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Communicating Marine Environmental Health: Connecting Science, Social and Policy Values

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by

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ABSTRACT

Communicating Marine Environmental Health: Connecting Science, Social and Policy Values

Rebecca Louise Jefferson

Human activities are degrading marine ecosystems and undermining the ecological functions and processes which provide valued goods and services. European and UK marine policy developments aim to implement the Ecosystem Approach to support better management of activities and maintain the health of regional seas. Current public perceptions of the UK marine environment are overwhelmingly negative, creating a barrier to engaging society with marine environmental issues and policy.

This thesis conducts a study of the attributes of a suite of 72 UK marine species to identify those which contribute most to marine ecological health. The findings show that structurally complex species are most important and are recommended as species to assess and monitor Good Environmental Status as defined by the EU Marine Strategy Framework Directive. Existing conservation policies are biased towards large vertebrate species, with ecologically important species being underprotected.

A survey of public perceptions of the marine environment revealed conflicting perceptions of charismatic megafauna. Charismatic species were the most interesting species but least important as measures of marine health. Ecologically important species were the least interesting, but ecological health concepts were considered important measures of marine health. Perceptions of the marine environment varied with socio-demographic and social value factors.

By integrating these studies, barriers and opportunities to engaging society with the marine environment were identified. Communication strategies which address these are proposed, including a suite of Spokes Species, potential high profile species to champion the marine environment. These include puffin, cod, basking shark and seagrass. A series of themes are proposed which implement other key findings such as the importance of personal experience in building connections with marine species. Communication strategies are supported by ecologically defined assessments of marine environmental health, are relevant to current policy developments and will resonate with social values of the marine environment.

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The readers of Seahorse and Smooth Hound will be delighted.

AUTHORS 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.

The word count of this thesis is: 68,681

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Chapter 1

Introduction

Human activities are degrading and damaging the marine environment at local, national and global scales (Halpern et al., 2008), and are undermining the ability of ecosystems to perform the functions and processes which provide goods and services essential to human life (Beaumont et al., 2007, Worm et al., 2006). Projected population growth predicts that human activities, and their associated pressures, will increase over the coming decades, further degrading marine ecosystems (Millennium Ecosystem Assessment, 2005). Changes in the management and nature of marine activities are thus needed in order to reduce the current level of environmental impacts.

The three pillar model of sustainable development identifies the need to consider social, economic and environmental impacts when managing natural resources (IUCN, 2008). The Ecosystem Approach is a framework which integrates these interests by recognising humans as part of the ecosystem (CBD, 2005). It engages the widest range of sectoral interests in order to optimise benefits for society, the economy and the ecosystem (Smith and Maltby, 2001) and has been adopted at international and national levels to promote sustainable management of the marine environment.

The EU Marine Strategy Framework Directive (MSFD, EU, 2008) and the UK Marine and Coastal Access Act (MCAA, MCAA, 2009) recognise the need for changes in the use of the marine environment and attempt to implement the Ecosystem Approach to deliver more sustainable management of activities. The MSFD aims to achieve Good Environmental Status (GEnS) in all European regional seas by 2020, delivering a healthy marine environment which supports social and economic needs. To assess marine environmental health, monitoring needs to encompass ecosystem functions and processes. Current marine monitoring focuses on individual species and impacts and does not provide this (Rogers and Greenaway, 2005, Gubbay, 2004).

A central principle of the Ecosystem Approach is public engagement; societal choice, inclusion of local knowledge, and participation of all sectors are fundamental to addressing social interests within the wider system. The strong commitment to the Ecosystem Approach, at both European and UK levels, clearly shows the need for better social engagement with the marine environment. Public perceptions of the marine environment are dominated by their associations with the coast. Perceptions of the subtidal marine environment are generally strongly negative, being dominated by fear, shame and disgust (Natural England, 2008). There is a lack of awareness of the species found in the marine environment with 44% of the English public believing the undersea to be generally, mostly or totally barren (Rose et al., 2008). These overwhelmingly negative perceptions illustrate the particular challenge of engaging the public with the UK marine environment: a barren environment which provokes negative emotions will not engender public support for better management.

