapter I will discuss a point of view that 'shakes hands' with other species who maintain our ecosystem.

2.2. Holistic Views

Perceiving the earth as a whole system, starting in the mid-twentieth century, coincided with increased awareness of bioregional impacts from human behavior. Holistic approaches to conserving large landscape relationships on a global scale began proliferating (Chase-Dunn & Hall 1992, 2006; Holling & Gunderson 2002; Leopold 1948; Lovelock 1967; Lovelock & Margulis 1974; Margulis 1970, 1995; Meadows 1972). Two examples of that view concerned themselves with complexity: Gaia Theory (Margulis & Lovelock 1974; Lovelock 1979) and Panarchy (Gunderson & Holling 2002). Gaia Theory presented the metaphorical idea that the earth comprises one biogeographic living system, capable of a measure of self-regulation. Gaia Theory incurred severe criticism for decades from other scientists, such as paleontologist and evolutionary biologist Stephen Jay Gould, who critiqued and dismissed Gaia Theory as anthropomorphically misrepresenting established knowledge. However, Gaia Theory modeled how parts of complex systems might be interdependent, and it inspired many followers.

The term Panarchy, originated with Belgian philosopher, economist, and botanist Paul Emile de Puydt in 1860, as an inclusive political philosophy. In their writings, Gunderson and Hollings applied Panarchy to analyze situations in adaptive management (2002). They contrasted that approach with hierarchical constructs, such as narrow stakeholder dominance in the Everglades, which they critiqued. Their work emphasized evolutionary cycles in nature and non-hierarchical food web relationships.

The study of ecosystems and the biosphere as complex adaptive systems addresses some of the central questions for ecology, in particular the relationship between the organisation of biodiversity and the functioning of those systems (Levin 1998).

So we are going to terraform the earth? ... We already are. We just don't know how (Robinson 2005).

In Robinson's science fiction novel, humans have carried out major, lethal climate change transformations. While focused on short-term goals, they were heedless of how they were 'terraforming' earth systems and were surprised by the outcomes. His vision may have varied in detail, but Robinson's critique of ecological consciousness holds. His book asserts that human decision-making precipitated the Anthropocene Era by ignoring the *precautionary principle*: that it is better to refrain from doing anything that may cause harm, even if we aren't sure of outcomes.

Views from conservationists, landscape ecologists, and restoration ecologists about restoration vary. The American land conservation and restoration movement owe a great deal to Aldo Leopold. He supervised, with his family, an iconic restoration of 24 hectares of a Wisconsin prairie. However, Leopold had no illusions about the future. In his 1948 preface to *A Sand County Almanac*, Leopold wrote, 'Conservation is getting nowhere because it is incompatible with [how] ... we abuse land because we regard it as a commodity belonging to us.... [but] land [also] yields a cultural harvest ...'

Early conservation models identified an imaginary historical moment (pre-sixteenth-century colonization by Europeans) as a goal. An example was the protection of Yellowstone National Park, replete with indigenous species but divested of Native Americans, who were evicted from the park when it was established in 1872. The United States government agencies failed to recognize how Native Americans had conserved biodiversity. On the Open Space Conservation Strategy website (http://www.fs.fed.us/openspace/national_strategy.html), the United States Department of Agriculture Forest Service defines conservation as, 'land that is valued for natural processes and wildlife, agricultural and forest production, aesthetic beauty, active and passive recreation, and other public benefits'. The intrinsic value of native peoples to whole systems integrity and their vulnerability to anthropogenic activities were not recognized. Those values reflected a Romantic view of nature.

Restoration of North America to a historically "pristine" state is conflated with the edenic experiences of seventeenth- and eighteenth-century European colonists. Paradoxically, that became a 'visionary' landscape overrun by invasive, domesticated herds of exotic animals devouring former prairie. Although the earliest colonists petitioned for and received Native American guidance, they ignored their culturally

integrated land management techniques, such as the ritualized work of basket-makers (see: http://www.enviro-design.org/pb/wp_4f5a9826.html?0.5) in littoral zones. Ever since, it has been a difficult battle to re-establish full access for native peoples and endemic animal species, such as wolves in the American National Park systems. The exclusions contributed towards destroying the careful, holistic ecosystem balance Native Americans had cultivated.

German biologist and geologist Carl Troll, first used the term *landscape ecology* in 1939 based on his observations of aerial photographic patterning in countries like Afghanistan, Iran, and India, introducing another kind of holistic experience. Troll's point of view was profoundly different from aboriginal Australian aerial landscape paintings of large environmental systems, mediated by dream experiences and without geospatial coordinate correlations. Contemporary landscape ecology is largely driven by digitized data collation and analysis. It focuses on studying physical patterns, processes, and structures in time and at scale (Turner 1989).

These physically detached relationships to the land 'beneath' the viewer, mechanically mediated by photography or GPS, not only differ from dream-sourced aboriginal perspectives, they also differ from the perspective of restoration scientists whom approach landscape from the point of view of an individual on the ground (if not in the muck), wrestling with rocks and trees to bring greater vitality to the depleted terrain they are walking and *ground-truthing* (comparing what is on the ground to what has been surveyed).

Landscape ecology considers the development and dynamics of spatial heterogeneity, spatial and temporal interactions, and exchanges across heterogeneous landscapes, influences of spatial heterogeneity on biotic and abiotic processes, and management of spatial heterogeneity for society's benefit and survival (Risser et al. 1984). [It] is an integrative field of study that weds ecological theory with practical application; addresses the exchange of biotic and abiotic materials among ecosystems; and investigates human actions as responses to and reciprocal influences on ecological processes (Odum & Barrett 2005).

Landscape ecology can inform environmental restoration with precise spatial data about relationships between biotic and abiotic factors such as water and geology. Hydrologic factors in more than one bioregional ecosystem sometimes define how many hectares or kilometres need to be included in a pattern analysis.

The International Association of Landscape Ecology (IALE) defines its mission as ‘the study of spatial variations in landscapes at a variety of scales. [This] includes the biophysical and societal causes of landscape heterogeneity. Above all it is interdisciplinary’. However, the content of the association’s flagship journal, *Landscape Ecology*, relies primarily on the *spatialization* of biophysical attributes. Spatialization is the process of converting statistical and GPS data into rasterized pixels, polygons, lines and points that represent a geolocated map which can be queried for relationships between agents. Robert MacArthur and E. O. Wilson, (MacArthur & Wilson 1967) introduced seeing landscapes as assemblies of ‘patches’ that create ‘mosaics’. Arguably, that is a misleading metaphor, because it implies a flat quality to observations and de-emphasizes the significance of subtle connectivity in the form of edges and ecotones. In 1986, Richard Forman and Michael Godron refined those landscape scale definitions to include corridors. They divided biogeographic systems into ecotones, *ecocline* (smooth gradients between habitat niches) and *ecotopes* (the smallest distinct features in landscape mosaics). Landscape ecologist Monica Turner’s 1989 article, ‘Effect of Pattern on Process’, is considered by many to be a landmark text. Turner built on previous patterning work in two ways: first, to clarify how habitat fragmentation results from modified mosaic patterns; and second, to establish how patterns of disturbance result in threshold change (the point before a system changes to another state). Restoration ecologist Jianguo Wu and others struggling with complexity took this mechanistic approach even further. Wu and David (2002) quantified iterations of relationships between discrete landscape elements to conclude that hierarchal and bottom-up approaches needed integration.

However, as the environmental ethicist J. Baird Callicott noted, these categorizations can result in problematic omissions about connectivity:

Ecology is not only a science; it is also a worldview. Plants and animals are internally related. Manipulating them can have unintended and often unwelcome consequences (Callicott 2012).

Today, the elements of novelty introduced by the Anthropocene, as well as different circumstances on different continents, have given rise to a range of interpretations of what environmental restoration can mean to large landscape ecosystems. European notions of both landscape ecology and restoration diverge significantly from the American view.

In Europe, waves of colonization by peoples and exotic (non-indigenous) species have severely compromised any 'historical' perspective on restoration. European restoration and landscape ecologists presume that the natural world will be fully integrated with a human and cultural presence. This can reflect a mechanistic point of view (Wiens et al. 1993). European references to biodiversity rarely imply primarily endemic species because there have been so many waves of colonization over centuries. In these European cases, scientists often speak generally of restoring sustainable, resilient functionality to a landscape dynamic with the support of (human) cultural practices, making the historical ecosystem markers relatively arbitrary. In contrast, the North and South American continents have long been isolated from species migrations from other landmasses, relatively speaking, before European settlement.

Some landscape theorists, such as restoration scientist Richard Hobbs and philosopher and ecological restorationist Eric Higgs, embraced the accelerated novelties of the Anthropocene.

The issues around novel ecosystems are part of a broader dialogue about humanity's changing relationship with nature ... the challenge is to find a path through the complex and pervasive issues that need to be tackled in the quest to nurture and maintain human populations and the world's ecosystems and species (Hobbs, Higgs & Hall 2013).

The problem with finding that path in restoration is the extent of human interference in solutions. Restoration ecology has been described as embracing concepts and tools that repair patches and mosaics of damaged ecosystems (Hobbs & Harris 2001), but that isn't a strategic response when successive perturbations lead to overwhelming degradation. The internationally accepted definition of restoration ecology from the Society for Ecological Restoration (SER), which is not an academic group although it includes many academics, was crafted by field practitioners:¹² "Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed..." (SER 2004). Restoration attempts to return an ecosystem to an historic trajectory. The document goes on to list a number of specific qualities characterizing successful restoration,¹³ but for discrete areas rather than their bioregional contiguity.

Higgs (1997) critiqued SER's definition for its exclusion of cultural context, the inclusion of which might supply some of that contiguity which often informs what we understand as a resilient, conserved ecosystem. Higgs argued (1994, 1997, 2003) for the importance of a cultural moral system and the language to support it, but additional cultural associations from art, the humanities, or indigenous knowledge were still excluded from his analysis. Nonetheless, Higgs presciently predicted (1997, 347) that by 2014, we would risk designing anthropocentric systems without relevance to actual natural processes.

Some environmentalists, such as philosopher Eric Katz (1992, 1997, 2009, 2011), questioned the ethics of restoration itself, because it may imply a 'free pass' to environmental despoilers and the implication that any restoration project could reproduce

¹² Cited in Chapter one.

¹³ The line between restoration ecology and ecological restoration has been parsed since the 1980s. In referencing the contemporary distinctions between the two disciplines, wetlands biologist R. Eugene Turner wrote in a personal email (2014), 'Ecology is the study of the form and function of natural systems and the distribution and abundance of organisms. Restoration ecology is concerned with a subset of the field of ecology: how these functions, forms, distributions, and abundances are affected by an intentional activity—restoration. The key order of things is that the adjective "restoration" is modifying the subject "ecology". Ecological restoration, in contrast, uses the ecological knowledge to advance the goals of restoration. The adjective "ecology" reduces the possible kinds of "restoration" to a subset. Ecological restoration, for example, is not restoration for political gain, economic outcome, or aesthetic appeal in the narrowed sense of the term. The definition of "restoration" could, however ... include the cosmos. These two terms (RE and ER) are not exclusive, and we can learn from the overlap. The fields of ecology and restoration can both be enhanced from properly designed and executed restoration activities that have data-rich monitoring'.

what has been destroyed. They argue that the very concept of restoration is a form of domination, that restoration can only produce a ‘big lie’ of ‘artifacts’ rather than anything approximating nature (Katz 1992). Katz exhorted his readers to question both motives and desired outcomes asserting that and restoration is disingenuous (although he supports the effort).

Environmental philosopher Robert Elliot (1982) compared restoration to an art forgery. Elliot’s arguments over authenticity go to the resilience of the completed work. Resilience as a restoration criterion is based on evidence of previous habitat, as might be indicated with core sampling from the site. Therefore, mitigation or *compensatory banking*, the process of creating wetlands, often where none have previously existed, might fairly deserve Elliot’s excoriation. Wetlands mitigation has often replaced viable wetlands systems with artificial, sometimes unsustainable systems such as those discussed by Brown and Lant (1999) and restorationist Margaret Seluk Race (1985). Race argued against such early mitigations in development plans (Race & Christie 1982). Despite early endorsement of the practice from the United States Environmental Protection Agency (EPA), by its own account, mitigation banking was often poorly engineered, inadequately monitored, and presented the appearance of quantities of acreage ‘created’ at the expense of long-term resilience and adequate scientific oversight resulting in more stringent regulation in 2008.

Conservation	Landscape ecology	Ecological restoration	Remediation
Preserves natural habitat	Studies patterns in environmental systems	The practice of restoring degraded environments where it existed before	Creates ‘new’ habitats where they did not exist before as compensation for loss of such habitats elsewhere.
Relies on policy and regulation to effect.	Uses metrics and GIS for measurements and analysis.	Includes daylighting and bioengineering for hydrology and plantings with policy reforms.	Requires ongoing maintenance to preserve an artificial system, much like Odum’s disclimax, and political support to preserve the systems.

Table 2-1: Comparing systems to address environmental threat and degradation (Rahmani2013).

Adaptive management is the process of engaging communities in restoration decisions with the goal of avoiding restoration failures. As I have indicated, landscape ecologists writing about environmental sustainability (Wu & Hobbs 2007; Wiens 2002; Gunderson, Allen & Holling 2009; Egan, Hjerpe, & Abrams eds. 2012), have often written that resilient restoration requires a cultural component, as in Gunderson's discussions of restoration in the Everglades (Gunderson 2000). In many cases however, adaptive management prioritizes human expedience (Ralph & Poole 2003) with little concern for other species.

Many scientists now realize the devastating repercussions of perpetuating such dominance patterns and have tried to establish another paradigm, like what landscape ecologist John Wiens and wildlife ecologist Robert Schooley refer to as patch connectivity (Wiens 2002; Schooley & Wiens 2003).

In 2009, Gunderson, Allen and Holling analyzed how the pitfalls of adaptive management diluted Leopold's land ethic idealism and values (Gunderson, Allen & Holling 2009). Gunderson and Holling (2002) did extensive analyses of adaptive management in the Florida Everglades, concluding that the 'democracy' of including all human stakeholders with an equal voice has meant that the loudest, generally corporate voices have taken the greater power in decision-making. Gunderson and Holling (2002) describe how Everglades agencies have become mired in what they call the 'Rigidity Trap', one of four systems they identify as dead ends, stalling restoration efforts. They document 'straitjacket' policy rules and regulations as another one of those systems. In other accounts however, observers of the Everglades see cause for optimism (Doyle, Drew 2008). Both landscape and restoration ecologists acknowledge the need for community support to effect resilient land management and (tacitly or explicitly) the need for clear communication, but despite years of adaptive management, there is little agreement about what that may look like. I believe this problem calls out for another point of view.

Environmental sociologist Matthias Gross (2010) describes how surprising events (like black swans) could alert science to new problems by using five research modes of participation that emphasize engagement as: (1 coercing, (2 informing, (3 consulting, (4 co-learning, and (5 coaching. He explains, 'People ... need to be ready to engage and

mobilize themselves, initiate actions, and take responsibility for the surprising side effects of their actions'. As an example, Gross (2010) describes the reclamation of the North Shore of Lake Michigan in Chicago, which commenced in 1929, and discusses conflicts with residents over such matters as the killing of deer. He concludes with a description of ongoing seed gathering occurring with limited education about ecosystem nuances, reflecting a European point of view that supports ongoing human engagement with littoral zone restoration for its own sake. However, that approach may risk sacrificing subtle complex system linkages that could deeply knit ecotones in bioregions with less disturbance than in much of Europe. Without an adequate emphasis on the informing mode embedded in such participatory events, it is unclear what the long-term implications might be for humans in the current environmental crisis. As Katz noted, this is where the art of restoration is both relevant and complex.

When landscape ecologists noted that restoration might be a matter of art as much as science (Elliot 1997), they implicitly invited artists into the discourse. When Elliot (1997) refers to restoration that reconstructs what we know was once present as spurious artwork, he provokes a discussion of what happens when artists seriously engage with restoration as an art medium.

Peter Singer (2002) asserted that humans who dominate and inflict harm on other species¹⁴ are guilty of discrimination comparable to racism. Rachel Carson's *Silent Spring* (1962) is credited as the first contemporary moral argument against indiscriminate chemical pesticide use, specifically how DDT affects other species. Carson launched decades of rhetoric and activism by drawing attention to the abuse of nature, detailing sad consequences for songbirds and eagles. Arguably, her most powerful strategic tool in this campaign was the metaphorical evocation of dying, poisoned songbirds.

Philosopher Tom Regan built on Singer and Carson's work, connecting ethics, empathy, and environmental resilience to speciesism. Regan (1980) expanded themes from John Locke's (1693) writings about cruelty towards animals to emphasize environmental justice. Regan asks not *whether* we do things deemed cruel to animals, but *why*, citing the precautionary principle, as Bekoff (2007) has. He concludes that inflicting

¹⁴ A number of ecofeminist writers established relationships between vegetarianism, chauvinism, animal domination, gender injustice, and ecological damage. See, for example, Gaard 1993, 2002; Adams 1991; and Warren 1987, 1990.

pain on animals or regarding them as mere commodities (as in the case of factory farming), sufficiently justifies our obligation to protect their welfare.

Stewardship of the earth, as I argue, requires partnering with other species and between demographics. Some ecofeminist discourse has parsed relationships to scientific method and terminologies of ethical issues.

2.3. Ethics

As I build this dam

I bury my life

The sun rises

And my spirit sinks.

Hiding my baby under a basket

And hiding my tears

I go to build the dam

The dam is ready

It feeds their sugarcane fields

Making the crop juicy

But I walk miles through forests

In search of a drop of water

I water the vegetation with drops of my sweat

(Daya Pawar 1988)

Physicist, activist, and author Vandana Shiva (1988) quoted this song from the Maharashtra district of India. It supports her thesis that women did sustainable agriculture there for thousands of years with adequate water until the European idea of progress broke links between the ecosystems that had traditionally fed people, crops, animals, and forests. Shiva's work in physics concerned variables in quantum statistics (Shiva 1978). She approached statistical relationships between international patterns of violence

towards women, the rise of monoculture crops, GMOs, devastation of watersheds and estuaries, and other effects of privatization of resources with the same analytic instruments she used to parse her work in physics. Her work documents the former abundance, corporate devastation, and successful resistance of women, charging in 1988 that, 'Globally, some 456 million people today are starving or malnourished because of the desertification of croplands'. Shiva references *Prakriti*, a holistic Indian worldview comparable to Gaia Theory and Panarchy. She contrasts that to relativistic thinking, and the reductive 'progress' of globalization.

Speaking of littoral zones, Shiva wrote, 'Rivers are drying up because their catchments have been mined, deforested, or over-cultivated to generate revenue and profits'. She concludes, 'The metaphors and concepts of minds deprived of the feminine principle have been based on seeing nature and women as worthless and passive, and finally as dispensable'. By dispensable, she indicates the rise in female infanticide. The system she critiques is a hierarchy of corporate power at the expense of all life on earth, with third-world women as the first casualties but also in the front lines of resistance. Without using the term 'ecotones', Shiva describes the systemic effects of eliminating. As a quantum physicist, Shiva internalized and acted upon the systemic implications that go beyond localizations, recording worldwide resistance to environmental despoliation and making apparent how social participation creates change. Shiva leapt from an ethical argument to a metaphorical one (Shiva 2002), advocating grass-roots organizing for an environmental 'war' between rural communities and multi-national corporations. Shiva's chronicles of the contemporary, inequitable, often disastrously devastating effects of water extractions and genetic biodiversity loss (biopiracy) and how third-world solutions from women are needed for all life, are glaringly and conspicuously ignored by Hobbs, Higgs, and others calling for alternative models to address the Anthropocene. Shiva is prominent among writers calling for social justice, but drops other species from her arguments. That is still the anthropocentric approach that many conservative scientists presume.

The feminist philosopher Sandra Harding (1986, 1987, 1991), like Higgs, introduced broad questions about the very language of science, arguing for an expanded, pluralistic point of view closer to contemporary, crowd-sourced, or participatory knowledge. She confronted the scientific essentialism of a mechanistic view of the world. Harding

critiqued those constructs as the legitimization of the same corporate rapaciousness Shiva addressed. Harding referenced the Marxist premise of the unique authority of the 'standpoint of the proletariat' to contest questions asked by Western science. However, Harding also critiqued (2006) Shiva's 'proof game ... that scientific legitimacy requires' on the grounds that 'environmental research cannot escape uncertainty'.

Harding advocated instead, that reliance on the precautionary principle 'should be the trigger to action'. She asked whether science can answer questions specific to the interface between women's work, consequences in personal lives, and dominance, because 'objectivity, rationality, and good method are persistently linked to certain models of masculinity, and only dominant Western ones at that'. Philosopher Val Plumwood referred to that view as, 'the Cartesian strategy (that) created the mechanical body deprived of autonomy and agency by concentrating intentionality in a hyper-separated organ of mind' (1993). Plumwood (2006, 2009) advocated, instead, an 'intentional stance', inclusive of all life.

Evolutionary biologist and philosopher Donna ay interrogated historical Western attitudes towards dominance in hunting, taxidermy, zoos, and laboratory animals, by making comparisons between colonialism, sexism, and speciesism (1990). However, Harding (1986, 2004) both critiqued Haraway for following scientific methodology in her analysis yet also affirmed her for deconstructing cultural pitfalls, while 'strengthening both the existing ideal and procedures for achieving objectivity' (Harding 2006 p. 147).

These arguments for a more inclusive and horizontal relationship to nature took a concrete experimental policy form in Cochabamba, Bolivia, and in Ecuador, where South American indigenous movements initiated a national program for indigenous rights in 2002. That program was proposed to the United Nations in 2007. A constitution for the rights of nature was adopted in 2008. Legal ethicists, e.g., Don Brown, (2009), along with indigenous groups, took on oil companies for environmental crimes and charged them with being in violation of the basic language of the UN Intergovernmental Panel on Climate Change (IPCC). They cited the obligation to protect the 'cultural aspirations' of peoples in danger from climate change impact. Their argument, in a press release I participated in crafting, and in a subsequent press conference within the 2009 15th

International Conference of the Parties, stated that First World countries are ethically liable for the consequences of global warming. That included the littoral zone inundations island nations are vulnerable to with sea level rise. However, by the time these ideas reached the IPCC, again the role of other species in human survival was omitted. Nonetheless, these discourses provided evidence that excluding the community of the other, whether human or animal, cannot serve the greater human good. I assert that the evidence of these thinkers supports my arguments for re-establishing ecotone integrity with animals which depends on embracing our dependence on non-human animals. This requires the willingness to relinquish the domination of those less powerful by those who are more powerful.

2.4. Adaptive Management (AM) with Animals

My premise about adaptive management is that we are not only already engaged in Shiva's water wars (over agriculture, biofuels, and fracking, among others), but are also hampered by being at war with ourselves. This is because, as I argue, anthropocentrism has negative repercussions. It undermines resiliency in infrastructure and restoration design essential for preserving the ecotones that protect water. Continuing to privilege anthropocentrism, therefore, works against human survival. In this section, I will discuss some indigenous views relevant to arguments for human-animal interdependence.

This research builds on my personal experiences with Native American individuals such as activist Dennis Martinez, Chair of the Indigenous People Restoration Network (Martinez, Hall 2008). Martinez organized a series of international forum events with the Society for Ecological Restoration, 1999–2006, for indigenous peoples to present their TEK about conservation techniques and solutions to global warming. Additional indigenous groups impacted me in personal encounters and readings, particularly in California (1968–1986), in Maine during *Ghost Nets* (1990–2010), and in association with Anishinaabee¹⁵ tribal leader and former Green party vice-presidential candidate (1996 and 2000) Winona LaDuke.

In writing about the heartbreaking failures of tribal resistance struggles in North America, LaDuke (1999) opens *All Our Relations: Native Struggles for Land and Life*

¹⁵The Anishinaabee integrates several Indian tribes in the Algonquin language group.

with the phrase, ‘The last 150 years have seen a great holocaust’. She was referring to the loss of species as an intimately personal calamity. LaDuke, as many traditional indigenous peoples, sees individual members of other species as literally kin to herself: their taxa are family communities that are part of her own extended family. As do other indigenous writers, she describes a tightly knit web of threatened relationships among biogeographic understanding, spiritual values, cultural practices, and created artifacts. She cites the James Bay dam ecoregions in particular, writing, ‘the settler’s eyes see differently than the Native’s’, implying that where natives see family, settlers saw commodifiable resources. Her phrase poetically summarizes the chasm between Western ‘science’ and TEK, clarifying why native peoples view results in a different relationship to habitat. The dominant contemporary culture tends to ignore the examples of some indigenous societies that have learned to conserve resources and sustain resilience.

Indigenous weavers in many native cultures have contributed to landscape management by harvesting specific trees and other plants at particular times of year, e.g. willows in riparian ecotones and sweetgrass in the littoral zone (Martinez 2008). The Zuni tribes sponsored one of the few scholarly accounts of this work (Norton et al., 2002), however, more frequently the accounts are informal narratives prepared for native communities. Those accounts allude to complex cultural contexts in colloquial terms. Indigenous practices link human behavior—the creation of cultural artifacts like baskets used for food preparation and ceremonial functions—with a range of biological community practices. Awareness of cross-species interdependence is reflected in indigenous religious ceremonies. When taking an animal’s life, traditional practice often requires thankful prayers for the sacrifice. Harvesting certain plants to create baskets effects ecotone management by regulating water temperatures for fish and other species in a variety of habitats, including marine fisheries. (Northwest Indian Fisheries Commission 2011). The potential contribution of these indigenous peoples was presented by Claudia Sobrevilla in a report to the World Bank (2008).

I argue that the TEK act of thanking, another ritual imbued with spiritual meaning, positions the human ‘taker’ as the petitioner in a dependent relationship. That contrasts with a Western presumption of anthropocentric entitlement. These sophisticated TEK methodologies have been largely dismantled since colonial times, although some tribes

have conserved these practices and have even been willing to share their knowledge with researchers. Unfortunately, many details of these practices are part of a dying oral tradition. More often, the dominant colonial point of view has persisted and excluded the value of indigenous practices, while being oblivious to the devastating impacts of European practices, e.g., the introduction of invasive species, which often destroyed the illusory, colonized 'edenic' ecosystems. This work of TEK ecosystem management was positioned in a holistic cosmological worldview that, I argue, is comparable to how acupuncture contextualizes energy flow or how Eugene Odum observed energy in food webs. Some restorationists might argue that the goal of successful adaptive management depends on local human project ownership. I believe these indigenous practices provide a fourth wall model.

Animals in this model are protected to disperse seeds that knit buffer zones and ecotones as we now replicate with nucleation. In addition to partnership with visible animals, water filtration and conservation also depend on complex relationships between organisms that knit soil and provide nourishment to vegetation. My argument is that when adaptive management prioritizes wildlife at the centre of restoration planning, it requires fewer remediative measures. I designed the *Ghost Nets* restoration to explore that point of view.

2.5. Nucleation Trigger Points

Modeling is an essential landscape ecology analytic tool. Models can make mathematical projections of statistical data and predictively scale up, as with the relative population growth between predators and prey (see Chapter one). *Ghost Nets* was conceived as a literal and idea model for nucleation, community habitat, and ecotone restoration.

Ghost Nets referenced the proscenium view as a means to focus attention on water and then constructed a fourth wall with restoration techniques. My aim was to symbolically parallel functions of *agent* and individual behavior. My motivation was to see what different information might emerge from my experiments. The actual design of the habitat systems, including proscribed walks, were part of an embodied participation model for wildlife on site. In the process of creating *Ghost Nets* I illustrated data for my

‘modeling’ experiments in schematic drawings and paintings, a reductive methodology later applied to other sites.

‘The environment was lost by increments, it can be restored by increments’, stated Wendi Goldsmith (1997), Chief Executive Officer and founder of the Bioengineering Group, in a conversation we had on the occasion of completing bioengineering to restore the *Ghost Nets* salt marsh.

To me, Goldsmith’s statement implied that ecotones and ecotopes (very small habitats) could be strung together to reconstruct the bioregions. In the example shown in Figure 19, I conceptualized how a series of overlapping (nuclear) trigger point restorations might achieve such bioregional healing for the Gulf of Maine.

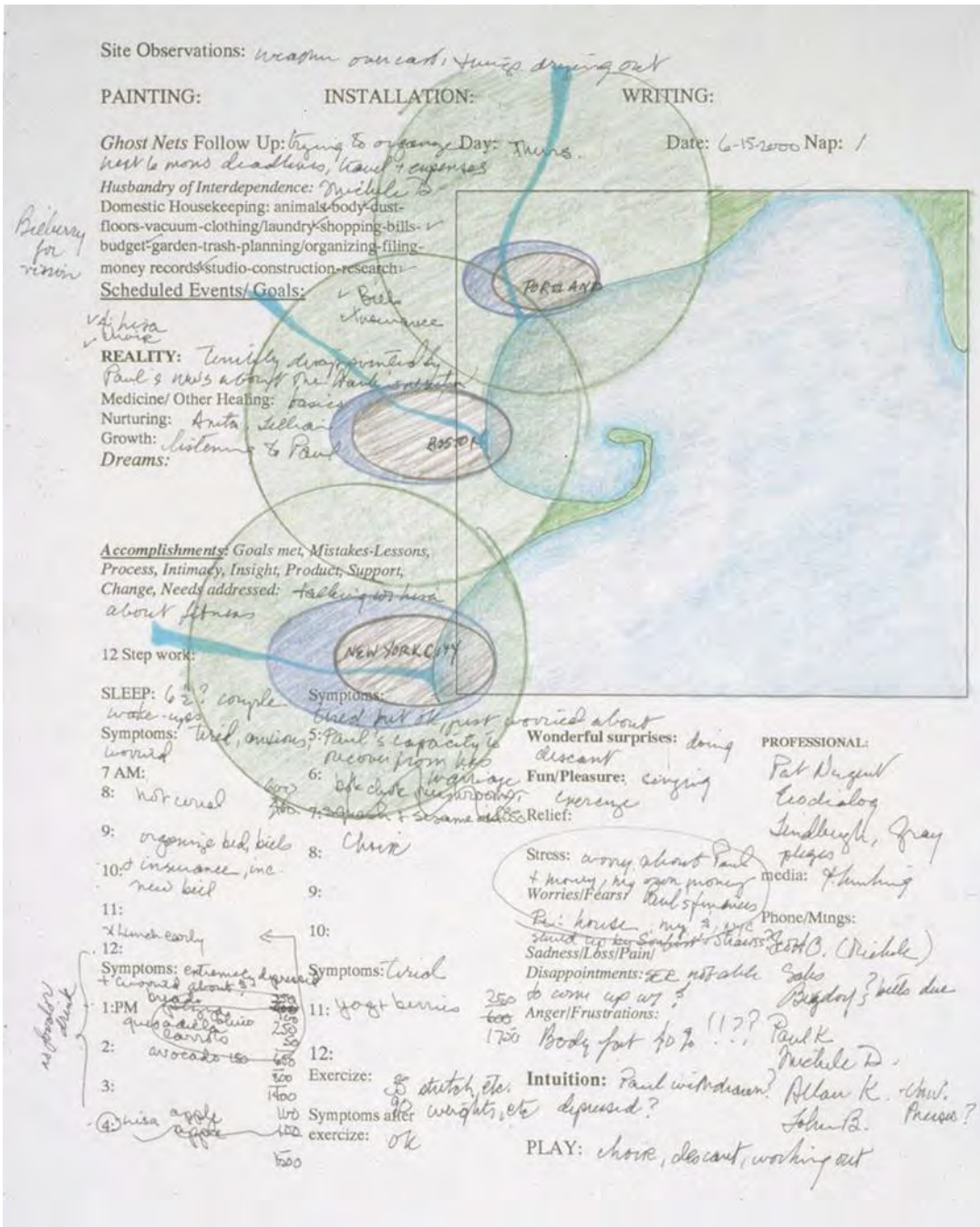


Figure 19: The above schematic sketch, done on a daily schedule, is an example of idea modeling for a series of bioregional nucleation trigger points, and how they might interact in the Gulf of Maine (Rahmani 2000).

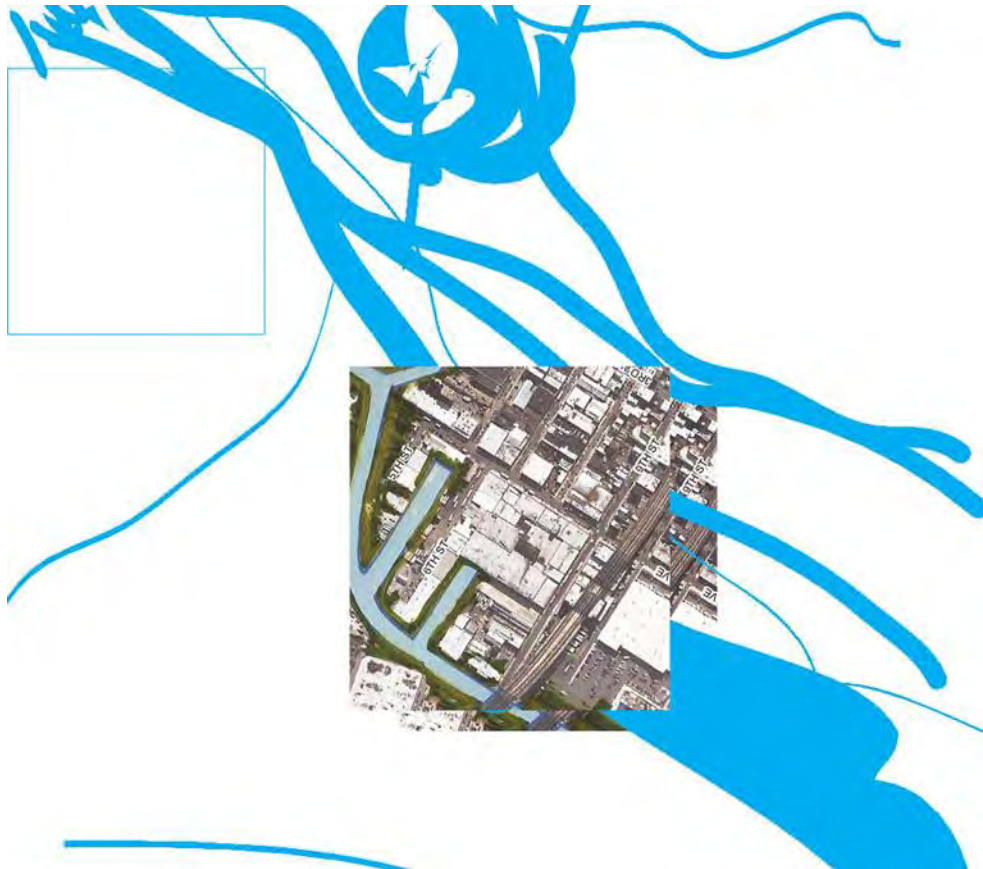


Figure 20: Idea model sketch of Gowanus Canal, New York City (Rahmani 2011).

Figure 20 was created before Hurricane Sandy in New York City to conceptualize how a possible nucleation trigger point might function as environmental triage in an urban setting. In this view, relationships to waterways are channelized and interrupted by built infrastructure. The lighter blue indicates the canal, flanked by green to indicate where ecotones might be established. The darker blue indicates how water would naturally flow through the region. The centre top satellite detail of an urban square indicates how the area looked at the time. The centre bottom square beneath it indicates how the area might accommodate a more natural pattern as climate change proceeds and sea level rises. The top left blank square indicates that we don't yet know how to create urban design predicated on accommodating such a natural water flow (Livingston 2005).

Conventional models are quantifiable but not infallible, because data input is subject to human judgment. The models I created tolerate a great deal of variability.

In 2004, biologist Robert Livingston presented a general critique of statistical modeling. I believe his critique, paraphrased below, argues for considering the limits of quantifiable falsification:

1. The fact that there often is not sufficient oversight for how the database has been assembled or its accuracy, and investigators may collect from only one site, or sites that are convenient rather than representative;
2. That taxa-based assumptions can be subject to reductionist, over-simplified, over-generalizations when there is not sufficient data from a range of sites or interactions between species are not sufficiently considered;
3. That empirical evidence and field-testing of dynamic and temporal factors are not taken into sufficient consideration, particularly in marine zones.

These challenges to reliable quantifiable models have been addressed in many ways. Some solutions include using fractal geometry, which assesses the iteration of patterning, and various forms of Geographic Information Systems (GIS). Kovalenko Dibble and Slade (2010) discussed the role of fractal analysis in controlling invasive plants as a solution to complex littoral zones. In most cases, redundant systems are applied to reduce what is called the *MAUP* (Modifiable Areal Unit Problem) of human errors in the database. Researchers from Hobbs (Hobbs et al. 2006) to Livingston (2005) who are concerned with environmental degradation have concluded that the use of quantitative approaches alone are inadequate to effect sustainable management. As Livingston suggests in his fourth point of critique (as an example of the need to reduce the MAUP):

Detritivores are positioned without references to their mobility in the web and therefore the model. Many animals within the system change their dynamics at various points in their life cycle history as well, as their relationships to food, feeding habits, and predators change (Livingston 2005).

Much has been written about the effects of over-fishing, but Livingston (2005) testified that chemical contaminants in the Gulf of Maine are equally devastating to marine

vegetation and animals. He concluded that nutrient loading, contamination—particularly of mercury (from carbon emissions)—eutrophication, and dredging practices are contributing to marine collapse. Restorationists have since also found residual mercury a significant problem in trying to re-establish *Zostera marina* beds.

Figure 21, created before I had access to GIS mapping, illustrates some spatial relationships between agents in the complex system of pollutants in the Gulf of Maine, including the impact of built infrastructure, lost ghostnets, aquaculture, runoff from timbering, contamination from paper mills, wind-born pollution from coal firing plants and other industries in the Midwest, and the loss of *phytoplankton*. This was layered with indications of how the deep-water Georges Bank area, considered the most fertile portion of the Gulf, might accumulate impacts where wild salmon runs and migratory sea birds would try to negotiate those effects. My intention was to visualize how the Gulf, though presumed to be pristine, is actually extremely contaminated and to try to understand where identifying nucleation trigger points might effect some regional restoration. Livingston's list suggests to me how ecological art might contribute to restoration redundancy.

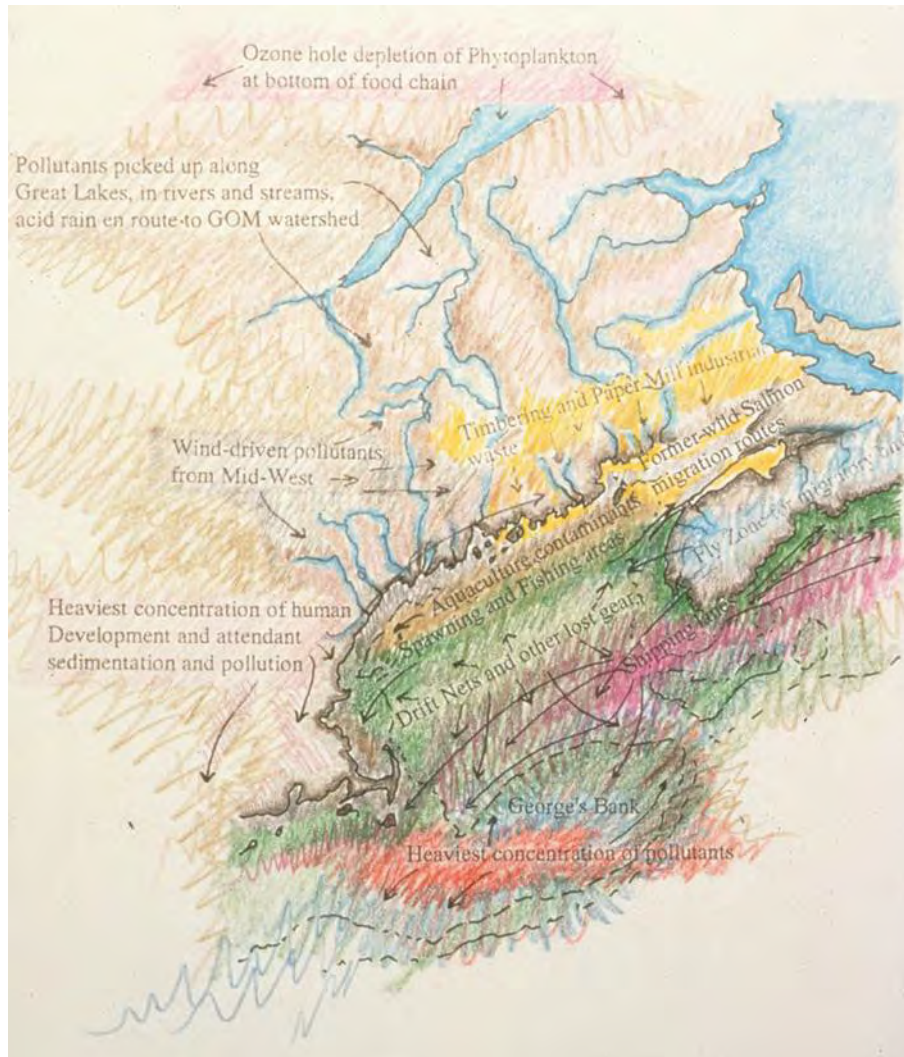


Figure 21: The Gulf of Maine as the Ganges: graphical (schematic) model of interactions between causes of degradation in the Gulf of Maine (GOM); includes the impact of ozone depletion on reduced abundance of phytoplankton which impacts populations of whales, seals and other marine animals (Forster et al. 2010) (Rahmani 1999).

We know that wildlife is integral to resilient successional landscape patterns—what Richard Forman calls mosaics (Forman 1995). Land animals can disperse foraged seeds by consuming them in one place and excreting them in another. Large predators fill important management roles in animal and plant species communities, based on patterns of predation and fear-aversive evasion and adaptation. In marine zones, animal mobility and size differently modify behavior, as does the dynamic quality of the environment (Reis, Bechara & Tres). For example, finfish larvae are vulnerable to the predation of *C. maenas*, but *C. maenas* is vulnerable to sediment desiccation during different tidal

regimes in various geomorphologies. The location of the restored estuary at the *Ghost Nets* site is typical of rocky intertidal marshes impacted by *dynamic* (high impact) tides for the upper half of the Gulf of Maine. Therefore, it seemed reasonable to assume that such geomorphic differences might also affect finfish life cycles. I thought that supporting their integrity might affect fish stock declines. I initiated *Ghost Nets* with the presumption that it would be an experiment in systematically re-knitting biotic mosaic patches. My performative intention was to develop a habitat proscenium for a participatory (fourth wall) experience with local species. I had three local objectives, which I will list below with my methodologies.

1. Conserving fresh water. This required implementing planting patterns of endemic species on formerly mined land to hold water in their roots and canopies as well as reduce soil erosion while filtering out contaminants. That strategy is called bioremediation.¹⁶ This was part of an effort to integrate my work with the presence of other species on the site, supporting microhabitat succession while replenishing and slowing down erosion that carried the meager remaining soil to the sea. In 1990, the entire site had approximately ten isolated patches of indigenous junipers and volunteer spruce growing from bare, broken granite detritus.

¹⁶The soil was tested in each microhabitat for chemical compatibility with each of the planting groups and residual contaminants. No toxic compounds remained, but I assumed and planned for air pollution and acid rainfall, requiring continued filtering.



Figure 22: Spruce and juniper struggling to find purchase on the *Ghost Nets* site when restoration began. Although these remnants are usually the site for nucleation, I chose to leave them to monitor for natural succession. Instead, the sites I chose for nucleation were planned to reinforce ecotone systems in relation to hydrologic patterns and were mulched for protection (Rahmani 1996).

My approach was intended to establish setbacks and ecotones around water bodies, modified by microclimate conditions, and create adequate animal corridors. I built a small home on the site in 1991 and have been in residence since, ritually monitoring the site and participating in the town's community life. I collected and distributed compost, and seaweed from the shore. Newspaper soaked in *mycorrhizae* (a fungus that can be liquefied and added to soil for enhanced plant root growth) was used as mulch by working it around root systems and weighing it down with rocks. Forbs and grasses were planted, so that their

root decomposition would make soil and become nitrogen fixers for other plants. Traps to gather debris and water created refugia on the site.

Bioengineer David Polster (2011) has described a similar means he employs to gather debris using wattles, live gully breaks, and other natural structural interventions to create catchments and refugia in drastically disturbed sites. From studying the site, and applying an aesthetic logic about 3-D design, I had intuitively applied parallel techniques throughout *Ghost Nets* by creating artificial mini-collections of branches and rocks or leaving storm-blown snags and other small structures to trap flow and reduce runoff that carried the remnant soil to the sea. The difference was that the traps I created were often installed as temporary sculptures.



Figure 23: Example of natural byfall trap, created by weather, on the Ghost Nets site in the North quadrant, between the watershed and the riparian zone, to catch debris that would eventually create new soil, provide habitat refugia, and slow erosion (Rahmani 2013).



Figure 24: *Lines of Demarcation* (Rahmani 2008).

2. Providing food for migrating and local species. Most of the islands in Maine have been denuded by past generations of sheepherding. Birds play an important role in regeneration. The *Ghost Nets* site is in a Class A fly zone for migratory birds that pass north and south along the Eastern Americas continental shorelines. Birds routinely consume seeds and their excretions, in which the seeds are embedded, provide fertilizer to nourish the seedlings. That starts successional waves of regeneration over time, including canopy trees, understory, and forbs. The forage I provided was intended to support migratory bird flights and help spread plant varieties to support bioregional forestry health. This was a methodology similar to that advocated by the Backyard Habitat Program for the National Wildlife Federation (<http://www.nwf.org/How-to-Help/Garden-for-Wildlife/Create-a-Habitat.aspx>).



Figure 25: ‘Before’ detail of the West quadrant of the *Ghost Nets* site in 1990, prior to beginning restoration work, demonstrating that there was no forage or shelter for either migrating or local birds. Neighboring homes are seen in the background. The pool of water in the foreground was collected in a pothole created by the previous owner dynamiting the site (Rahmani 1990).

My approach incorporated wildlife forage plantings with permaculture and decorative patterns into the uplands riparian garden design. The patterning was determined by sculpturally conceived stroll gardens, marked by boulders, all based on nuanced observations of changes in microhabitats. The heterogeneous geomorphology of the site and extreme exposure to the ocean on the west side created a wide range of microhabitats. The plants selected ranged over hundreds of species, but those I focused on were primarily endemic species planted based on correlating their requirements to microhabitat analysis, such as *Arctostaphylos uva ursi*, *Juniperus virginiana*, *Iris versicolor*, *Amelanchier laevis*, *Cornus sericea*, *Prunus avium*, and *Pinus strobus*. These were integrated with specimens from more southerly oak-hickory forests in anticipation of vegetative community

migrations from global warming, such as *Magnolia grandiflora*. In addition, the terrain was watched for local volunteers, such as *Linaria vulgaris*, common to waste areas, and *Aquilegia*, which may have remained from previous settlers' gardens. The vertically layered planting patterns nourished animal communities above and below the soil line visible to humans.



Figure 26: One day of monitoring the Ghost Nets site, documenting walking paths and planning plantings in the riparian zone in the context of personal life. This page illustrates how color combinations were conceived to overlap seasonally and provide a continuous 'walking mandala' for sensual experience of the site while monitoring habitat changes (Rahmani 1996).



Figure 27: ‘After’ detail, in the West quadrant of the *Trigger Point Garden*, a stroll path created for visually monitoring use of forage plants shown from the same point of view seen in Figure 25 (Rahmani 2012).

3. Enhancing (littoral) coastal habitat to support finfish survival. This required me to create a bioregionally, strategically positioned restoration as garden design, which would reconnect the fragmented habitat of the uplands riparian zone and the restored estuary with ecotone transitions. My strategy maximized water retention in the uplands soil and filtered it so that when spring melt and rains created runoff, nutrients did not overload the estuary at the base of the site. The ecotone emphasis was intended as a working model for homeowners to use in managing relationships between fresh and salt water.

Following my initial focus on the uplands riparian system to establish robust water filtration. I established additional plantings that would encourage successional nucleation in edges where patches might overlap and in the ecotones at the edges of patches. Those plantings included *Nyssa sylvatica*, *Quercus rubra*, *Viburnum opulus* var. *trilobum*, *Juniperus horizontalis*, and *Tiarella cordifolia*. In the estuary, my approach was to do bioengineering work, with The Bioengineering Group, at the southernmost end of the *Ghost Nets* site, where it

ends in the sea. Sixteen truckloads of riprap were removed from the site to allow daylighting to reveal estuarine soil and permit tidal exchanges. Elevations were calibrated to match the local control site, a pristine location with comparable characteristics. I worked on restoring all the other *Ghost Nets* microhabitats before the salt marsh bioengineering, organizing that work into phases of earth-hydro-ecosystems. Those three ecosystem phases were riparian, watershed, and estuarine. Each phase was three years long and structured as an endurance performance around specific local relationships with soil (or sediment in the estuary), wind, animals (including humans), and water.

As shown in Figure 24, the restoration of the salt marsh was tracked, in part, by leaving sections of the uplands slope untouched, to observe the relative rates of plant colonization (line of demarcation indicated by the vertical blue line). A constructed wave attenuation barrier was installed as temporary sculpture and monitoring device. The barrier slowly disorganized over a decade, from the dynamic wave action of high impact spring storms (marked in red). That eventually left it almost indistinguishable from other aspects of the remaining detritus. The two functional wave attenuation barriers are indicated in the Figure, one natural (foreground green line) and one built as sculpture but disorganized (horizontal blue line.)

2.6. Nucleation Trigger Point Model

The localized nucleation developed as a means to build on natural successional processes where the site was not entirely degraded. My approach was grounded in island biogeography theory, and in how species move between refugia. Nucleation has been an economical and efficient restoration strategy that is gaining interest but has not yet been studied in littoral zones or for application to bioregional assemblies.

There are two basic techniques to effect restoration with nucleation. The first is to build on refugia of remnant patches in the landscape. The second is to establish small islands of shrubs, trees, and perches in relatively protected areas, such as those created by natural or created blow-downs, which can then generate ‘seed rain’ when animals use them, to effect germination.

I will now compare a conventional environmental restoration approach, using Forman's (1995) criteria as a model, to my own heuristically grounded art methods in the *Ghost Nets* case study model to create nucleation trigger points. In order to compare relevant similarities and differences between a mechanistic and a heuristic approach to restoration in our strategies I will use Forman's terms: *stating the objective, detecting linkage patterns, assemblage of elements, efforts towards functionality, and the observations of discrepancies* (Forman 1995).

Forman's criteria	Science methods	Art methods
<i>Stating objective</i>	<ol style="list-style-type: none"> 1. Initiate a series of localized successional islands. 2. Establish ecological drivers, including animals. 	<ol style="list-style-type: none"> 1. Initiate performative 'housekeeping' for the world. 2. Conceptualize relationships to bioregions.
<i>Detecting linkage patterns;</i>	Site would be periodically assessed by quadrant analysis.	Site was periodically photographed and painted.
<i>Assemblage of elements</i>	<ol style="list-style-type: none"> 1. Seeding in prescribed patterns around climax tree nuclei refugia. 2. Seed rain germinated in nurseries 3. Seedlings established in nuclei plots. 4. Brush piles 5. Adding local soil 6. Matrix design 7. Artificial perches 	<ol style="list-style-type: none"> 1. Soil analyses of microhabitats; planting design; seeding and planting. 2. Allowed animals to disperse in natural succession. 3. Mulching, cover crops such as <i>Vicia villosa</i> to prevent erosion and naturally build nitrogen.

- | | |
|--|---|
| 8. Tree seedling groups at regular intervals | <ul style="list-style-type: none"> 4. Creating locations for refugia as sculpture with boulders, detritus. 5. Dousing seedlings with Mycorrhizae; adding local seaweed to soil; creating soil with compost. 6. Nucleation points integrated with aesthetic design and paths. 7. Establishing canopy trees and understory plants that also function as perches. 8. Trees planted in circular patterns based on interpretation of Medicine Wheel premises. |
|--|---|

Efforts towards functionality

Dependent on stochastic animal dispersion.

Micromanaged by physical interaction with the site, with periodic interventions.

Observation of discrepancies

Monitored, quantified observations leading to call for greater theoretical integration within the (scientific) restoration community.

Use of schedules to map my impressions with subjective interpretations; call for recognition of the contribution of art to systems planning, addressed to managers,

scientists, activists, and other artists.

This chart shows that many of the same stages Forman identified and the techniques used for nuclear succession were also utilized at the *Ghost Nets* site. The four major differences were:

1. the integration of aesthetic approaches, somewhat randomized by design elements, vs. highly regularized patch design;
2. the integration of human and wildlife use with paths for monitoring change;
3. integration of large landscape policy goals with localized biological goals;
4. the deliberate choice of a site on the basis of biogeographic positioning.

In addition, the following processes were used at the *Ghost Nets* site:

1. cleaning out trash from the former dump to prepare the proscenium;
2. wherever possible, replacing boulders that had been dynamited to make sculpture
3. placing seaweed on the land where it had been strip mined and shepherded, conceiving of that process as painterly, to build an 'impasto' of soil;
4. identifying invasive pasture grasses, such as *Galium mollugo L.* and *Cynodon dactylon*, for elimination;
5. intaglio pruning of planted trees and understory to expand the proscenium for other species by creating perches, openings for sunlight, and wind modification;
6. personalized stewardship as an art life practice.

The result of this work was terrain transformed from windswept, barren rock to deep soil teeming with earthworms, many varieties of visiting birds, all articulated by many shaded microhabitats rich in vegetative diversity.

In the next section, I will discuss how the *Ghost Nets* case study explored adaptive management as to scale the project, as an exploration of the fourth wall.

2.7. Adaptive Management in *Ghost Nets* and *Fish Story*

Arguably, the drama on the world proscenium today, as my second quote opening this chapter referenced, involves water. The global fourth-wall drama, which my research addresses, is how to include other species in the resolution of that conflict. It may appear that the labor-intensive approaches of the *Ghost Nets* project would be less efficient than conventional restoration methodology. However, I argue that this methodology conveys ownership and participation in ways that are accessible to individual non-professionals, which may insure long-term community stewardship, and is similar to how indigenous peoples tend their habitat.

Conceiving of the proscenium metaphor as a way to focus attention on water allowed me to characterize a personalized and interdependent relationship to nature. A model for that relationship was the writing of American naturalist Henry David Thoreau on the Maine landscape of his times (1864). He grounded his journalistic observations in ethical presumptions about nature. That retreat to ennobling wilderness continues to be a deeply ingrained trope for American audiences. Thoreau, with whom I feel an affinity, suggested we can reconceive our connections to other forms of life and ‘live deliberately.’ In the account below the degradation of the Maine environment from which the state is still recovering is described.

Think how stood the white-pine tree on the shore of Chesuncook, its branches soughing with the four winds, and every individual needle trembling in the sunlight, — think how it stands with it now, — sold, perchance, to the New England Friction-Match Company! ...The mission of men there seems to be, like so many busy demons, to drive the forest all out of the country, from every solitary beaver-swamp and mountain-side, as soon as possible (Thoreau 1864).

Despite many frustrations and failures, most restorationists still agree that adaptive management is critical to large-scale ecosystem restoration (Holling & Gunderson 2002). However, as Gunderson and Light (2006), along with others have written, solutions are often bogged down by conflicts among the pursuit of sound science, those dismissing sound science, and the voices of extractive industries or entrenched bureaucracies.

Corporate interests such as the sugar cane industry in the Everglades or ‘Big Oil’ in the Gulf of Mexico often deliberately confuse the public with strategically detailed disinformation campaigns (Brown 2013, Mann 2012). On the other hand, community engagement can catalyze informal education (Cuomo 2011).

The island presented an opportunity to engage with a range of water problems. It is a sole-source aquifer, dependent on rainwater, vulnerable to coastal saltwater intrusion and well draw-down. In *Ghost Nets* I tried to establish the sincerity of my community credentials to affect local policies, by serving on several local regulatory committees, including Water, Ferry, and Comprehensive Planning. During the period of *Ghost Nets* many residents seemed unaware how vulnerable their water system is. Therefore I actively participated in producing and distributing educational publications. Speaking of my involvement, Susan Lessard, then town manager, wrote in 1999 (see appendix), ‘her concern for the environment has led her to both initiate and participate in public discussions on water quality and supply, concerns over increased tourism and its real costs and benefits, and maintaining the character of this island community’. The outcome of what I learned from this participation was a 2002 project leading to the restoration of an additional twenty-six acres of critical wetlands habitat on the island, *Blue Rocks*. It was conceived as a biogeographic extension of *Ghost Nets* that could contribute to watershed and habitat protection for the larger community (the strategy for that project will be described in more detail in Chapter three).



Figure 28: Detail of the surface water in the quarry, part of the North quadrant of the *Ghost Nets* site, ringed by planted hardwood and volunteer conifer trees. Boulders in the centre of the quarry allowed a simple way to track surface water levels during the summer months, when drought can affect aquifer draw-down (Rahmani 2012).

In *Fish Story* (see introduction and Chapter five) I reconstructed the steps I had taken to choose the *Ghost Nets* site. In the latter case, I began with questions about how to unravel the ‘ghostnets’ of environmental degradation, how to protect fish populations, and where conserving water might leverage greatest transformation, before choosing my site. In the case of *Fish Story*, before the project began, in 2011, I had the goal of identifying trigger points to reverse dead zones in Gulf of Mexico regions.

At Dr. Eugene Turner’s suggestion, we tracked the problem back to Iowa, where factory farms were releasing nitrogen into the Mississippi River. When the opportunity then arose to do an ecological art project in Memphis, I seized on it as roughly midpoint between those systems. Subsequently in 2012, a possible trigger point was identified where the Wolf River, a tributary of the Mississippi, had been diverted rather than emptying into the river and contributing systemic flushing.

2.7.1. Choosing Sites for *Ghost Nets* and *Fish Story*

1. Excellent baseline data exists on the historic ecosystems in the Gulf of Maine prior to extensive European settlement. This data can be found in early settlers' diaries, maps and accounts of initial explorer's contacts, and other documents. I accessed this data at Historical Societies in Vinalhaven and the City of Portland and much of it is summarized by Philip Conkling, in his book, *Islands in Time* (1985).

We have clear and detailed textual and photographic records showing how marine populations have generally declined in the Gulf of Maine and particularly in the waters surrounding Vinalhaven Island, along with inarguable information about some of the anthropogenic causes of those declines. Those causes include humans as efficient top predators: over-fishing animal stocks; filling and covering wetlands; generating offshore pollution; and introducing waves of invasive, predatory species that have decimated endemic taxa in the littoral zone. The most notorious example of assault on sea life from humans has been the steep decline in once-abundant codfish (*Gadus morhua*), popularly chronicled in *Cod: A Biography of the Fish That Changed the World* (Kurlansky 1997). This book offers a micro-history of the larger patterns of marine exploitation that have driven many fish species to the brink of extinction. That exploitation was so extensive that it resulted in evolutionary change for *G. morhua*. Within two centuries, by culling out all large specimens for consumption, the average size of the cod catch was reduced from metres-long specimens in the 1700s to mere inches in the twentieth century. Catch quantities are reputedly 4 percent of their 1850s totals (*ScienceDaily*, 2005).

2. The island of Vinalhaven, Maine, has unique environmental and cultural features. It is 13 miles from the mainland, creating a measure of isolation and relative control over animal migration patterns while at the same time isolating the local community.

Culturally, it is a heterogeneous mix of year-round fishing families, whose roots go back to the island's first settlers whom often, and early on, assimilated with the Native Americans who were summer resident. Contemporary demographics include sophisticated retirees such as former academics, and international cohorts of artists, intellectuals, and old-money families, whose arrival each summer, swells the population six-fold. Island attitudes toward nature is both casual, acceptance of local features of

spectacular beauty, and intimate, in the engagement with specific sites and even particular rocks.

Penobscot Bay is the second largest embayment on the East Coast. In all there are almost a thousand miles of shoreline, including 624 islands and ledges. The largest and most populous of these is the island of Vinalhaven—only 12 miles from the mainland (Levitt 2011).

3. The East side of the island, where *Ghost Nets* is sited, is exposed to high-impact waves. The island is a sole-source aquifer, dependent on rainfall to restore fresh water. It is vulnerable to salt water intrusion and coastal subsidence from the over-drawing of the water table when the island experiences a drought period or a summer population surge. This makes the site a particularly interesting location to study the impact of sea level rise. The highest known storm surge level (1994) was marked in the restored estuary in 1997. As in all systems that protect water, adequate filtrating vegetation and the animals that sustain that filtration will conserve the quality and quantity of fresh water. But the island had previously suffered significant erosion and had been severely impacted by shepherding and granite mining.

4. It also situated close to an offshore cold-water plume that provides an additional series of complex marine habitat edges.

2.7.2. Sensitivity to Initial Conditions

During the monitoring of the last phase of work at *Ghost Nets*, high concentrations of *C. maenas*, were discovered in the restored estuarine area. Their presence alerted me to the continental problem of invasive species and served as an instructive model for how quickly and completely a small change can precipitate large-scale disaster. The crab were first documented in the Americas in 1817 in Boston Harbor, apparently coming from ship's ballast. The practice of loading ballast from coastal waters and then dumping it inshore continues to this day, despite the option of doing so further out to sea, where it might do less damage and where species like *C. maenas* might not have flourished. Instead, green crabs are now significant predators in the North American littoral food web—an unwanted black swan.

C. maenas, the size of a fingernail, also called shore crab, has proliferated at astonishing rates in coastal North America. One female crab can reproduce twice a season and release 185,000 eggs.¹⁷ They have particularly decimated shellfish and eel fisheries by voraciously consuming larvae, creating serious littoral zone food web depletion and subsequent fisheries collapse (Klassen & Locke 2007) and disrupting the food supply for migratory sea birds and seals. *C. maenas* also devastates swaths of eelgrass with their claws as they move along the ocean floor (Malyshev & Quijon 2010), disrupting species lower on the food web who depend on healthy eelgrass beds. Mechanical solutions alone have not eradicate its presence. Government agencies have spent fortunes attempting to rescue the fisheries industry because of the damage these organisms and other invasive species have inflicted (Mooney 2005) on the food web.

A food web is usually presented as a complex system of energy consumption among taxa. The metaphors of open and closed systems discussed in Chapter one are relevant to food web dynamics in the littoral zone, where management issues have become enmeshed in a constellation of problems, from pollution to overfishing, to sea level rise to invasive species, all symptomatic of past ecosystem management failures. However, food webs are often presented without the pernicious impacts of humans (Figure 29). I have not seen a food web presented as I view it: dominated by an anthropocentric point of view (Figure 30).

Image not available

Figure 29: In this typical food web illustration, human presence is indicated by a harmless, unmanned rowboat (source: http://www.glf.dfo-mpo.gc.ca/Gulf/By-The-Sea-Guide/Estuaries#food_web,2009).

¹⁷ Prince William Sound Regional Citizens Advisory Council, 2004

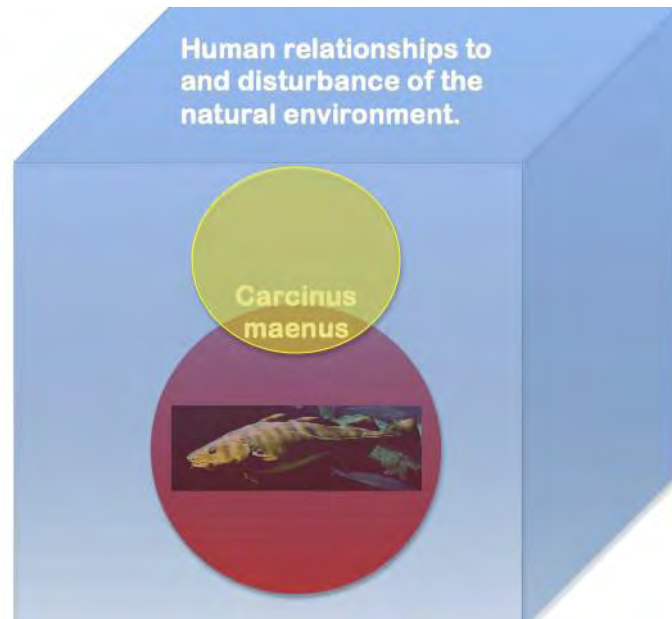


Figure 30: This illustration presents a (closed) box of human behavior and attitudes. Familiar habits introduce unexpected disturbances, which then create food web problems. An example was the introduction of *C. maenas* and the demise of finfish from coast to coast in North America. Species shown is cod, iconic to the Northeast Americas but which is now struggling to survive (Rahmani2011).

2.8. Summary

This chapter argued for a deeper consideration of animals' roles in environmental triage and adaptive management. I touched on ways art, ethics, and nucleation might inform a model for 'unraveling' bioregional complexity in the Anthropocene. Science is a slow process of comparing results, but contemporary scientists agree that problems of *novel ecosystems* (created by humans), loss of water quality and quantity, and food web disruptions, along with the consequences of habitat degradation, encroachment, and fragmentation (all caused by human agency serving anthropocentric attitudes) require urgent and original responses. As Eugene Odum (1953) and Kuhn (2012) pointed out, new metaphors can enter the discourse to effect substantive changes to scientific thinking, influencing where and why to shift perspective and ultimately create a political base for policy change. I presented the fourth wall metaphor and the proscenium view to reconsider how we engage with landscape. I suggested that attention to ecotones might be analogous to discovering the point of sensitivity to initial conditions in chaotic, complex systems. That point might be used to locate nucleation *in* the conceptual fourth wall. I argue that small events can emerge from these interactive experiences and transdisciplinary thinking that may effect large-scale self-organisation with 'demon information' (Chapter one).

The shifted point of view I propose sees our relationship to the rest of the earth as differently grounded in ethics and water conservation, closer to an ecofeminist or indigenous point of view, and profoundly practical. In this view, humans are only one of many actors in dramatic constructs. This is very different than a mechanistic, anthropocentric, or even strictly heuristic experience of large landscape systems. The drama of living in that point of view and prioritizing water for all species becomes a new model.

My arguments are based on the premise that we live in times of extraordinary urgency. Therefore, we need to focus on the pragmatic values behind our ethical point of view. I contend that requires embracing our dependency on other species, relinquishing expansionism, and understanding how art may play a role in new paradigms. Artists have taken a role in deliberately opening up closed systems, including the very dynamics of verification that Kuhn (2012) analyzed. Artists often draw on special skills to evoke

deliberate surprise in systems. Scaling up restoration solutions has everything to do with reconsidering the point of view that drives what and why we restore. Once we have determined our values, we can better decide if we might begin nucleation to effect large landscape restoration.

In the next chapter, I discuss in more depth how art has wrestled with this systemic urgency and ecological arts' role in resolving environmental urgency.

Chapter 3

Ecological Art and Resiliency

Conflict is the gadfly of thought. It stirs us to observation and memory. It instigates to invention. It shocks us out of sheeplike passivity, and sets us at noting and contriving. —John Dewey 1922

In this writing, I assume a confluence between the conflict philosopher John Dewey alludes to above and deliberate perturbations that can lead to resilient restoration. This chapter explores how ecological art might uniquely contribute new paradigms, strategies, and methodologies to urgent environmental crises. I contend that ecological art contributes to more effective and holistic environmental restoration strategies and policy changes. That is because artists can be expert witnesses for ecosystems. Restoration science may benefit from their insights. I also contend that ecological artists can contribute to these processes with play, holistic approaches, provocative discourse, and new ideas about resiliency.

As I will argue, embodiment and the strategy of ‘serious play’ in art can take many forms. I will establish how those forms can provide strategic options for restoration management. My goal is to investigate how art might help engage a mainstream public in adaptive management with other species. My research will present why that engagement could function as demon information in closed systems: black swans in sensitivity to initial conditions. I posit that recognizing this potential function is essential because it might effect greater exchanges of information than any constellation of disciplines without art can effect. I also argue that transdisciplinary ecological art is better prepared to deal with uncertainty and facilitate ecosystem change than science alone or other genres of art. Therefore, ecological art combined with restoration science could reinforce and inform each other and lead to greater resilience.

3.1. Background

These claims will be better understood in the context of philosophical and critical

thinking about contemporary visual art. In the introduction, I wrote that many ecological scientists today believe hallmarks of the Anthropocene Era, such as high consumption rates and fossil fuel use, are imminent threats to human survival. Since the Industrial Revolution and accelerating with World War II, sweeping technological and sociopolitical transformations culminated with the nuclear bomb, genocides, electronic media, feminism, and the rising power of global corporations. These changes have caused globalized feelings of cultural and ecological urgency, dislocating known social contracts (O'Brien, Hayward & Berkes 2009), even as people sought to extract order from chaos.

Complexity science and systems theory developed concomitantly in this period with what is called post-modernism, the period when idealism has been supplanted by cynicism. These development began informing and dissolving boundaries between disciplines with new information. Modifying systems by introducing new data has been identified by physicists as a thermodynamic process that exchanges work energy (Shannon 1948). Some physicists believe order may be discerned from studying points of sensitivity to the initial conditions of chaos (Haken 2010). How could a study of surprising information from art (black swans) clarify sensitivity to initial conditions?

In the ecological sciences, complexity theory contributed to its interdisciplinary nature (Wu & Hobbs 2002). Many restoration scientists began testing disciplinary boundaries. As I wrote in Chapter two, environmental ethicists and others began paying attention to interspecies community functions and services (Benayas et al. 2009). My aim in this chapter is to draw attention to how artists have responded to the complexity precipitated by the velocity and scale of global environmental change.

In the late twentieth and early twenty-first centuries, many artists explored the new experimental forms and philosophies that emerged with industrial and social change. These new aesthetic paradigms were paralleled by the rise of transdisciplinarity in Europe. Reacting against 'silos' of perception and outreach amongst conventional science disciplines, Romanian philosopher Stephane Lupasco was among those exploring worldviews grounded in quantum mechanics to understand complex functions and address sustainability (Lupasco 1951) and what Lupasco posited was an 'included middle' ground of consciousness. Other thinkers variously interpreted the included middle, as I will explore later in this chapter.

Twentieth-century art critics and curators drew on philosophy to interrogate, explore, and shape public discourse and ethical, aesthetic relationships to change. Analysis of transformations in thinking about art is sometimes situated between a closed, individualistic view of the world and one that is more open and porous (Burger 1987; Calinescu 1987). Arguably, the transformation from traditional forms (such as painting or sculpture) to land art and ecological art are an example of how information may modify closed systems of thought. I will argue that ecological art experiments can be informational trigger points for further transformation because artists can present novel restoration models. Often that process reconciles new aesthetic (formal) paradigms with older ones, as Thomas Kuhn argued historically occurs in physics (Kuhn 2012), even as paradigms, such as older forms of art, appear to be jettisoned.

An example is ecological artist Aimee Morgana's tutelage of an African Grey parrot as an artwork (Goodall 2005), which contested speciesist presumptions about the reflective capacities of other animals. Morgana's work interrogates the discursive philosophical and art criticism context of artistic experiments as a system of learning. In that case, the audience's attention is drawn to the mark of the artist in the evidence of the parrot's conversation. Morgana both challenged established definitions of art's role and used text (bricolage) to advance her definition.



Figure 31: Aimee Morgana using cards to teach the parrot N'Kisi to speak (photo by Grace Roselli 2000, courtesy of Aimee Morgana).

Another example of a new aesthetic paradigm was expressed when ecological art curator Amy Lipton introduced the term *ecovention* in 1999, for the catalog of the *Ecovention* exhibition, first published in 2002. Lipton defined that process as an aesthetic practice informed by ethics and located in physical sites (Lipton 2002, 147). This concept reflects a shift from the end of the twentieth century to early twenty-first century aesthetic discourse on the nature of the artist's mark. *Ecovention* redefines the role of the arts and artists as activist and remedial, serving as environmental triage on the landscape at a time when the landscape is being radically redefined by the impact of the Anthropocene.

Lipton's text stresses the importance of the viewer's perception of aesthetic strategies, implying that the frame of perception doesn't begin or end at the site. As I discuss in Chapter two, the point of view, or where attention is given to the site, shifts both the experience of art and of environmental restoration.

Lipton and Morgana are members of the Ecoart Dialog Collective, a group compiled of over 100 international online members who are invited and individually considered for

inclusion, based on the maturity of their work and thinking about ecological art. The collective formed in 1999, when fellow ecological artists Susan Steinman Leibovitz, the late Jo Hansen, and myself co-moderated a large panel on the state of the art of environmental art, 'Off the Mainstream, Into the Mainstream', for the College Art Association (Rahmani 2002). The group's intention was to draw attention to a new generation of environmental art with new strategies.

The Ecoart Dialog has functioned as an online platform, as a social network, in face-to-face gatherings around the world, and as a source for public panels. Advancing a distinctly activist approach, members have discussed case studies and examples referenced in this writing, layering interpretation, philosophical theory, research, and practical implementation to interrogate the integrity of an artist's mark on the culture or the particular site.

As a collective, the Ecoart Dialog network operates in the strategic category of 'distance art', defined by Australian new media artists Annemarie Chandler and Norie Newmark as a place that sources virtual technology, conflating art discourse and activism and creating performative space (Chandler & Newmark 2005). This is a definition of disembodied location that art historian Miwon Kwon has referenced as the new 'nomadism' of contemporary art (Kwon 2002). That nontraditional notion of site is grounded in and expands on aesthetic values and ideas about transgressing conventional locations. Playwright and author Antonin Artaud anticipated such dispersion as the 'body without organs,' (Artaud 1947). The idea evolved further with the land art movement, as it moved out of the gallery and into the 'raw' landscape. In ecological art, this invited artists into interdisciplinary collaborative work and adaptive management.

Conflating restoration science's adaptive management with participatory art in ecological art as described in Chapter two, could add depth to restoration science strategies by including other ideas along with other species, human debts to the earth, and criteria for who or what inhabits the fourth wall of public space. In the wider cultural context, such inclusive thinking echoes the proposals of semiotician and philosopher Jacques Derrida for resolving divergent opinions in the *akora* (Greek for 'place', which he deconstructs metaphysically; see Derrida and Caputo 1997). Derrida is sometimes credited with marking the inception of post-modernism with his linguistic

deconstructions. Derrida proposed a new order for Western culture, in contrast to fetishized commodification (Derrida 1994), with the idea of surrendering a gift into the community. In his writings, akora replaces location to suggest answers to modeling questions grounded in a close examination of concepts of gift and place. Derrida was inspired by Antonin Artaud's *Theatre of Cruelty* (Artaud 1936). Artaud saw a means to shock life perceptions into awareness while affirming another order in his conception of location (Artaud 1936; Derrida 1998). Derrida's thinking, like that of ecofeminism cited in Chapter two, models how to enter discursive conceptual locations with the generosity and complexity that allows room for other species. Derrida's conception of space included a proposal for gift-based justice. He repopulated place four-dimensionally and contrasted this new 'gift' culture with opportunism, commodification, or extractive relationships in the akora (1997). Derrida's akora also drew attention to the artist's contribution to aesthetics. He affirmed the personal struggle science historian Thomas Kuhn (2012) referenced in any period of transition.

In contrast, the writings of mid-twentieth century formalist art critic Clement Greenberg narrowed attention to a formalist frame of perception and discourse. Greenbergian formalism advocated an ethically 'pure' aesthetic (Greenberg 1960). In his writings he focused on the loaded implications of the tache marks of abstract expressionist painters like Jackson Pollock. Greenberg's thinking also contrasted with European philosophers referencing Karl Marx's critique of objectifications in capitalist societies (Lifshitz 1933). Both the impetus towards greater activism and valorizations of formalism for its own sake were 'answers' to urgency. Healing this schism between formalist purity and an activist agenda was partially addressed by the German sociologists Theodor Adorno and Maz Horkheimer (1947), writing at the same time as Lupasco. Adorno and Horkheimer, like systems theorist von Bertalanffy (1968), saw the world holistically, advocating reconciliation with nature as an extension of human experience. He critiqued the 'modern' world as complicit with Fascism, infecting every aspect of culture with tropes of dominance (Adorno & Horkheimer 1947), while reflecting Marx's analysis of the function of art objects that emerged from and reinforced late capitalism, thus recapitulating social conflict. They characterized dispassionate scientific language and thinking as symptoms of a system needing revision. That was the

point of view amplified by ecofeminists such as Donna Haraway, Sandra Harding (Haraway 1985; Harding 2005; see Chapter two), and others. They included gender questions and speciesism in considerations of who had the right to inhabit the akora and where to leave the ‘mark’ of human engagement with nature.

Ecological art often integrates these systemic and evolving critiques by modeling deliberate interventions at conceptual or literal (ecoventions) points of sensitivity to initial conditions. How could a more effective systemic model emerge from those interventions? An historical answer is in the relationship between play and art.

Philosopher John Dewey addressed playfulness and art as a source of knowledge (1909). Dewey emphasized heuristics, the quotidian of everyday life, ritual, and process (which he referenced as ‘journeying’), with nature as an aesthetic guide (1934). Play, as he conceived it, introduces uncertainty and emergence in a psychologically manageable frame. This journeying could generate original insights and an educational methodology (Dewey 1922; Dewey, & Tufts 1932). Dewey’s approach influenced artists such as Pollock and Kaprow.

Dutch artist, educator, and ecodialog member Jan van Boeckel wrote in a post about Dewey’s effect on his own practice of ‘...experience as a continuous oscillation between “receptive undergoing” and “actively acting upon” the world’ (van Boeckel 2013). Dewey’s thinking moved the artist’s located mark to a point that invited chance. However, in the concept of ecovention, that mark remains localized. The next question might be where to place an ecovention and how it function as a nucleation.

Often, science advances by asking the right question. If there is a precedent for science taking questions from ecological art it is in how ecological restoration is increasingly informed by expert witnessing from unconventional, often unquantifiable sources, such as TEK. In Chapter two, I detailed how *Ghost Nets* was informed by TEK as well as by restoration science in collaboration with bioengineer Wendi Goldsmith and wetlands ecologist Dr. Michele Dionne. This effort led to new questions for scientists, such as the role of geomorphologies in population distributions. It was in 2000, for example, that Dionne noticed the high incidence of invasive European Green crabs (*C. maenas*) at the restored *Ghost Nets* site. In response, I initiated a collaborative grant proposal with Dionne for the Lindbergh Foundation to study how different salt marsh geomorphologies

in the Gulf of Maine determined biological communities. The submission was a finalist, and although we did not pursue the research at the time, Dionne subsequently collected comparative data used in this dissertation.

In this chapter therefore, my claims go to how ecological art might be a source of expert witnessing in creating or inspiring idea (or conceptual) models. I will attempt to demonstrate where ecological art, art critical theory, adaptive management, complexity theory, and unconventional modeling might intersect, often engaging interdisciplinary and transdisciplinary approaches.

Lupasco's concept of transdisciplinarity influenced quantum physicist Basarab Nicolescu, also a Romanian. Nicolescu, building on Lupasco's work, foresaw Adorno's vision of reconciliation in transformed education, advancing transdisciplinarity as a synthesis of science, the humanities, and the arts into something more than interdisciplinarity (Nicolescu 1986). Interdisciplinarity in this writing refers to disciplinary combinations in which the boundaries between disciplines remain intact during production, but the outcome may be a new phenomenon. Nicolescu's goal (1986) was to establish a series of transdisciplinary institutions to research and teach sustainability for the Anthropocene. In this writing, the distinction I make between interdisciplinarity and transdisciplinarity in ecological art depends on an equally thorough understanding of science and art. I argue that whether the result is new knowledge (that could not be achieved by either an artist or a scientist alone) is determined by whether either has committed to a pro-active relationship to investigations and outcome. That commitment may require one to 'straddle' complex thinking. The willingness to make that commitment might also reflect how culture recapitulates comparable transitions in thinking about physics.

As the science historian Thomas Kuhn (2012) limned the transition from Euclidean to quantum mechanical physics, philosopher, sociologist, and activist Henri Lefebvre further developed Derrida's analysis of place (1997). Lefebvre discussed relationships between urban spatial perception, the experience of the body in infrastructural articulation, deconstructing ideas about people and the environment (Lefebvre 1947). His writing from the thirties and forties informed the *Fluxus* movement of artists seeking to create more accessible art from the quotidian of everyday life, and informed social

practice art, creates art out of community relationships. The playfulness that informed Dewey (1909) also informed Fluxus, often taking form in word play as seen in the 1963 manifesto by Georges Macuinas (Figure 32). In contrast, Lefebvre's point of view is resolutely anthropocentric and architectural however, for example, when he writes of 'infinite space'. He writes as though wild and open places and their animal citizens were inconsequential to human sustainability (1974).

I argue that these tensions among perceiving the object as apotheosis, as Greenberg (1960) experienced it, as the artist's mark as statement or ecovention (Spaid 2002), or as coming to the akora with a gift all contribute to locating ecological art in an historic encounter with environmental urgency. Implicitly, that is an encounter between intention and outcome. This is a philosophical mandate as much as a literal and cultural challenge, and often joined by science.

When ecological art is included in restoration science, it generally enters as a means to raise awareness and change perceptions of environmental problems. However, in large landscapes, art and science are equally constrained by chance in governmental policies. As restoration scientist Joy Zedler has pointed out, targeting restoration opportunities on the basis of expedience often means the work is politically, rather than scientifically prioritized: goals can be unrealistic for the time frame or inadequately monitored (Zedler 2005). Reducing the chance of such constraints was why I chose the *Ghost Nets* site, purchased it with my own funds and created it as a case study to test Trigger Point Theory. Trigger Point Theory then became the basis to analyze the Mississippi Water Basin to design *Fish Story*.

Chance has inspired many artists in the mid-twentieth century in addition to the Fluxus movement. Play and chance engaged the German artist Joseph Beuys, who like Kaprow had been involved with Fluxus. Beuys was initially interested in deliberately less 'spectacular' presentation of ideas about change.

Image not available

Figure 32: A copy of the Fluxus Manifesto created by founder George Maciunas. Its informality and provocative language illustrate the passionate political intentions of this overtly playful movement as well as the bricolage of its form (George Maciunas 1963).

Beuys initiated the term ‘social sculpture’ to describe an artist’s impact on society and culture. His interest in understanding other thinkers (e.g. the social philosopher Rudolf Steiner), and applying that knowledge to politics, for example co-founding the Green Party (1980). He set precedents for other artists’ engagement with experimental research and claimed teaching as his primary art form. Eventually he moved into policy concerns and overt political action. Beuys interpreted Artaud’s spectacle as revolution by embracing the role of artist as social ‘shaman’ in an engagement with politics. I see that interpretation as an experiment with the fourth wall (see Chapter two). In this writing, I

find it to be another significant step towards simultaneously expanding and collapsing the fourth wall into the larger public sphere.

The idea that socio-political accountability could collapse the fourth wall was addressed by art critic Claire Bishop. She refers to the subsequent resolution of values as ‘resorting to ethical criteria’ to judge the value of art (Bishop 2012). However, adopting an ethical point of view neither fully resolves formal questions nor does it answer appeals for scientific validation. I argue that rather than resorting to ethics alone, the formal issue can be integrated into the redefinition of the artist’s mark, pointing to where attention must be ‘gifted’ to the akora.

3.2. Art Criticism in Tandem

Critical art theory has struggled with postmodern conflicts over holistic ethical values. The implications for ecological art of tensions among form, ethics, and practical (quotidian) life can be considered in more depth by examining the evolution of thinking in the writings of two late-twentieth-century American art critics/ writers. Their ideas reflected continuing tension between formalist art (defined as modernist ‘art for art’s sake’, disengaged from social concerns (epitomized by Greenberg) and art born from vernacular art life experiences, charged with sociopolitical significance (as Fluxus and Beuys began to explore). I identify two threads in this development of a politicized aesthetic trajectory from disengaged formalism to politicized environmental activism, which will also position ecological art:

1. the early but ambivalent affirmation of essentialism by critic and aesthetic philosopher Arthur Danto (Danto 1964);
2. conceptualism as it was first defined by the art writer and curator Lucy Lippard and critic and curator John Chandler and later further developed by Lippard to connote work that was more idea and action than object (Lippard & Chandler 1968; Lippard 1997, 2007, 2014).

Danto compared the process of revolution in art to revolution in science. He was the first to name the complex system that supports artmaking, exhibition, and thinking (the

vernacular term for the business and professional aspects of artmaking) as ‘the *artworld*’ and went on to argue that any artifact produced and defined as art in the artworld context is also framed and defined by that same context and therefore delimited. Danto’s language responded to the semiotics of Greenberg’s equivocal term *purity*, maintaining that to the extent that art purports to express a ‘pure’ vision, it is essentialist and disenfranchising (Danto, 1990). Declaring the end of art in 1964, Danto called the blurring of art and life the death knell of art, although he continued to write art criticism for *The Nation* until 2009 by discussing the philosophical questions art provoked. Danto implicitly answered his own question, ‘but where is the art?’ by identifying some formal parameters of performance art as a new canon, including the primacy of the human performer, the physical location of the audience in the same space with the artist, and the time duration of an event tied to site specificity. His importance in this research was to denote how incremental the transitions were to an ecological engaged art form.

An activist both in leftist politics and art, Lucy Lippard cofounded the Art Workers Coalition (1969) and the Feminist art journal *Heresies* (1977). Lippard was an early and prescient champion of minimalism, conceptualism, earthworks, feminist art, and ecological art. Unlike Danto, the strength of Lippard’s arguments is not just in her passionate logic but also in the endurance of the movements she espoused. In the *Weather Report* exhibition catalog (2007) at the Boulder Museum of Contemporary Art on global warming that she curated and in which I participated, she wrote,

[These artists] are willing to be in the world, make art in a global arena, and are knowledgeable enough to enter into dialogues with scientists.... I have always said that art cannot change the world ... alone. But working with other disciplines and audiences, and given the chance to be seriously considered outside the rather narrow world of art, artists can contribute a certain visual jolt to reigning clichés (emphasis mine; Lippard 2007).

Lippard’s implicit question is whether ecological art can impact the negative aspects of the Anthropocene if taken seriously. Her questions built on the views of ethical structuralists. She asks how form might inflect meaning in public relationships and also

whether ecological art might rescue us from the Anthropocene *if* art can get partners and attention.

If implies uncertainty. Uncertainty in art becomes riskier when art intersects actual environmental impact. Risk often requires identifying new skills. The function of any idea model in science is to suspend disbelief while asking new questions to the point of falsification. As art evolves, new challenges require new skills.

3.3. Land Art as Action

Land art is often cited as the formal precursor to ecological art (Spade, Lipton 2002). In itself profoundly apolitical, land art, by taking the artist's mark to the earth, nonetheless represented a crucial formal bridge between painterly abstract expressionism, minimal sculpture of the fifties and sixties, Happenings, and art responsive to ecological urgency. It began to identify formal skills that might be applied at the landscape scale, for example, manipulating geomorphology to create a new proscenium.

Robert Smithson is often cited as the pre-eminent land artist. His forms visually evoke Antonin Artaud's principle of the spectacle, imposing grand tache on the land. I will contrast his *Spiral Jetty* with Hans Haacke's *Grass Grows*. Haacke's work is closer to the politically sophisticated *Situationists*, an international group of artists and other intellectuals, primarily active from 1957–1972. Situationist beliefs were based on surrealist and anti-capitalist philosophies. Led by Guy Debord (1955) they were devoted to deconstructing the concept of spectacle, particularly in mass media. Both men concerned themselves with how systems and perception function. Both works are composed of elegant curves. *Spiral Jetty* alludes to an American sense of grand, unpeopled vistas and expansive, physicalized actions. Both change our preconceptions about site. Smithson's poetic writings assert the purity of his artistic intentions and the seriousness of his historical trajectories, almost reverting to Greenbergian essentialism. Smithson addressed his scale as, 'big', firmly aligning himself with modernism. *Spiral Jetty* (15' x 1500', 1970), makes his mark with mud, basalt rock, and salt crystals, jutting into the Great Salt Lake in Utah.

Image not available

Figure 33: *Spiral Jetty* is an example of the land art that some confuse with ecological art. The distinction is that Smithson's concern when working with earth materials, was to have an impact on the land as a neutral means of art for arts' sake. Ecological art is more concerned with healing damage to the land (Robert Smithson, 1970).

In the Earth Art Show¹⁸ (1969), organized by artist-curator Willoughby Sharpe for Cornell University, Haacke described *Grass Grows* as a cubic yard of topsoil mixed with peat moss then seeded with two varieties of rye planted to sprout in time for the opening.

Image not available

Figure 34: *Grass Grows* was composed with soil and rye seed that sprouted in time for the opening (Haacke, 1969).

¹⁸ The full group of exhibiting artists was Walter De Maria, Jan Dibbets, Hans Haacke, Michael Heizer, Neil Jenney, Richard Long, David Medalla, Robert Morris, Dennis Oppenheim, Robert Smithson and Gunther Uecker.

Grass Grows was placed in the Andrew Dickson White Museum, where it received natural light, confounding understanding at that time of the experience of what Smithson referred to as ‘the dialog between the inside and the outside’. Haacke declared indifference to the appearance of or audience response to the dirt. ‘What you see is just a vehicle for the concept’, Haacke explained, adding that his interest was in growth for its own sake as an ecosystem (Smithson 1996). This interest places him on a trajectory away from Greenberg and Smithson and parallel with Kaprow, Lippard, and Chandler’s definition of conceptual art as action and idea rather than object.

British walking artist Richard Long is sometimes included as a land artist but is often cited by ecological artists as an inspiration to their practice. He seems to embody Dewey’s ideal of ‘journeying’. I cite Long as a transitional artist who often included references to sound, drawing attention to listening and hearing during his walks. Many ecological artists use walking strategically, either to engage audiences or to research a site. That methodology is simple, economical, and heuristically inclusive. Long’s work contrasts with other land artists’ in his attention to the site as a relatively undisturbed proscenium rather than a blank canvas or raw clay. It differs radically in its scale and impermanence and yet shares a minimalist aesthetic. He began in 1967 with *A Line Made by Walking*, in which he traced and retraced his steps until he had worn a line in a grass field, close to London.

On his website, part of Long’s statement refers to ‘The music of stones’. After his first walk, he took a grainy, black-and-white, amateurish photograph, in a style associated with conceptual art, to document the path of his performance. He related this work to John Cage’s¹⁹ 1952 sound composition, *4’33”*, which consists of four minutes and thirty-three seconds of silence, performed by a pianist. As a young audience member in 1964, I recall the stunning experience of listening to small noises in the audience for that amount of time, transforming my perception of sound and informing my own walking practice for the rest of my career. Long’s work evokes a similar attention to incremental observations. As in my references to Danto, Long’s incrementalism evokes how ecotones might be understood as both a theoretical and a literal concept about how systems change.

¹⁹ Cage’s ideas also inspired much of the Fluxus movement.

Image not available

Figure 35: *White Light Walk* (Richard Long 1987).

Long's poetic score for *White Light Walk* is both a 'treasure map' for journeying towards an attentive experience and a document of experience. After *A Line Made by Walking*, Long performed much longer walking works, e.g., in the Himalayas. He is of interest to this research not only for his strategic clarity but also because any line is a point of separation, establishing a metaphorical ecotone and acting as another kind of tache on the land.

Land artists shared Kaprow's mandate to act on life but for the most part, like Lefebvre, with little regard for that life or its limitations. They took license to mold large pieces of the landscape into monumental sculptural forms, leaving behind monolithic footprints, and they seemed to experience that license as a celebration of masculine individualism, independent of other dynamics. In conversation with Kaprow, Smithson stated, 'Utility and art don't mix', implying his independence from mundanity (Smithson 1996). As the movement overlapped the emergence of environmental consciousness, the primary critique of most land art became its disregard for ecosystems in addition to its disengagement from human content or ethics. Lippard (2009) described the land art she had previously promoted in her writings as 'the urban colonization of the West...' while pleading that 'there is a point at which artists, too, have to take some responsibility for the things they love'.

3.4. What is Ecological Art?

The artists engaged in ecological art are our contemporary shamans. Through their work, they attempt to heal the rift that has developed between people and nature.... museums (can) play an activist role in the community ... (and) ... expand into direct involvement in the restoration of nature.... (Matilsky 1992)

In this quote from the catalog for the *Fragile Ecologies* exhibition she curated, which references Beuys' idea of the artist as shaman, Barbara Matilsky expanded on Beuys's proclamation of shamanism and reframed post-modernist responsibilities for the natural world in the agora. Matilsky valorized the individual artistic vision but foresaw the necessary collaborative and activist role of institutions in environmental restoration, implicitly both inviting the viewer into a participatory art experience and collapsing yet another fourth wall between object and audience. Art critic and historian Suzi Gablik, wrote contemporaneously with Matilsky that, "a morally neutral art-for-art's sake philosophy... has led artists to their marginalized condition" (Gablik 1992). She then cited examples of how art could challenge that marginalization and support an environmentally ethical stance. Matilsky gave the example of Mierle Laderman Ukeles, whose 1984 *Touch Sanitation* turned on the feminist notion that the private is public, personalizing the simple tache on a public, but invisible agency, making it complex and visible. A tache on the land may also be complicated by the artist's role as spectator or agent of real-world, emergent change. Matilsky's position however, was later critiqued by art critic T. J. Demos (2009) as weighted too heavily towards restoration without adequately including community or even taking into consideration the global warming cost of shipping art to exhibitions.

3.5. Artmaking Meets Restoration Ecology

I will now consider the implications of skill and the artist's mark. The tache that draws attention in ecological art is relevant to restoration science. This is where aesthetic actions can cross from inspiration to science, to become transdisciplinary. The artist's engagement with uncertain boundaries among art, science, audience, and stakeholders,

goes to effecting restoration protocol. Restoration scientist Lance Gunderson wrote,

One reason why rigid scientific and technological approaches fail is because they presume a system near equilibrium and a constancy of relationships. In this case, uncertainties arise not from errors in tools or models but from lack of appropriate information for the models.... Adaptive management therefore views policies as hypotheses—that is, most policies are really questions masquerading as answers. Since policies are questions, then management actions become treatments in the experimental sense (Gunderson 2000).

Gunderson's view of adaptive management processes seems to support Zedler's suggestion to study smaller experiments over greater time in arguing for a process of investigation rather than prioritizing immediately visible results. As with the assertions from Katz and Elliot, that restoration falls short of good art inviting in artists, Gunderson's quote invites considering how a systematic application of fourth wall concepts might enhance adaptive management. The transdisciplinary implications for ecological art are to offer additional criteria to test uncertainty and the impacts of ecoventions, but the burden on science is to be open to Lippard's plea for taking ecological art seriously. The implications for restoration science are to consider how to observe the information ecological art contributes. The possible connections between the tache, the fourth wall and resilience then become language problems to define complexity. The salient definitions go to how to design experiments and assess monitoring protocols. The capacities for connection include value identified by expert witnessing from ecological art. It is therefore worth considering how the ecological art genre has struggled with definitions in the ecoart collective.

3.5.1. Defining Ecological Art within the Genre

In 2003 the ecoart collective self-published a mission statement identifying some ethical criteria for where to pay attention beyond the direct (ecovention) tache on the land. That was the result of ongoing discussions defining parameters of ecological art since 1998. Environmental art has been defined as art that concerns itself with the

environment in general. In contrast, ecological art has been defined as specific strategies for ecological restoration or other means to ameliorate the complex damage humans have done to ecosystems.

The pitfall of generalities is their need for objective assessments, either formally or scientifically. Like Matilsky's earlier quote, the ecodialog statement did not prescribe specific engagements with communities. Individual members went on to emphasize specific aspects in their practice, as evidenced by the website of Mary Jo Aagerstoun, then president of the EcoArt South Florida project, updated in 2011. She included ecological art under the umbrella of environmental art, emphasizing social practice and commenting on its collaborative functionality and independence from conventional displays, such as in museum venues (see <http://ecoartsofla> 2011).

Artist and dialog member Basia Irland then wrote a definition de-emphasizing collaboration: 'Some eco-art projects focus on the idea of resilience ... which might be enhanced by the using three other "r"s": restoration, remediation, and reclamation' (Irland 2013).

Image not available

Figure 36: In this spread from the *Ecovention* catalog, an early typical exchange from the ecodialog is presented, framing the discourse as a collaborative art research project (see appendix for full page view) (Spaid 2002).

In, *To Life: Ecoart in Pursuit of a Sustainable Planet* (2012), artist, curator, and author Linda Weintraub, a dialog member whose survey textbook about environmental artists

now reaches many students, again used a far broader definition, closer to previous definitions of environmental art. Her goal was to draw in a wider audience and, as she wrote on her blog, ‘...choosing “eco” was a literary decision. “Environmental” is a murky and cumbersome five-syllable word. “Eco” is a crisp ... vivid, two-syllable word’.

The French social philosopher Sacha Kagan, also an ecodialog member, contextualized another definition in his phrase ‘aesthetics of complexity’.

...the aesthetic experience should foster a sensibility that would acknowledge the shared process of creativity between natural phenomena and the artist, highlight the interpenetration of nature and culture, and more generally function as a ‘sensibility to the patterns that connect’ ... to become a sensibility to complexity (Kagan 2011, 267).

Rules	Land art	Ecological art	Landscape ecology
Functional premise	Art cannot be functional.	Art can catalyze change.	Must have quantifiable results.
Location	Site can be equally inside or outside.	Site is most often outside.	Is always outside.
Visual appearance	Visuals are subservient to concept.	Visuals may be critical to audience participation.	Visuals are illustrative.
Audience	Not important	Participation important, including from other animals	Subject to adaptive management that includes animals as resource commodities
Science	Marginal	Critical	Essential
Financial support	Available from patrons; often substantial but rarely making collectable objects.	Often marginal	Usually federally financed and large-scale
Gender	Predominantly known as male	Predominantly female in practice	Mixed, although usually male
Duration	Can be permanent or temporary, but if outside, would usually be intended to be permanent	Can be permanent or temporary; rarely may be evolutionary	Is always intended to be both permanent and evolutionary

Table 3-1: Comparisons among land art, ecological art, and landscape ecology as they are defined in this writing. These comparisons help clarify what values are shared from an older aesthetic and what values are emerging from more recent practices. The observations of gender representation are empirical and anecdotal (Rahmani 2013).

Kagan is firmly grounded in transdisciplinarity and an ethic of sustainability. He implies that a conversation is taking place in the fourth wall that must be judged for its ethical value to the whole ecosystem. His fourth wall conversation is between external events that might include nature, the artist, and a globalized, embodied sensibility. He tasks the artist with invitations to that conversation, to participation, and to collaboration, introducing uncertainty, play, and education into complex systems.

Despite different emphases, these various definitions articulate a collective ethos that is radically different from land art's definition of the formalist tache on the land. They reference several ambitious and idealistic goals congruent with restoration science. However, they also reflect difficulties with defining a genre that continues to define itself. More than a decade after the original ecodialog mission statement, the ecodialog includes many mature practitioners, including some like the artists Newton and Helen Mayer Harrison. Their visual work defines where attention is to be paid, and they clearly articulate strategies for collaboration and participation applicable to adaptive management.

I will now discuss several artworks as models for expert witnessing. Each artwork I will consider resorts to bricolage to consider alternate systems to address urgency.

Expanding on the ecodialog discourse cited above, I argue for a definition that requires humans to routinely prioritize other species (see Chapters one and two), a different category of transgression than either conventional formalism or social politics.

In my evaluatory criteria for the works I will discuss in the next section, I will consider:

1. transdisciplinarity in Kagan's context of complexity;
2. identifying or locating the tache of functional systemic intervention;
3. positioning humans in a species matrix without hierarchy or special privilege, referencing how ecotone planning impacts clean water and is predicated on that interdependence;
4. proposing a more effective paradigm for restoration science.

I will begin by comparing strategies in several early ecological art projects from 1971 to 1991, primarily from the ecoart collective, in which the artist's mark (tache of

attention), bricolage, and some sort of journey to insight emerged as formal language.

3.6. Ecological Art as Paradigm Shifts

What happens when you pay attention to anything, especially routine behavior, is that it changes. Attention alters what is attended (Kaprow 1993).²⁰

As in Haacke's *Grass Grows*, artist Alan Sonfist utilized natural processes as a means to pay attention, to expand an experience of what 'inside' and 'outside' might mean to growing systems. Sonfist initiated his first *Time Landscape* with a 1965 proposal to restore a forty by forty-five by two hundred-fifty-foot indigenous habitat on a vacant New York City lot in a way that would replicate natural succession. It was installed in 1978 and enclosed by a metal fence at La Guardia Place in lower Manhattan, in the vicinity of New York University. The New York City Parks Department describes details of the restoration design and lists the vernacular names of twenty-two species that were installed in 'the three stages of forest growth from grasses to saplings to grown trees', as Sonfist recalled them from his childhood walks along the Hudson River. This project is a remarkable tache on the urban landscape, both conceptually and visually. It serves both educationally and as an archaeological object intended to change consciousness. Enclosed in metal, Sonfist's work frames a living system but also implicitly imprisons it as a wild animal might be in a zoo, sending a paradoxical message to the viewer, who sees something simultaneously precious and inaccessible. The completed work became difficult and expensive to maintain, because unlike a conventional garden, it depends on specialized skill and knowledge to maintain. Sections are now neglected and replanted with exotic annuals. Bare spots or mulch would not be compatible with Sonfist's intention, and invasive species must be monitored. Isolation in an urban setting made it impossible to provide ecotone edges. It was an historic precedent for bringing indigenous 'garden' models into urban settings but seemed to omit an adequate maintenance vision for how it might go from a reminder of times past to a model for future urban planning.

²⁰ Kaprow is referring to what has been called the 'observer effect' in quantum systems physics. Walter Heisenberg noted that with certain wave-like processes, the act of measurement changes what is observed, because position and momentum cannot be measured simultaneously.

In some restoration science projects, that would disqualify its success. On the other hand, that exact responsibility speaks volumes about how a small experimental site can be a cautionary tale. It speaks to the habitat that we routinely destroy and the pathos of failure.

Image not available

Figure 37: *Time Landscape New York* (Alan Sonfist 1965–1978).

Ecological artists Helen Mayer and Newton Harrison have concerned themselves with ecosystem models since 1970, presenting extensive environmental strategies as proposals in gallery settings. One of three parts in *Survival Pieces* (1970–72), *Survival #3 1971*, was developed at the beginning of their collaboration. ‘We asked ourselves: How do we get our food? We decided to take responsibility for making food’ (Harrison 2013). It was devised as a series of ‘Portable Fish Farms’ to present answers to global food scarcity. A temporary fish farm was built in the Hayward Gallery in London and then transported to the Palais de Beaux Arts in Brussels. More recently, it was presented at the Barbican Gallery in London and at the Cincinnati Museum. The installation comprised six rubber-lined tanks, evocative of Donald Judd’s boxes, each eight by twenty by three feet, containing a variety of fish, brine shrimp, and lobsters. The animals were then killed by

electrocution, cooked, and served as a feast to an elite audience of 250 (installation and performances: *Harvesting and Feasting*). On the Harrison Studio website, there is a light-hearted description of volatile responses to the artwork from the Royal Society for the Prevention of Cruelty to Animals.

Image not available

Figure 38: *Portable Fish Farm: Survival Piece #3*, installation and performance *Harvesting and Feasting*. Six rubber lined tanks, each 8' x 20' x 3' containing catfish, brine shrimp and lobsters (Newton and Helen Mayer Harrison 1971).

Although other artists at this time, including Beuys, were experimenting with bringing livestock, domestic, and wild animals into gallery spaces and having group feasts, this was a particularly clear metaphorical representation and framing of unconventional food production with a broad social agenda that leveraged personal connections to create attention. The terminology of presentation—*survival*, *portable*, and *feasting*—served as powerful signage to the esteemed audience, employing bricolage, the typical conceptual art practice of using words strategically as semiotic signals.

In 1970, we knew far less than we now know about the suffering of animals, particularly cold-blooded animals such as fish. There are several further issues in this work relevant to unresolved questions about modeling for urgent response to the Anthropocene. First, the idea that a visual artist might offer a solution to a global

problem, as in the street theatre tradition of Yippie²¹ activism in the United States, against the Vietnam War. Second, the manner of killing the animals and the narrative that emerges of institutional confrontation. Third, empathy for the pain of the animals. Fourth, issues of class coming into play in the composition of attendees at the feast. Fifth, the formal device of assembling a number of constructed tanks filled with water and live animals in a gallery for later consumption as a participatory event was considered. Sixth, the consideration given to the research required to effect the work. Seventh, the assemblage of several accepted tropes, such as bricolage and crowd management to drive home content. Eighth, the necessity to reflect on the use of live animals and their potential suffering.

Each of these strategies to address issues was original in context but problematic for different reasons. Questions evoked remain unresolved insofar as critics still debate the role of text in art, the implications of numbers of audience members, and the presence of animals. The model, like Sonfist's *Time Landscape*, was too expensive to replicate. However, like Maxwell's Demon, these devices are provocative, creating a discursive context that goaded other artists to frame their own positions. The work contributed argumentation points to movements for local and urban farming. It is unclear if long-term effects may have been achieved outside the art community from this specific event, but as with Haacke's and Sonfist's works, it publicly established a set of historical structural precedents that tested the boundaries defining art. As these strategies were refined by time and other artists, they evolved as routine formal means in the genre.

In 1982, artist Agnes Denes created *Wheatfield* on two acres of Battery Park in lower Manhattan, two blocks from Wall Street. Like Sonfist's *Time Landscape*, this work was designed for a vacant lot, but instead of indigenous plants intended for perpetual display, she seeded it with wheat that she then harvested, ground, and baked. As with the Harrison *Portable Fish Farm*, Denes offered it to be eaten, completing a full life cycle from seeds to human digestion. On her website, Denes wrote:

Wheatfield—the philosophy: To attempt to plant, sustain, and harvest 2 acres of

²¹ The American Yippie movement staged entertaining public spectacles designed to attract widespread media coverage during the Vietnam War to draw attention to serious problems.

wheat here, wasting valuable real estate ... made it the powerful paradox I had sought for the calling to account. It was insane. It was impossible. But it did call people's attention to ... realize that unless human values were reassessed, the quality of life, even life itself, was in danger... (www.agnesdenesstudio.com 2014).

Denes claimed the psychological, economic, and metaphorical power of her piece, recapitulating essentialist ecofeminist associations to nurturing and caretaking. As do many ecological artists, she believed that the model for change must be attitudinal. Denes proposes that art is best prepared to create a shifted perspective. Similar to the Harrison's work, she offered an alternate educational experience of and a container for a group social experience of consumption. In the case of *Wheatfield*, unlike the work of the Harrisons and Sonfist, the frame was not the material walls of a gallery or fence but the cultural associations with the Manhattan financial centre in the early eighties. Like Ukeles, Denes used the media to announce her work to a broad public. Like the works referenced by the Harrisons' and Sonfist, this model on expensive urban real estate was not efficiently replicable. But it offered an awareness of sustainable cycles of life, and made pointed statements about land values and urban gardening.

Image not available

Figure 39: *Wheatfield* (Agnes Denes 1982).

In 1991 Mel Chin created *Revival Fields*, a bioremediation project for a series of fifty-foot-diameter sections of the toxic Pigs Eyes landfill in Minnesota. Chin planted bioaccumulators and when they matured, incinerated them in order to harvest metals. The Walker Art Center website describes this work as a metaphorical event of ‘public service’.

The contaminated earth was enclosed with a chain-link fence and divided by paths that form an X. The project’s boundaries were marked by a square. Chin conceived of these overlays as a target, a metaphorical reference to the work’s pinpoint cleanup. The divisions were also functional, separating different varieties of plants from each other for study (Walker Art Center 2003).

Although Chin claimed these processes on his website as original, bioaccumulators have long been used for mine reclamation. The act of framing each healing site however, as Sonfist had framed his *Time Landscape*, with two steel fences, one circular and the other square, drew important attention to an event identified as art that had escaped public notice. What was original was Chin’s literal and figurative framing and then offering of the ‘harvesting’ as a denouement, similar to the Harrisons and Denes. The

caveat was that the ‘consumption’ Chin offered was of metals rather than food. Chin created additional *Revival Fields* sites in Palmerton, Pennsylvania in 1992, in the Netherlands, and in Stuttgart, Germany, each expanding the audience for conversations about bioaccumulation. In these three examples, the goal is discourse and attention to essential processes in unfamiliar contexts.

Image not available

Figure 40: *Revival Fields* working drawings (Mel Chin 1992).

Generating food, glimpsing the past, and cleaning up toxic human waste are invisible processes that modern, urban Western cultures take for granted. More than the installations, performances, or physical models, I argue that the critical contribution of these works is that they make visible the recently disappeared. Modernization removes us from basic processes, denying our embodied dependence on the ecosystems we are dismantling. Each of these works took known data and framed it as interpretive education, making teaching into art. I will now turn my attention to several works from ecodialog members. Many of these works resort to Long’s trope of a walk or journey of discovery.

The Rio Grande River is 1,896 miles long. From 1987 to 1994, French-born American artist Dominique Mazeaud walked portions of the river, ritually collecting garbage for her

performance project, *The Great Cleansing of the Rio Grande: A Pilgrimage, September 17, 1987 to April 17, 1994*. She defined these events as a spiritual, ritualistic pilgrimage that was only documented by accident, when a friend took a picture of her unawares.



Figure 41: Dominique Mazeaud in the process of cleaning the Rio Grande River (Dominique Mazeaud 1987).

This is not the image of a heroic land artist carving mountains²² or even Long's austere line in the grass. It is not Mierle Laderman Ukeles' elegant and monumental task as artist-in-residence for the New York City Department of Sanitation, or Chin's grand installation. It is the image of a lone, vulnerable, ordinary woman performing a tedious, invisible, thankless, and immense job that is very emotionally evocative. Her intention was cleansing. It is arguably a task every person on earth may shortly be required to perform to weather the Anthropocene. Mazeaud modeled what that might look like. However assiduously Mazeaud performed this ritual, in a measured manner, it was also with full consciousness of the artworld frame. She established that by periodically sending two slides with a statement to figures in the artworld and accompanying the

²² Land artist James Turrell is known for creating a decades-long event of making Roden Crater into an art work (1979–present).

slides with brief text.

I don't document my work because anyone behind the camera's eye would defeat the purpose of my work, which is ritual. I therefore leave documentation to chance.... I want to live simply and chemical-free ... I am aware that I may not get an NEA,²³ (for which the applications are expected to be top quality) but that was OK, that actually, I had received several unsolicited grants! (Mazeaud 1987).

In this language, Mazeaud positioned herself as both an artworld insider and as a deliberate outsider in her assertion of an ex-urban location, eschewing art world conventions, 'playing' with Haacke's trope of the inside and the outside. Formally, she also placed her journey in a disembodied fourth wall between her story and her audience, taking advantage of precedents with mail art that used the postal system to establish a range of relationships between artist, art product, and bricolage. Her tache was absence: the evidence of human carelessness removed from the landscape and then her own disappearance. Mazeaud announced a deliberate invitation to chaos (chance), expectation (the National Endowment for the Arts), and transgression of conventions, but simultaneously established professional immunity from repercussions by referencing the credibility of her support. In her email signature, Mazeaud refers to herself as a *heartist*, connecting her work on the river to her subjectivity. Referencing her lifestyle in the context of this work, she positions herself as an ecofeminist by coupling her personal life to healing work and a spiritual dimension. Writing of Mazeaud's work, Gablik (1992) contextualized these heuristic ideas as a relational experience. She compared Mazeaud's work to the art history of Marcel Duchamp's transgressive 1917 exhibition of a urinal, Carlos Castaneda's mysticism, and the need for a compassionate ethos (Gablik 1992).

In that text, Gablik implicitly conspired with Mazeaud to message the world about new values. Mazeaud and Gablik signaled the prioritization of an ethical and humbled relationship to earth matters, grounded in traditional feminine caretaking roles. In asking

²³ The NEA is the National Endowment for the Arts, which at that time was still distributing individual fellowships.

what quantifiable impacts there have been from her project, we may be asking the wrong question. Unlike the Harrison's *Portable Fish Farm* model, Mazeaud's project embodied a metaphor and an idea model, rather than a practical plan to actually clean the river. However, because the task was cleaning an entire river for seven years, Mazeaud's small actions were monumentalized to redefine a relationship between art and scale.

Unlike Sonfist's *Time Landscape*, the mark of Mazeaud's work persists only in memory. Mazeaud, like Ukeles, displaced the ecosystem irresponsibility of land art which Lippard had admonished, with the implicit assumption of demanding personal responsibility for degrading the akora. These are also radically different tropes than art historian Miwon Kwon's view of contemporary artists nomadically jetting from one dematerialized site to another to produce transient work. However, it is equally true of this work that 'the physical condition of a specific location recedes as the primary element in the conception of a site' (Kwon 2002 p.19). From the point of view of restoration science, it is provocative to imagine an army of ordinary people walking degraded landscapes to put bioregions back together.

Eve Andree Laramée concerns herself with the large landscapes and demographic effects of radioactivity, identifying opposition to atomic power as a lifelong cause. As with Mazeaud, her focus is both local and global. *Halfway to Invisible* is her research project about the effects of the 'nuclear-military-industrial complex' on the Four Corners, an area where Colorado, New Mexico, Arizona, and Utah intersect. There, she studies 'the impacts of nuclear test bombs and mining for uranium on water and Native American peoples around Santa Fe'.

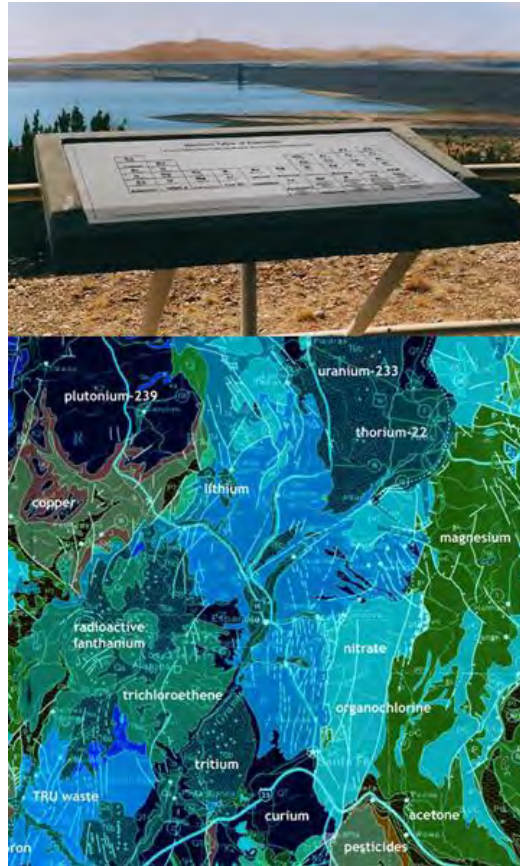


Figure 42: *Fluid Geographies* maps the impacts of radioactive waste (Eve Andree Laramée 2001–04).

In gallery installations, Laramée’s work identifies and documents specific toxic impacts on particular peoples due to infiltration of riparian littoral zones and watersheds. She describes her future intentions as an interactive process of engaging government officials in testing the efficacy of filters she would distribute.

In a February 2013 post to the *ecodialog*, Laramée detailed her working methodology as a travelog of her aesthetic journey, similar to how Long documented his walks. She called that list, “Eve’s Seven-fold Procedure:

Wandering / Tracking / Field Work / Research / Manifestation / Active
Engagement” (Laramée’s 2013 online communication in the author’s archives)

Laramée’s list described an invisible process with a spiritual aspect. Her list is an implicit performance score for activity. However, there is no plan for remediation or restoration of the landscapes she records so meticulously. The primary value is in how her independent research practice informs her interpretive presentations.

Long, Mazeaud, and Laramée document journeys that are both physicalized with travel and focused inward as personal experiences. They make long-term, personally performative commitments to alleviating degradation. Laramée's practices are framed by the task of remediating serious, but different kinds of environmental damage. Unlike conventional restoration science, these are unfunded research projects.

In 2005, British artist David Haley, also from the dialog, proposed tracking a water journey with GIS to see how water moves for, *A Drop in the Ocean: A Trace of Life*© *Proposal for Homecoming, an Atlantic Odyssey*. As with Laramée's project, this was a researched conceptual work with globalized implications for tracking migrating pollutants from dissolved plastics, fishing drift nets, radioactivity (that concerns Laramée), and mercury that degrades many wetlands systems. It represented how degradation in one location can affect the entire world. Conceived as an idea experiment, the work utilizes Dewey's invocation of playful artistry to gain unusual knowledge.

Haley composed a conceptual work that followed the theoretical passage of 'one water-born bacterium from the source of the River Mersey in the Peak District of the Pennines, England, through vapors and winds to the Gulf of Mexico, and back' (Haley 2005). Haley then posed a series of transdisciplinary questions, implicitly asking whether similar questions would have emerged from science alone. He states premises that new life might come from bacteria, and then extrapolates his questions:

How will global warming and climate change affect this situation?

Can a bacterium survive the different states of water on this journey (liquid, solid, vapour, fresh, saline)? Does the presence of bacteria in water, with their ability to swap genes and evolve according to need, suggest that the weather is a biological phenomenon? (Haley 2005)

Haley's project might be tested by tracking isotopes. However, as with Maxwell's Demon, it would require new knowledge to thoroughly answer any of his concluding questions. The implicit question is, what might happen if such questions from an artist were given credence? Haley's simple proposal actually addresses the complexity of how

hydrologic systems function and how the smallest possible human impact might have great global consequences.

As discussed in Chapter two, resilient restoration that protects water may depend as much on conserving or restoring endemic animal communities as plant life. This is more than a question of population counts. It goes to how humans interact with other species and how we regard their intelligence and autonomy. There has been a great deal of recent research on animal sensibilities and communications, from dolphin research to studies of elephants.

Artist Aimee Morgana's work with parrots began in 1985. In 1998, she purchased a six-months-old Congo African Grey Parrot, naming him N'Kisi with the intention of exploring his capacity for conversation. In experiments with field study methodologies to test his ability to comprehend human speech and thinking, by 2012 Morgana had found that N'Kisi recognized and employed over seventeen hundred words. He routinely spoke in complete, grammatically correct sentences, including telling Morgana on a daily basis, that he 'would like to be in a book', presenting us with the idea that a different relationship to animals might result in an animal making a tache on our perception. Morgana taught N'Kisi to speak as she would a human child, by reading him children's books, which he seemed to enjoy, and she journaled their interactions. With biologist Rupert Sheldrake, she conducted a double blind study of N'Kisi's statistically high capacity for telepathic synchronicity. That was shown in his verbal descriptions of pictures Morgana was simultaneously viewing in a 'remote,' physically isolated viewing room.

Morgana, like Haley (2005), asked unconventional scientific questions, with a playful attitude to systems change. Both works are based on probabilities and presumptions outside the academic scientific community. Like Laramée, Morgana pursues her questions independent of institutional support. Morgana calls language-using animals 'ambassadors' and compares her work to Annie Sullivan teaching Helen Keller, suggesting a more heuristic approach to animal behavioralism. The significance of this project is not just that Morgana embarked on a systematic, albeit unorthodox scientific investigation as an art project, but also that like the other artists referenced here, her work challenges existing thought systems about our expectations. It is an inexpensive but time-

intensive model to explore animal behavior by studying a single parrot's capacity for human-like interaction. I argue that Morgana's work with N'Kisi links our relationships with animals back to our relationships with ourselves in perceptual ecotones between species, arguably, in a common akora. Embracing those perceptions may bear on how we design ecotone systems to protect water because it represents qualitative new knowledge about community relationships.

The idea of having unconventional conversations in the akora is equally relevant to social practice art, teaching, adaptive management, and ecological art. In 2002, I explored the limits of the akora in the *Ghost Nets* case study by serving as chair of the Natural Resources sub-committee for the 2005 Vinalhaven Comprehensive Plan. As part of our work, we, with Gordon Longworth of the College of the Atlantic, had assembled GIS layers of all the island's natural resources for the Vinalhaven Land Trust to make zoning recommendations. When I was invited to create an outdoor work for the 2002 *Site Specific*²⁴ show, I assembled all those layers and made drawings of where the resources overlapped, using colored pencils on tracing paper.²⁵ My analysis applied trigger point nucleation for environmental triage locations for contiguity between systems. In addition to the original *Ghost Nets* site, I identified Pleasant River, a public causeway narrowed by the Army Corps of Engineers one hundred years earlier. The location is towards the centre of the island, but in an area that bisects the land, allowing estuarine geomorphology and numerous configurations of habitat edging and ecotones. It is northwest of the southeastern shore of the island, where I had completed bioengineering the restoration for *Ghost Nets* in 1997. I conjectured that opening the causeway would immediately affect twenty-six acres of wetlands, enhance the health of the surrounding area, and support contiguous habitat. Like Morgana or Haley, my approach was speculative but serious play, serious in the intention to yield new knowledge.

With the permission of the selectmen and town manager, I designed an event to draw attention to the degraded wetlands. Along the causeway, I painted approximately forty granite rocks and boulders, each some twenty feet across or larger, with a casein paint slurry (ultramarine blue pigment, buttermilk, and indigenous mosses). The work was

²⁴ Curated by Pat Nick, former director of the Vinalhaven Press, Vinalhaven Island, Maine.

²⁵ Layering observations with tracing paper was a technique innovated by landscape architect Ian McHarg.

titled, *Blue Rocks*. I correctly presumed my action might draw a powerful response from the town as an act of outsider ‘ownership’ of local rocks, despite the official permission. One public official, a selectman, did take exception, threatening to subpoena me to clean the rocks.

In a short article in local media (Rahmani 2002), I announced a ‘Wash-In’ for the rocks, to discuss the impacts of blocked tidal flow on local wetlands. The local Garden Club helped me complete the event. Our provocative visibility near the road contributed to lively town discussions about restoring the area. In 2004, an engineering company installed a new culvert at an expenditure of over \$500,000 from the United States Department of Agriculture and other federal agencies. When the work was completed, it did re-establish regional tidal flushing. The surrounding area flourished, and I was even more intrigued by the possibilities of Trigger Point Theory.



Figure 43: Detail from the *Blue Rocks* installation, in the background scum on the stagnating water can be seen, an effect of the blocked causeway (Rahmani 2002).

In many ecological art works it is difficult to separate strategies of public art, private events, activism, and education. The fourth wall dissolves entirely in participatory art,

and then even the word ‘art’ or location of the tache becomes difficult to locate. What all these examples from ecological art have in common, besides the discoveries of new knowledge about effectuating ecosystem change, is an effort to identify and change dysfunctional cultural relationships to biological processes, with varying degrees of playfulness and determination to change systems. There are pedagogical implications to these efforts. Conflating art and pedagogy has historical precedents, not just in Beuys’ work, but in the long tradition of ateliers. It is now accepted that public education can be part of an art practice.

In 1983, Kaprow made the distinction between artlike art, and lifelike art, as art that draws attention to itself and the artist, and art that seeks an understanding of a whole. At the end of his life, Kaprow engaged in very simple activities, eschewing spectacle. Some examples from that period include transferring dust from one home to another in order to examine the nature of friendship, or taking a walk in the desert with his wife, separated by distance and communicating with walkie-talkies. These minimalist events without overt relationships to biosystems, nonetheless embodied teaching *koans* (poetic Zen parables) of attentiveness.

In his writings at the time, Kaprow cited a number of artists engaged in civic actions as private artists functioning publicly in ways perhaps invisible to the greater community. He concluded that the supreme goal of an art practice may not be the production of artifacts or public education, but self-knowledge, ‘the overall meaning of art (may) change profoundly—from being an end to being a means, from holding out a promise of perfection in some other realm to demonstrating a way of living meaningfully in this one’ (Kaprow 1993). In contrast, Beuys said, ‘Art that can not shape society and therefore also can not penetrate the heart questions of society, [and] in the end influence the question of capital, is no art’ (Beuys 1993).

My research, asks a different question. Could boundaries between self-knowledge and macrosystem knowledge dissolve when ecological artists pay attention to landscape? Could the perceptions that emerge be valuable to restoration scientists?

3.6.1. Pedagogy and Imagination

The theme of self-realization as an aspect of art easily segues into research on changing systems of pedagogy. Cage, Kaprow, and Beuys were renowned teachers, advocating in their own practices a blurring of boundaries. They presumed that crossing those barriers would change systems of perception and behavior. Many academic ecological artists, such as van Boeckel, drawing on John Dewey's writings, along with Beuys's and others' examples—particularly those interested in art life—regard their teaching careers as extensions of their art practice. They contest distinctions between teaching and studio practice, making pedagogy their strategy for revolutionary, transdisciplinary transformation. Several dialog members have introduced new departments in their universities and colleges focused on ecological art studies, often in collaboration with science departments to foster transdisciplinarity. Increasingly, ecological artists with varied foci, are presenting and being invited to present at scientific events, including SER. That shift indicates the growing recognition that as much as artists have to learn from scientists, science may also have something to learn from art.

American artist and educator Beverly Naidus, also an Ecoart Dialog member, describes her interdisciplinary ecological art pedagogy in *Arts for Change: Teaching Outside the Frame* as creatively energizing. 'Reclaiming the idea that art can act as both a deconstructive force and as a reconstructive one (providing a visionary role) is a pivotal theme I dare the reader ... to imagine the world we want ...' (Naidus 2009). It may be that imagining a future in the face of the real problems of the Anthropocene may be a singularly radical act.

3.7. Summary

I have presented some current ecological art thinking and practice relevant to designing new systems to address urgency in the Anthropocene Era and leave an original tache on our thinking. As I have shown, ecological art can respond to urgent environmental concerns. It can bring forward unexpected methodologies and contribute new points of view that add new information to fields of research. Ecological art asks and answers questions in new ways. As I have argued, it can playfully discover new ways to generate new knowledge and change systems. Examples were presented that engage with water

and environmental justice. These examples illustrate how systematically engaging with the fourth wall can generate new knowledge and model innovative practical idea experiments with provocative, transdisciplinary implications for environmental and restoration science. Novel insights relevant to environmental science can arise from ecological art even without the basic processes of science, such as quantification and falsification. Ecological art can still add conceptual depth, clarity, and new insight to problems of and design to address pollution, speciesism, and habitat loss. I have discussed how aspects of ecological art might reconcile a contemporary cultural history of ambivalence about the roles of audience, artist, object, institution, and authority. This may lead to new, transdisciplinary ways to integrate philosophical positions into strategic implementation and adaptive management.

Ecological art provides a range of options which could change paradigms of behaviors, discourse, and redefine the nature of art. Certain artworks can help land managers reconsider how they implement adaptive management. As I will show in the next chapter, ecological art research may function as expert witnessing. It can suggest how new data might be included in statistical modeling. This may effect more efficient approaches to environmental restoration with more resilient results in strategic ecotone design.

Ecological art can elicit tacit knowledge. It can introduce embodiment and play into adaptive management. This could enhance and catalyze valuable perceptions about biodiversity and community interactions between species and in human communities. Integrating ecological art with education may shape and guide public attitudes and the thinking of new generations, one student at a time. That would make each person the nuclear site of an intellectual trigger point. It might erase fourth-wall boundaries in social practice. That erasure might correspond to how Maxwell's Demon changes a closed system (see Chapter one) by re-organizing information.

The examples presented may suggest new forms of collaboration that could arise from precedents in ecological art practice. Although it is still unclear whether scale of presentation is critical to effect political will, it is empirically clear that broad participation in new paradigms is important if society is to survive the Anthropocene. The paradox of grappling with Anthropocene urgency, however, is that generating knowledge and establishing new patterns of behavior requires reflective time. For this reason, I have

focused on examples that might have solid science behind their research, even though they may not be falsifiable at this time. The invention of novel tests inspired by these novel models is needed.

In my arguments, I have focused on a narrow definition of transdisciplinarity in ecological art. My contention is that works within that definition can offer radical new systems of thinking and models about environmental complexity. Designing tests for the impact of these transdisciplinary models is a challenge. Fully including artists in theoretical modeling, or participatory adaptive management for large landscape projects may depend on meeting the challenge of presenting sufficient data that could mobilize scientists to take up Lippard's challenge of *if*. If ecological art is to engage science seriously, questions about conventional, hard scientific falsification and quantification still need to be answered, and institutional support will be needed to complete that work. However, in this chapter, I have given sufficient evidence to show how incorporating ecological art can reveal new problems, point to new solutions, present new paradigms, pose original questions, and lead to unique approaches to actual restoration in the Anthropocene.

There is evidence that some scientists are open to these ideas. The impact on restoration might be gauged by the increasing prominence of ecological artists in various venues, such as SER conferences, hosted by scientists.

Chapter 4

Horizontal Scores

Mapping is a way to explore alternative paradigms about worldviews. I will argue that mapping is the perfect visualization of metaphorical relationships, because it renders a worldview that is both abstract and representational, creating bridges between intuition and the material.

This chapter correlates sophisticated technologies to create performance scores with various forms of maps. GIS is a common tool for identifying restoration sites, as noted by the National Oceanic and Atmospheric Administration (NOAA 2010) of the United States. All forms of mapping can contribute to effective adaptive management.

Participatory maps (derived from free hand community interpretations of relationships between agents), interpretive, and GISc mapping will be compared. Each approach can reveal relationships between bioregional restoration and issues of environmental justice and ethics as a methodology to direct attention. I will suggest how that methodology might also indicate new modeling strategies. GISc is one way to connect environmental goals to quantification, direct activism, and advance ecological art. GIS manifests abstracted metaphorical relationships. It layers otherwise unrelated, complex data and correlates geographically referenced points of confluence between those layers. The software allows the technician to visually render anything that can be described statistically as points and rasters. It can then precisely localize that data. This is the spatialization process.

These are means to direct strategic restoration design. Could they be layered with heuristic knowledge to actualize nucleation trigger points in the littoral zone? GIS will be considered to see how it can provide expert witnessing for ecological art. I also consider whether new data relationships might inform how we conceptualize a food web.

I suggest that by comparing mapping with performative or musical scores it is possible to rethink, along more holistic lines, how models are designed. For example, water that supports life in littoral zones functions like human breath in bel canto. Bel canto singing is a vocal technique required for classical opera with the goal being to create a clear and

consistent musical line. Comparing water with breath and music evokes how dynamic hydrological processes are analogous to the flow of Ch'i. I believe that analogy can also inform thinking about restoration design.

I will consider the limits of each approach to mapping and discuss the implications of combining these approaches. I will show how insights that emerged from the *Ghost Nets* case study were subsequently mapped and applied to the *Fish Story* case study to create a more holistic point of view.

Philosopher Gilles Deleuze and activist and psychotherapist Felix Guattari, a student of the philosopher and psychoanalyst Jacques Lacan, published two influential books together (1972, 1987). These thinkers advocated a multi-faceted point of view about living phenomena that conflated how both music and mapping express complexity.

Music has always sent out lines of flight, like so many 'transformational multiplicities' ... What distinguishes the map from the tracing is that it is entirely oriented toward an experimentation ... in contact with the real. The map ... is itself a part of the rhizome ... conceived of as a work of art, constructed as a political action or as a meditation (Deleuze & Guattari 1987).

Deleuze and Guattari conceptualized experience as rhizomatic, metaphorically map-like, and analogous to topological mixing. Their description implies a combined horizontal and vertical experience of space and time. In their view, experience expands and infiltrates the world as a form of connectivity and relationship while sending taproots into those same relationships. In their representation of those processes, Deleuze and Guattari distinguish between uncritical tracing and mapping, a difference they find representative of the complexity of experience. (A phrase they use—'it constructs the unconscious'—implies to me, however, that a map can erase previous information and replace it with a transformed system, as Maxwell's Demon did in replacing mass with the work of information). Models, maps, and scores, in this writing, are correlated as analogous to conceptual experiments, they all presume the potential for predictable outcomes, whether of agent behavior, destination, or a musical performative line.

Cartography may be closer to Deleuze and Guattari's conception of a tracing. Even when it is georeferenced, cartography differs from Geographic Information Systems (GIS) or Geographic Information Systems science (GISc). GIS is generally illustrative, while GISc yields quantifiable new data that cannot be discovered with other means. GIS is used less often and GISc even less so. One reason for this is that locational precision is not always necessary in a project. Another reason is the relative cost and technological sophistication required of GISc.

What distinguishes GISc from other cartographic methods is its capacity to render georeferenced statistical data that can have rhizomatic qualities. Source data may be vertically layered from any number of information sources, so long as it can be converted into quantifiable attributes and assigned coordinates. What makes cartographic GIS into GIS science (GISc) is the conceptual move from representation, in the sense of tracing, to revealing new knowledge from the confluence of attributes, such as the originality and interpretation of layering. That new knowledge can produce viable modeling because of the mathematical precision of the input.

Organizing data to determine what attributes will be rendered is the greatest part of the research work preceding GISc. Data is often acquired by participatory mapping in a crowd-sourced, freehand process. Participatory maps are often generated from informal adaptive management meetings but can include GPS-located maps from satellite imagery. This participatory process renders a more subjective, intuitive, and heuristic experience of spatial relationships than GIS alone could produce. Data from participatory mapping can then be the basis for GISc. The advantage of including the participatory mapping is that it allows choice, on the basis of stakeholder concerns, about what layers and attributes should be spatialized for precise locations.



Figure 44: Encaustic painting over Google Earth view of the Wolf River, an interpretation of how periodic flooding could affect suburban residences on the outskirts of Memphis, TN. Part of the *Fish Story* project (Rahmani 2013).

In this writing, I will use the term ‘mapping’ to imply a layering of transdisciplinary associations and data applicable to CAMs. In the sense that such data is predictive and to the extent that any model can be prescriptive, this mapping can be seen as a performative score. Ian McHarg, considered by many to be the father of modern landscape architecture, set a precedent for this approach. His GIS technologies often make drawings that layer his perceptions, determining how he would address bioregional problems (McHarg 1995). The precedent for this idea is in navigational mapping and military planning. Contemporary georeferenced mapping can also show how activist behavior is affected by perception, as in the green maps that connect geospatial data with community concerns (see: <http://www.greenmap.org/greenhouse/en/home>). In this way, GISc can take a holistic, adaptive management perception of events and render them as both ecological art and restoration science. Mapping becomes a score for rhizomatic art life.

Drawing on algorithmic systems built into the software, GISc makes it possible to layer the digitally rendered geographic systems and statistical data into a visual display. Data is organized by themes and attributes in statistical tables such as Excel sheets and

then rendered in another file form to geolocate the data. This permits users to spatialize, visualize, organize, and model relationships between heterogeneous datasets. It can model predictive answers from a new class of rules-based questions embedded in the software. Those queries are often based on Boolean logic (Boole 1854). Boolean thinking is essential to digital logic, which can then be electronically translated. The result is the reduction of human error by introducing automatic mathematical calculations and generating quantitative outcomes from qualitative experience. Boolean logic is also fundamental to the creation of algorithms for GIS work and semiotic thinking (Pierce 1867).

Choices about what attributes to spatialize reflects points of view about the world. The terms of mapping, choreographic notations, and musical scores share the intention of making depictions of movement in time and space, whether perceptual, embodied, or acoustic. Although movement can be horizontal, vertical, or a combination, Deleuze and Guattari (1972, 1987) imply that movement can take place in all those directions simultaneously (rhizomatic). Perhaps significantly, before his death, Guattari evinced an interest in environmental concerns, in which rhizomatic experience is fully realized.

Deconstructing cartographic dimensionality is a valuable exercise for understanding the implications of portraying rhizomatic multiplicity. I will explore that deconstruction and how it may show that GISc mapping can be integrated into a wider strategy to identify and activate trigger points. I will begin with horizontality.

The law of horizontality was discovered by Nicolaus Steno (1687), a Danish physician, considered one of the founders of the science of geology. He proposed that geological sedimentation was laid down in discrete, stratified planes. This insight was a precursor to how data layers are rendered in GIS. Centuries before Charles Darwin, Steno observed that fossils are organic relics of earlier times. Previously, it had been commonly thought that strata generated from the earth were a kind of crystal. The law of horizontality therefore, also implied a simultaneous vertical and horizontal perception of stratification, long before topological mixing (Kropotkin 1885) or Deleuze and Guattari's (1972, 1987) rhizomatic thinking.

The reference to music in Deleuze and Guattari's writing implies that mapping experience and perception can be conflated with producing musical scores. Music can

encompass simultaneity, time and energy, ideas about silence, dynamics, mathematics, and healing that can also be visualized in mapping. The words ‘horizontal’ and ‘score’ also reference spatial perception and sound.

Mapping music as an experience of time and space is determined by intervals for absence or duration of sound and volume, indicating the dynamics of delivery in that experience of time. Intervals of sound and silence and subtle configurations of pitch and rhythm, all of which can also be heard in coastal tides, and indicated in a map as a score. The implications of mapping the littoral zone evoke a complex acoustic experience that opens up to the horizontal expanse of the marine world. Sheet music, which comprises a score, can also be defined as an indicator of those qualities (codified notational language, in itself an abstraction) rendered on a horizontal surface, normally paper. In the West, a score usually includes a treble and a bass clef to indicate sound generated by independent human activities, such as the right and left hands of one performer or different vocal registers in a choir, (high and low, respectively). This comprises a minimal form of complex modeling in which agencies function independently and in relationship to predict the outcome of a line of music.

At the seashore, we hear the melodious sounds of waves, weather, and animals, dominated by the energetic advance and recession of tides. If the inferences of these terms, such as horizontality or musical score (delivered on sheet music) are searched in Wikipedia, a Tibetan manuscript is shown that illustrates a definition of sheet music, resembling a map.

Image not available

Figure 45: Nineteenth-century Tibetan musical score, an illustration of how sheet music can resemble a map (source: https://en.wikipedia.org/wiki/Sheet_music#/media/File:Tibetanmusicalscore.jpg, 2014).

I considered how song is produced as analogous to the complexity of healthy littoral zones. Water, gravity, sedimentation, and biota in the littoral zone can be experienced musically and expressed in mapping, informing environmental planning strategies.

Conceiving of this dynamic experience as something for scoring also alludes to the role of listening in adaptive management and generating participatory maps in a way that invites subtle understandings.

The human voice, like the tides or human Chi'i, requires regular intake and release of energy to produce sound from the relationships between disparate agents in a controllable CAM. Air being expelled in singing involves more than just the physics of sound waves (see Figure 46), or in the case of tidal flushing, more than just hydrology is involved. In bel canto singing, the musical line requires control of multiple physiological microsystems, including diaphragmatic breathing, the small muscles around the larynx and in the mouth to raise the soft palate, and the large muscle of the tongue. These small systems depend on larger ones in the torso, legs, and neck. In addition, the sound waves that are emitted may require modulation, depending on ambient acoustic circumstances. Much of bel canto singing consists in learning to manage the airflow that determines acoustic quality. Smooth delivery requires athletic breath control, accommodated to the score. The phrasing, volume, inflection, pitch, and tonal qualities are all mediated by this airflow and determined by the singer's physical strength, limited by the individual vocal range and the singer's stamina, along with gravity and muscularity, to control and sustain these processes. When these elements are successfully integrated, complex sound flows like the tidal flush of water in a healthy marine littoral zone, as a continuous experience from beginning to end of the delivery of each phrase. As in the restoration process, those skills require meticulously constructing a new system while deconstructing a degraded one. In the case of the voice, the degradation is caused by conventional speaking habits that oversimplify sound production.

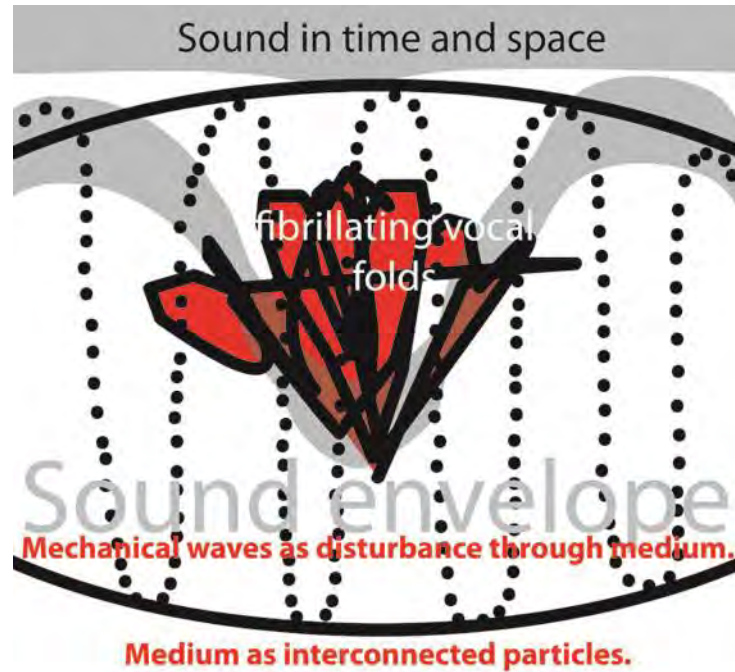


Figure 46: This cartographic schematic represents how physics impacts air management in bel cantosinging, analogous to ecotone function in wetlands systems (Rahmani 2013).

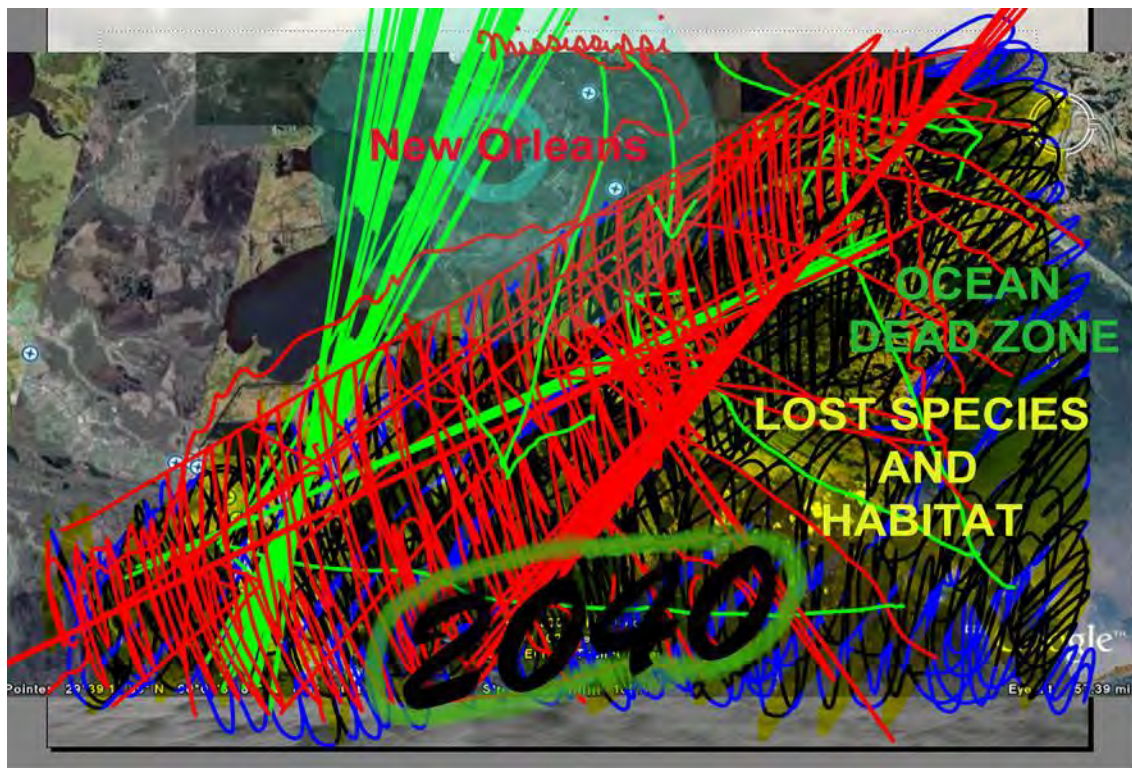


Figure 47: This mapping sketch shows how nitrates from the Mississippi Water Basin interact with other agents and stressors to cause increasing environmental problems in the Gulf of Mexico. It illustrates some of the problems I intended to address in *Fish Story* (Rahmani 2007).

The hydraulics of tidal flushing is comparably dependent on gravity and pressure from wave velocity. However, littoral zone restorationists sometimes focus on restoring hydrological metrics (NOAA 2014) when that hydrology is symptomatic of far more complex systemic problems, such as urban development in littoral zones, uplands fragmentation, and toxic runoff. Those interactions were my concern in *Fish Story*.

In the Introduction, Figure 5 shows an interpretation of the way some agents mobilized by climate change, such as drought or flooding, affect the macro-level of complexity in the Mississippi Water Basin. If left unchecked, by 2040, these agents could have disastrous effects on the MWB (Figure 47), which was something that informed *Fish Story*. By implication, in Figure 47, littoral zones along the Mississippi River, in the Gulf of Mexico, as in the Gulf of Maine, could be overwhelmed by environmentally degrading dynamics, such as fossil fuel exploration and drilling in the Arctic, currently being pursued, which could cause additional carbon loading to the atmosphere exacerbating extreme weather events. In Figure 47, although outside the frame, the location of Memphis could be interpreted to represent a human larynx. As the larynx is positioned at the centre of the human body's vocal physiology, Memphis also appears to be at the centre of systems that can increasingly impede bioregional health.

4.1. Background: Modern Geography and Interdisciplinarity

Before the role of life artist was defined by Allan Kaprow (1993), geographer Peter Kropotkin illustrated how an individual's life might animate mapping as a score on the world stage, an example which informed geography as new knowledge. Kropotkin was one of the foremost nineteenth century educators on the value of geography (Kropotkin 1885). Born into the highest echelons of Russian aristocracy and leading a colorful life of adventurous exploration, during which he eschewed his title and entitlements as a prince of the realm, Kropotkin was part of a wave of nineteenth-century naturalists who made a transdisciplinary connection between science and politics.

A polymath, educated in mathematics, economics, zoology, geography, and other disciplines, Kropotkin initiated research on Finnish glaciology and the structural orientation of Asia based on the northeast-to-southwest mountain ranges. Politically active internationally, he made direct connections between evolution, animal rights,

politically progressive philosophy, and geography (Kropotkin 1902). He was lionized by the Bolsheviks and became part of movements in Paris and England for expanded human rights and environmental justice. He subsequently rejected the Bolsheviks as too authoritarian, becoming an anarchist idol.

Kropotkin exemplified more than the conflation of disparate disciplines. His values were grounded in biogeographic concerns (that GISc is only beginning to manifest) and in living life as (performance) art. He embodied a commitment to living rationally and cooperatively, performing in a large landscape proscenium from a shifted point of view about life grounded in and generating geographic new knowledge. He foresaw the teaching of geography to children as, ‘... nothing less than a complete reform of the whole system of teaching in our schools’ (Kropotkin 1885), a point of view Dewey might have recognized as experientially based.

Where maps measure and notate the world ... mapping is a creative act that describes and constructs the space we live in, a project that “reveals and realizes hidden potential” (Abrams, Hall 2006).

Mapping, as described in the quote above, is the product of what Kropotkin termed mutuality, because it can emerge from and empower communities. In war, or for purposes of colonization and exploitation, maps can be the undoing of entire populations. But they also have the potential to contain and share original experiences of space.

It is in this context that I conceive of mapping as a tactical strategy for urgency, a horizontal score to move forward, a way for people to not only describe behavior but to project future behavior from a visual container and then make appropriate choices. The ‘score’ then becomes a directive for acts of intervention in bioregional fragmentation and environmental injustice.

Mapping as a score for changed behavior can be as effective as modeling actual behavior. I shall demonstrate how this may be possible by examining relationships between invasive *C. maenas*, geomorphology, and the occurrence of *Zostera marina* (eelgrass), to query our human values. The results contributed to my thinking when designing *Fish Story*.

4.2. Own Practice I: Mapping and Activism

Precise geo-referencing has developed since the sixteenth century. Rene Descartes first introduced the radical concept of x and y coordinates for analytic geometry in the seventeenth century. In 1569, Gerardus Mercator created a navigational map that projected a grid of longitudes and latitudes onto a cylinder, rendering parallels and meridians as straight lines. Coordinate location (the Cartesian coordinate system) was later combined with the Mercator system to establish a grid over the entire earth. The mapping outcomes enabled precise point-source, modern marine travel, enabling in turn a long era of conquest and colonization by Europeans. These locational techniques were precursors to GISc. A classic example is John Snow's 1854 work tracking clusters of cholera outbreaks to the addresses of afflicted people using specific wells in London.

In other cultures, such as the Maori of New Zealand and aboriginal Australians, mapping dreams and spiritual experiences from walkabouts have always been considered as real, if not more so, than the material world. Such maps may be seen as precursors to participatory mapping to 'locate' experience. Participatory mapping, seeks to visualize where interests converge or diverge to negotiate adaptive management. Participatory mapping may give relative space and shape to agents according to subjective value, e.g., perception and memory, emotions of fear or serenity, government regulations, a bicycle route, or a river. That can make a relatively inexpensive bridges between intuitive and precise observations and engage hitherto unlikely sources for critical analysis. Participatory mapping is often used to formally engage outsider communities. In some cases, entirely new constituencies can be brought into empowerment, such as sex workers in Madagascar (Kruse et al. 2003) engaged to track sexually transmitted diseases.

In examples such as these, events and experiences are not always expected to be as locationally accurate as psychosocial reality. That can be an environmental disadvantage of the technique. If a church is represented as disproportionately large in relation to a forest stand, for example, it can be difficult to later georeference important data. As with discursive adaptive management, less vocal participants can be excluded. At worst, participatory mapping can become a 'treasure map' to extract scarce or protected resources and exploit vulnerable populations.

In 2009 a publication of the International Fund for Agricultural Development (IFAD 2009), a United Nations agency, recommended that communities undertaking participatory mapping with outside stakeholders protect themselves with written legal agreements. IFAD suggested that goals be clearly identified by asking questions such as:

1. Why do we want to make a map?
2. Who do we want to show it to?
3. What are some of our most important land-related issues?
4. What can we use the map for in the short term?
5. What can we use the map for in the long term?
6. Is there a predefined reason for creating the map?

Indigenous communities often initiate participatory mapping as a tool for environmental activism and conservation. These maps may begin as drawings on the ground, be developed in 3D, and include oral or written histories and songs as well as graphics, creating accessible performative scripts for map readers, with increased detail in every iteration. In Figure 48, Indonesian forest peoples found that mapping allowed them to see where and how to share responsibility for forest management. This map formed the basis of a petition for equity from richer landowners.

Image not available

Figure 48: This UNESCO-assisted participatory map demonstrates how shared resources have been enabled (Ralph & Poole 2003).

In another method classified as participatory mapping, researchers organized a questionnaire to generate statistical data. Respondents were asked to rank their concerns, which were then entered as weighted attributes and georeferenced for graphical display. An example was a study with pastoral Kenyan farmers in public planning for ranked risk management (Smith, Barrett & Box 2000) as a critical methodology for land and water management. In the Smith study, despite apparent similarities across class, gender, and other factors, vulnerability to natural risks such as climate, disease, bandits, markets, and wildlife, microvariant concerns about education and health were revealed and brought to the attention of government policy makers.

In poorer communities the need to integrate participatory mapping with low-cost GIS can be served by participatory GIS (PGIS). Globally, indigenous peoples have combined participatory mapping and GIS to argue for native rights and resource protection. However, as much as participatory mapping and GISc can be used to effect conservation policy as means of empowerment or useful insight, they can be abused at the hands of powerful stakeholders (Chambers 2006). Conversely, important GISc can be suppressed to placate constituencies.

Increasingly in the West, what gets mapped is far more complex than simple indications of where material, abiotic elements might be located. As precise GPS (geographic positioning systems based on satellite data) referenced maps become available online, they have also become a means for ordinary people to visualize the locatory particulars of their own experiences in complex ways. Mapping tools are proliferating among citizen science group tools and being used to effect policy changes. Geography is where we locate inequities and injustice. Mapping can be our score to redress inequities, a ‘cartography of injustice’.²⁶ But its potential to change policy depends on realization in a fourth wall.

4.3. Mapping as Score

Participatory mapping takes place in a performative fourth wall. It is often a key tool for ecological artists working with communities because of its structural elasticity for accommodating disparate and often high-volume human data. Encompassing complexity in problem analysis reduces the likelihood of unexpected events. Given the qualities of abstraction and metaphor embedded in mapping, it is not surprising that many contemporary artists, especially those concerned with complex conceptual or ecosystem functions, have explored mapping as either a genre or a tool. The more complex the data represented in maps dedicated to problem-solving, the more likely it may be that intervention would be successful. Figure 5 from the *Fish Story* project, illustrated some of the complex interactive factors and relationships determining water systems in the United States. These complexities had to be understood before we could consider the immediate impacts on the Memphis region, such as factory farm nutrient runoff. Once we

²⁶ Quoted from correspondence with geographer Elwin Wyly, 5 February 2013.

had a chance to study these maps, we could design strategies for public participation in Memphis.

Fish Story was intended to engage people in the conservation and restoration of waterways. It built on lessons from *Ghost Nets* and *Blue Rocks* in order to locate a restoration trigger point for large landscape change (Burkholder et al. 2007). Mapping for Figure 49 was developed during *Gulf to Gulf*, from a series of collaborative webcast conversations with paleoecologist Dr. James White, and biological ecologist Dr. R. Eugene Turner. In press releases and other announcements, we pronounced Memphis the ‘centre of the world.’ Symbolically and continentally, Memphis is located at the bioregional confluence of global dynamics, including the Mississippi Water Basin and the Gulf of Mexico, and impacted by carbon emissions from the use of fossil fuels.



Figure 49: Map generated with *Gulf to Gulf* collaborators James White and Eugene Turner in preparation for *Fish Story*. We analyzed how Memphis, Tennessee, appeared to be at the centre of a number of biogeographic systems. Those systems are subject to degradation as a consequence of fossil fuel use, such as natural gas and oil (indicated by star on Texas). The purpose was to prepare (Google Earth, Rahmani 2013).

Memphis is centrally located along the Mississippi River, the sixth largest riparian zone in the world. The Mississippi River Basin watershed is the third largest in the world but is heavily polluted by factory farming upstream. ‘Waste from agricultural livestock operations has been a long-standing concern with respect to contamination of water resources, particularly in terms of nutrient pollution’ (Burkholder et al. 2007). That pollution contributes to dead zones in the Gulf of Mexico, downstream. The city of Memphis has been characterized as a racially divided, economically depressed community in which large numbers of young people have little access to opportunity or quality education. The 2010 United States Census ranked it first in the nation for poverty (Giuffo 2011). For me, these qualities made Memphis a paradigm for the kinds of global circumstances and conflicts affecting water quality and littoral zones worldwide. Our goal for this project was to find new knowledge about resiliency for Memphis’s riparian zones, watersheds, animals, and people. We conjectured that we might find our trigger point in the local river tributaries.



Figure 50: In this photograph of the *Fish Story* installation in Memphis, children can be seen responding to the imagery (photograph by Lester Merriweather 2013).

On May 7th, 2013 I led a workshop that will be discussed in greater detail in my final chapter. In response to a brief questionnaire distributed after the event, one respondent replied to the question:

‘Q: What did you learn?’

‘A: ... insights into the interconnectedness of various forces at work’.

Engaging disenfranchised inner-city youth in planning and development for the project was an unrealized priority for *Fish Story*. The obstacles were limited time at the location and lack of financial support for that participation. Their needs emerged as the single words, “RACISM” and “DENIAL” seen in Figure 51.

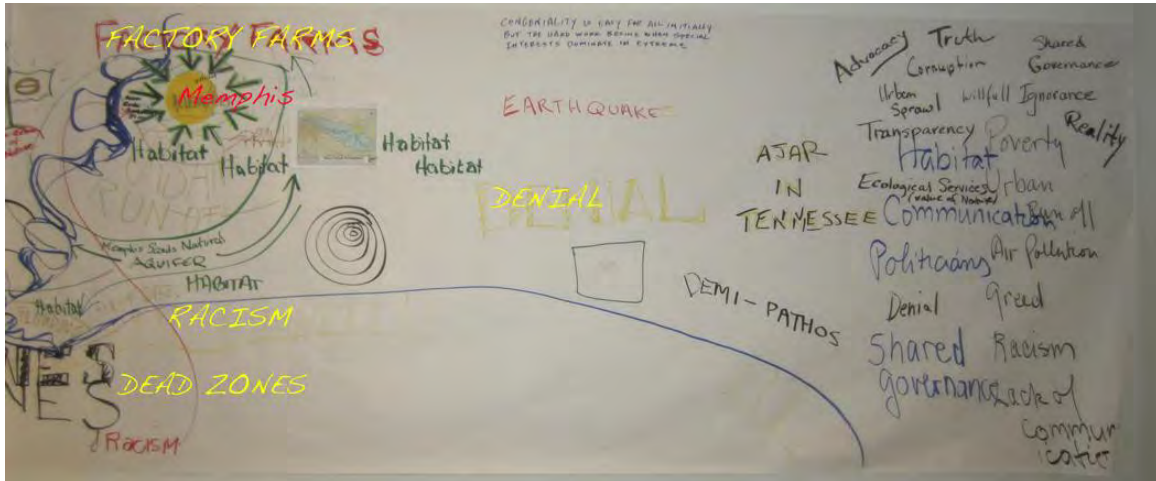


Figure 51: Participatory map (96"x 360") produced for *Fish Story* (Rahmani 2013).

4.4. Mapping as Discourse

Newton and Helen Mayer Harrison have used mapping as educative illustration to highlight climate change. For example, in *Greenhouse Britain: Losing Land, Gaining Wisdom* (2007), they indicated where sea-level rise would inundate coastal lowlands of the United Kingdom in a ‘high ground’ drawing based on GIS mapping of projected effects of global warming on Europe.

Image not available

Figure 52: *High Ground 2000* (Newton and Helen Mayer Harrison, 2000).

... we decided to define the high ground according to where the rivers began and the beginning of watersheds happened.... The concept then suggested that restoration, reclamation, and ecological design, if combined, could protect the high grounds and the rivers that flowed from them from the predicted flood and drought ...²⁷

The Harrisons describe these elegant displays for gallery settings, ‘sites for conversation’. Arguably, they are scores, because people could see the maps as self-evident directives to perform correct actions in response to the threat of sea level rise. The further presumption in this kind of display is that the artist’s task ends with the presentation of insight. That creates an opaque fourth wall between the artist and audience, maintaining distinct, uncontested roles between producer, viewer, and activist.

In 2002, to illustrate the relationship between trigger points, interpretive mapping, and GISc, I produced *If*, as part of the Camden Conference on Global Water Resources, providing a point of discourse for attendees. The labor-intensive painted mural was part of a much larger installation. In Figure 53, the *Ghost Nets* site is indicated as a gold circle, as is the Mississippi Water Basin to the left (not shown), with a trigger point

²⁷ Newton Harrison, 2013 email correspondence in the archives of the author.

indicating where the riparian zones meet, not far from Memphis. The blue paint represented an interpretive representation of linkages between water systems. The far right boxes indicated how open space in the city of Portland, Maine, might be linked in order to defragment habitat in urban space by connecting ecotones. This installation was deliberately planned as an *endurance event* (a performance that requires great stamina), to consciously exhaust my limited resources with the difficulty of painting a large mural in a short time while dealing with CFS and the knowledge that the work would be completely erased when the exhibition came down. The reason to perform that endurance event was to embody the effort required to reconnect fragmented habitat. Those performative elements, as in the examples of ecological artists described in the previous chapter, were invisible to the viewing audience, except by inference that the wall would be erased when it was repainted white at the end of the exhibition. Deliberate over-exertion is a repetitive trope in the execution of my projects, intended to recapitulate what I think surviving this era requires. In *If*, these invisible exertions referenced how a map, no matter how relevant or difficult to generate as a score for action, is only an idea model of predictive geomorphic relationships.



Figure 53: *If* installation detail at the Center for Maine Contemporary Art, Rockport, Maine, (120" x 456"). GIS graphics created with Dr. Irwin Novak then mounted on a box construction (Rahmani 2002).

The premise that GISc could describe a contiguous system of trigger points was explored further in *Blue Rocks* on Vinalhaven Island (see Chapter three). Figure 54 is an interpretive drawing from that work, based on layering GIS maps, identifying where trigger point nucleation might have maximum impact, and predicting the outcome of restoration.

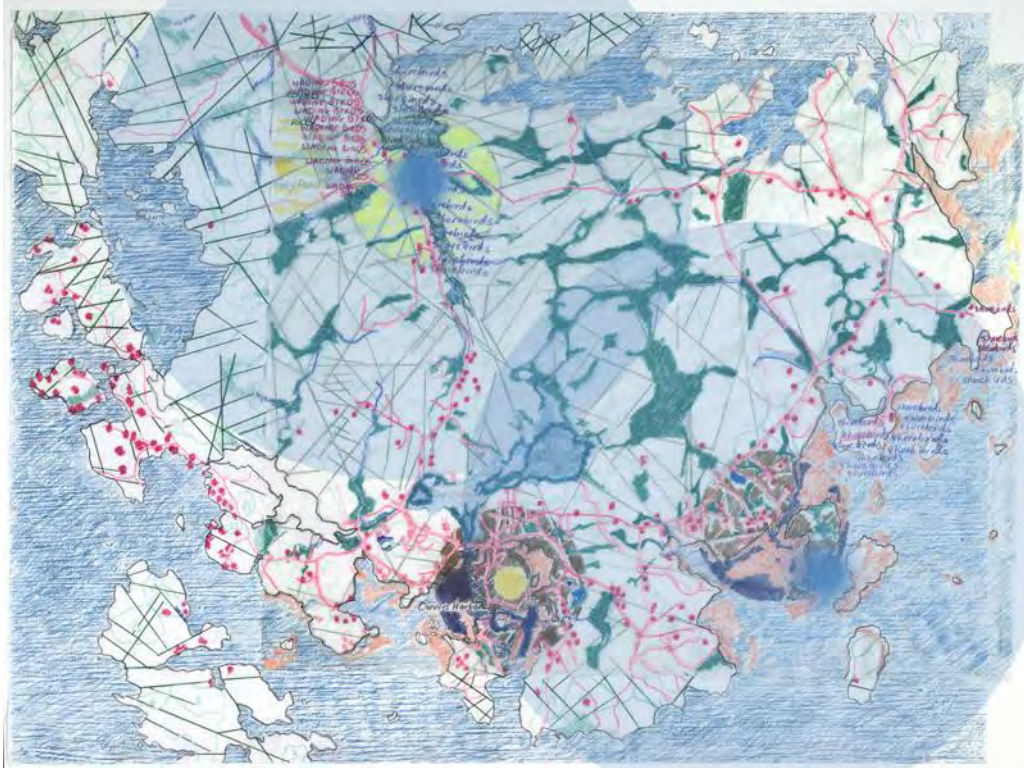


Figure 54: Three sites were circled on this aerial GIS map of *Blue Rocks*, where I had initiated trigger point nucleation events. The circle in the top left indicated the installation site where there was a confluence of the most natural edges (Rahmani 2002).

The *High Ground*, *If*, and *Blue Rocks* maps indicate approaches to mapping alternate relationships to water systems using GIS. The differences between them are formal subtleties in preparation, presentation, and audience perception. Those subtleties include assumptions about the site of posing performative questions; the location of the proscenium in relation to the audience's conversations; spatial relationships between audience, artifacts, and performer; and how that fourth-wall space is articulated.

For example, the *Blue Rocks* mapping was primarily intended for limited circulation among people who could (and did) effect local policy, much as Ian McHarg (McHarg 1995) created his layered mapping drawings for an even more limited audience. The differences between these mappings raise questions about which kinds of maps in which

setting might best represent a score for precisely what action is needed to generate significant practical results. However, none of these strategies were quantitatively tracked. The related and unanswered salient questions are about whom the audience was and their capacity to change policies. The *Blue Rocks* mapping served as a guideline for where nucleation restoration might have maximum regional impact. The *Blue Rocks* restoration became a case study for the New England Office of the United States Department of Agriculture, subsequently reaching many thousands of people. This can be an even more provocative process when the mapping is crowd-sourced.

Wendy Brawer, who describes herself both as an artist and a designer, launched greenmaps.org in 1995 as a collaborative venture site to connect globally sustainable activities in which authorship is relinquished. In 2009 she estimated that she had connected 4,000 sites. The greenmaps website now claims to have connected 30,000 locations in 65 countries. The policy effects claimed by that connectivity have included successfully advocating for New York City urban farmer regulations and permaculture initiatives.

Since 2009, the do-it-yourself (DIY) science movement, in tandem with the rise of social networking and information sharing systems, has accelerated map sharing, blurring boundaries between artists, scientists, activists, and home hobbyists. Resource sites range from greenmaps.org to sophisticated modeling sites that invite crowd-sourced information from public agencies, such as the National Oceanographic and Atmospheric Agency.

The Indigenous Mapping Network has combined PGIS and GISc. Their resources range from inventively using basic Google Earth functions, to sophisticated georeferenced graphics and social networking that links indigenous groups globally. Their goals include affecting policy, creating educational forums, and empowering formerly powerless native peoples. Members periodically post their accomplishments and questions on the site, often driving visitors to extensive websites and detailed blogs that can then be shared internationally. Many examples of the work posted demonstrates that participatory mapping doesn't require outside guidance. These groups are effecting necessary change with their own resources, using mapping and legal action to take on mining companies and other sources of exploitation that cause environmental

degradation. In reverse of the predatory corporate practices Vandana Shiva reports, the GIS software company ESRI, that produces ArcGIS and other large mapping companies, are partnering with tribes such as the Brazilian Surui peoples of the Amazon to help them protect their lands. (Moore 2012).

These are examples of using GISc to translate the intuitive complexity of heuristic human experience into a series of databases with locational accuracy, making the invisible visible and empowered. I will now discuss two additional approaches to making these relationships more visible in littoral zones, originated by Eric Sanderson, a scientist, and Eve Mosher, an artist.

The Mannahatta (the indigenous Lenape name for Manhattan Island) Project, began in 1999. Landscape ecologist Eric Sanderson used GIS, combined with militia maps and settlers' correspondence, to reconstruct locations of pre-settlement habitat, much of which was originally coastal wetlands. His goal was to make the data available for future New York City planning and to create a precedent that would bring more nature back into cities. The data was rendered as a 3D model, installed in 2009 at the New York Historical Society, and received with great interest.

The 3D model in itself was visually less prepossessing than the implications of the data that had been assembled, as well as the urban educational value. In his book, Sanderson described in detail the fifty-five distinct Mannahatta island ecosystems, so abundant that had that value been recognized in the 1600's, as he wrote, it would have conserved the island as a national 'crown-jewel' park system (Sanderson & Boyer 2013). Sanderson describes a 'map' of a food web system which he refers to as a 'grammar of habitat' including abiotic features as much as taxa. He conducted several walks to illustrate the contrast between what had been mapped and lost and the existing built infrastructure. In one walk I attended through lower Manhattan, Sanderson pointed out exactly where each microhabitat would have been, with particular attention to locations of former streams, currently manifesting as persistent drainage issues. Sanderson's work briefly references salt marshes, omits barrier islands, and concludes with a picture of a green New York City in the year 2409: a pleasant, car-less place with greened roofs but no provision for sea level rise and the accelerating climate change of the Anthropocene.

After Hurricane Sandy, Sanderson pictured a differently resilient future city during

hurricane season, golden with the winter colors of restored *Spartina*. Two months after Sandy, Sanderson published a reflective essay on how salt marshes and barrier islands might have protected the city. He produced GIS maps of projected future flooding incursions. Sanderson wrote that we have the knowledge of prophecy (with predictive GIS modeling) but not (yet) the wisdom to apply that knowledge to implement barrier beach protections.

In 2006, American artist Eve Mosher began researching how climate change would affect New York City. Based on that research, in 2007 she spent six months walking what became the *HighWaterLine* (both figuratively and the name of her project), marking it with a small cart that deposited blue chalk on the ground as she passed. She engaged people on the street as she walked, in effect making a map into a score and then creating a three-dimensional (mapped) score for others to follow. When, shortly after Hurricane Sandy, the line proved to be all too prescient, she blogged, 'I never wanted this to be a reality. Five years ago I couldn't have even imagined it. And along comes Sandy. And now it is true' (Mosher 2012). She has since published instructions inviting a wider audience into her process.

As with some earlier examples, these mapping projects focused on bringing known scientific data to large audiences in an elegant container for education and discourse, either inside or outside of a gallery. This in itself is a shift in systems from discussing scientific data in collegial circles, to inviting in an increasingly larger constituency, not all of whom are necessarily academics.

In these examples, the variety of venues and range of relationships between originator and audience becomes rhizomatic education. However, modeling potential change is different than directives to engage in actual restoration.

My mapping research explored how a transdisciplinary approach to GISc mapping could derive new knowledge by asking a different set of questions and coming to different conclusions. How could a small (nuclear) restoration such as *Ghost Nets* generate a mapping model for Trigger Point Theory in the vast and complex global littoral system?

I chose to create a set of GISc maps that would apply collection data about animal specimens in the southern Gulf of Maine from Wells National Estuarine Research

Reserve (NERR) to what is known about littoral relationships in the Gulf of Maine. In 2010, I enrolled in an evening certificate degree program in GISc at Lehman College, City University of New York in the Bronx that ran from 2010 to 2013. The traveling required to fulfill that decision introduced a new element of endurance to my process.

Although the IFAD (2009) questions on page 162 were about participatory mapping, I decided they might also apply to my intention to use GISc as a score for restoration. My interpretations were:

1. I wanted to demonstrate how layering data could determine sites to effect trigger point nucleation restoration for littoral zones in the Gulf of Maine. The source data was gathered by Wells NERR after the *Ghost Nets* case study was completed
2. I wanted to show scientists how ecological art might yield different insights for intractable restoration problems and encourage them to devise their own tests of ecological art's predictive capacities.
3. The most important land use issues involved determining what practices result in the loss of *Z. marina* beds, such as shading from built infrastructure, ballast dumping, dredging, or mercury contamination. I wanted to see whether ecotone relationships between finfish abundance and *Z. marina* could be identified.
4. The short-term use for this map was to have a basis to discuss nuclear trigger point restoration for the littoral zone as a viable direction for further experimentation.
5. I hoped to inspire scientists to support engaging ecological artists in restoration work that could increase finfish abundance and serve as a point of reference for application to other large scale littoral systems.
6. I hoped to establish falsifiable proof of the *Ghost Nets* case study as an idea model for Trigger Point Theory.

C. maenas interested me as an indicator species and as an introduced (demon information) stressor in littoral zone systems. Conceptually, I intended to apply the thermodynamic principle of branching in topological mixing to my relational concerns. I wanted to use *C. maenas* as an example to identify a trigger point that would reverse

ecosystem damage. I thought that identification would be comparable to how *Blue Rocks* had emerged from a free-hand layered map.



Figure 55: *C. maenas* or European green crab (source: https://en.wikipedia.org/wiki/Carcinus_maenas#/media/File:Carcinus_maenas.jpg © ans Hillewaert 2013).

4.5. GISc Methodology I

In both the *Ghost Nets* and *Fish Story* case studies, my attention was on factors affecting fish resilience. Some scientists believe fish are indicators of species' capacity to adapt to the pressures of the Anthropocene because of their vulnerability to a range of pressures. A discussion of fresh water fish decline in China under the pressures of the Anthropocene, for example, illustrates that confluence of global pressures (Dudgeon 2011). Many species of fish are disappearing because of the direct and indirect effects of warming waters and other anthropogenic behaviors. In both of my case studies, my concern with resilience was directed as much towards how I might conduct my research as what I might learn.

The *Ghost Nets* restoration site developed while I was observing my own methodology develop. *Fish Story* then explored how that methodology might be applied to macro concerns and identify nucleation trigger points.

The goal of my mapping was to see what happens when an artist, rather than a scientist, initiates large landscape restoration as ecological art. I deliberately stepped outside the artworld's philosophical container by immersing myself in GISs. As I will explain, the relationship between *C. maenas* and finfish represented a nexus between complex agents, a paradigm of complexity. Self-reflection as an aspect of my methodology came to be as much about the art process as the science I was learning. First, I identified what was known.

Because the evidence is overwhelming that over-fishing and *bykill* (marine species with no commercial value that are inadvertently caught and killed in fishing nets) are the dominant factors driving many species to the brink of extinction as the industry fishes down the food web, much GIS work on marine food webs has focused on the economic impacts of offshore over-fishing. However, anthropologist Julia Olson, has argued that GIS is commonly misused to increase fish capture through ocean zonation, as part of a commodification of all natural elements (Olson 2010). Olson also references the work of Matthew Turner (1989), who argues for the use of GIS to generate new paradigms in critical social science with a "broader" spatial context'.