Ocean Citizenship is the concept of a society which is connected to the marine environment and individuals who recognise their roles as agents of change (Fletcher and Potts, 2007). This requires behaviour change, from individual behaviours such as consumer choice of sustainable seafood, through to societal engagement with management processes. Behaviour change is, however, a complex process affected by many factors (Kollmuss and Agyeman, 2002). Knowledge, emotions and values, in addition to external factors, can create barriers which prevent engagement with an issue. In turn, these factors can vary within a population due to socio-demographics or social value perspectives. Barriers must be identified and understood before they can be addressed in a way which resonates with the values and interests of target audiences (Lorenzoni et al., 2007).

Three types of values are investigated within this thesis. Ecological values relate to the species, functions and processes which provide goods and services used by society. Ecological values are assessed though scientific measures and are fundamental to other values of the marine environment. Social values reflect the interests of the population, showing those features of the subject which are particularly important. Policy values are the drivers of legislation development, and may echo social values, or objectives which achieve positive social outcomes, or may reflect political interests. The term marine environmental health is used to refer to a positive scenario for the marine environment which can be valued from multiple perspectives.

This thesis investigates how social, ecological and policy values towards the marine environment vary by identifying the definitions of marine health. Ecological marine health underpins the provision of goods and services, which may be valued by society. Public engagement in the marine environment will be supported by the ecological understanding of marine health; monitoring marine ecosystem health

through GEnS assessments also provides the opportunity for public engagement with information about the state of regional seas. This can only be done if the information is relevant to the social values of the marine environment, and therefore an understanding of socially defined marine health is needed. By identifying the potential connections between ecological and social values, it may be possible to develop communication strategies which are supported by sound science, policy relevant and that resonate with the public.

The outputs of this thesis will include a series of recommendations for the development of communication strategies:

- An assessment of the barriers to engagement with the marine environment. Developed from Kollmuss and Agyeman's (2002) model of barriers to pro-environmental behaviour, these will identify the challenges of better engaging society with the marine environment and highlight opportunities where communication strategies can target these barriers.

- A series of Communication Themes will detail some of the conceptual principles which may help to support better engagement with the marine environment.

- A suite of Spokes Species to act as a focal point of interest whilst connecting social, ecological and policy values of marine environmental health.

Spokes Species are particular species used to connect different values. In contrast to high profile species used in other conservation communications, such as flagship species (traditionally large, charismatic vertebrates), Spokes Species are selected to represent and connect social and scientific values. These species are then developed to be the 'Spokesman' of the UK seas, providing a focus to particular aspects of marine environmental health. By selecting a suite of Spokes Species, it is possible to represent different components of the marine environment. Each Spokes Species will be selected for their relevance to particular audiences or messages. They will reflect a range of values from social through to ecological, representing the UK marine environment and various perceptions of its health.

Thesis Aim

To identify ecological, social and policy values towards marine environmental health and how these can be connected to develop a public communication strategy which is scientifically robust, policy relevant and resonates with a public audience.

Objectives:

1. Assess whether marine environmental health can be monitored though single species indicators and what species best inform on the ecological attributes of health.

2. Assess whether the guidelines for delivering Good Environmental Status as defined by the EU Marine Strategy Framework Directive, reflect the ecological health values identified in Objective 1.

3. Measure gaps in concern for marine environmental issues between groups with different associations with the marine environment.

4. Measure how perceptions of marine environmental health differ with social values and socio-demographic factors.

5. Identify the barriers and opportunities to communicating with the public about marine environmental health.

Methodology

To achieve the aim and objectives, a variety of methods will be applied. Chapter 3 delivers a metadata analysis of ecological and policy data from a suite of UK marine species to address Objectives 1 and 2. The first survey (Chapter 4) uses a mix of quantitative and qualitative questions to assess concerns and interest in the marine environment. This uses a series of three parallel surveys tailored to particular groups of respondents (Objective 3). Survey 2 (Chapter 6) provides an assessment of public perceptions of the marine environment. This applies a social segmentation model developed from Maslow's Hierarchy of Needs to identify how perceptions vary with social values (Objective 4). Focus groups are used to further investigate the survey findings and identify directions for future research (Chapter 7). Objective 5 is addressed in Chapter 8 through the integration of the findings of the earlier chapters.