As I have written earlier, habitat loss and degradation are further causes for fisheries decline. Human expansion has resulted in the loss of vast tracts of wetlands and Z.

marina habitat to infrastructure encroachment, endangering coastal protections from storm damage and sea level rise as well as impacting fisheries, even as, worldwide, we will lose even more wetland to sea-level rise from global warming and climate change. The United Nations reports that since 1900, the world has lost 50 percent of all wetlands. Some accounts indicate that this includes a 90 percent loss of all salt marsh where fish spawn, forage, and grow to the *recruitment* (reaching age of reproduction) stage.

By the 2080s, sea-level rise could cause the loss of up to 22% of the world's coastal wetlands. When combined with other losses due to direct human action, up to 70% of the world's coastal wetlands could be lost by the 2080s, although there is considerable uncertainty (Nicholls Hoozemans & Marchand 1999).

In a healthy coastal ecosystem, such wetlands losses would be mitigated by tidal flushing, but impervious built infrastructure or *hardscaping* (paved surfaces that are impervious to water) has made that impossible in many port cities. Toxic pesticides and heavy metal discharge, eutrophication from agricultural and household runoff, as well as acidification have killed coral reefs and *Z. marina* habitat. Invasive species are also adding to the degradation of salt marsh habitat.

The marine impacts of pollution and global warming on the health of species has inspired a great deal of research and policy attention. However, less attention has been paid to cumulative relationships between geomorphology and the marine food web, including relationships between *Z. marina* meadows and the nekton trophic relay. Another agent that affects many aspects of the food web, from the root systems of *Z. marina* to small crustaceans, is acidification. Both of these require silicate, which is dissolved by acid conditions. As policy makers struggle to address overfishing and control invasive species, it is important to question whether recovering stocks will have the necessary habitat to re-establish themselves.

In a healthy littoral zone ecosystem, *Z. marina* and oyster (*ostreidae*) beds have a symbiotic relationship. The most critical features preserve structural integrity and water quality for the littoral zone on which fish depend. *Ostreidae* are filtrators, capable of filtering fifty gallons a day (Greenberg, P. 2012), and removing massive quantities of

pollutants. The accumulation of *ostreidae* beds can provide an additional substrate that, along with barrier islands, protects shorelines from erosion.

Z. marina is as crucial to marine ecosystems as forests are for many land species, providing habitat for shelter, spawning, and foraging. *Z. marina*, as with meadows on land, provides primary habitat for marine life in general and fish in particular. The well-being of *Z. marina*, whose roots contribute to sediment stability, is particularly vulnerable to upland and shoreline human activity, including human predation and built human infrastructure. *Z. marina* beds have also been disrupted by fishing techniques such as trawling and dredging, shading from built human infrastructure, and the claws of *C. maenas* traversing the ocean floor, which pulls up roots.

In 2000, Dr. Michele Dionne collected data from the *Ghost Nets* site and analyzed it at Wells NERR. Dionne noted the relatively high abundance of *C. maenas* at the site. A *C. maenas* had also been found in the stomach of a *Melanogrammus aeglefinus* (haddock) during a data collection with fyke nets. The undisturbed control site was also monitored, and fewer *C. maenas* were collected there. The restored site had been heavily disturbed and was adjacent to rock fill. We both continued to be intrigued by the high incidence of *C. maenas* at the *Ghost Nets* site. As an artist without scientific training, I wondered whether different geomorphologies would support different balances between *C. maenas* predators and finfish species. Dionne questioned whether the rock detritus might factor into the abundance. She pursued these questions by initiating a series of data collections in Southern Maine to compare populations of *C. maenas* and finfish at different sites. In 2010, I decided that the answer to my nucleation trigger point question might lie in a GISc analysis of Dionne's data. She gave me access to her data to work on at Lehman College.

The abundance of *C. maenas* and its presence in the *M. aeglefinus* stomach at the *Ghost Nets* site indicated two possibilities. The first was a geomorphic determinant for *C. maenas* abundance. The second, based on the *M. aeglefinus*, was that finfish, if they could survive to a certain age, might prey on *C. maenas*. While designing an experiment for Trigger Point Theory in 2010, I recalled that during the creation of *Ghost Nets*, in conversations with local fishermen, I learned of a critical function *Z. marina* have in marine spawning. Researchers have known for some time that *Z. marina* are important

habitat for finfish and have sought conservation and restoration protocols the beds (Fonseca, Kenworth & Thayer 1998; Orth 2006). It is also known that *C. maenas*, in addition to predation on finfish larvae, tends to destroy both established *Z. marina* beds and newly seeded restorations (Davis, Short & Burdick 1998). I was interested in whether a confluence of geomorphology, density of built infrastructure, and *Z. marina* abundance might factor in finfish survival rates against *C. maenas* predation. I thought that investigating this question might test my premise that sufficient data layering might indicate where nucleation trigger points could be identified in the littoral zone to maximize restoration success.

Dr. Fred Short, coeditor with Dr. Edmund Green of *World Atlas of Seagrasses* (2002), is internationally considered the current leading researcher on *Z. marina*. In Short and Green's modeling for *Z. marina* resilience, they identify several criteria for successful restoration, including:

An ability to grow whilst completely submerged, which presents problems, as lowered gas concentrations and rates of diffusion; an adaptation to survive in high, and often varying salinity; an anchoring system to withstand water ...

Current Gulf of Maine Council criteria for *Z. marina* restoration design also include a criteria for baseline site analysis of:

- water quality (ammonium, nitrite/nitrate, phosphorus, dissolved and particulate organic carbon, chlorophyll *a*, turbidity, total suspended solids [TSS]),
 - light attenuation,
 - current/wave energy,
 - epiphyte load,
 - use of the site by fish or macrocrustaceans, and benthic invertebrate communities.
- ... design criteria include 'transplant spacing, light attenuation, and patterns of current flow in the vicinity of the transplant site' (Gulf of Maine Council 2012).

The problem of sediment disturbance has been so serious however, that Short designed a wire cage to prevent bioturbation (sedimentation disturbance caused by various animals, including *C. maenas*) until transplants might become established.

My GIS research question also concerned whether a geospatial analysis of relationships between *Z. marina*, finfish, invasive *C. maenas* populations and salt marsh features would indicate rates of *C. maenas* disruptions of finfish habitat for Casco Bay in the Gulf of Maine, where Dionne made her data collections.

4.6. GISc Implementation

Image not available

Figure 56: *C. maenas* distribution is global. Blue indicates native range, black dots indicate isolated viewings, red indicates invasive impact and green represents potential range (source: <http://carnivoraforum.com/topic/9333581/1/2014>).

C. maenas have been monitored in North America for almost two hundred years, since their introduction by way of ship ballast and hull exteriors, most likely as larvae. The first sighting was in 1817, and they were present in Casco Bay, Maine, by the early 1900s. By 1954 they had been sighted as far north as Nova Scotia and researchers began to see evidence that they were responsive to warmer ocean temperatures (Welch 1968).

More recently, research has shown that a number of new genetic strains have entered the North Atlantic from Northern Europe (Roman 2006). A prime source of food for these small invaders has been clam spat. *C. maenas* have demonstrated spectacular success establishing themselves while decimating coastal finfish population habitats in North America. On the East and West Coast of North America, this threatens carefully managed sustainable fisheries that have been vastly profitable. On the East Coast, *C.*

maenas have been well established for some time. The West Coast—for example, Puget Sound—is still struggling to find controls to protect fisheries. A primary potential predator on *C. maenas*, diamond-back terrapin sea turtles, once most numerous around Cape Cod, have long since been extirpated by overfishing.

Historically, the waters of the Gulf of Maine apparently produced unlimited schools of fish, especially codfish. Today, cod are rare. When found, they are a fraction of their historic size because they have genetically adapted to human predation (Kurlansky 1997). The rise of seawater temperatures due to climate change hospitable to *C. maenas*, combined with new genetic *C. maenas* strains, ensures that *C. maenas* will continue to expand their range.

The impact of *C. maenas* on finfish in North America has been quantified, including their relationships to salt marsh geomorphology and *Z. marina*. Jodi Harney (2008) identified four critical habitat attributes using species occurrence data from Western Vancouver Island, British Columbia (National Marine Fisheries Service, Juneau, Alaska). Harney derived her data from low-tide oblique aerial imagery on the Alaskan coastline with the ShoreZone²⁸ mapping system created in the early 1980s.

- Protected (P) or Semi-Protected (SP) wave exposure categories are mapped at all 15 sites (100%).
- Sand or mud flats are mapped in 7 of the 15 sites (47%).
- Eelgrass is mapped in 7 of the 15 sites (47%).
- Salt marsh vegetation is mapped in the supratidal zone of 10 of the 15 sites (67%) (Harney 2008).

The Gulf of Maine is an excellent study site to explore questions about relationships between animal populations and geomorphology, because it has many marshes.

...More than half of all tidal marsh wetlands in the Gulf of Maine are found along the Maine coastline (Jacobson et al. 1987). This is a conservative estimate since it does not specifically include the narrow tidal marsh fringe that is widespread along the 4,500 mile length of Maine's intertidal shore, or the marsh habitat

²⁸ 'Applied to more than 40,000 km of shoreline in Washington and British Columbia' (Berry et al. 2004; Howes 2001).

associated with many of Maine's 4,613 coastal islands... (Dionne, Haas & Leonard 2006).

These wetlands are divided into three distinct salt marsh ecosystems. The Southern Gulf of Maine is characterized by large barrier meadow marshes. The far north contains mud flat systems exposed for long periods by large tidal dynamics. Midcoast Maine and most of the upper half of the coastline is rocky intertidal fringing marshland, like the *Ghost Nets* site. Casco Bay, located in Southern Maine near Wells, where Dionne's collection sites were located, includes 136 islands and represents about 20 percent of the 3,300 approximate total square miles of shoreline in the entire Gulf of Maine. In 2002, shortly after monitoring the *Ghost Nets* site, Dionne began directing the collection of animal samples in Casco Bay and repeated those collections again in 2004.

The Wells NERR data collections came from 15 sites, organized by geomorphology and human impact.

Ten sites were eliminated due to inadequate access. From the remaining 15 sites (equally divided among the 3 impact levels), 4 were randomly selected from each of the impact groups for study. Sites ranged from 50 to 150 m in length, and 10 to 40 m in breadth, defined primarily by geomorphology (slope, shoreline indentation, natural or human-made shoreline features such as ledge, sand bars, pavement, and rip-rap) (Morgan et al. 2005).

Of the remaining locations, nine had adequate data for comparative analysis. The degree of human impact on the ecosystems at those sites ranged from high to low. Collection sites included some close to the mouth of the Presumpscot River, where salinity was lower. The original collection tables included 15 species of crustaceans and fish assembled in 55 columns. I assembled two Excel sheets from the field notes. Metrics other than biomass included salinity, elevation, and plant diversity (including native species richness). Fringing marsh data had been separated by high and low (flooded twice daily) marsh. Categorization was coarser than the Cowardin system (Cowardin & Golet 1995; Cowardin et al. 1979) and consisted of combining subtidal and intertidal wetlands.

One Excel sheet was prepared to make a statistical relationship between geomorphic features and vegetation (see appendix). The second was prepared for a GISc analysis.

In preparation for the statistical analysis, I assembled Dionne's raw field notes in Excel to compare collection data on the animal species and vegetative abundance in the four months represented for each tidal event. The vegetation predominantly included *Spartina alterniflora*, which, in combination with elevation and water, has been shown to provide nekton (fish) habitat (Rozas & Zimmerman 2000).

The statistical modeling run for this research by biologist Giovanna McClenachan of Louisiana State University, indicated inverse (negative) relationships between the percent of shoreline vegetation cover and animal species and individual specimens collected. The human impact of land use intensity (LUI) during the months of collection did not correlate with percent of vegetative cover or *C. maenas* but did correlate to numbers of species. (The model for this was 'total species caught per m²' = 'human impact' P = 0.04.)

The strongest animal species correlations were among *C. maenas*, *Alosa pseudoharengus*, *Crangnons*, and *Anguilla rostrata*. No correlation was seen between *C. maenas* and other species in the statistical analysis of inshore vegetative cover, which is consistent with other recent findings (Wong & Dowd 2014).

Sufficient disturbance from anthropogenic activities for example, can counter the usually fecund edge effect of ecotones. Therefore, I conjecture that the explanation for the inverse relationship is that ecotone function is being negated globally in the inshore littoral zone by cumulative anthropogenic impacts, despite local LUI variance. Although defining the variables of that impact may be beyond the scope of this research, it is further argument for layering a broad range of attributes in a bioregional analysis and for conducting subsequent monitoring.

Data in the GIS analysis based on the Wells data did establish a statistical relationship between the LUI within a 100-metre buffer, presence of *Z. marina*, and the percent of *C. maenas* collected per metre in nets at three sites. My GISc model built on that data, paying particular attention to what might be learned about ecotones in the buffer zones at distances of 10, 20, 50, 100, and 200 metres.

Calculations I then made from the 2002 Wells NERR collections indicated *C. maenas*

were 80 percent of the biomass at sites of high anthropogenic disturbance. They were 50 percent at relatively undisturbed sites, which may be a reflection of how much time the site had to accumulate sedimentation from tidal flushing, affecting *C. maenas* habitat.

For further analysis at a later date, these observations might be compared to data collected in 2004 at similar intervals and the first Excel sheet of vegetation distribution. The implications of the percentage ratios studied are difficult to quantify precisely. The only baseline for finfish populations is anecdotal, from diaries and journals of early explorers and more recent oral accounts, from fishermen. These accounts reference very high populations of finfish in the Gulf of Maine, followed by a precipitous decline after the introduction of sonar used to pinpoint schools of fish, while *C. maenas* was presumably colonizing the region. The current finfish biomass data provides great contrast to those earlier accounts. In contrast, *C. maenas* density which was not noticeable to fishermen even a couple of decades ago, appears to have increased equally dramatically.

4.7. GIS Experimental Methodology

For the purpose of this study, only three indicator finfish species were selected for tracking with GISc in relation to *C. maenas*. The selected species were studied from four collection events in 2002: June, July, August, and September. The three finfish species were earmarked for analysis based on their historic dispersion and migration patterns. Silversides (*Menidia menidia*) were chosen because their entire life cycle tends to take place in estuaries (Fay, Neves & Pardu 1983). Tomcod (*Microgadus tomcod*) on the other hand, spend their juvenile stage in upper estuary heads and then swim into lower saline estuaries (Stewart & Auster 1987). Mummichogs (*Fundulus heterocilius*) spawn eight or more times a season, in a range of fresh to salt water. They live in both estuarine and deep-ocean habitat (Abraham 1985, 1–14). *F. heterocilius* are omnivorous and important in the estuarine food web because they are normally abundant.

The preliminary data from Wells NERR on the species distributions from those collection dates was isolated and calculated for biomass of each selected species at each site on each of the four collection events in 2002. It was then re-entered into Excel sheets

to produce a .csv file (which allows conversion between statistical data files to apply to database management and for layers in GIS cartography.)

I used Excel for the assembly of statistical data, ArcGIS software to create the GIS cartography, and buffer modeling to examine the impact of *C. maenas* on finfish abundance. In constructing the maps, I began by assembling a basemap from the shape and vector files. In addition to bathymetry, I included the location of *Z. marina* beds crucial to finfish support and topology, including the location of the Presumpscot River, Yarmouth and Falmouth, Maine. Those files are publically available from the Maine Office of GIS. Shape and vector files were added in ArcGIS to establish spatial correspondences. I then added the .csv files of biomass data I had calculated from Dionne's raw collection data, converted them into shape files, and projected them onto the created basemap. This allowed me to view the incidence of *C. maenas* and finfish abundance in relation to *Z. marina* beds and in the context of inert characteristics such as built infrastructure.

Image not available

Figure 57: The Wells NERR collection sites were mapped to indicate their location in the Gulf of Maine (Bickford 2014).

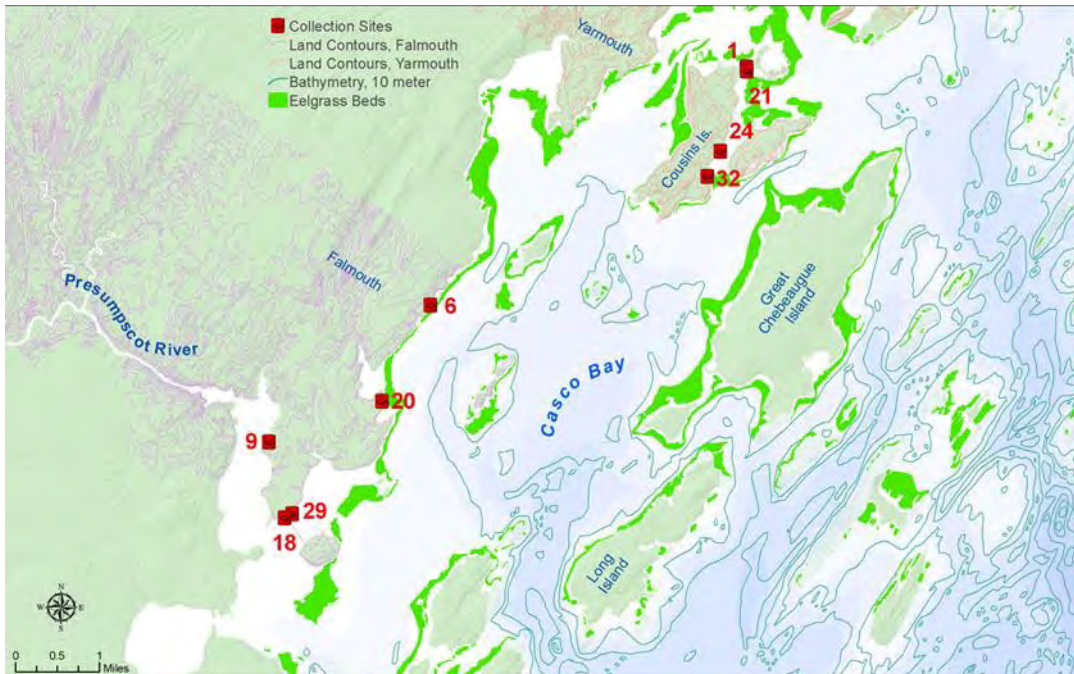


Figure 58: In this map, the location of collection sites can be seen in relation to each other, bathymetry, and topology (Rahmani 2013).

Preliminary summations in Excel indicated consistently striking imbalances between the biomass of *C. maenas*, *M. menidia*, *M. tomcod*, and *F. heterocilius*. For example, collections in June and July of 2002 at the nine sites selected yielded a total sum of 555.7 grams of *M. menidia* biomass, 459.93 of *F. heterocilius*, only 6.2 of *M. tomcod*, but 15,551.8 grams of *C. maenas*. Even granted the additional shell weight of the crabs, the biomass disparity between *C. maenas* and the three selected fish species was dramatic. Considering how low fisheries catch has dropped, the discrepancies in biomass imply that finfish populations at these locations may be collapsing due to *C. maenas* disruptions before the fish reach maturity. However, the numbers may also indicate that finfish were traveling elsewhere in response to the competition from *C. maenas* (Smith 2014).

Additional factors affecting populations include ocean acidification, dissolving the shells of small crustaceans and silicate in the sediments. This obviates *Z. marina* achieving root purchase, which in turn reduces food supplies, warms waters, and depletes oxygen—for example at site 20 in July. It also heightens competition between species for the remaining food sources. Detailed relationships between animal species and *Z. marina* may be seen in GIS buffer maps of animal populations and *Z. marina* distributions (Figure 59).

Relationships between collection sites and eel grass at 50, 100 and 200 meters resolution buffers

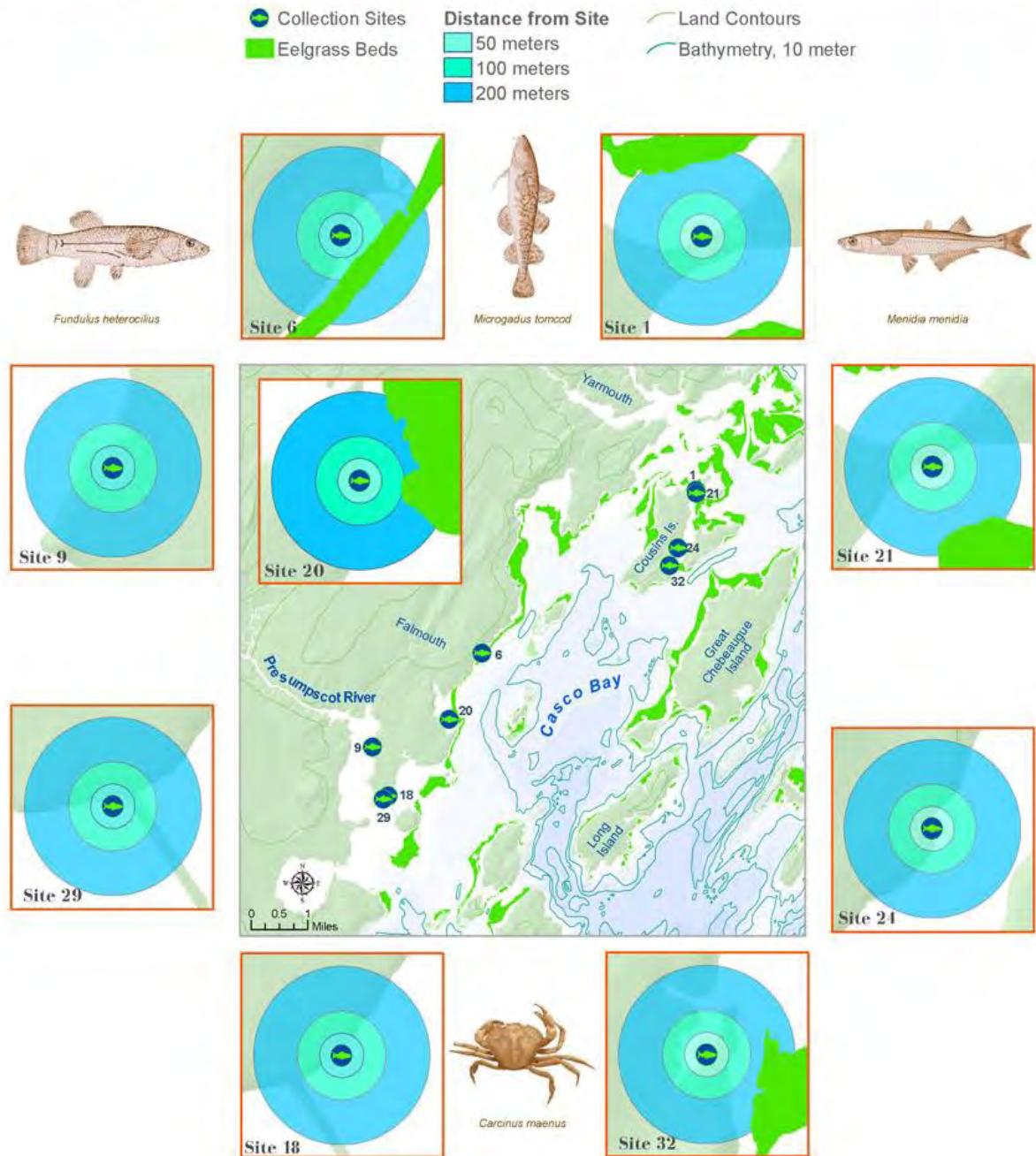


Figure 59: In this map of relationships between species, proximity is seen in 50, 100 and 200 metre buffer zones (Rahmani 2013).

I isolated the sites with the highest incidence of *Z. marina*—sites 1, 6, 20, 21, and 32—for a deeper analysis. Table 4-1, derived from the Excel sheets of collection data, shows an early summer spike in *C. maenas* populations (y axis of biomass) with the highest spike at collection site 18 in Falmouth, where the most human disturbance occurred.

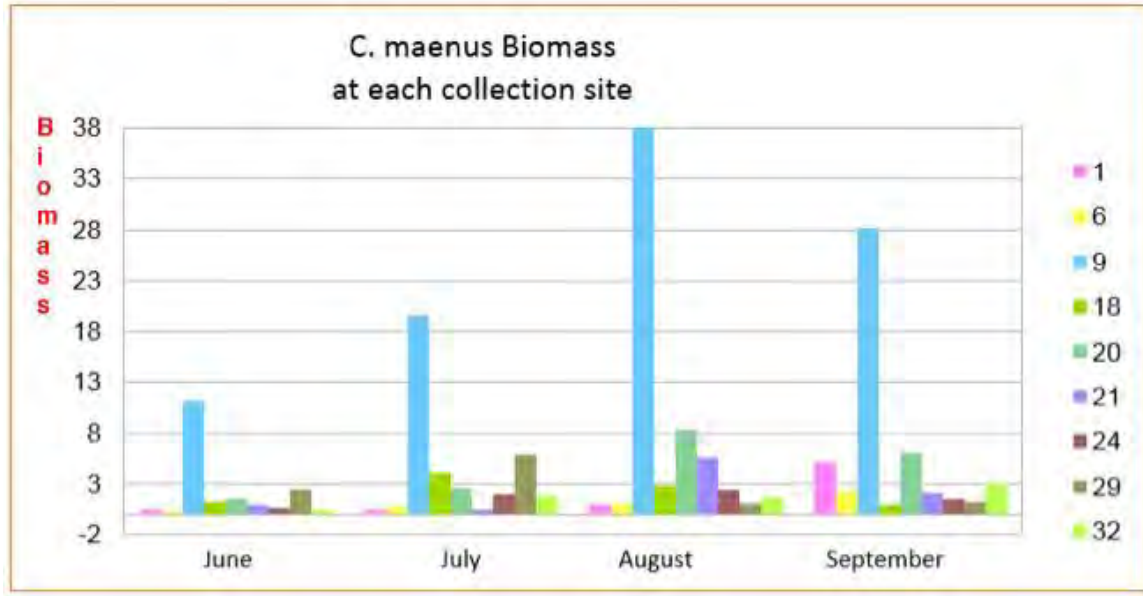


Table 4-1: In this table, it can be seen where the *C. maenas* population spikes are located and how they correlate to human disturbance shown in Figure 59. The x axis indicates amount of biomass at each site, indicated by a color code key to the right of the graph. The y axis shows the months of collection (Rahmani 2013).

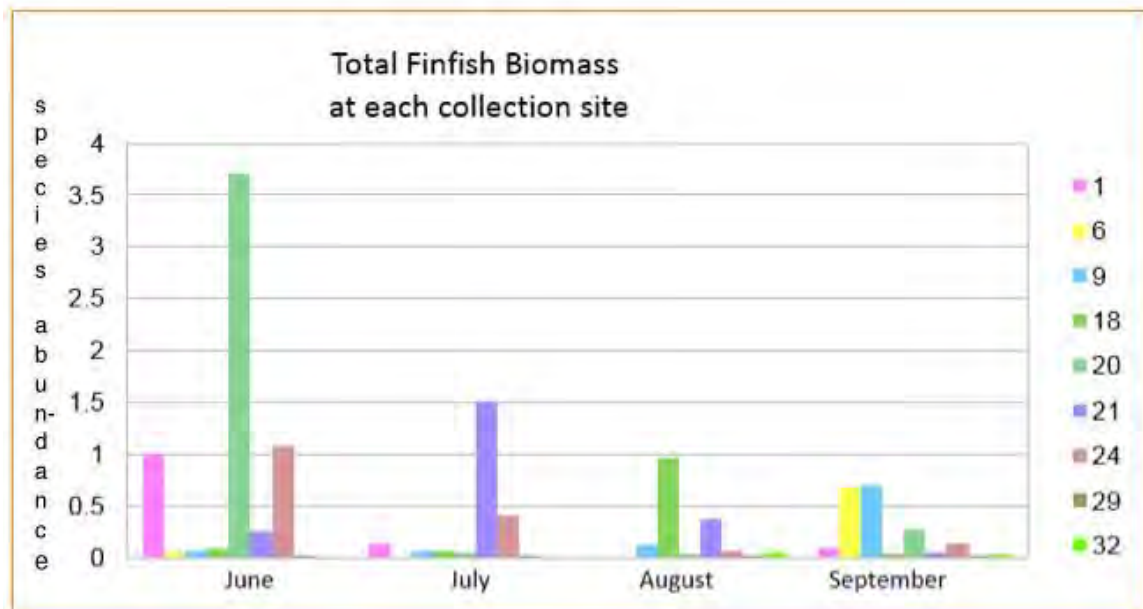


Table 4-2: This table shows relative populations of finfish at each collection site. The population biomass was so low at all sampled sites that they would not even have been visible had they been included in the table (4-1) of *C. maenas* biomass (Rahmani 2013).

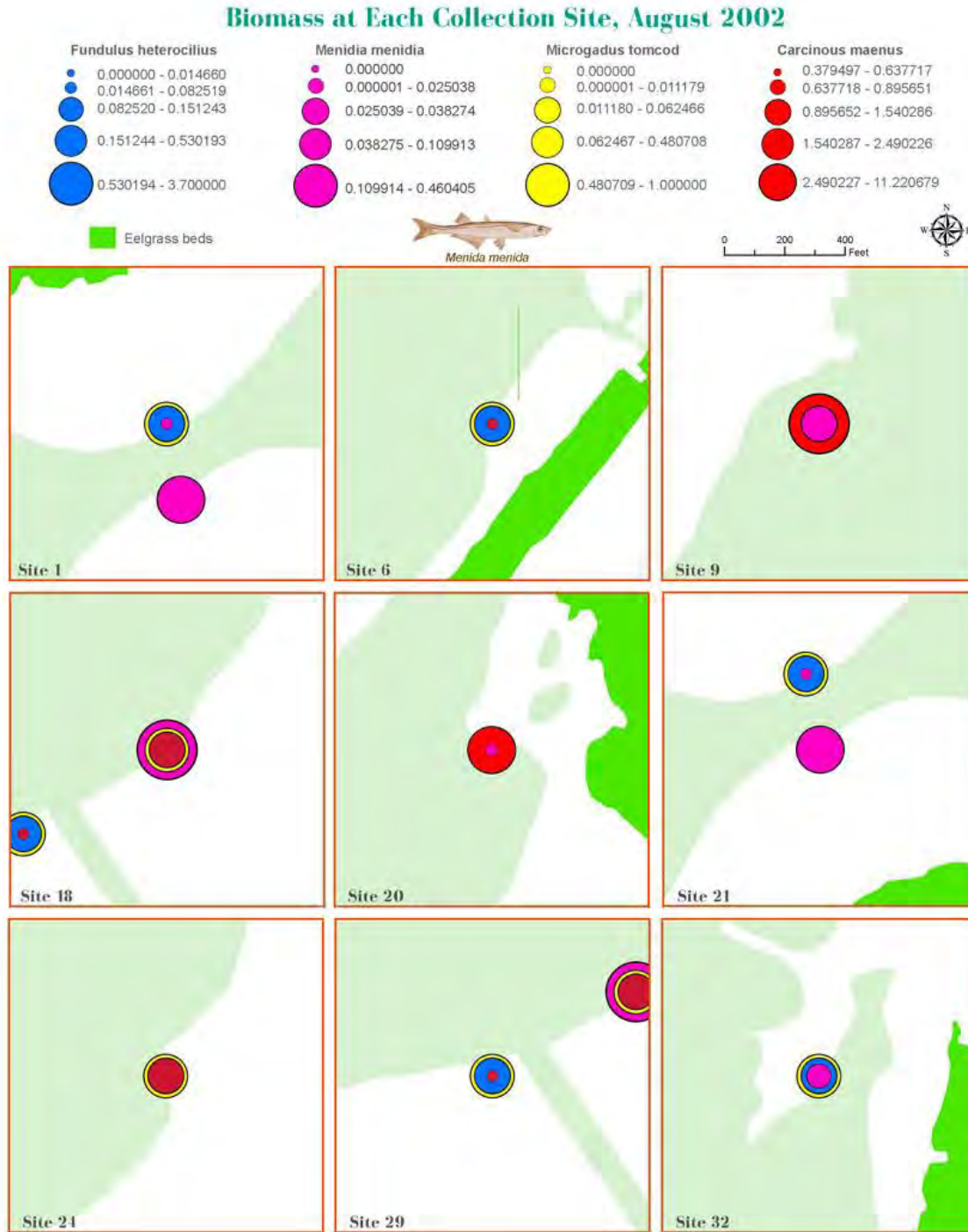


Figure 60: In this map, a more detailed view can be seen of the relationships between animal species and *Z. marina* at each site in one collection event. The pale tone is land mass. The medium tone represents *Z. marina* (Rahmani 2013).

Figure 61 indicates the locations of high, intermediate, and low human impact on ecosystems at the collection sites. Table 6 looks at collection data from two of the sites

(18 and 32) that seem to be at the relative extremes of crab abundance for just two months in 2002.

	June C	June S	June T	June M	July C	July S	July T	July M
Site 18	1563	0	0	31.4	3443.9	0	0	21.5
Site 32	219	0	0	0	1038	0	0	0
S= <i>M. menidia</i> , C= <i>C. maenas</i> , T= <i>M. tomcod</i> , M= <i>F. heterocilius</i>								

Table 4-3: In this table it can be seen, in grams, how wide the gap is between maximum and minimum biomass weight of the four selected species collected at the extremes of two sites on two collection events (June and July 2002) (Rahmani 2013).

Site 18 can be seen in Figure 61 to be in an area of high impact from human activity and built infrastructure, whereas site 32, on an off-shore island in Yarmouth, is listed as low impact. However, Site 32 is also the site of an oil-fired power plant that emits discharge into the water, a dirt parking lot that drains into the sea, a town dock for the local ferry, and a noisy marina (Smith 2014). An inference from this might be that human disturbance is inadequately monitored, increasing potential imbalances between *C. maenas* and local finfish. However, there is a threshold where, even in the presence of *Z. marina* beds, for example at site 32, neither finfish nor *C. maenas* can withstand the level of disturbance.

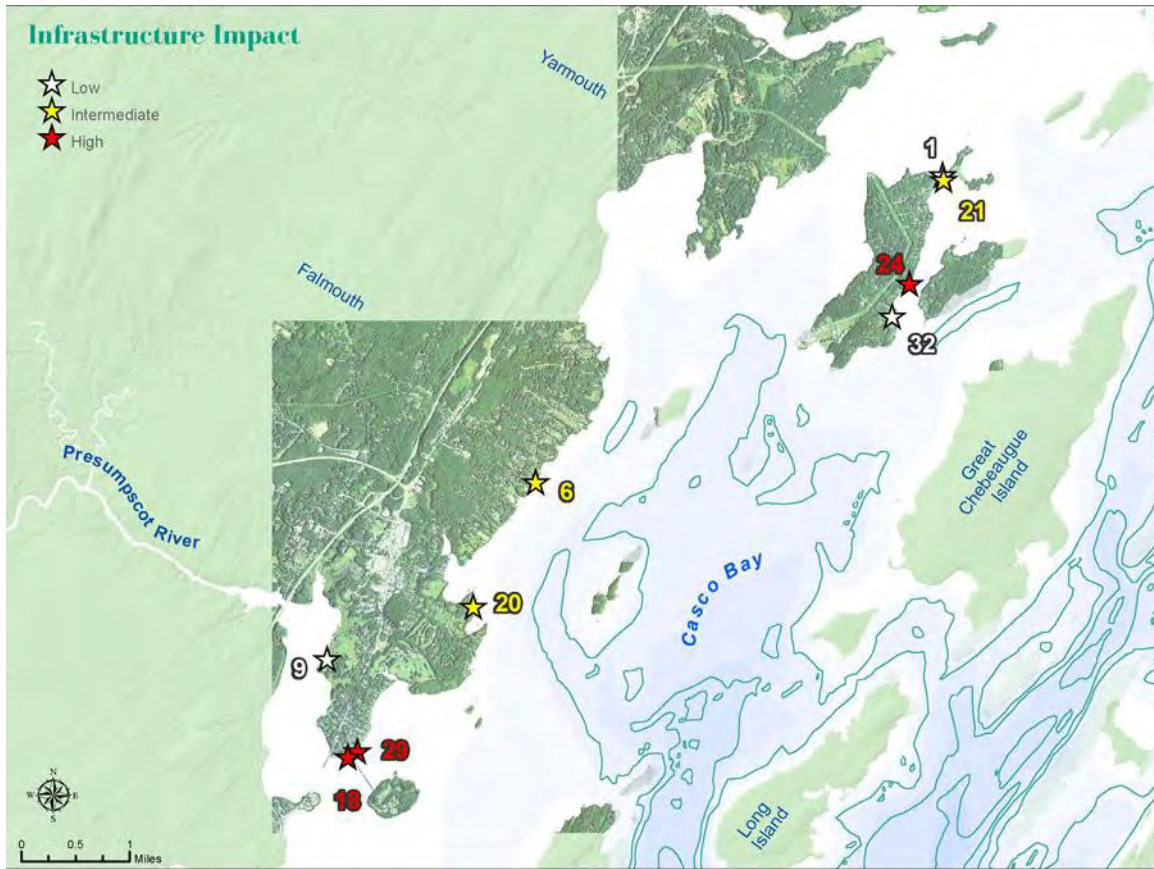


Figure 61: GIS map showing correlations between collection sites and relative impacts of built infrastructure (Rahmani 2013).

4.8. Results and Questions

Pursuing my GIS education was intended to create a performative parallel to how individuals might respond to ecosystem deterioration under pressure from epic environmental stressors. I was curious about the nature and picture of the data as neutral art material and the free associative thinking it evoked (Figure 18). My intention was to test a strategic model for undertaking a difficult task with limited resources.

Heuristically, I experienced this as an experiment in endurance performance, comparable to the complexity of littoral zone habitats and analogous to how breath flow in bel canto singing and organizes physical stamina to sustain a series of high notes from a score over a long period. My claim for this GISc research was that mapping relationships among *Z. marina*, geomorphology, built infrastructure, *C. maenas*, and finfish populations in the Gulf of Maine might reveal optimum sites to consider for nucleation trigger points. A related question I wanted to explore was whether it is

possible to quantify the impact of built-infrastructure land use on fisheries survival. The analysis of data collected for this project indicated a correlative relationship between the abundance of *C. maenas* and the populations of finfish at all sites studied, where journals from earlier times and anecdotal evidence from living fishermen indicated that previously, there were abundant cod (Kurlansky 1997). The data-based layers of the GISc maps seemed to demonstrate that *C. maenas* is out-competing finfish for habitat. Data also seemed to imply that islands of refugia for *Z. marina*, with limited built infrastructure, might support finfish recovery.

My hope was that where there are *Z. marina* beds, finfish fare better against *C. maenas* predation despite built infrastructure and consequent human impacts. I thought that rules based on that correlation might be added to the restoration criteria listed by Short and Green (2002) and the Gulf of Maine Council for *Z. marina* restoration.

Based on my initial spatialization it seemed that although proximity to *Z. marina* beds and distance from built infrastructure marginally enhanced finfish abundance at sites 18, 20, and 21, in some collection events, the biomass of crabs significantly overwhelmed the survival opportunities for finfish at all nine sites sampled, to the point where at some sites, very few finfish were collected (sites 9, 32). A more detailed future study comparing results from several years of collection may reveal more fine-grained relationships between topological and bathymetric distinctions, variations in the breadth and depth of marsh channels, and other vegetation patterns²⁹ in addition to *Z. marina*, salinity, and collection data. However, based on informal discussions with other researchers (Neckles et al. 2012), there is not enough information to decisively conclude causation or whether targeting any of the nine collection sites would enable finfish to recover.

It was instructive that at site 32, finfish populations were minimal, although it appeared to have the lowest biomass for *C. maenas* and was designated intermediate LUI. However, there was a great deal of human activity and environmental insult counterweighing potential habitat opportunities. Approaching site 32 as a potential nucleation

²⁹ Further data is available from Dr. Pamela Morgan, New England University, Portland, Maine, who has contributed her observations to Dionne's papers.

trigger point location would require engaging in all the contextual complexity of dysfunctional relationships to the environment.

At this time, based on available data, it appears that efforts concentrating on only one variable, such as the presence of *Z. marina*, could not rescue finfish populations from collapse. However, the low populations of *C. maenas* at site 32 might suggest that if some restoration scientists' mantra of 'build it and they will come' is true, reducing LUI and reinforcing those *Z. marina* beds might create a nucleation trigger point. The 'build-it' mantra is not, however, a guarantee of success (Brudvig 2011). Therefore, no determination can be made except the speculation that finfish may already be on the verge of collapse, beyond restoration remediation. The Trigger Point Theory premise that sites of maximum degradation might have locational significance, whether at the *Ghost Nets* site or at the City of Memphis for *Fish Story*, is conditional on the European caveat that functionality, not necessarily taxa, may be restored after a collapse. It was indeterminate from the data whether applying trigger point nucleation as restoration triage could restore finfish.

In conclusion, restoration clearly requires coordinating agents of a complex system in uncertain conditions. Trained volunteers can seed *Z. marina* beds and protect plant plugs from *C. Maenas* with wire cages. *Z. marina* restoration techniques might still triage relationships between remnant *Z. marina* beds and struggling finfish populations, such as at site 32. However, restoring finfish populations depends on whether finfish have already reached a point of collapse and whether there would be the political will for embedding such efforts in comprehensive regulatory reform.



Figure 62: Detail view of human activity near Site 32 (Tin Smith 2014).

I concluded that restoring finfish populations to the Gulf of Maine requires an integrated, systematic, educational, bioregional strategy, including an emphasis on conservation; redesigning wharfage and other built infrastructure to reduce shading of *Z. marina*; the reduction of carbon emissions and hardscaping that generates pollutant run-off into the sea; regulation of in-shore activities, such as boaters and waste discharge; requiring ballast to be off-loaded in the deeper ocean rather than in-shore; and eliminating dredging and other wholesale fishing techniques that destroy *Z. marina* beds, and reduce fragile biotic populations.

Additional data and testing might also answer some questions discussed with Dionne:

- How are the density and breadth of *Z. marina* beds relevant to animal populations?
- What relationships might be determined by comparing salinity levels, for example at the mouth of the Presumpscot River?
- Might some of the data on salinity be contradictory, for example at the Saco River sites?
- What relationship exists between topography, bathymetry, *Z. marina*, and species abundance?

Future research questions that might emerge from more complex spatial analysis include:

1. Can we show a relationship between salt marsh typology in Casco Bay, Maine, invasive *C. maenas* incidence, and the survival of juvenile finfish using marshes?
2. How might the length-to-breadth ratio of marsh type correlate to juvenile fish survival?
3. Is there a ratio of high marsh area to low marsh area, or alternatively, a percentage of total marsh to low marsh optimal for juvenile finfish survival?
4. What data might emerge from comparing the *Z. marina* layers with rockweed and *Phragmites*?
5. What impact value is the vegetation-to-water ratio?
6. What impact value is the percentage of soft sediment un-vegetated surface, or alternatively, the ratio of soft sediment area to vegetated area, for juvenile fish survival?
7. What impact value is the distance from marsh to nearest source of *macroalgae* for marsh ecad (organisms modified by habitat) habitat?
8. Might we calculate the impact of increased tidal inundation from global warming on salt marsh distribution?
9. Can we quantify how much the fisheries are being impacted by present salt marsh conditions in Casco Bay?

It was beyond the scope of my research, but the question remains about the extent to which adult finfish might predate on *C. maenas*.

My results were as follows:

1. The mapping layers seemed to affirm that supporting *Z. marina* beds could provide resilience to finfish populations, *if* the fish are still present in the ecosystem and environmental insults are permanently reduced.
2. Mapping is a 'score' of action for restoration based on an application of Trigger Point Theory but requires more than a locational approach. The relationship

- between an ecological art practice and unique questions for GISc requires further clarification.
3. Resilient restoration depends on uplands land use to stem and reverse practices that result in the loss of *Z. marina* beds, such as shading from built infrastructure, ballast dumping, dredging, and mercury contamination.
 4. A short-term use for this mapping could be as points of discussion in formal conferences, papers, exhibitions, and informal discussions with land managers and scientists.
 5. The long-term use of the maps will be to continue to deconstruct the thinking that created the problem of imminent fisheries collapse and to consider those points in relation to other sites, such as *Fish Story* Memphis.
 6. The predefined reasons for providing a falsifiable experiment for the *Ghost Nets* case study as an idea model for Trigger Point Theory was inconclusive. However, the research clearly indicated widespread abuse of littoral zone ecotone systems, a reckless disregard for the preciousness of clean water and the neglect of urban design that might protect healthy ecosystems.

The information presented here might encourage future researchers to continue to explore how unconventional, transdisciplinary correspondences between *Z. marina* and aspects of adaptive management could affect the future of *C. maenas*, remnant populations of finfish, and humans.

The predictive data I sought to support a trigger point CAM was evidence to establish rules to determine at least one location where restoration scientists and managers might focus future restoration triage actions to successfully support the increase of finfish populations. The mapping indicated that site 32, should it be adequately regulated, would be a potential locational, 'build it and they will come' opportunity. It was also confirmed that unraveling a complex situation, as with a 'bed of nets', requires a matrix of approaches.

The goals of my endurance based mapping experiments were to press the boundaries of perception with if a performance technique. I will now present a food web that contextualizes my previous discussions of anthropogenic activities in the littoral zone and

emerged from that experiment. In the drawing below, I illustrate how built infrastructure and the introduction of exotic and invasive species, such as domestic cats and *C. maenas*, degrade natural systems and overcome established endemic interactions, inducing trophic cascades.

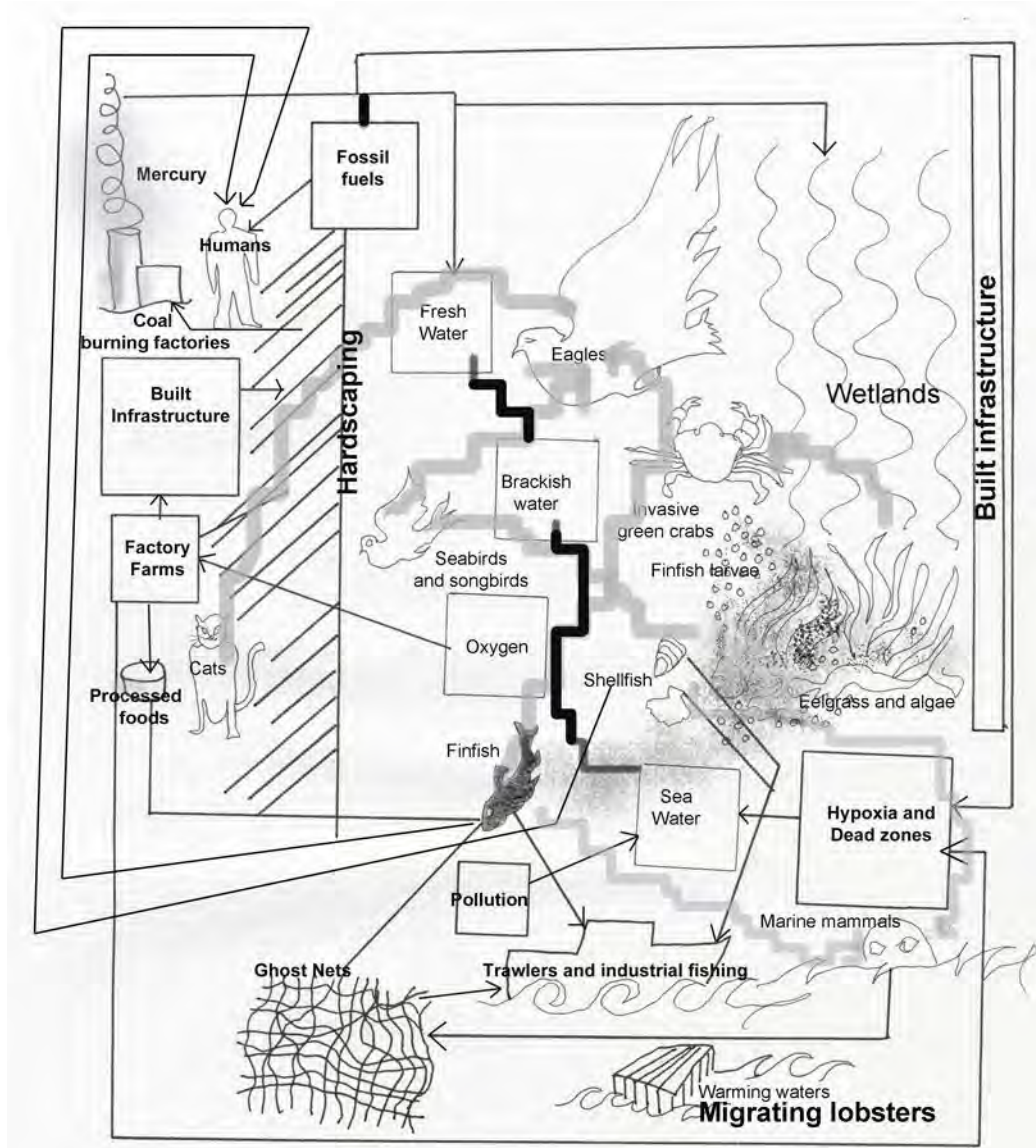


Figure 63: This food web of energy consumers illustrates how littoral zone wildlife is presently surrounded by Anthropocene impacts, containing finfish in a closed system. In this view, biotic energy is replaced by anthropogenic activities and abiotic elements such as impervious surfaces of hardscaping and built infrastructure (Rahmani 2014).

In Figure 64, I applied the implications of Figure 63 and my conclusions from the GIS mapping to my area of research for *Fish Story*. The view of the Mississippi Water Basin

was inverted so that north points downwards towards Lake Michigan. I drew correlations between bel canto singing and bioregional relationships that define wetland systems, including interactions between factory farming practices that release nitrogen, hypoxia, fossil fuel development, and *Z. marina* resilience.



Figure 64: Sketch of correlations between bel canto singing and bioregional connections to environmental degradation in the Mississippi Water Basin. Intervention at various points in this system could restore healthy flow to the waters and ecotones of the whole littoral complex (Rahmani 2014).

The parallels illustrated between vocal physiology and geomorphologies are extrapolated from the rhizomatic effects of pursuing transdisciplinary scientific research. In bel canto, the singer's capacities are managed by the musical line and supported by the composer with rests that allow refreshed breath. I deliberately sustained this effort to complete the 'musical line' of my research and to investigate whether my result might be a black swan. Any endurance event is delimited by physiology. In this case, it was dramatized by the exigencies of CFS.

The drawing illustrates an artist's view of how a trigger point CAM might predict the outcomes of human behavior, if water conservation, ecotone health and realistic urban design were integrated with tributaries of the Mississippi Water Basin. The tributaries would function like lungs. The air traveling through the system would be comparable to the tidal flushing that should take place in the deltaic region of the Mississippi River, where it meets the Gulf of Mexico. Instead, hypoxia creates dead zones and interferes with the replenishment process.

4.9. Summary

In this chapter, I analyzed how some ecological artists have used mapping to engage audiences in a discursive fourth wall. I considered how perception has transdisciplinary, rhizomatic qualities that can inform mapping and be informed by maps. I presented the results of two experiments, 1. GISc work based on scientific data. 2. Interpretive mapping based on an endurance event. The latter compared bel canto singing to how complex hydrologic flows and protective ecotones function in littoral zones.

The GISc experimental design was intended to test Trigger Point Theory. The informal *Gulf to Gulf* webcast episodes were presented as another means to explore whether Trigger Point Theory might be a novel strategy to restore the Mississippi Water Basin and the Gulf of Mexico. Implications discussed that emerged from those conversations and the mapping they inspired tested how organized virtual discussions might lead to more rigorous analytic functions. The littoral zone food web model I presented is based on a rhizomatic point of view that includes biotic and anthropogenic abiotic agents, such as built infrastructure (Figure 61). It suggested that insights informed by art might be useful. Both approaches suggested that mapping might change perceptions of relationships between humans and water systems and lead to greater sensitivity about the value of ecotone systems.

Neither experiment resolved issues about inferring causality from correlation with transdisciplinary work. Rather, they evoke more questions about the value of idea models, and of engaging ecological artists in primary scientific restoration research.

Figure 5 in the Introduction, and Figures 44, 47, 52, 53, 63 and 64 contrast with the more fine-grained qualitative GISc mapping I presented while still using sophisticated

techniques to interpret relationships. They demonstrated how art might reframe restoration science problems by considering agent relationships heuristically. As I have shown, connecting personal and political experiences, such as endurance events and activism, to quantification represents new possibilities for insight.

Interdisciplinarity is familiar to restoration managers. Ecological art as a source of analytic data is less so. Managers are often enthusiastic about including social practice artists as an aspect of adaptive management, and other artists and designers as illustrators and interpreters of their work. Scientists are rarely equally receptive to inviting ecological artists into theoretical and strategic planning for projects.

In this chapter, I argued that layering quantitative modeling from GISc with art could lead to more effective participatory mapping and activist land management from volunteers by including knowledge from more aspects of human experience. The results could contribute towards restore complex ecological systems.

I have shown how mapping can inform and change behavior. The meaning of the phrase ‘horizontal score’ was to reference how rhizomatic experience establishes relationships between observation of landscape phenomena and choices to act to sustain the biological health of that landscape. The GIS associations were correlative, rather than predictive but did not close off the possibility that another test might still identify nuclear nucleation trigger points. I argue that the correlations examined should be strong incentives to other researchers to test my premises.

The endurance aspect of my strategies was introduced and will be explored further in the next chapter as another way to gather heuristic data and tacit knowledge. I will show the value of conflating endurance with interdisciplinary means from other forms. The *schedules*, as documents of heuristic data-gathering will be discussed. Those documents represent a simple approach to mapping perceptions as part of performing ecology.

Chapter 5

Performing Ecology

In this chapter, I will describe performing ecology methodology and outcomes. Performing ecology is my term for an art life practice that led to and continues to experiment with Trigger Point Theory for ecological restoration. I argue that performing ecology could be a tool for environmental triage in and generate new knowledge about the littoral zone. I will detail how it evolved in *Ghost Nets* and *Fish Story* as extensions of my studio practice, and as a means to explore community engagement in workshop events. My goal is to consider whether and how this methodology might lead to successful restoration initiatives by laypeople, working with artists and restorationists. I also seek to answer whether this investigation might lead to modeling rules for an artist version of a CAM.

Performing ecology as a form of endurance performance, deliberately invited a measure of chaos and loss of control into my two case studies. Endurance events often put artists in physical or mental jeopardy. Intentional chaos invited different insights and observations of self-organisation. Did black swans emerge? A secondary question, when considering the implications of enduring chaos in an art project, was whether self-inflicted duress implicated my audience? The idea of implicating an audience in endurance events was articulated by art writer Frazer Ward (Ward 2012). As he wrote, it depends on the positioning of the audience and their values. The idea of implicating the spectator plays on subjective aspects of the fourth wall.

When an artist takes on an endurance performance about the environment, even if enacted in relative isolation, such as Dominique Mazeaud in her *Cleansing of the Rio Grande*, or my own completion of *Ghost Nets* despite CFS, does audience implication become another form of social practice, in that empathy for Mazeaud, for example implicates the audience in allowing a separate class of maintenance workers to remediate the damage of many? Could that be relevant to adaptive management? If my audience knew I had CFS, were they implicated in my collapses when I invited the collapses that contributed to the insights that emerged? A CFS collapse is characterized by being bedridden with weakness, loss of focus or concentration, and a myriad of neurological symptoms, such as severe headaches and sleep disturbances, including insomnia. When

LaDuke speaks of a holocaust of her relatives or Shiva refers to indigenous groups protesting industrial impacts, the audience can choose to experience empathy for other people or species or implicate themselves in their choice to abjure ecosystem responsibility.

My own conjectures about collaboration, particularly with non-human agents, will be investigated. Does changing my relationship to other species with my own positioning change the work of restoring degraded systems? Does that differ from an indigenous person's relationship to place? Is empathy a form of redundant environmental engineering?

In addition, I will consider how time-based performative strategies, including embodiment exercises with voice and movement, applied in *Ghost Nets* and *Fish Story*, could become primary research tools and provide expert witnessing. I will examine whether living on the *Ghost Nets* site while engaging with the local community was a critical methodology. I will argue that my consistent physical presence at the *Ghost Nets* site, allowed me to bridge TEK methods, Western science, and an artist's approach to restoration. Did that effort change my experience of land ownership in any significant way? How might these layers of experience produce tacit knowledge and affect outcomes?

Based on these questions, *Blue Rocks* will be discussed in more detail as an extension of *Ghost Nets* and an experiment in adaptive management. As I will show, *Blue Rocks* reinforced my thinking about how Trigger Point Theory might contribute to fisheries' resilience. The lessons learned from *Ghost Nets* and *Blue Rocks* were applied to *Fish Story*. Those lessons informed how I structured my performance-audience relationships in *Fish Story* to scale up small nucleation restoration sites to bioregional planning

I will consider how metaphors such as acupuncture and CFS informed *Ghost Nets*, *Fish Story* and the evolution of Trigger Point Theory and how I think my experience with metaphors might contribute to theoretical restoration science. I will suggest that artifacts and other unconventional methodologies, like lucid dreaming, meditation, workshops, and games can become part of legitimate scientific inquiry.

I argue that these details of a performative approach can reveal subtle but critical aspects of habitat linkage, adaptive management, and means to monitor sites (see

questionnaires in appendix). Performing ecology can be effected with a combination of onsite work and virtual means can maximize the effectiveness of restoration work.

When I began *Ghost Nets*, I did not have a deep understanding of restoration science. Had I had the tools of science—what Kahneman (2011) called ‘slow thinking’—to balance my (fast) qualitative insights about natural functions, the result might have been different, and reliably falsifiable. The most crucial omission was not having a core sample at the *Ghost Nets* site before the estuary was restored. At the time, the tools of science were unavailable because of limited funding, lack of institutional support, my own ignorance and the extent of the artistic slow thinking I was immersed in from the commitments I had made. Fast and slow are relative concepts, as I will demonstrate. Performing ecology weighted each life decision with intentionality about environmental ethics, in which activism is attitudinal (Callicott 1999).

The formal parameters for performing included: (1. data gathering research with conventional and unconventional methods and structured conversations (often using virtual and social media) that establish rhizomatic connections across communities; (2. mnemonic artifact production, integrated into a meditative practice; and (3. site-transformative interventions, including interactive experiments with the local habitat governed by the precautionary principle. Structured time commitments and physicalized embodiment are relevant to all three parameters and are conceived as musical experiences.

In *Ghost Nets*, performing within these parameters was conceived as a response to global conditions, performed on the micro-proscenium of the two-hectare site and then mapped for biogeographical relationships. In *Fish Story* the macro-continental system was mapped and conceptualized on a large-landscape (global) scale in a collaborative process, and then trigger points within that system were identified. Both projects were conceptualized to live in contiguous public fourth walls. The intended aesthetic outcomes of each approach were to, restore vitality to the site, leave a tache of art on my audience’s perception of the land, and transform myself.

5.1. Own Practice II: Performing Ecology

Climate change is unique in that it demonstrates the scale and complexity of interactions between humans and the environment. It creates challenges for protection that citizens might expect from the state (O'Brien, Hayward & Berkes 2009).

I would measure my success by how invisible (as art) the results were.... I sometimes feel frustrated that I am most effective (at restoration) when I'm (personally) most invisible (Rahmani 1998).

A point of view that reframes and empowers personal behaviour builds on discourse from ecofeminism. In that frame, the personal is political, the local is global, and private behavior inflects public outcomes. I distinguish those values from personality-driven art pedagogy as exemplified by Joseph Beuys's exuberant celebration of the artist as shaman-teacher (see Chapter three) or market-driven cults of artistic personality (Yablonsky 2009). The desired outcome of performing ecology is littoral zone resilience emerging from personal engagement with a site. In performing ecology, these conceptual relationships function as elements of a symphonic score, as the branching that Deleuze and Guattari (1972, 1987) describe (Chapter four), and as topological mixing.

5.2. Personae and Performance

Public art theorist Claire Bishop (2006, 2012) has supported ideas promoted by Antonin Artaud (1936, 1958) and Joseph Beuys (1993): that art must shock the audience and utilize large spectacle to effect revolution. An example of this is in the work of the Living Theatre, a company I performed with for their 1970 San Diego production of *The Plague*. Interrogating whether activism and spectacle in performance art successfully effects change or reveals black swans requires examining relationships in the fourth wall between participants or volunteers, the artist and patrons (Culture Grrl, 2008).

Much postmodernist thinking questioned the implications of the visible role of the individual artist in object production (see Chapter three), what art historian Judith Rodenbeck calls the 'effacement of the self' (Rodenbeck 2011). Conventionally, artists

and scientists are routinely expected to make visible the invisible, but rarely reveal how Rodenbeck's self-effacement might unfold as an incremental relational process.

Allan Kaprow's later works reflected his studies of Zen as a means to effect change without spectacle (Kaprow 1993) and supported my interest in finding leverage from the personal to the public without self-aggrandisement. Regarded by some as a Zen master at the end of his life, Kaprow, like ecological artist Mierle Laderman Ukeles, (see Chapter one) deliberately framed subtle, incremental, relational behavior, in order to question and critique social values. An example was when Kaprow swept the stairs at the 1972 Documenta art fair in Kassel, Germany. In *Ghost Nets* I ambivalently embraced the persona of the artist as invisible anti-hero. It was consistent with experiencing my practice in a community with other species and eventually led me to what art theorist Judith Butler calls, the 'deconstruction of identity and gendered psychoanalytic relationships in performance' (Butler 2011). Although Butler writes about gender perceptions, her insights also correspond to what ecofeminists have written about speciesism. Butler dislocates point of view from role-determined embodiment, 'conjuring a reality that does not yet exist, and holding out the possibility for a convergence of cultural horizons that have not yet met' (Butler 2011).

Kaprow and Ukeles' precedents for incrementalism corresponded to a basic premise from *Ghost Nets*: to challenge 'the trap of the familiar' in search of self-organisation, by identifying the anomalies of butterfly effects and black swans rather than presuming the inevitability of accepted patterns. I argue that unraveling the complexity of the ghostnets metaphor has been as abstract but logical a task as any mathematical formula applied to creating a CAM. That process of observing anomalies in incrementalism such as Turing or Lorenz had done mechanically, was reflected in my schedules as I chronicled coming to terms with CFS, while progressing with restoration work. Conceptually, that unraveling was analogous to my research on the dynamics of ecotones in littoral zones, for example, studying buffer zones around site 32, detailed in Chapter four.

My intention with my schedules was to detail a process of sculpting ecosystem change over time and space: in the case of *Ghost Nets*, literally on the land; and in *Fish Story*, in a perception of the land. Considering sculpture as both literal and perceptual began for me in the late 1960's as an aspect of performance work (Rahmani 2007). My emphasis

was on collaborative relationships with colleagues and biogeography over extended periods, combined with endurance work, as a means to sharpen my own perceptions of increments.

5.3. Bricolage and Semiotics

Language, as Lakoff and Johnson detailed (1980), creates story and connection. During the performance of *Ghost Nets* I consistently and publically used the term ‘housekeeping’³⁰ to tag my signature. As Ukeles had framed the significance of maintenance work, and Kaprow had elevated the trivial, my intention was to valorize the daily routines that transformed a dumpsite and connected them to a global responsibility, as Mazeaud had done with the Rio Grande. Housekeeping differs from ‘stewardship’, as used by land managers, as one of those ‘...soft-edged words that sidestep both the promise of restoration and the many questions it raises’ (Jordan & Lubick 2011, 103). The semiotics of ‘housekeeping’ contrasts with the term ‘stakeholders’ as often referenced in adaptive management. ‘Stakeholders’ implies power and ownership while ‘housekeeping’ is closer to what Jordan and Lubick (2011) refer to as the subjective fourth dimension of restoration that serves nature.

In *Ghost Nets* and *Fish Story*, the CFS metaphor determined story structure by requiring me to identify minimal interventions: small, unspectacular tasks, each a possible trigger point of environmental triage. *Blue Rocks* was such a triage action that had on-the-ground consequences beyond the initial event.

Virtuality was another opportunity to extend transformative strategies. As ecofeminist Donna Haraway wrote of, ‘...lived social and bodily realities in which people are not afraid of their joint kinship with animals and machines...’ (Haraway 1991), I saw that kinship as a commitment to art life that could erase boundaries between artist, location and audience. The virtual world became the means, in *Fish Story*, to expand potential impacts with minimum expenditure of limited stamina.

The participation of agencies and the local community in the restoration that emerged from *Blue Rocks* was as successful an outcome for me as the actual restoration. Since I

³⁰ That tagline is, ‘What the world needs now is a good housekeeper’. (Self-published in artists book by the author 2008)

was deliberately avoiding attention to my role as an artist, the community stayed focused on the results rather than the source of the catalyst.

In a questionnaire distributed to local residents in 2013 requesting their recollections about my work on the *Ghost Nets* and *Blue Rocks* sites, most respondents stated that they were unaware of my role in the work, but two words were used in consistent juxtaposition to describe the ‘before’ and ‘after’ of the two sites: “mess” and “beautiful”. They described the *before* of the *Ghost Nets* site as ‘an awful, smelly mess’ and stressed the wildlife and regional value of the restored site *after*, as ‘beautiful’, for which they were ‘thankful’. One respondent wrote,

I visited the site yesterday and was really surprised to see that it’s all mown and many trees and bushes (that) have been planted. I sat on the rocks and took in the *beauty* that surrounds it. The Pleasant River Grange (*Blue Rocks*) is another *beautiful* place. What a difference ... and all those beautiful rocks exposed...
(italics mine)

The same questionnaire was distributed by email to people off-site who learned of the project from mailings, subsequent writings, exhibitions, or conferences. Many of these respondents identified themselves as part of the ecological art world, a demographic that clearly understood my premises. A typical email response was,

Your work is different from the other artists ... as well as from institutionalized restoration, in that you made a personal commitment to LIVE in the site that you are restoring. This personal connection to site breaks down scientific and artistic ‘comfort zones’ of subjectivity and objectivity as you become physically dependent on ... the work that you do there. It goes beyond restoration work to a state of complete embedded-ness in the surrounding environment and the complexity of repairing and maintaining something that has been degraded (Alex Toland, ecological artist, 2013 email in response to the questionnaire).

When Toland used the term ‘embedded’, she evoked two relevant semiotic references. First was Beuys’s advocacy of politicized process. Second, war and resistance, as when correspondents are ‘embedded’ in military maneuvers.

5.4. Metaphor, Narrative, and Endurance

Endurance art gained attention in the 1980s with the work of artists like Teh Ching Tsieh, who submitted themselves to physiologically challenging experiences over time as performance. More recently, performance artist Marina Abramovic founded an institute to study this kind of work (Abramovic 2013). Endurance art as a genre is associated with extreme physical events that require exertion, stress, and risk (Ward 2012).

The poetics of metaphor and story-telling often supported my endurance work in performing ecology, by focusing my attention, despite severe CFS symptoms. Metaphors, mantras, mnemonic artifacts and related conceptual structures evoked poetry and story-telling. I meditated on them over long periods of time in both my case studies as methodologies to sustain intense mental concentration during periods of collapse. The mantra ‘Stay, Wait, Look, Listen’ organized my time management in those periods when I collapsed from exertion.

I also employed metaphors to interact with my audience. Metaphors orchestrated my intentions and actions. The metaphors became nested within each other and functioned in relation to each other. Periods of collapse became part of a larger performative musical score. Days I was bedridden and incapable of thought, became rest intervals in that musical experience of performing ecology.

In addition to being idea models (Chapter one), metaphors often represent condensed social teaching narratives, as they did in my case studies. However, social critic Susan Sontag critiqued the language of illness as a false teaching that leads to victim-blaming (Sontag 1978). Martha Stoddard Holmes, critiquing Sontag, in turn wrote,

...metaphor has a prosthetic function, with all the nuances of prosthesis: it extends our sense of touch, getting us closer to those things we cannot palpate ourselves or see without technology... (Holmes 2011).

Holmes's description approximates how the CFS metaphor, combined with my healing experiences of acupuncture contributed insights to my evolving Trigger Point Theory as I worked on *Ghost Nets* and *Fish Story*. The chance event of getting CFS shortly after beginning *Ghost Nets* modified my expectations for embodiment options on the site. CFS introduced unpredictability while I was bedridden. During the times I was primarily bedridden, I averaged two to three functional hours a day, one third of which time was an endurance event of physical and mental distress despite symptoms. One hour was allocated to self-care and care of my animals. One hour was devoted to developing my long-term restoration strategy for the land, which often included making artifacts. One hour was allocated to walking the paths I was creating that defined microhabitats and ecotone relationships. During those walks, I looked for small changes indicating emergence and self-organisation. As the project unfolded, I could incrementally dedicate more time each day to each category of work, unpredictably interrupted by intervals of collapse.

During the intervals of collapse, I depended upon the house Robinson had designed to sustain my motivation. The small footprint on post beam construction, a precursor to the small house movement, allowed me to conserve stamina from place to place when I left my bed and at every turn, the view from my windows showed me the landscape I had committed to for ten years. The imposed relationship between time and urgency in my art life sensitized me to the musical elements of tempi in performance design for restoration. The tension of that conflict allowed me to think through how Trigger Point Theory might be applied elsewhere.

During *Fish Story*, I applied the same endurance strategy used in *Ghost Nets*, allocating more time than my stamina could sustain on a daily basis. By that time, I was able to allocate many more hours than in *Ghost Nets*, but those allocations were still subject to periodic collapse. In both case studies, I deliberately used time to stress my system with the intention of shattering my perceptual boundaries. My primary device invited disorder and permitted black swans of knowledge to emerge from irrational sources. Additionally, I recorded my dreams and practiced *lucid dreaming*, the process of entering sleep with the goal of engaging in dreamlife.

In many indigenous cultures, determinist behavior draws as much on the validation of irrational visions and dreams, as it may on observations of weather patterns or animal migration. In European thought, similar elemental directives to trigger and observe irrational thought took form in surrealism, employing free association and the role of the unconscious, influencing postmodernist thinkers.

In Chapter four, I introduced the idea that mapping is a scored metaphorical journey through a branching world, like Lakoff's conceptual correspondences, these may result in knowledge structures and directives for activism (Lakoff 2002, 2008, 2012). Now, I will introduce a dream metaphor that became, literally, a physical journey which emerged from lucid dreaming and will illustrate how performing ecology led to *Ghost Nets* before I contracted CFS.

Performing ecology: In November 1989, I was practicing lucid dreaming. I went to sleep one Friday night, unsure of my next work project. I awoke Saturday morning from a lucid dream directing me to go to Northern New England. Within an hour, I located a friend with a home on Vinalhaven Island, made the decision to move there, and a plan to go there. I stepped off the ferry onto the island the next day and moved there permanently three months later. The first week I took residence, I learned of ghostnets on a National Public Radio (NPR) broadcast and intuitively recognized it as the name of my next project (paraphrased from Rahmani 1989).

When Western science speaks of heuristics, it usually means data retrieved by conscious sensual experience, often resulting in the equivalent of tacit knowledge. In the story above, I included a data source that was unconscious (a dream) and applied it as a conscious methodology to initiate ten years of work. Whether or not previous years of studying maps and considering water degradation may have also informed that dream, the decision I made that Saturday morning guided me as surely as any falsifiable experiment I could have designed. In that hour after waking from my dream, I first committed myself to the *Ghost Nets* project as a whole-life experience. I regard my responses to that lucid dream and the radio segment as chance opportunities. They arose from an aesthetic point of view that shaped the formal parameters of my performance.

The appropriation of ghostnets as the founding and organizing metaphor for *Ghost Nets*, used naming to semiotically guide my audience's attention, as well as my own. My intention was to invite associations that might unravel environmental complexity (see Chapter one). I calculated and made public that literally 'unraveling' damage to the site would take ten years, based on how long previous meditative projects had taken to complete, determining the length of my commitment in advance.

Contemporary science doesn't easily lend itself to poetics, mystery, or personal hardship. However, complexity science and chaos theory recognize the uncertain power of the chance black swan. Physicist Richard Feynman wrote of the relationship between mystery and uncertainty, 'I believe that to solve any problem that has never been solved before, you have to leave the door to the unknown ajar' and again, '[A]ll of the things we say in science, all of the conclusions, are uncertain, because they are only conclusions' (Feynman 1988).

As performing ecology created a structure to reach inwards while acting in the world, I simultaneously reached outwards in conversations. The foundations for *Fish Story* were laid by assembling the *Gulf to Gulf* team in 2009 to address climate change. In 2012, in response to Tom McGlynn's invitation to participate in the 2013 group exhibition *Memphis Social*, the team agreed that Memphis should be targeted as a point of critical confluence between systems in serious ecological trouble. In 2012, we determined that fish might be indicator taxa for the bioregional health of the Mississippi Water Basin (MWB).

In contrast to the physical accessibility and relative manageability of the *Ghost Nets* site, the United States Environmental Protection Agency (EPA) describes the MWB as a

...meandering 2,350-mile journey south to the Gulf of Mexico, (where) the Mississippi River is joined by hundreds of tributaries, including the Ohio and Missouri Rivers. Water from part or all of 31 states drains into the Mississippi River and creates a drainage basin over 1,245,000 square miles in size (EPA 2015).

The data quoted above was both inspiring and daunting. Therefore, an additional predetermined number of hours over the course of one year were ‘spent’ in meeting with team members and key participants in regular *Gulf to Gulf* webcasts. Most of that time was devoted to studying and discussing the biogeographic and demographic data. We reviewed the theoretical framework for the activities that took place during ten days of work in May 2013. Much of the reflective time to develop *Fish Story* took place in these live webcast conversations. To conserve stamina, I allocated a greater time to contemplating the site than in activities requiring my physical there. Before arriving in Memphis, our research culminated in my production of a large drawing of tributaries to the Mississippi, based on Google maps and inspired by our conversations and designed for a room size installation at the Memphis College of Art, Memphis, TN.

My commitments to unraveling the complex relationships between fisheries and the human behavior I observed, including my own, were systematically addressed in my schedule journals, documenting my use of time.

5.5. Journals (Schedules) as Methodology

The schedules were an idea experiment designed to meditate on combining heuristic systems and observations. They narrowly focused my attention on incremental evidence, meanings, and efficiencies of each action that might perturb or reinforce resiliency in my restoration work. In *Ghost Nets*, after determining the project site, initial time duration (1990-2000), and title, I publicized my intention to restore the wetlands on the site over the following decade. My willingness to include a public practice in the performance process circumscribed by the limitations of CFS was only known to a small circle. I then decided which routines to instate as ritual assignments in the remaining time available each day after my one-hour walk and self-care. The results of those rituals were tracked as evidence of possible increments of transformative progress in my schedules (see Chapter two, Figure 26). Periodically, the design of the schedules was modified as categories were realigned, omitted, or added to, often reflecting how my stamina slowly increased. I also gained greater skill in targeting my stamina towards effecting my goals. That growing skill allowed me to clarify my thinking about how trigger points might work.

Cities and Oceans of If- Aviva Rahmani

Week Review Date: 12-29-14

Packages Out (name & date): Columbia
 Blast for New Year's, Dusk Dialog to Ray

Money Concerns and Solutions: pushing myself to get jobs I don't want
 I can sustain + keep my health

Personal Goals: make projects w/ knee, hip pain + less relapse
 Challenges: Cont. stress, pressure, anxiety

Solutions: pace myself, call go where I can
 Giving it over: Recovery

Earnings:

HALT: pain + exhaustion, despair

Acting Out behavior: COE, despair over practicing to Shelley

Sudden Impact: over-look, overwhelm

Assessing options & choices: take the rest I need

Emptiness: vague loneliness + feeling of isolation New Year's

PRIMARY ART GOAL: drawing

Support Art Goal: Dusk Dialog, Columbia, CFS, packages rat

Labor Intense Production Goals: writing, seeing art, showing art

Setbacks, Distractions & Obstacles: cont. CFS relapses, knee Dialog VA

Solutions & Epiphanies: intensive PT

Support Received Free: more serious engagement w/ Ray w/ Dusk

ACCOMPLISHMENTS: Blast for New Year's, Webcast to Flek

Focus: Dusk Dialog, Columbia

Gratitude:

LOVE/JOY/ABUNDANCE: connection w/ family + friends

Diss/ Acad progress: organizing my thoughts for Reviews, book + new writings, panels

Exercise:	Time	Type	Singing
M:	.5	Beats	.5
T:	.5	Walking	.5
W:	1.3	Beats	.5
Th:	.5	Walking	.5
F:	.5	Walking	.5
S:			
S:			
Subtotals:			
Average Total:			

IMAGE:



Lish Story Memphis macro Research

Weight:
 Where: When:

Measurements:

Upper Chest:

Bust:

Ribcage:

Waist:

Arm:

Abdomen:

Hips:

Thighs:

Knee:

Calf:

Lost:

Gained:

REWARDS:

Day	Calories	Events	Sleep
M:	2000	Collapse, cont., dinner	7
T:	2400	" Dusk Dialog, PT	7
W:	1800	Chiro, PT, VA Collapse	8
Th:	2300	Collapse - Columbia	8
F:	2100	PT, Chiro, Columbia, Dusk Dialog?	7
S:			6
S:			
Abstinence: Tot. Cal.:		Av. Cal.:	
Total Sleep:		Av. Sleep:	
Days collapsed:			



We're in midst of chaos.

Develop guidelines for

Emis. Trauma as trauma

care. (trauma management)

start w/ multi-system

approach extra trauma

medicine - Carleturnquet.

Keep water flowing -> keep blood in body Operational experience. - science times

Figure 65: 12-29-14 an example of a weekly "cover sheet" for a set of seven daily schedules, which created a "map" or "score" of each week's work and tracked progress (Rahmani 2014).

During *Ghost Nets*, I spoke frequently on the phone with performance colleagues about my strategic choices, comparing our respective value-based choices about art life which I experienced in the daily details of work on the site and breaking my professional

isolation. My most frequent correspondents were the feminist performance artist Barbara T. Smith and Allan Kaprow. The former was similarly interested in indigenous studies. We discussed broad metaphors from Native American culture, such as the role of the Four Winds, or the meaning of justice in myths and animal totems. I often reflected on these ideas while observing other species that came to use the site. It was during this same period that Kaprow's own health began to deteriorate. The insights that emerged from paralleling our physiological concerns became a subtext for me. These conversations served the same purpose artists often fulfill with studio visits. We did not specify endurance art but the conversations helped me conceptualize how endurance events could contribute to a process of meticulously sorting elements of chaos and provide a fourth wall for my thinking.

5.6. The Fourth Wall in *Ghost Nets*

Social practice can follow a proscribed pattern described in detail in the writings of art critic Claire Bishop and others (see Chapter three). Social practice spectacle assembles a large crowd for an interactive event, resulting in a personal and collective experience. Although my intention with *Ghost Nets* was to create a seamless outcome from an engagement with nature, where the artist's touch might be invisible, I wanted to present that process as an alternative to the conventional public art that critic Rosalyn Deutsche had discussed (Deutsche 1996), in which the art recapitulates community norms. Therefore, in *Ghost Nets* and later in *Fish Story*, I experimented with how to engage off-island people in reflections about habitat transformation. In *Ghost Nets*, an episodic, narrative script was disseminated as brief reports about my conceptual participation with the site, in periodic press releases over the life of the project. The press releases were sent to a mailing list of several thousand as mail art³¹ and contributed to a series of short, published articles.

An example in response to the first press release for *Ghost Nets* Jerry Tallmer concluded his 1990 essay on *Ghost Nets* for the *New York Post*,

³¹ Mail art, which grew out of the democratizing, often ironic Fluxus movement, intended to create an art form that was accessible and cheap. It flourished until the Internet supplanted the form.

The lives and dangers of the Maine fishermen—and of an ocean trapped in modern technology’s huge monofilament nets—will be among her chief concerns these next nine years. Who knows what she will catch in her own multifilaments? (Tallmer 1990).

Articles like Tallmer’s were my first bridge to an off-island audience. They announced my content as object and my journey to the island as metaphor. By definition however, none of these audience members could participate directly in my activities nor ‘see’ me in the work. Therefore, the project could only exist in people’s imaginations and anecdotal gossip: as an idea with no way for me to track responses or measure ‘audience’ interest. A rare exception was Lucy Lippard, who came to visit the site before referencing it in her 1997 book, quoting me from her visit.

...her *Ghost Nets* project [was] a continuation of earlier works concerning ‘the trap of familiar versus paradigms of interdependence’. ... she experiments in various ways with saltmarsh and forest restoration, forage for migratory birds and fish productivity, documenting her study of microclimates with a ‘ritualized diary’, and making seascapes that ‘take a familiar trivialized format and look at it in more depth ... *Ghost Nets*, ... [is] a series of collaborative, homely events ... that do not overemphasize my identity-difference as an artist’ (Lippard 1997).

Periodically, I reported on my work, in articles for the *Working Waterfront* newspaper of the Island Institute, with an approximate circulation of 60,000 including the Maine islands. In my articles, the goal was educating other islanders, particularly fishing families whose wharfage and shorelines might be appropriate for restoration rather than attention to the project as an art event. Typical article titles included, ‘A Pilgrim’s Progress, Experiences in Wetlands Restoration’ (1995), and ‘Restoring a Pocketmarsh’ (1998). It was only after the completion of the project in 2000, that I identified myself as an artist in an article titled, ‘Ghost Nets: Art Meets Ecological Restoration’ (Rahmani 2000).

I also took advantage of international environmental conferences to publically showcase my work by conserving stamina before I arrived and “paying” for the exertion with intervals of collapse afterwards. My first conferences were relatively local, e.g., at the Island Institute located in Rockland, Maine. I first presented *Ghost Nets* at the 1992 Natural Areas Conference at the University of Maine at Orono. Conferences have since become a major strategic venue for artists who don’t rely on objects as their primary output to create a following. They were an important vehicle for me to research and share my ideas about locations as trigger points while learning about restoration ecology science, particularly in marine zones, and have live interactions with audiences of hundreds or thousands. In those cases, I showed slides of the site while narrating my intentions and results. On occasion, I could expand the conference audience through thematically connected installations (Chapter four, Figure 50). During *Fish Story*, the virtual world allowed me to expand my outreach forms with social media, posting webcast recordings on Vimeo, blogging, and periodic e-blasts. These efforts engaged people in my methodology and enlisted participation from afar.

5.7. The Medicine Wheel Inspiration

The beliefs and rituals of indigenous peoples and TEK contributed to *Ghost Nets*. TEK inspired aspects of my ecosystem thinking and restoration design, including sculptural elements conceived as artifacts of my work to enhance biodiverse microhabitats.

The most influential TEK approaches were: (1. ‘giving back’ as an a priori condition for all relationships, particularly in relation to wildlife; and (2. ‘listening’ as a characteristic of modeling leadership, which I applied to observing local wildlife. Both principles referenced responsibility for an holistic and pragmatic environmental ethic. ‘Giving back,’ recognizes the need to routinely replenish resources. Listening requires understanding mutuality.

The Plains Indian Medicine Wheel, which I began studying in the 1970s in California, dominated my planning phase as a means to meditate on human relationships to local biogeography. My teachers had been Plains Indians who had conducted workshops, lectures, and ceremonials.

Many indigenous peoples reference “The Four Winds” as organizing metaphors to effect change. The Medicine Wheel also references the four compass points and ascribes attributes to the winds of each quadrant. Restoration of the uplands riparian zone and salt marsh, were planned in divisions of four geographical quadrants. My intention was to structure contemplative elements into the strategic plan (Rahmani 2010). Each quadrant was articulated by stroll gardens with distinct experiential goals (Illumination, Innocence, Introspection, and Wisdom), and means to observe microhabitat changes affected by climate coming from the four wind directions. I based symbolic elements of the layout, such as vegetation colors and wind pattern orientations, on inspiration from Native American versions of the Wheel. Yellow predominated in the East, green in the South, red in the West and white in the North.

As part of my site research I studied the Plains Indian Medicine Wheel and its connection to the beliefs and practices of the Iroquois (Northeastern) and Wabanaki (Maine) Tribes with resident healer, Ricki Soaring Dove. Dove is not Native American but had studied for many years with Plains Indian peoples and was connected to Northeastern medicine people. I was also able to meet and discuss ideas with members of the Wabanaki tribe I met on the mainland at basket weaving events.

At the beginning of *Ghost Nets*, I invited Grandfather ThunderCloud, a Cherokee Elder, to perform a Medicine Wheel ceremony on the site in August 1991, to symbolically heal the land. I invited public attendance with announcements and press releases.

Under Soaring Dove’s guidance, I designed a month-long retreat to prepare for the ceremony in a former sawmill building on the site. The building, which has since become my studio, was exposed to rain and wind between rotting wallboards. The location was a few feet from deep water, allowing me to feel ‘in’ the habitat. During that month, I gathered a number of 10–12” stones required for the ceremony, from every part of the island. During that period of rock retrieval and focus, my relationship to objects as materials and as artifacts of my practice changed to conform more closely to either the way Native Americans might interact with ceremonial objects for utilitarian purposes or than my previous experiences as an artist producing and framing objects for any kind of consumption, desire, or mnemonic (an assist to memory and meditation) purpose. That

stone gathering was complicated when, at the retreat's inception, I first collapsed with CFS but did not yet know how to assimilate my experience into my practice.

After the rocks were gathered, they were assembled for Grandfather ThunderCloud's visit. When he arrived, he individually chose and placed each stone in a circle for the Wheel, about thirty feet in diameter, with a flat stone in the centre for a small fire, to enact the ceremony. Normally, the fire would have been ignited directly on the soil. The fire rock was added as required by the local Fire Department. The island had been experiencing a drought, although, as Grandfather predicted it would, it rained heavily the day before his arrival. After the ceremony, the rocks were re-assembled as an indoor meditative installation in my studio.



Figure 66: Detail of the stones for the Medicine Wheel ceremony, showing the Fire Rock at the centre before it began (Rahmani 1991).



Figure 67: Detail of the Medicine Wheel rocks placed inside my studio (Rahmani 1995).

That initial experience with the ceremonial rocks determined my relationship to other boulders and rocks on the site. Boulders and rocks became my most critical means to physically organize the garden and sculpturally articulate its space, including a small meditation area in the Western quadrant. The Western quadrant was organized around a large ‘Grandfather’ boulder, surrounded by four smaller boulders at the four wind directions (see Figure 68). As I described in Chapter two, developing each quadrant of the garden was scored as one of three three-year long phases. During each phase I meditated daily on how my conventional scientific research on plant and animal communities might relate to relevant indigenous symbolic terminologies and philosophical constructs.

Towards the end of *Ghost Nets*, in 1999, I met Native American TEK activist Dennis Martinez (Tohono O’odham, Chicano), at a Society for Ecological Restoration (SER) International conference, where he had established the Indigenous Peoples Restoration Network. Martinez advocated blending TEK and Western science, particularly in fire regimens. He acted as an advisor to the US National Parks Service for Southwestern fire management techniques. Exposure to his ideas allowed me to deepen my own thinking about the Medicine Wheel as an aspect of TEK, how Trigger Point Theory might fit into

biogeographic management strategy and how my symbolic exercises could be integrated into a larger framework of international TEK practices and environmental restoration strategies. An example, was in how TEK open space management for functional habitat, edging, and ecotone variation for wildlife which I applied to the design of pathways and stroll gardens at the *Ghost Nets* site. As with the contemplative aspects of performing ecology, implementation of these metaphor-based scores for restoration required endurance. The results were monitored during daily walks, in my schedules, and with photography. That monitoring was different than a conventional scientific record of quadrant observations recorded at strictly chronological intervals. It included autobiographical details with observations about how succession evolved, design implementation, meditative foci, and how interactions between planted and endemic volunteer vegetation changed the site on the site.



Figure 68: This aerial shot of the meditation area around a ‘Grandfather rock’ (about 8’ diameter) also shows the paths established around the Western quadrant of the site (photo by Ben Magro 1997).

Over nine years, my most dramatic labor on the site entailed moving the large rocks dynamited by previous owners. When they were too large to embrace with my arms, backhoes (operated by others) were used. The rocks defined boundaries between microhabitats, reconstructed uplands riparian water tributaries, created steps, and defined the stroll gardens. In the final phase of *Ghost Nets*, sixteen truckloads of granite detritus, left over from the quarrying industry (dumped in the rocky intertidal marsh), were removed to daylight the estuary. After daylighting, boulders were placed at the base of the riparian zone, in front of the estuary, as a temporary wave attenuation barrier.



Figure 69: Wave attenuation barrier inserted in 1998 to slow the eroding effects of spring storms while the plantings took root. Granite detritus remains from the former quarrying industry can be seen in the upper half of the image, left at the site on purpose, to compare rates of plant colonization (Rahmani 1998).

Moving the rocks was ritualized and generated land art sculptural artifacts. The rock moving was periodically performed despite activating CFS symptoms of exercise intolerance. The result on those rock moving occasions was a routine cycle of labor and meditation: one day of endurance working and three days of bed rest.

Seasons punctuated my meditations, and, with the daily walking rituals, generated a hypnotic focus to my relationship with the site, abetted by the creation of mnemonic

artifacts. This experience of phased and punctuated time began to modulate my associations to rhythmic musical composition.

5.8. CFS and Acupuncture

As I have written, my relationship to the land and my body, because of CFS, required organizing time and stamina efficiently. Acupuncture and nucleation restoration are based on locating or creating energetic patterns, respectively of Ch'i or for refugia. Considering these ideas encouraged me to experiment with patterns of nucleation between soil (or sediment in the estuary), wind velocity, animals (including humans), and ecotones between fresh, brackish, and salt water.

In applying these correspondences to each phase of *Ghost Nets*, I focused on the three ecosystems at the site, detailed in Chapter two: riparian zone, watershed and estuary and organized my daily hour of activity on the site was around consecutively restoring each ecosystem.

5.8.1. Obstacles to Implementation

1. The *Trigger Point Garden* 1990–94: created the uplands riparian zone. My aim was to begin with linkages, such as water filtration and soil building. The greatest obstacle was the labor of soil-building because it required the most physical stamina and mental focus on how different microhabitat systems might be chemically related. The quadrants were marked by different exposures to wind, salt spray, inclines, and soil chemistry, and indicated with boulders.



Figure 70: A large boulder is lowered into the transition between the West and South garden quadrants to mark the riparian zone in the *Trigger Point Garden* phase of *Ghost Nets* (Rahmani 1991).

The garden elements needed friable, nutrient-rich soil and water conservation. It required building layers of grasses, forbs, shrub understory, and canopy trees. I understood how critical the soil was, so in addition to compost, I collected seaweed and dug it into the scant soil on site. Nitrogen-fixing bare-root saplings and plants were seeded between bare rocks and mulched with newspaper soaked in liquid applications of mycorrhizae. Each vegetative species was recorded for monitoring in a printed form, often including a sketch or photograph, alphabetically organized into four large notebooks.

The first season, saplings were planted and hand-watered, by carrying plastic jugs of water to each planting site from my well source. Planting *Four Hundred Trees* became a discreet event. Trees were planted during this phase to replace lumber used in the construction of my home, although the home itself was built on a ledge, so that no additional trees were cut down. As plants grew and died, fallen leaves and weeds were turned back into the soil to create green manure. My daily, systematic observations determined how rocks and boulders of varying sizes were positioned to provide a range of views and points for contemplation and monitoring.

2. *KindWind*, 1994–97: refining the elements of the watershed. My challenge was understanding how fractal increments in edges and ecotones might knit soil to conserve water. The meditative focus of this phase was environmental justice particularly in relation to global fresh water resources. Plantings for the fresh water watershed and natural buffer zones I established included, *Salix*, *Amelanchier*, *Pinus*, and *Quercus*, chosen to stabilize temperature and protect delicate forbs such as trillium. I addressed water conservation by my approach to the location and composition of windbreaks. I attempted to direct wind patterns, directions, and velocities to create and enhance refugia for birds and other animals within each microclimate on the exposed shoreline. This allowed me to observe ecotones in small patches. Those patches became opportunistic experiments in naturalistic texture, scale, color and seasonal effects as well as proskeniums to observe and interact with nature.

3. *Traffic Dance*, 1997–2000: effecting the estuarine daylighting. My challenge in the South quadrant was to visualize how the littoral zone community interacted with the marine zone and the uplands riparian zone. This required a meditative focus on interspecies relationships. The estuarine wetlands required daylighting to allow tidal flushing of soil and sediment. My aim was to link the fresh water watershed, the riparian zone, and the restored estuary, mixing fresh and salt water for habitat.

This phase focused on littoral zone biodiversity. My approach aimed to maximize habitat and forage systems serving the wide range of animals dependent on salt marsh habitat. The beginning of this phase was marked by three days of conventional daylighting and planting in March of 1997. It began with backhoe excavation under the supervision of bioengineer Wendi Goldsmith. Goldsmith calibrated the final levels for the

site by comparing it to a local control site, (which I have documented in various ways during the life of the project). When the fresh water first passed to the salt water in the littoral zone, it passed through a line of granite that marked the highest known storm surge line, noted in 1994.



Figure 71: *Connecting the Dots*. Fresh water can be seen meeting salt water across the storm surge line for the first time in one hundred years at the *Ghost Nets* site (Rahmani 1997).

Coir rolls were employed for wave attenuation and as a planting medium for bare-root salt marsh grasses: *Spartina alterniflora* and *S. patens* were staked in place. Other native seedlings and shrubs were planted, with a small crew of helpers, in the soil which had been bared after daylighting. In 2000, funding the Nancy H. Gray Foundation for Art in the Environment supported Dr. Dionne to monitor the success of the work.

Each phase addressed supporting ecotones in communities for a more natural hydrology geomorphically by:

1. trying to arrest erosion and redirect the path of spring run-off water with shallow, hand-dug ditches and positioning rocks and boulders to control stream flow (each

day during the trigger point phase of *Ghost Nets* rocks were moved or ditches dug);

2. observing, documenting, and memorizing volunteer species behavior, relationships between patches and larger mosaic matrices (which I studied by continually referencing regional maps), and how they appeared to support corridors used by migratory animals.

These systemic aspects of performing ecology on site became increasingly transdisciplinary and were documented in a variety of art media forms. Because I came to these tasks as an artist rather than a scientist, the rock installations were created with functional intent but spatial aesthetics. In addition to the ways stones and boulders were used in the garden, during the excavation process I marked the highest known surge level with a line of flat granite chips (Figure 71). It was a year later, when coir rolls intended to anchor salt marsh plants proved inadequate to the intensity of spring wave dynamics, that I placed seventy large boulders in a wave attenuation barrier with a backhoe where I had observed the most storm impact (Figure 69). These rituals and ecosystem experiments created ‘prosceniums’ for habitat. I perceived the interaction between human and animal traffic as a choreographed ‘dance.’

5.8.2. Embodiment

On site, I embodied my understanding by physically engaging with the habitat. Embodiment in art and how it manifests in ecological art is part of a philosophical trend going back to the last century with John Dewey’s work, as described in Chapter three. Experiencing the site as a dance proscenium was an all-weather heuristic practice, modulated by applying techniques from ballet, *Pilates* work, and music, to discover additional tacit knowledge.

Ballet evolved in the sixteenth century concurrently with fencing, as an aspect of the art of war. Ballet attacks space with the thrusting movements and evasions of swordplay. The movements I applied from working with Joseph Pilates (from 1962 until his death in 1967), were exercises in experiencing my body as an animal might: attentive to small movements, fluid transitions, and the sounds around me. Pilates devoted his attention to

teaching physical awareness of and responsiveness to the environment. He did this by designing spatially precise movement routines based on careful observations of animal movement. Pilates originally developed his system of physiotherapy to unlearn the how modern life distorts the animal health of human physiology. Pilates work is more fluid than ballet because it relies more deeply on full-body and breath engagement in response to object positions. Ballet and Pilates informed how I walked the stroll gardens as a choreographed spatial experience, attentive to my environment. That information allowed me to sustain consistent rhythms in transitions between habitats and ecotones, providing structural integrity for each daily walk.

5.8.3. Walking and Singing

Walking the *Ghost Nets* site meant traveling the garden stroll paths in all seasons with heightened sensitivity to my own movements. I followed a prescribed pattern (see Figure 73), while paying attention to details of the soundscape, microhabitat changes, and how my body adjusted to the rise and fall of the terrain, practicing steady breathing to inhale the variations of smell, particularly as the garden matured, sometimes stopping to sketch what I saw (Figure 72). In each quadrant, I focused my attention on the animals associated with that quadrant in the traditional Medicine Wheel, for example, eagles in the east, whose soaring I could clearly watch as I walked.

Often, my walks included vocalizing, drawing on bel canto as I traversed the paths. In 1999, towards the end of *Ghost Nets*, I was invited to sing with the local church choir. In addition to introducing me to another part of the local community, singing changed my local engagement by giving me a different point of access to traditional island fishing families and their knowledge. My singing commitment led to bel canto lessons with coloratura Debra Vanderlinde, formerly with the New York City Opera. I have continued my training during this research and have used bel canto in trigger point workshops, including one that was part of *Fish Story*. On site, vocalizing with the ambient sound was a methodology to maximize and sensitize my heuristic experience of the ‘initial conditions’ of space, community, and complexity. The vocalization exercises used breath control and were informed by my acoustic perception of the littoral zone. They extended what my movement training had taught me about observing a site.



Figure 72: Strolling and drawing in the East (Illumination) quadrant of the *Trigger Point Garden* (photo by Daisy Morton 2008).



Figure 73: A map showing the trajectory of meditative walks in the *Trigger Point Garden* indicated with a red line, starting and ending in the east. Initial tree and understory plantings in each quadrant are indicated as numbered groups. The blue circle indicates my projected local nuclear trigger point restoration impact (Rahmani 1993).

As I walked, sang, observed, and listened, I contemplated how my body contained model templates, as in the physiology of bel canto singing (described in Chapter four). I found that, as with GISc, when I layered complex experiences then recorded them in my schedules, I differently contextualized what I 'saw'. Later, studying the same journaling, patterns of relationships emerged that I might otherwise have missed. The clearest pattern that emerged from these complex considerations involved time and contributed towards organizing my experiments with time into symphonic structures.

The walks often allowed me to observe unusual details in edges or ecotones, for example, instances of nurse relationships between species, as when birch and spruce grew close to each other.

5.8.4. Artifacts as Mnemonics

During *Ghost Nets* and *Fish Story*, in addition to the schedules and major gallery installations, I produced traditional visual objects, including video and two-dimensional images as artifacts of attention research. Those artifacts activated the intention of the tache as a mnemonic device to further meditate on each site. These applications are what artist Roy Ascott has called, 'objects of art as trigger points for experience'.

After completing excavation for *Ghost Nets*, a series of prints and paintings were created to study the control marsh used as reference in the post-bioengineering monitoring phase. These were small works, intended to reflect the irony of representing the 'beauty' of a naturalistic environment that, as discussed in Chapter four, is under profound threat by using a scale that would reiterate the control humans have. They literally placed the view in the viewer's hands.



Figure 74: *A Beautiful View #4*. Fourth in a series of nine sugar lift aquatint prints, 4" x 5" (Rahmani 2010).

In the period before *Fish Story*, the *Oil & Water* (2010–13) series was produced, as a reaction to the British Petroleum (BP) Macondo spill, in order to consider problems in the Gulf of Mexico. After the spill, I used our *Gulf to Gulf* webcast time to strategize ways to connect our concerns about Gulf (littoral) zones, the impact of extractive industries, and climate change. The conversations were made publically available and downloaded from over eighty-four countries, with minimal active outreach or editing. Focusing on and contemplating images produced during the webcasts, drew my attention back to the problem of fish habitat that had motivated *Ghost Nets*. Continuing concern for fish guided my thinking to produce *Fish Story* when the opportunity presented itself. The title referenced how ‘fish stories’ often infer a big lie (exaggerating the size of a fish caught or almost caught). The lie, in the case of *Fish Story*, was that the Mississippi River is still a viable habitat for healthy fish, which is comparable to the illusion recorded in the series, *A Beautiful View*, that all is well in the environment.



Figure 75: *Oil & Water #11*. Eleventh in a series of fifteen images about the relationships between fossil fuel extraction, water pollution and corporate profits (Rahmani 2011).

Drawings and paintings for *Fish Story*, of the Mississippi River and its tributaries were created in New York City, based on Google Earth photos, and then shipped to Memphis for installation. The preparation required cutting out many silhouettes of individual fish to be fixed to the “river”. The cut-outs evoked the relational properties of each species as predator or prey and of their habitat preferences, connoting a sense of personality (see Figure 77) to each one. Cutting each silhouette required me to ‘feel’ the adaptive functions of each animal’s physiological characteristics, as my hands cut the shapes, such

as how bluegill (*Lepomis macrochirus*) linger in dappled shade of littoral vegetation and are prey to largemouth bass (*Micropterus salmoides*). That cutting experience allowed me to imagine each species' interactions in their communities and made my tache into a trigger for my perception, even as I produced it.

Painting in details of the Mississippi River and its tributaries required brushing liquid silver paint over a large expanse (2.64 m x 11 m) of relatively absorbent black paper to create representations at a scale beyond my physical reach, allowing me to experience (embody) the uncontrollable vagaries of water flow over the biogeographic terrain as I studied Google aerial map details. The work was completed by crawling carefully over the surface of the painting as it was rolled out on the floor of a very constrained apartment in Manhattan. Those body constraints, a contrast with the physical expansiveness of walking the *Ghost Nets* site forced me to work on eight sequential segments at a time over a period of several days without seeing the other segments until the work was installed in Memphis. As each segment dried, my cat had to be shooed away from the wet brushwork, as I might have tried to eliminate invasive species from the habitat. The experience recapitulated how the waters of the Mississippi are constrained by fragmentation, built infrastructure, and invasive species. It gave me a sense of what fish need to negotiate habitat obstacles. It holistically merged embodiment with data research and I experienced it as much as a performance as a painting practice.

Without the distraction of portraying literal built infrastructure, the act of painting the tache of water flow under the circumstances described above also allowed me to understand potential flooding patterns differently than studying GIS or printed maps alone. Tracing the paths of water while crawling along the painting surface was comparable to ritualistically walking the *Ghost Nets* site on a daily basis for ten years, or of canoeing the Wolf River to the Mississippi River to better understand the Mississippi Water Basin habitat because it physicalized the perception of space with my whole body

The artifacts emerging from both case studies were explorations of mediated interactivity with site. I experienced producing the final images differently than generating commodities, and they looked different than participatory mapping, which does not try to follow literal physical terrain as either walking or painting would. In Memphis, the installation of the completed river painting required help from several other

artists who were participating in *Memphis Social*, thus becoming a participatory performing ecology event in itself: an opportunity to educate people about global warming and fish while I explained my process.



Figure 76: The *Memphis Commercial Appeal* featured this shot of the *Fish Story* installation in an article by Fredric Knoppel about the *Memphis Social* exhibition (photo by Katie Maish 2013).

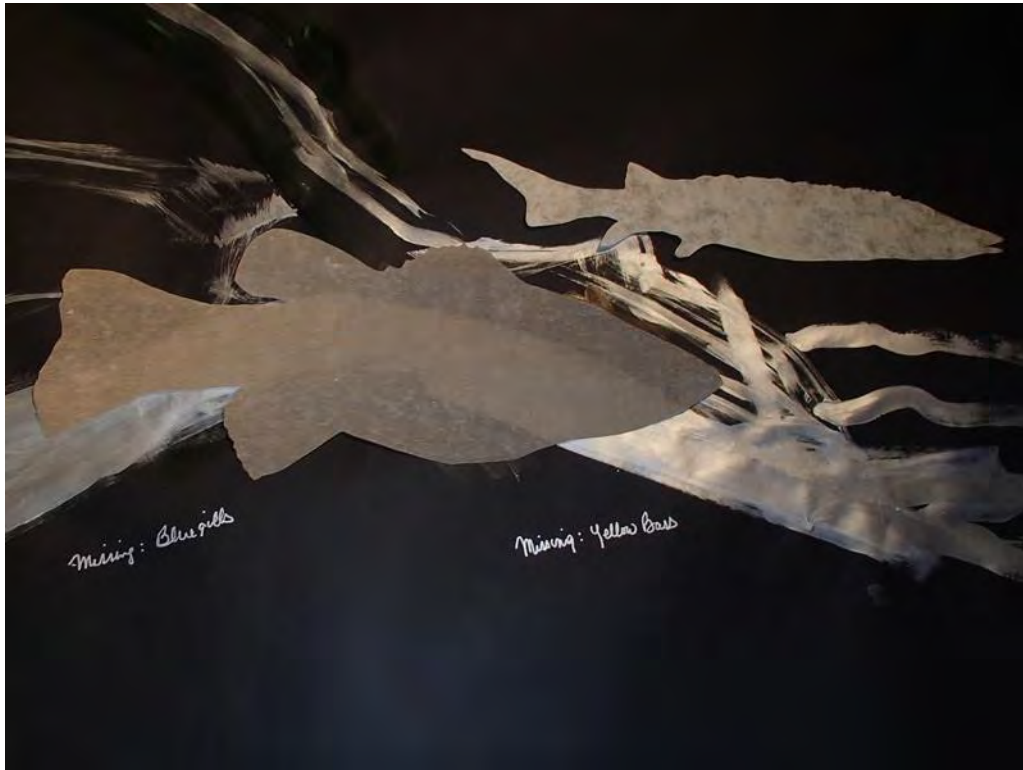


Figure 77: Installation detail from *Fish Story* 2.64 m x 11 m painting of the local river systems, with cutouts of endemic fish (Rahmani 2013).

Four events were designed for *Fish Story* in Memphis: (1. a canoe trip of the Wolf River (a tributary of the Mississippi), with *Gulf to Gulf* team member, Dr. Eugene Turner; (2. a workshop with local environmentalists; (3. an installation (which included the river painting); and (4. a webcast that compared environmental degradation and restoration efforts worldwide. These of the events were documented and composed into a short video edited by Edward Valibus (see appendix).

Almost 20,000 hits were recorded for the blog posts leading-up to events in Memphis. My goal was to build on and offer our audience different approaches to consider regional water concerns and invite participation with Dr. Turner and myself for the workshop, installation exhibition, and webcast. This was done using email blasts announcing where and when each event would take place. The options were intended to allow participants to enter or exit the project from several locations, platforms, and events. The *Fish Story* events were designed to crowd source asking, how will fish survive the Anthropocene, and then implicitly, how might humans survive?

The sequence of events that contextualized the production of *Fish Story*, starting in 2012 and including the pacing for the workshop, were conceived symphonically. The opening ‘allegro’ movement was my period of training and map production. The ‘adagio’, though brief, was the canoe event. The ‘scherzo’ was the installation. The final ‘allegro’ was the installation and webcast. By organizing my activities in this way, I was able to pace myself to compensate for CFS symptoms, and integrate that personal experience with my public activities into something aesthetically coherent.

The most important artifact that emerged from *Fish Story* was a calculation Dr. White and I completed the night before the opening of *Memphis Social*. In a printed handout available in the installation, we announced that an adequate response to carbon emissions causing global warming would be to re-green the earth by 36 percent by 2030.³²

5.9. Virtually Connecting the Dots

Fish, as an indicator of littoral zone health, thematically linked *Ghost Nets* to *Fish Story* as a reflection of water problems. I will now describe two black swan events in my theoretical and methodological transitions between the two case studies.

The first event was Hurricane Katrina in 2005. In response, I made the commitment to focus on global warming. At the time, I was attending a Society for Ecological Restoration (SER) International conference in Zaragoza, Spain, and Katrina was a black swan. Shortly afterwards, I made the decision to stop flying and find alternate ways to work internationally.

My decision to stop flying was made during a 2006 workshop (precursor to the trigger point workshops) I conducted at Woods Hole Oceanographic Center, in Wood Hole, MA. I asked participants to map, on a blackboard, the trajectory each of them took to fly to the event. The resulting spider web that emerged of lead emissions spewed over oceans and rivers from aviation fuel, to me, was a black swan awakening about the consequences of air travel. My subsequent goal was to use virtual means to reduce emissions while connecting trigger point sites bioregionally, to use the virtual discursive model like a low-cost think tank.

³²That correlation was developed between White and myself for *Fish Story*, May 2013.

I then began the virtual collaborations that led to *Gulf to Gulf* and did not fly again until I began my residency requirements to complete this research.

The virtual conversations of *Gulf to Gulf* drew on forms Nicolas Bourriaud identified as *relational aesthetics*, an approach to artmaking that relies on a range of discursive practices as an extension of practice (Bourriaud 2002).

The second event, in 2006, took place during a six-week 'virtual residency' project when I initiated a series of podcasts using TalkShoe, a system that allowed for live chat during podcasting. I conceived the project in order to research impacts of global warming and water problems simultaneously, in Geumgang, Korea (for the Geumgang Biennale); Pescia, Italy; and New Delhi, India (with Ravi Agarwal and Khoj International). The residency included making individual relationships with people and suggesting ecoventions (see Chapter three) in emails, podcasts, and blog posts. It was followed up with a series of approximately one hundred podcasts, which at their peak were downloaded in 3,000 hits per week. These virtual collaborations became strategic models for later screen sharing events. *Trigger Points / Tipping Points* debuted in 2007, as the first webcast project I did with Dr. James White. Our project considered how deltaic regions were being impacted by global warming and how those impacts on water supplies coincided with regional human conflict zones. We studied the Nile in relation to the Sudan, the Ganges in relation to Bangladesh, and the Mississippi in relation to the Gulf of Mexico. This created an initial knowledge base for *Fish Story*. My formal interest was in using the webcasts like acupuncture, to give attention to large, critical geographic sites using small but intense foci of attention. The black swan experience in *Trigger Points / Tipping Points* was the data that emerged about the extent of imminent environmental and social damage that would come from climate change. It also demonstrated the potential power of the virtual world to address that damage. The format evolved into the *Gulf to Gulf* series, and helped create the basis for *Fish Story*.

Dr. White and I expanded that discursive model in *Gulf to Gulf* (2009–present), to include Dr. Dionne, Dr. R. Eugene Turner, and other invited guests to study the impacts of global warming on gulf systems internationally. The goal of *Gulf to Gulf* is to leverage virtual space while answering complex questions. The webcasts are a collaborative tool to reduce flying time and identify new trigger points for restoration.

The Gulf of Mexico is known as a site of spreading dead zones—marine areas impacted by eutrophication—loss of oxygen induced by chemical fertilizers—and a focus of Turner’s research. There is a loop of impact between extracting fossil fuel from the Gulf of Mexico and using derivatives from that oil to fertilize factory farms upriver that then pollute the river system and create dead zones. When I asked Turner where a trigger point might be to restore overall health to those ecosystems, he replied, ‘Iowa’ because it is the greatest source of nitrates from factory farms which then travel down the Mississippi to the Gulf. His reply determined our focus in *Fish Story*. In the next section I will describe how the *Gulf to Gulf* webcasts activated *Fish Story* as another way to apply performing ecology

5.10. Applying Performing Ecology to *Fish Story*

Memphis Social was a citywide group exhibition of works about social context (Koeppel 2013). I used the *Gulf to Gulf* webcasts to maximize the impacts of my limited stamina while creating the events.

During *Gulf to Gulf* webcasts the year prior to *Memphis Social*, the team I had assembled and I identified several reasons why Memphis could be the centre of the world, symbolically and continentally³³ (Brown 2011). In one-hour monthly or, bi-monthly webcast conversations we found, made, and discussed maps and schematic drawings of the Mississippi Water Basin. Those maps were layered with anecdotal data.

The *Gulf to Gulf* team agreed that fish upstream of the Gulf of Mexico would serve as indicator species for dead zones downstream. Endemic fish are impacted by habitat degradation along the entire Mississippi River and its tributaries. I hoped that following the fortunes of fish along the lesser riparian zones, where habitat had been degraded in various ways, might help us locate at least one restoration trigger point (Hilty & Merenlender 2000, 185–197) that could effect larger changes (Rahmani 2012, 1–9). Fish were chosen because, for many people, the life of a fish is as invisible as the source of

³³ Clayton Brown wrote that the phrase “Memphis is the centre of the world!” refers to a time when cotton dominated economic life. The statement, made in 1959 by Gerald Dearing, a columnist for the *Memphis Commercial Appeal*, expressed how the city on the Mississippi River served as the throne room of the cotton kingdom. ‘No city depended more on the white gold that flowed into its warehouses and onto its wharves, and no city embraced cotton as did Memphis’ (Brown 2011).

their tap water. Some fish, like *Micropterus dolomieu* in river systems (Hilty & Merenlender 2000), are also indicator taxa for aquatic environmental disruption. When it was decided that fish were the way into the larger issues we wanted to address, I elected to call the project *Fish Story*. It launched in October 2012 by inviting people to share personal fish stories as an outreach strategy for my *Pushing Rocks* blog (<http://pushingrocks.blogspot.com/>).

On my blog, I wrote about other topics that the fate of fish seemed to parallel, linking human homelessness and dying fish. I thought both reflected symptoms of dominance hierarchies in systems. In this, I was continuing my practice from *Ghost Nets*, layering sources of information to observe new possible relationships. In private emails and the team webcasts, I planned events in Memphis to be sequential movements corresponding to symphonic rhythmic structure. Like *Ghost Nets*, the sequences were embedded in my life and took place over predetermined envelopes of time. Unlike *Ghost Nets*, the greater part of my embodied time was spent training in preparation for canoeing the Wolf River, a tributary of the Mississippi River.

After the year of virtual and artifactual preparation, *Fish Story* began May 4th, 2013 with the canoe trip down the Wolf River. I had trained three times a week at one hour each for several months in New York City as preparation for the experience, despite continuing symptoms of exercise intolerance from CFS. I regarded that preparation as an endurance event, reiterating the kind of exertions I think adaptation to the Anthropocene would require of us all, and blogged about that experience.

We started our canoe trip accompanied by six river guides from the Wolf River Conservancy, who were charting that section of river for the first time. The Ghost River is an ecosystem replete with poisonous snakes and beautiful bottomlands that is struggling to recover from clear-cutting, the invasive privet, and a past history of industrial pollution. It is called the Ghost River because the impenetrable swamp has claimed lives lost in its wilderness. The Wolf River runs through a series of contrasting city demographics to where the tributary was diverted to create a peninsular enclave and boatyard by the Army Corps of Engineers, at the point where it should reach the Mississippi.

Our general goal in *Fish Story* was to find new knowledge about resiliency for riparian zones, watersheds, animals, and people in the Memphis region. We conjectured that the local river tributaries would be where we might find a trigger point. Memphis has an invasive exotic genus from the olive family called privet (*Ligustrum vulgare*, *L. sinense* Lour. and *L. japonicum* Thunb.) which is impacting the littoral zone there, much like *C. maenas* is impacting the Gulf of Maine. Privet is a ‘keystone controller’ (Hunter, Gibbs 2006): a species that prevents the re-establishment of a biodiverse endemic ecosystem. Privet out-competes the endemic dense canopy trees, including oak, yellow poplar, sweet gum, sycamore, and cypress that would shade riparian water, promoting the abundance of fish and the animals that depend on them. It functions just as *C. maenas* does in the Gulf of Mexico, out-competing finfish for habitat resources. When Turner and I canoed the Wolf River, the impact of privet was evident in the loss of tree canopies that should have shaded the river banks and afforded fish habitat. In addition, the connection between the Wolf River and the Mississippi that might have afforded additional habitat was eliminated to create a peninsular enclave and boatyard.

During the expedition, I photographed the terrain and directed Turner in shooting various details while listening for the local sound, which was disconcertingly minimal, probably reflecting the loss of canopy and previous ecosystem damage. I then edited and posted the photographs with other documentation on my blog or Facebook page to continue expanding our audience.



Figure 78: Photograph taken during canoe trip down the Wolf River, Memphis TN (Rahmani, Turner2013).

At one time, the river had been described as teeming with wildlife, including many species of fish, with clear water and a gleaming white sand bottom. As with many waterways, past industrial pollution blackened those white sands, and the restoration effort still needs a great deal of work to re-establish biodiversity.

As would emerge from the GIS maps in Chapter four, it became clear to me that focusing on an individual nucleation trigger point outside a globalized biogeographical context could be futile if larger patterns of behavior had not been shifted. Therefore, the live public webcast conversation event in Memphis was intended to connect residents to events and locations globally. ‘Connecting the River Dots’ was webcast from the

Memphis College of Art and featured ecological art practitioners. The presenters were: curator Yvonne Senouf of M.E.L.D. (<http://blog.meld.cc>), speaking about endangered river systems (and in particular one that had been paved over) in Athens, Greece; artist Eve Andree Laramée (<http://evelaramee.com>), addressing radioactive hazards worldwide but focused on New Mexico and the Four Corners region; and artist Ruth Hardinger (<http://www.ruthhardinger.com/>), presenting the impacts of hydraulic fracturing ('fracking') on watersheds, and a map focusing on possible methane leaks in New York City. *Fish Story* team member Dr. Eugene Turner and I discussed wetlands impacts and restoration (recording available online: <https://vimeo.com/67578327>). The webcast discussions drew analogies between impacts on riparian and watershed systems globally, on human disregard for the consequences, and on the implications of massive environmental impacts from nuclear waste, fracking, and built infrastructure. Connections between the presented locations were noted. The discussion referenced the impacts of routine hierarchal dominance patterns affecting other species and peoples, such as the indigenous peoples of the Southwest, because of speciesism and racism. Making these intellectual connections both specific and virtual were important but different layers of embodied knowledge. Next I will describe how, performing ecology, led to a conceptual framework for workshops, another methodology to identify trigger points with embodiment and describe how that framework was applied in *Fish Story*.

5.11. Symphonic Solutions

Table 5-1 compares the performance of both case studies to a (layered) CAM with independent variables. The table maps idea models for redundant, complex restoration engineering. In considering how a healthy littoral infrastructure could function if restored from degradation, I drew on musical systems that recapitulated complex rhythms and circulations of air and water in seasons and tides.

Time and scoring is the simplest organisation of sound waves into music (Varèse 1966, 11–19). In trying to make spatial sense of the schedules from the three phases of *Ghost Nets* and my walking and singing practice, I had applied a mantra as a conceptual score, one I had designed in 1970 for long-duration (several years) performance events. 'Stay, Wait, Look, Listen' was a four-part symphonic conceptual structure to pace my focus and

attention. This exercise organized time-based activities. It was performed as a spatially located event (in space time) while balancing action and contemplation. ‘Stay, Wait, Look, Listen’ was a mnemonic mantra that emerged as a design for resilient solutions to the human time paradox of change and adaptive pressure. Observing spatial time this way, conflated Kahnman’s fast/ slow thinking models and applied classical symphonic form to (slow) planning and short bursts of (fast) action, such as I had experienced with *Ghost Nets*. Those fast and slow rhythms of perception referenced different kinds of concentration.

This structure applied classical Western symphonic systems to giving attention to a site. The inclusion of ambient sound was presumed. As in classical notation, tempo was an interpretive device. The first (‘Stay’) and last (‘Listen’) movements are in a tempo described as ‘allegro’ (happy and fast), and the middle movements (‘Wait’ and ‘Look’) are respectively in a tempo described as ‘adagio’ (gracefully slow), ‘moderato’ (moderate tempo), or ‘scherzo’ (fast, playful, and dance-like), with the final ‘andante’ (deliberate, but not as slow as ‘adagio’) as a recapitulation of themes. That sequence, organized around a call-and-response structure, expressed the emotional cycles I experienced. The distinctions framed periods of meditation and action with conceptual play: a semiotic mantra to sustain tempi over long periods. In both case studies, this model recapitulated cycles of labor and meditation from *Ghost Nets* imposed by CFS. Self-imposed deadlines sustained the symphonic structure. During the fast concentration movements in *Ghost Nets* and *Fish Story* I mentally assembled the equivalent of many attribute tables of data, layered and calculated relationships between that data, and quickly arrived at playful decisions to shape the next, dialogic phase of performance.

In the course of my research, I expanded this symphonic trope. In applying my mantra, the first two words (‘stay’ and ‘wait’) refer to time relationships. In *Ghost Nets*, the allegro and scherzo phases applied to how information was assessed and accessed. The playful (scherzo) aspect of interaction with scientists at conferences emerged as critical to effective collaboration in both case studies and contributed to the design of the Anthropocene Game in workshops, described later in this text.

Symphonic structure; tempi	Conceptual structure	<i>Ghost Nets</i> phases	<i>Fish Story</i> phases	<i>Ghost Nets</i> Climax event	<i>Fish Story</i> Climax event
<i>Allegro</i> Fast, happy	<i>Stay</i> Commitment to place, data gathering	Naming the project for the lost drift nets; Decision to buy the town dump and live there	Decision to apply Trigger Point Theory to Mississippi Water Basin in 2009	Discovering and retrieving drift nets at the new town dump.	Calculating how much greening would be required to offset climate change in April 2013
<i>Adagio</i> Slow, measured, languid	<i>Wait</i> Meditative; artifactual production	<i>Trigger Point Garden</i> , 1990–1994	Training for Memphis 2012–2013	Medicine Wheel ceremony	Canoeing the Wolf River 4 May 2013
<i>Scherzo</i> Fast, Playful	<i>Look</i> Observational	<i>KindWind</i> 1994–1997	Week in Memphis as part of <i>Memphis Social</i> May 2013	1994: Initiated collaborations with scientists; 1997: Daylighting the salt marsh	<i>The Anthropocene Game</i> 7 May 2013
<i>Allegro</i> Fast, happy	<i>Listen</i> Interactive; Transformative	<i>Traffic Dance</i> 1997–2000	Decision to advance restoration work, 2013	Building wave attenuation barrier, 1998	Installation and webcast 6–10 May 2013

Table 5-1: In this chart, correspondences between the symphonic structure, ‘actions’ in each phase of *Ghost Nets*, and *Fish Story*, time, experience, and climax events are indicated and correlated both vertically and horizontally (Rahmani 2013).

5.12. The Trigger Point Workshops

In 2009, when research began for this writing, I was experimenting with applying what I had learned about virtual collaborations to creating embodied workshops. The trigger point workshops evolved, like the ecodialog collective and *Gulf to Gulf*, as a means to collaboratively address serious environmental problems with performative ecological art. My intention was to collaboratively discover new methodologies for identifying trigger points for climate change.

The first trigger point workshop was held with climate change activists at the Survival Academy in Copenhagen, while I attended the United Nations Intergovernmental Panel on Climate Change (IPCC) Conference as an observer and participant as an official Affiliate with the University of Colorado at Boulder. The workshop event took place over several days, allowing participants to consider a variety of strategic approaches based on trigger-point premises, in the midst of the political chaos. Our focus stayed on locating

protest activities to activate the most effective response to climate change. The workshop generated a number of schematic maps to effect trigger points for future planning.

While conducting the workshop, I was simultaneously scheduled to participate in a press conference at the Bella Center where the IPCC was being conducted, about the work I had begun in 2007 with Dr. White. However, the press conference was cancelled when government responses to activist demonstrators became violent. As a result, the Bella Center was barred to official observers on the day I was scheduled to present. I blogged these events to extend my outreach (High Tide COP15 Project).

Almost immediately after the conference parties departed, conservative corporate interests began campaigns of disinformation in the United States, and the movement to address climate change collapsed under the weight of well-financed confusion. Two lessons from that experience energized my trigger point workshops and the *Gulf to Gulf* webcasts. The first, was to turn my attention to citizen empowerment with tools such as I hoped the trigger point workshops might foster. The second, much discussed in the media since, was that social networking can be self-organising and powerful. *Fish Story* attempted to explore both lessons while building on what I was learning from doing workshops.

In workshop events after COP15, groups of various sizes were instructed to individually take on the personae of agents causing environmental conflict in their local regions and follow the strategic logic that emerged from embodiment. Examples of agents included poverty, a watershed, money, ‘frackers’, and human communities, depending on where they were sited.

The second trigger point workshop at the Electronic Music Foundation in New York City, in 2010, focused on hydraulic fracturing. In that workshop, designated agents included, the watershed, the community, frackers, and mountaintop removal. The event took place as regional grass roots opposition was just beginning to mobilize, at a time when resistance seemed futile. The Josh Fox film *Gasland* (2010) had just been released. In the ensuing workshop discussion, the theme that emerged was, ‘there are more of us than there are of them’, framing the idea that in effect, each person might be a ‘trigger point’ for ecosystem health. Furthermore, when individuals collaborate, fracking might be resisted. Several more trigger point workshops followed, performed in Great Britain,

Santa Fe, and again in New York City. They included experiments with length, time of day, numbers of participants, sequence of ideas introduced, and experiences such as listening to a cappella singing. I learned that when workshops were relatively brief or engaged large numbers of people, they were much more difficult to focus and substantive, useful insights into real problems were more difficult to achieve. Smaller groups with longer durations (permitting the cycle of labor and meditation) focused on specific, localized problems were most useful to participants and instructive to myself.

In 2011 a small workshop performed in Monte Verita, Switzerland, for a conference on ecological novelty, was one of two workshops performed with participants self-identified as primarily scientists. The second was in 2014 at the Association of Environmental Studies and Sciences. In both cases, the experience culminated with artmaking representing agents in complex systems. Of the Monte Verita workshop, in response to a questionnaire asking what participants felt their drawings represented about an agent's role in an ecosystem and how novelty changed that role, one participant wrote:

I tried to capture a sense of harmony in disharmony, or vice versa, represented by the symmetry of the arcs in my drawing but the asymmetry of the colour filling the polygons created by the intersecting arcs. ...In the drawing, the individual arcs represent distinct organisms or components of an ecosystem, which have an independent existence (but share a common source at the base of the drawing). As the arcs rise, they cross, generating a complexity of interactions. However, the individual components are not lost within these interactions, and resume their independent identity as they diverge within the centre of the drawing.

The Anthropocene Game was created for and tested in these trigger point workshops, starting at the Gasser Grunert Gallery in New York City, on 21 January 2013, to address the effects of Hurricane Sandy and concerns about fracking (Silverstein 2013). The game was designed as an experiment in employing embodiment techniques between strangers to find new knowledge. It required role-playing and embodiment about the causes of environmental degradation with physical contact, to 'win' the game of dominating a

designated space. Four months later, in Memphis I combined *The Anthropocene Game* with participatory mapping.

In Memphis, I invited leaders from all the major local environmental groups to attend the *Fish Story* workshop, in addition to some artists from the *Memphis Social* exhibition. As I had done in previous workshops, I invited the audience to call out what agents they felt were dominating environmental concerns in Memphis. The agents were listed at the far right of a large piece of paper on the wall, where participatory mapping later took place. During the playing of the game, each person chose an agent to represent from the list that had previously been created. Physical contact was encouraged under controlled rules, to express the dominance of that agent on future events and other agents. Individuals were encouraged to vie for the centre of the room, literally in the fourth wall between audience chairs and what would become the map surface on the wall. They were instructed to call out the name of which agency they represented and use gentle force to push or pull each other into or out of the centre to 'win' the game. The most striking agency voiced and later discussed came from Matt Farr of Shelby Farms Conservancy, who chose to represent racism. He stated that racism is a significant impediment to progress, implying that it might be the trigger point we must address to restore environmental health to the region, more than any physical location. In playing the game, it was equally notable that I had to use all my physical strength (which was technically against the rules of the game), and did so alone, to push Farr, a very large man, out of the centre of the game, as I repeated the word 'habitat', and he continued to repeat the word 'racism'. In the end, Farr, as racism, appeared to allow me, in the role of habitat, to take the centre and win the game.

As with other occasions when this workshop was performed, after the participatory embodiment and before a group discussion, participants were asked to be seated, close their eyes, and to spend a short period in meditation listening to a song I sang to them a cappella (recording available online: <http://www.youtube.com/watch?v=irQtqnCuZUE>). I sang, 'Au Bord de L'Eau' by Gabriel Fauré, in all the workshops because the song line to me sound like running water. I believed the music evoked a state of mind that could leave the group open to thinking differently and engaging tacit knowledge. The sensual experience of listening to the human voice singing about water was intended to

contextualize analytic thought about water in Memphis, after the vigorous interaction of the embodiment play.

After the meditation, the group began mapping (see Figure 79, a detail of the resultant participatory mapping) to describe their thinking. They generated a participatory map of agencies to be addressed that might visualize connections between bioregional and environmental justice agencies in Memphis. Perhaps mistakenly, I did not ask them to discover a ‘trigger point’ that evening, because I wanted them to identify for themselves what was causing ecosystem degradation. In spite of billing the event as part of *Fish Story*, discussions of relationships between human communities and fish were vague. Arguably, it also seemed significant that no terms referencing other animals were evoked in this mapping exercise except my general suggestion of ‘habitat’. I was conflicted between guiding the experience and allowing the evening to self-organise.

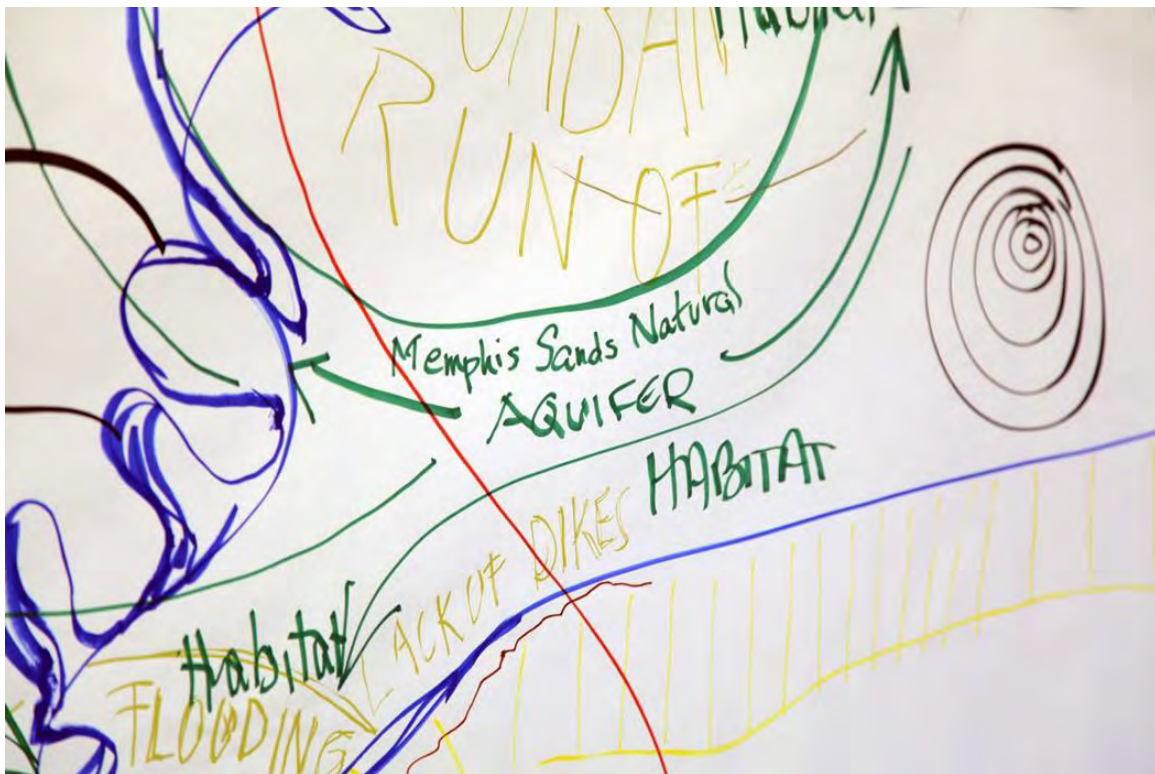


Figure 79: Detail of 6" x 30" participatory map from playing *The Anthropocene Game* (Rahmani, 2013).

My experience performing the workshop in Memphis in the context of other events over several days and with a year of preparation and advance outreach, was more effective than an isolated evening performance or, even more, an hour of interaction after

an introduction to what ecological art can be, as in other cases when the trigger point workshops were enacted as performing ecology.

In every workshop event, including the one in Memphis, elements of performing ecology to identify trigger points might have been applied more aggressively to adaptive management issues. In some cases, there were anecdotal accounts of individuals doing so after the event.

In retrospect, I might have used the pacing to help participants devise connections between existing strategies in Memphis, see how insights from the workshop might have advanced their own agendas (see questionnaires in appendix), and where racism fits into that picture. In the Memphis webcast a few days later, racism was discussed in more depth. I think it would require years of additional local work coordinated with federal policies to see significant shifts.

5.13. Summary

This chapter details how some heuristic practices of performing ecology can contribute valuable observations of and interactions with site and can be layered with scientific methods (e.g., GISc). I have argued that the performative methodologies and aesthetic activism of *Ghost Nets* and *Fish Story* are ecological art research techniques, the results of which unfolded with time. I showed how ritualized, time-based relationships to sites might provide unique insights. This could inform how to rebuild microhabitats and ecotones for water buffering. I described some embodiment performance strategies applied in *Ghost Nets*, which were examples of how art can capture empirical data and function as expert witnessing. These integrated strategies include classical methodologies from dance, music, and visual art.

I showed how diverging from familiar routines, habits, and shifting points of view, might create new paradigms. The results demonstrated how performing ecology could be like Maxwell's Demon to reorganize information. The novel approaches described resulted in conceiving of restoration work as a symphonic process which demonstrated a technique to support restoration work despite obstacles and setbacks over a long period of time. That result supported my argument for how performing ecology could enhance a transdisciplinary approach to restoration science.

Corridors are an important layer for habitat planning. I argued that establishing corridors requires understanding how humans and endemic species negotiate complex common space and needs for clean water. Performing ecology on the *Ghost Nets* site and extrapolating the insights that emerged to *Fish Story* helped me assemble that data.

As I explained, insights from *Ghost Nets* about dynamics in the Gulf of Maine, resulted from performing ecology. The pattern of conversations with a small group of artists during the creation of *Ghost Nets* led to virtual conversations with a small group of scientists who contributed to *Fish Story*. Those conversations were means to scale up lessons from *Ghost Nets* to large sites like the Mississippi Water Basin and the Gulf of Mexico and develop strategies to use minimal stamina for maximum impact. The virtual conversations evolved from the same methodologies that allowed me to be observant while walking the *Ghost Nets* paths. The trigger point workshops were developed as tools to explore a different point of view for scaling from the local to the bioregional and systemic levels. I explained how I used artifacts of observation from the shifted point of view of systems thinking, including drawings, photographs, and paintings (e.g., *Beautiful View, Oil & Water*).

Performing ecology is a methodology to shift perceptions of land managers, environmental restorationists, urban planners, and land owners, to reveal new activist opportunities for resilient solutions to degradation and reveal new insights. For example, the incrementalism of the Turing machine is similar to how CFS imposed a slow incrementalism on my restoration work. Planning for a long term strategy of small, steady progress was a performative means used in *Ghost Nets* and *Fish Story* and could be a useful reminder if restoration becomes a mainstream activity.

Chapter 6

Conclusion

In this chapter, I will recapitulate insights that emerged from my transdisciplinary research. The methodologies that were discussed will be assembled and I will recommend future research. The goal of this dissertation was to observe how a transdisciplinary ecological art practice might contribute to ecological restoration strategies, such as nucleation, in response to rapid and unpredictable environmental changes. I presented the metaphors of the butterfly effect and black swans to illustrate how thermodynamic principles and the idea model of Maxwell's Demon might inspire new approaches to complex systems. My research attempted to establish testable correlations, empiricism, parsimony and relevance to other theories in answer to Paul Thargaard's criteria for falsifiability (1988).

Ghostnets, CFS and acupuncture were discussed as metaphorical idea models to find small, catalytic points in degraded bioregions. I referenced those points as triggers, effecting triage. They were particularly discussed as a means to restore resilience to littoral zones.

Throughout this text, I explored ecological artworks and examples from TEK that might function as C AM's. I discussed how those models might be emergent events in communities and black swans in the Anthropocene era. The strategic importance of changing attitudes was premised on prioritizing how the needs of other species, and the ecotones they protect, preserves water for humans.

My argument that strategic ecological restoration planning could benefit from these approaches expands the interdisciplinary mission of professional groups like SER into transdisciplinarity. Disparate points of confluence between systems of thinking, such as metaphors and GISc were assembled as methodologies to identify trigger points and sustain transformation. Evidence that nucleation can instigate succession in forests supported the possibility that identifying small areas (nucleation trigger points) for restoration could catalyze restoring large landscapes elsewhere, such as the littoral zone. However, as I concluded in Chapter four, activating a physical location as a nucleation trigger point for environmental triage, requires holistically changing the context of

systems of perception and activity to sustain results. I posited that resilient strategies require relinquishing an anthropocentric point of view because water protection requires recognizing our dependence on other forms of life.

I argued that art can add heuristic knowledge and provide expert witnessing for complex adaptive systems (or CAMs). Such strategies are evident in holistic, ecofeminist, and indigenous worldviews where interspecies communities are prioritized. I suggested that adaptive management can include collaborative approaches with virtual platforms, and aesthetic modalities. The results could help re-establish contiguous relationships in bioregions.

As I have also argued, transdisciplinary heuristic practices could remediate anthropogenic activity. I posited that an individual art life practice, which I call performing ecology, can be adapted to service restoration. Visual artifacts can be expert witnesses to identify trigger points, as my drawings were in analyzing the Mississippi River for *Fish Story*. 'Marks' (taches) and structural elements may emerge from classical musical systems, like bel canto and symphonic forms, as in both my case studies. The artist's mark, unfolding in time might include mapping, objects, or new ideas, as well as actual restoration.

The time and tempo elements I analyzed in performing ecology evoked musical ideas. In interaction with a site, that raised my experience of restoration to the level of a conceptual symphony. I have argued that such aesthetic markings can cause butterfly effects that change points of view, foci, shifts attention and becomes new ways to live and implement restoration.

I have claimed that when ordinary citizens work together creatively, they can link the physical with the conceptual ecotones of bioregional systems. Citizen involvement in restoring ecotones in this holistic way could initiate a measure of the 36% greening needed, to mitigate global warming, as identified in 2013 at the end of *Fish Story*. I argued that the health of fish, (as taxa), might be indicators of progress towards healthy water systems. Therefore, I argued, our relationships with wildlife, particularly fish, can predict our future relationships to water. The quality of this relationship could be seen by assessing the integrity of littoral zone ecotones.

I appropriated Maxwell's Demon from physics, because it inspired a different understanding about how relationships between agents could change systems. An example of this was in how recognizing the symphonic tempi in my case studies allowed me to reconcile personal paradoxes of time and urgency. I will review these ideas by referencing my chapters.

6.1. Trigger Points for Large Landscapes

The main aim of this research was developing a methodology to identify trigger points for ecosystem resiliency. The purpose was to protect clean water (see Chapters three and five) for all life. CFS was used as an idea model for how small efforts could achieve that goal bioregionally. I have argued that identifying nucleation trigger points requires layering systems to find relationships between biogeography, environmental justice and aesthetics (see Chapter two).

6.2. Layers of Triage

Environmental triage was introduced in this dissertation as a term for responding to the conflict between the time sensitive urgency of the ecological crises humans face and the time delay for human capacity to adapt to change. I have referred to this conflict between urgency and adaptation as a 'paradox of time.' Triage was chosen because it requires a similar capacity to layer considerations in extremity. As I argued, anthropocentrism, often expressed as intensive extractions of fossil fuels and other resources causes this extremity.

Shiva calls the consequences of these extractions "water wars" and LaDuke identifies them as the 'murder of her extended (animal) family.' Some have critiqued the use of extreme terms such as war, holocaust (Patterson 2002), and rape (Merchant 1980) to describe anthropogenic impacts on earth systems, because such usage conflates human suffering with the suffering of other species. That, however, is precisely the ethical environmentalist argument (Chapter two) and it is my argument for the appropriation of terms like environmental triage. Identifying trigger points as triage in this ethical context bears on making adaptive management effective, because it prioritizes long-term strategies.

In Chapter one, I describe several metaphors and their relationships to complexity theory. Complexity science, chaos theory, and black swans provided theoretical contexts for my research. As I wrote in Chapter one, a black swan, in contrast to conventional methodologies, represents the emergence of a surprising event that changes our point of view about how systems function. Black swans were identified as the chance elements art can introduce into complexity, which the artworks I have referenced deliberately effected. As Odum, Deleuze and Guattari understood, perceiving the complexity of energetic systems is a multi-dimensional experience. This process of rhizomatically layering information and points of view is central to my thesis. As with other CAMs, my goal was to observe patterns in complexity. As I have argued, locating patterns of confluence models how to identify nucleation trigger points. A result would be the restoration of ecotones and the wildlife that inhabit them which could effect ecosystem contiguity in fragmented biosystems, conserve water and protect the littoral zones that support clean water.

I identified effecting nucleation trigger point triage as comparable to identifying trigger points of blockage in acupuncture. The acupuncture model is analogous to other global energetic systems. Chapters one and two discussed why ecofeminist and indigenous critiques of Western speciesism must be considered to triage whole systems.

As I wrote, Eugene Odum (1953) and Thomas Kuhn (2012) referenced how new metaphors and terminologies I identify as black swans enter the discourse to effect substantive changes to scientific thinking. Layering black swans clarifies where confluences occur. At a point of such confluence, we might observe where effects emerge from conditions of sensitivity to initial conditions and end in self-organisation, where butterfly effects or black swans might be identified. As Shiva argued (1978), where and why to shift perspective to observe those anomalies might generate policy change.

In Chapter two, I argued that analyzing large landscapes for environmental triage requires an ecofeminist analysis of the fallacies of dominance patterns. I discussed how anthropocentrism inevitably leads to environmental injustice and systems collapse. My arguments for the ethics of embracing our dependency on other species were pragmatic. I argued that anthropocentrism destroys elemental resources, including water, by ignoring the role of endemic animal communities in sustaining resilient ecotones. Redressing

environmental justice in relation to other animals is triage to sustain human life.

I have argued that when entire species are extirpated by anthropogenic ecosystem disruptions, the loss of biological ecotones from systems becomes analogous to human erasure of the moral boundaries inherent in environmental ethics. Those moral boundaries have been defined by environmental ethicists, some indigenous communities, and by ecofeminists (Chapter two). As I showed throughout this writing, in the Anthropocene, such questions have practical implications and biosystem consequences. When ecotones and edges that knit species between habitats are erased, water quality can be a casualty for all. These considerations may encourage individuals to engage in community efforts to change behaviors.

Ecofeminists like Sandra Harding (2005) and Donna Haraway (1990), observed that conventional scientific methods (Chapter two), can perpetuate and even reinforce colonial and dominance patterns over other species at the expense of knowledge. For example, Harding argued that this occurs in the very language of science, and Haraway detailed the complexity of the same process at work in the conflation of animal (primate) research, racism, and sexism.

I contextualized that research by comparing the points of view of landscape ecology, environmental restoration, and TEK. I claimed connections between targeting, scaling up restoration solutions, and ethics (Chapters two, three, and four).

In Chapter three, I highlighted how individual artists have used science to triage systemic urgency with ecoventions and innovative approaches to systems thinking. My examples were chosen to argue for art's role in changing systems. I discussed some ways art may leave a mark, or *tache*, not only on land in the form of restoration, but in the minds of people, to triage environmental attitudes. The artist's *tache* was identified as a black swan, indicating what to consider to effect triage.

I described how philosophical responses to World War II segued to an awareness of environmental urgency that took expression among ecological artists. That awareness led to experiments with how systems might be reconceived, such as interspecies communications (Morgana). As I considered in Chapters three and five, a trigger point identifies sensitivity to initial conditions, which becomes the proscenium for triage as a performative action. That proscenium is where small responses to degradation,

conceptual, physical or virtual, might emerge as black swans to effect large-scale ecosystem self-organisation with ‘demon information.’ Philosophical questions can determine different points of view, thus weighting values when modeling geospatialization for trigger points. That philosophical process begins to conflate science, with art and activism.

Conceiving of artworks as black swans to introduce new points of view and information was a recurrent theme. In Chapter three, I suggested that anomalous but deliberate examples from ecological art, such as Aimee Morgana’s work with N’Kisi (Chapters one and three) might introduce black swans that could become butterfly effects, leading to conceptual self-organisation in complexity, transforming entropy with new information and erasing old presumptions—in this case, presumptions about animal intelligence. In that chapter, I discussed how the ecoart collective and others have struggled with definitions of ecological art as an emergent form to address environmental urgency. A number of examples were discussed from ecological artists, including Helen Mayer and Newton Harrison, David Haley, Dominique Mazeaud, and Eve Andree Laramée, whose systems-based projects implicitly sought trigger points to change perception. Changing perception through pedagogy was examined and considered as a trigger point in the work of artists Beverly Naidus and Jan van Boeckel, who reference artist-thinkers like Joseph Beuys in their practice.

The research about and interrogations of my case studies and examples I initiated, were intended to consider novel approaches to small sites in systems. I explored whether those sites could leverage bioregional restoration (trigger points) by taking a greater range of agents into consideration. The artworks I referenced were intended to disrupt assumptions, as do black swans, about the natural world and our relationship to it.

Chapters three and four explored relationships and implications when mapping one set of values or circumstances replaces another. In my figures, I presented various maps of biogeographic relationships modified by an artists’ vision could illustrate novel points of view. I argued that some maps, which differ from participatory mapping, could locate trigger point triage, for example for *Fish Story*. That outcome might replace one pattern with another, as Maxwell’s Demon would, and introduce black swans. Mapping sound

production in bel canto singing was presented as a means to contextualize trigger points in bioregional littoral zone relationships, for example in the Gulf of Mexico.

Chapters three, four and five analyzed several examples of black swan emergence from ecological art. The research by Eve Andree Laramée, on radioactivity became a teaching system. I proposed that ecological art can effect trigger points by reconnecting fragmented patterns in ecotone relationships. I explored that strategy for restoration from the local to the bioregional scale in the example of *Blue Rocks* and in the mapping of *Z. marina* and *C. maenas* abundance in littoral zone sites. These examples were extensions of the *Ghost Nets* case study where I identified problematic attitudes and patterns of behavior in marine and littoral zones. Those behaviors have contributed to the global decimation of finfish populations. I described the confluence of the pressures on finfish from overfishing (to the point that cod has been genetically reduced in size). Invasive *C. maenas* was presented as an example of a devastating consequence of ignoring the precautionary principle in littoral zone environments. Today, cod larvae can no longer compete against *C. maenas* for food and the combination of effects *C. maenas* and mercury have on *Z. marina* beds (that nurture finfish larvae) has also been detrimental.

In Chapter four, I discussed a number of ways that maps may be read as performative scores for strategic activism. Monitoring the success of nucleation where it originated in tropical regions is still being studied on a local level (Reis, Bechara & Tres 2010). Although we don't have conclusive results in those regions, the methodology appears so promising for endemic species and apparently low impact that in this writing I have argued for using GIS as a tool to explore applying nucleation to the littoral zone (Chapter three). I presented my GIS maps as ways to identify nucleation trigger points as strategies to enhance regional finfish habitat in the Gulf of Maine. I then narrowed my arguments further to consider fish as indicator taxa for disturbances leading to ecosystem collapse and I applied GISc to speculations on how Trigger Point Theory might help identify where to apply nucleation in the littoral zone to support fish health.

The GISc model I created investigated how attribute tables might query a database and combined that model with a statistical analysis (see appendix). The theoretical credibility of my conclusions still require testing on a quantification and falsification level for quality assurance and control. However, although there were not sufficient data collection

events to conclude anything further than the fact that vegetation was the determinant factor in species abundance at the locations studied. My conclusion reinforces the critical role of ecotone relationships, even in locations degraded by human impact and under variable seasonable weather conditions, such as one might predict with global warming.

In completing my analysis to create a score for activism, I continued to layer disparate data, referencing Deleuze and Guattari's (1972, 1987) rhizomatic terms to organize my thinking about layering mapping attributes. I referenced the ghostnets metaphor while questioning whether the identification of trigger point sites could expand *Z. marina* in the littoral zone and support fishery resilience. Establishing a geolocated relationship (site 32) between *Z. marina* and finfish was then suggested as a trigger point.

The outcome of my GISc mapping for the southern portion of the Gulf of Maine was correlative rather than predictive. As I have referenced, land use forestry studies are underway comparing nucleation to plantation-style or passive restoration, but it may be decades before we see those results. Meanwhile, the evidence I presented, for example in my discussion of site 32 from my GISc, indicated that a quantitative analysis, even with limited data, may still help target nucleation trigger point restoration work for worthwhile consideration in littoral zone environmental triage. That indication is in direct response to the caveats of unpredictable systemic change from continued pollution, incursions of invasive species, and sea-level rise. The statistical analysis reinforced the GIS findings on the importance of studying relationships between ecotone vegetation and animal communities. Chapter five expanded the conceptual relationship between ecotones and heuristic knowledge. I detailed how systematically layering attention and enlisting classical creative methodologies, including bel canto singing, dance, and the production of visual artifacts with personal experience—such as coping with CFS—might maximize sensitivities to initial conditions that contextualize efforts at environmental triage in the littoral zone. Performing ecology is an art life practice, therefore, I showed how subtle aspects of timing and spatial perception that quantitative analysis might miss can be captured with this model. I showed how endurance performance can become part of the work of replacing one set of data with another. My experiments often included efforts to balance action directed by urgency and reflective time. Chapter five discussed how living with CFS focused my ritualized meditations and the rigorous and continuous

prioritization of limited resources to draw attention to the emergence of anomalies in layered complexity. This work illuminated how prioritization might be tied to designing resilient solutions.

In exploring related ideas in *Gulf to Gulf* webcasts and trigger point workshops, I described experiments with timing, structure, and emphasis. *Fish Story* Memphis evolved during the *Gulf to Gulf* webcasts. They led to speculations about why Memphis might be designated as a potential trigger point for the Mississippi Water Basin, and within Memphis, why connecting the Wolf River to the Mississippi River might be environment triage. As I noted at the end of that chapter, the outcome of applying Trigger Point Theory as aesthetic activism in Memphis for *Fish Story*, was the proposition that re-greening the earth by 36 percent might mitigate climate change. In that case led to an insight, with a hypothesis that would merit further research.

6.3. Heuristic Research

I chose my ecological art case studies and examples, and locations for trigger point workshops, as arguments for what art can bring to the systematic monitoring of ecotones and systems design (Chapters one, three, and five). Walking patterns were described as ontological contemplations of the incremental relationships of small sites to large systems. I discussed how the work of Jackson Pollock, Allan Kaprow, Mierle Ukeles Laderman and other artists, leveraged aesthetic paradigm shifts to understand complexity science and chaos theory differently, whether in ‘action’ painting by activating the space, in everyday life with embodied actions, or in re-establishing fragmented human connections. These precedents were formal conceptual systems for engaging proactively, as demon information might transform entropy in closed, familiar systems. As I detailed, Kaprow’s elegy to Pollock (1958) articulating how paradigm shifts manifest in art, as polymath Michael Polanyi’s essay on personal knowledge (1962), predating historian Thomas Kuhn’s descriptions of the emergence of a paradigm shift in science (2012) describe how heuristic insights into complexity deepen our understanding of how systems can change.

In this research, I considered how such systems change might be seen as innovative modeling, as in David Haley’s conceptual tracking of the circulation of a drop of water in

the world's oceans. While discussing the acoustic recording work that composer Bernie Krauss did on ecosystem degradation, or David Dunn's work with pine bark beetles, I illustrated how artists can apply research techniques to discover useful, previously unknown environmental data.

Monitoring the *Ghost Nets* (1990–2000) case study extended over almost three decades in several forms. The monitoring was a heuristic vehicle to develop Trigger Point Theory developed. It allowed for playful and intuitive digressions from a linear determinism but was also informed by collaborative research practice with scientists over the life of the project. This research analyzed how the performative aspects of my case studies evolved into a score for restoration, and how guidance for that score might be generated from creating artifacts as abstracted heuristic models (such as the *Bed of Nets* 1991). Artifacts of observation, including drawings, photographs, and paintings (*Beautiful View* 2010, *Oil & Water* 2009-2013), were discussed as additional means to gather data about a trigger point site and its context. Embodiment performance strategies developed in the *Ghost Nets* case study were presented as additional methodologies to assemble heuristic empirical data. The embodiment strategies were enhanced as performing ecology during the period of this research in the nine trigger point workshops with a various number of participants, time durations, and demographics. Those workshops culminated in the design and implementation of *The Anthropocene Game*. After *The Anthropocene Game* in Memphis a discussion ensued about racism and habitat restoration. These explorations, as Dewey proposed play is for children (1916), were methodologies to arrive at significant insights for adults.

6.4. Resilient Anthropocentrism

In the view of many indigenous peoples and ecofeminists, humans are only one of many environmental agents in sustainable systems. The TEK, ecofeminist thinking, and ecological art I reference relinquishes an anthropocentric view of interactive agents for the sake of long-term resilience.

In all my chapters, I claimed the reason ecological restoration needs to consider less anthropocentric methodologies, is pragmatic. TEK practitioners, and Western approaches were compared in discussions of how the theoretical and ethical shift from an

anthropocentric to the more horizontal approach was represented by some ecofeminists. Classical methodologies such as bel canto singing were discussed as another model for relinquishing individualism in service to a musical line which might be comparable to relinquishing anthropocentrism in environmental humility of ecofeminism and TEK. I suggested new models of activist opportunities for participatory art to address environmental degradation. I described how these points of view were integrated into my case studies, including embodiment exercises and interaction with habitat through vocalization and adding critical phenomenological and iterative layers to strategic analysis.

These arguments about point of view addressed debates in landscape ecology, for example over the ‘art’ of restoration practice. I posited that referencing restoration as art invited contributions from ecological art to restoration. Restoration in my case studies referenced data layers from many disparate systems. Lessons from listening to and observing ecosystems were detailed as methodologies to acquire tacit knowledge. Examples of how knowledge was gained included traversing a site by walking or canoeing it (‘Stay, Wait, Look, Listen’, Chapter five). These experiments sought to return attention to the environment by giving it a different quality of attention. The results were parameters for performing ecology.

As discussed in Chapter two, environmental choices challenge humans to define ethical concerns underlying water issues, for example, as Vandana Shiva posits: over water for poor indigenous populations versus foreign corporations, as more than a tragedy of the commons (Shiva, 2002).

In Chapter two I argued that the arena metaphor, often referenced in discussions of landscape, in contrast with proscenium view, presumes an omniscient understanding of our present environmental crisis. That presumption may be comparable to presuming vertical patterns of species dominance. The proscenium view is more limited and I argue, invites participatory experiences in the fourth wall to frame perception of the possibilities of interdependence between living species. My view positioned water centre stage, contextualized by endemic animal communities and grounded in ecofeminist and indigenous premises about ethics and water conservation.

Examples I gave in Chapter three from ecological art that focus on water, human rights, and animals, argued for how fourth-wall participation can generate new knowledge to address urgency. In both my case studies, I considered the ethical and pragmatic relationships between water and fish. However, agents I discussed in the Gulf of Maine data, reflected the complexity of any water-animal challenges. Some insights that would require further exploratory research were that,

- A. our present relationship to water needs to consider all human created impacts. In my food web, for example (Figure 63, Chapter four) I illustrated how run off from hardscaping impacts clean water, degrading habitats that shelter fish;
- B. most CAMs, as I showed in chapter two, could be strengthened by including TEK or ecofeminist, holistic and heuristic thinking into choosing attribute tables for strategic planning for ecosystem dynamics, such as those gathered in my daily *Schedules*.

The success of idea models presented in the introduction and Chapter one suggest that intractable problems with resilience for large degraded landscapes might be approached as problems in physics. Resilience might be perceived as a quantum mechanics problem, which requires the work of new insights and methodologies to replace information. When natural systems are threatened by excluding critical information, such as the impacts from dumping ship ballast inshore, the short-term gains are problematic. The perceived ‘ease’ of anthropocentric and economic interests is a fallacy in point of view. For instance, the invasion of *C. maenas* has affected the survival of finfish and other crustaceans, which results in many coastal economies being threatened. My premise has been that considering longer-term, more complex, and perhaps more labor-intensive strategies, such as including ecological art and performing ecology in management planning, may effect more efficient approaches to environmental restoration. The result might be more resilient management solutions than relying on engineering and social models alone (such as conventional adaptive management).

Performing ecology was proposed in Chapter five as a transdisciplinary methodology for resilience. It grew out of my own performance practice which originated in the late

1960s, and was informed by the activist values of that period. I explained how knowledge that emerged from grounding performing ecology in those values became a methodology to reach out to disparate audiences in my case studies. My descriptions of those methodologies was presented for land managers, environmental restorationists, urban planners, and landowners at conferences and in writings to suggest how to generate more holistic experiences of ecosystems.

Contemplative time to absorb new ideas is crucial for audience participants and artists, even as we face the planetary emergency of the paradox of time. The potential performance of re-greening 36 percent of the earth will require interdependent strategies to address global warming with less regard for immediate human advantage. Meanwhile, aspects of performing ecology might be applied to local conditions by anyone, as is practiced in most traditional societies, as a holistic art life practice.

6.5. Art Life in Service

Although many restoration scientists would disagree that art, or art life performance work, is relevant to science, I assert that it is relevant because as I argue in Chapters two, three, and five:

- 1) art can provide an alternate systems model;
- 2) art can create personal relationships in unique ways;
- 3) art notices and makes visible things that are otherwise overlooked;
- 4) art, if combined with fast but skilled intuitive thinking, can uniquely and simultaneously address urgency and reflection.

Elements of a hypothetical trigger point CAM—could be implemented by laypeople with modest training. However, full implementation may require a greater knowledge of complex systems than an untrained layperson may have or individuals might accomplish alone. I have shown how insights about restoration and adaptive management can be derived from individual ecological art practices to direct attention to effect environmental triage. I argue for engaging ecological artists as equal partners with scientists and lay

citizens in ecological restoration projects at every stage of adaptive management and restoration.

Formal strategies were discussed from my two case studies. In *Ghost Nets*, the CFS metaphor functioned as an idea model to address the paradox of time as an embodied model for ecological restoration. In both case studies, CFS inspired systems of thoughtful allocations of minimal personal resources to leverage maximum transformation, even in endurance events. CFS reinforced my commitments to metaphorical constructs and mnemonic artifacts. It structured how to stay focused on holistic systems while being engaged in specific practical tasks. That structuring realized the application of two feminist ideas: (1. the personal is political (and global); and (2. patterns of dominance, whether sexism or speciesism, are inefficient in an interdependent.

The metaphor of entanglement in ghostnets determined my restoration model to create *Ghost Nets*. It inspired me to find small points to disentangle the snarled ‘monofilaments’ of complexity in environmental degradation. Trigger Point Theory became a map to intervene in ecosystem complexity at a number of related locations as well as a meditative device.

Performing ecology represents how everyday experiences, as art life such as meditational focus could modify personal behavior. This is rhizomatic thinking that could reveal more precise trigger points in clusters of confluence at points of sensitivity to initial conditions. This approach was first experimentally expanded from *Ghost Nets* to *Blue Rocks* and then more systematically explored when I used *Gulf to Gulf* and *The Anthropocene Game* to conflate adaptive management with gathering bioregional information for *Fish Story*. In both case studies, *Ghost Nets* and *Fish Story* my intentions were to layer-collage art life performative methodologies with scientific methods (e.g., GISc), to shift my own habits and routines as a test case, and to create new paradigms to find trigger points elsewhere.

6.6. Virtual Adaptive Management

In *Ghost Nets* and *Fish Story* I explored the role of virtuality to produce artifacts while developing ideas about prosceniums for participatory art and adaptive management. Employing *Gulf to Gulf* webcasts became a way to direct an informal ‘think tank’ to

prepare a transdisciplinary team approach for *Fish Story*. Many scientists do not agree that layering aesthetics and art life in strategic planning for ecological restoration could be pertinent to their practice because of art's inherent subjective, personalized, and heuristic qualities. However, as I have asserted, the paradox of time implies that unprecedented approaches must be applied to environmental restoration work and adaptive management.

I framed my questions as hypothetical problems in physics (introduction), making an effort to translate speculations into practical methodologies for land management and adaptive management and to develop effective strategies over time. My goal with the *Fish Story* webcasts was to experiment with a simple approach to collaboration, despite wide geographic distances from each other, and create a playful platform to identify trigger points for restoration. The webcasts have since been accessed from many countries and may be providing useful templates for others.

6.7. Artifacts of Attention

I described Mierle Ukeles's *Maintenance Art* project as an example of a well-conceived framework to draw attention to sanitation workers and evoke complex associations from audiences. Similarly complex approaches were investigated in the work of other artists and in artifacts from my own art practice. A range of mnemonic and utilitarian artifacts were described in Chapter three from ecological art projects that drew attention to environmental issues, from farming to pollution. These works were analyzed for possible butterfly effects and black swans in response to environmental urgency. The butterfly effect that resulted in the GISc mapping evidence occurred during monitoring of the *Ghost Nets* site, when a European Green crab was found in a haddock stomach.

Therefore, I began to see how a CAM might emerge that was grounded in several disciplines and systems of knowledge, including nucleation in restoration ecology, indigenous peoples' relational sensitivities, and participatory public art, all of which I allowed to inform each other as agents in relationship. The butterfly effect was the deliberate invitation to research the complexity of possible trigger point sites. The resulting premises included several critical to this writing:

1. If nucleation appeared to work in forestry on the local level, it might be possible to leverage refugia as trigger points in other systems such as the littoral zone for bioregional effect.
2. Resilience and iteration might be reinforced by layering attribute tables informed by expert witnessing from an ecological art practice.
3. Geomorphic edges would indicate where to focus attention and restore ecotones in the littoral zone. In Chapter four, for example, I argued that existing *Z. marina* beds were indicators to target littoral zone restoration sites.

Do ecological artists differently engage communities in a fourth wall of participatory experience? How does that contrast with the earlier genre of land art? In Chapter three, I argued that the distinction was the sense of responsibility to ‘make things better’ for the earth and a commitment to a deep green agenda. A more nuanced and complex relationship between audience and artwork has evolved with the genre of ecological art. I discussed how the butterfly effect might manifest with ecological artists involved in education, shaping and guiding the thinking of new generations, one student at a time, and making each person an intellectual trigger point for self-organisation. As I showed in the first part of Chapter four, the complex layering potential of participatory and GISc mapping invites social practice and can inform adaptive management to change attitudes. Participation in workshops, such as described in Chapter five, with playful exercises like *The Anthropocene Game*, can lead to new insights which can themselves become butterfly effects, as with the insight in 2010 from a workshop on fracking, that there are “more of us, than there are of them” or the insight about the impact racism has on restoration work. Racism, as Haraway (1990) analyzed it, is close to speciesism. Restoration therefore, has to be equally attentive to marginalized social groups as endangered species in a greater matrix of agents. However, as I wrote about *Fish Story*, when trying to work with the complex demographics of racism in Memphis, for example, a different level of engagement with community is required than was approached in *Blue Rocks*. As the location of site 32 in my GIS maps for the Gulf of Maine, the wider context of overlapping systems in the Mississippi Water Basin meant that using artifacts from an

ecological art practice to locate the physical trigger point may be the first step of many to activate transformation.

The most important artifacts from both my case studies were the completed restoration sites or evidence of progress towards that restoration. I described how poetic devices framed each stage of restoration in *Ghost Nets*. I also explained why the demographics of the targeted *Fish Story* site, at the blocked connection between the Wolf and the Mississippi Rivers were heterogeneous and complex. For example, the *Fish Story* site was differently degraded than *Blue Rocks*, but many of the littoral zone issues were similar, such as invasive species, dwindling endemic fish, and a fragile watershed. At both sites, stakeholder conflicts required sensitive adaptive management and mapping. In Chapter two, I noted how the extension of *Ghost Nets* and *Blue Rocks* restoration work was financed, after my instigating performance, by the United States Department of Agriculture.

In *Fish Story*, a conceptual butterfly effect emerged in a collaborative *Gulf to Gulf* webcast when, as I explained in Chapter two, Dr. Turner responded to a question I posed about locating trigger points with a comment about the effect Iowa was having on the Gulf of Mexico. The goal of eradicating *L. sinense* along the Wolf River emerged after *Memphis Social*, when I extended my collaborative outreach to Shelby Farms in Memphis as another way to effect change in the Mississippi Water Basin. Eradicating *L. sinense* was a goal of Shelby Farms that would allow canopy trees to re-establish succession and shade littoral zones in the tributaries of the Mississippi.

In both case studies, re-establishing integrity to habitat and hydrological dynamics required an ongoing (adaptive management), whole-system approach for predictive modeling, engaging the entire community, as I described in Chapter five.

In the course of both my case studies I kept records of events in my daily schedules. That enabled me to look back to see butterfly effects that instigated layering data rhizomatically, in the manner Deleuze and Guattari (1972, 1987) described, as a process of topological mixing (chapter four). Those layering approaches were analogous to how GISc works to analyze emergence in possible confluences or how an acupuncturist finds trigger points.

In Chapter three, I discussed how the evolution from land art to ecological art reflected

similar developments in adaptive management. That evolution was compared to approaches in participatory art and other forms of art outreach, including ecological art pedagogy, to illustrate how artworks might catalyze butterfly effects in adaptive management.

In Chapter four, I discussed whether mapping artifacts could model predictive action. I compared mapping to music performance scores, arguing that those correlations could lead to more effective participatory mapping, activist land management, and quantification, by introducing tacit knowledge to catalyze the butterfly effect. I discussed additional objects and performative practices, such as Eve Mosher's *Blue Line*, that could be seen as black swans, leveraging butterfly effects.

In Chapter five, I discussed how my Schedules might be considered mapping artifacts derived from performing ecology to identify or articulate conceptual space. Examples of other 'maps', that functioned as utilitarian objects were given, like the boulder creations and stroll pathways at the *Ghost Nets* site or mnemonically, the *Bed of Nets* from *Ghost Nets* or the *Oil & Water* series from *Gulf to Gulf*. I explained how, in the case of *Bed of Nets*, the nets represented metaphors whose mnemonic qualities expanded my sensitivity to initial conditions, adding layers to perception.

The trigger point workshops were performed as part of my research to refine methodologies that could be scaled up, to coordinate regional adaptive management planning, and for participatory art. The workshops ranged in length from one hour at Brunel University, United Kingdom, to several days at the Survival Academy in Copenhagen. The three most effective workshops were held in 2009, at the Survival Academy in Copenhagen, to address global warming activism, in 2010, at the Electronic Music Foundation in New York City to address hydraulic fracturing, and in 2013, at Crosstown Arts in Memphis, Tennessee, to address watershed issues in the Mississippi Water Basin for *Fish Story*, where they culminated in the second performance of the *Anthropocene Game* (Chapter five). *Fish Story* showed how results and insights about dynamics in the Gulf of Maine, resulting from *Ghost Nets*, might be applied to thinking about large sites like the Mississippi Water Basin and the Gulf of Mexico. As I have shown, the performative methods (performing ecology) used in *Ghost Nets* and *Fish Story* could also be sources of expert witnessing.

6.8. Artifacts as Expert Witnesses

Artists present organized heuristic knowledge as expert witnessing in the form of artifacts. The performing ecology methodology layered slow, heuristic observations over time with different methodologies, like walking a site and acoustic experiments, to generate tacit knowledge about possible trigger points.

A goal of producing artifacts in various forms while completing each case study was to discover patterns and create mnemonic events that would be embodied witnessing for trigger points. For example, the painted maps of the Mississippi River generated during *Fish Story* as noted in Chapter four, illustrated the extent of possible future flooding patterns.

Also in Chapter four, I described and mapped how the physiology of producing bel canto vocalization recapitulates structural elements of other natural systems, including how habitats interrelate in the littoral zone to be considered in the reconstruction of ecotones.

6.9. DIY Ecotones

Chapter five detailed performing ecology as an engaged methodology for restoring habitats as an intrinsic aspect of daily life. Although not everyone can commit to such a methodology full-time, many aspects can be adapted by others, the motivation would be to add tacit knowledge about trigger points to water conservation and ecosystem restoration.

6.10. Fish as Indicators

I have argued in this dissertation that our relationships with wildlife, particularly fish, determines future water quality and quantity and can be predicted cartographically. In my case studies, my motivation was to improve habitat for fish, because I have contended the taxa are indicator species for healthy water systems.

In *Ghost Nets*, I studied the dynamics that erase fish habitat and experimented with those that restore it by increments. In *Fish Story*, lessons from *Ghost Nets* guided my research on the MWB. As I referenced earlier, restoration alone—for example, if mercury deposition and carbon emissions are not reduced and the behaviors that reinforce the use

of fossil fuels are not changed—then the elimination of most North American fisheries will continue.

In *Fish Story*, e-blasts and blog posts were used to create connections between people's personal lives and the experience of fish struggling for healthy habitat. I sought to help my audience empathize with the plight of other species. That was a plea to extend human compassion beyond anthropocentric boundaries. I argue that it is dangerous for humans to ignore connections between themselves and the other (non-human) animals on this planet, because when we don't see our place in a whole system and project the implications of that failure, we are liable, as we have done, to continue destroying the systems human life depends upon.

Strategically deliberating and prioritizing choice about keystone indicator species goes to reimagining critical discourse about restoration science. There is a lively debate in environmental sciences about the value of restoring species versus taxa that might fill the same niches. The value of continuing to protect endemic species is sometimes questioned, particularly in Europe, where there have been many *regime shifts* (significant ecosystem changes). However, my premise was that approaching this problem entirely quantitatively and anthropocentrically may cause one to miss critical black swans that might replace perceptual data.

The survival of fish was presented as a paradigm for human capacities to connect empathy, fine-grained observations of how holistic systems function, and reasonable actions. As I have argued, acting on empathy is a pragmatic response to the paradox of time.

6.11. CAM Physics

Physics, particularly Maxwell's Demon, was presented as a system representing the nature of change that might be analogous to effecting Trigger Point Theory. Three metaphors that describe mathematical phenomena were chosen for this research. The premises I researched through the lenses of the metaphors I chose, such as the butterfly effect, described sensitivity to initial conditions. The somewhat contested principle of dual entropy—that the work of including data and heat energy equally represent entropic mass and questions of order and disorder—has been implicit in my research. In the

example of Maxwell's Demon, the work of data replacement effects erasure of the memory of any former entropic nature. I posited that the work of an endurance event also erases past memory, for example, to introduce symphonic systems to performing ecology

My case studies and examples explored preemptively identifying where black swans might function as butterfly effects in novel CAS, such as are emerging in the Anthropocene. In all my chapters, I proposed that the source of information to change entropy is an aggregate of redundant layers. Artworks were referenced to illustrate how metaphors precede realization, as in how Maxwell's Demon led to information theory or the Turing machine led to computers.

In the degradation dynamics I researched for this writing, trophic cascades and endemic ecosystem community relationships connected by ecotones are effectively erased. As I explained in Chapter one, in natural systems, there is no return to the exact previous state, because the same sensitivity to initial conditions is unlikely to return. Principles of reversibility and irreversibility in entropic transition are critical to the study of any complex system but still experimental premises. Rules for entropy in the second law and functional ecology, especially in modeling, are not yet fixed concepts (Meysman & Bruers 2007), partly because of ambiguities in defining and measuring entropy in living systems. I argue that the questions they raise are critical to resilient restoration. The butterfly will never flap its wings precisely the same way. There are too many variables. However, attitudes and points of view might be regarded as malleable sets of data. If art can effect significant perceptual shifts, then it is theoretically possible to 'replace' self-destructive patterns. Other patterns might emerge from performing ecology to effect Trigger Point Theory as aesthetic activism.

I have argued that considering some works of ecological art as black swans is another way to test the thermodynamic reversibility of ecosystem damage with the principle of dual entropy. Eugene Odum's (1968) food web model illustrated an embodiment of entropy. Understanding the relationship between thermodynamics and ecology in Odum's food web reflected the developing field of non-equilibrium thermodynamics. It represented interactions between species as an immersive, art-like experience. However, the nature of the energetic system humans must come to terms with differs from relationships between non-human species portrayed in most food webs that exclude

anthropogenic effects. Neither Odum's, nor most other food web representations since have included the impact on entropy when built infrastructure and other anthropogenic systems interact with living systems. Arguably, measuring entropy are even more problematic when abiotic and biotic agents interact (Figure 63, Chapter four).

Researchers I discussed, like Robert Costanza (Costanza et al. 1997a; Costanza et al. 1997b) calculated the economic value of these collisions between built infrastructure and natural systems. Costanza's work sounded an economic alarm about disregarding the consequences of the extractive behaviors and imprudent interactions indicated in Figure 63.

As I also described, Edward Lorenz's (1963) actual quantitative observations of weather pattern computations led to refining our understanding of seminal mathematician Henri Poincaré's 1850 definition of chaos theory, with applications to systems theory. Lorenz's calculations revealed sensitivity to initial conditions and the unlimited potential of chance. The Turing machine's calculations discovered limitations but led to developing the concrete tool of computers with apparently unlimited application (Chapter one). The common factor in these examples was the meticulously systematic observation of event patterns over time. I have argued that those meticulous observations were comparable to the documentation of incremental change in my Schedules (Chapter five). The relevance of patterns that emerged at one small site (*Ghost Nets*) were then explored on a larger scale (*Fish Story*).

In the introduction, I identified five stages to compare Maxwell's Demon's progress towards change, which I will now reinterpret in the light of this research.

1. Establishing a novel boundary between transdisciplinary ecological art that consciously addresses complexity and disciplinary silos in art and science.
2. Observing how scientific analytic tools, such as GIS and statistics, might indicate where and how trigger points might intervene in littoral zone degradation.
3. Discriminating information between conventional Western approaches to environmental restoration and TEK or ecological art.

4. Memorizing data by tracking many layers of ecosystem analysis, for example in my schedules.
5. Exercising erasure (of previous information) by arguing that small interventions could have large effects and presuming that 36 percent re-greening of the earth is possible.

6.12. Metaphorical Models

Metaphors such as acupuncture, lost ghostnets and CFS provided strategies to structure my thinking about restoration work and observe agents (Chapter two). The metaphors suggested ways to approach a problem through a contemplative attention lens as a conceptual and a theoretical tool. During *Ghost Nets*, acupuncture became a way conceptualize catalyzing systems change (nucleation) from a small site to the bioregional level. In *Fish Story*, we began with a bioregion and slowly focused in on the particular site, applying the ghostnets metaphor. CFS structured *Ghost Nets* over a long period of time and determined the pace of progress, whereas *Fish Story* compressed work onsite to six days. Both strategies balanced time and energy in space. In Chapter four, I asked how maps might function as a score for such actions. In Chapter five, I used tempi to further organize the implementation of a score.

CFS, which limits available energy, became a device to prioritize options and agents. It was a methodology to weigh experimental options (Chapter five). The illness metaphor of CFS was presented as a model for parsing decision-making with limited energetic options and time to prioritize agents. The work of that parsing was conceived as comparable to Maxwell's Demon's work, separating molecules to effect entropic change. In Chapters two and five, I illustrated how this worked with daily schedules.

6.13. Agents

My research observed how qualitative agents emerged from the patterns I studied in idea models. The five agents I researched were metaphors, point of view, urgency, mapping, and art life (performing ecology). I will now summarize how each chapter represented an agent in complexity.

1. In Chapter one I described how a number of metaphors, idea experiments, and analogic models demonstrated that abstract idea models can shape transformative thinking, as Lakoff and Johnson (1980) showed, metaphors could determine behavior. I discussed the work of several early systems theorists. In order to contextualize an expanded perspective on metaphors as idea models, including Odum's (1953) food web. I demonstrated how idea models could lead to significant scientific developments, in the way that Maxwell's Demon and the Turing machine (Chapter one) became physicalized.

The needs these idea models addressed were: (1. the complexity and scale of environmental devastation versus limited resources; and (2. the urgency of problems caused by the Anthropocene conflicts with the time it takes most species to adapt to radical change (the paradox of time). Evidence was presented and discussed for the conceptual, philosophical, and practical aspects of considering each agent in this writing.

2. In Chapter two I showed how points of view for effecting environmental triage can include or exclude important data, inflecting conclusions and outcomes. In comparing premises from landscape restoration, restoration ecology, indigenous perspectives, and ecofeminism, habitat contiguity and other species were considered to illustrate the strengths and weaknesses of each point of view. I argued for an expanded application of nucleation restoration with layered points of view. I proposed that a less anthropocentric relationship to ecosystems is a pragmatic choice and discussed how adaptive management and participatory art might share a fourth-wall experience of habitat. I maintained that experience might lead to more ecologically resilient self-organisation after strategic planning.

Audience and point of view in the theatrical fourth wall were conflated to discuss how people perceive ecosystems. I then compared that perception to a series of worldviews about biogeography. Concepts of Panarchy and the Gaia principle were discussed as whole-earth macro-system, along with the way nucleation might fit into such representations. My premise in investigating these systems was that effective precedents exist for prioritizing endemic wildlife in regional planning. Concerns about theatre and participatory public art to engage

broader public support for restoration work informed planning for *Fish Story*.

3. In Chapter three, I followed the trajectory of art theory on the topic of urgency as it was expressed primarily in American criticism to demonstrate criticism and curatorship that became a collaborative experience with artists, subsequently shaping the development of ecological art. I then showed how that collaboration segued into an ongoing contemporaneous discourse (the ecodialog) between practitioners, privately and publicly, to clarify the values of a new genre.

As I wrote in Chapter three, art critics and curators functioned as translators between artists and a wider public in response to the urgency of environmental circumstances. Often working with artists, art writers and curators have found new ways to ask questions of the public and present new systems as solutions. The idea that art might represent an alternate system as one of the agents to consider urgent problems was the main premise of my third Chapter.

4. In Chapter four, I described various approaches to mapping, from participatory community cartography to GISc, as methodologies that might contribute towards identifying trigger points. Detailed examples of how GIS might contribute to that identification analyzed some relationships between *Z. marina* and finfish led to a number of suggestions for how a more holistic mapping might effect restoration.

The attribute tables I assembled for Chapter four referenced animal species, location, and *Z. marina* to see if the right configuration of layered agents might identify where to target effective restoration strategies. The GISc model investigated what was learned about *C. maenas* but revealed that geographic location wasn't the only criteria for success. Successful management of *C. maenas*, will require coordinated interventions in a number of existing systems.

5. Chapter five defined how performing ecology could generate heuristic and tacit knowledge that might then be layered with quantifiable data for restoration work. I described how performing ecology emerged from and became my daily art practice. Embodiment as art life was an agent that might interact with idea models, point of view, a sense of urgency and mapping.

6.14. Rules

Chapter three, I discussed Lippard's premise that 'if' scientists and others took artists and art seriously we might advance towards environmental solutions more quickly. Rules for any model indicate what might happen when identifiable agents interact. Often that means just two or three simple rules determine inexact outcomes. In this writing, two primary Boolean (IF and THEN) rules emerged from the case studies and examples I presented. IF humans face the paradox of time and urgency, THEN equilibrium tends to emerge from 1) embracing paradox and 2) engaging in serious play. I will now discuss how these two rules might manifest in six categories of application.

1. Layering despite urgency. Layering and finding confluences takes time. In triage conditions, time is not always available. However, IF (applying Boolean logic) Maxwell's Demon is viable, THEN the work of layering and endurance performance, part of performing ecology, may reveal new information about how points of confluence between systems function. That insight could result in systemic transformation. With or without GIS, there is an argument for engaging art in the process of layering agents for restoration. THEN artifacts of attention from artmaking can effectively layer perceptions. As I described, using art to layer perception can lead to new approaches to problem solving as well as targeting points of nucleation. In my case studies, it led to measuring the tempi of restoration tasks and a conceptual symphony. IF strategic planning is experienced as a symphonic performance, over long periods of time, each measure and movement has discreet value. THEN, playfully framing stages of progress could add resilience and depth to strategic planning when obstacles arise.

2. Metaphors as idea models for restoration work. IF, complex systems appear intractable they might still have at least one simple point of entry for self-organising information. THEN there is the opportunity to discover the 'thread' to unravel disorder (as with retrieved ghostnets), which may only be accessible with heuristic experiments and tacit knowledge. Metaphors can organize the time and work of finding triage trigger points and serve as idea models such as adapting to art life with CFS. That adaptation can be parsimoniously expressed as the prioritization of options (O) limited by the stipulation

of minimal use of energy (ME) sustained over time (T) for maximum effect (MEf): $ME + T = MEf$.

3. Follow disruption. IF disruption is a socio-cultural experience caused by short-sighted strategies such as dumping ship ballasts inshore, as well as an on-the-ground manifestation, such as incidence of *C. maenas*, THEN detailed attention to ecotones requires simultaneous attention (a concern which consistently arose in my research) to whole ecosystems.

4. Playfulness. IF embodiment and play enhance and catalyze valuable perceptions about biodiversity and community interactions between species and in human communities as adaptive management, THEN that 'work' of serious play can erase boundaries between disciplines and perceptions. Those erasures might correspond to erasures initiated by Maxwell's Demon to change closed systems. Playfulness was explored virtually (Chapters three and five) with serious transdisciplinary play between researchers such as the *Gulf to Gulf* webcasts. It resulted in *Fish Story*.

5. Accept paradox. IF the paradox of Anthropocene urgency is that generating knowledge and establishing new patterns of behavior requires reflective time and (as I described in Chapter five), and the goal is effecting Trigger Point Theory as aesthetic activism at the macro scale THEN performing ecology at the micro scale is required.

6. Identify the entry point. IF the scale of complexity the Anthropocene presents is beyond comprehension, THEN our work goes towards identifying the smallest, least demanding point on which to bestow attention in sensitive initial conditions for maximum change.

In Chapters two, four, and five, I investigated the implications of questions about what is visible or not: how we might layer complex information about observation and practice to decide where we might choose to pay attention. In addition, the metaphor of CFS guided my decisions about effecting triage. The practical demands of living on a degraded site with limited resources personalized place and invested my decisions with an urgency that, I argue, brought me closer to the instructive views of indigenous peoples about land stewardship. I discussed insights that emerged from workshops conducted during the period of this research as I developed the rules for this CAM. I argued for how

these rules might be applied to environmental restoration and why they might function as demon information in closed systems of thought.

IF the performative methodologies and aesthetic activism in *Ghost Nets* and *Fish Story* were applied as enhanced ecological art research techniques, intended to provide redundant modeling systems for a transdisciplinary restoration science, THEN ritualized, time-based relationships to a site might provide unique insights into water buffering that connects functionality in biosystems. Those insights could inform how to monitor resiliency from a more layered point of view. THEN the rules derived from this research for my CAM might produce nucleation trigger points that could effect environmental triage in the Anthropocene.

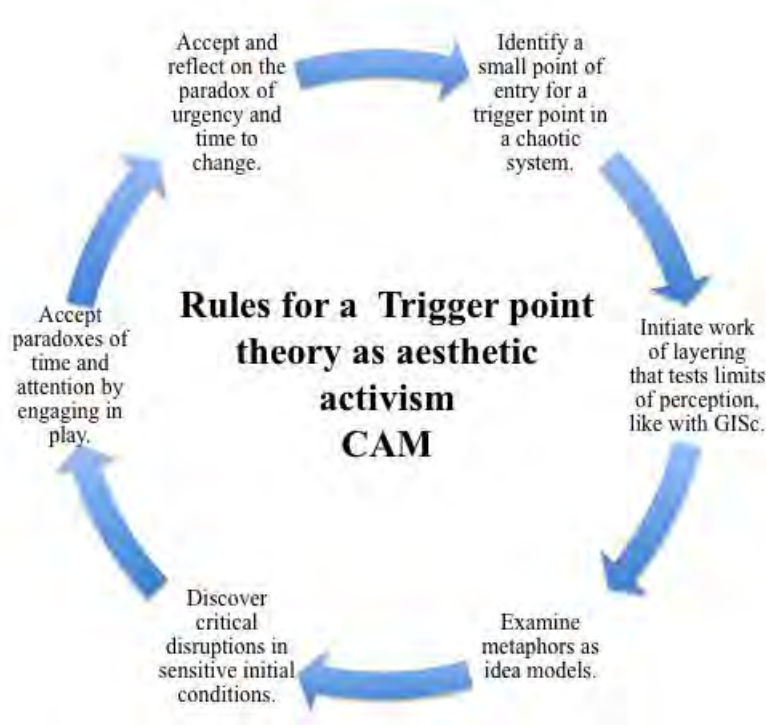


Table 6-1: Applying the two rules of paradox and play to the six categories of a hypothetical CAM. (Rahmani 2014).

6.15. Future Directions

If ecological artists are to engage science seriously as more than illustrators or social facilitators, questions about conventional hard scientific falsification and quantification

may still need to be answered. GIS could supply the missing quantification link to effectively scale up a different modeling perspective. GIS can spatialize disparate attributes for quantifiable analysis and modeling.

Additional GIS work, adequate testing and falsification and mathematical modeling is needed. That work might explore some relationships discussed in more depth and assess success. My own future research will continue to experiment with applying the models and I have identified to activate trigger points in collaborative teams.

Future collaborative research will be continued in small-group applications of Trigger Point Theory as aesthetic activism through the web and in additional trigger point workshops. One example of the latter, produced with White and Turner, is a website platform (www.gulftogulf.org) dedicated to re-greening the earth 36 percent by 2030 to mitigate climate change, restore fish habitat, preserve clean water, and support resilient, adaptive evolution for humans. There is not at this time adequate earth surface to contain an increase of 36 percent re-greened space but the calculations imply that if the surface requirements could be solved, the low impact solution of adding vegetation to the earth, such as ecotone restoration, might be viable ways solutions to global warming.

This summation may help land managers, ecological artists, environmental activists, and others to work together and further research about the possible application of nucleation trigger points. Although, the evidence advanced by this research is correlative and theoretical it is strongly suggestive that exploring these ideas may be fruitful.

6.16. Recommendations

I have argued for leveraging small sites for large environmental impacts with ecological art. IE, as Lippard (2007) wrote, artists are allowed to contribute towards and be supported in projects with scientists and others, then, I contend, we might discover new paradigms for restoration. I recommend support to pursue those possibilities.

Interdisciplinarity is considered a hallmark of ecological restoration. Some artists are beginning to emerge as principal investigators, experimenting with different scales and configurations of participatory groups. New forms of collaboration should continue to arise from these precedents in ecological art practice. New insights relevant to environmental science can arise from ecological art even without quantification and

falsification, because ecological art provides a range of attitudinal options. Those options could result in changed mainstream behavior, a redefinition of the nature of art, and result in a significant greening of the planet.

As I have shown, ecological art emerged from a history of ambivalence and reconciliation between the roles of artist, artist as object, object, institution, and authority in times of urgency. I recommend engaging ecological artists at every stage of restoration because they bring surprising questions, unexpected methodologies and new information to fields of research. Transdisciplinary ecological art can add depth, clarity, and new knowledge to environmental concerns. It can effect inspiration and model innovative ideas and practical experiments with implications for environmental and restoration science. Ecological artists can provoke discourse and present changed paradigms. Certain artworks could help land managers reconsider their approaches to adaptive management and decide what data is included in modeling.

Historically, artists have taken a role in deliberately opening up closed systems, including the very dynamics of verification that Kuhn (2012) analyzed, often drawing on skills to evoke deliberate surprise into systems. If artists can engage with science and land managers, they could contribute to solve problems in times of extraordinary urgency. I suggest that more scientists need to take time to fully understand the process of generating art, or else they may presume they understand what ecological art is without careful attention to what artists say about their own practice. Full implementation requires building budgets that include ecological artists in all phases. This is an educational problem that may resolve as more artists write about their practice in detail.

I recommend research funding to include ecological artists as full partners with scientists, equally compensated. I suggest that restoration science and resilient public environmental policy might benefit from including ecological art projects. At the beginning of the *Ghost Nets* project, financial support for that research might have allowed it to progress faster and achieve determinate results. The lack of funding for ecological art projects is not comparable to inadequate support for science research because presently there are far fewer options to support ecological art. Including ecological art might contribute significantly to how ecological restoration might answer the fraught urgencies of the Anthropocene Era.

In bel canto, the performer's capacities interact with the musical line is supported by the composer with rests to breathe. I deliberately sustained performing ecology, despite threats to my health, to complete the 'musical line' of my research while searching for black swans. A consequence was that I was perpetually on the edge of chaos (at the point where stress and emergence result in new insights). My intention was to create a performative parallel to how the earth has deteriorated under the relentless pressure of the Anthropocene and test how a strategy with limited support and resources might impact novel ecosystems. I have shown what might be accomplished by one person with limited resources, which led to insights and methodologies. With adequate support, and a larger team of investigators, including citizen participants, or even with limited resources, humans might effect great impacts on environmental degradation.

Systematically experimenting further with Trigger Point Theory could be a relatively inexpensive project. Should this research be found worthwhile, longer periods of applied collaborative work with larger teams could be transformative. That extended period would permit engaging local, federal, and international policy in a new value system, such as the Environmental Ethics Committee tried to address at COP15 (Chapter five).

6.17. Limitations

Scientifically, my hypotheses about the value of applying nucleation or triage trigger points to large, bioregional degradation required additional data and testing of that data. Determining falsifiability for the GIS version of my hypothesis and idea model required more data to be determinate. It was also beyond the scope of this writing, for example, to expand the numbers of layers of my GISc work, to the sociology that produced run-off pollutants into *Z. marina* beds from parking lots at site 32 in my GIS research or other aspects of heuristic and tacit knowledge that might determine behavior.

Additional studies, baseline data and modeling experiments to establish the falsifiability of precedents might have accomplished actual restoration work in Memphis for *Fish Story*. Since the nature of my case studies included learning from while transforming and being transformed by the sites, in retrospect, I might have also given more thought at the beginnings, to assessing community impacts at the end.

On the other hand, establishing qualitative meaning for my evidence also depended on

the analysis of subjective impressions from expert witnessing. In the latter case, as I indicated in Chapter five, almost fifteen years after the completion of *Ghost Nets* or *Blue Rocks*, the simple adjective 'beautiful' endures. "Beautiful," however, was not tempered by references to baseline conditions or the means to test regional impacts.

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RESUME**Science Publications:**

Rahmani, A. (2014) “‘Fish Story’ Memphis: Memphis is the Centre of the World’. *Journal for Environmental Studies and Sciences* [Online] Vol. 4 (2; June): 176–179. [Online] available at: <<http://www.springer.com/environment/journal>> [13 June 2014].

Art Publications:

Rahmani, A. (2013) ‘Triggering Change: A Call to Action’. *Public Art Review* 48 (24), Spring/Summer, 23.

Rahmani, A. (2012) ‘Mapping Trigger Point Theory as Aesthetic Activism’. *PJIM* 4 (2), Winter, 1–9.

Rahmani, A. (2010) ‘Feminist Ideas then and Now...’ *WEAD* [Online] available at: <<http://weadartists.org/feminist-ideas-then-now-are-linkedchanged-expandedcontracted>> 24 August.

Rahmani, A. (2010) ‘Collaborating with the Earth: Trigger Point Garden’. *Public*, 41, 158–165.

Rahmani, A. (2010) ‘An American at COP15’ [Online] <<http://magazin.cultura21.de/piazza/english/an-american-artist-at-cop15.html>> 6 June.

Rahmani, A. (2010) ‘Island in the Sun’. *Mammut*, Spring, 17–18.

Rahmani, A. (2010) ‘Island in the Sun’. *Working Waterfront*, February/March.

Rahmani, A. (2010) ‘The Press Conference’. February Quarterly Issue [Online] <<http://sustainablepractice.org/newsletter/10Jan/>>.

Rahmani, A. (2010) ‘The Horizontal Press Conference’. *CSPA Quarterly* 2 (26), February, 14–17.

Invited Presentations and Participation in Conferences:

(2014) ‘Changing the Odds: Applied Trigger Point Theory, a Transdisciplinary Methodology for Anthropocene Complexity’. Workshop leader, AESS Conference. 11 June, PACE University, New York.

(2014) ‘Artists of the Anthropocene: Regarding Life Aquatic’. Panel participant, with Brandon Ballengée and Betsy Damon with Peter Anders, chair, AESS Conference. 12 June, PACE University, New York.

(2014) 'Art's Critical Role in Linking Climate Science with Global Engagement'. Symposium discussant, with Marina Psaros, Natalie Jeremijenko, and Valerie J. Amor, discussant and moderator. AESS Conference. 13 June, PACE University, New York.

(2014) 'Dirt Dialogs'. Poster prepared for exhibition and subsequent book (2015 publication date) curated by Alex Toland, for the 20th World Congress of Soil Science. 8–13 June, Jeju, Korea.

(2013) 'Trigger Point Theory: An Idea Model for Large Landscape Restoration in the Anthropocene'. Panel presenter, Dawn R. Magness, chair, 'Session 1.02: Restoration Ecology at Large Scales II', at the "SER2013 World Conference on Ecological Restoration: Reflections on the Past, Directions for the Future". 8 October, Monona Terrace Community and Convention Center, Madison, WI.

(2013) 'Un/Natural Occurrences'. Artist and Scientist Panel participant with Peter Fend, Eve Mosher, Susan Goethals Campbell, moderated by Gary Golden. 27 September, Central Booking, New York.

(2013) "'Fish Story" Workshop' presented for 'Memphis Social', curated by Tom McGlynn. 7 May, Crosstown Arts, Memphis, TN.

(2013) 'Superstorm Sandy: Before, During and After'. Poster presenter for 'Nature, Ecology, and Society's 12th Annual Colloquium'. 8 March, City University of New York, New York.

(2013) 'Trigger Points After the Storm'. Hosted evening event/discussion in 'Philosophy & Ontological Apparatus Dialectic Revival Series', exhibition by Alyce Santoro. 21 January, Gasser Grunert Gallery, New York.

(2012), 'Using Media to Make Change'. Panel participant with Dennis Broe and Buck Moorehead, moderated by Claire Goodman. Eleventh Annual Big Mini Media Festival. 16 November, Long Island University, Brooklyn, NY.

(2012) 'Why We Restore: An Exploration of Values'. Panel participant during 'Restore America's Estuaries 6th National Conference on Coastal and Estuarine Habitat Restoration', 'Restoring Ecosystems, Strengthening Communities'. 20–24 October, Tampa Convention Center, Tampa, FL.

(2012) 'Tools for Collaborative Research in Complex Ecosystems'. Panel participant at 'ISEA2012 Albuquerque: Machine Wilderness' symposium. 19 September, Natural History Museum, Albuquerque, NM.

(2012) 'Modeling Innovative Outreach and "SOS (Science Outreach Society)" Gulf to Gulf'. Panel chair during 'International Conference on Culture, Politics & Climate Change'. 15 September, Millennium Hotel, Boulder, CO.

(2012) 'Trigger Point Theory as Aesthetic Activism, Environmental Restoration, and an Art Practice'. 7 March, Swiss Federal Institute of Aquatic Science and Technology (EWAG), Duebendorf, Switzerland.

(2012) 'The Art and Science of Environment Change'. Panel participant at 'Annual Meeting of the Association of American Geographers'. 25 February, Hilton Hotel, New York.

(2012) 'Visions for Water: Ecological Artists Modeling Solutions for our Challenged Water Systems'. Panel participant. 11 February, Cathedral of St. John the Divine, Cathedral House, New York.

(2011) 'A Better World by Design'. Conference panel participant. September 30–October 2, Brown University, Providence, RI.

(2011) 'What Ifs: Climate Change and Creative Agency'. Participant in panel moderated by Eve Mosher as part of 'U-n-f-o-l-d: A Cultural Response to Climate Change'. 12 October, Sheila C. Johnson Design Center (SJDC) at Parsons The New School for Design, New York.

(2011) 'Performing Ecology'. Workshop facilitator at ETH sponsored Ecological Novelty conference, 'Understanding and Managing Ecological Novelty: Towards an Integrative Framework of the Socio-ecological Risks of Novel Organisms'. 7 September, Monte Verita, Switzerland.

(2011) 'Trigger Points and Ecosystem Change'. Panel leader at ETH sponsored Ecological Novelty Conference, 'Understanding and Managing Ecological Novelty: Towards an Integrative Framework of the Socio-ecological Risks of Novel Organisms'. 5 September, Monte Verita, Switzerland.

(2011) 'The Art of Ecology: Transdisciplinary in Practice'. Panel participant at 'SER 2011 4th World Conference on Ecological Restoration'. 21–25 August, Merida, Yucatan, Mexico.

(2011) 'Trigger Point Theory as Aesthetic Activism'. Panel discussion and live webcast for 'Half Life: Patterns of Systemic Change'. 25 March, Santa Fe Institute of Art, Santa Fe, NM.

(2011) 'Trigger Point Theory as Aesthetic Activism: A Workshop on Restoring Degraded Environments'. Presented 'The Culture of Climate Change, 10th Annual Nature Ecology Society Colloquium'. 10 March, City University of New York, New York.

(2011) 'Trigger Point Theory as Aesthetic Activism'. 4 March, Centre for Contemporary Art and the Natural World, Haldon Forest Park, Exeter, UK.

(2011) 'Trigger Point Theory as Aesthetic Activism'. 3 March, University College Falmouth, Woodlane Falmouth, Cornwall, UK.

(2011) 'Trigger Point Theory as Aesthetic Activism'. 2 March, Drama Studio, Gaskell Building, School of Arts, Brunel University, Uxbridge, Middlesex, UK.

(2010) 'Leonardo Education and Art Forum (LEAF) at ISEA'. Workshop presented at ISEA 2010 RUHR Conference, Dortmund, Germany.

Group Exhibitions:

(2014) *Winter Works*, exhibit curated by Elaine Crossman. Vinalhaven, ME: New Era Gallery, 24 May–25 June.

(2013) *Holiday Show*, exhibit curated by Elaine Crossman. Vinalhaven ME: New Era Gallery, 29 November–31 December.

(2013) *Prints Drawings and Photographs 2013*, exhibit curated by Elaine Crossman. Vinalhaven ME: New Era Gallery, 31 August–25 September.

(2013) *Memphis Social*, exhibit curated by Tom McGlynn. Memphis: Hyde Gallery, Memphis College of Art, 10–18 May.

(2013) *One of a Kind IV*, exhibit curated by Heidi Hatry. New York: AC Institute, 4 April–May 18.

(2013) *Climate Change: Conveying Realities*, exhibit curated by Chris Cuomo. Athens, GA: eco*art*lab, 23 March–27 April.

(2013) *In the Green*, Online exhibit curated by Audra Bowsky. Woman Made Gallery available at:
<<http://womanmade.org/show.html?type=solo&gallery=inthegreen2013&pic=1>>, 20 March–22 April.

(2013) *One of a Kind III*, exhibit curated by Heide Hatry. New Brunswick, Canada: Owens Art Gallery, Mount Allison University, 11 January –24 February.

(2013) *It's the End of the World as We Know it (and I Feel Fine)*, exhibit curated by Amy Lipton. Mahwah, NJ: Ramapo College Art Galleries, 30 January–6 March.

(2013) *Works on Water* exhibit. Novato, CA: Marin Community Foundation, 5 October–5 February.

(2012) *Prints, Drawings & Photographs 2012*, exhibit curated by Elaine Crossman. Vinalhaven ME: New Era Gallery, 1–26 September.

(2012) *Beyond Landscape* exhibit. Novato, CA: Marin Community Foundation, 15 June–28 September.

(2012) *FiveMyles Benefit* exhibit. Brooklyn: FiveMyles, 14 June.

(2012) *Winter Works 2012*, exhibit curated by Elaine Crossman. Vinalhaven, ME: New Era Gallery, 26 May–20 June.

(2012) *Unbound – An Exhibition in 3 Chapters*, exhibit curated by Heide Hatry. Halifax, Nova Scotia: Dalhousie Art Gallery, 16 March–6 May.

(2011) *Horizon Lines*, exhibit curated by Amy Lipton. New York: ecoartspace, 9 October–30 November.

(2011) *Beyond the Horizon*, exhibit curated by Amy Lipton. New York: Deutsche Bank, 6 June–21 September.

(2011) *Water Aid*, exhibit curated by Alice Zinnes. New York: Benefit to fight hydrofracking, home of Joe Levin. 13–14 April.

(2011) *Oil Spill: Information Gulf*, gallery exhibition curated by Katie Avery. Santa Fe: Santa Fe Art Institute Gallery 1, 14 March–15 April.

(2011) *One of A Kind: An Exhibition of Unique Artist's Books*, exhibit curated by Heide Hatry. Cambridge, MA: Pierre Menard Gallery, 3–27 March.

New Website:

<http://www.gulftogulf.org/>

“Gulf to Gulf” Webcasts:

What Are We Responsible For? (2014) [Online] 8 May. Available at: <http://gulftogulf.adobeconnect.com/p3s5xj75yze/> [13 June 2014].

Answers from the Bottom Up (2014) [Online] 11 April. Available at: <http://gulftogulf.adobeconnect.com/p7zitu49ohm/> [13 June 2014].

Complexity, Virtuality and Feminism Part II (2014) [Online] 14 March. Available at: <http://gulftogulf.adobeconnect.com/p8nmjxtyq96/>. [13 June 2014].

Leverage 36% Green from Memphis? (2013) [Online] 12 November. Available at: <http://gulftogulf.adobeconnect.com/p2ql575r5ky/> [13 June 2014].

Women and Global Warming (2013) [Online] 2 October. Available at: <http://gulftogulf.adobeconnect.com/p4ufyjw4qw/> [13 June 2014].

Obama's New Standards (2013) [Online] 24 July. Available at:
<<http://gulftogulf.adobeconnect.com/p1g5dxbage6/>> [13 June 2014].

Fish Story: Connecting the River Dots (2013) [Online] 11 May. Available at:
<<http://gulftogulf.adobeconnect.com/p78xjxrzj38/>> [13 June 2014].

Connecting the Waters (2013) [Online] 2 April. Available at:
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PUBLIC⁴¹

ART | CULTURE | IDEAS

A photograph of a red paper bag containing green grasses, set against a dark background with a blurred light source.

Gardens

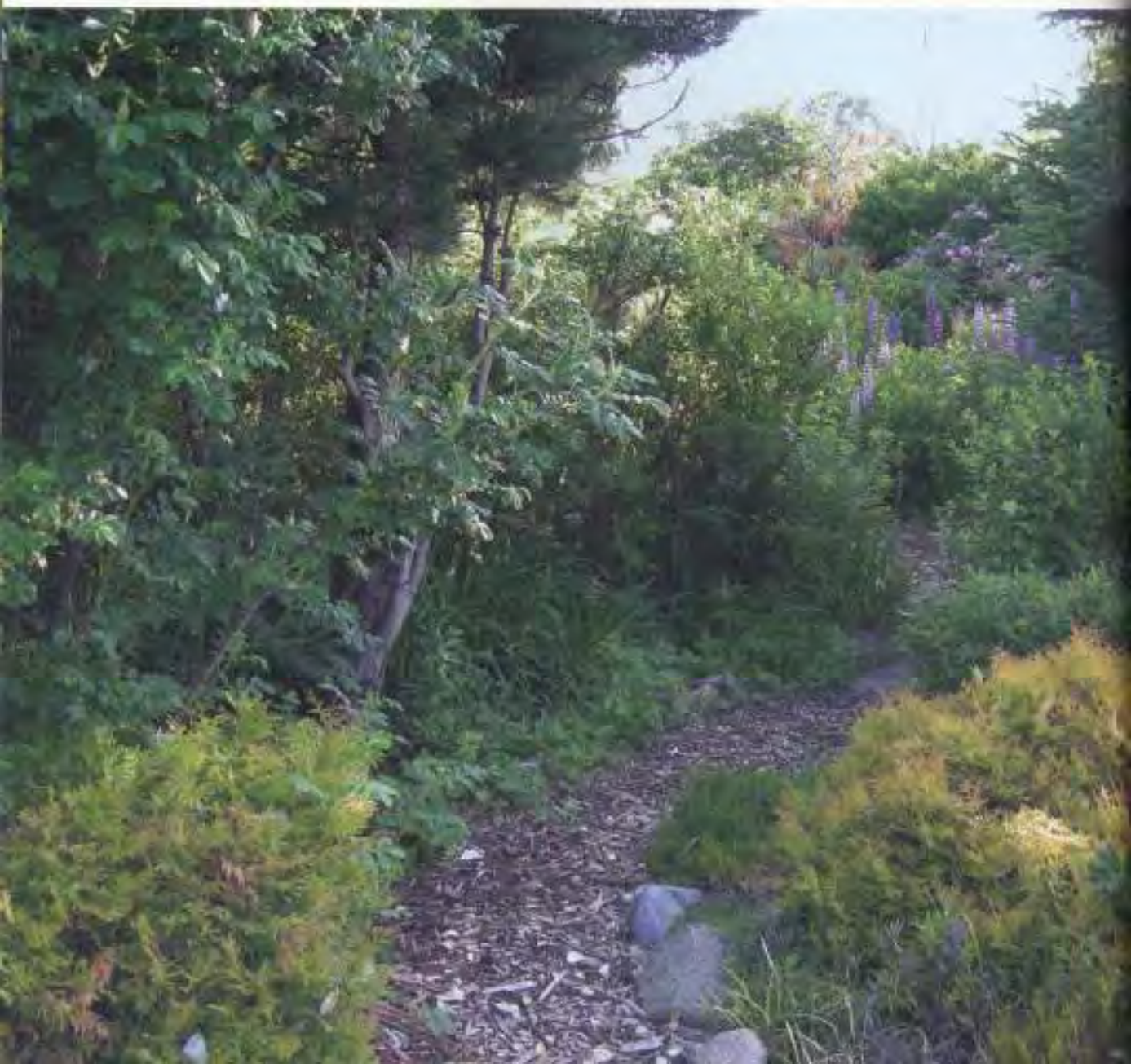
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Collaborating with the Earth

Aviva Rahman

Ghost Nets (1990-2000) was an ecological restoration artwork, named after the term for lost fishing drift nets that trap sea life. I chose the name because I saw my task as an unravelling of a lethal, tangled, ecological mess. The end product was the *Trigger Point Garden*, organized as a series of contiguous microhabitat restorations on the two and a half acre site of a former town dump. The garden articulated an experiment in what I call "trigger point theory," an approach to restoration that equally engages art and science.

In photographs from 1930, the *Ghost Nets* site can be seen as a bleak hill of granite tailings from the quarry industry, piled high along a man-made spit of land on Vinalhaven Island, Maine. The tailings created a deep water wharf on the island's southeast coast and buried the natural topography. The site became the town dump, and was subsequently abandoned, then designated for an ethanol plant. When I first encountered it, the uplands riparian zone had been dynamited for speculative development and looked like a pockmarked moonscape of blasted rock and bare, thin, sandy soil. Within weeks of my arrival on the island, I committed myself to reviving the site. I sold my former home in southern California and began researching northeastern indigenous plant species.

The Trigger Point Garden in June 2008. All photos by Aviva Rahman (unless otherwise noted).







The geomorphology of the site is characterized by its exposed location more than thirteen miles out to sea. Offshore, a cold water plume intersects the warm currents of the gulf stream. This confluence of forms and movements creates a rich tapestry of ecological edges that, in addition to supporting prolific seabird populations, helps support the still fertile fisheries of the Gulf of Maine.

The winds off the North Atlantic that visit *Ghost Nets* are routinely 50 to 60 miles an hour—strong enough that three new wind turbines generate power for two islands. Engineering is an ongoing maintenance concern. Each year, some of the rocks that protect the wharf are washed away. The winds routinely take down ancient trees and bend young ones, making off with shingles and collaborating with the waves to steal whole chunks of earth from the land in storms. During one spring storm in 1994, high tides and strong winds brought waves over the land to my wharveside studio with no break in the horizontal onslaught as far as the eye could see. There is always the sound of wind on the *Ghost Nets* site, sometimes soft and sibilant, sometimes a dull roar that ebbs and surges, creating syncopations. If wind indicates change as some Native Americans believe, the shape of the *Trigger Point Garden* must reflect the transformations I experienced on the site.

Monitoring the health of the estuarine restoration with fyke nets, Wells NERR, 2000.

In 1990, as I began work on the *Trigger Point Garden*, I physically collapsed and was diagnosed with a severe case of chronic fatigue syndrome (CFS). Simultaneously, I realized that I needed to recover from two decades of producing emotionally-charged art about abusive relationships. Trigger point theory was grounded on the premise that mutually healing relationships are possible between species, without privileging humans. My interpretation of physiological research into the causes of and cure for CFS segued into a study of bio-ecological data pertaining to the site, its position in both the Gulf of Maine and the northeast corridor for migratory wildlife species and elementary thermodynamics. I wanted to expand the healing model to include other species that inhabited or visited the site, creating a widening circle of collaborative healing, as well as a restoration model for small salt marsh sites in the larger Gulf of Maine. Trigger point theory speculates about what might happen if we restored a series of severely degraded sites, such as *Ghost Nets*. I believe that a very small area of strategic restoration can leverage large landscape impact.

In Western medicine, symptoms of CFS are isolated and treated independently. In traditional Chinese medicine, all disease symptoms are regarded as a blockage of energy in the whole system. Healing occurs when the source of the blockage is treated and energy is freed. In acupuncture, this is accomplished by stimulating points of intervention (trigger points). I perceived the original degradation of the *Ghost Nets* site as a blockage in the larger system of the Gulf of Maine.

From 1990 to 2000, I alternated hauling rocks and digging holes for trees with periods of bed rest, maintaining a core meditational focus on balancing observation and experimentation. On days I was bedridden, I studied scientific texts on restoration and photos I had taken of the maturing garden to understand how a small watershed in the north quadrant of the site connected to an even smaller estuary in the south. In hundreds of 4" x 4" sketches, I tracked ecological relationships between fresh and salt water systems, infrastructure and wildlife.



The *Ghost Nets* site, 1990. Photo courtesy of the Vinalhaven Historical Society.

Early on I noticed that the central axis of Native American Medicine Wheel iconography appeared analogous to circular corridor research on wildlife movement. This observation provided a blueprint for my work. Though I also drew inspiration from a number of aesthetic traditions and ecological design practices, many design details of the *Trigger Point Garden* were inspired by traditional Medicine Wheels. In a traditional Wheel, there is a "Fire Point" at the centre. In the *Trigger Point Garden*, I chose the centre point from one of several spring-fed water quarries on the site that have since filled in with reeds. Standing on a ledge above that quarry in 1991, I could see sky mirrored in its surface, making blue water the garden's heart, the "mirror point."

Before beginning major plantings, I tied a string to a stick stuck into the meagre soil near the mirror point, and I paced off measurements in all directions for the formal placements of boulders, paths, and large trees. Drawing on my Native American Medicine Wheel inspiration, canopy trees were placed in each of four geometric quadrants of the garden. As I planted the trees, however, I also laid out and planted paths for strolling. Following the natural bent of the landscape, imagining how it might have been before it was dynamited to yield its bones to quarrymen now long gone, I contoured surfaces with shovel and rake, applying what I learned from studying Chinese and Japanese gardens to mapping walkways. Today, walking between dogwood and the shimmering leaves of aspen, the water and far islands can be glimpsed as borrowed views seen in a measured rhythm of revelations between the twists and turns. This allows visitors to move from location to location, visually knitting the ecological systems of the watershed, riparian zone, and estuary, as well as the larger open landscape of sea and water. The paths are also permeable, allowing rainwater to seep back down into rock fissures, replenishing the local aquifer. Alongside each path are low plant communities, as well as trees, rocks, and boulders, which serve as monitoring points as well as places to sit and meditate.

While the *Trigger Point Garden* paths aren't geographically geometrical around a central axis as they might be in a traditional Medicine Wheel, the plantings are. Geometric configurations of plant communities separate enhanced microclimates and indigenous ecosystems, expressing an aesthetic in the spirit of William Robinson, who first introduced the idea of naturalistic design in English gardens in the late nineteenth century. The arrangements of colour, scale, and forage ecologies I chose referenced colour patterning inspired by the Native American Medicine Wheel, but were also experiments building on an interest in colour theory acquired as a student of Bauhaus principles at the Cooper Union School of Art and Architecture.

Finally, in the spirit of Masanobu Fukuoka, I created horizontal plant community networks, encouraging beneficial insects and foraging birds. Nitrogen fixers, such as Baptisias were vertically layered from canopy to ground cover, generating ecological benefits above and below the soil line. In choosing berry and fruit bearing shrubs, I followed the guidelines of the National Wildlife Federation Backyard Habitat Program for various birdlife, earning *Ghost Nets* a certificate of achievement as the 31,689th "mini-refuge."



Monitoring the health of the estuarine restoration with fyke nets, Wells NERR, 2000.

Collaborations with scientists were simultaneous with struggles for recognition and economic support of *Ghost Nets*. More than any other part of the site, restoring the estuary needed financial assistance. I wanted to prove to fishermen that even one third of an acre of marsh could provide critical spawning grounds for a quantifiable amount of the catch for their billion dollar industry. But when I looked for funding for the estuarine restoration, for monitoring, or to test my theories, I failed to make the case to funding agencies about the value of one small catalyst restoration site. During the decades I worked on *Ghost Nets*, the political priority was to fund very large tracts whose restoration could also provide dramatic photo opportunities. I tried arguing that pocket marshes are one half of the salt marshes in the fertile Gulf of Maine and must be serving critical functions. I pointed out that habitat dies from the outside in because wildlife corridors function circularly, not linearly; that habitat fragments provide essential connectivity; and that the opportunity to restore one small catalytic marsh perfectly, using it as a model and inspiration for others to do likewise, might be more important than supporting the size and capital investment in projects that would take far longer to accomplish. Large sites often languish for decades, diminishing each year with encroachment as they await "complete" funding. Eventually, encouraged in particular by my friend, the late artist, Allan Kaprow, I funded the bio-engineering work with a combination of in-kind support and my own savings. Perhaps the chief value of this expensive struggle was to force me to articulate my intentions for the *Trigger Point Garden*, preparing me to take ownership of a theoretical position, even as my health continued to improve.

Coming to the end of *Ghost Nets*, my challenge was proving that we had achieved a true "restoration." Without a baseline study, my only evidence was the rich soil found under the sixteen truckloads of broken granite debris we removed. In 2000, that empirical evidence was confirmed by Dr. Michele Dionne in a study conducted to monitor the health of the estuarine restoration, which netted a foraging haddock and eighteen indicator plant species.



Detail of completed *Blue Sea Lavender* event for 2009 *Site Specific* exhibition. Painted branches and granite chips, 45' x 70' on the surface of the parking lot for the Lane's Island coastal reserve.

In 1998, I photographed one lonely but vigorous volunteer of the then endangered sea lavender plant in the restored estuarine shoreline of *Ghost Nets*. It appeared in the granite rubble of the southern quadrant of the *Trigger Point Garden*, eventually inspiring a five-part, public art project in 2009, which created temporary "gardens" of broken branches and paint in sand elsewhere on the island, as well as *Blue Sea Lavender*, a film about our need to learn to negotiate with other species for our own survival. The *Trigger Point Garden* was, in these and other ways, always about more than moving rocks, digging holes, and watching water move differently. It was a way to experiment with changed relationships among people, environments, communities, values, and the earth.



CSIPA *Quarterly* WINTER 2010

ISSUE ON INTERNATIONAL ECO-POLICY AND ITS RELATIONSHIP TO ART & CULTURE



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COP15 | COPENHAGEN

PERFORMING THE PRESS CONFERENCE & WORKSHOP FOR TRIGGER POINT THEORY AS AESTHETIC ACTIVISM, COPENHAGEN 20

by Aviva Rahmani

THE HORIZONTAL PRESS CONFERENCE

My December 18, 2009 press conference in the Jasger Jorn room at the Bella Center for the 15th Conference of the Parties (COP15) was scheduled the same day President Obama was scheduled to arrive in Copenhagen. The same week that press conference was scheduled, outside Bella, at the invitation of Oleg Koefoed of Cultura 21 Nordic, I was scheduled to conduct a three-day workshop on the theoretical basis of my ecological art work. I was attending COP15 as an official observer and part of the University of Colorado (UC) Non-Governmental Organization (NGO). What I would see as an observer, was an effort on the part of many to help make sense of and advance progress on a problem shared by the whole world, regardless of what policy makers would say in plenaries. I was moved to notice that easily 50% of participants were under 30. But I saw an equivalent push-back from those determined to cast a blind eye on history, for their own short-term comfort and advantage.

What I experienced as an artist was neither light-hearted nor simple. But it was a lesson about what can happen when enough people converge on the same problem. The groups I was working, in touch, exchanging information with and learning about, from December 6-19, are too numerous to count. In addition to the UC group, Cultura 21 and Cultura 21 Nordic, they included Avaaz, the Yes Men, representatives from the World Bank, Island Nations, heads of American agencies, Greenpeace, 350.org, gallerists from Khoj International, New Delhi, India, ARTPORT and Poulsen

in Copenhagen, High Tide (for whom I blogged), the Climate Forum, the Climate Pirates, Culture Futures, the eco-art dialog, World Wildlife Fund International, European Union negotiators, the Center for Sustainable Practice in the Arts and the Danish police. The press conference was subsequently re-scheduled three times, as I worked with the United Nations press office to negotiate around the growing panic of conference organizers and police in the face of a perceived degeneration of civil control towards the end of COP15.

The press conference I planned to deliver would have challenged policy makers to include language about art-making in their adaptation policies for climate change. It would have given an example from my collaborative work with scientists. COP documents speak of the need to address the "aspirational goals" and support the "resilience" of vulnerable nations confronting the stress of adaptation to climate change. But they go on to define those goals strictly economically. As others pointed out, you can't address "aspirations" or resilience solely economically.

Early September 2009, Neena Bhandari reported from Sydney, for the IPC (which covers the United Nations) that "An agreement by 21 Asia Pacific Economic Cooperation (APEC) forum leaders on Saturday to adopt "aspirational goals" to reduce greenhouse gas (GHG) emissions has been criticised by voluntary agencies as grossly inadequate for saving the world from the effects of climate change."

Art is the glue holding societies and cultures together, particularly when they are under stress. In Copenhagen, the press conference became the art and it was a collaborative, intuitive production.

My experiences in Copenhagen were fraught with paradoxes. It was terrifying for what wasn't accomplished at the conference. It was inspiring for what I learned about work being done to mitigate climate change all over the world. Horizontal connections were made between disparate groups and individuals spontaneously connecting as equals at events that ranged from the formal reception and diplomatic plenaries of COP15 to the Climate Pirates who sailed into port from Germany and the vast demonstrations in Christiana. It was frustrating because my COP press conference never happened.

Everything that happened in Copenhagen was staged for layers of media and an international audience. In that sense, the critical days, from December 7 to December 18, were one continuous, anarchistic media event, with no single individual, group or nation consistently taking center stage. Ultimately, the whole world became the venue for a giant teach-in, in the form of the largest Happening ever. It was attended by millions around the world, some of whom were reporters, all of whom had a stake in our outcome.

Copenhagen was the site of multiple realities about global warming. Many of us simultaneously participated in a wide range of activities with a broad assembly of groups in attendance. In addition to blogging, I went to and participated in sessions at the Bella Center; helped work on the press conference for the Collaborative Program on the Ethical Dimensions of Climate Change (EDCC); showed up for various art openings and shows in the city, indoors and outdoors; participated in demonstrations; exhibited my own films; helped set up other people's installations; attended several other

COP15 - Focus



Photo: Aviva Rhamani

conferences; hosted a workshop; networked at the COP reception; had dinner in restaurants with various groups, where other attendees were also dining, and visited a few tourist sites, where ordinary Danes asked me about the conference while others staged elaborate art works to draw attention to global warming.

The media were all over the Bella Center during COP15. Island nations, as Tuvalu, Kiribati and the Maldives took center stage for the longest time, represented by eloquent spokespeople addressing what needed to be done and why. The press ran with their passionate stories.

At every turn in Bella, through the halls and before plenaries, colorful demonstrations were attended by masses of flashing cameras of every size and type. The extent to which sophisticated performance art has saturated activism and how funny many were was striking. The "Fossil Awards," gave out awards to the country that had most obstructed progress that day, with great pomp and ceremony, every evening at 6: PM to hundreds of cheering, jeering and singing COP participants.

Outside Bella, in the streets of Copenhagen, was an installation about immigration (of climate refugees) mounted by Sacha Kagan on the basis of a work by students at the CCC Programme of the Geneva University of Art and Design. It included credible yellow wet-signs with the text "Caution Border", police tape marking off parts of the street, printed with the slogan, "This is not a natural border" and slick black and yellow hand-out cards printed with provocative questions about borders. At demonstrations, the press caught glimpses of innumerable notable activists from every corner of the earth, from Wengari Maathi to Vandana Shiva. But the media also witnessed events turn violent at the hands of the Danish police.

Back inside Bella, at official Side Events, reporters took notes and shot pictures of government ministers speaking to crowded rooms, sometimes to the extent that many of us were sitting on the floor. In the Jasger Jorn room at Bella, press conferences filled out informational gaps in the Side Events held in other rooms.

After much internal conflict, I had flown to Europe for COP15, despite a previous vow in 2006, after Katrina, to reduce my carbon footprint by eschewing flight. The press conference I planned would have been an opportunity to present my work with Dr. Jim White, of the Institute for Arctic and Alpine Research, UC Boulder as a model for how we need to look at problems arising out of global warming, using virtual communications. The work with Dr. White has been premised on a series of experimental research projects applying Trigger Point Theory Theory as Aesthetic Activism to problems caused by global warming. We conducted our work in desktop sharing conversations, including other scientists and artists. The press conference would have included a presentation of our work, SOS Gulf to Gulf, comparing the impact of global warming on gulf systems internationally. It connects problems with Somali pirates, Katrina, education in Bangladesh, dead zones in the Gulf of Mexico and lobster migrations in the Gulf of Maine.

Trigger Point Theory is a way to look at situations and see where to apply the least pressure to effect the most change. Flying to Copenhagen, working virtually, doing a press conference in Bella, were ways I was applying that principle. My ideas developed out of my collaborative ecological art practice, from monitoring change at the sites of two environmental restoration projects I initiated and other related experiences. Trigger Point Theory as Aesthetic Activism evolved as a strategy to analyze causes of ecological degradation and create environmental restoration plans out of that analysis. It is presently my dissertation topic at Z_node, Institute for Cultural Studies, Zürich University of the Arts, (ZHDK) Zürich, Switzerland and the School of Technology, Communication and Electronics at the University of Plymouth England.

Trigger Point Theory works by diagnosing a very small "patch" (in the language of landscape ecology) in a degraded system, comparable to identifying an acupuncture trigger point on the body of the earth, in a greater degraded ecosystem, whose restoration could catalyze regional healing for a larger landscape. Acupuncture

identifies tiny points in systemic meridians of energy flow. Comparably, many indigenous rituals also seek to harmonize human needs with a whole ecology approach to sustainability. Diagnosing and identifying that process is the heart of my theoretical work.

The Trigger Point Theory Theory as Aesthetic Activism workshop was held in the Global Room at Verdenskulturcentret, in Copenhagen. The workshop brought together a number of people concerned with global warming who were involved in events that month. The participants represented a spectrum of interests from those engaged in the most radical demonstrations to simply concerned citizens.

The workshop was organized around applying Trigger Point Theory to our various activist concerns with free-hand mapmaking. I presented approximately twelve premises to observe situations for possible "Trigger Points." As, how to identify where many factors come together, creating ecological edges that enhance each other and the importance of establishing buffer zones to insure resilience.

The last day of the workshop was scheduled the morning of the second scheduled date for my press conference: Wednesday December 16. It was rescheduled when word spread that NGOs would be issued secondary passes to enter Bella towards the end of the last week of sessions.

What I had to say in Jasgar Jorn had been transformed by my first ten days in Copenhagen. The press release I wrote Tuesday night opened with,

"Protestors world wide see COP15 as a conflict between money and legalisms. This press conference asserts that this is why art needs to be at the table. Art can help build capacity and facilitate the adaptation COP15 needs to address with vulnerable nations. We will present SOS Gulf to Gulf, a virtual model for a role for art in creating resilience."

COP treaty negotiations need input from artists because art conveys the "aspirational goals (COP15 treaty language)" of culture. Culture is what contains civilized behavior despite chaotic transitions. Much of the plenary discussion framework was about the crisis

of adaptation to the effects of global warming. Yet there was no mention of art's role in cultural sustainability.

That afternoon, violence against the demonstrators on the part of police closed down Bella to anyone who hadn't already entered that morning. I went there anyway. After much discussion, the police allowed me to hand 500 press releases for distribution through the fence gaps erected around the building to Marilyn Averill, the UC's NGO coordinator, who was already inside.

After the Wednesday closure and cancellation at Bella, we rescheduled the press conference again, back to Friday morning. No one knew what would

registrants, effectively locking me out of the building and closing my door to Jasger Jorn and the webcams there. Instead, the Friday before I left, I recorded the press release I'd prepared for COP15, at the Poulsen Gallery, for the Yes Men and Avaaz.

The Yes Men and Avaaz had set up a fake Bella Center (Good COP15 <http://www.good-cop15.org> shadow Bella Center). They taped a number of presentations, some of which have been mounted on the website. The tapes illustrate that everyone has aspirations in relation to global warming. Most are light-hearted, often humorous general proclamations and wishful statements about the world we need.



Photo: Aviva Rhamani

What was ultimately seen by the world beyond Copenhagen didn't just come from Jasger Jorn, the Poulsen Gallery or the streets. It also came from hundreds of blogs (including my own <http://high-tide-cop15.blogspot.com/>) and a thousand candle light vigils around the world, many initiated by 350.org, the group started by Bill McKibben. Arguably, 350.org was the most effective group because their message about carbon particle reduction was so simple.

The experiences of developed countries are particularly mediated through media. Media can be another venue for visibility or a portal for an audience to go to another site, another world. The denouement of COP15 challenged us all, arguably especially artists, to give some hard inspired thought to how we can help the media show people some new doors to open. What I might have had to say or what anyone else had to say, is part of an immense jigsaw puzzle. It may adequately address global warming if we can just wrap our brains around how to perform a really effective horizontal press conference.

THE ASPIRATIONAL PRESS CONFERENCE

"When we take "aspirational goals" seriously for the Least Developed Countries (LDC), we see that the arts in each culture and between cultures are a means to express aspirations, sustain its people, bridge communication gaps and be a container for important historical information, including indigenous environmental knowledge. Art is a means to intimately connect people." - excerpt from my SOS Gulf to Gulf press release prepared for COP15.

The international experiences we're having now because of unchecked global warming terrifies any sane person. Global warming can also be connected to terrorism. The consequences of rising carbon emissions include massive migrations of culturally disrupted climate refugees, for whom terror and rage are appropriate responses. The fact that many of these disrupted cultures have a history of sexism, privileging violent machismo in response to crisis and excluding women from full socio-political participation, contributes to chaotic behavior. Contemporary art that confronts

this complex reality is an intensely intimate expression of connection between people, binding the aspirational goals of all life. In Islamic Jihadist rehabilitation, the creative act of "making" is considered a healing option to violence.

The meaning of doing a press conference as an activist performance in Copenhagen (COP15) for me, hinged on defining an artist's relationship to policy. My intention for the press conference had been to provide context for and an alternative model from which to negotiate.

The first week at COP15, when I met and briefly worked with EDCC, I paid close attention to how they framed the need for accountability in the treaty policy language and made the decision to follow their example. One of the discussions that stuck most firmly in my mind centered on the relationship to press as partners in public education. I realized that in addition to presenting a new model, I would need to provide a new definition of art.

At the end of the second, informational page of my press release, I wrote (with references to treaty documents):

1. Gender issues relate to questions of art and culture. Disproportionately, artisans in indigenous cultures are often women. Their practices often preserve the, "land use, land-use change and forestry sector"; and represent how to "respect the knowledge and rights of indigenous peoples, (including their free, prior and informed consent). Deforestation is often a consequence of the cultural disruption that displaces gender roles.
2. Art and humanities foster creativity throughout all sectors of society. In transition periods, creative problem-solving is as essential to survival as financial or regulatory support.
3. The costs of sustaining cultural communities in relation to other ecological costs is not only minimal but has historically transferred wealth in a variety of forms back into an economy. This will help cultures in transition maintain identity and independence, a response to the need to, "develop low-emission [high growth sustainable] development strategies."

Early 2007, Marda Kirn put Dr. Jim White and I together to develop a collaborative

project for the "Weather Report" show on global warming, curated by Lucy Lippard for the Boulder Museum of Contemporary Art. White and I began work with a passionate commitment to explore how to address global warming. Our work together further radicalized us about the urgency of associated problems, particularly migrations. A few months later, the idea to attend COP15 and hold a press conference there began gestating at a party after the opening. A number of us were sitting around a kitchen table, including Subankhar Bannerjee, Mary Miss, Lillian Ball and Marda Kirn, talking about art's role in public policy. I suggested we hold a joint press conference in Washington, D.C., to present our ideas. Over the next few months, we tried to organize something. But the logistics daunted us and the plan went on my back burner for a year.

Late 2008, Jim and I began working together again and the same questions about migrations arose. It was then that I said I wanted us to go to Copenhagen (COP15). Dr. White couldn't go but by August 2009, I had my official status to attend. Simultaneously, Oleg Koefoed, who had organized the Culture Futures conference the first week of COP15 in Copenhagen, invited me to lead the Trigger Point Theory as Aesthetic Activism workshop.

Many of us who came to Copenhagen are still making sense of what happened there, what was accomplished, how we all connected and where we might go from here, from islands to artists. Post COP15, the larger degraded landscape to restore has emerged as the "aspirational goals" of this planet. It still needs mapping. But one thing is clear, change will come, if it comes at all, from horizontal coalitions in civil society, taking the messages we all heard in Copenhagen and beyond, from press conferences to policy people to the world. Artists are poised to take a great part in that adventure.

Aviva Rahmani is an ecological artist, whose art work has reflected environmental and social concerns throughout her forty-year career. Her projects range from complete landscape restorations to museum venues that reference painting, sound and photography
www.ghostnets.com

Fish Story Memphis: Memphis is the center of the world

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Fish Story Memphis: Memphis is the center of the world

Aviva Rahmani

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Abstract In this article, artist Aviva Rahmani describes her methodology for an ecological art project about environmental restoration in Memphis, TN. The city of Memphis attracted her because it is in the middle of the third largest watershed in the world on the Mississippi River, the sixth largest river on earth. *Fish Story* was a transdisciplinary collaboration with paleoecologist Dr. James White and wetlands biologist Dr. Eugene Turner for Memphis Social, a citywide exhibition. The project launched May 4, 2013, and culminated with an installation that opened to the public May 11, 2013. It was a test for Rahmani's Trigger Point Theory, an approach to environmental degradation that locates nucleation sites to catalyze bioregional restoration for large degraded ecosystems. The *Fish Story* goal was to identify trigger points in Memphis and explore their activation. Fish were identified as iconic taxa, whose welfare reflects the welfare of the waters humans depend upon. As fish go, so go people. The story of fish is the story of our human future.

Keywords Transdisciplinary · fish habitat · Mississippi water basin · Trigger Point Theory · nucleation · performing ecology · participatory mapping · Anthropocene era · Geographic Information Systems · GIS science

As an ecological artist, I take responsibility for scientific competence in my experiences as an affiliate at the Institute for Arctic and Alpine research (INSTAAR), University of Colorado at Boulder (UCB), as a researcher with the Zurich-Node group of the University of Plymouth, UK, and in completing a certificate in Geographic Information Systems with City College of New York. I have worked to redefine public art to include personal accountability to bioregions and environmental justice. That is a form of social practice in relation

to the environment that I call “performing ecology.” My work includes creating transdisciplinary¹ (Nicolescu 2008) strategies to engage constituencies, finding points of leverage for large landscape ecosystem problems, that I call trigger points (Rahmani 2012) and discovering new knowledge from these processes. My aim is to effect resilience for water and habitat in the Anthropocene.

In 1990–2000, I completed my environmental restoration project, *Ghost Nets*.² It became the basis for my current research practice and is a case study for my dissertation, “Trigger Point Theory as Aesthetic Activism.” Additional large-scale restoration projects have included *Blue Rocks* which led to the restoration of 26 acres of wetlands in 2004.³ *Ghost Nets* also led to my project for Memphis, *Fish Story*, the second case study for my dissertation. The content of *Fish Story* evolved from *Gulf to Gulf* (2009–present, publically available as a series of raw webcast mini-think tank recordings)⁴ which has examined the relationships between global warming and gulf regions internationally. *Gulf to Gulf's* core group has been a small team of scientists and myself. After the BP spill in the Gulf of Mexico, we dedicated our time to strategizing ways to deal with connections between the impact of extractive industries and climate change. Fish, such as *Micropterus dolomieu* in river systems (Hilty and Merenlender 2000), are indicator taxa for environmental disruption. We began focusing on how fish habitat might indicate where to intervene in large systems such as the Mississippi Basin watershed, which became *Fish Story*. Our work is fiscally sponsored by the New York Foundation for the Arts (NYFA), enabling us to raise money as a tax-deductible project. This article will discuss the goals and methodologies of *Fish Story* in more depth.

¹ Transdisciplinarity, as a practice that transcends boundaries between the humanities and the sciences, has been promulgated as an answer to the Anthropocene. See Nicolescu, Basarab's “Transdisciplinarity: Theory and Practice.”

² More information about the project can be found at www.ghostnets.com.

³ For images and additional information, visit <http://womanmade.org/show.html?type=solo&gallery=inthegreen2013&pic=1>.

⁴ Recordings can be publicly accessed by visiting <https://vimeo.com/user4960423/videos>.

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In 2012–2013, at the invitation of curator–artist Tom McGlynn, cofounder with Bill Doherty of “Beautiful Fields”⁵ (awarded the domestic 2013 franchise support grant from apexart), our team created *Fish Story* for Memphis Social, for 3 weeks in May 2013. “Beautiful Fields” is a team of artist–curators who assembled exhibitions to “address the notion of the social as both context and subject.” “Memphis Social” was a citywide group exhibition of works about social context (Koeppel 2013).

My plan for *Fish Story* was to create a public art project to engage people in the conservation and restoration of waterways. I hoped that following the fortunes of fish might help us locate at least one restoration trigger point that could effect larger changes (Rahmani 2012). Memphis is the center of the world symbolically and continentally.⁶ It is significantly located along the Mississippi River. The Mississippi River Basin watershed serves 18,000,00 people,⁷ is the third largest in the world, but is heavily polluted by factory farming upstream. That pollution contributes to dead zones in the Gulf of Mexico downstream (Burkholder et al. 2007). The city of Memphis has been characterized as a racially divided, economically depressed community in which large numbers of young people have little access to opportunity or quality education. These factors make it a paradigm for the kinds of global circumstances and conflicts that affect water quality worldwide. In addition to locating a trigger point, our goal for this project was to find new knowledge about resiliency for Memphis riparian zones, watersheds, animals, and people. We conjectured that research towards implementing this project would support our observations that the local river tributaries would be where we might find our trigger point, for example in the continued restoration of the Wolf River.

I based *Fish Story* on the premise that talk alone does not solve the kinds of urgent environmental challenges we face today. Some knowledge about solutions comes from body experience, especially in contact with others (embodiment). Some comes from meditation. Some comes from our senses, e.g., listening to sound, activities, or working with soil and plants. And some comes from talking. This holistic approach is shared by many who are part of an embodiment movement that goes back to John Dewey's (1938) work.

Developing *Fish Story* from *Gulf to Gulf* culminated 3 years of work. My collaborators included Dr. R. Eugene

Turner,⁸ ecologist and Distinguished Research Master and Professor, Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, LA; Dr. James White,⁹ paleoecologist, Professor of Geological Sciences and Director of INSTAAR at the University of Colorado at Boulder; and others, to identify where we can intervene in ecological devastation. *Fish Story* was the first on-the-ground application of our thinking. In 2012, James Bradley, executive director at WebServes,¹⁰ joined the team as our technology consultant and is presently developing an educational website for students of wetlands restoration, based on this project.

When we decided that fish were the way into the larger issues we wanted to address, we launched the project in October 2012 by inviting people to share their personal fish stories for the Pushing Rocks blog.¹¹ Fish were chosen because for many people, the life of a fish is as invisible as the source of their tap water. On my blog, I wrote about other topics that fish seemed to parallel. I linked human homelessness and dying fish. They both reflect symptoms of dysfunctional systems that have sacrificed many human and nonhuman lives. A dramatic example was the failure of New York to adequately respond to Hurricane Sandy (Gibbs & Holloway 2013). *Fish Story* worked to increase awareness towards restoring degraded ecosystems. It was about global warming: knitting bioregions and connecting dots to environmental justice, one critical location at a time.

Here was my fish story:

I remember the only time my Father invited me to go fishing with him. It was a sunny, warm day. I was four. In our rowboat out on the water, he had a can of worms, from which he pulled a fat candidate with one hand, while lifting a hook with the other. Suddenly, I realized he meant to thread the sharp, steel point through that small, soft, helpless creature's body and I began shrieking, sobbing uncontrollably and inconsolably, as, shocked and confused, he stared into my face. That was how I first learned where dinner came from.

As an artist, I designed four phases of activity for *Fish Story* for Memphis in May, to build on and offer different approaches to considering regional water. Participants were invited to enter or exit the project from several locations, platforms, and events.

Fish Story for Memphis began May 4th with a canoe trip. I trained for several months in preparation for that event, despite health issues, regarding it as an “endurance

⁵ See <http://www.beautifulfields.org/>.

⁶ The phrase “Memphis is the center of the world” refers to a time when cotton dominated economic life. “Memphis is the cotton center of the world!” That statement, made in 1959 by Gerald Dearing, a columnist for the Memphis Commercial Appeal, expressed how the city on the Mississippi River served as the throne room of the cotton kingdom. “No city depended more on the white gold that flowed into its warehouses and onto its wharves, and no city embraced cotton as did Memphis.” (Brown 2011)

⁷ See <http://www.nps.gov/miss/riverfacts.htm>.

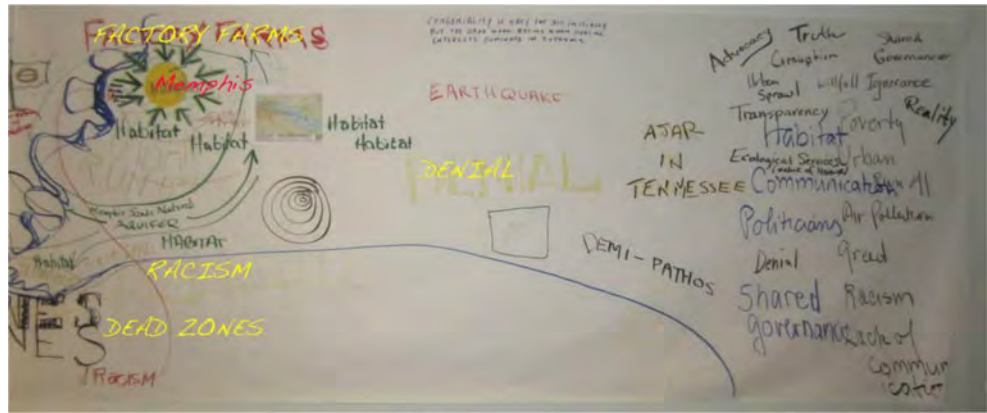
⁸ See <http://www.oceanography.lsu.edu/turner.shtm>.

⁹ See <http://instaar.colorado.edu/people/james-w-c-white/>.

¹⁰ See <http://webserves.org/>.

¹¹ See <http://www.ghostnets.com/blog.shtml>.

Fig. 1 A 6 ft×30 ft participatory map generated from the Anthropocene Game for *Fish Story* © Aviva Rahmani 2013



event,” paralleling what I believe the Anthropocene requires of us all. Dr. Turner and I started our canoe trip at the end of the Ghost River where the Wolf River begins, which then feeds into the Mississippi River. We were accompanied by six river guides from the Wolf River Conservancy, who were charting that section of the river for the first time. The Ghost River is an ecosystem replete with poisonous snakes and beautiful bottomland wilderness but struggling to recover from clear-cutting and invasive privet. The Wolf River continues through a series of contrasting city demographics to where the tributary was diverted by the Army Corps of Engineers where it should reach the Mississippi.

Participatory mapping is a way to visualize how things fit, from water to despair. On May 7th, I led a workshop at the Crosstown Arts Gallery to produce participatory maps that would contribute to a larger public installation at the Memphis College of Art. Participants were asked to play the “Anthropocene Game,” an exercise in role playing causes of environmental degradation, to spend a short period in meditation and listen to a song before they

began the mapping. (See details of the resultant participatory mapping in Figs. 1 and 2).

I had first created and tested the Anthropocene Game at the Gasser Grunert Gallery in New York City, January 21, 2013, to address the effects of Hurricane Sandy¹² and concerns about fracking.¹³ Sandy was one symptom of a new phase of environmental change confronting humans with new challenges. The “game” was designed as an experiment in employing embodiment techniques between strangers to find new knowledge. As in Memphis, a meditation took place after the game and before a group discussion. During the meditation for both events, I sang an a capella French art song, “Au Bord de L’Eau,” by Gabriel Faure to the group.¹⁴ The song line sounds like running water. I believed it evoked a state of mind that could leave the group open to thinking differently. During the playing of the “game,” physical contact was encouraged under controlled rules, to express the dominance on future events of one influence or another.

My premise for singing the song was that how we come to observation is framed by every aspect of our consciousness. I believed the sensual experience of listening to music like water, filtered thru the human voice, helped contextualize analytic thought about water.

After our meditation, the group generated the map of factors to be addressed to connect the bioregional and environmental justice elements of Memphis and reveal a trigger point. The most striking comment was that racism is a significant impediment to progress, perhaps indicating that it might be the trigger point we must address to restore environmental health to the region. In response to a brief questionnaire distributed after the event, one respondent replied to the question:

“Q: What did you learn?”

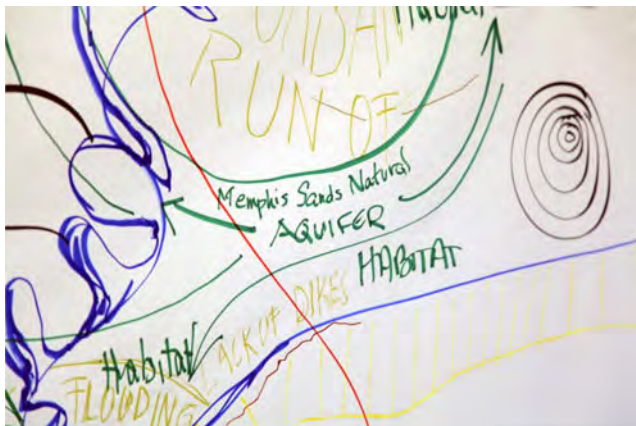


Fig. 2 Detail of 6 ft×30 ft participatory map from playing the Anthropocene Game © Aviva Rahmani 2013

¹² For impacts of Hurricane Sandy on New York City, see http://www.nyc.gov/html/recovery/downloads/pdf/sandy_aar_5.2.13.pdf.

¹³ Discussion of New Yorkers' concerns about fracking can be seen at <http://blogs.plos.org/publichealth/2013/06/18/what-is-the-health-impact-of-fracking/>.

¹⁴ Vocalist Aviva Rahmani accompanied on piano by Debra Vanderlinde. The recording can be heard at <http://www.youtube.com/watch?v=iRtqnCuZUE>.



Fig. 3 Photo by Lester Merriweather—Installation detail from the Hyde Gallery, with audience, showing a view of a 107 in. × 432 in. painting of the local river systems and cutouts of endemic fish © Aviva Rahmani 2013

A: ... insights into the interconnectedness of various forces at work.”

The following several days were devoted to installing documentation from the river trek, the workshop, the participatory mapping, and other events at the Hyde Gallery in Memphis College of Art (Fig. 3). The installation included a printed statement that said an adequate response to global warming might be to regreen the earth by 36 % by 2030.¹⁵

The last phase of activity was a live webcast conversation “Connecting the River Dots”¹⁶ with ecological art practitioners: curator Yvonne Senouf of M.E.L.D.,¹⁷ who spoke about endangered river systems in Athens, Greece; artist Eve Andree Laramee¹⁸ who addressed radioactive hazards worldwide; artist Ruth Hardinger¹⁹ who presented the impacts of fracking on watersheds (Silverstein 2013) and *Fish Story* team member Dr. Eugene Turner and myself.

This constellation of events was designed to ask how fish will survive the Anthropocene, the era when humans have come to dominate every aspect of life on earth. Many scientists believe no living species has evolved to cope with this level of rapid change, and in fact, many species of fish are disappearing, some because of the indirect effects of warming waters (Eklöf et al. 2012). We are experiencing what I call a “collapse of time,” since we entered the fast phase of climate change in 2010, forcing urgency upon us all. Many people respond to urgency with fight or flight, but collaboration across disciplines and background is another option that may

be equal to this collapse of time. Art and artists are trained to respond to circumstances with the speed of intuition. Scientists contribute insight based on quantifiable data. Working collaboratively, in a transdisciplinary manner with art and science, communities can pool knowledge bases and constituencies for greater resilience. In the Anthropocene, even racism may yield to knowledge.

In conclusion, we observed that the tributaries are indeed a critical part of the Mississippi water basin puzzle, but so are people. Trigger points for change in the Mississippi watershed will require not only the sustained efforts of ecological restoration scientists working on the Wolf River, but far more extensive plans for public education about, and engagement in, restoration. That engagement must include the regional participation of young people who will inherit the mistakes of their elders, particularly from the inner city areas of Memphis. *Fish Story* was a modest initiative towards accomplishing the long-term goal of devising strategic responses to environmental damage in the Anthropocene era. This project provided a beginning to effect the 36 % greening Dr. White calculated might be imminently required of all humankind. Our experience was that art may play a significant role in changing necessary public paradigms for thinking and behavior. It was an incentive for further research and experimentation to build on lessons learned.

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¹⁵ That correlation was developed between White and myself for *Fish Story*, May 2013.

¹⁶ Recording of “Connecting the River Dots” can be found at <https://vimeo.com/67578327>.

¹⁷ See <http://meld.cc>.

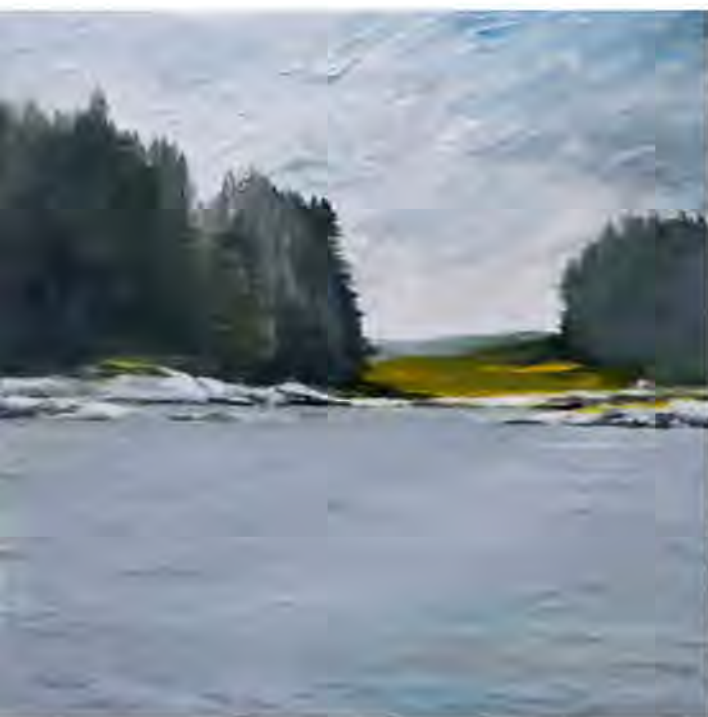
¹⁸ See <http://evelaramee.com/>.

¹⁹ See <http://www.ruthhardinger.com/>.

I came to Vinalhaven Island, Maine, in 1989, when it was an artist's dream of a remote place to forget the world and concentrate on beautiful light; a place at the end of the world to treasure and protect like an adorable child. In truth, the reality was I came to an alien fishing culture and bought the town dump, transformed it into flourishing wetlands, Ghost Nets, and then sallied forth at intervals into the world, knowing I still had this toehold on a Shangri La I was clinging to like a limpet.

It is January 25, 2010 and we are enduring a noisy lashing rainstorm that put out our power for an hour, instead of a decent, silent blizzard. It isn't that unusual to have rain here at this time of year but it is also not usual.

I miss the certainty of winter white in dead quiet. I miss gazing at the boreal Spruce forest that is already beginning to migrate, knowing it will be that same green forever. I miss the cardinals I used to see in the spring-time. I carefully watch the faces of fishermen who can't catch lobsters the way they used to, because they are moving to colder waters. I see for sale signs on properties whose families can no longer pay their mortgages, are losing their boats not because of the economic downturn, but because our ocean wilderness is changing. I miss a secure shoreline at high tide that won't drown my studio at the end of my deep-water wharf. When the spring tides come now in a storm, I wonder if this will be the one to carry away my life's work.



Caption

Some of what worries me is the loss of albedo, or the reflective value of snow, ice and ocean surfaces. Some of what worries me are the new responsibilities we all have.

In Copenhagen, the gap between South Pacific Island states facing extinction and the Maine islands seemed dramatic. But Mohamed Nasheed, president of the Maldives spoke for many at COP15, when as the Cassandra of the proceedings; he warned that no island, no coastal region would be spared the consequences of rising seas. The goal is for the Maldives to become carbon neutral. Island nations in the South Pacific such as Kiribati and Tuvalu are facing full evacuations, imminent land and cultural loss and have become inadvertent models of adaptive behavior.

The survival strategies of the poorest island nations were presented at COP15 with modest grace. Kiribati described its resources as "sticks and sand" and presented a moving display of their cultures' songs and dance to a packed audience of enthusiastic supporters while passing out handmade necklaces of local shells. Tuvalu has advertised its needs with the film, *Trouble in Paradise*. It's strategy was to challenge the remaining almost 200 nations of the planet to be responsible to all. Kiribati and Tuvalu both proclaim they want to stay on their land but are assessing what transferrable skills they can contribute as new immigrants to other lands such as Australia. They are well aware that no nation welcomes immigrants today. In a study of public attitudes towards their crisis, Kiribati natives describe their responses to their plight as primarily fear and grief.

There was a time when any island was a symbol of remote refuge. Now islands worldwide are suddenly in the position of becoming mentors to the world, even as we face a new and frightening vulnerability.

I miss the way I used to experience time. Climate perceptions were slow and steady. Decisions could be made quickly. Now climate is a rushing train and when we make quick decisions, they are often wrong. For example, we put wind turbines on our island but didn't anticipate the effects of terrible noise pollution on a number of residents, including terrified chickens and ducks.

Models prescribed by island states are three pronged. First is the courage to demand transparent, accountable binding treaty agreements of the larger nations, including our own federal government. Islands nations and Least Developed Countries (LDC) took political leadership in Copenhagen, achieving the suspension of COP15 negotiations until a binding agreement could be transparently agreed upon. This diplomatic crisis forced developed and developing countries to public accountability. The second prong is enlisting help to map regional vulnerabilities such as to hurricanes and tidal flooding. Third is reinforcing shoreline buffering while developing emergency plans for evacuation when and if necessary.



Caption

In the face of global warming, islands are rebuilding barrier reefs, reinforcing coastal buffer zones with indigenous plantings and seeking funding to create models of where rising seas will reclaim land in the next decades. We know the international dimensions and complexity of migration problems will increasingly effect serious socio-economic and political disruptions. Causes include desertification from drought and deforestation, as in Africa and salt water intrusion into aquifers, as in Bangladesh. Island states provide examples of discreet planning for calamity. They are early warning systems for land loss in other communities as climate change continues.

It is tempting in Maine, founded on stable granite rather than a fragile atoll like Kiribati, to presume such concerns are remote. But as the representative from Tuvalu stated, and most scientists concur, what Tuvalu faces today, we will all face tomorrow.

The effects of global warming are felt first in equatorial regions, as in the Pacific islands and Africa but most dramatically at the polar extremes. Accelerated and extreme impacts will begin to be felt by 2030, in most of our lifetimes and certainly that of our children. In Maine, our spruce, lobsters and many songbirds are migrating or disappearing.

Generally, Maine is considered one of the best-prepared states in the United States. Hawaiian planners reference work done in Casco Bay. But speaking at a COP15 side event on coastal preparedness in the American

pavilion, Thomas Strickland, head of the U.S. Department of the Interior stated:

Task forces can assess sources of danger and vulnerabilities and have plans in place for eventualities. In addition to fresh water and development, some concerns might include: economic impacts, storm water run off and infrastructure resilience, costs of protections, assessing ecosystem services lost, prioritizing what to protect and value as salinity moves up into estuaries, modeling and habitat equivalency, changes in habitat spatial distribution, cost benefit analysis of restoration vs replacement and between conservation and adaptation.

This is not exactly how Maine islanders are used to treating our shoreline. We have enjoyed a cavalier sense of entitlement to dispose of marshes and expand lawns to the low tide mark.

I wasn't born here on Vinalhaven Island. I didn't feel entitled to bury wetlands. But I did come here imagining it was a not only a precious child but a safe womb. And it was, in many ways, for many years. No more. It is a place, like all islands today, that is being forced to grow up, to parent the world even as the world drowns us.

Aviva Rahmani...

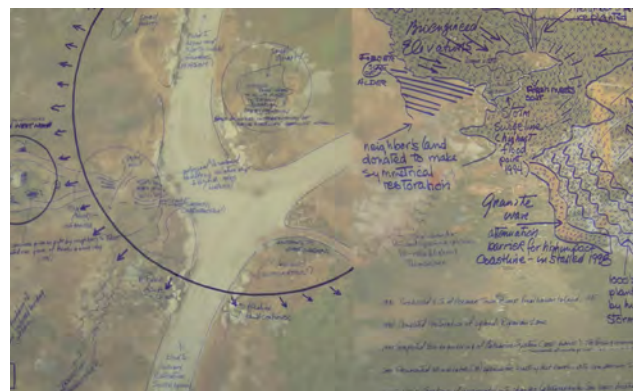
Mapping Trigger Point Theory as Aesthetic Activism

AVIVA RAHMANI, MFA

KEYWORDS Cartography, ecological art, ecological degradation, ecological restoration, environment modeling, Geographic Information Systems science (GISc), GIS abstraction, mapping, participatory mapping

URL <http://www.ghostnets.com>

ABSTRACT Geographic Information Systems science (GISc) is often used by policymakers to analyze relationships between statistical data and precise geographic locations. In this essay I have considered how GISc information about land sites may be integrated into a performative ecological art practice as well as how art may contribute to land management. Ecological art is defined here as endeavors whose Deep Green agenda may catalyze on-the-ground ecosystem support. The objective for *Mapping Trigger Point Theory as Aesthetic Activism* is to show how using GISc combined with art practice to identify and advocate the restoration of small sites may catalyze efforts toward large landscape environmental rehabilitation. Such efforts may function as environmental triage for landscape biomes. On a small scale these nucleus sites have been effective triggers for forestry restoration, identifying habitat remnants to anchor bioengineering. It is more difficult in coastal marine zones because the terrain is harder to control. This essay will describe how Trigger Point Theory evolved after the Ghost Nets coastal marine site ecological art project (www.ghostnets.com, 1990–2000, FIGURES 1–3) and is being developed to contextualize sites by combining performance art with GISc. This effort continues in a predictive modeling project to identify sites where restored eel grass beds might support finfish resilience. Presently, non-native, predatory green crabs are devastating forage fish stocks at the bottom of the food chain on both coasts of North America. Initial cartography used performance and participatory mapping to intuitively identify relationships. In modeling terms, art became an “expert witness” to inform the site analysis. Trigger Point mapping is part of an integrated strategy of science and art that seeks to identify modeling rules, addressing where resilience can be restored to degraded regions.



FIGURES 1, 2 AND 3: *The Ghost Nets* site focused on a section of land that, originally, was the site of a deep water wharf for schooners bringing stone to eastern cities. The site fell into neglect until it became the town dump (above, upper image). The site was purchased in 1990 by the artist and restored in 1997. The project moved through interpretive installations, such as this composition of the three sculptures exhibited at the Center for Maine Contemporary Art, Rockport, Maine 2002 (center image). This gained public awareness of a representative “trigger point” site. The lower image (above, lower image), is a drawing (detail) on tracing paper over digital photographic collage of changes to the site over time. Original aerial photography by Ben Magro 2007, integrated artwork by the author.

INTRODUCTION

In 1958, Allan Kaprow, in his elegy for Jackson Pollock, famously suggested that art might now move off the canvas and into everyday life. Since then, art has indeed done so—it has moved into every aspect of daily life, including the management and interpretation of data streams.

One particular rich set of data is geographic data. In the last decades Geographic Information Systems (GIS), have increasingly become the method by which to layer spatial and statistical data. As an artist, I originally approached GIS with caution, daunted by its complexity. However, as GIS has emerged as a powerful policy tool used by city planners, federal agencies, political analysts and other institutional entities, it has also been embraced by artists. It is a visually effective tool because it can precisely locate relationships between spatially located objects (geographic, infrastructural) and the “hidden” (air pollution, hospital admissions, food web dynamics) drivers of environmental change. It can also predict the cumulative impact of multiple drivers over time through the layering and correlating of data into visual models. These capabilities are especially intriguing to ecological art restoration because disparate elements can be positioned on a biospheric continuum. The biosphere conceptualizes the organization of the biotic and abiotic elements of large habitat systems into landscape scale aggregations of habitat and species distribution in relation to geomorphology. The study of that organization in evolutionary terms is biogeography. GIS science (GISc) references the academic theory that such spatialization modeling can uniquely result in effective analysis and interpretation. The outcomes from these efforts can inform policy on the local and global level (an example is the modeling done by the Intergovernmental Panel on Climate Change [IPCC] to determine sea level rise). GISc is the science of using algorithms to analyze the spatial variables of GIS layers of data. GISc layers statistical data with geographically precise depictions based on satellite and GPS data and then queries the algorithms to determine relationships between information that can be used for policy decisions. As an artist, I first became interested in using GIS in the nineties to analyze biogeographic elements of the sites I was involved with. I began by working with scientists who had mastered the technology.

This essay will address some of the unique opportunities and issues that emerge when an ecological artist engages in GISc as an extension of site analysis, specifically, in relation to a working hypotheses about leveraging landscape scale restoration. This led to the premise of trigger point theory as aesthetic activism, which emerged from my practice. My formal study of GIS in the Geography Department at

Lehman College, City University of New York (CUNY), and my studies in information mapping allowed me to produce effective work on a biospheric level. With the growth of GISc skills my thinking concurrently evolved about data visualization. Some aspects of which I will discuss in an attempt to redefine the opportunities under the contexts of: participatory mapping, expert witnesses, the relationship between biogeography and geopolitics in regional planning with google maps, and landscape scale predictive modeling in relation to particular problems about biodiversity.

Beginning in the mid-nineties, I collaboratively partnered with GIS cartographers. Against the benefits of collaboration where limitations, including the maintaining of a separation between art and science as well as the reduction of intuitive perceptions and insights that always arise when an artist has hands-on experience of a media. It has only been recently that I segued from my dependence upon those partnerships to support a continuum of performative art in my practice. I now combine drawing, sculpture, and painting representations of site characteristics in tandem with performance techniques as preparatory work for each site toward generating my own GISc spatial analysis. I have found that a division of labor, in which my task is intuitively visual-poetic-philosophical research, and my collaborator is the tech person generating verifiable data, to be a rather clumsy interface. Hence the objective toward learning to create my own GIS maps. But my own path to understanding how to use GISc has been as challenging as it has been creatively provocative about how to conceptualize information.

The hypothesis underpinning this essay is that a biogeographic GISc analysis can be combined with tools from an art practice to more effectively determine where to target restoration efforts. Data mapping has been one way I structure my ecological art practice. A premise behind this hypothesis is that support for human survival depends more on recognizing our place in biogeography than presuming and accommodating the privilege of anthropocentric concerns. A critical sub-claim of Trigger Point Theory is for the necessity to integrate GISc, in the context of an holistic ecological art practice, to identify small sites in a large landscape whose restoration can effect regional restoration. Trigger point theory as aesthetic activism originated from my ecological art practice while restoring degraded sites in Maine and investigating the potential to restore numerous other sites internationally. Trigger Point Theory developed in my ecological art practice as both a hypothesis and a method to address massive environmental degradation—with minimal

intervention. My interest in GISc is to establish replicable interpretations of data which can test my insights about landscape biomes. My focus is on using GISc to analyze relationships between natural resources, environmental degradation, and built infrastructure for the purpose of designing ecological solutions to threshold change. Threshold change is the point when so many features of an ecosystem have been removed, that the entire species community irrevocably collapses to another state.

GISc goes beyond cartography, regardless of how precise, into a separate scientific predictive modeling discipline. The implications are vast and fragile: in addition to spatializing statistical data for policy decisions, the world of GISc, peopled by remote sensing, satellite captures, and band widths is a worldview unto itself. GIS is sometimes subject to atmospheric vagaries, outright equipment failure, or other causes for diminished accuracy. As with any constellation of electronic devices the data is more or less dependent on the accuracy of the data that is collected. Despite these limitations, using GISc allows us to claim how many degrees the earth's temperature might rise in thirty years. Nonetheless, if the statistical data is at all imprecise, the entire policy determination can be called into question, as recently happened with IPCC figures. Predictive modeling in general, especially agent based modeling, is designed to address and compensate mathematically for uncertainty and unpredictability. For that reason, expert systems are routinely introduced into the algorithmic design. (An expert system is a source of data from outside the loop of familiar information sources, as, for example may be a fisherman who can uniquely add empirical data to an understanding of marine food webs dynamics.) In the case of the spatial analysis of potential restoration sites, my empirical observations of regional landscape features—from the point of view of an artist—have provided an “expert system” of additional data.

Before the current ubiquity of GISs, Ian McHarg, often called the father of modern landscape architecture, used similar layering techniques to analyze a site with various information sources; information that then functioned as composited layering, albeit without the precision of GISc, before engaging in any site work. In my work with GIS specialists, or on my own, my goal is always to substantiate the layered perceptions that drive my design strategies. The perceptions I initially brought to the mapping process came from more conventional aesthetic research practices, such as: photography, painting, or drawing, walking a site to observe details, listening and reflecting on what I experienced.

The methods used were eclectic. The first time I systematically applied biogeographic principles to identifying a site for restoration was in 1990, when I initiated the ecological art restoration work, *Ghost Nets*, to restore a coastal town dump in Maine, on a fishing island, to a thriving uplands riparian zone and flourishing wetlands by analyzing large landscape water systems. Based on the information I had in 1990, I believed we were confronting a critical decade of environmental choice, particularly in relation to water and set out to create a paradigm of what might be an answer to that threshold of change. In preparation for choosing the site, I spent several years studying maps of the United States in relation to water availability use and patterns of climate change. Once I decided where to start work, I began making sketches of the geomorphology and microhabitats, eventually graduating to satellite imagery and an increasingly more detailed conceptualization of how to identify small sites which might act as “trigger points” in degraded regions to effect sustainable change. In addition to studying maps and learning about the site from local people, particularly fishermen, I appropriated metaphors as a set of conceptual “expert witnesses” to guide my research.

Metaphors that guided my reflections included ghost nets and acupuncture. I chose the project title, from the lost fishing drift nets that strip mine the sea, called ghost nets. They represented the paradigmatic metaphor of extractive thinking and behavior I hoped to escape: the trap of the “lethal-familiar.” I considered the biosphere as a web of energetic meridians, like acupuncture, in which trigger point restorations might function to release blocked energy and perform what I came to call, “environmental triage.”

The metaphor of acupuncture, supplying a layer of the performative meme, in the creation of *Ghost Nets* had several implications. One was that small interventions could have disproportionate effects, which would be both economic and natural advantage. Based on that hypothesis I had sought a very small area for the *Ghost Nets* project to test the possibility of catalyzing efficient restoration. The process might be perceived akin to the use of acupuncture to free the meridians of blocked energy in the human body, the precise application of the acupuncture needle has a multiplied effect. In forestry, small patches of remnant habitat are often identified for “nucleation” to trigger successional restoration. Nucleation is a somewhat different idea than trigger point theory but it is related to the premise that it is possible to identify a small starting point to effect large landscape change. My goal with GISc

became to marry spatial analysis to intuitive aesthetic skills. Nucleation is an example of an established precedent for leveraging small areas for restoration. The spatial analysis of biogeographical options would focus that precedent and house the marriage between hard conventional restoration science.

BACKGROUND

My history with mapping had began much earlier, in the sixties. It was sparked when I took a computer language class at the University of San Diego at La Jolla and became so fascinated by the diagramming of logic. I began designing complex “mind maps.” As an ecological artist working with the analysis, interpretation of, and intervention in large landscape degradation, mapping became an essential part of my toolbox to make sense of the information that is the raw material of my practice. I came back to mapping periodically until the eighties, when I began studying biospheric regions more systematically. My performative motivation to study the mapping of bioregions in the late eighties was to find a physical site which might serve as the actual location of a research platform for what I anticipated would be the “decade of environmental change (1990–2000).” In the late nineties, I collaborated with geologists at the College of the Atlantic and at the University of Southern Maine to investigate spatial relationships. My aim in learning GIS for myself was to design an experimental system that would allow me to test trigger point theory as aesthetic activism. This idea, that (small) strategically identified restoration sites in degraded areas could catalyze large landscape sustainability required proof. My task was to demonstrate how ecological art functions as an expert witness system to contribute new knowledge to hard environmental modeling science about the impact of restoring small sites.

EMERGING PRACTITIONERS, AND OPPORTUNITIES OF GIS

GIS had been imbued, for a long time, with the masculinized aura of an IT in-group. Cold war time research was an impetus to begin combining spatialized analysis and remote sensing for more accurate identification and interpretation of land conditions. GIS, locationally based in GPS technology and its cousin, remote sensing, has played an important role in strategic military technology (for example, to identify nuclear ballistic missile warheads). GIS developed from conventional cartographic work which aimed to indicate the precise physical location of points, lines, and polygons. This information was primarily used for targeting and military logistics, or by domestic policy

makers, primarily male. This is changing. Professor Juliana Maantay, former Chair of the Earth, Environmental, and Geospatial Sciences Department, and founder and director of the GISc Program at Lehman College, City University of New York, recently commented that her classes, “used to be dominated by men but increasingly, it is a field being infiltrated by women and now women seem to dominate most classes.” The department has a particular interest in environmental justice and Maantay’s Geographer-at-Large blog banner quotes, “Geography, sir, is ruinous in its effects on the lower classes. Reading, writing, and arithmetic are comparatively safe, but geography invariably leads to revolution.” (1879 testimony before a Select Committee of the House of Commons, London, England, regarding expenditures of the London School Board). This quote illustrates the implicit relationship between GISc and activism.

As an environmentally activist artist, this makes GISc even more attractive. Conclusions from GISc work can support policy in everything from: the health sciences, to projections for animal corridors, to determine regulations for endangered species, to choose where to build a high rise development or a freeway. Outside of academic and governmental circles it is often used by NGOs in combination with participatory mapping for indigenous groups to pass along ecological tribal knowledge in efforts to fight back against extractive industries. When GISc is used with participatory mapping, it invites a community to “mind-map” regions and include the input of expert witnesses (people outside the mainstream of conventional knowledge systems who can provide special insight into an area). Thus intuitive data can then be layered with GIS, in this manner GIS permits non-professionals to analyze instances of environmental injustice. GISc queries aggregate statistical with spatial data to indicate where problems can be anticipated. An example would be comparing projected mining sites to the locations of endangered natural wildlife habitat.

PROJECTS AND PRACTICE

Cartographic GIS can be combined with contemporary installation design to lend mathematical, objective precision to visualizing intuitive, subjective extrapolations. In such a manner, scaled up examples allow viewers to literally walk through the cartography. In 2000, when *Ghost Nets* was completed, I began working more directly with GIS on urban restoration as I began a new decade-long project, *Cities & Oceans of If* (FIGURE 4). In an installation completed with GIS in collaboration with Dr. Irwin Novak, University of Southern Maine I asked Dr. Novak to help



FIGURE 4: Detail of “If” installation at the Maine Center for Contemporary Art, Rockport, Maine

me identify all the open space within a certain buffer distance of the local estuary that had been long since filled and converted into a public park, Back Cove. We analyzed the zoning data on land adjacent to Back Cove, Portland, Maine to identify where open space might be used to establish ecotone linkage, providing flooding protection, water filtration and habitat buffering for the local estuary.

In 2002, working with the Vinalhaven Land Trust, as Chair of the Natural Resource sub-committee of the Town Comprehensive Plan, we mapped 600’ buffer zones (the optimal distance to protect water quality) around fresh

water in order to determine where development might occur without impact on the sole source aquifer. The purpose of that mapping was to investigate water conservation, and as in the example of the Back Cove map, the effort was an essentially cartographic endeavor. That mapping was generated on the basis of empirical data, rather than expert witnessing. Subsequently, the committee voted not to release the map, this to avoid engaging in the politics of various stakeholder landowners. In 2002, using freehand skills, I traced the GIS maps provided by the Land Trust. Layering data about shore bird nesting sites, soils analysis, fresh water bodies, and other geomorphological features using the old-fashioned means of vellum and colored pencils I created a composite of these natural resources. These tracings provided a crude spatial analysis of where the greatest biological diversity should logically be situated with it’s spatial relationship to the *Ghost Nets* site. My goal was to visualize how a series of restored trigger points might have a synergistic effect on the landscape.

The site identified, was a narrow causeway created by the Army Corps of Engineers one hundred years ago. As part of a public art event, “Site Specific,” curated by Pat Nick, I created an art event, “Blue Rocks,” to draw attention to the site (FIGURE 5). At that time the causeway was characterized by foul and stagnant water. 70 Boulders were painted with a slurry of ultramarine blue pigment, buttermilk, and pureed local mosses. The slurry

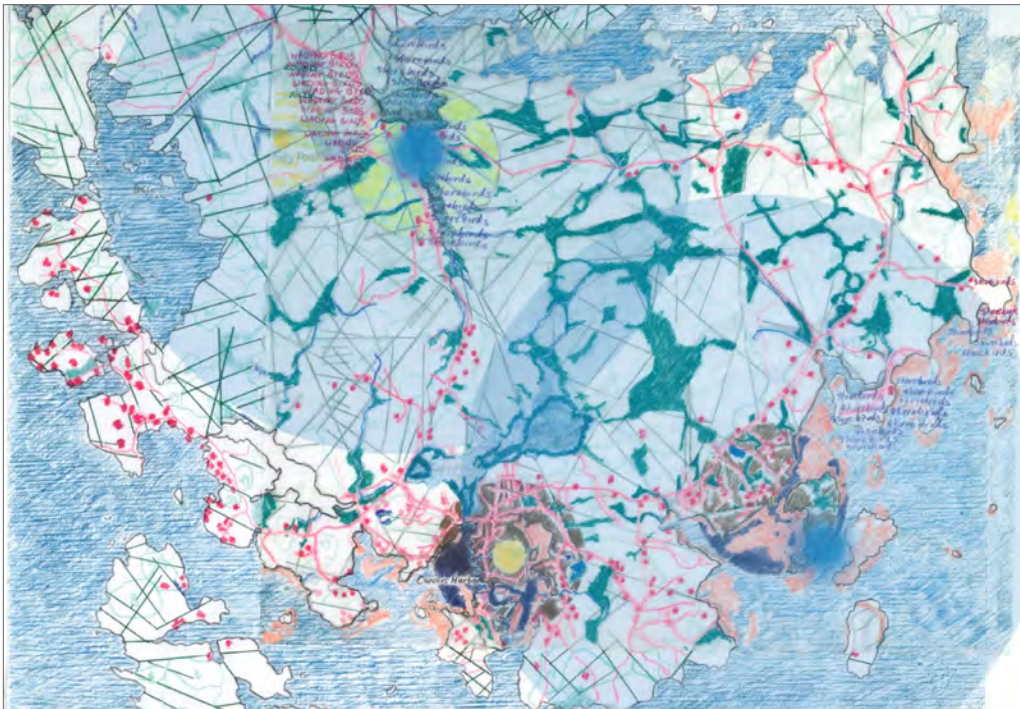


FIGURE 5: “Blue Rocks,” an Analysis of overlapping Trigger Points

would have encouraged more moss growth as it decomposed. In time, controversial attention to the site functioned as a catalyst toward a kind of “*de facto*” participatory mapping. When asked to wash the rocks of the blue pigment I complied with a very public “wash-in,” this rose awareness of the wetlands issues. Increased attention to the site ultimately led to an investment by the USDA to restore 26 acres of wetlands totaling more than \$500,000. Based on the revived biodiversity of the site those 26 acres have very successfully recovered. The restored site is now an island tourist attraction for the generous natural beauty and wildlife there. This is empirical evidence for how trigger point theory as aesthetic activism can function.

Empirical, anecdotal and intuitive data emerge from participatory mapping. This data can operate as expert systems to guide more verifiable GISc queries. In *Cities & Oceans of If*, I studied maps to visualize where and how I thought Trigger Points might be restored with landscape-scale implications. I began the process in 2000; over the next decade, as I continued to analyze sites, particularly in relation to their buffer zones around water, ecotones of transitions between habitat, I began to intuitively see more global linkages and biospheric relationships which might have benefitted in depth from the skills of GISc.

In conducting research for over fifty sites that interested me to various degrees, I spoke to the people I encountered and looked for scientists to partner with whom could verify my intuitions and empirical observations. One such individual was Raji Agarwal with whom I collaborated virtually in 2006 in the analysis of water issues affecting New Delhi, India. This collaboration was facilitated through Khoj International. In 2007, I began working on line in desktop sharing sessions, generating maps based on Google Earth with geobiochemist Dr. Jim White, Director of the Institute for Arctic and Alpine Research (INSTAAR), University of Colorado at Boulder,

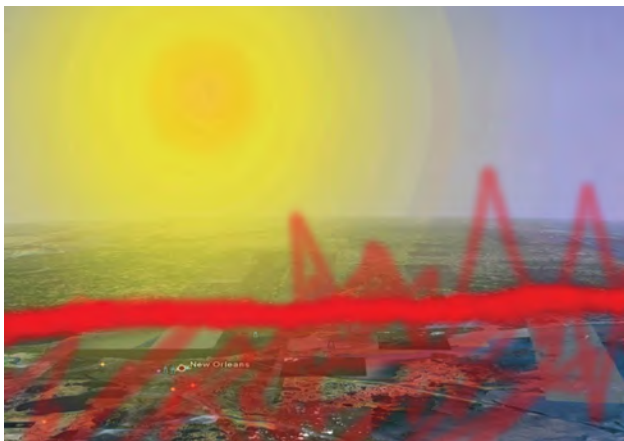


FIGURE 6: *The Louisiana Coastline in 2030*

Colorado. We began our collaboration as part of the *Weather Report* show organized by Marda Kirn and curated by Lucy Lippard, for the Boulder Museum of Contemporary Art, Boulder Colorado in 2007. We have continued our mapping-based virtual collaboration with regular webcasts. In our collaboration, our roles as informed expert witnesses became interchangeable as we analyzed climate change data. In FIGURE 6, we used Google Earth to consider where the coastline for Louisiana might be in 2030 assuming uninterrupted global warming as now modeled (for Baton Rouge). The horizontal red line indicates the highest possible tidal line based on the geomorphology, soil subsidence due to extractive industries, and projected sea level rise.

We studied how climate change immigration patterns from Bangladesh will have intercontinental implications. The graphic was generated in photoshop during the live desktop sharing conversation session through WebEx on google earth satellite imagery. In a series of webcasts with scientists, we have often traded places as expert witnesses exchanging information, to discuss geopolitics with Google maps, as in the relationship between China, India, and Bangladesh over their access to water from the Ganges. The text, “Trouble,” emerged as we discussed the geopolitical urgency of the need for fresh water between these three nations. For, as the ice pack of the Himalayas which feeds the Ganges recedes, the Ganges is progressively diminished as it travels to the rice paddies of Bangladesh, there to be salinated inland by sea-level rise. This is another example of where more precisely spatialized statistics could bridge the difference between subjective commentary and impact on foreign policy. But the map still makes the graphic point that distress, migrations of vast populations, and unrest may be inevitable for the region. In regional planning, if the often irrational patterns of geopolitics would not be a consideration, such a map developed with GISc, could be used by regulatory agencies to insure adequate water for all. As a resource to apply trigger point theory as aesthetic activism, I might additionally use the same information to design vegetative infrastructures for bioremediation and filtration around reconstructing local ecotones within those buffer zones to conserve the dwindling water resources.

In peer-reviewed restoration science monitoring is critical in order to generate replicable results and prevent falsification of premises. Using GISc, this is made more possible based on relatively limited data. In 1999, two years after the bioengineered daylighting and restoration of the salt marsh at the *Ghost Nets* site, the dynamic vitality of the habitat was monitored by the Wells National Estuarine Research Reserve (Wells NERR). Although the

site was found to be healthy, a provocative finding was the presence of a European Green Crab (*Carcinus maenus*) in the stomach of a haddock caught in the Fyke Nets (these are nets shaped as bags, generally held open by hoops) used for specimen collection. Green crabs, inedible to most animals, including humans, were first documented in 1867 at the Boston Harbor. They apparently arrived as hitchhikers with ship's ballast. They later populated to become a voraciously predatory species, (*carcinus maenus*) which typically grow to six centimeters in length.

Green crabs have since become a serious threat to finfish on both coasts of North America, threatening the fishing industries and the stability of marine food webs. The discovery of the green crab in the haddock's stomach (at the Ghost Nets site) implied the possibility that if a finfish could survive to a certain size, it might be able to consume the crabs. Considering these implications would develop into a GISc project, tracking the relationship of different marsh systems to food web dynamics. In addition to the evidence that a finfish had consumed a green crab (whether or not nutrition might be derived for the fish), there was evidence that higher quantities of crabs were found at the restored site. This was possibly due to a shoreline that still had much granite rip rap from a former island quarry industry. In comparison, the pristine control wetlands site had fewer crabs, where presumably, there were fewer niches in which the crabs could hide. This implied that different marsh geomorphologies might present opportunities for different food web dynamics, for some of which, the finfish might have a competitive advantage over the green crabs. The monitoring results from Wells NERR begged additional questions about whether green crabs were edible for mature finfish and whether certain habitats generated a greater or lesser abundance of these invasive species. The answers to those questions about habitat variations could also answer whether there might be modest restoration solutions might be identified to trigger support for the finfish populations. It took another twelve to begin to design a model, using GISc to investigate this possibility.

DEVELOPING THE THEORY OF TRIGGER POINT

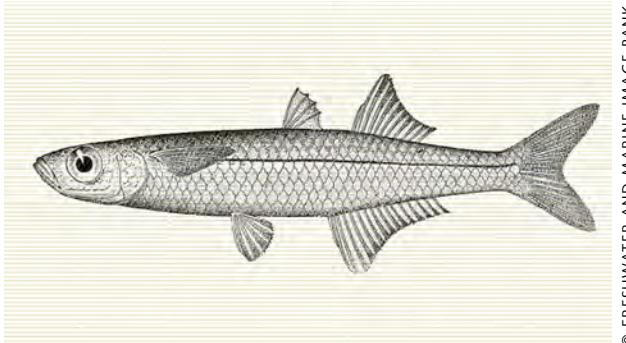
My previous experiments had not resulted in proof of theory for my hypothesis, because the data was neither replicable nor falsifiable. That motivated me—so, in 2008 I pursued a PhD on the topic of, “Trigger Point Theory as Aesthetic Activism,” with the goal of creating an experimental container to iteratively prove, or falsify, my hypothesis. I am now in my final year of writing the dissertation (Z-Node, University of Plymouth, UK) with an ecological

biologist, Dr. Angelika Hilbeck of Eidgenössische Technische Hochschule, Zürich, as my first supervisor. Wetlands biologist, Dr. Michele Dionne, Wells National Estuarine Research Reserve (Wells NERR) is my external supervisor. In 2010, when I realized GISc could be the container, I enrolled in the GISc certificate program at Lehman College.

I took on the task of experimental design for my dissertation topic, “Trigger Point Theory as Aesthetic Activism,” as a *performative* opportunity. The theoretical premises I am researching are suited to GISc because the questions are about relationships between salt marsh characteristics and the functional integrity of species in resilient balance. Taking ownership of the GISc technology, though daunting, allows me to explore spatial relationships more freely than I might in a collaboration which depends on someone else to produce the mapping. Identifying trigger point sites requires integrating what I can bring to the queries, based on my experiences as an artist, with the input of the expert system information of others. All that has to merge with the algorithms to make sense of statistics and lead to an argument to support restoration policy proposals. This would become my database for the GISc work. I thought the mapping might reveal relationships between variations in salt marsh habitat characteristics at those collection sites and the relative population abundance of crabs to finfish. The hope was that those correlations might indicate where to focus nuclear restoration efforts as trigger points in the system.

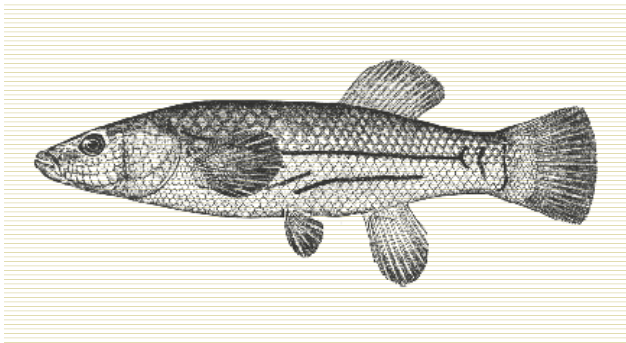
Data in the form of a series of shape files were downloaded from the Maine Office of GIS to generate the base-map. The resulting map included the collection study sites, bathymetry, topography, and coastline polygons. The raw data tables were then reconstructed with longitude and latitude for each site and reduced to four indicator species out of 18 for the tables.

It is commonly assumed that over-fishing is the primary cause of fisheries decline in the Gulf of Maine. However, it is now well known that the European green crab predation on finfish larvae has also accounted for dramatic population drops. It is also known that marine eel grass pastures are essential to fish spawning; these have been decimated by the movements through the grass of the crabs themselves, dredging, fill, shadowing beds with wharf structures, and other human activities. Mapping these relationships could indicate where relatively economical targeted restoration work, as, daylighting eel grass, could have dramatic impacts. In addition to the biomass of green crabs, calculated by dividing the gram weight of each specimen collection at each site by the square foot of the

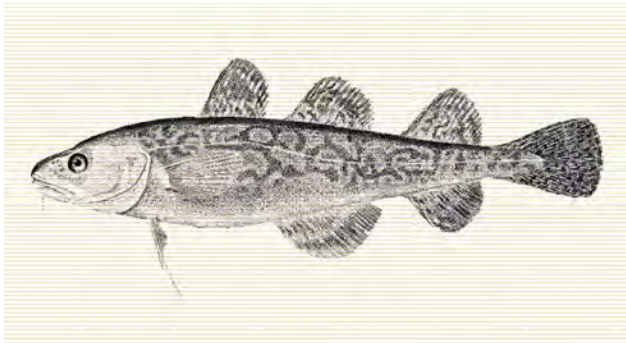


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Silversides (*Menida menida*) live in temperate marine and freshwater habitat. They average 4–5.5 inches long. (Drawing by Hugh M. Smith 1907)



Mummichogs (*Fundulus moholis*) burrows in mud and lives in sal marshes, depositing its eggs in dead vegetation. Average size, 5 inches. (Drawing by H. L. Todd)



Tomcod (*Microgadus tomcod*) swims between headlands and inshore, feeds on crustaceans (also liable to predation from green crabs) and spawns in estuaries. Average size is 9–12 inches. (Drawing by J. J. Waldbaum 1792)

FIGURE 7: Indicator species in the Gulf of Maine

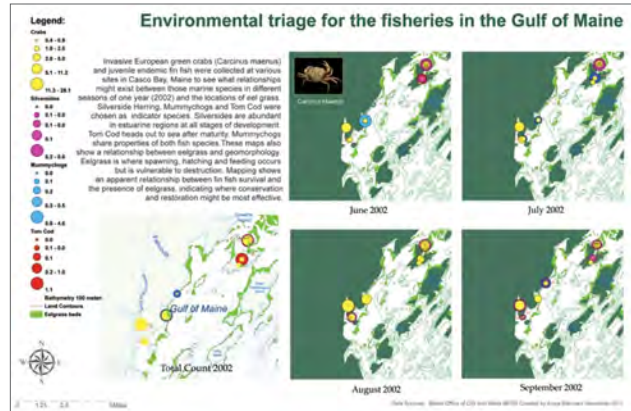


FIGURE 8: Environmental triage for the fisheries in the Gulf of Maine; Mapping European Green Crabs in relation to Fin Fish Abundance and Eelgrass bed locations in the Gulf of Maine

vegetation, for each of four finfish species calculated at each of ten sites, for each of four collection dates in 2002.

The four indicator species chosen, included the green crabs themselves, Silversides, Mummichogs, and Tomcod (FIGURE 7). These were chosen based on their migration patterns in relation to the coastline: whether they spend their life cycles primarily in estuaries, migrate up river, or spend most of their lives in the near coastal, open ocean. When it became clear that I didn't have enough information about the coastal shapes to correlate to populations, I downloaded polygons of the eelgrass beds, a critical habitat to support finfish.

The typical salt marsh site (such as the Ghost Nets restoration site) of the upper half of the Gulf of Maine is composed of small rocky intertidal sites of approximately one-third acre. It is a fair presumption that those marshes have a distinct function in the food chain, yet many of them have already been filled by development. The fishing industry is under pressure from a number of factors, including over-fishing, loss of habitat from fragmentation, and the impact of the predation of invasive species, again, such as green crabs. What I was looking for in the GIS map produced was whether specific sites could be identified to afford the greatest degree of support to finfish, thereby presenting a prototype model for which small sites might be targeted as trigger points. The preliminary mapping, using a limited collection of sites and events, indicated possible relationships between species populations and eel grass. These preliminary findings are being spatialized with GISc for further analysis (FIGURE 8).

Rules for spatial analysis derive from expert witness systems as indicators for how to modify GISc query systems. For example, a Rule might be introduced which states that

every time attributes are queried about relationships between finfish populations and green crabs a correlation will always be found with the depth of bathymetry and the extent of eelgrass bed. The idea of correlating community abundance and eelgrass had come from a casual conversation two decades ago with a fishermen, Ira Greenlaw, who described what he had observed about the use of eelgrass by lobsters. That relationship can now be built into the query of data layers for the analysis and visualization.

CONCLUSION

In the information age of anthropocene life, artists are working as much with data as physical elements and performance skills. GISc mapping becomes one more element to collage observations as any other art end-product might combine ideas. In this case of Trigger Point Theory as Aesthetic Activism the end product is an activist engagement in life, art as life, life as art and science, played out on a proscenium of global environmental degradation.

BIOGRAPHY

Ecological artist *Aviva Rahmani's* art work has reflected environmental and social concerns throughout her forty-year career. Her projects range from complete landscape restorations to museum venues that reference painting, sound, and photography. Aviva Rahmani is affiliated with Institute for Arctic and Alpine Research (INSTAAR), University of Colorado at Boulder, gained her MFA in 1974 from Cal Arts and is presently both a PhD candidate with the Z-Node of Plymouth University and a GISc certificate student at Lehman College, CUNY.

Rahmani's current work reflects her interest in the application of mapping analysis in order to "explore potential solutions for urban and rural water degradation in large landscapes." Rahmani has taught, lectured, and performed internationally. She is the recipient of numerous grants and fellowships, including two from the Nancy H. Gray Foundation for Art in the Environment, received in 1999 and 2000. She is currently using the internet "to perform residencies without the international travel that spews jet fuel over the earth's waters." *Virtual Cities and Oceans of If* and the on-going Virtual Concerts address global warming and geo-political conflicts by demonstrating, analyzing, and interpreting the local impact of global warming at international real world sites.

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Triggering Change

An experimental public art project in Maine leads to a call-to-action

BY AVIVA RAHMANI

In 1990, I bought a former coastal town dump on Vinalhaven Island, a fishing village in the Gulf of Maine 13 miles out to sea. I built a modest residence on the land and began the work of ecosystem restoration. When I first arrived, the location was remote in winter, cut off from the mainland by infrequent ferries and capricious weather. Isolation tested my internal resilience.

On Vinalhaven, I discovered the metaphor of lost drift nets, or “ghost nets”—monofilament fishing nets that trap and kill marine life. Ghost nets seemed a symbol of our tangled dysfunctions. That metaphor became the seed of *Ghost Nets*, a 10-year project and a laboratory for my notion of “trigger point theory.”

Trigger point theory is connected to the Chinese notion of *chi*, or *life force*, which is activated at trigger points on the body. This concept of chi is paralleled by basic principles of thermodynamics in the physics of how closed and open systems function. Trigger point theory and chi share ideas about activating energetic flow by identifying blockage points in biogeography.

Shortly after I began work on *Ghost Nets*, I was diagnosed with a severe case of chronic fatigue syndrome (CFS) that I have treated ever since with acupuncture. CFS taught me to make thoughtful choices about building systemic resilience. Acupuncture taught me that small interventions can have big implications.

Trigger point theory sees acupuncture as a model for an approach to restoring areas of large landscape environmental degradation with public ecological art: Artistic interventions in vital trigger points, such as my town dump on Vinalhaven, can—like the acupuncturist’s needle—activate broader ecological healing.

Determining the physical location and the course of action for “treatment” is a process of both analytic calculation and intuition, with layers of observations about environmental justice, bioregionalism, and speciesism.

In practice, I began my site work by walking it daily for an hour, listening to the sounds of weather and wildlife, singing with those sounds, making notes and sketches, and taking photographs. I regarded those activities as a performatory research project. My practice at the site expanded to include geographic information systems science (GIS), acoustics, meditation, experiments in game theory, drawings and paintings of the site, bioengineering, phytoremediation, and permaculture.

On days when I felt strong, I continued to walk the site over and over, observing with all my senses. On days when I could not, I meditated on how restoring land must be as deliberate as acupuncture on an ill human body. Identifying where to insert a needle to effect triage on the human body is analogous to acting locally, thinking bioregionally and globally.

Restoring health to degraded areas often begins with a point of nucleation, a seeding of plantings that builds on some remnant of healthy function. In my practice, I am often inspired by how physics can help us think about earth forces, or flow. In ecological restora-

tion work, this energetic flow is carried by healthy waterways, which depend on adequate buffering setbacks and animal corridors.

The art historian and critic Rosalyn Deutsche notes that supported public art often reinforces prevailing values. And certainly, public artists can be as thoughtless about their relationship to our ecosystem as can any other sector of society. Using trigger point theory, artists can take a different approach: one that combines activist interventions as a form of public art with the goal of healing the ecosystem.



“Acupuncture taught me that small interventions can have big implications.”

We live in times that present an extraordinary opportunity to artists to lead the way in such work. Every issue impacting the earth today, from economics to poverty, is either caused or exacerbated by ecosystem degradation. Artists can not only change perceptions, but help reverse this degradation. With trigger point theory, I have created a model that challenges and inverts prevailing values. My vision is that trigger point theory, combined with other strategies, can change public policies that degrade the earth.

My challenge to artists who work in the public realm is to show less interest in leaving their handprint on a site and to concern themselves instead with its transformation from collapse to vitality.

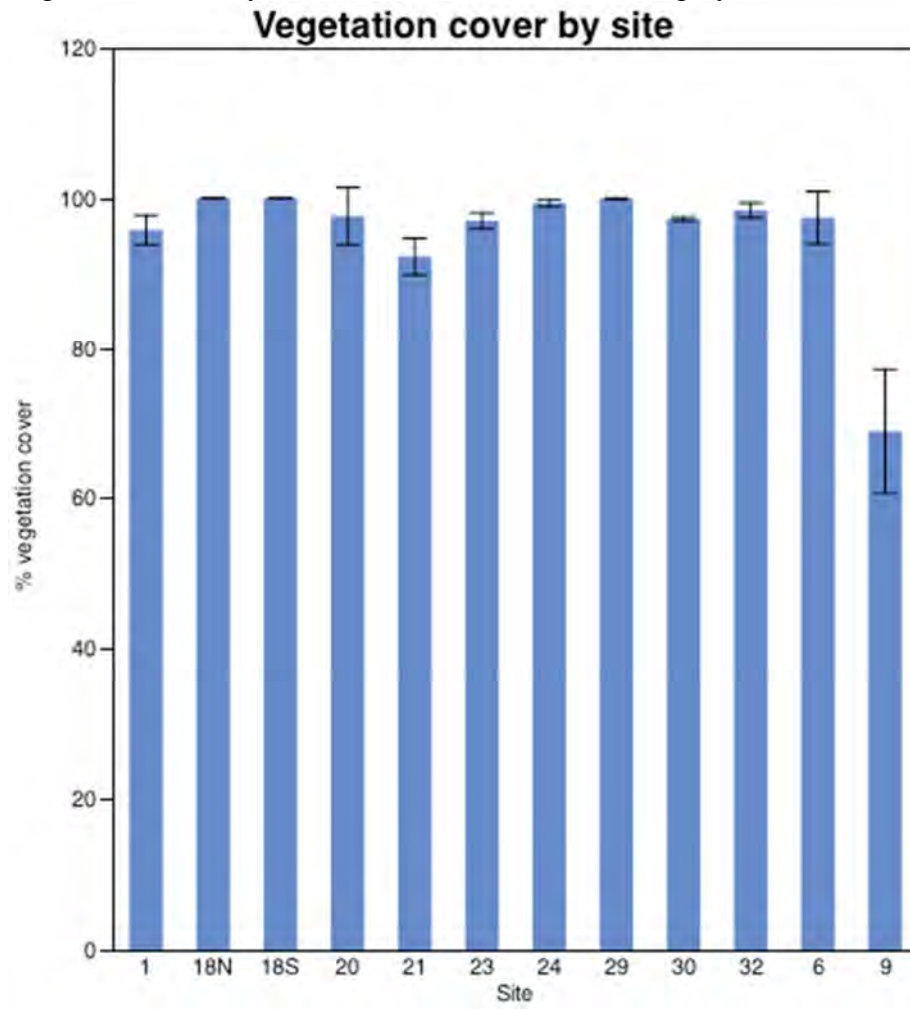
AVIVA RAHMANI has explored art, science, and natural ecosystems in her work since 1969. She studied at the University of Plymouth, UK, Zurich-node, Switzerland, and at City College of New York. Her projects include *Blue Rocks*, a 26-acre wetlands restoration, and *Fish Story*, which applies trigger point theory in Memphis, Tennessee.

Author	Topic:
Lynne Hull	<p>📅 Posted on January 18, 2001 01:46 PM 🗨️</p> <p>Hi Group, since Aviva asked for more philosophical dialog, I'll throw this one out 5 ecoartists are invited to do a site visit at a large rust belt city near the confluence of several rivers. Some of the possible sites to work on are industrially trashed, creeks partly channelized and industrialized, some areas in riparian corridor, others in mowed lawns, serious problems with sewage overflows, leaking storm sewers, etc. A large restoration project is beginning. Some areas are still in pretty good shape- mature trees, reasonably clean water. Preservation as a wildlife corridor/greenbelt has been suggested but is not yet in place. There are a couple of totally destroyed sites right in the high-rise downtown as well- empty lots or big holes in the ground. Where should the artist choose to work? Are there ethical questions involved? One of the artists suggests "Work in the creek, where restoration is beginning- it needs help the most." But a biologist not involved in the project suggests "Go for the preservation project- protect the biodiversity you have left and stabilize it." Another says: "Take the downtown hole. It's the highest profile, to reach the audience you won't reach on an eco-art project." Any other thoughts? best, Lynne.</p> <p style="text-align: right;">IP: Logged</p>

Aviva Rahmani	<p>📅 Posted on January 20, 2002 06:43 PM 🗨️</p> <p>Lynne asked how we say our responsibility to a site. I suppose my question back is whether ethics are part of our tool bag or whether some of us consider that extra baggage? I have a bias towards ethics... Maybe this is skirting the issue, but my feeling is that when I look at a site, my first job is to gather all the info I can and then go with my instincts. Research always turns up something unexpected. I do think that we have an obligation in our practice to be clear about why we have taken the choices, paths we have. Perhaps that's why many of us were disturbed by Kac... either he wasn't clear or we disagreed strongly with his choice. This is thinking out loud a bit but I know I take my ethics with me wherever I go and they inform my practice but don't predetermine it... I think whether or not we have made correct choices can only emerge in retrospect by seeing the consequences and our own sense of ease or unease. Honestly, I could be repelled by the idea of moving in a direction with my work only because of the audience impact, an injunction from a scientist about what they want illustrated or the most obvious starting place...tho I understand that for many, the educational impact would be pre-eminent, for others scientists lead the way, etc. For me that would be dodging my responsibility: to make a coherent analysis of the situation out of my responsibility: to make a coherent analysis of the situation out of my own informed intelligence, commit myself to means and then knock myself out to make it as effective & beautiful as I can.</p> <p style="text-align: right;">IP: Logged</p>
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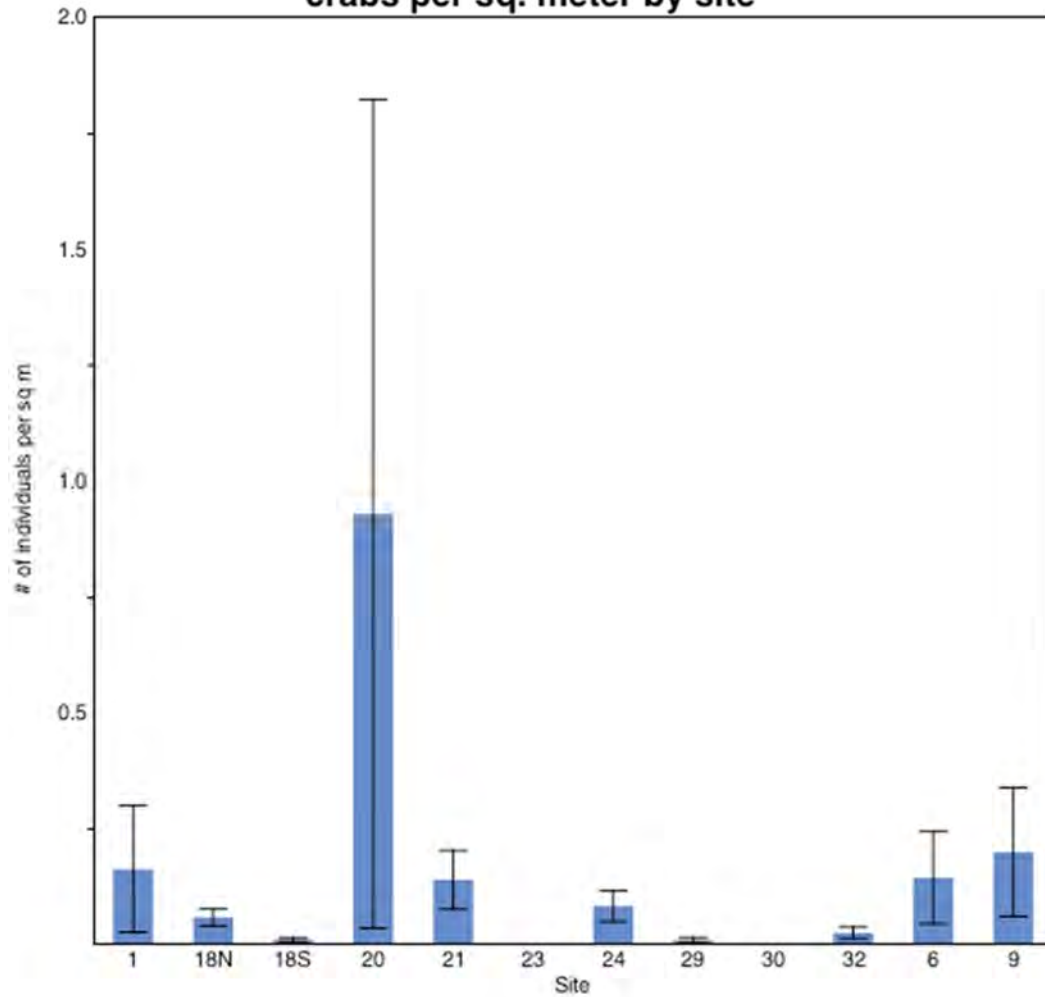
Author	Topic:
Deirdre Elmansoumi	<p>📅 Posted on January 21, 2002 02:35 AM 🗨️</p> <p>Thank-you Aviva. Although I had never thought of the ideas you put forth in quite that way, they sounded very comforting to me. I especially appreciate your highest regard for gathering information before proceeding with action. I wish to work interactively with nature; gathering information, taking some small steps of action, and then closely observing the effects of what I've done. As I see it, working interactively, with nature requires patience, time, and utter curiosity. It seems to me that it would be impossible to work this way with a formula. You words have freed me from feeling like I have to defend my ethics.</p> <p style="text-align: right;">IP: Logged</p>
Mo Dawley	<p>📅 Posted on January 22, 2002 05:40 AM 🗨️</p> <p>Aviva, Bravo, Well said. The idea of informed instinct appeals greatly to me. Although a sense of ethics requires us to be aware, communicate and investigate ourselves and our environment and can be a pain in the butt, it is necessary "baggage" as far as I'm concerned. Some might say that a sense of ethics might compromise an individual's creative process or flow, but in the long view, I imagine somehow an individual taking that path would be squelched eventually down the road since we are all connected. Ethics is tough because it is far-sighted and a rough road. It's always so much simpler to give up and go for the throat or sensationalism or what have you. Thich Nhat Hah says "Our only true possessions are our actions" Alice Walker says "...violence is not radical enough. Love is more radical."</p> <p style="text-align: right;">IP: Logged</p>
Helen Harrison	<p>📅 Posted on January 23, 2002 09:15 AM 🗨️</p> <p>Good for you! I agree about an informed intuition and about ethical thinking being part of all decisions, not only about art. Thanks for saving me from having to think through an answer. Best of everything to you.</p> <p style="text-align: right;">IP: Logged</p>
Susan Steinman	<p>📅 Posted on January 24, 2002 12:22 PM 🗨️</p> <p>I assume that for all (99%) of us, ethics is a major given part of our chosen life's work. Therefore I think Lynne's real question may have gone unanswered. The very real pressure is that work is needed on many fronts at once, given that we have only x amount of time, money, energy, etc. , where can we be most effective when we are invited to do our "guest projects." This requires different considerations than projects in which we are long-term residents or have multiple-year financial support. Where we begin, or choose to work, is often a "King Solomon's decision." Something is gained; other intangibles lost. Perfection is neither a reasonable nor healthy goal. Research is critical, of course, but it is impossible to cover all the variables</p>

Vegetation cover by site, with error bars. All are roughly the same except site 9.



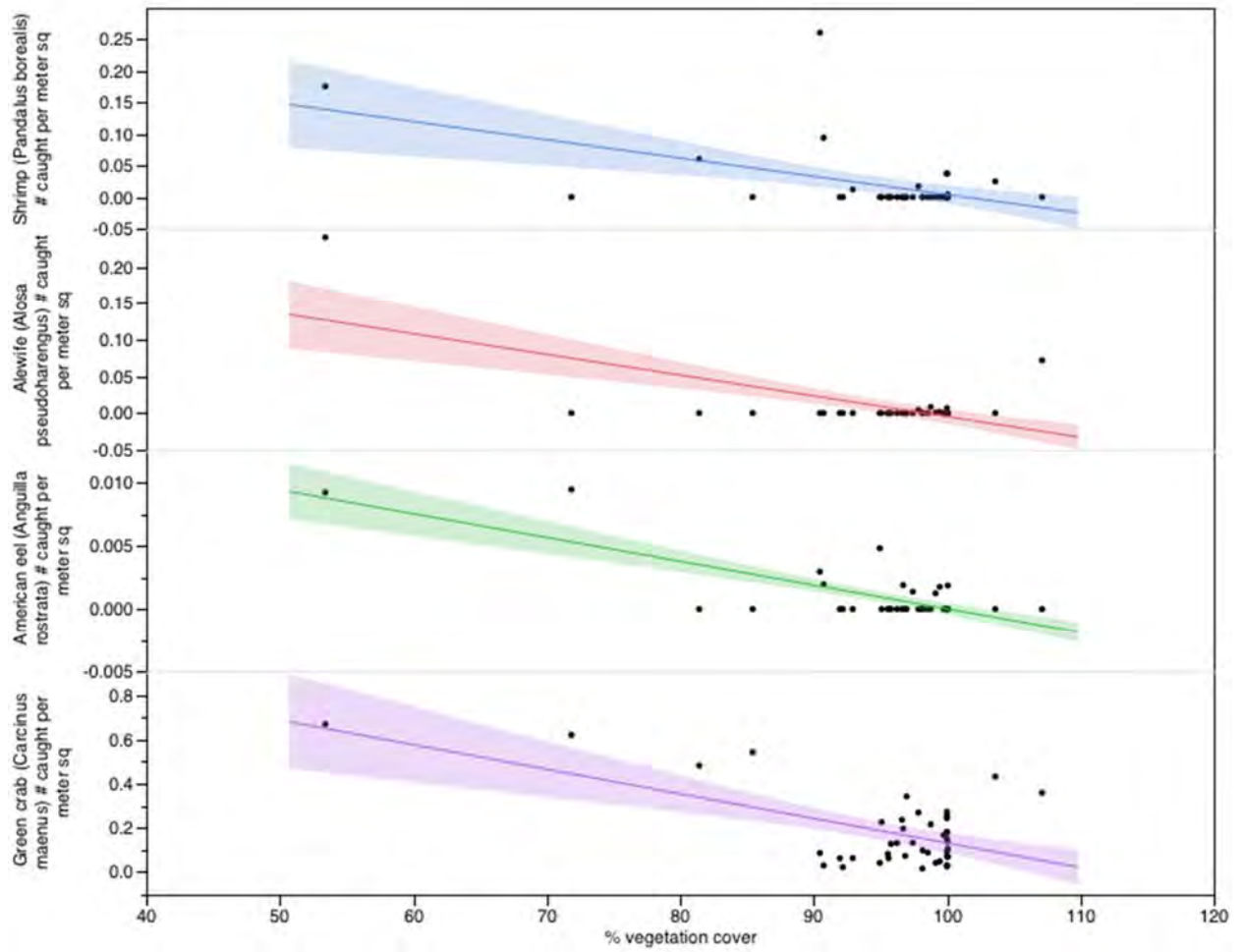
of individuals of all species except GC by site. Very large error bars means there is no difference per site, despite site 20 seeming to have a lot more. This basically all has to do with one sampling event.

Mean of total number all fish and other species but not green crabs per sq. meter by site

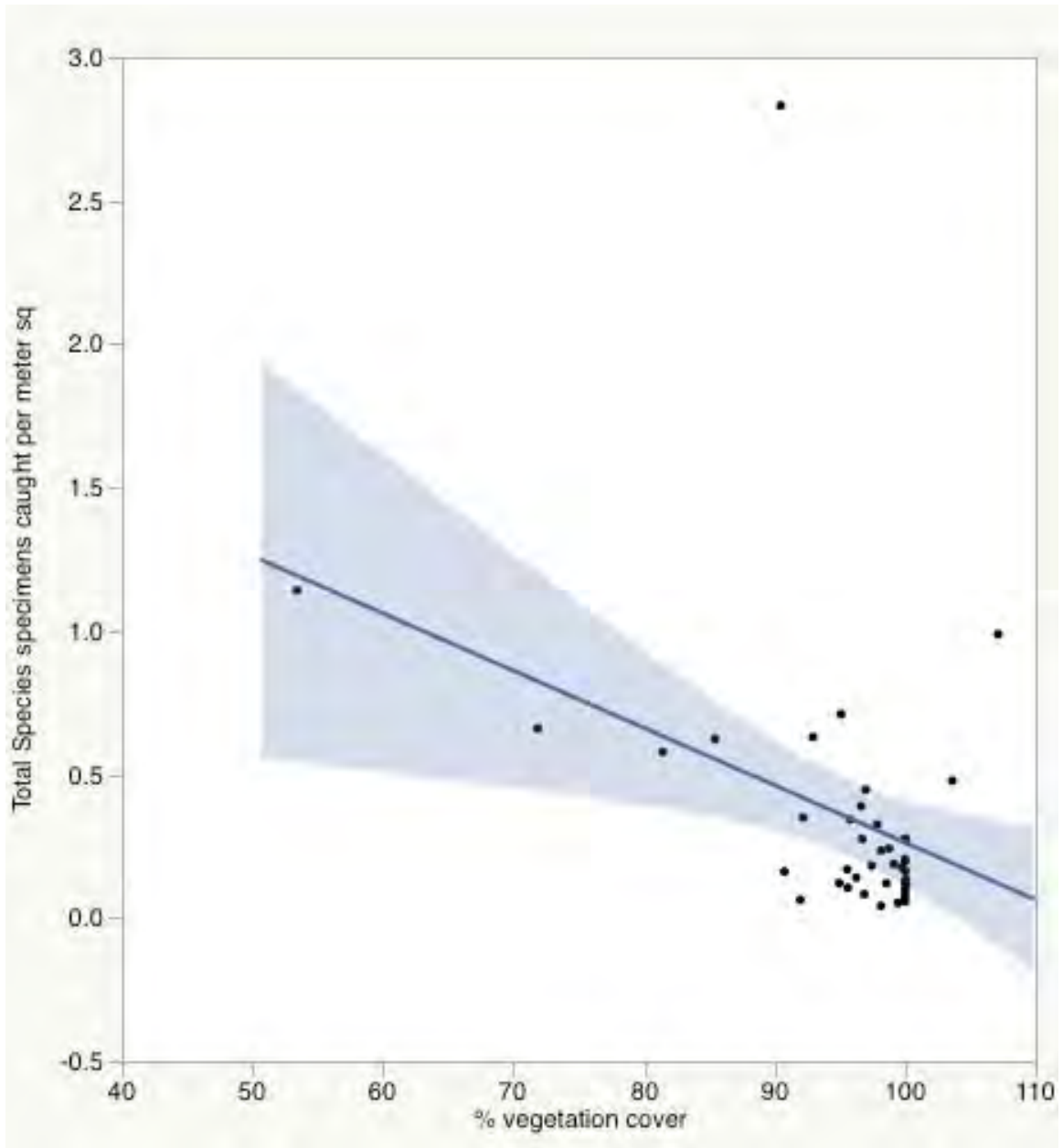


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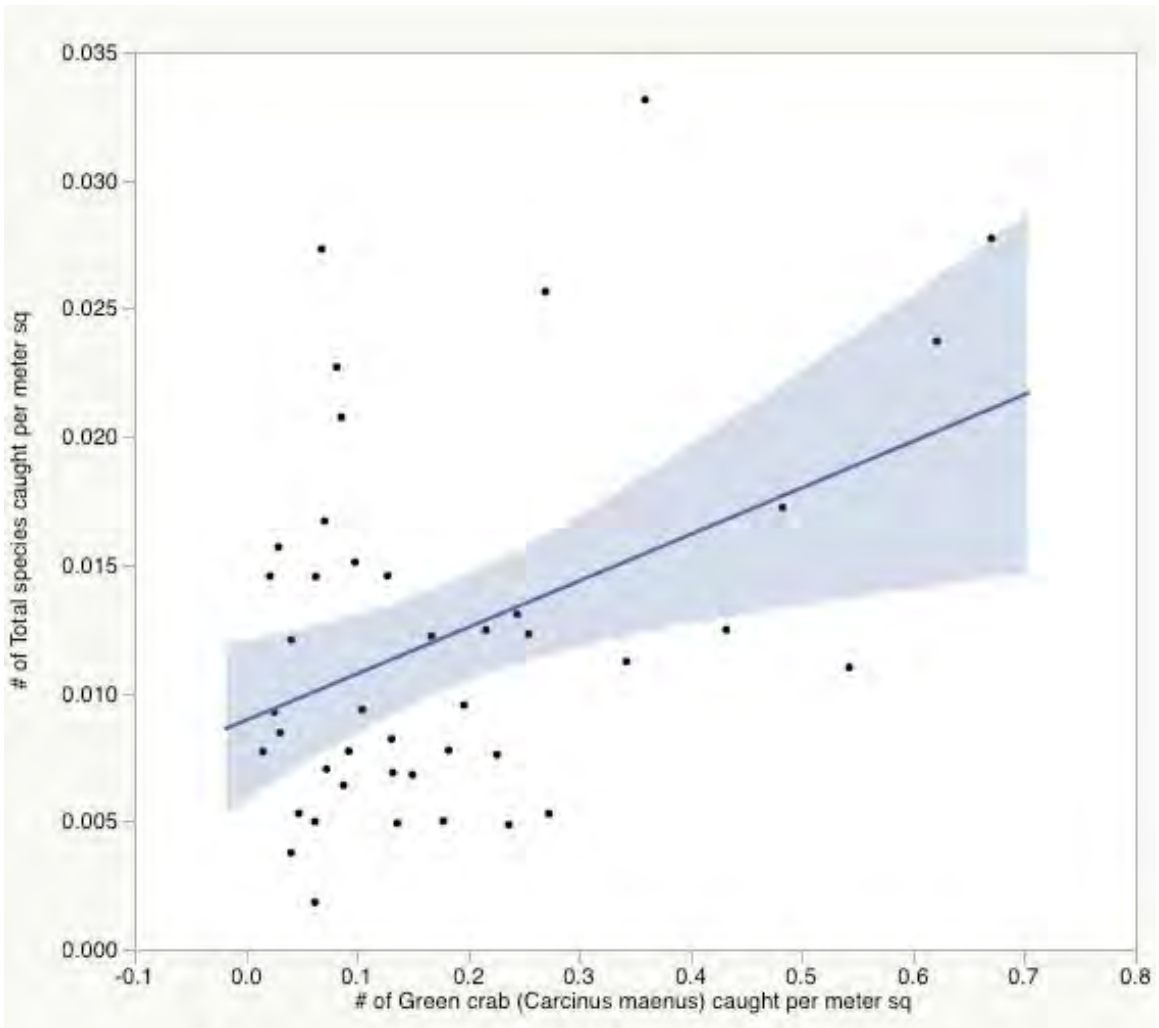
Shrimp, Alewife, American eel, and Green Crab plotted against vegetation % cover.



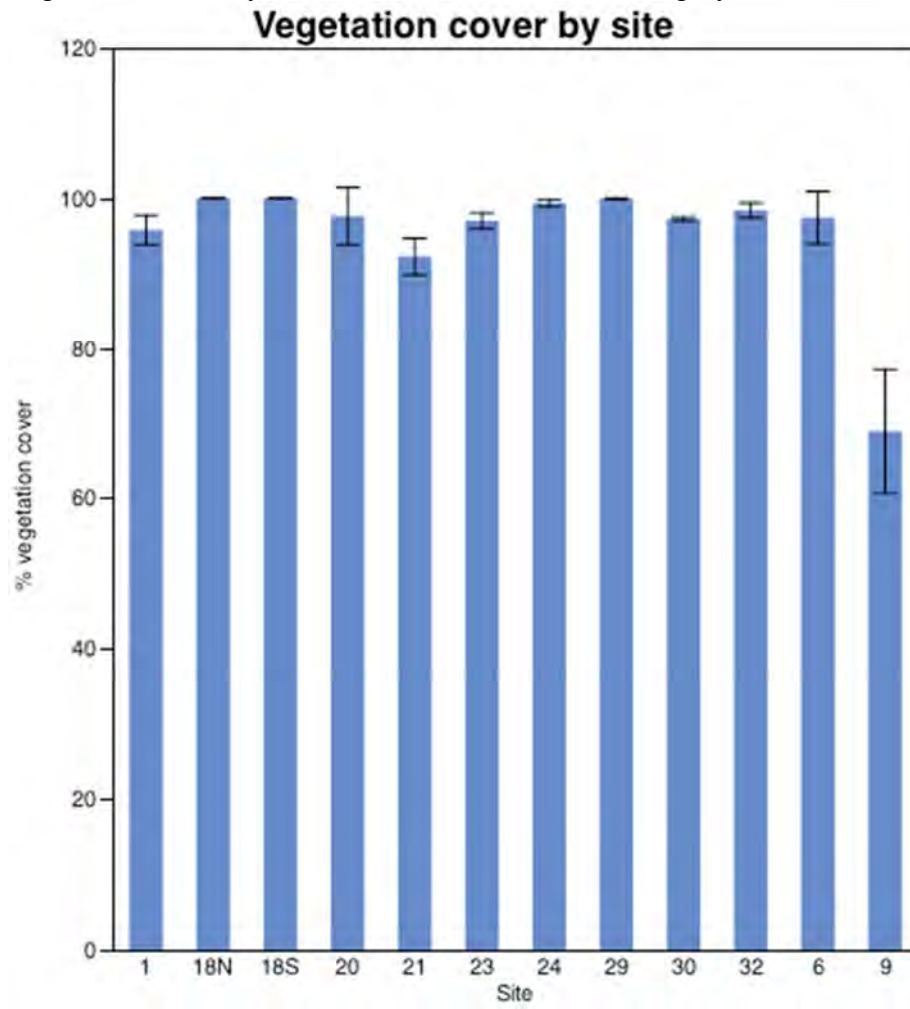
Green crab vs. % vegetation cover



Total # of other species caught vs. number of GC caught

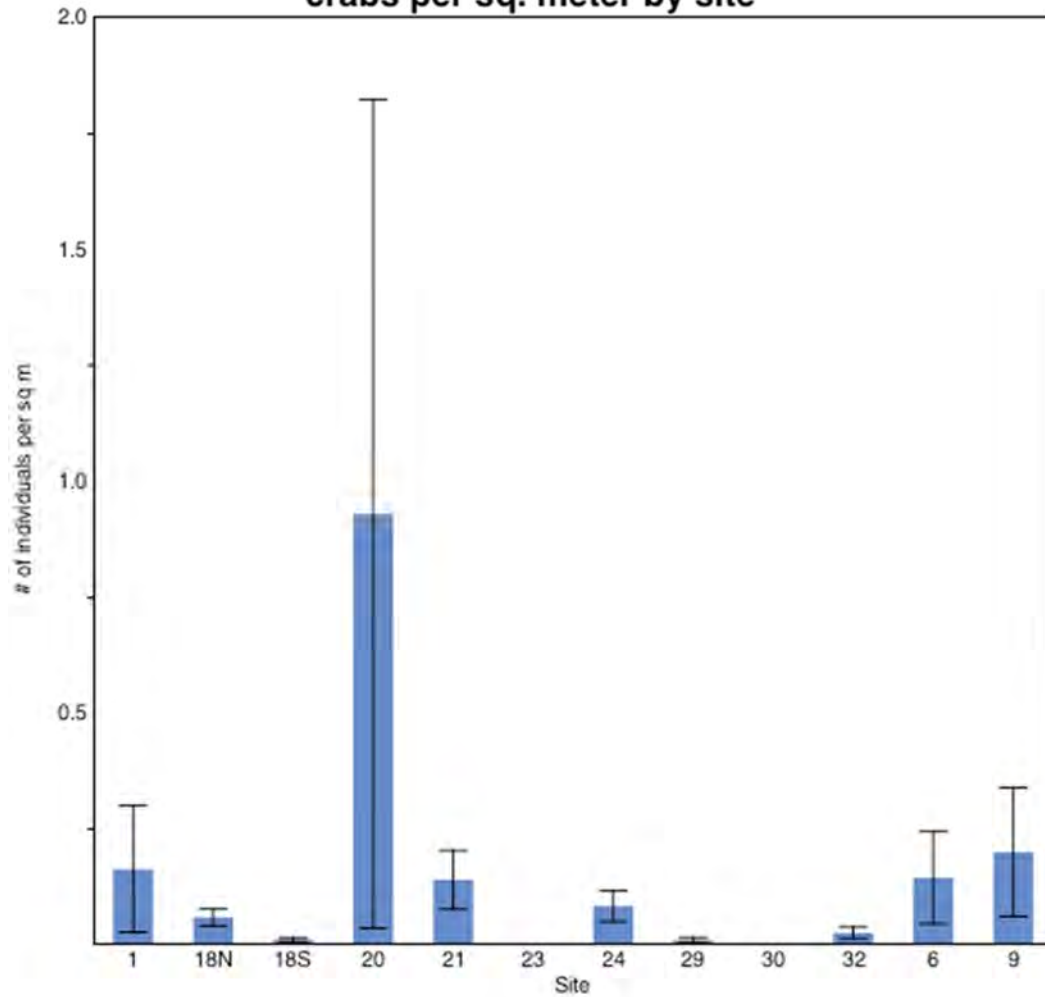


Vegetation cover by site, with error bars. All are roughly the same except site 9.



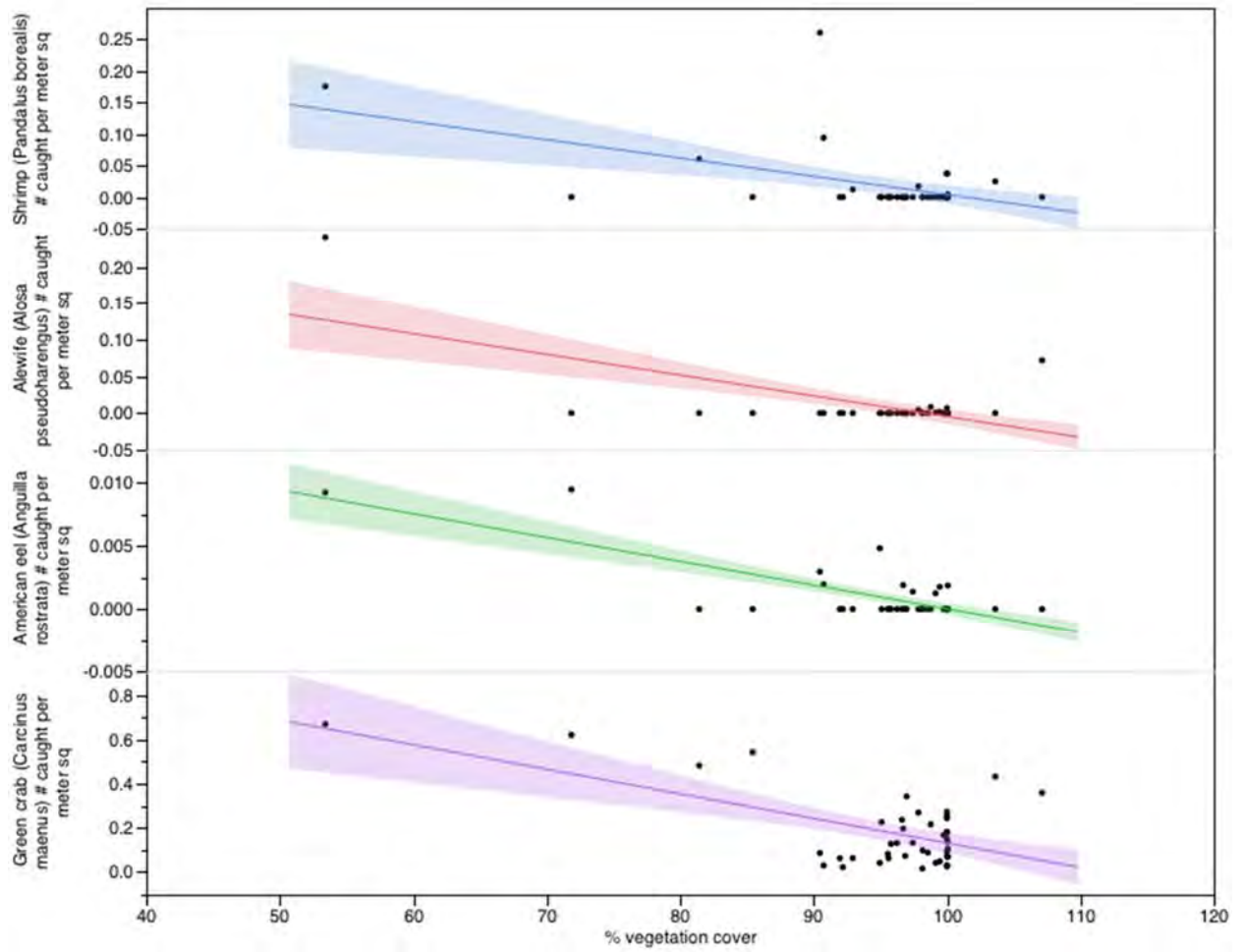
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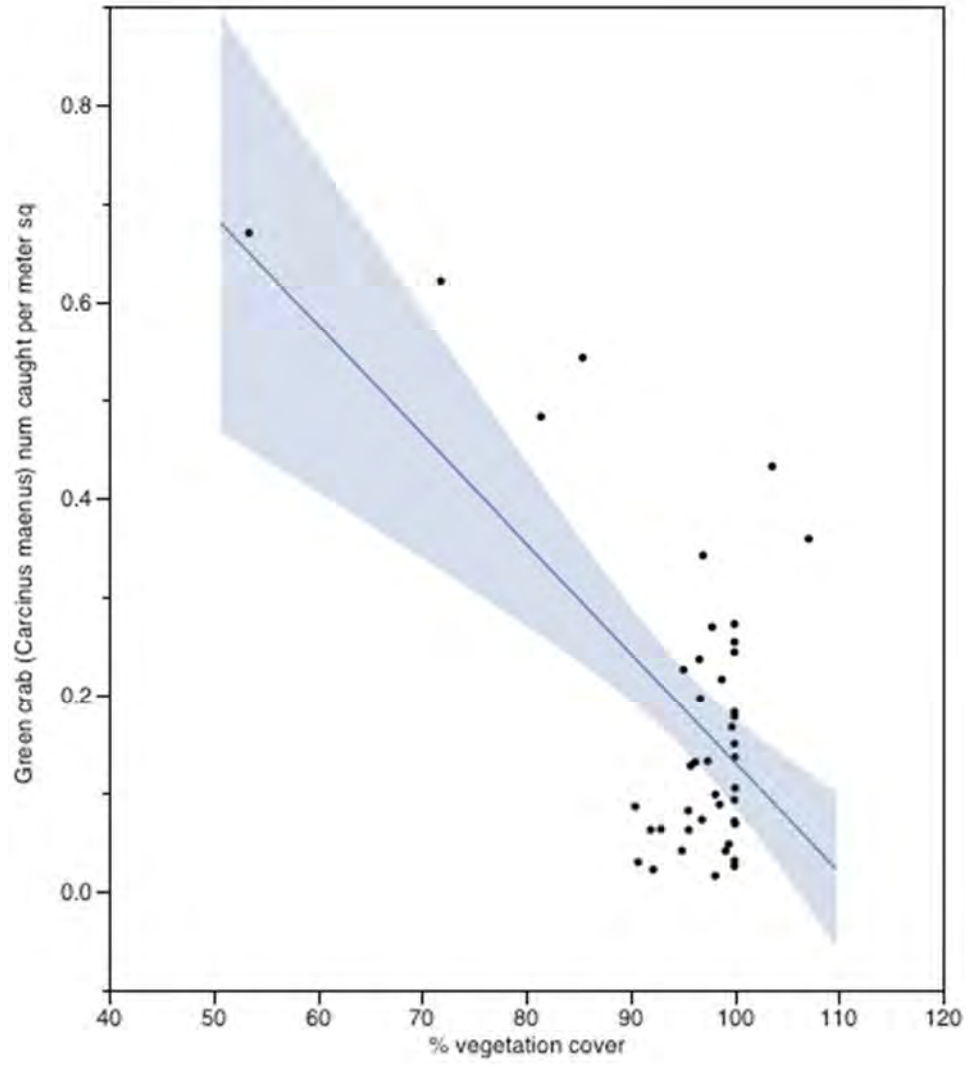


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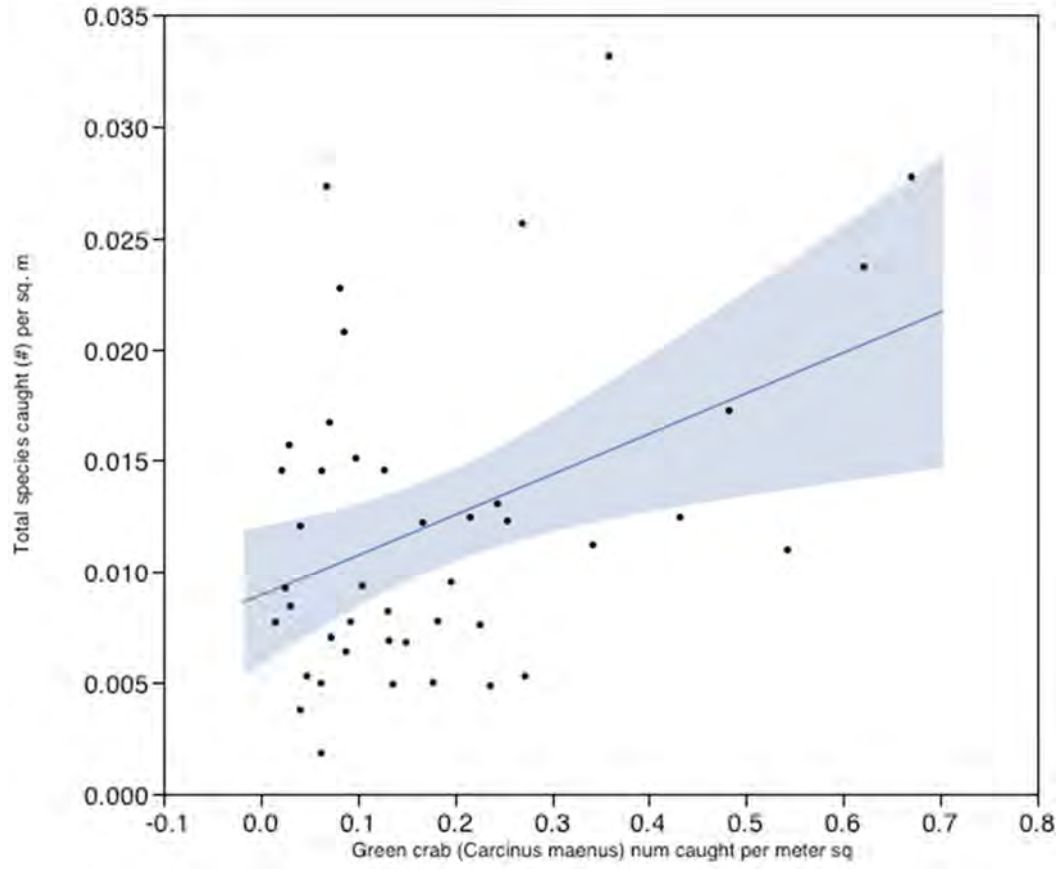
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Green crab vs. % vegetation cover

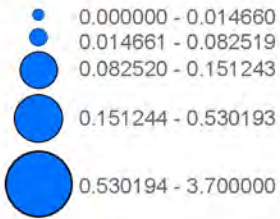


Total # of other species caught vs. number of GC caught

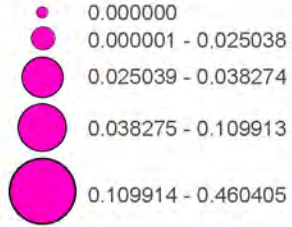


Biomass at Each Collection Site, August 2002

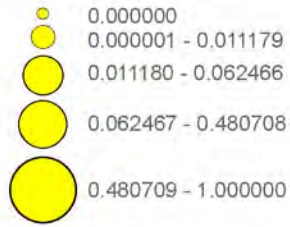
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Menidia menidia



Microgadus tomcod



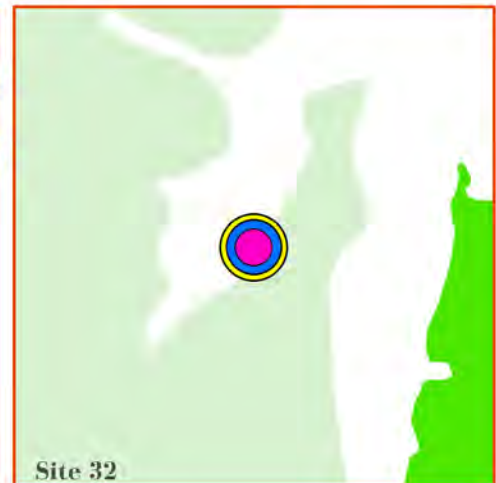
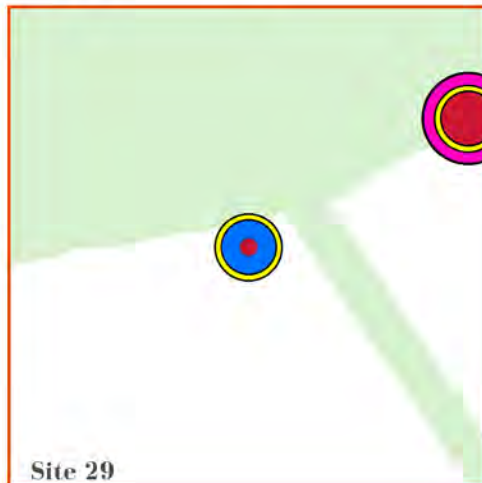
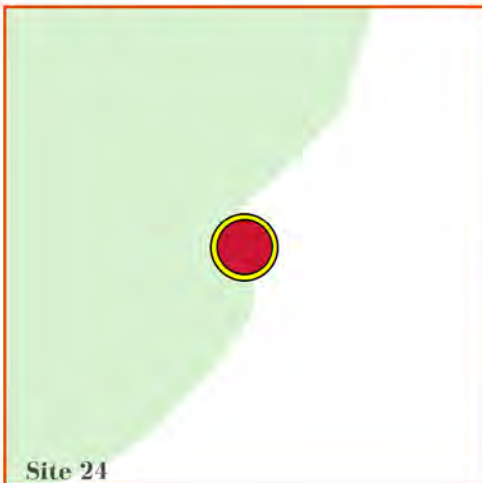
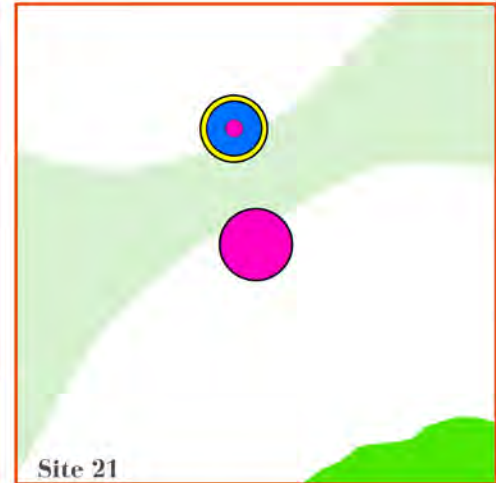
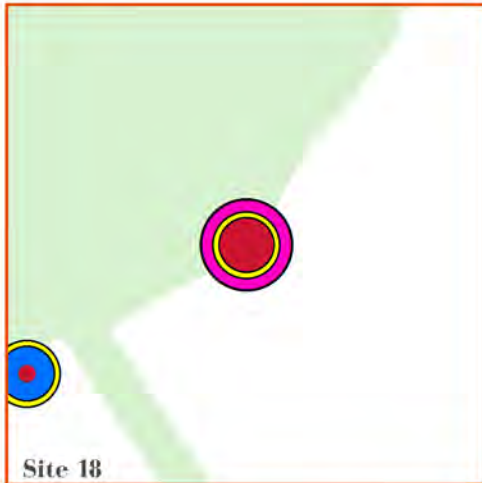
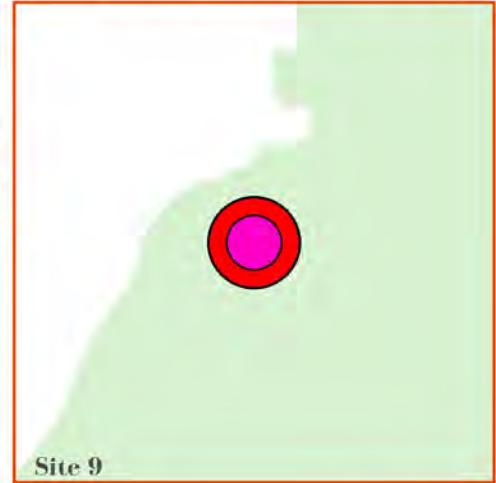
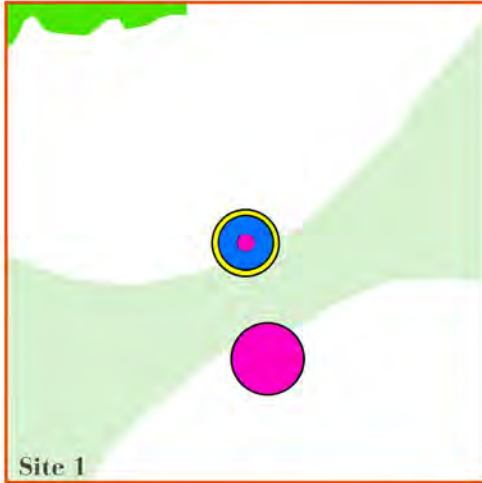
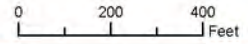
Carcinus maenus



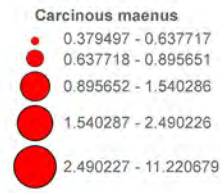
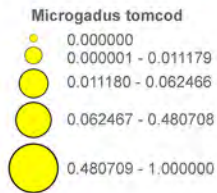
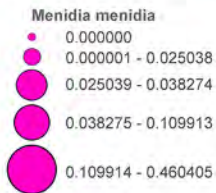
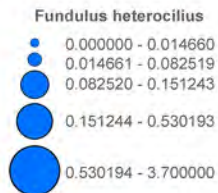
Eelgrass beds



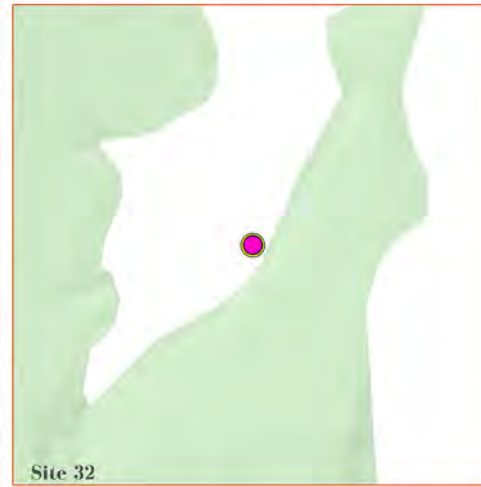
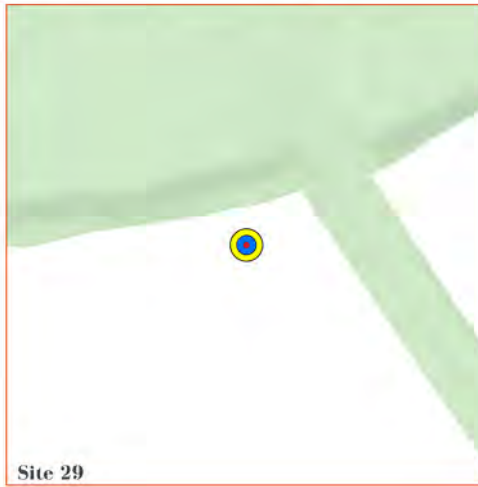
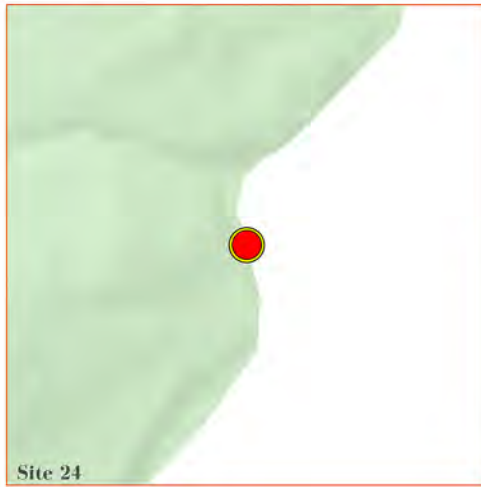
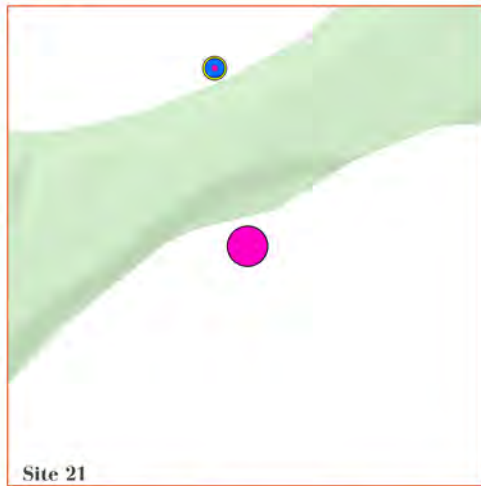
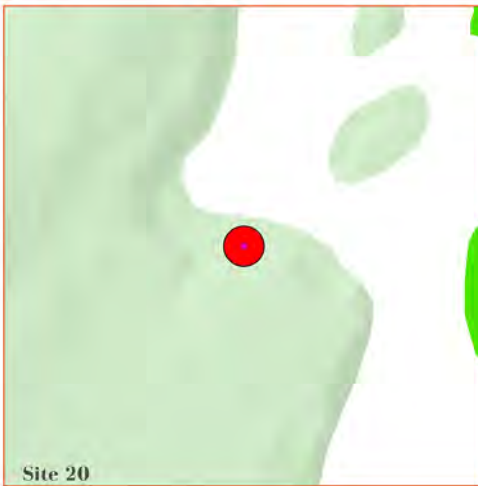
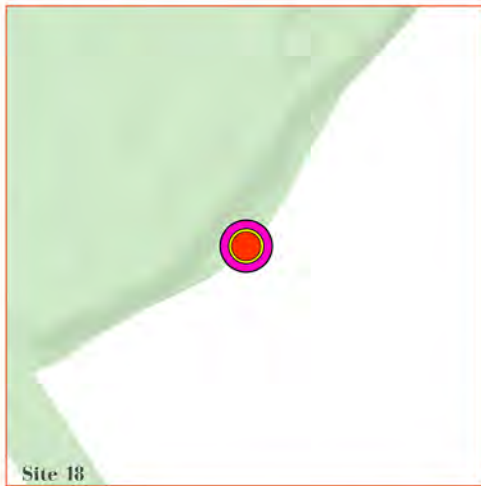
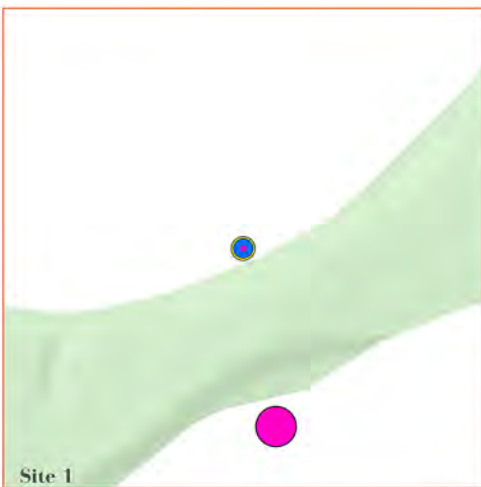
Menidia menidia



Biomass at Each Collection Site, August 2002

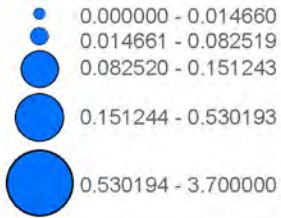


■ Eelgrass beds

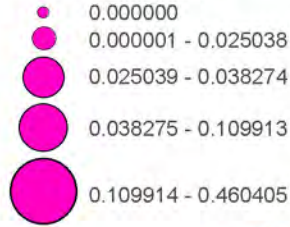


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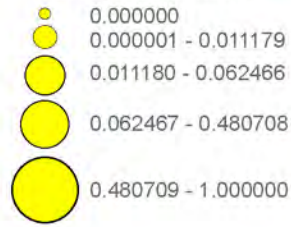
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Menidia menidia



Microgadus tomcod



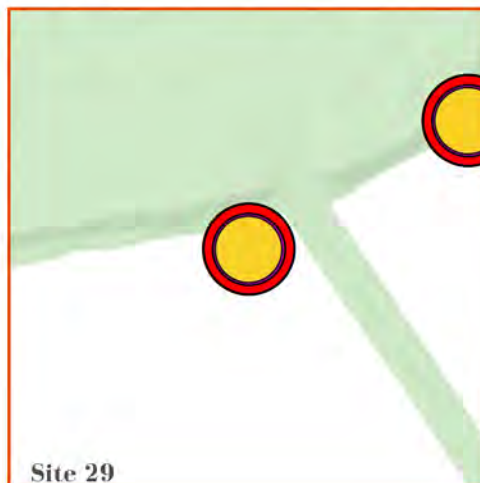
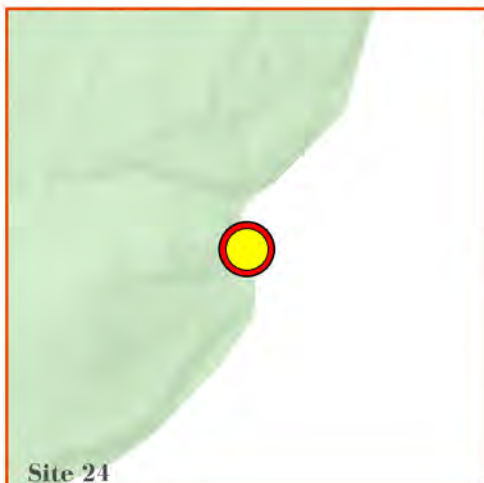
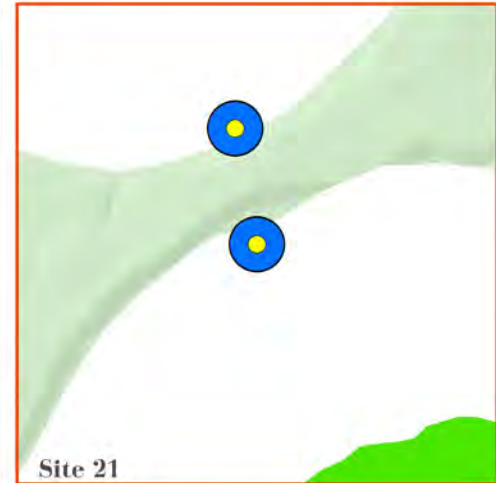
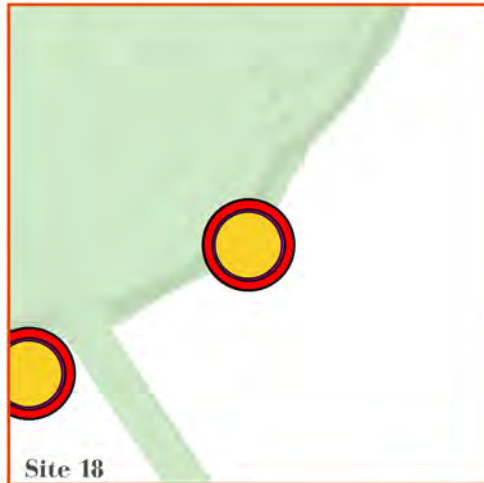
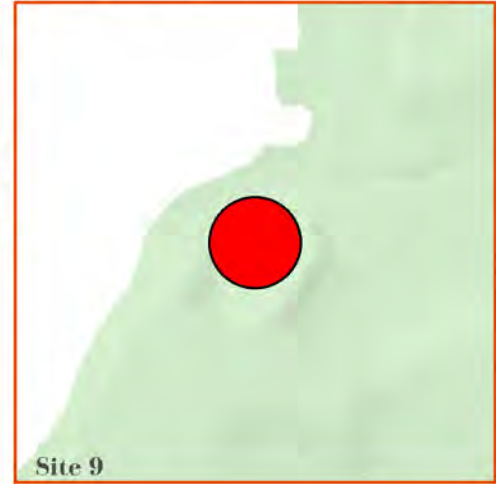
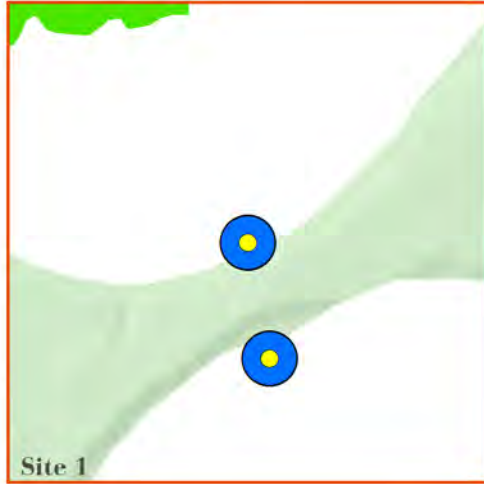
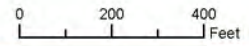
Carcinus maenus



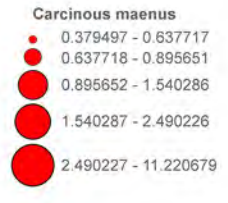
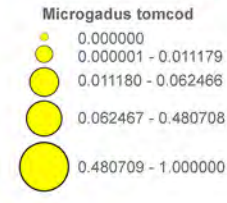
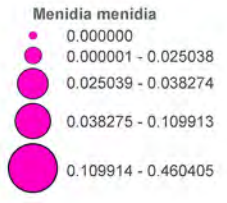
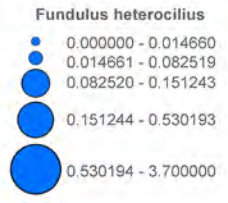
Eelgrass beds



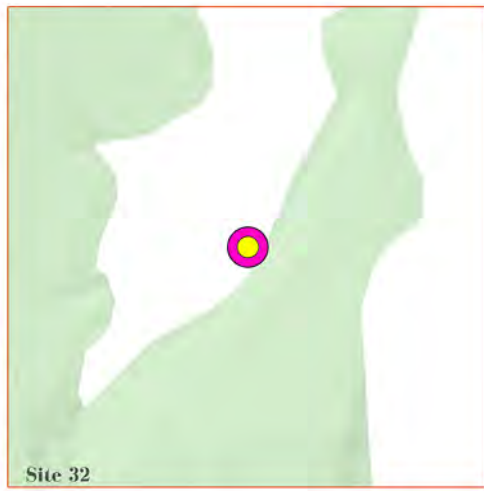
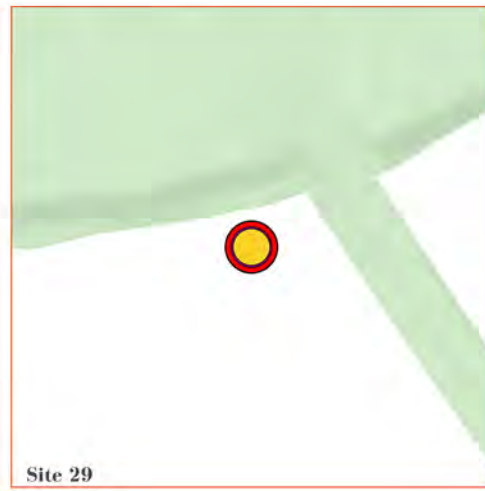
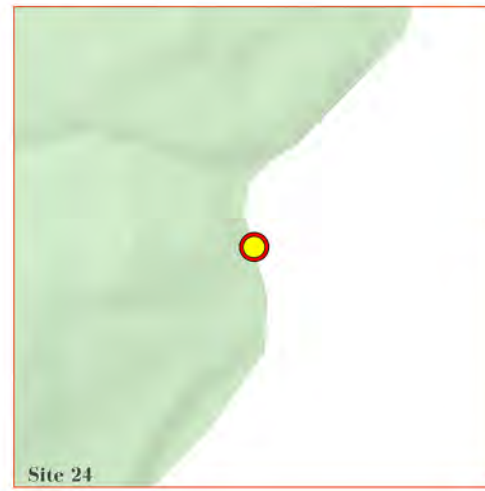
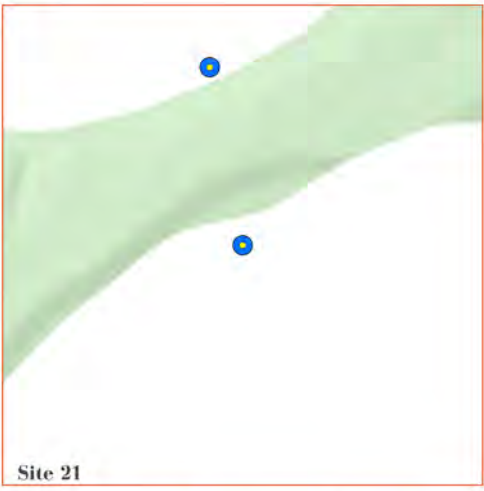
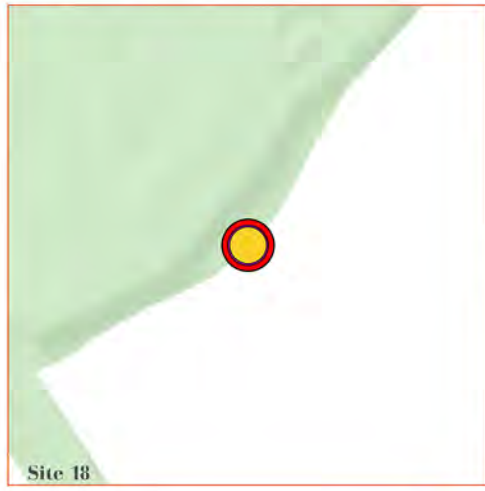
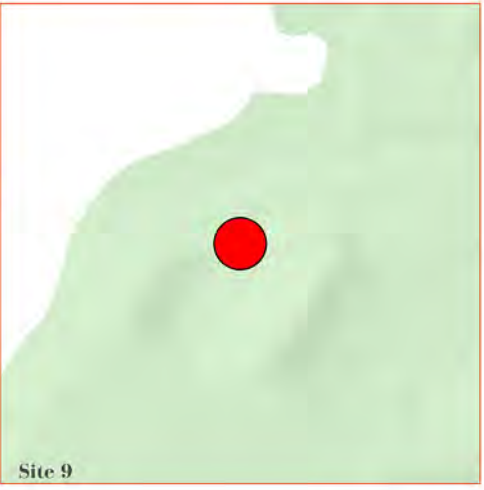
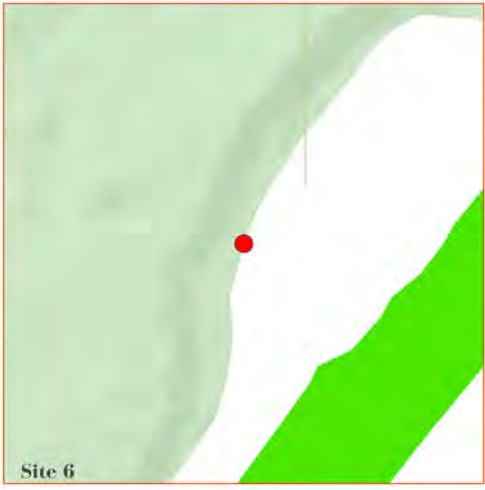
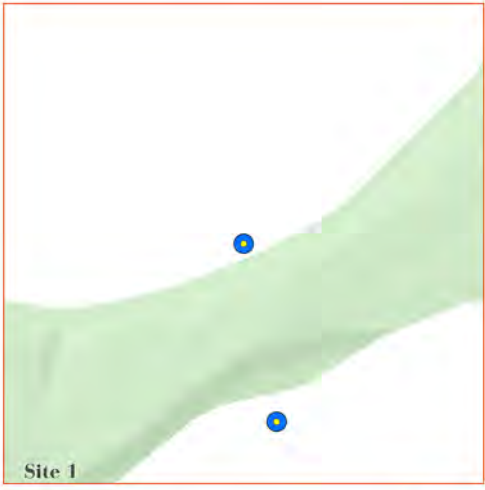
Menidia menidia



Biomass at Each Collection Site, July 2002

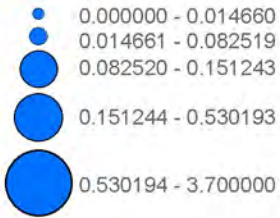


Eelgrass beds

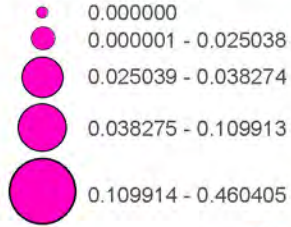


Biomass at Each Collection Site, June 2002

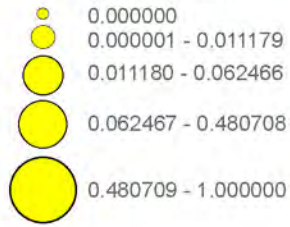
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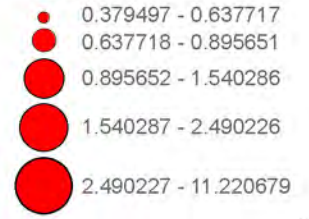
Menidia menidia



Microgadus tomcod



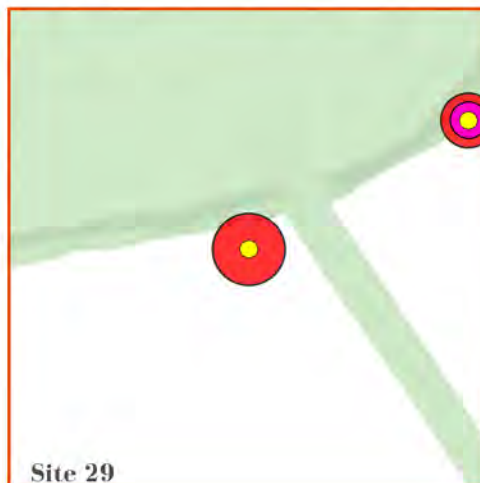
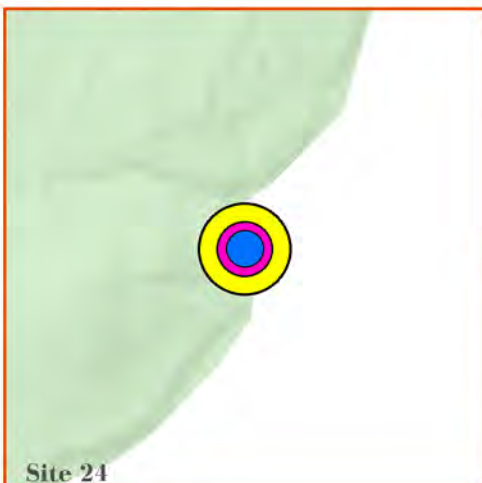
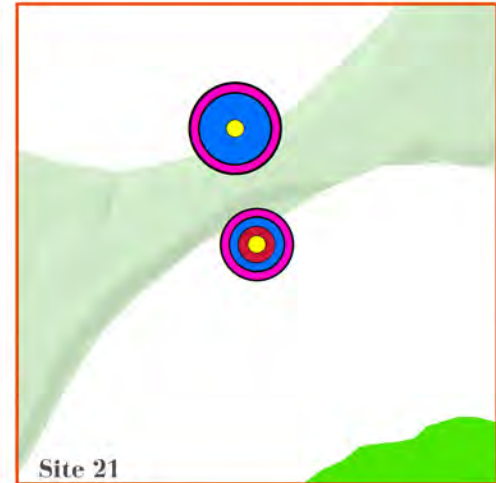
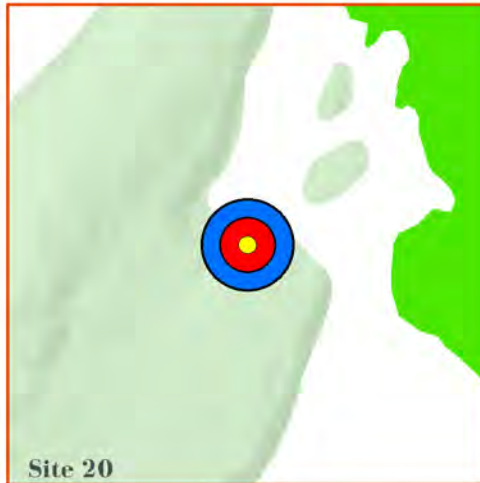
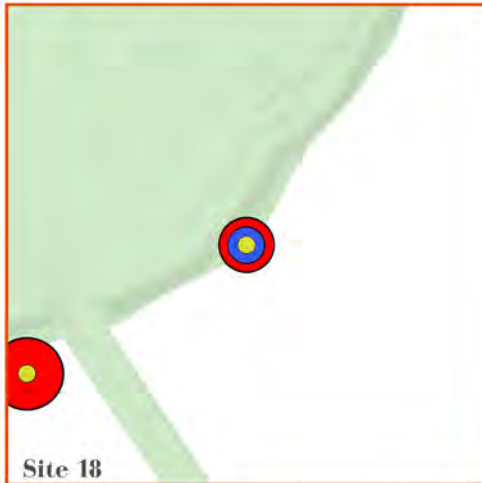
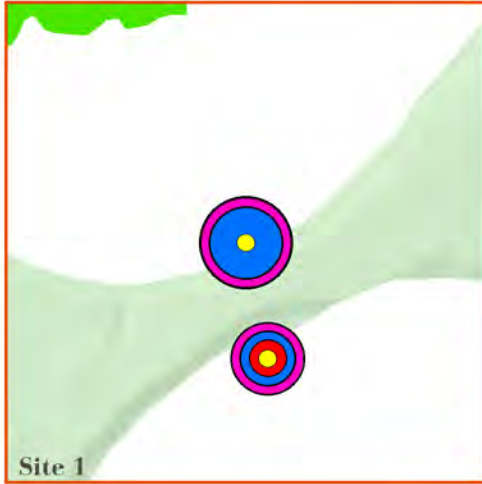
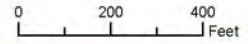
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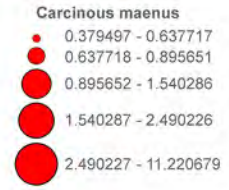
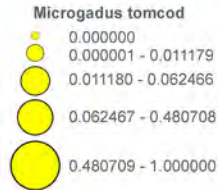
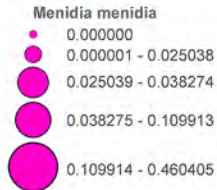
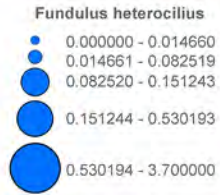
Eelgrass beds



Menidia menidia



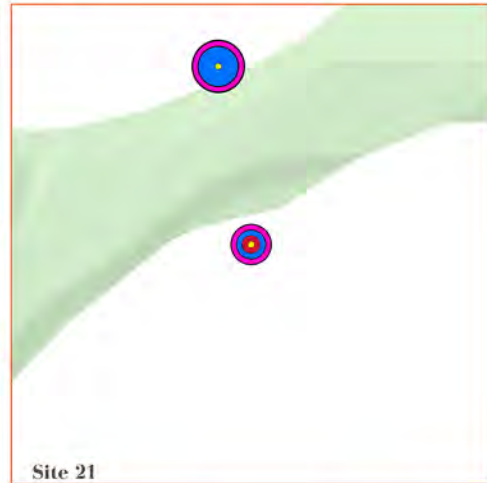
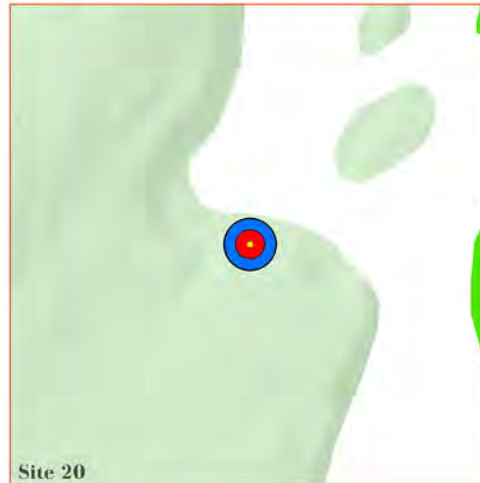
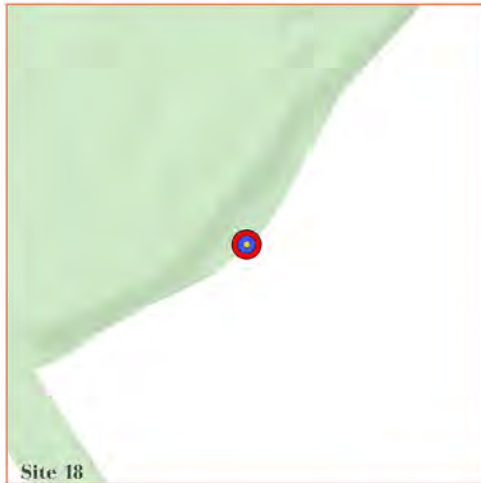
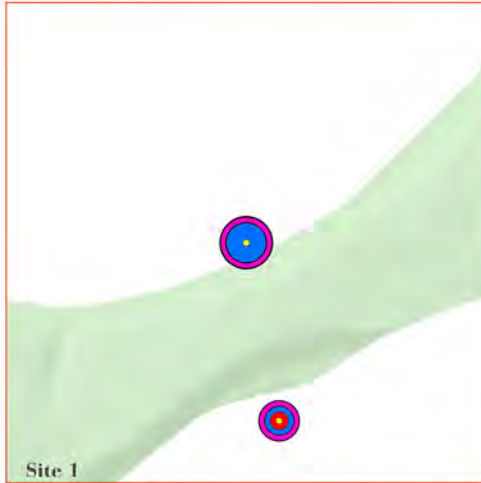
Biomass at Each Collection Site, June 2002



Eelgrass beds

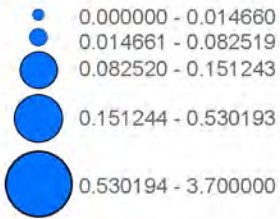


0 200 Feet

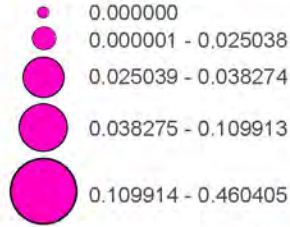


Biomass at Each Collection Site, September 2002

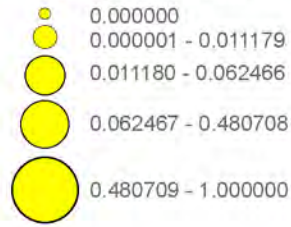
Fundulus heterocilius



Menidia menidia



Microgadus tomcod



Carcinus maenus

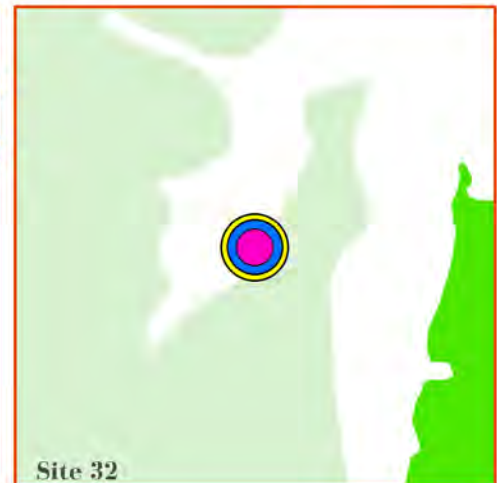
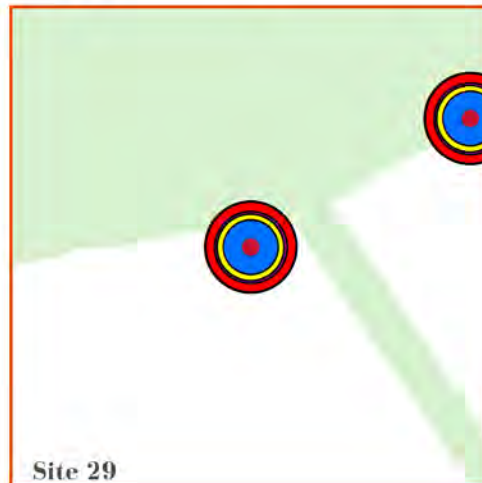
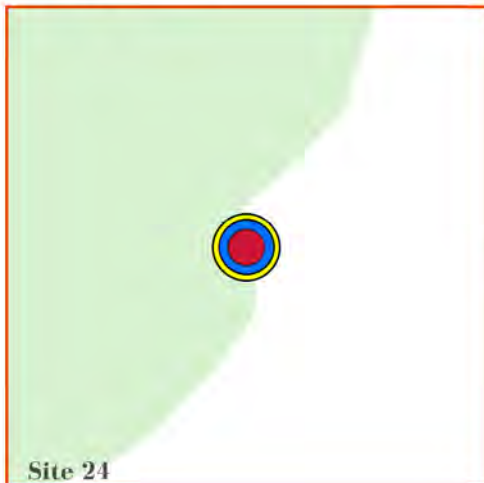
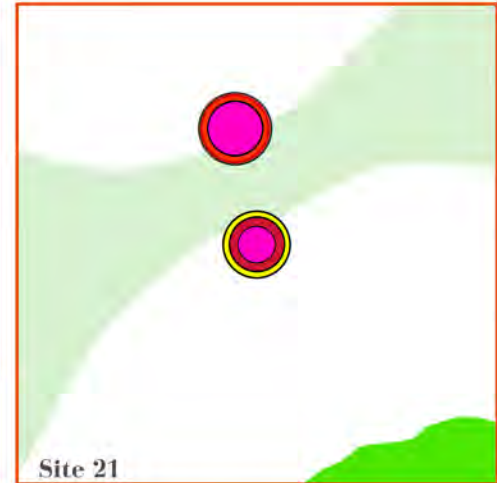
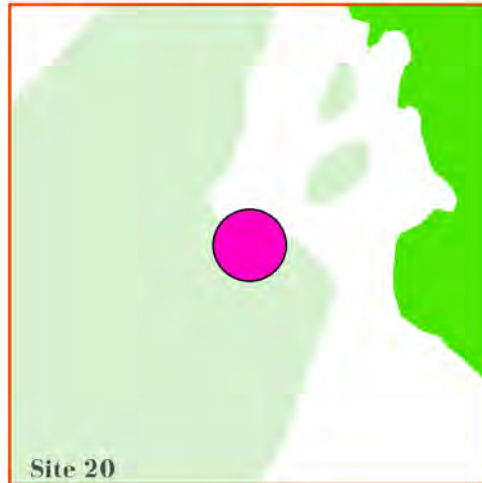
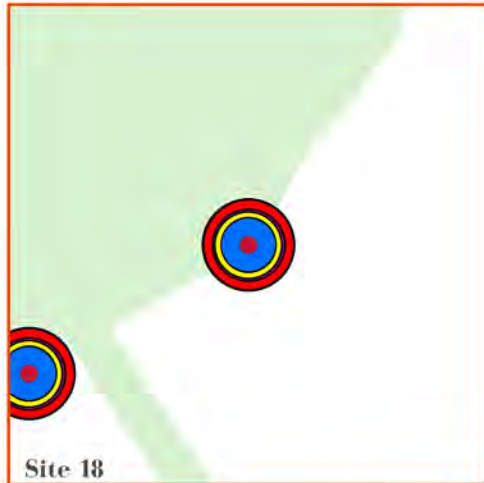
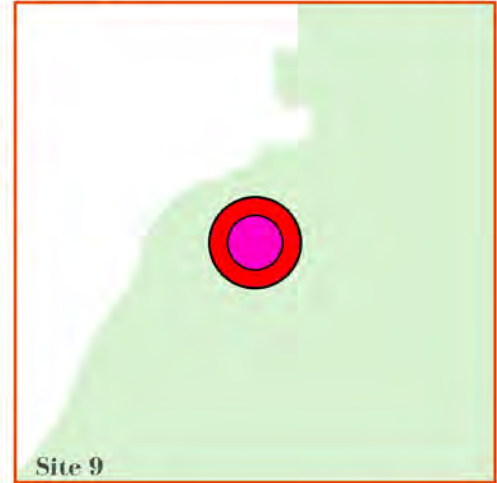
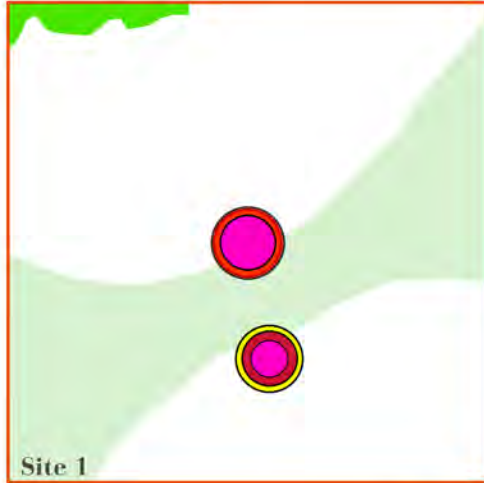


Eelgrass beds

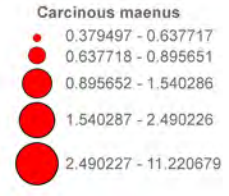
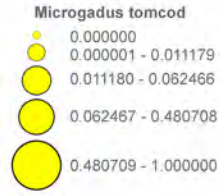
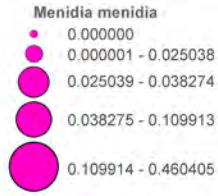
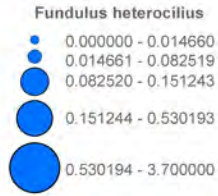


Menidia menidia

0 200 400 Feet



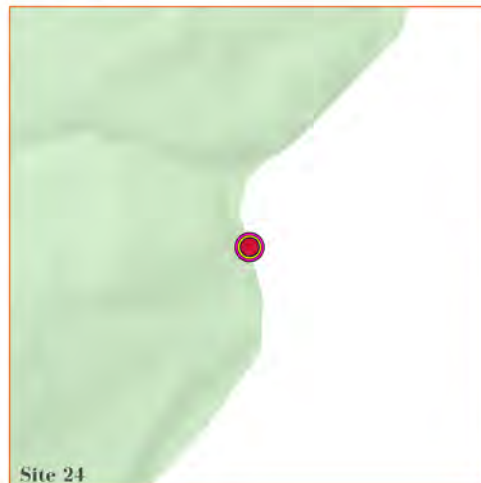
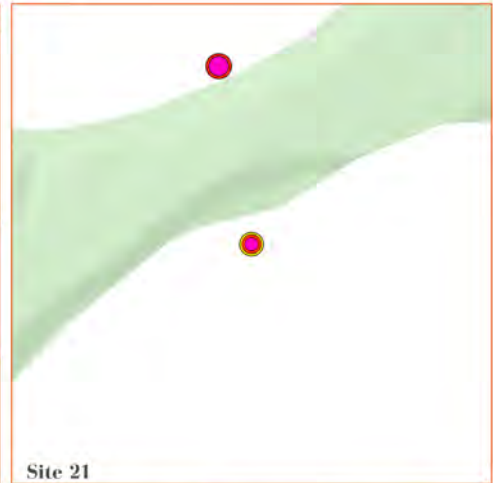
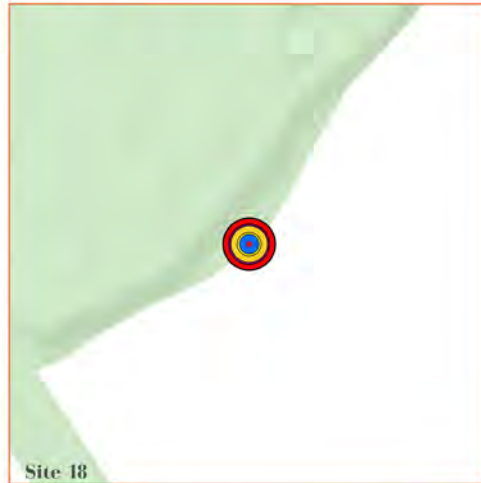
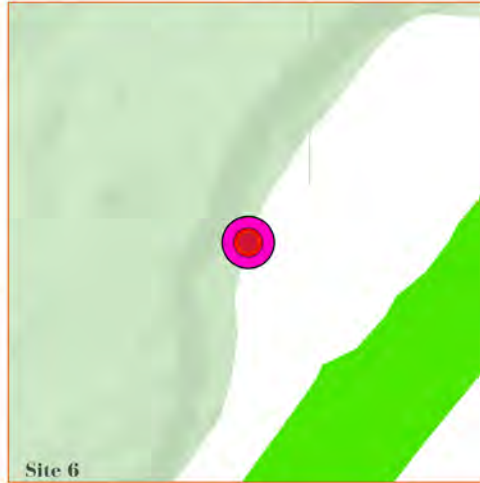
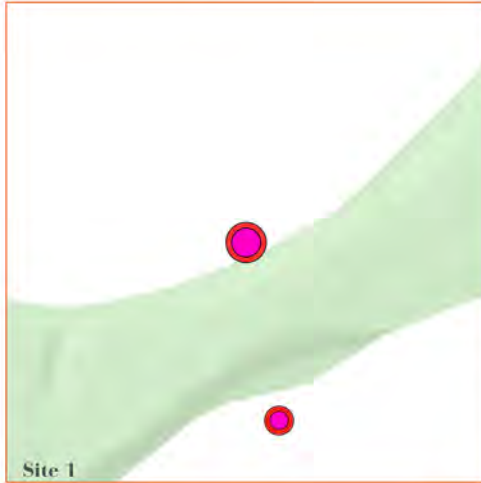
Biomass at Each Collection Site, September 2002



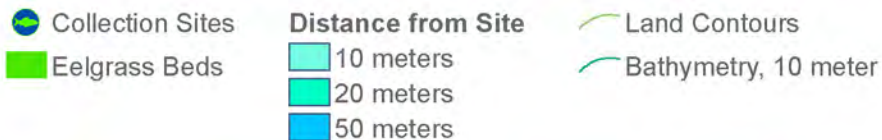
■ Eelgrass beds



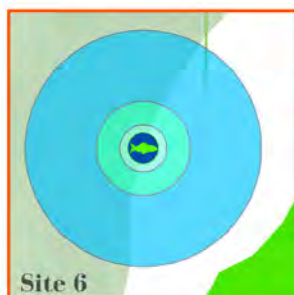
0 200 Feet



Relationships between collection sites and eel grass at 10, 20 and 50 meters resolution buffers



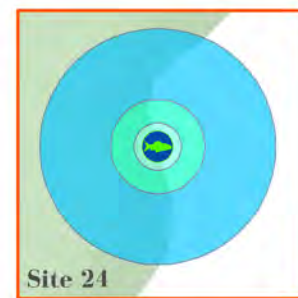
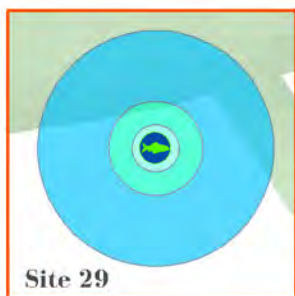
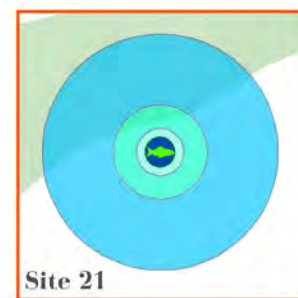
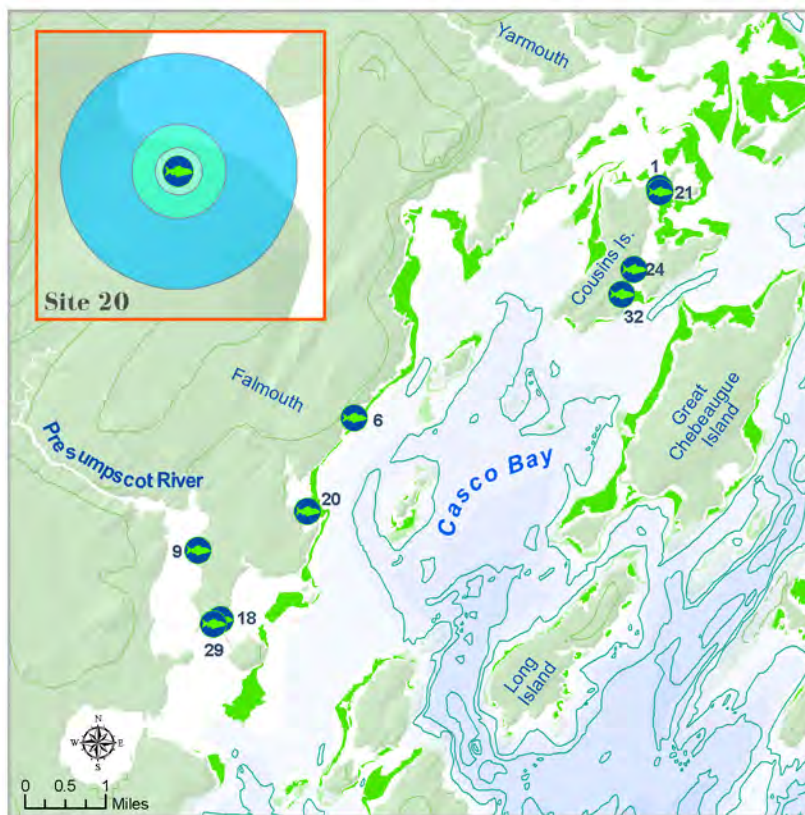
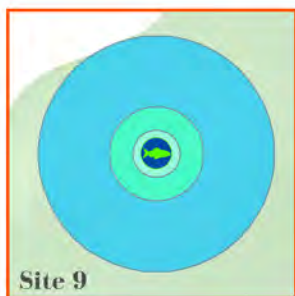
Fundulus heterocilius



Microgadus tomcod



Menidia menidia



Carcinus maenus



Relationships between collection sites and eel grass at 10, 20 and 50 meters resolution buffers

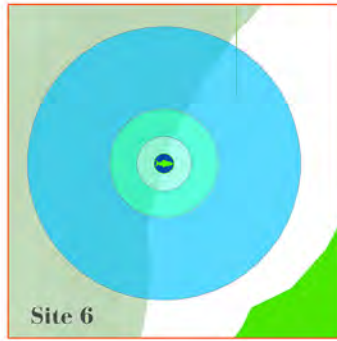
● Collection Sites
 ■ Eelgrass Beds

Distance from Site
 ■ 10 meters
 ■ 20 meters
 ■ 50 meters

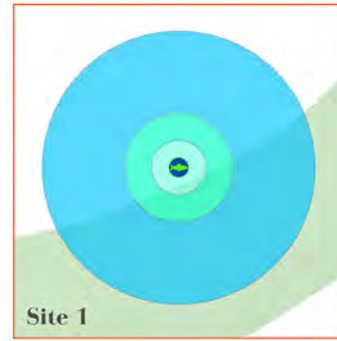
— Land Contours
 — Bathymetry, 10 meter



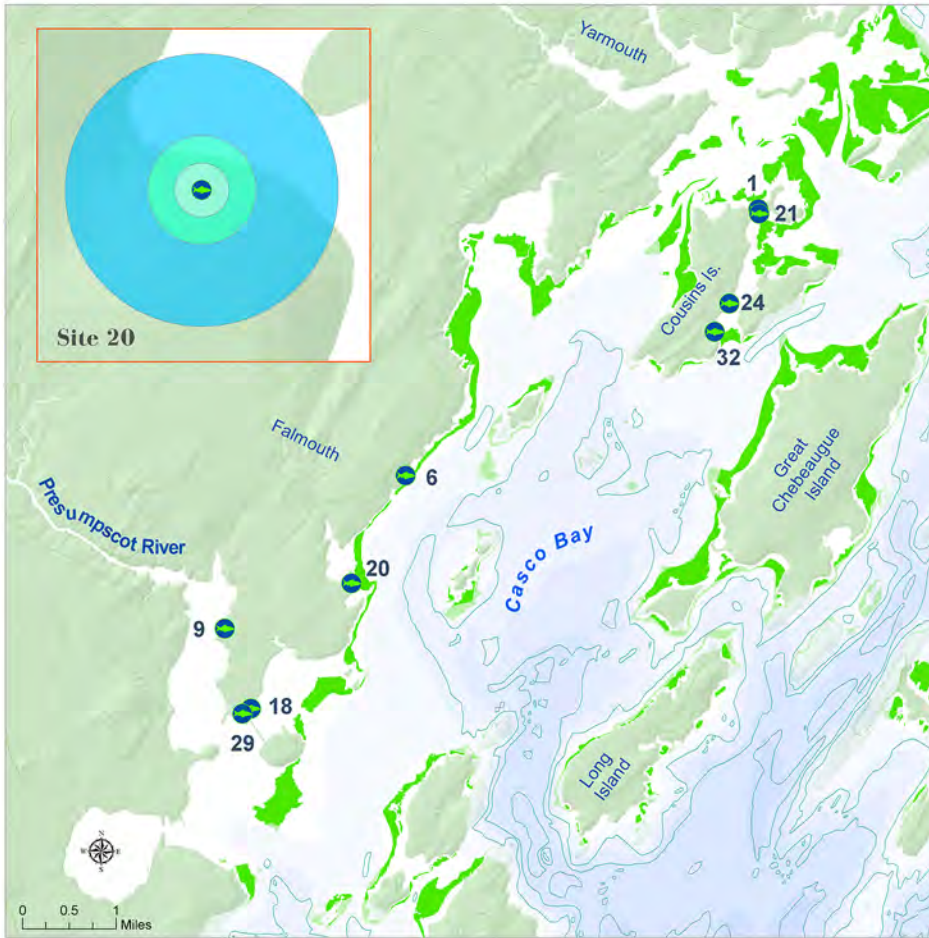
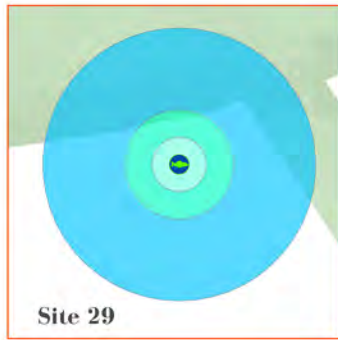
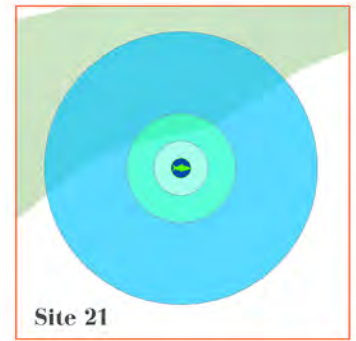
Fundulus heteroclitus



Microgadus tomcod



Menidia menidia



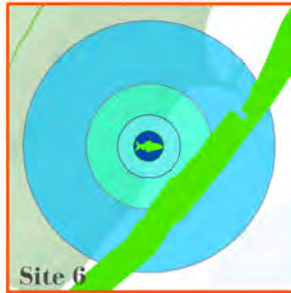
Carcinus maenas



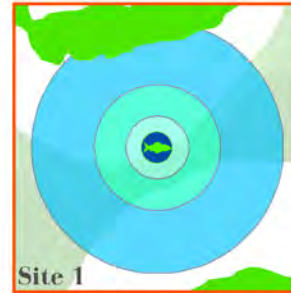
Relationships between collection sites and eel grass at 50, 100 and 200 meters resolution buffers



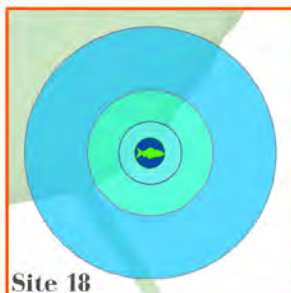
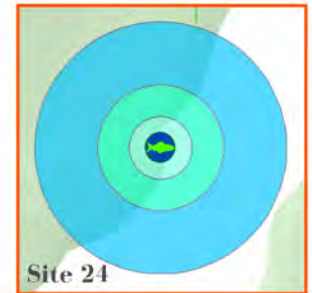
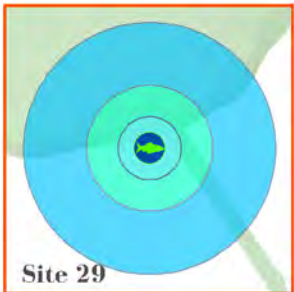
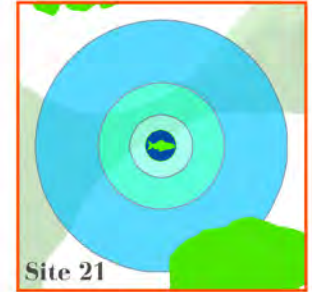
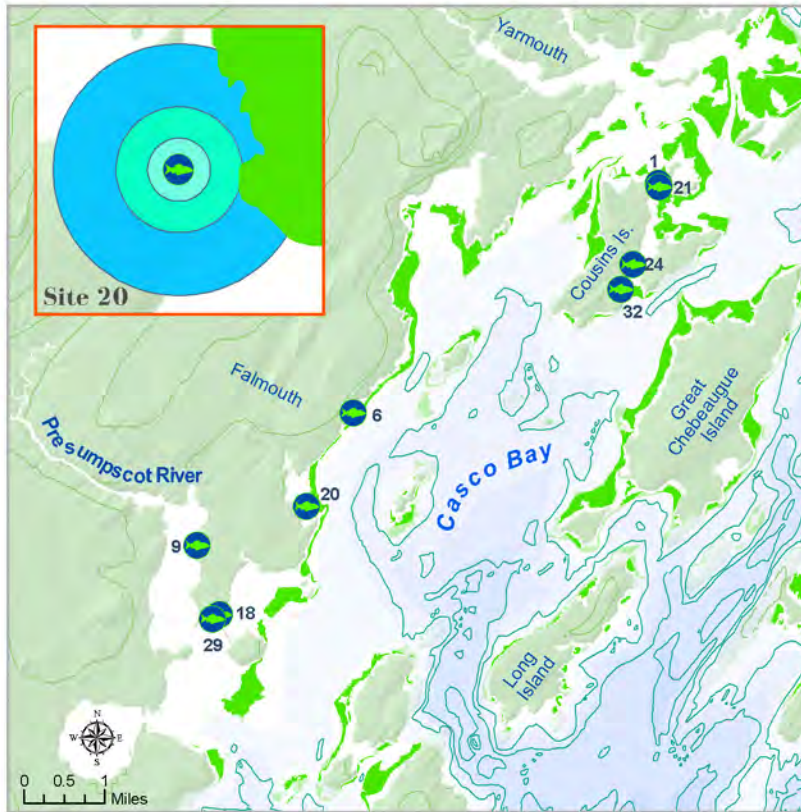
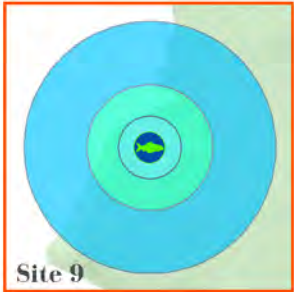
Fundulus heteroclitus



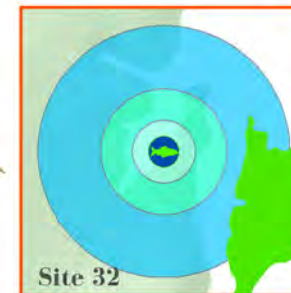
Microgadus tomcod



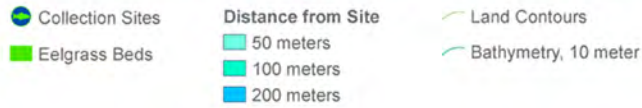
Menidia menidia



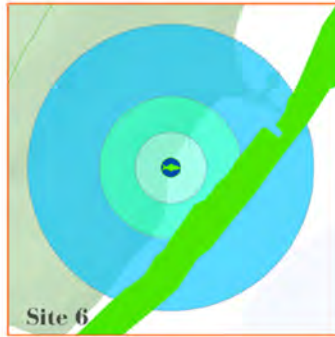
Carcinus maenas



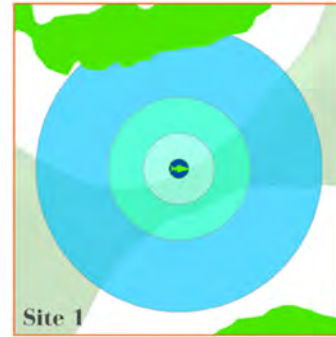
Relationships between collection sites and eel grass at 50, 100 and 200 meters resolution buffers



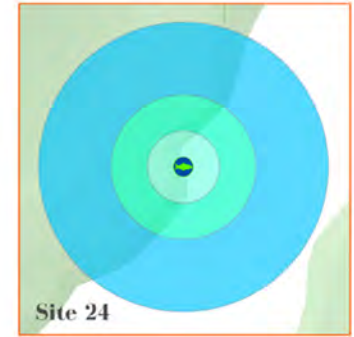
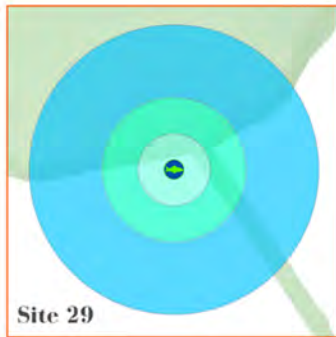
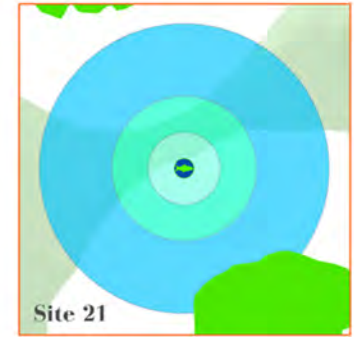
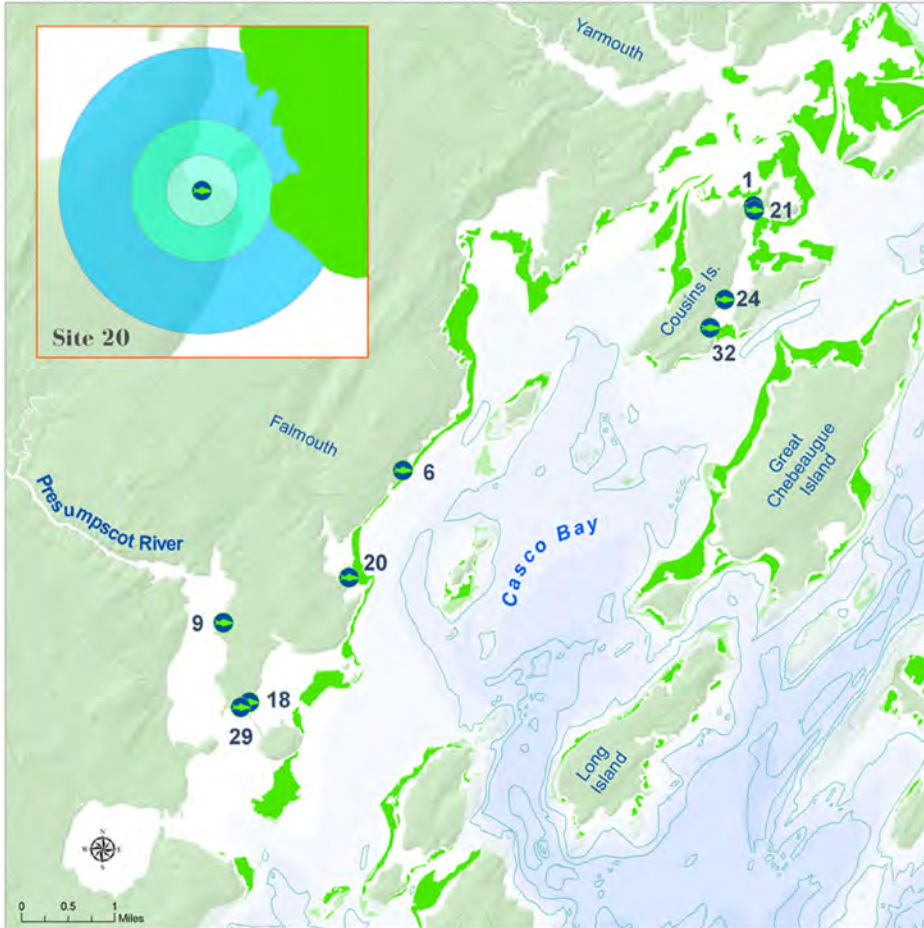
Fundulus heteroclitus



Microgadus tomcod



Menidia menidia

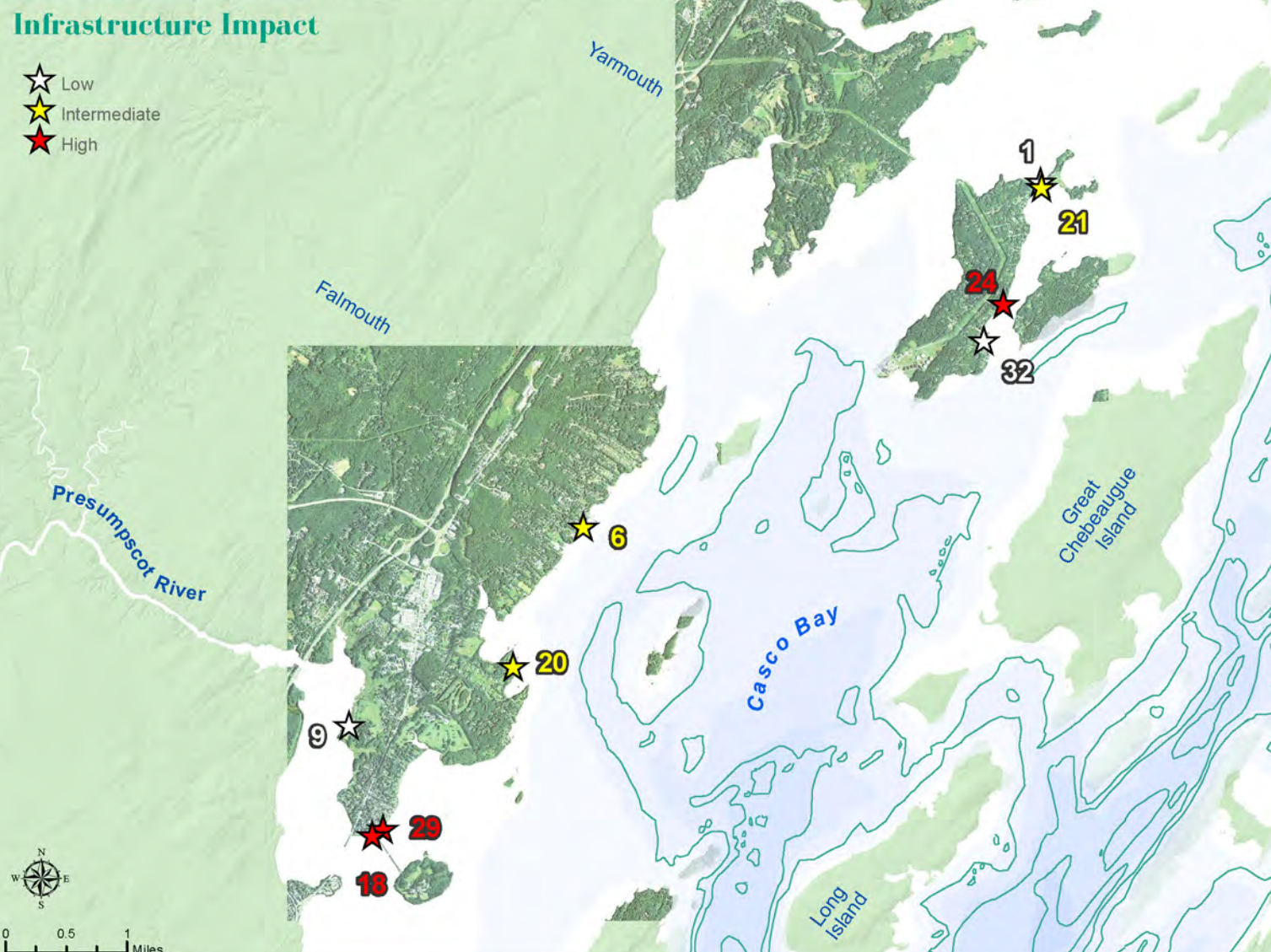


Carcinus maenus



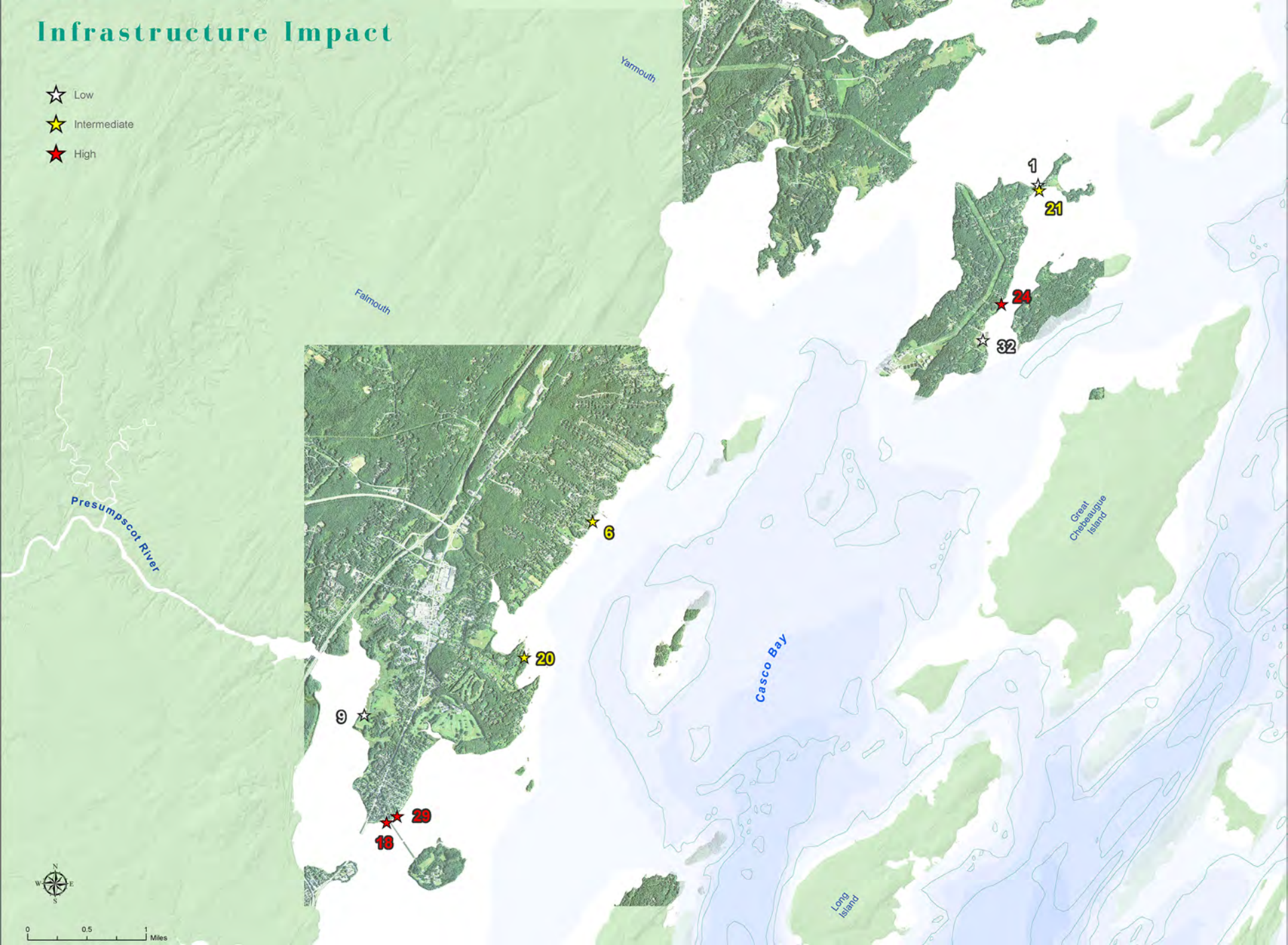
Infrastructure Impact

- ☆ Low
- ★ Intermediate
- ★ High



Infrastructure Impact

- ☆ Low
- ★ Intermediate
- ★ High



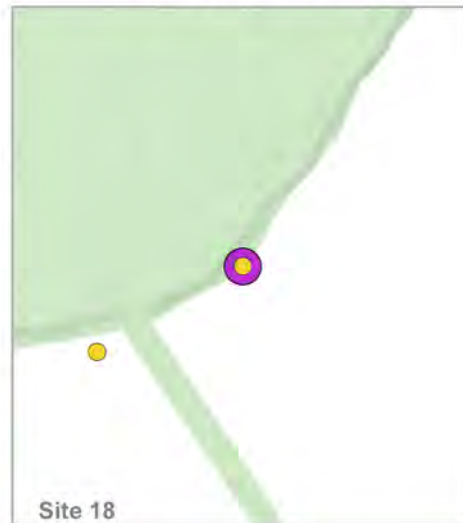
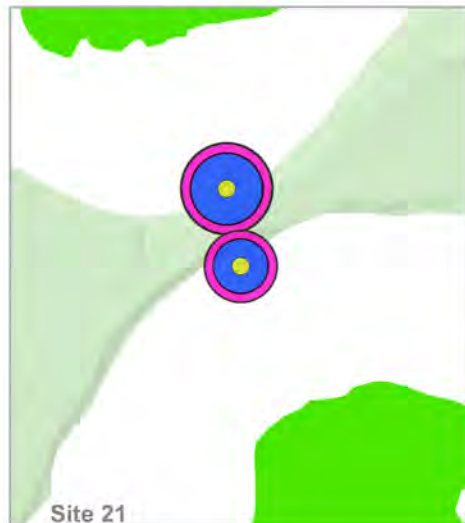
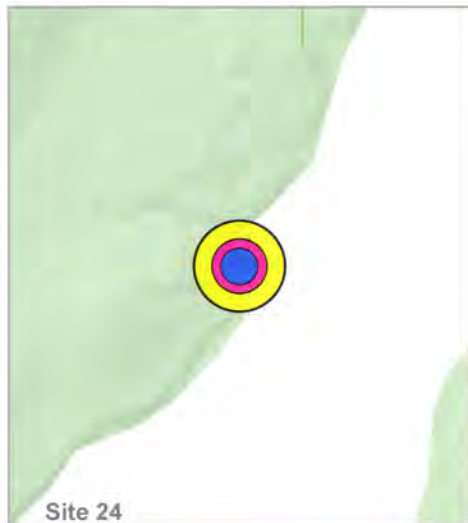
June 2002

July 2002

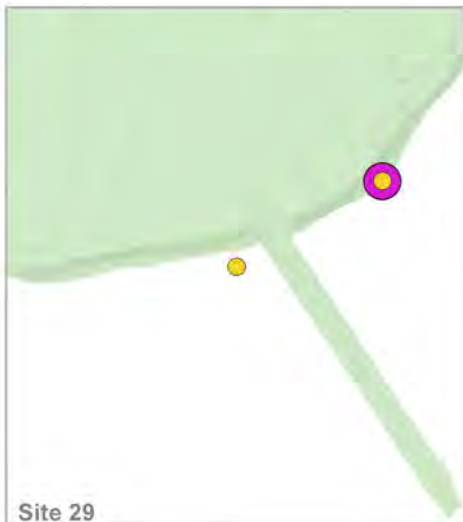
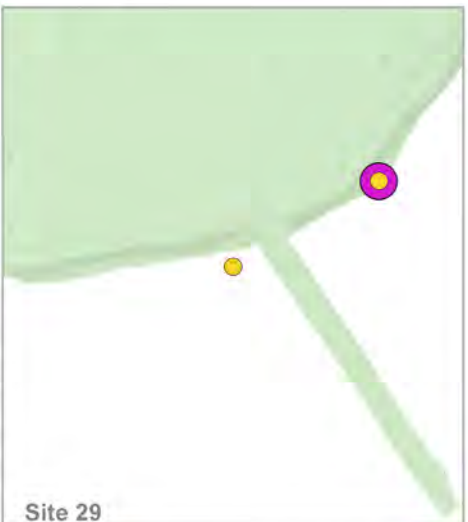
August 2002

September 2002

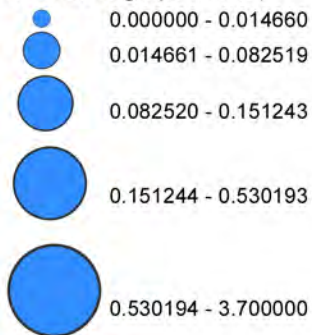
Greatest Biomass, Total Finfish



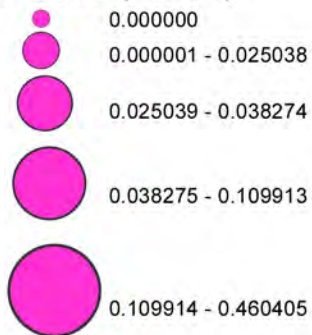
Leastt Biomass, Total Finfish*
*does not sites with zero total finfish



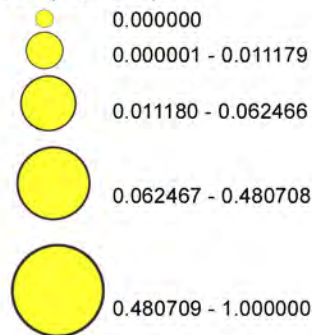
Mummuchugs (Biomass)



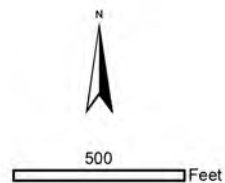
Silversides (Biomass)

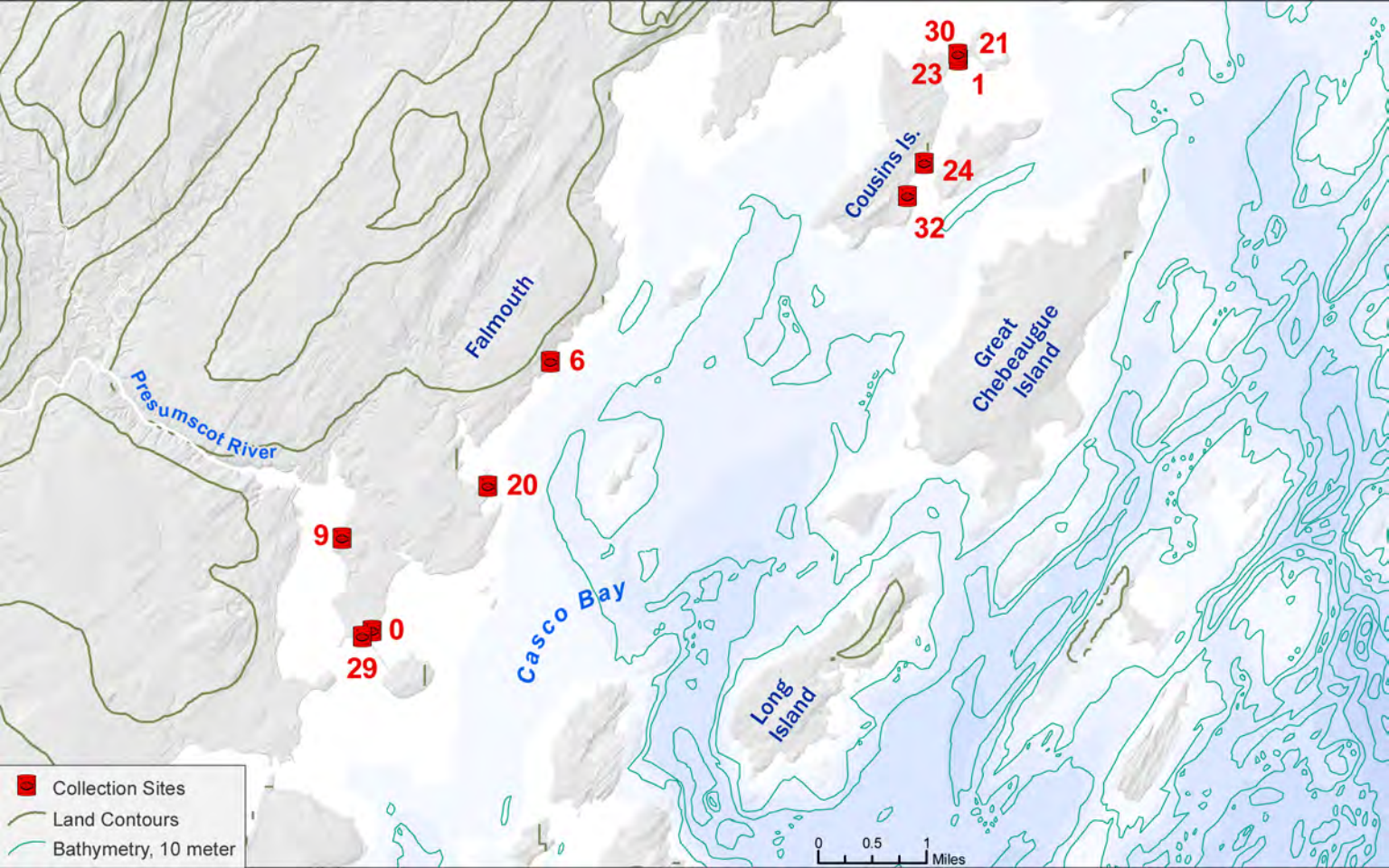


Cod (Biomass)

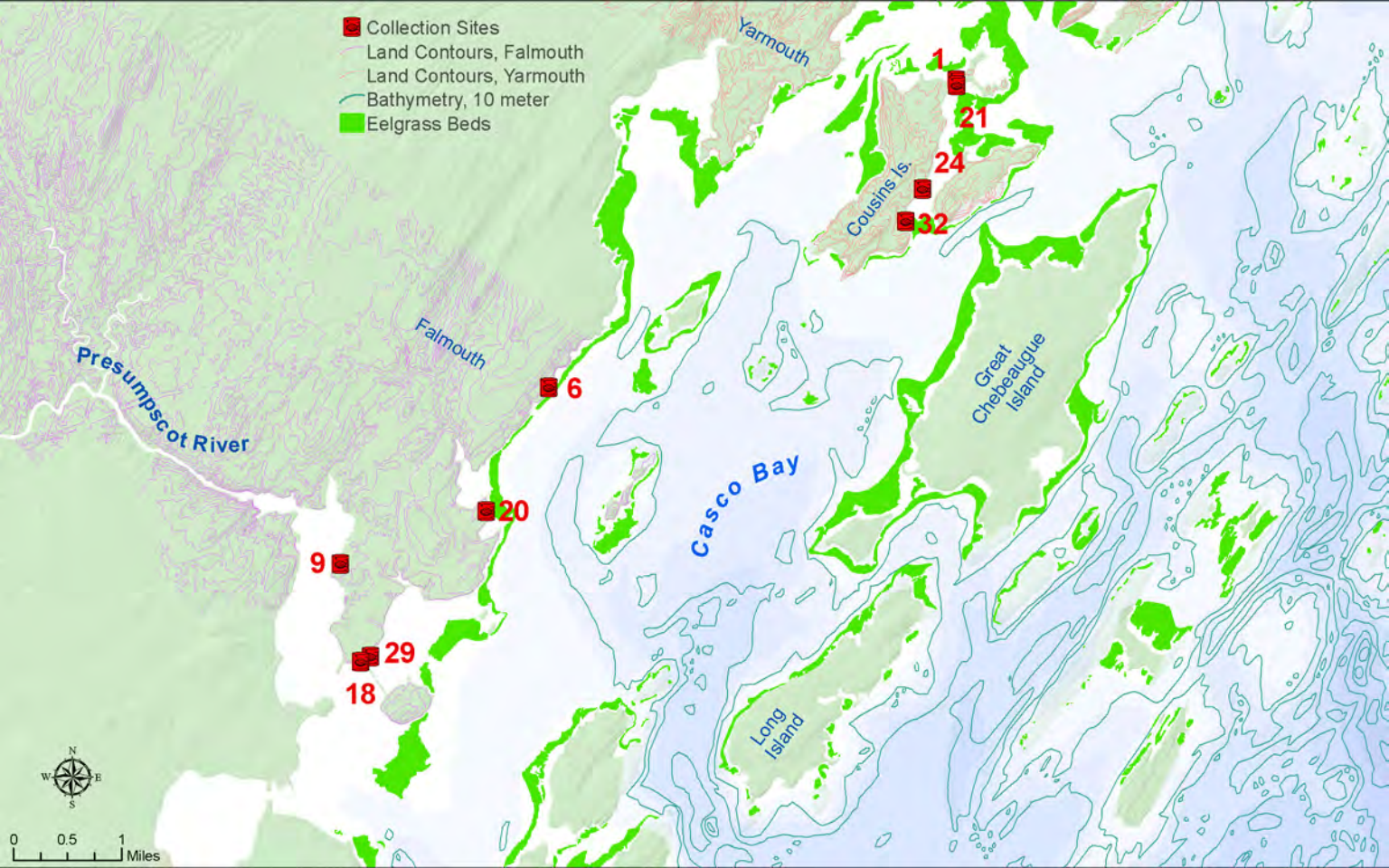


- Land Contours
- Bathymetry, 10 meter
- Eelgrass Beds



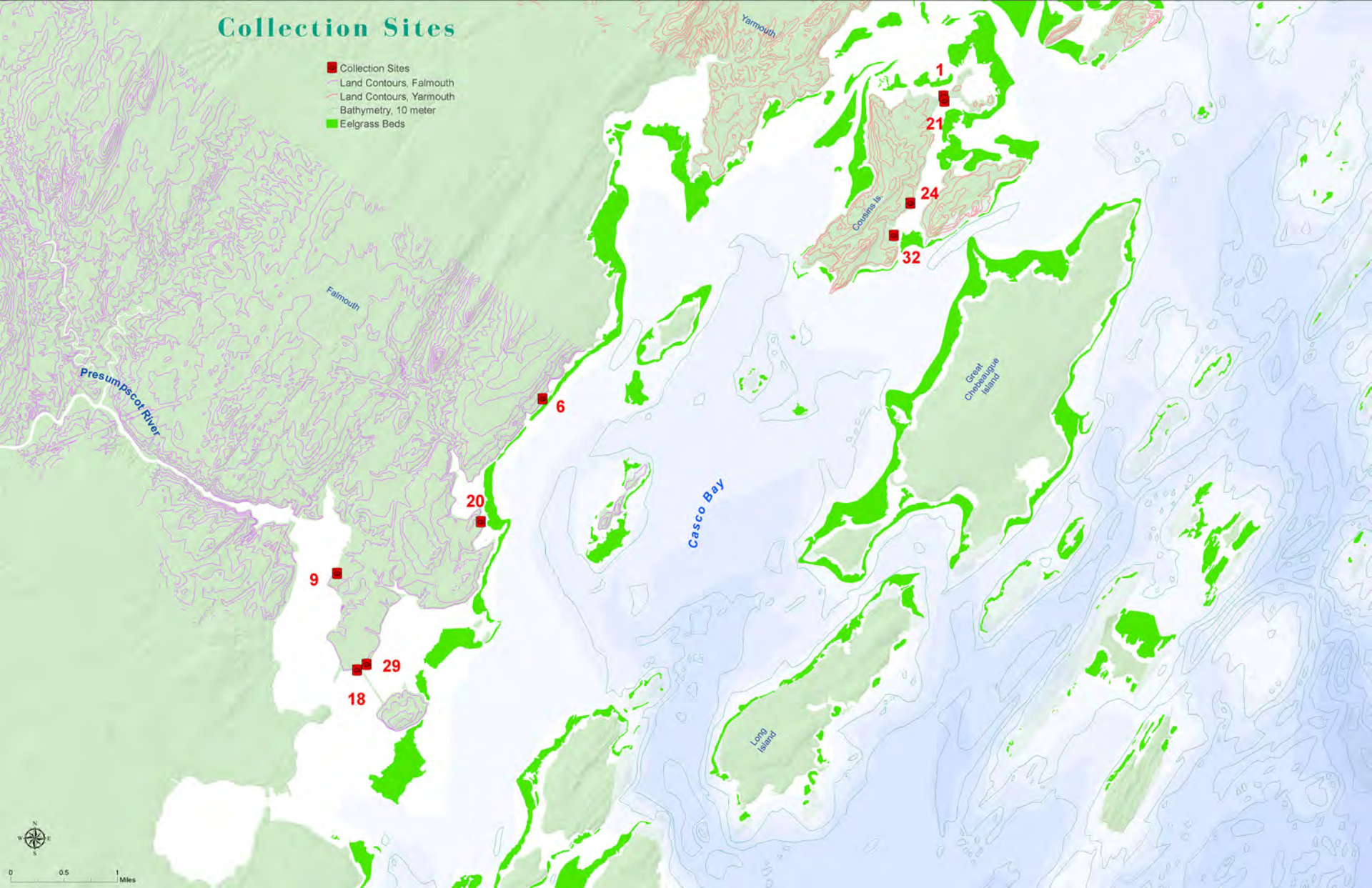


- Collection Sites
- Land Contours, Falmouth
- Land Contours, Yarmouth
- Bathymetry, 10 meter
- Eelgrass Beds



Collection Sites

- Collection Sites
- Land Contours, Falmouth
- Land Contours, Yarmouth
- Bathymetry, 10 meter
- Eelgrass Beds



Aviva's Request for Information

- **If you recall the original state of the town dump, and/ or of Pleasant River, could you please describe what you recall?**

The shore/grout bank where you have planted coreopsis and grasses was once used as a dumping ground for used equipment. I don't know if it was part of the "town dump". I thought the old dump was on the other side of the Reed property towards the east and Arey's Cove. However, I don't know how far back in time that area was used as a dumping site and maybe it was. I can't really say. In any case, your efforts to improve the aesthetics of the property have succeeded. The plantings you have installed in the once barren grout bank now flourish and bloom with grasses and color.

- **Were you aware of my efforts about either site at the time?**

We were, of course, aware of your efforts in Roberts Harbor since our property abuts yours and you asked us about using a corner near the shore for part of the restoration.

- **What thoughts did you have then about what you knew of what I was doing?**

I knew you envisioned a different look for the area, but I wasn't sure it was going to be worth the time, labor and money you would have to put into it. Now, years later, when I see insects, birds and small mammals enjoying the habitat in the reclaimed area I only wish you had continued the project another 100 feet! :)

- **Were you personally involved, in any way, with either site? If so, how?**

No.....just an onlooker to the reconstruction

- **Have you changed your thinking about the value of restoration work as a result of either project?**

I've always valued reconstruction in order to restore the damage humans have done to the environment. I was skeptical of the outcome of your Roberts Harbor project though, especially since the southwest wind and waves would be very harsh for your new plantings.

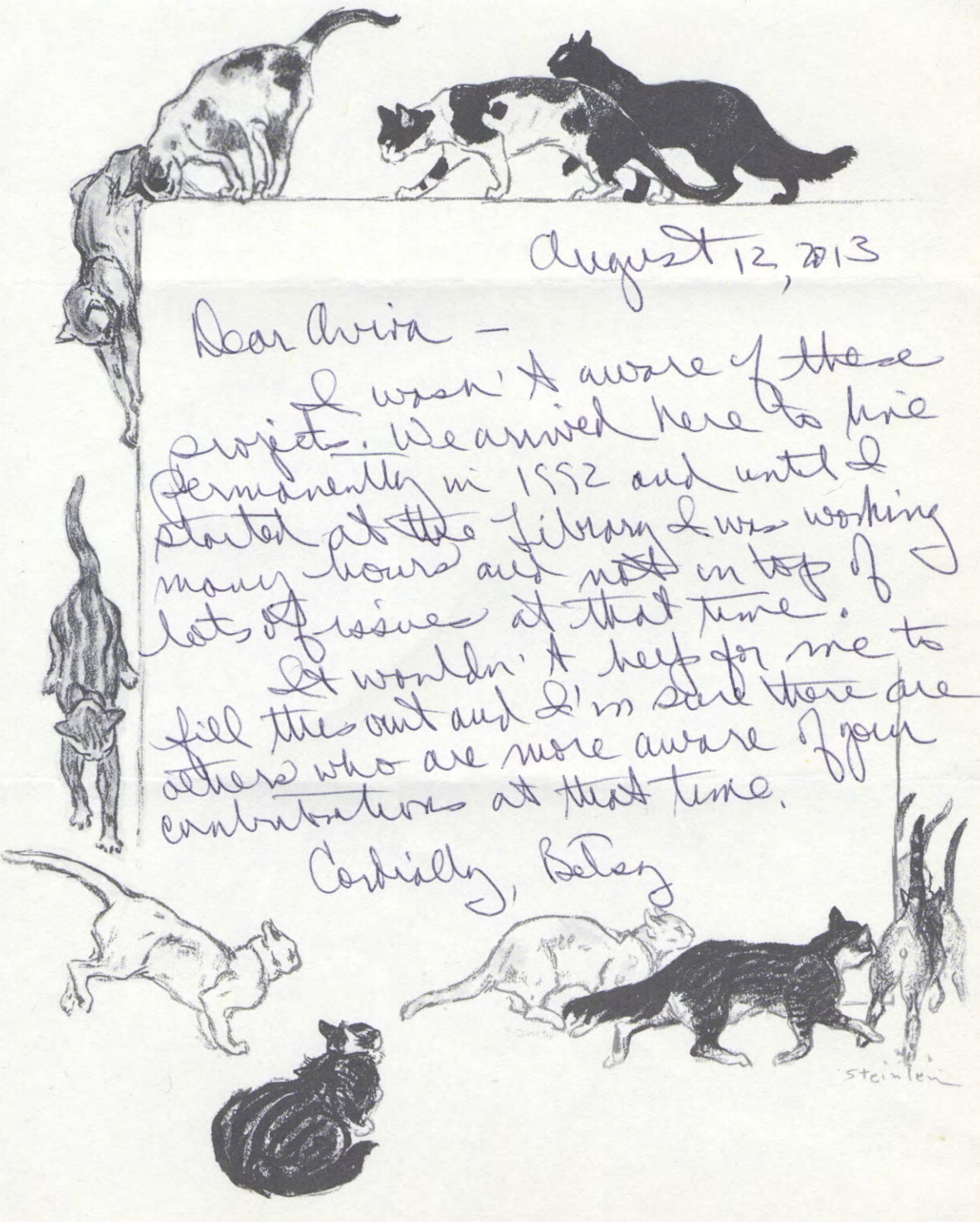
- If so, please describe your thinking.

- **Have you been personally involved with restoration or conservation work yourself?**

We are more involved in personal conservation rather than conservation work. Bob and I are conscious of our water resource. We siphon our dug well to water the garden. We plan our laundries, showers and even toilet flushings. We donate annually to conservation

groups. We also try to keep our energy consumption (fuel and electric) low. Of course, this benefits us with lower bills, but it is also a benefit to the environment.

Would you like to add any thoughts?



August 12, 2013

Dear Arvia -

I wasn't aware of these projects. We arrived here to live permanently in 1952 and until I started at the library I was working many hours and ~~not~~ on top of lots of issues at that time.

It wouldn't help for me to fill this out and I'm sure there are others who are more aware of your contributions at that time.

Cordially, Betsy

Steinlein

August 9, 2013

Dear Awiwa,

In regard for your dissertation I am recollecting the work done for you in combination with your ecological concerns years ago and the effort made to make an area near the water as your Ghost Net project. As I had worked with a number of people in developing the test I recall the labor involved in establishing the format. Even on a small scale it was sizeable the main challenge in keeping the water edge planting to take root with a protective means preventing washout. I understand^{good} your plantings were somewhat successful and that the combination of existing growth and introduced grasses and such was successful the balance being met and nature of course the guiding factor and mediator having the last word including all else.

My view on restoration work and ecological establishments is somewhat pureist although balance to say keep trails, parks and stroll gardens in the habitat to live by in the

reminders. To walk with nature and keep
a clean house the important is clear
I have had my personal experience with
Nature and when harmonious it is a
blessing. Knowing ones own limits in
a similar regard is challenging and
necessary to keep in ones mind set so
I now utilize my creative talents to
inspire from another angle. I have
seen good statements made, well
thought out with planning and opinions
in the various areas of such projects
and unfortunately some random disregard
for others to lead incorrectly. I design
to the easy way which is usually
enough of the work required to make
our coexistence with Nature a pleasure
and not an added burden. So disregarding
Nature is exactly what she will give back
unless we remember what is important
about being alive and respect the relationships.
Being in nature is the great teacher we
must remain connected to this source so
that we can ready be alive again.

Thank you,
David

Arviva R.

1/ I used to use the dump. It was just a place to dump our trash but it seemed wrong to be dumping in such a beautiful place.

2/ I was barely aware you were trying to improve the dump but I didn't know how

3/ It sounded like a good idea

4/ I was not personally involved.

5/ I still think it is a good idea

6/ see 5

7/ No

8/ NO

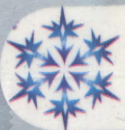
~~Deek Hillburt~~

8/11/13

For Aviva Rahmani' s Questionnaire

1. I remember well the original state of the town dump – it was a mess. Smelly, no order in its arrangement, no place to recycle, it was a place to keep away from, although the actual site was beautiful.
2. No, I was not aware of any plans to clean it up.
3. I did not know what Aviva was doing.
4. I was never personally involved with either site.
5. Yes, I am convinced that restoration work can be invaluable.
6. The present dump is an excellent example of what can and should be done to make transfer stations clean, with recycling made easy and affordable.
7. Yes, I have been on the board of the Lower Hudson Nature Conservancy and the Constitution Marsh preserve of The National Audubon Society.
8. What Aviva has done for our island of Vinalhaven is a template for what a single person can do to improve their own environment.

William C Evarts
August 19 2013
73 Fish Head Road
Vinalhaven, Maine
04963



Ms William Evarts
7 Gracie Sq
New York, NY 10028-8001



Request for information

I am required, for my dissertation, to ask people who may recall, about the affects of some of the work I've done on the island. I would be very grateful if you could please answer, to the best of your ability a few questions, based on the following information to refresh your memory:

1990-2000, I purchased and then restored the former town dump. My goal had been to make a connection between saving small wetland systems and potential impacts on fish spawning, which I mapped as GISc in 2012 with data from Wells NERR. Recently, for the garden club, whom will visit the site August 19, 2013. I described the present state of the site for them as:

My garden combines indigenous and hybrid plantings, including trees, as a restoration project. It is ecological art, begun in 1990, created on the former town dump to restore wetlands on the site. I call this project *Ghost Nets*, for the lost fishing drift nets, that stripmine marine life. It is designed as a series of stroll gardens over 2.5 acres, to study small changes in habitat over time.

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(Please contact me 207 863 0925 if you need any further information or want to visit the *Ghost Nets* site before answering these questions):

1. If you recall the original state of the town dump, and/ or of Pleasant River, could you please describe what you recall?
 - The dump was originally a huge area of tailings dumped from now defunct granite quarry operations right at the oceans edge. Later on, it appears that the Town used the area as a dump. There was much old rusty junk in evidence. Aviva reclaimed the portion of the dump that was on her property and, while the rest of the area has begun to be grown over with grass etc., the portion that Aviva has been regenerating is significantly greener and has considerably more biodiversity.
2. Were you aware of my efforts about either site at the time?
 - I was somewhat aware about Aviva's efforts on the dump at the time.
3. What thoughts did you have then about what you knew of what I was doing?

- I thought it was an ambitious, but very worthy effort, and eager to see how things would evolve.
4. Were you personally involved, in any way, with either site? If so, how?
 - Only as a friendly observer
 5. Have you changed your thinking about the value of restoration work as a result of either project?
 - Not really as I work in the field of conservation, landscape architecture and sustainable urbanism and have been aware of the possibilities and the emerging field of restoration for 40 years.
 6. If so, please describe your thinking.
 7. Have you been personally involved with restoration or conservation work yourself?
 - Yes. Have been involved in protecting various parcels of land in Massachusetts (Boston, Concord, Brookline) and open space systems in the New York City Tri State region. I have also been involved in efforts to demonstrate and promote sustainable urbanism in the US and UK focusing on a range of things from incorporating sustainable urban drainage in new developments, sourcing materials locally, building in a locally contextual manner etc,
 8. Would you like to add any thoughts?
 - Aviva has dedicated much of her professional life to the intersection of art and environmental protection with exceptional attention to hands-on results and showing the way for others. Her efforts to refine and clarify what that means are very important to the combined fields.

Hooper

Hi Ariva

Answer to question 1 is I recall very well as a young boy use to help my Uncle Ken Holdings and go on is dump run with small dump truck and we would collect and go there by your land and I use to think a strange place to have a dump so close to the ocean and a beautiful view and was glad when they closed it down and started the dump in a different spot! Now after years with covering and time is turned into a much nicer part of the island! Didn't realize you were part of the clean up project! But great job Ariva and was needed! Good luck on what you are working on now!

Take Care

J J


1. I first visited the island in 1999.
So non applicable.

2. No.

3. -

4. -

5. Always supportive. This experience reinforces that.

a. 

7. Yes. Helped save land in Wangatact, CT.

8. It will be important to publish these results. Further, it would be good to make some popular writing on it available in the interim.

V.H. ME
AUG. 13-2003

AVIVA - *prob. planted 2000*
I do recall the old Town Dump. It was a real eyesore and garbage was strewn over a large tract of land.

I was not aware that you had purchased that piece of property. You are to be commended for a job well done. I visited the site yesterday and was really surprised to see that is all mowed and many trees and bushes that have been planted. I sat on the rocks and took in the beauty that surrounds it.

The Pleasant River Grange is another beautiful place. What a difference with all the grass and bushes cut down and all those beautiful rocks exposed - plus the flower plantings.

I think its wonderful to have things restored - buildings and land. I hope that people all around will be more conscious of the beauty that surrounds us and work to keep it that way.

You are certainly doing your part
and for that I say

Thank you - and
Keep up the good work.
We all benefit from it.

Sincerely,
Madelyn Hildings

Request for information

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Subsequently, in 2002, I drew attention to the Pleasant River site on the island in order to encourage restoration of that site, by painting the boulders along the causeway with a slurry of biodegradable blue pigment, moss and buttermilk. I called that, "Blue Rocks." My intention was to create a bioregional connection between sites. The result was investment by the USDA and 26 acres restored.

(Please contact me 207 863 0925 if you need any further information or want to visit the *Ghost Nets* site before answering these questions):

1. If you recall the original state of the town dump, and/ or of Pleasant River, could you please describe what you recall?
2. Were you aware of my efforts about either site at the time? *no*
3. What thoughts did you have then about what you knew of what I was doing?
4. Were you personally involved, in any way, with either site? If so, how? *no*
5. Have you changed your thinking about the value of restoration work as a result of either project?
6. If so, please describe your thinking.
7. Have you been personally involved with restoration or conservation work yourself? *no*
8. Would you like to add any thoughts?

Marion Tolman

Request for information

I am required, for my dissertation, to ask people who may recall, about the affects of some of the work I've done on the island. I would be very grateful if you could please answer, to the best of your ability a few questions, based on the following information to refresh your memory:

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(Please contact me 207 863 0925 if you need any further information or want to visit the *Ghost Nets* site before answering these questions):

1. If you recall the original state of the town dump, and/ or of Pleasant River, could you please describe what you recall? *do not recall*
2. Were you aware of my efforts about either site at the time? *yes at both sites*
3. What thoughts did you have then about what you knew of what I was doing? *- glad about the dump site.*
4. Were you personally involved, in any way, with either site? If so, how?
5. Have you changed your thinking about the value of restoration work as a result of either project? *Not really - I think restoration is a worthwhile endeavor*
6. If so, please describe your thinking.
7. Have you been personally involved with restoration or conservation work yourself? *yes*
8. Would you like to add any thoughts?

4. I was working hard thru VLT on the Pleasant River Dam site along with the town and Lydia Sparrow.

- 1) I certainly do recall the condition of the old dump and, had I then, as a young boy, been possessed of the understanding I enjoy now I'd have been appalled at what we felt free to do that tiny piece of our environment. We did feel free, however and not because we were cavalier about our surroundings and those plants and animals with whom we shared that space but because we were ignorant, in the fullest and most forgivable sense of the word, of the consequences.
- 2) I was not aware of your efforts.
- 3)
- 4)
- 5) I have certainly changed my thinking although that transformation was the result of many thousands of things.
- 6) Asking me to describe my thinking is too daunting an assignment.
- 7) Yes
- 8) no

Request for information

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(Please contact me 207 863 0925 if you need any further information or want to visit the *Ghost Nets* site before answering these questions):

1. If you recall the original state of the town dump, and/ or of Pleasant River, could you please describe what you recall? *NO, before my time on island for dump.*
2. Were you aware of my efforts about either site at the time? *yes*
3. What thoughts did you have then about what you knew of what I was doing? *Pleasant River was improved for wildlife*
4. Were you personally involved, in any way, with either site? If so, how? *NO*
5. Have you changed your thinking about the value of restoration work as a result of either project? *worthwhile for shore birds + plants*
6. If so, please describe your thinking. *worthwhile*
7. Have you been personally involved with restoration or conservation work yourself? *NO*
8. Would you like to add any thoughts?

It takes someone like you to make the rest of us conscious of shoreland restoration.

impressed with your concern and activism

Natural Ocean-side wetland

Request for information

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(Please contact me 207 863 0925 if you need any further information or want to visit the *Ghost Nets* site before answering these questions):

1. If you recall the original state of the town dump, and/ or of Pleasant River, could you please describe what you recall? *I remember the dump had a beautiful view*
2. Were you aware of my efforts about either site at the time? *NO*
3. What thoughts did you have then about what you knew of what I was doing?
4. Were you personally involved, in any way, with either site? If so, how? *NO*
5. Have you changed your thinking about the value of restoration work as a result of either project?
6. If so, please describe your thinking.
7. Have you been personally involved with restoration or conservation work yourself? *YES, in many areas*
8. Would you like to add any thoughts?

Thoughts 2013

Question # 8:

After touring Ariva's walkways and gardens, I never would have known it was Vinalhaven's Town Dump. (The Transfer station "town Dump" has been relocated to a different area and is presently on Around the Island Road).

Ariva has completed a fresh, oxygenated environment with wild flowers, heather, and natural plants, shrubs, and trees. If more work is needed, finishing trails, adding new trails and plants it can add to the environmental niche she has created.

→ Information concerning wildlife in this area would have been interesting, including a list of animals living on the property and those animals visiting on a temporary basis. Also, a few types of rocks, stones, boulders found on the property for educational study would have been interesting.

The land is located on the shore line and the directional flow

of breezes and energy is sometimes difficult to ascertain. I think a directional sign, North South East West on the land would be helpful orienting oneself with wind and cloud directions, storms, and the rising and setting of the sun.

Information concerning types of soil, acidic or base and its relationship to the energy flowing through the land would be interesting.

Before the town dump was purchased in 1990 by Aviva Rahmani, , it was a heap of rusted metal, old car chassis, farm equipment, debris, especially wire and parts of machinery. You did not walk on it since much of the stuff stuck up at odd angles and was dangerous to navigate. Since it's purchase, it has been converted into an attractive park like setting. I was not aware of Rahmani's efforts at the dumps restoration but I certainly applaud her efforts to transform it.

I was not aware of Aviva's efforts at the Pleasant River site but there again I learned that making it possible for the rapid exchange of tidal waters has benefited the area, a large wetland marsh. I have noticed a change in the type of grasses and other vegetation growing in that area and wonder if that has had an effect on the bird and animal population.

I was not involved in either project. Except for several garden club projects; establishing a vegetable garden manned by the students and planting trees and creating attractive garden plantings both at the old high school and the new elementary through High School as well as being the "worm Lady" in the 4th grade class project of monitoring a worm compost bin which the children manned for two years, I have not been involved with restoration or conservation work.

I believe that educating the community to the wisdom and benefits of composting, conservation of water, restricting the use of pesticides and recycling, may be less dramatic than ~~ka~~ a large project that has broad visible results but weill help to make people much more conscious of what it takes to restore our planet to good health.

Rhoda Boughton

Good Luck Aviva on
your dissertation
R

Osiyo, Sending smoke skyward
for your Health and Help and
Happiness.

(Traditional Lakota Greeting)



Hi Anwa,

Good to hear from you, too - and to learn
that you're finishing your P.H.D. You go girl.

I'm soo impressed with your amazing stick-to-it-iv-ness.
(no such word?)

I'm honored to respond to your request to answer your
questions.

Before I begin - just wanted to get you up to date on my
life. I've decided that I'm truly happy down here in S.E. Florida,
living my simple, meditative life - in a year round climate - where I can
still jog (inside my Mobile Home Park) 5 miles 3x a week) hike in 3 or 4
wild & natural areas nearby - 9 mos. of the year & Kayak 2x a week
year round. - so the idea I originally had of living with Nancy in
Essex Junction (near Burlington, VT) was not good - too many months of
cog, brutally cold weather for me. Here also, I'm growing in huge pots -
lots of greens (Kale, Collards, Arugula, Mustard, Spinach, Parsley, Red Green peppers,
Basil & lots of other foods). Also, Whole Foods Market, P.B. County Public
Library, P.B. Mall, Hospitals, Great Medical Care, etc. are all within
3 miles of my trailer - soo - except for my flying up to be with all my
family - they & dear friends come stay here with me - when they can.
I'm fully retired now (as of 2012) & loving all my free time. Still
volunteer at the nearby Childrens Hospital - dressed in my Elf costume - (18 yrs
now - to do Pastoral Care there - & then go to a local pre-school Day
Care - to read to kids (also in my Elf costume - soo life is very joyful
& wonderful for me. I do miss my "Spirit Home" of 50 years ->

But realize how very difficult it is now to get there. But who knows.
Hope that you're well + enjoying your life there on V.H.

So here's my responses to your request for some answers —
(I don't have any technology - No Computers, Tablets, Fancy Cell Phones,
etc - Just my Land line + a Jitterbug cell phone (which is for emergencies)

1 - My recollection of the original town dump way back in the early 60's -
was - Jambal Cans, pushed over the cliff into the ocean, old tires, house trash, rugs -
+ Garbage strewn everywhere. A stinky mess - but we also called it the
V.H. exchange - where we met each other + shared our usable goods.

2 - After I met you - early 1980's and you began coming to one weekly for Bodywork -
I learned about your very ambitious + dedicated plan to clean up + restore several
areas on (meager) property.

3 - I was so very impressed + honored, that you were willing to invest
so much of your time + funds to do such a monumental piece of
restoration - especially an area - that local + summer folks couldn't
really care less about.

4 - Only way that I was involved, was to be honored by you to come to your
Medicine Wheel site to help smudge it, to put out prayers there + to part of an
official Ceremony conducted by a (?) Penobscot Tribal Elder.

5 - Over many years, I became aware, thru visiting the sites + hearing you share
all your plans and all the help you got (thru grants) + experts - who shared your
visions.

6 - Hopefully - after all these years + your constant dedication to this "Holy"
work - the shoreline + restorations have borne witness to the years of constant
dedication.

7. Only in quiet, unsung ways.

8. Many prayers + thoughts go out to you, Ariva, as you constantly go about
your life of helping others to try to see how urgent + critical it is to preserve,
conserve + care for our precious shorelines, oceans, etc. Bless you always -

Much Love + Keep on keeping on - Ariva. You're in my prayers
+ hugs -
Ricki Soaring Dove

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(Please contact me 207 863 0925 if you need any further information or want to visit the *Ghost Nets* site before answering these questions):

1. If you recall the original state of the town dump, and/ or of Pleasant River, could you please describe what you recall? *AN UNSIGHTLY MESSY AREA*
2. Were you aware of my efforts about either site at the time? *No*
3. What thoughts did you have then about what you knew of what I was doing? *YOU DESERVE OUR THANKS.*
4. Were you personally involved, in any way, with either site? If so, how? *No.*
5. Have you changed your thinking about the value of restoration work as a result of either project? *I AM IN TOUCH OF THE VALUE OF RESTORATION.*
6. If so, please describe your thinking.
7. Have you been personally involved with restoration or conservation work yourself? *No*
8. Would you like to add any thoughts? *KEEP UP THE GOOD WORK.*

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1. If you recall the original state of the town dump, and/ or of Pleasant River, could you please describe what you recall?

I did not see the site in it's original condition. When I first heard about your work, I thought you were cleaning up the whole island of Vinalhaven, which I knew had a long history of mining and fisheries. After reading more I realized it was a concentrated effort in one area (the former dump).

2. Were you aware of my efforts about either site at the time?
3. What thoughts did you have then about what you knew of what I was doing?

When I read about what you were doing I had just begun researching "ecological art". I could relate your work to artists such as Mel Chin, the Harrisons, Dan McCormick, and

Shai Zakai. I wondered about things like the integration and acceptance of the local community, the long term (and often unseen) effects of the dump, and your own personal methods of restoration.

4. Were you personally involved, in any way, with either site? If so, how?
5. Have you changed your thinking about the value of restoration work as a result of either project?

I think that artist's often approach restoration differently than scientists or engineers in that they include aesthetics, ethics and emotional connection in the work that they do. They also include public participation and "citizen science" more often than institutionally commissioned restoration efforts. Your work is different from the other artists I mentioned, as well as from institutionalized restoration, in that you made a personal commitment to LIVE in the site that you are restoring. This personal connection to site breaks down scientific and artistic "comfort zones" of subjectivity and objectivity as you become physically dependent on you're the work that you do there. It goes beyond restoration work to a state of complete embeddedness in the surrounding environment and the complexity of repairing and maintaining something that has been degraded.

6. If so, please describe your thinking.
7. Have you been personally involved with restoration or conservation work yourself?

Comment [a1]: I'd include Nr. 6 in the previous question.

Yes. I've participated in biotope mapping projects as part of larger environmental assessment monitoring efforts, and community organized park stewardship programs. I'd like to go more in this direction!

8. Would you like to add any thoughts?

Sept. 11, 2013

Dear Ariva,

As usual, I am somewhat at a loss to know just what to think or say when contemplating your now decades long project. I believe it is useful for one to try to implement one's ideas about ecological improvement on however small a scale. So I have watched you persist in your efforts with respect and ^{with} some awe at your commitment and perseverance. I will try to answer your questions as I come to them in the order in which you asked them.

1. I do recall the old, disused town dump of Vinalhaven from the period 1990-2000. It was covered with some landfill and quarry rubble and overgrown with weeds, wildflowers, and shrubs of various kinds. Along the water, much granite rubble and some seaside vegetation grew. It was a small waste-land you might say but the seaside view looking south, east and westward was grand.
2. During this period my wife, Carol, and I became acquainted with you and your ideas about ecological renewal, which seemed to me at the time to be impressively theoretical but hardly likely small enough in concept for one person to implement with much success.
3. As you began your efforts to renew the natural environment along your waterside looking west, I was hired along with
4. David Baughton to plant a variety of seaside vegetation and marine vegetation along this west inlet separating I believe your property from that of Fred and Laura Reed. At the time
5. I thought it ironic that while you were attempting restoration of natural habitat, Fred and Laura were creating more traditional fruit and vegetable gardens, and a lawn on their property which, like yours, was a combination of former dump and industrial granite extraction site. As you persisted with your project along its various avenues implementation - ~~both~~ practical, theoretic and artistic - I began to realize that theory and practice could perhaps never be equal primarily because your acreage was so small that you could never fully implement all your ideas (even assuming you had the money and land and seaside to do it all). The implementation would be too vast for a single individual. Fortunately, art still remained available. And you have not neglected it.
7. I think you have mastered a great deal of theory and artistic technique, as well as much practical knowledge of ecological

restoration. Even if you have ²⁻ much left to do,
or have failed to achieve all your vision of what's
possible, you continue on all fronts to make an
informed, creative effort. That in itself is an
achievement.

my Best,

Wayne Cooper

Alison Knowles
122 Spring St.
New York, N.Y. 10012

tel: 212 226 5703
fax: 212 941 5654

Feb. 18, 1998

The Ghost Nets Project 1991-2000

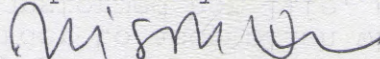
To whom it may concern:

For many years I among others have been following the development and now the realization of the Ghost Nets Project of Aviva Rahmani. I saw video documentation of the progress of Ghost Nets a few years ago. As I have worked with Aviva in California when she was my student in the Art Department at Cal Arts from 1970-73 and followed her work since then, it became clear to me that the piece would eventually succeed to the letter of its intention. It is very impressive to me that an artist would physically change his/her living working environment in order to accomplish what she set out to do. Aviva totally transformed her life, moving permanently from the urban art center of New York, to an island off Maine. It is also very impressive to me that such a work has been done without institutional support and is, finally of such a formidable dimension in time, ten years. One can only conjecture the economic, cultural and personal struggles she has overcome.

I am quite sure, that the environment has been rebuilt according to what she set out to do, but as well the human element has been transformed. I feel sure that everyone involved in this great project has felt the implications not only to the land and water where they live but what such a change means in their very lives. The people on the island will fight to maintain this transformation day by day into the future.

The Ghost Nets project of Aviva Rahmani culminates her previous work: the concern with all types of rebirth and recovery, environmental concerns in particular and her rich use of metaphor. With great personal pleasure I recommend the Ghost Nets project to you for consideration.

Respectfully submitted



Alison Knowles

Mar. 31, 98

To whom it may concern -

It's no accident that as the world's economies and cultures increasingly mix, the arts have done the same. Crossovers between the visual arts, music, literature and theater are commonplace. And the arts, in turn, ^{have} absorbed politics, technologies and the social sciences.

An artist who played a strong rôle in early feminist art is Aïva Rahmani, who helped the movement to see that the breakdown of categories in the arts was an effective means of breaking standard models assigned to women in society. The feminist artist was no longer obliged to display specialized skills and values established by a long history of men's examples (however admirable in certain respects).

It was only a logical step to extend these insights to the ecological imbalances in nature caused by human self-interest. She moved to a small community in Maine where she saw that the land on which her home stood had been laid bare by former quarrying. Plants, animals, birds, even the nearby sea edge, were lifeless. She set about to turn this around.

It is the tale of "Ghost Nets". It's an ongoing saga that has also become the outline of a moving book. The lesson that may be learned from Rahmani's experiences is that personal, relatively modest efforts at rebuilding nature and society are as necessary as the more publicized ones that would restore rain forests and deserts. Her book should certainly be published!

- Sincerely,
Allan Kaprow
Professor Emeritus
UCSD

To whom it may concern,

I first became aware of Aviva Rahmani's Ecologically Conscious Artwork six years ago while doing preliminary research work for my book, *Sculpting with the Environment, A Natural Dialogue*. Over the years I have come to greatly admire her as a bioneering artist whose creativity, insight, tenacity, and community service has enabled her to achieve a reclamation as art project that has spanned the course of 10 years.

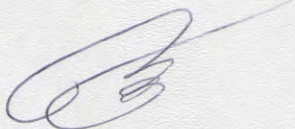
To find solutions, one must first ask the questions. She has asked hard questions to herself, her community, and the art world. Aviva has not only been able to have the vision to ask questions regarding ecological solutions but has also proceeded with finding the answers in such a way as to involve not only her local community, but also a growing community of artists around the world who are also asking questions and sharing solutions for the healing of our planet.

As I view art, the act of art making is to use our material world to create a bridge of understanding between our physical world and our world wherein lies our spirit, our hopes and our vision. Aviva's vision resides in a world when our ecological systems of the planet are healed and our cultural systems are fully in sync with the systems of creation that support all life as we know it. Her art is a telling testament of her ability to bring her vision into fruition.

Her same organizational abilities that have allowed her to oversee and complete a major wetland restoration have served her well as a curator and driving force in the Eco-dialogue that has begun through the internet.

I look forward to following her career and giving her support in whatever way I might be able over the years.

Respectfully,



Baile Oakes

VINALHAVEN PUBLIC LIBRARY

PO BOX 384

One Carver Street

Vinalhaven, Maine 04863

tel: 207-863-4401

fax: 207-8634701

email: vppl@vhaven.lib.me.us

November 22, 1999

To Whom It May Concern:

I am writing in support of Aviva Rahmani and her efforts to bring her environmental interests and talents to a wider audience and community.

As the Vinalhaven town Librarian, a new member of the town Garden Club, but not an environmental specialist, I am only a bit familiar with Aviva's key Ghost Nets project. I am, however, more familiar with her other community efforts some more environmentally-related than others.

Aviva, along with Joan Wye, representing the Vinalhaven Garden Club, prepared the Vinalhaven Ferry Terminal Landscaping Plan for the time when the State of Maine replaces our current woeful terminal. It is a plan designed to enhance the natural beauty of the existing location. The ferry, its pen and surroundings is a place of emotion--happiness to have family and friends arrive or to leave to go Christmas shopping and sadness to have folks leave and overwhelming pleasure to return home from the mainland. The design, to me, reflects a quietness allowing you to experience all those emotions.

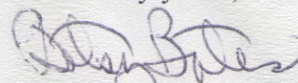
The ferry and all the surrounding issues is a real part of our lives. Aviva chaired a Ferry Committee to explore changes in the ferry policy ranging from line-up procedures to designated boats solely for trucks. She followed through with notes, meeting, questionnaire construction and interpretation doing a very thorough job.

She organized a twelve-step group which meets at the Library each week. She is very diligent in her efforts to open community awareness of this group and the meeting time/place.

Lastly, Aviva joined the Union Church choir in the past year and, as I see it, opened even more to her personal community.

I hope in a small way I've been able to add another piece for your picture of Aviva.

Sincerely yours,



Betsy Dickinson Bates
Librarian



The Connecticut College Arboretum

P.O. Box 5511 • 270 Mohegan Avenue • New London, Connecticut 06320-4196
(203) 439-2140

Dear Mr. Lehman,

March 25/1996.

Thank you for sending along the proposed restoration plan for your property in terms of salt marsh restoration. You appear to have a knowledgeable person working on your wetland project. I assume the low marsh Spartina alterniflora will be flushed by every tide and that the higher S. patens areas will be only occasionally flooded by high high tides.

Will look forward to seeing photos of the restoration in the future.



The Plant Collections and Natural Areas of Connecticut College

Merry

12 January 1998

Guggenheim Foundation Recommendation

As preface to this recommendation I must mention that I am writing on behalf of two distinguished artists who both seek Guggenheim Foundation support – though they do not know each other, each one's proposal compliments the other. Aviva Rahmani brings her history of fine art into an ecological activism - an integration of scientific principles and aesthetic practice. Colin Beatty is developing a personal visual ecology, through principles based in his original training in science/ biology.

Aviva Rahmani's influential work gained recognition in the 1970s; she explored the visual representation of gender issues using sculptural methods and materials, while participating in the Los Angeles community of women artists who initiated activist performance. During the 1980s, she continued to merge aesthetic and social issues: Rahmani created video works exploring splits between body imagery and self definition, as well as a valuable series of interviews and articles on censorship and contemporary art. By the early 90s, she had moved her involvement from the urban "art world" into a landscape environment: a new area of critical necessity and aesthetic probability – which resulted in the eight year rehabilitation of a salt marsh, become a dumping ground within an estuary.

"Ghost Nets", her intervention within an endangered natural site has been extended as an ecological collaboration, connecting this project to larger undertakings in eco-aesthetic awareness, ecosystems management. This is a process of interconnection and complexity, building a counter force to the alienation of nature from our work environment, one which requires the sensibility of a visual artist and the experience of an artist/ activist.

As of this writing, "Ghost Nets" has become an aesthetic template for saving and reintegrating wetlands into the larger ecosystem where they have been endangered. A fellowship would enable Rahmani to extend as well as consolidate the practices which have engaged her in its demanding physical labor, ecological research and community outreach. I consider her work to be a most positive harbinger for the future of an engaged aesthetic which benefits a living environment. I sincerely hope that the committee will find her work as worthy as I do.

Carolee Schneemann

Emily B. Lane
P.O. Box 466
Vinalhaven, Maine 04863

December 2, 1999

To whom it may concern:

I first became acquainted with Aviva Rahmani in 1997 when she expressed an interest in working on a community planning grant application for the Town of Vinalhaven. I didn't realize it then, but such a project mirrors Aviva's concern with community environmental affairs and how best to deal with encroachment issues, while being sensitive to both the environmental and community needs. The planning grant development typified Aviva's ongoing efforts to create models for alternative land use, a theme which runs through her "Ghost Nets" project about bioengineered restoration of the ecosystem in a salt marsh wetlands site.

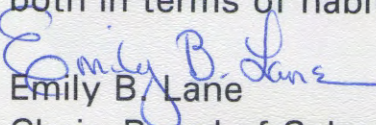
As Selectman, I had volunteered to work on the application which identified transportation problems that existed in a travel corridor between the Vinalhaven ferry terminal and Vinalhaven's Main Street business district, a distance of .3 miles. This mixture of local, business and tourist activities created a significant traffic congestion and the street's narrow construction and lack of sidewalks could not accommodate these conflicting uses and there were a number of safety problems. Degradation of local, residential properties and loss of neighborhood character caused blighted conditions in the area. Aviva was most astute in her analysis and evaluation of a mixed use area involving passenger, freight, bicycle, pedestrian, transit and ferry land use activities. We were to develop a corridor enhancement and management alternative plan for egress and ingress. Aviva recommended hiring consultants to evaluate and make recommendations for problems of pedestrian and vehicular traffic and

parking, defining the scope of such impacts and identifying various planning options. After various alternatives became available and issues were well defined, she proposed a public workshop bringing together various members of the community .

Aviva has also played an active role in the analysis of water issues as Vinalhaven wrestles with economic development. With a single source aquifer, Vinalhaven needs to be extremely sensitive to the issues of water use and salt water intrusion. Aviva has extensively reviewed and analyzed several studies done on subsurface and surface water renewal has been active in Water District discussions on filtration and the impacts of future population increases on Vinalhaven. She was instrumental in publishing a series of educational pamphlets on water conservation for the Town.

Most recently, Aviva applied what we studied in the ferry corridor grant and exhibited her environmental and restoration expertise in a landscape design for the new ferry terminal in Vinalhaven. Her abiding concern for enhancement and management of traffic and pedestrian flow is obvious in this project, as is her extensive training and involvement in environmental art. The design makes use of local, natural elements of wild grasses, Amelanchier, roses, and granite and guides people to significant local elements part of the island's "fragile ecosystem" and making "a strong and bold statement that was nonetheless subtle and blended with the native wildness," according to Aviva.

As Selectman, General Manager of Claw Island Foods and a citizen of the Town of Vinalhaven, I feel Aviva has, and continues to contribute her extensive knowledge of technology, environmental art and concern for our local fishing culture to make Vinalhaven a restored community both in terms of habitat and infrastructure.


Emily B. Lane
Chair, Board of Selectmen
Town of Vinalhaven

March 26, 1999



MAINE
COAST
ARTISTS

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President & CEO
John Chandler
Artistic Director
Catherine F. Knowles
Business Manager
Bruce Brown
Curator
Robbie Applegate
Assistant Curator

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Tom Wilhelm

Founded in 1988

Maine Coast Artists is a non-profit
organization dedicated to the
advancement of contemporary art in
Maine through exhibitions and
educational programs

Ed Bishop
National Endowment for the Arts
Nancy Hanks Center
1100 Pennsylvania Avenue, NW
Washington, DC 20506-0001

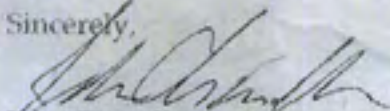
Dear Mr. Bishop:

I wish to support the proposal submitted by Aviva Rahmani. We are considering mounting an exhibition of her project, *Ghost Nets*, at our gallery in the fall of 2000. The exhibition is contingent upon her success in raising the funds to complete her project by that time.

Should we do this exhibition, the projected costs are expected to be in the vicinity of \$21,000. I have some expectation that we will receive a grant to enable us to do the video projection portion of this exhibition. At this time other funding is still problematic, but we hope to do such an exhibition, making do with lesser funding if necessary.

Maine Coast Artists is a non-profit visual arts gallery dedicated to the advancement of contemporary art in Maine. A few years ago we received an NEA Advancement grant. Part of our mission is to bring cutting edge art installations to our Maine audience. Aviva Rahmani's *Ghost Nets*, a most interesting marriage of art and environmental science, presenting as it does the reclamation of a marsh land from the devastation effects of past industry, will make quite an impact on this environmentally conscious art audience.

Sincerely,



John Chandler

162 Russell Avenue
Post Office Box 147
Rockport, Maine 04856-0147
207 276-2873
Fax 207 276-2400
E-mail: mca@midcoast.com
web: www.midcoast.com/~MCA/



The Wells Reserve

December 2, 1999

To Whom It May Concern:

I am writing this letter of recommendation on behalf of Aviva Rahmani whom I have known personally since the Fall of 1998. We became acquainted through her connection with Dr. Michele Dionne, our staff ecologist, who followed Aviva's progress in restoring a section of fringing salt marsh on her property in Vinalhaven, Maine.

I think that her approach to ecological restoration and environmental art is very refreshing and revolutionary. She is an artist who is blending her art with a practical approach to restoration and building linkages to the scientific community. One of the biggest gaps in the scientific pursuit of environmental restoration is the lack of a compelling message to the public as to why restoration of degraded habitats is so vital to the future well being of the earth and its inhabitants. I have greatly admired the fact that Aviva is making the attempts, almost single-handedly, at various scientific conferences to promote her important genre. Through her Ghost Nets project, she has raised the awareness of the value of salt marsh habitat in eastern Maine. Aviva has shown how individuals can actually make a difference by creating functional salt marsh habitat along a segment of shoreline greatly disturbed by human action.

An area now that is receiving increased attention is the recognition that scientists and coastal managers must better coordinate their efforts. I see Aviva's work with Ghost Nets as an extremely important first step in convincing other artists and practitioners to consider a broader array of diverse media to increase public awareness of the effects of environmental degradation and the physical and spiritual benefits that restoration provides.

Aviva has been very energetic and dedicated, even courageous, in pursuing her vision. We at the Reserve have enjoyed discussing her projects with her and hope that she can be successful in expanding the horizons and the following of environmental art and ecoart. We are involved in restoration science here at the Reserve and see great value in what she is doing.

Sincerely,

Kent Kirkpatrick
Director

The Wells National Estuarine Research Reserve

RR #2, Box 806 • Wells, Maine 04090 • 207-646-1555

LEON GOLUB/NANCY SPERO

530 Laguardia Place
New York, NY 10012-1427
ph 212 477 5396
fax 212 533 0605

February 24, 1998

ref: Aviva Rahmani

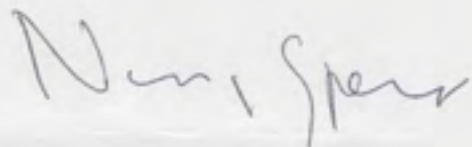
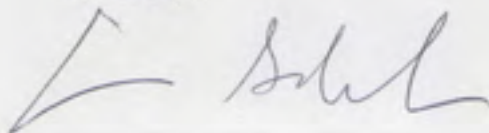
To Whom it May Concern,

We first became acquainted with Aviva Rahmani in the early eighties, when she was still working in California, because of her involvement with social issues that addressed our own concerns: violence in the culture, the abuse of vulnerable members of our society, as, children in her project about child abuse: the Medicine Wheel Murals (1985), and paintings about street attacks, one of which was juried by Leon into a show at the New Orleans Museum of Contemporary Art.

Despite her lack of institutional support, she has continued to be a presence amongst artists whose concerns have been politically sensitive. Her work has been consistent in taking stands outside the mainstream. Ms. Rahmani has brought a similar level of dedication to "Ghost Nets", in her concerns about the environment and how our relationship to nature becomes a metaphor for other human issues. It is time for it to come to the attention of a broader audience.

The recent project, "Ghost Nets", continues her involvement with recovery issues. Although distance has made it impossible for us to be as familiar with it as we might wish, what we have been able to see is intriguing and exciting enough for us to be able to recommend this work to you. We encourage support for this project.

Sincerely,



Feb. 22, 1998

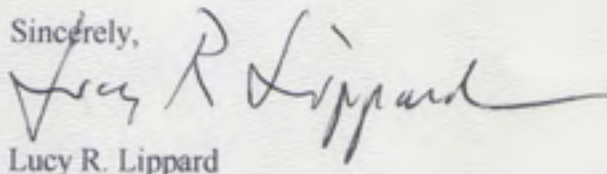
TO WHOM IT MAY CONCERN:

I am writing to recommend your consideration of Aviva Rahmani's *Ghost Nets Project* for publication and exhibition. The work establishes a bond between environmentalism and visual art that is all too rare. Rahmani has restored degraded habitat within an important migratory bird fly zone and done so with the tools of an artist as well as her ecological knowledge and commitment.

Like all art, Rahmani's project is a model for ways of seeing nature and the world around us. *The Ghost Nets Project* will be a challenge to present visually but a challenge worth taking, as it indicates new ways in which artists can become instrumental in environmental restoration and consciousness-raising. The fusion of practical issues with metaphor is an increasingly popular option for artists who are struggling to make their models known to larger audiences who might profit from them and the breadth of Rahmani's project makes it exemplary..

I am familiar with Rahmani's socially concerned and feminist art over the years and have visited the Vinalhaven site as well. I hope to see this project receive the attention it deserves. Should you need more detailed information, please feel free to call me at 505-466-1276.

Sincerely,

A handwritten signature in black ink that reads "Lucy R. Lippard". The signature is fluid and cursive, with a long horizontal flourish extending to the right.

Lucy R. Lippard

HC 75 Box 77
Galisteo, NM 87540



The Wells Reserve

29 March 1999

Aviva Rahmani
Ghostnets
Oatmeal Quarry
PO Box 692
Vinal Haven, Maine 04863

Dear Aviva,

Thank you for sending me the summary of your request to the National Endowment for the Arts. I am very happy to play a part in your project, and I believe the collaboration of art and science will produce results that are greater than the sum of the parts. To some extent this partnership is a novel experiment, so it is hard to predict the specific outcomes. But I am expecting that the film you produce will use sight and sound in a way that will communicate basic ecological concepts and engender interest and action much more effectively than a documentary produced from the scientific point of view alone. I know also that I will benefit as a scientist (as indeed I already have) through discussions with you about landscapes, linkages and communication. The simple act of sharing our thoughts on the same subject, while coming from such different backgrounds, is extremely stimulating and challenging. It is also an excellent exercise in communication - the dialogue should lead to a product that is scientifically sound, yet accessible to a very broad audience.

Sincerely yours,

Michele Dionne, Ph.D.
Research Director

Mills College
5000 MacArthur Boulevard
Oakland, California 94613

MILLS

February 14, 1998

TO WHOM IT MAY CONCERN

This is an enthusiastic letter of support for Aviva Rahmani's **The Ghost Nets Project, 1991-2000.**

Rahmani is an original and bold artist, who has been involved in feminist performance art and various vanguard exchanges from the early 1970s to the present--first in California and now in Maine. From the start she has been highly innovative and original in both her thinking and execution. Currently she is involved in this project, which so far lacks institutional support. From all accounts it sounds a conceptually rich piece that would, as she herself has stated, be a culmination of her previous work "on recovery, environmental concerns and metaphorical imagery."

I strongly recommend the project to you.



Moira Roth
Trefethen Professor of Art History

Principal Investigator's Name: Aviva Rahmani

Principal Investigator's Phone: (O) (207) 863 - 2516 (H) (207) 863 - 0925

Project Title: "Ghost Nets: Using a Collaborative Balance of Art and Science to Model a Salt Marsh Restoration for the Maine Islands"

Instructions: The Charles A. and Anne Morrow Lindbergh Foundation requests that the endorser evaluate the attached proposal using this form. Your evaluation should be based upon the proposed project's ability to solve the problem and the solution's ultimate practical application. Please state your opinion as to the applicant's ability to carry out the proposed work successfully. The Foundation's concept of balance between technological growth and preservation of our human/natural environment is key in the selection process. It is based on the conviction of Charles A. Lindbergh: "The Human Future depends on our ability to combine the knowledge of science with the wisdom of wildness;" and of Anne Morrow Lindbergh: "Power over life must be balanced by reverence for life." The endorser is to send 8 copies of the completed Endorser's Report Form (sending the application is not necessary) directly to: Marlene K. White, Grants Administrator, The Charles A. and Anne Morrow Lindbergh Foundation, 708 South 3rd Street, Suite 110, Minneapolis, MN 55415-1141, (612) 338-1703, (612) 338-6826 (FAX). FAX or E-Mail copies are not acceptable for review purposes. Eight (8) hard copies via mail or other delivery are required. **Endorser's Reports must be postmarked by June 11, 1996.** If applicant or endorser desires delivery verification, arrangements must be made directly with delivery service of your choice. All Endorser's Reports remain confidential.

Evaluation:

My primary concern is health: the health of people, the health of this beautiful island where I live, the whole ecology and the planet's health. I'm honored to be considered an endorser for Aviva Rahmani's project because I believe in what she is trying to do. I have watched the slow erosion of the ecosystem suddenly speed up in the last decade and I want to recommend Aviva Rahmani because I believe in her sincerity and dedication to doing what she promises to do. She sets goals and goes to great lengths to achieve them. She is a risktaker and that is what we (the planet) need now. She is a risktaker in allowing scorn and ridicule of her visionary ideas, but she believes in the urgency of keeping the wetlands intact on island communities. She has learned to deal with attacks with the energy of Coyote, the trickster. This is a hard place. This island teaches difficult lessons. There's been a lack of real understanding of the water issues here, but Aviva has persisted where a lot of other people would have packed up their bags a long time ago and gone to a friendlier place. She is a futurist whose vision reminds me of the Native Elders and teachers with whom I've worked and studied (to become a Medicine Woman), who have taught me to see this area of concern as a test so others can follow suit.

Aviva Rahmani could achieve a balanced technological model to save wetlands. The team she assembled is incredible and she's done an enormous amount of research. Other people haven't even tried to deal with the issues here. There has been no movement on the island to deal with the water issues. She will get through the ridicule because of her integrity of purpose and because she won't get discouraged. She could certainly mobilize people with a visual, practical and educational example that would be very accessible to be seen. It would show very clearly demonstrable results to people from away to get to and see the changes. It would be possible for people from Japan to get here and see the example of others. It is a clearly visible site. Through photos and careful documentation of the project so far it is quite evident that Aviva Rahmani is well on her way to reaching her goals. She hasn't just started. She's been working on this for years and has made this place her permanent residence.

Aviva's whole life is about a balance between technology and wellness. In personal as well as professional matters she has worked towards health, starting with her own health, which was in jeopardy, and extending to the health of her property, the ecology, her community and the planet. I'm in awe of her energy and the desire she has put into restoring and healing. When she got that site it was a mess, as ugly as anything. She did it in spite of ridicule and cynical remarks. She just kept looking for ways to heal the area. She should get the grant! Of all people!

Endorser's Signature: Ricki Soaring Dove Date: June 10, 1996Endorser's Name: Ricki Soaring DoveAddress: Bx. 46, Vinalhaven, Me. 04863Telephone Number: (207) 863-4603

TOWN OF VINALHAVEN
P.O. BOX 815
VINALHAVEN, ME 04863
PHONE: (207) 863-4471
FAX: (207) 863-4393

December 3, 1999

To Whom It May Concern,

The purpose of this letter is to serve as a reference/recommendation for Aviva Rahmani. I have served as the manager of the Town of Vinalhaven for the past six years and have had the opportunity to work with Aviva on a number of projects.

Aviva is an active and involved member of the community of Vinalhaven on a number of levels. Her work in developing and restoring wildlife habitat through her GhostNets project has been done in a thorough, careful, and well-researched manner. As Chair of the Town's Citizen's Ferry Advisory Committee Aviva has been a catalyst for improving safety and accessibility issues for the traveling public who use the facilities. A talented environmental artist, Aviva also co-authored a proposal for beautification of the soon to be constructed ferry terminal, parking areas, and docking facilities.

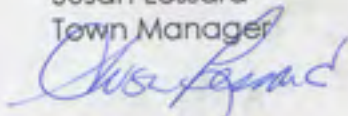
Her concern for the environment has led her to both initiate and participate in public discussions on water quality and supply, concerns over increased tourism and its real costs and benefits, and maintaining the character of this island community.

She is an asset to this community. We do not always agree on what the best course of action is in a given situation, but I can count on her for good information, sound research, and a seemingly endless supply of energy. She also has the willingness to step forward with a different idea - and the willingness to defend it when it is not a popular viewpoint.

I am unfamiliar with her work outside the boundaries of this community, but I believe that if she approaches it with the same enthusiasm and energy and persistence that she utilizes here it is destined for success.

If you require additional information, please feel free to call.

Sincerely,
Susan Lessard
Town Manager



The Harrison Studio

Helen Mayer Harrison, Newton Harrison & Associates

Post Office Box 446
Del Mar, California 92014
619 481 9351 home office
619 534 3810 studio
619 481 9363 fax

April 2, 1999

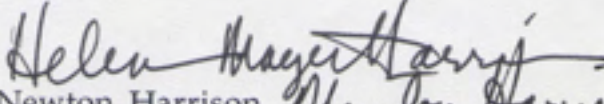
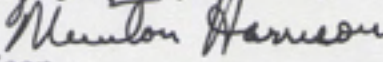
TO WHOM IT MAY CONCERN,

We are writing in support of Aviva Rahmani's work "*Ghost Net*". We have known Ms. Rahmani and watched her work over many years. If memory serves, we met about 1970. As artists who have been committed to working with eco-systemic values for the past 30 years, from conceptual works dealing with drain basins, rain forests, and estuarial lagoons, as well as smaller, intimate systems in particular places, we know well how difficult it is for an artist to gain acceptance working in this area. To do so requires crossing and integrating many disciplines while at the same time remaining true to the basic discipline of art. The basic discipline of art emerges from image formation, pattern recognition, storytelling, and expressing deep intuitions about the nature of culture and the human condition.

Rahmani does this in her work, '*Ghost Net*'. She has essentially taken a 2 1/2 acre degraded site in her own community in Maine and set about its restoration in over a nine year period. The site is valuable in itself, but also valuable as connecting part of a larger corridor. At one level she has worked in the way any good ecologist works by careful and continuous attention to detail. She has encouraged the ecological regeneration by working with the natural flow of orders, seeing the site as a mini-drain basin, and the terrain within it as self restoring with minimum but careful attention to the species migrating back into the terrain. The differences between Rahmani's work and that of a typical, well-funded ecological restoration are many. They exist in her work with community involvement and with the sensibility of the artist. Thus, a video appears, stories and narratives appear, images and texts appear, and an interplay between the parts appear so that a whole system is presented in the condensed and felt and empathetic manner that the artist can bring to any work. We think it most important that artists find appropriate subject matter join with the eco-cultural discourse that has emerged in the past 15 or 20 years in the public consciousness. It is for these many reasons that we recommend, indeed hope, that the work '*Ghost Net*' receives the fiscal

support that it needs to continue its life as both a work of ecology and a work of art done from an eco-feminist perspective.

Respectfully,


Newton Harrison 
Helen Mayer Harrison
Research Professors
University of California, San Diego

Valley Environmental Services

63 French King Highway
Greenfield MA 01301-1337
(413)774-5696 fax (413)774-5699

February 26, 1998

Mr. Scott P. Farwell and Ms. Claudia Sait
Maine Department of Environmental Protection
State House Station 17
Augusta, ME 04333-0017

RE: Tidal Marsh Restoration, Roberts Harbor, Vinalhaven, ME

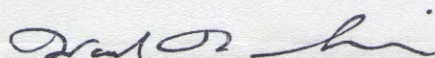
Dear Mr. Farwell and Ms. Sait:

Pursuant to the requirements of the Permit-By-Rule for the above reference project, enclosed please find photographs of the completed project. The work was conducted last spring, with planting completed in April. The majority of the planted vegetation has survived to date.

The area will continue to be monitored. However, at this time it appears that the project has been very successful.

If you have any questions or concerns regarding this work, please contact me at the above telephone number; or, contact Wendi Goldsmith of the Bioengineering Group at (978) 740-0096.

Sincerely,
Valley Environmental Services



Ward W. Smith, PWS
Professional Wetland Scientist/Registered Soil Scientist
WWS/kt

cc (letter only): Bioengineering Group
Ms. Aviva Rahmani

1998 ENDORSER'S REPORT FORM

Principal Investigator's Name: Arvia Rahmani
 Principal Investigator's Phone: (0) (207) 863-0925 OR (207) 863-2516
 Project Title: GhostNets: Using a Collaborative Balance of Art + Science to Reduce Salt Marsh Restoration for the Maine Islands

Instructions: The Charles A. and Anne Morrow Lindbergh Foundation requests that the endorser evaluate the attached proposal using this form. Your evaluation should be based upon the proposed project's ability to solve the problem and the solution's ultimate practical application. Please state your opinion as to the applicant's ability to carry out the proposed work successfully. The Foundation's concept of balance between technological growth and preservation of our human/natural environment is key in the selection process. It is based on the conviction of Charles A. Lindbergh: "The Human Future depends on our ability to combine the knowledge of science with the wisdom of wildness;" and of Anne Morrow Lindbergh: "Power over life must be balanced by reverence for life." The endorser is to send 8 copies of the completed Endorser's Report Form (sending the application is not necessary) directly to Marlene K. White, Grants Administrator, The Charles A. and Anne Morrow Lindbergh Foundation, 708 South 3rd Street, Suite 110, Minneapolis, MN 55415-1141, (612) 338-1703, (612) 338-6826 (FAX). FAX or E-Mail copies are not acceptable for review purposes. Eight (8) hard copies via mail or other delivery are required. Endorser's Reports must be postmarked by June 17, 1997. applicant or endorser desires delivery verification, arrangements must be made directly with delivery service of your choice. All Endorser's Reports remain confidential.

Evaluation:

My firm, The Bioengineering Group, Inc., has been involved with the site assessment, project design, permit procurement, and construction supervision of the marsh restoration on Ms. Rahmani's property from 1994 through the present. Most of our firm's clients are public agencies, utility companies, and other major landholders with legal responsibility to engage in large-scale environmental restoration projects. From the outset of my involvement with the GhostNets project, I have had enormous respect for Ms. Rahmani's insight into the nature and extent of anthropogenic degradation of her property due to historic quarrying activity and her diligent research into the development of solutions for site restoration, unlike many who approach projects similar to this only when required, and only to the simplest extent needed. She had developed compelling schemes for sharing her vision of upland site regeneration through garden design and of aquatic species protection through various media addressing the problem of discarded fishing nets. When she contacted me, she already had identified the suitability of removing hundreds of cubic yards of quarry debris in order to expose and restore an area which had likely once hosted a healthy fringing salt marsh. Due to the technical challenges of planning and permitting a project in a site exposed to storm surges and monthly tidal cycles, as well as her stated desire to maximize the habitat productivity of the restored marsh complex, the project calls upon some state-of-the-art stabilization and revegetation techniques. Having been responsible for similar types of projects throughout the US and abroad, I can attest to the fact that the GhostNets marsh restoration project represents a unique level of integrity in terms of site-sensitivity and artfulness in implementation. The marsh itself was designed with the requisite elevations, growing media, water circulation patterns, and plantings to serve as a microcosm of the ecologically significant coastal and estuarine communities typical of the Gulf of Maine. Although the site is designed to function fully as an ecosystem, Ms. Rahmani's main objective has been to create a beautiful and appealing landscape which can serve to educate and motivate people to change their behavior related to coastal management. Standing at the margin of the marsh which was installed this spring, looking out at the unimpacted islands off the harbor and then up into the rejuvenated but rugged meadows, woods, and gardens it seems relatively easy for the layperson to grasp how water flow and animal usage patterns serve to link and connect the landscape. In contrast, adjacent turfgrass houselots and rubble-strewn quarry lands stand as examples of ecosystem damage people have caused over time. In the planned next phase of the project, ongoing biological monitoring and development of multi-media presentations will allow for public outreach to scientists and natural resource managers as well as to the general populace who actually tend to impact coastline - for better or worse - on a daily basis. As a professional in the field, I believe the message of coastline stewardship that Ms. Rahmani offers is valid and important, and that her means of expressing the message are compelling (we have, after all, contributed approximately \$6000 of professional services at no charge out of a sense of community service and commitment to the particular project). The technical and financial hurdle of successful completion of the marsh restoration work is accomplished, representing a significant scientific achievement even prior to a complete monitoring program. The remaining outreach element will be the major contribution to elevating public awareness, enhancing personal conviction, and increasing technical knowledge. I know of no other person active in this important arena who is better qualified than Ms. Rahmani to successfully change the way people think about Maine's coastal resources. Her work as an artist in various media including land, as well as her work in collaboration with multi-disciplinary scientists, encompass and embody the subtle complexity and seriousness of her message.

Endorser's Signature: Wendi Goldsmith Date: 6/17/97
 Endorser's Name: WENDI GOLDSMITH, Sr. Biorengineer
 Address: The Bioengineering Group, Inc. 53 Mason St Salem MA 01970
 Telephone Number: 508/740-0096



Coastal America

Northeast Region

To: Ms. Aviva Rahmani
Pequot Road
P.O. Box 692
Vinalhaven, Maine 04863

Dear Ms. Rahmani,

It was a pleasure working with you at the GPAC meeting. As we have discussed the Coastal America team in the Northeast is collaborating with federal and state agencies to restore many of the degraded tidal salt marshes in New England. As scientists we are knowledgeable in the technical aspects of producing large restorations. As an artist you are familiar with expressing a message to the public. I would like to encourage a collaboration between your work and those of the Coastal America Team. We have digital video of the Galilee Salt Marsh restoration and will be conducting additional flyovers this year. I propose this collaboration because I think the message to the public is important, and federal agencies are limited in the type of public outreach we conduct.

I would also expect your work to be done in collaboration with Wells NERR, and that this project will look at the problem of salt marsh loss and restoration in the Gulf of Maine and extrapolate to other areas of the coast. You would have the lead in designing the preliminary material to educate and energize a general public to arrest loss and restore habitat. This work would also be in support of the task force on coastal physical alterations with the GPAC group.

I am looking forward to collaborating. Any of your potential funding sources should feel free to contact me for the Coastal America perspective on this project.

Sincerely,

William A. Hubbard
Chair, NERIT
Chief, Environmental Resources Branch
New England District
US Army Corps of Engineers

william.a.hubbard@usace.army.mil

1. I did my undergrad in sociology but was frustrated by the prevailing model that reality was socially constructed and ignored materiality. I'm a graduate student now at UVM looking at how integrated humans & nonhumans are.
2. I was hoping to hear more about trigger point theory and how art + science could collaborate more.
3. The idea model was a rich exercise that demonstrated how diverse the human faculties & experiences are.
4. Very well! This will help me follow the transdisciplinary scholars in my thesis.
5. I loved the idea of metaphor, especially all of the examples given. The complexity was more easily conceptualized with the roles you constructed.
6. The pace of the workshop was excellent. The terms (like system, complexity, idea model) were ambiguous initially but gradually became clearer.
7. Yes. Especially to scientists (preferably in the same room as humanists + artists!).
8. Please do include me!

emiltsao@gmail.com

**Questionnaire for Trigger Point Theory
as Aesthetic Activism workshop**

1. What is your professional background and how does it relate to your environmental concerns?
EDUCATOR & TREASURER OF SAVE THE MANATEE CLUB
Author of MARSHES OF THE Ocean Shore
2. What were your expectations for or motivations to take this workshop?
I am A TRANSDISCIPLINARY TEACHER & AM USING MURRAY GELL MANN'S QUARK & THE JAGUAR IN CLASS
3. What was your practical take-away?
THAT WE CAN MAKE CHOICES THAT CHANGE PEOPLE'S THINKING.
4. How did your experience address your concerns?
THE DISCUSSION OF ECOTONES WAS VERY REVEALING OF NEW
5. What new idea did you think was most useful to consider?
AGENCY AND THE PARADOX OF URGENCY WAYS TO connect ideas
6. What would you have liked to spend more time on or considered in greater depth?
OBSTACLES TO CHANGING BEHAVIOR
7. Would you recommend this workshop to colleagues or friends, if so, why?
Yes BECAUSE OF THE IDEA OF GIS LAYERING THAT TEST - & CHALLENGES THE LIMITATIONS OF OUR BIASES & DISCIPLINES
8. Would you like to share your email, to be included in email announcements about further trigger point theory events?
jsirg@collins.edu

Thank you for attending and for your feedback today.

Aviva Rahmani

Thanks for your informatives and able guidance in the session. I appreciated your discussions and detail about the egress of Gulf of Mexico

Questionnaire for Trigger Point Theory as Aesthetic Activism workshop

1. What is your professional background and how does it relate to your environmental concerns?
ms & PhD in astronomy, MFA in interdisc. art.

I teach sustainable ag & make environ. art.

2. What were your expectations for or motivations to take this workshop?
I liked the description in the on-line conf. program - the idea of mapping is useful to me, wanted to meet you in person!

3. What was your practical take-away?

4. How did your experience address your concerns?
The 6 rules, ideas to use in classroom when I teach. The idea of ecotones & stress points.

5. What new idea did you think was most useful to consider?
yes - helped me look at old problems in a new way

6. What would you have liked to spend more time on or considered in greater depth?
too many to mention - I took lots of notes - I liked the key elements & diagrams work

7. Would you recommend this workshop to colleagues or friends, if so, why?
I thought the whole thing flowed well. You did a great job. I also how the conversation was balanced - everyone was listened to, and you also participated as well as facilitated.

8. Would you like to share your email, to be included in email announcements about further trigger point theory events?

yes - ~~rhonda.janke@ksu.edu~~ Rhonda Janke
send to parideeza@yahoo.com

Thank you for attending and for your feedback today.

Aviva Rahmani

- please ^{also} send your summary of talk on Monday

Thanks

you mentioned - Elizabeth Colbert & Nathaniel Rich

Please answer these questions about the Fish Story webcast:

- Why did you come this afternoon?

B/c it WAS ON the schedule

- Have you been concerned about environmental changes?

- If you have been concerned, what actions have you taken?

I live about as green as I can to the point that I get teased by my friends.

- Have you been thinking about how environmental damage is globally connected?

- Did you learn something new about environmental issues?

- What did you learn?

I have 4 pages of notes.

- What might you now do differently as a result of what you heard today?

Cry?

- What other issues would you have liked us to deal with?

Why people don't question this. What CAN we do.

- What did you like best about the event?

The scientific information.

- What might you do differently?

put in a med ppt.

Please give us your contact information if you want to stay in touch.

Corrana.Close@gmail.com.

THANK YOU!!!

Please answer these questions about the Fish Story webcast:

- Why did you come this afternoon?

co-participant in Memphis Serial

- Have you been concerned about environmental changes? YES

- If you have been concerned, what actions have you taken?

Try to live work, play and make art in ways that lessen my impact and footprint Be mindful of using, consuming on planet

- Have you been thinking about how environmental damage is globally connected? YES

- Did you learn something new about environmental issues?

- What did you learn?

- What might you now do differently as a result of what you heard today?

- What other issues would you have liked us to deal with?

- What did you like best about the event?

Interaction of different artists / participants in webcast

- What might you do differently?

Please give us your contact information if you want to stay in touch.

ncqf@aol.com

Shula Rose

www.yurtcity.blogspot.com

THANK YOU!!!

Please answer these questions about the Fish Story webcast:

- Why did you come this afternoon?

to hear fish stories

- Have you been concerned about environmental changes?

yes

- If you have been concerned, what actions have you taken?

NONG really
(taking
garbage to
green mk.
centers)

- yes ○ Have you been thinking about how environmental damage is globally connected?

- yes ○ Did you learn something new about environmental issues?

- What did you learn?

Displacement of people

- What might you now do differently as a result of what you heard today?

? don't know yet

- What other issues would you have liked us to deal with?

creation of jobs as counterpoint
to jobs that involve fracking etc

- What did you like best about the event?

brevity; knowledge of presenters

- What might you do differently?

Please give us your contact information if you want to stay in touch.

THANK YOU!!!

do know about Eve Laramee's work
& + Brandon Battenja (works with
frogs + mutations
from pollution)

Please answer these questions about the Fish Story webcast:

- Why did you come this afternoon?

I WANTED TO LEARN ABOUT THE
RIVER (MISSISSIPPI)

- Have you been concerned about environmental changes?
- If you have been concerned, what actions have you taken?

I HAVE BEEN CONCERNED ABOUT
① GREAT LAKES LEVELS ② OIL SPILL IN GREENPOINT BROOKLYN

- Have you been thinking about how environmental damage is globally connected?
- Did you learn something new about environmental issues?
- What did you learn?

RADIUM IS STORED IN SW ?!

- What might you now do differently as a result of what you heard today?

NOT SURE

- What other issues would you have liked us to deal with?

ELABORATE ON WOLVERTON RIVER

- What did you like best about the event?

MULTI MEDIA

- What might you do differently?

DO IT DURING OPENING

Please give us your contact information if you want to stay in touch.

lat212@earthlink.net

THANK YOU!!!

Please answer these questions about the Fish Story webcast:

- Why did you come this afternoon?

Curiosity

- Have you been concerned about environmental changes? *Yes*
- If you have been concerned, what actions have you taken?

Worked w/ Partners of the Americas

- Have you been thinking about how environmental damage is globally connected? *Yes*
- Did you learn something new about environmental issues? *Not really*
- What did you learn?

- What might you now do differently as a result of what you heard today?

Read more about it.

- What other issues would you have liked us to deal with?

- What did you like best about the event?

The interactive nature of it

- What might you do differently?

Please give us your contact information if you want to stay in touch.

dappleby@memphis.edu

THANK YOU!!!

Please answer these questions about the Fish Story webcast:

- Why did you come this afternoon?

Curiosity

- Have you been concerned about environmental changes? *Yes*
- If you have been concerned, what actions have you taken?

Worked w/ Partners of the Americas

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- What did you like best about the event?

The interactive nature of it

- What might you do differently?

Please give us your contact information if you want to stay in touch.

dappleby@memphis.edu

THANK YOU!!!

Please answer these questions about playing the Anthropocene Game:

- Why did you come tonight?

TO SUPPORT A FELLOW
ARTIST

- Have you been concerned about environmental changes?

- If you have been concerned, what actions have you taken?

SUPPORT ANTI-FRACKING
WITH MY ART

- Did you know what the term anthropocene mean before you came this evening?

- Did you learn something new about environmental issues?

- What did you learn?

- What might you now do differently as a result of playing the game?

STRESS COMMUNICATION

- What other issues would you have liked us to deal with?

ARTISTS ROLE AS
COMMUNICATOR

- What did you like best about the evening?

THE PLAY, AN WILLINGNESS
TO COMMUNICATE

- What might you change about the game?

NOTHING. I LIKE ITS SIMPLICITY

Please give us your contact information if you want to stay in touch.

TOM MCGOWN

THANK YOU!!!

Please answer these questions about playing the Anthropocene Game:

- Why did you come tonight?

I was curious in what
and how you were going to address
the issues.

- Have you been concerned about environmental changes? yes
- If you have been concerned, what actions have you taken?

Support Environmental groups

- Did you know what the term anthropocene mean before you came this evening? no
- Did you learn something new about environmental issues? no
- What did you learn?

- What might you now do differently as a result of playing the game?

- What other issues would you have liked us to deal with?

- What did you like best about the evening?

the people, singing

- What might you change about the game?

more concrete

Please give us your contact information if you want to stay in touch.

Rob @ Rob van der Schoor. EU

THANK YOU!!!

Please answer these questions about playing the Anthropocene Game:

- Why did you come tonight?

To better understand how an outsider perceives and translates the current situation in Memphis

- Have you been concerned about environmental changes? *Yes*
- If you have been concerned, what actions have you taken?

local advocacy, robust conversations at the pub, heavy online/social media discourse.

- Did you know what the term anthropocene mean before you came this evening? *Yes*
- Did you learn something new about environmental issues? *Yes*
- What did you learn?

A few insights into the interconnectedness of various forces at work

- What might you now do differently as a result of playing the game?

→

- What other issues would you have liked us to deal with?

We didn't talk about fish hardly at all, I think you can leverage this media further.

- What did you like best about the evening?

reflection + discussion, and of course Aviva's singing. 😊

- What might you change about the game?

clearer instructions on the front end might have prevented name changes mid-stem

Please give us your contact information if you want to stay in touch.

THANK YOU!!!

Please answer these questions about playing the Anthropocene Game:

- Why did you come tonight?

To learn, to experience, to help make a change

- Have you been concerned about environmental changes? *yes*

- If you have been concerned, what actions have you taken?

involved in several sustainability action/advocacy groups

- Did you know what the term anthropocene mean before you came this evening? *sort of*

- Did you learn something new about environmental issues?

- What did you learn?

topics/groups listed - interesting to see + consider how they relate

- What might you now do differently as a result of playing the game?

be more humble ~~-----~~

- What other issues would you have liked us to deal with?

- What did you like best about the evening?

ability to exchange ideas

- What might you change about the game?

Please give us your contact information if you want to stay in touch.

Virginia Mabeau

THANK YOU!!!

Please answer these questions about playing the Anthropocene Game:

- Why did you come tonight?

When I met AVIVA I knew anything she did would be meaningful, sincere, + interesting

- Have you been concerned about environmental changes?
- If you have been concerned, what actions have you taken?

I am overwhelmed by feelings of inevitability, that positive change is unlikely

- Did you know what the term anthropocene mean before you came this evening? NO

- Did you learn something new about environmental issues? YES

- What did you learn? Not its complicated

- What might you now do differently as a result of playing the game?

push past my ignorance

- What other issues would you have liked us to deal with?

What can I do

- What did you like best about the evening?

The singing in the context of the issues

- What might you change about the game?

nothing

Please give us your contact information if you want to stay in touch.

THANK YOU!!!

Please answer these questions about playing the Anthropocene Game:

- Why did you come tonight?

Came with a friend

- Have you been concerned about environmental changes?
- If you have been concerned, what actions have you taken?

YES, and NOT ENOUGH.
Concerns are: water, air and compromise of these

- Did you know what the term anthropocene mean before you came this evening?
- Did you learn something new about environmental issues?
- What did you learn?

NO
MORE A RE-STATEMENT as opposed to learning

- What might you now do differently as a result of playing the game?

Hopefully listen more and consider the other person's stance

- What other issues would you have liked us to deal with?

You mentioned fracking - we did not include in game

- What did you like best about the evening?

Your voice, people's comments

- What might you change about the game?

Maybe a bit more structure in how to participate in the game

Please give us your contact information if you want to stay in touch.

THANK YOU!!!

Thank you.

Please answer these questions about playing the Anthropocene Game:

- Why did you come tonight?

wasn't familiar w/ anthropocene concept,
wanted to learn more

- Have you been concerned about environmental changes?

- If you have been concerned, what actions have you taken?

Other than recycling? Not much

- Did you know what the term anthropocene mean before you came this evening? no

- Did you learn something new about environmental issues?

- What did you learn?

- What might you now do differently as a result of playing the game?

be more open to dialogue on this topic,
surprised at spontaneous dialogue that
occurred

- What other issues would you have liked us to deal with?

- What did you like best about the evening?

Singing, moment of peace,
Reflection

- What might you change about the game?

Please give us your contact information if you want to stay in touch.

THANK YOU!!!

Please answer these questions about playing the Anthropocene Game:

- Why did you come tonight?

Curiosity and because friends wanted to come

- Have you been concerned about environmental changes?
- If you have been concerned, what actions have you taken?

Yes, advocate for environmental protection

- Did you know what the term anthropocene mean before you came this evening? *Not by that term*
- Did you learn something new about environmental issues? *no*
- What did you learn?

- What might you now do differently as a result of playing the game?

nothing that I can think of

- What other issues would you have liked us to deal with?

- What did you like best about the evening?

- What might you change about the game?

Please give us your contact information if you want to stay in touch.

THANK YOU!!!



A Beautiful View #1 Arwa Rahmani 2/60 March 12, 2010

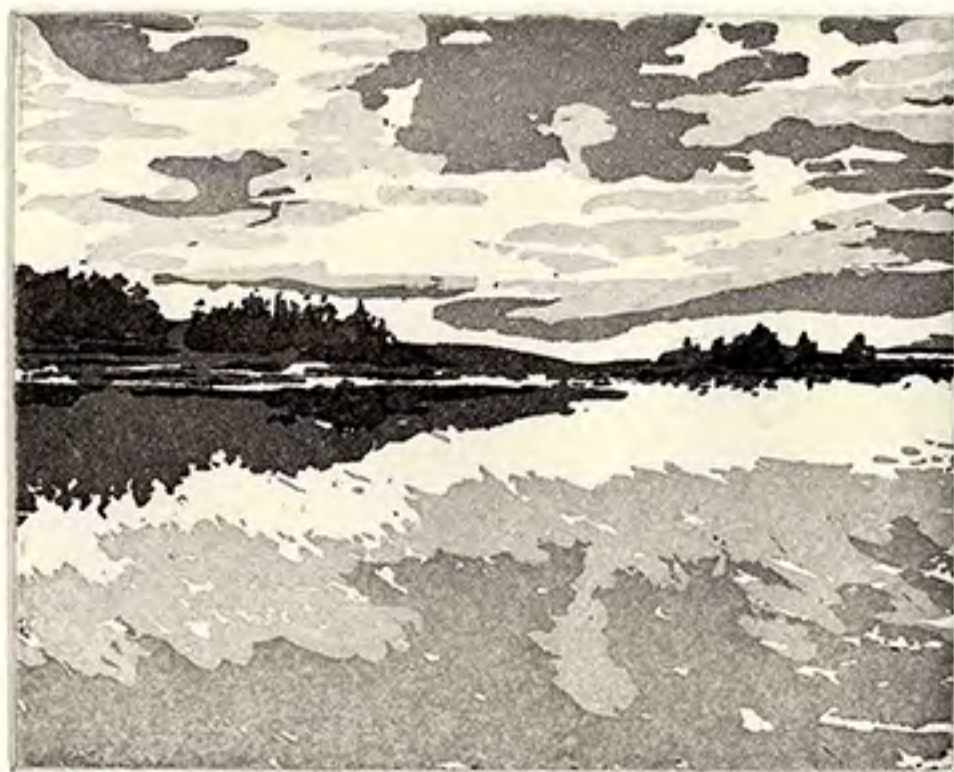




A Beautiful View #3 Arvo Karpman 4/50 March 12, 2010



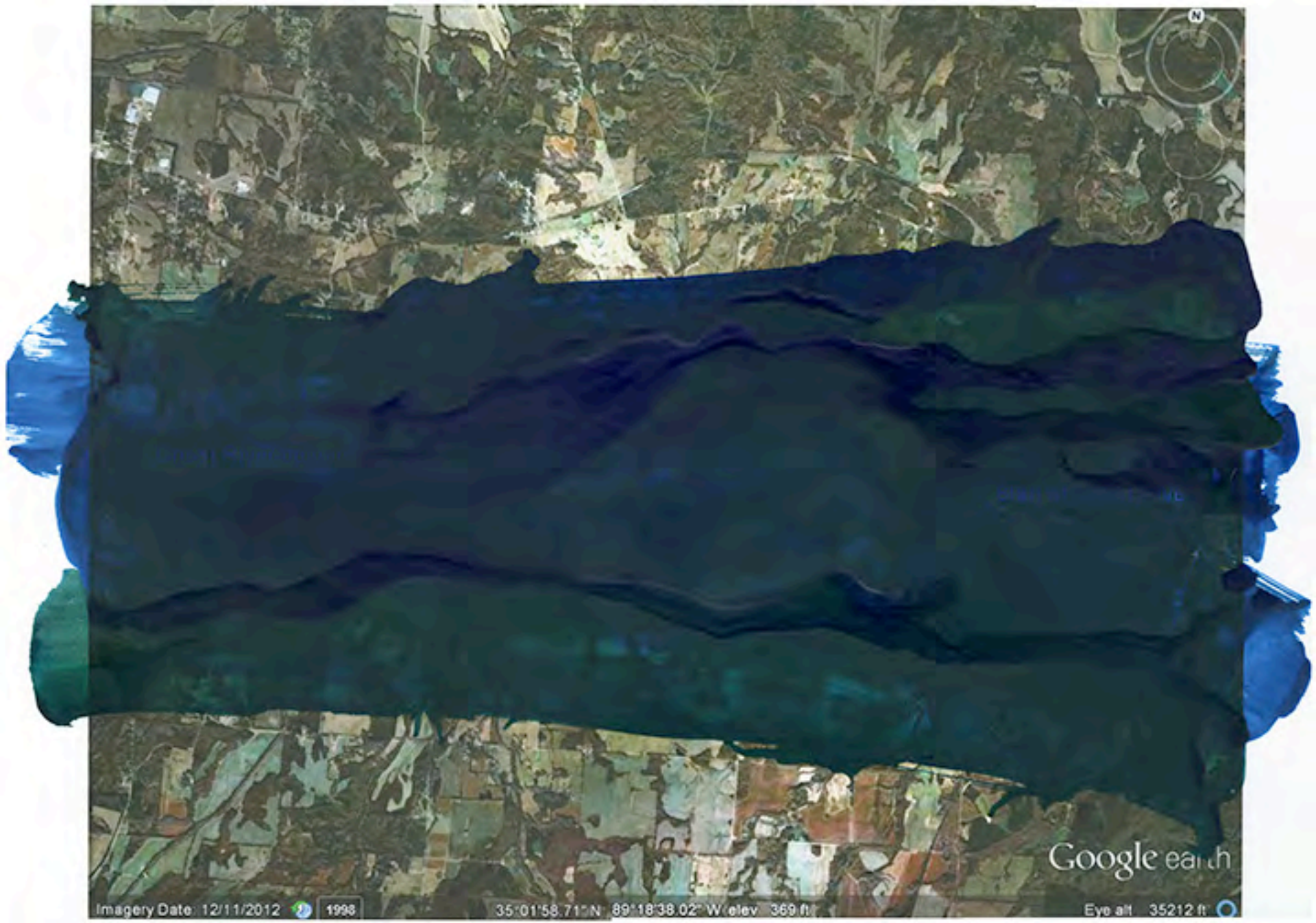












Google earth

Imagery Date: 12/11/2012 1998

35°01'58.71"N 89°18'38.02" W elev 369 ft

Eye alt 35212 ft



Ghost River becomes Wolf

Image © 2013 TerraMetrics
© 2013 Google

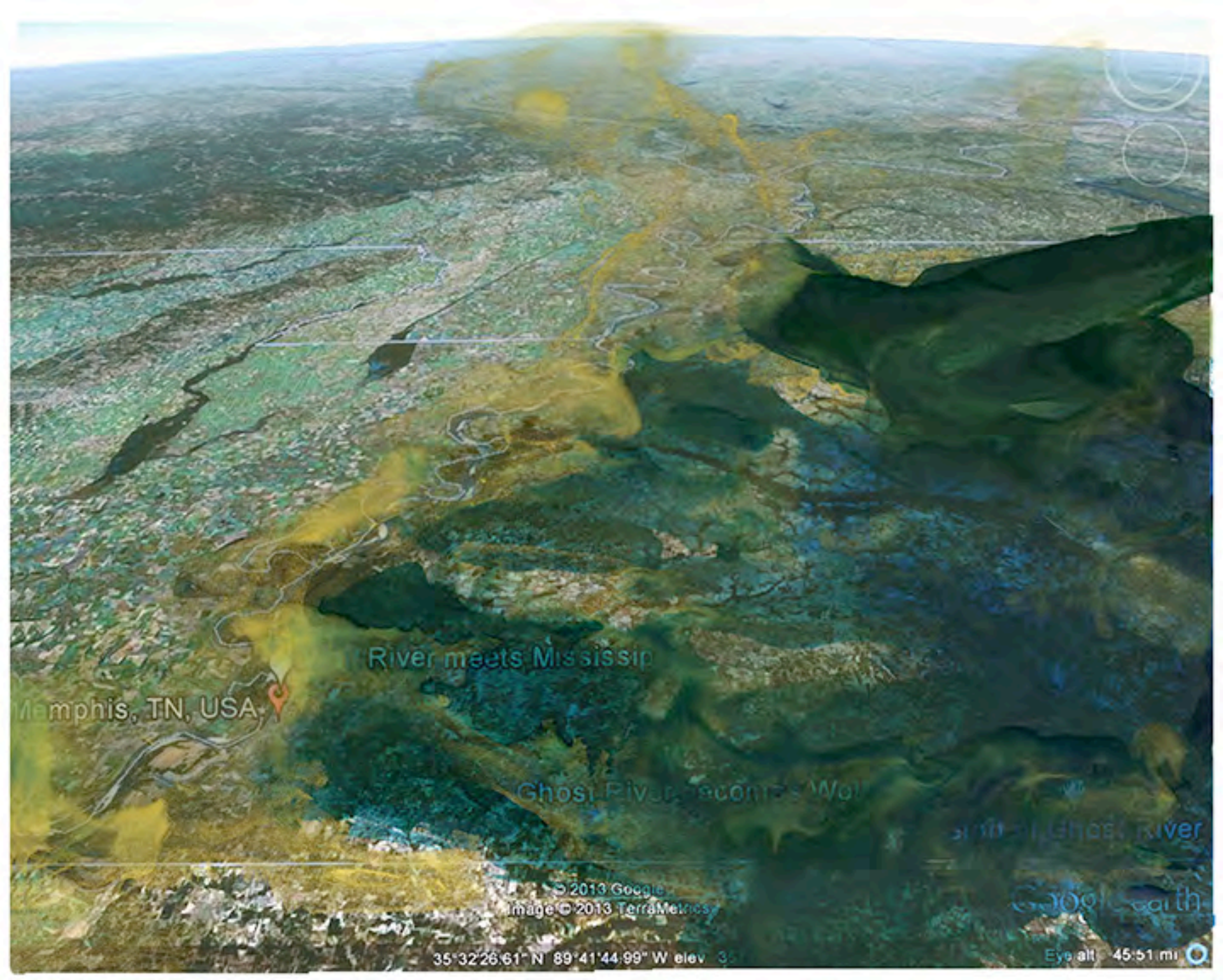
Google earth

Start of Ghos

Imagery Date: 12/11/2012 1993

45°03'07.18" N 89°18'05.02" W elev 427 ft

Eye all 14222 ft



River meets Mississip

Memphis, TN, USA

Ghost River becomes Wol

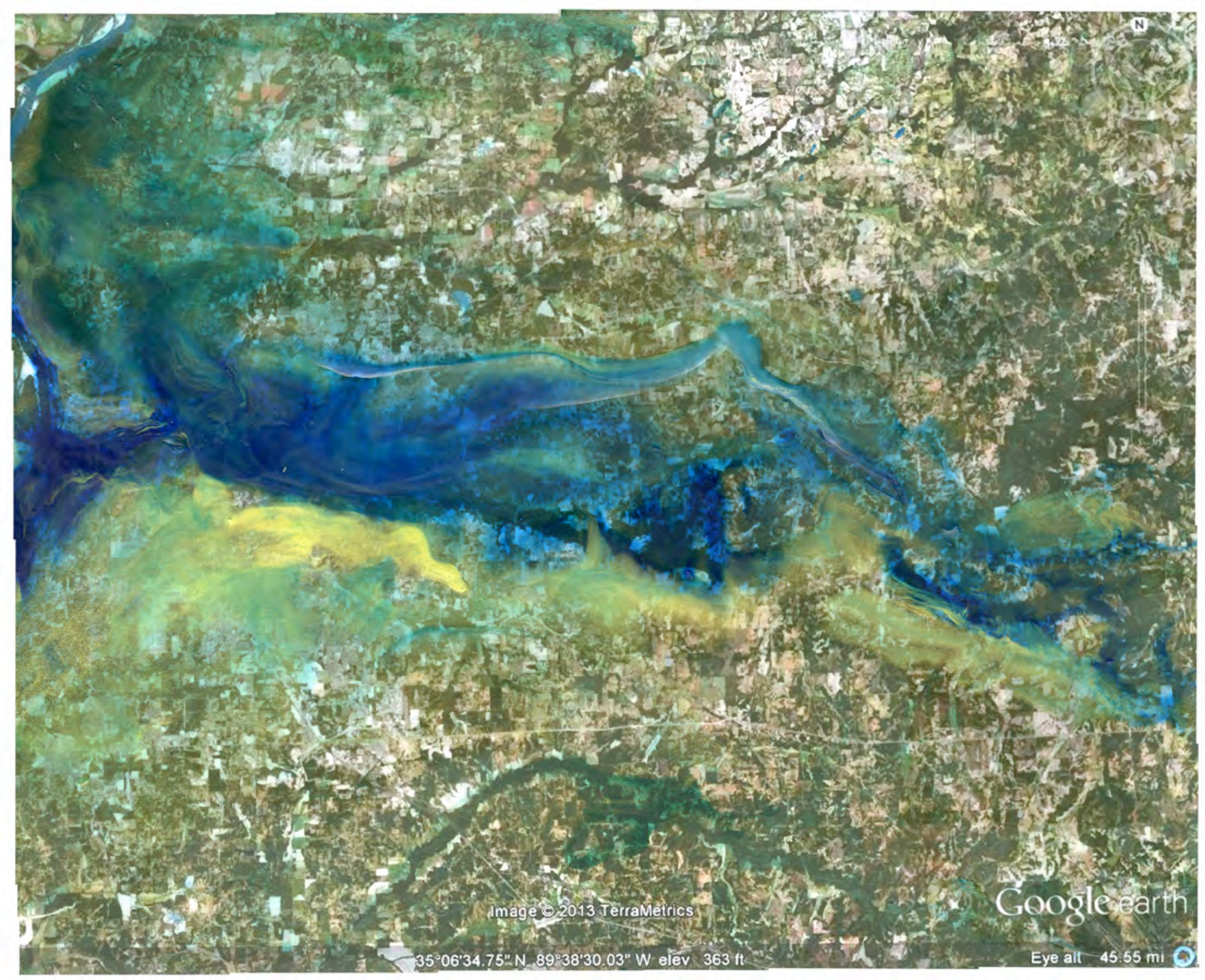
and of ghost river

© 2013 Google
Image © 2013 TerraMetrics

Google Earth

35°32'26.61" N 89°41'44.99" W elev 35

Eye alt 45.51 mi



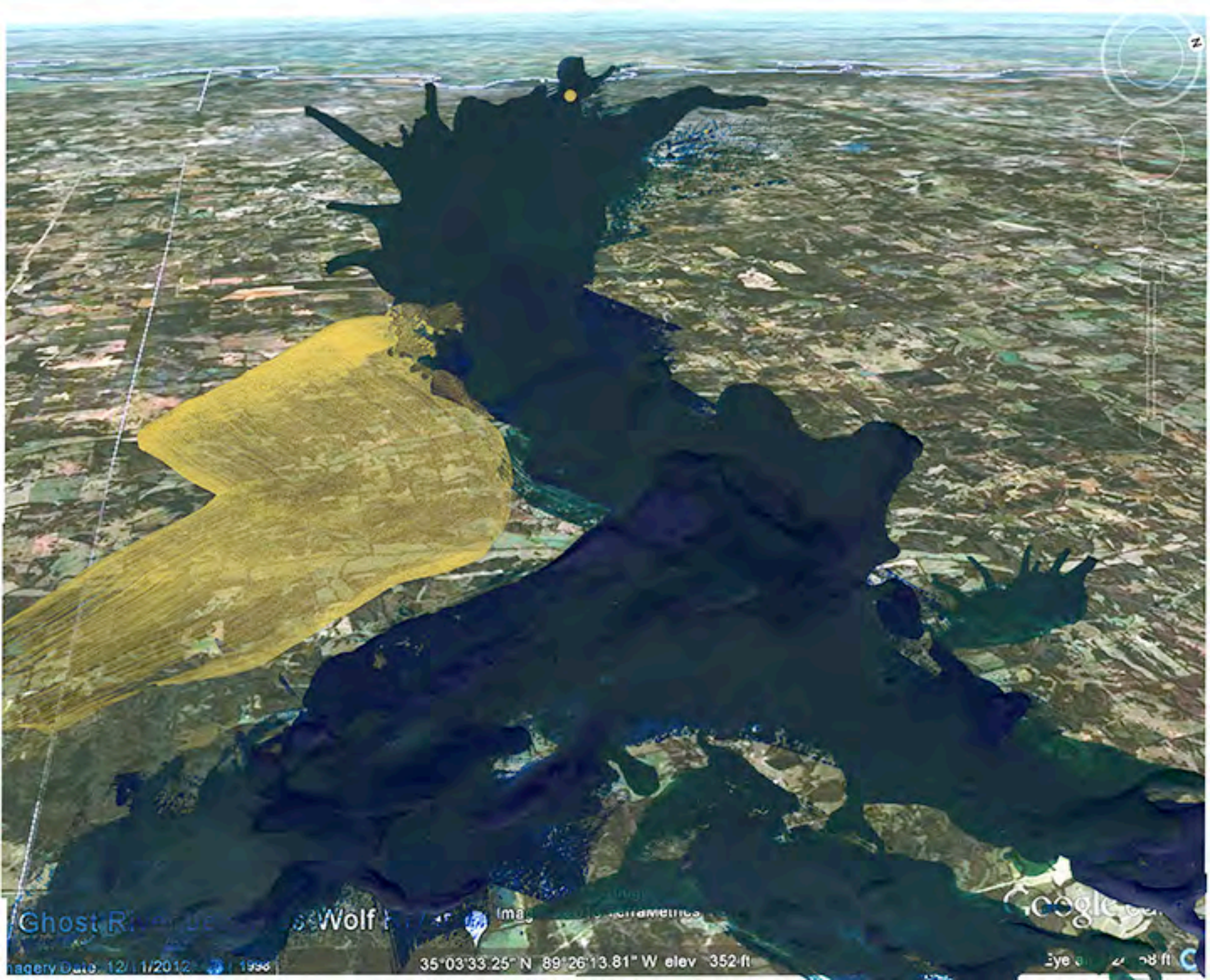
N

Image © 2013 TerraMetrics

35°06'34.75" N 89°38'30.03" W elev 363 ft

Google earth

Eye alt 45.55 mi



Ghost River, Texas Wolf

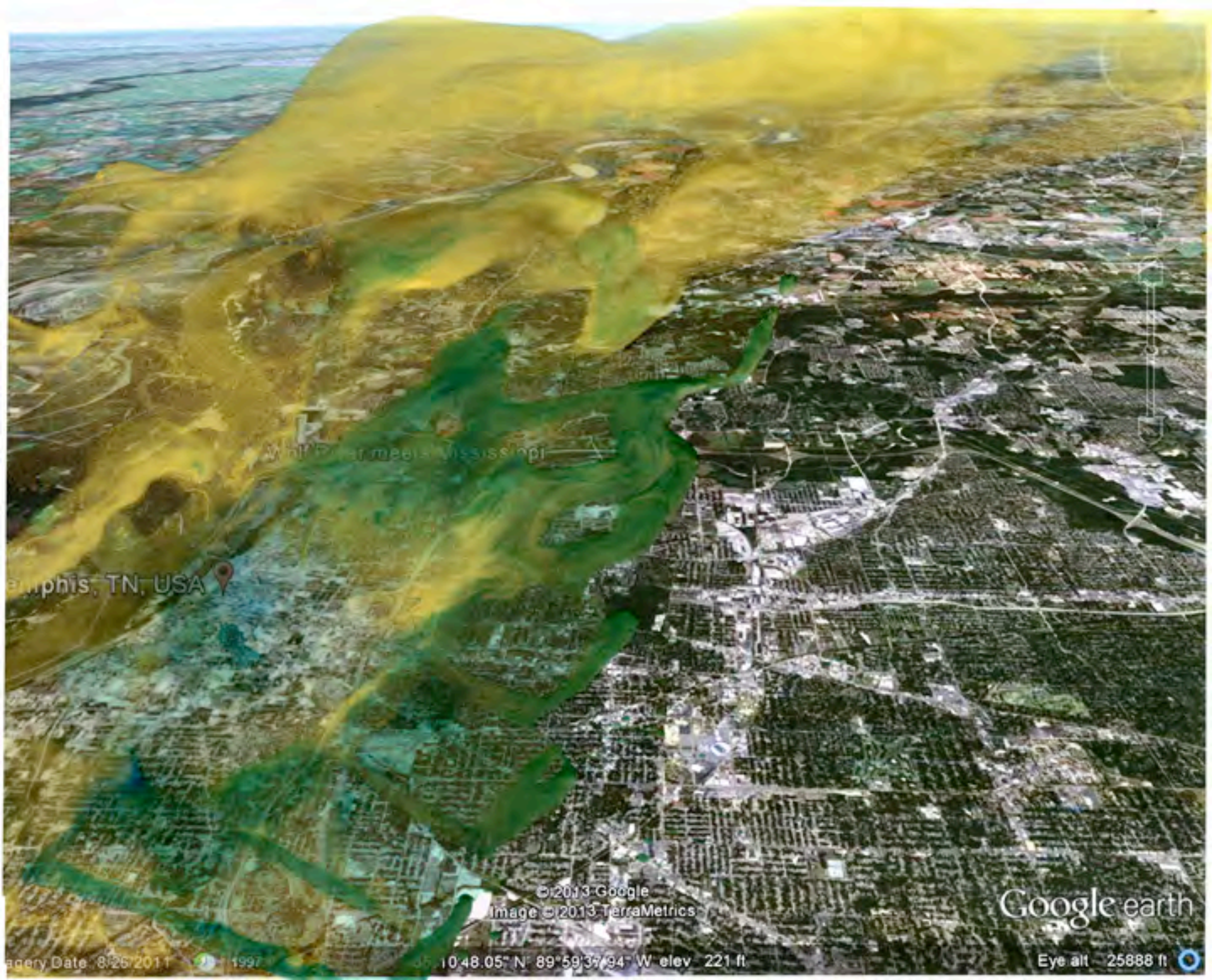
Image

Google Earth

Imagery Date: 12/11/2012

35°03'33.25" N 89°26'13.81" W elev 352 ft

Eye 38 ft



White River meets Mississippi

Memphis, TN, USA

©2013 Google
Image ©2013 TerraMetrics

Google earth

Imagery Date: 8/26/2011

1997

35° 10' 48.05" N 89° 59' 37.94" W elev 221 ft

Eye alt 25888 ft











WATER



WATER



WATER



Oil



WATER
WATER





WATER
WATER
WATER