Thesis overview

Chapter 2 provides the background to the various themes investigated in the thesis. This includes the multiple values of the marine environment which influence definitions of marine environmental health. The structures of the Ecosystem Approach and EU and UK policy developments to achieve more sustainable use of the marine

environment clearly identify the need for sound science and an engaged public. The factors which influence behaviour change are reviewed, identifying how these create barriers to social involvement. Studies of public perceptions of the marine environment, and of public conservation concerns, are limited but suggest that public concern is dominated by issues which do not present the greatest threats to ecological health. For example, issues such as oil pollution, sewage and litter are often of greater concern to the public than those issues which compromise the healthy functions of marine ecosystems (Spruill, 1997). Species are frequently used as communication tools, with a bias towards those species which evoke positive emotional responses, particularly large, charismatic vertebrates.

Chapter 3 identifies the ecological criteria for defining marine environmental health, and assesses species for their contribution to these criteria. This assessment identifies species which have the highest ecological health score, and also those which are of greatest value in monitoring ecosystem health. The chapter continues by reviewing the current policy protection of these species in comparison with their contributions to ecological health. The species are also considered against the criteria of Good Environmental Status, as defined within the EU Marine Strategy Framework Directive. This stage of the analysis allows an assessment of whether these criteria facilitate implementation of marine health monitoring at the system rather than species scale.

Chapter 4 presents Survey 1 which identifies how perceptions vary between groups with different associations with the marine environment. Marine scientists are surveyed to provide an expert opinion and benchmark perspective. Four non-expert groups include coastal managers, marine recreation employed, coastal and inland residents. All respondents are asked what marine environmental issues they are concerned about, questions relating to communication of marine issues, and how their interest in the marine environment was inspired.

Chapter 5 details the social segmentation model used in Survey 2. This model allows an assessment of how perceptions vary with social values, enabling analysis of the survey results to understand the motivations of these perceptions. The chapter details the development of the model from Maslow's Hierarchy of Needs and identifies its strengths against other social segmentation models. The results of two previous studies into perceptions of the marine environment which apply the Maslow model are reviewed, providing a background to the three profiles which the model identifies.

Chapter 6 describes Survey 2, a survey of public perceptions of the marine environment. A suite of 12 UK marine species is selected to represent ecological, commercial, aesthetic and policy values of the marine environment. Respondents are asked which species they recognise, associate with UK seas and would be most

interested to learn more about. Further questions assess what the public associate with a healthy and unhealthy marine environment. Socio-demographic and social values variables are used to analyse how perceptions vary within the population.

Chapter 7 further investigates some of the key findings of Chapter 6 through the use of focus groups. This provides the opportunity to further examine the findings of the survey, and better understand some of the patterns which emerged.

Further to the discussions within each chapter, Chapter 8 draws together the findings of the thesis and presents a series of outcomes. Particular barriers and opportunities to engaging society with the marine environment are identified based on the findings of previous chapters. In response to these, a series of Spokes Species and Communication Themes are proposed to maximise on these opportunities. Two Spokes Species are discussed in greater detail to show their relevance to social, science and policy values.

Chapter 2

Background

Human activities are damaging marine environments around the world (Halpern et al., 2008). If activities remain at these levels, both in volume and type, the ecological systems which support our society may be jeopardised. Projected population growth predicts that pressures from human activities will increase over the coming decades (Millennium Ecosystem Assessment, 2005), but changes in activities can reduce this pressure and facilitate a more sustainable use of the marine environment. As a first step towards achieving such changes, society needs to be better aware of the importance of a healthy marine environment in providing essential goods and services. This thesis assesses how science and society value marine environmental health. Through connecting these values with current policy developments, it is possible to identify opportunities to better engage society with marine environmental health and inspire behaviour change.

2.1 A healthy marine environment

2.1.1 Values of a healthy marine environment

There are many types of values expressed in regard to an environment. Kellert (1996) describes nine values of nature and the environment which can be used to understand the relationships between people and the environment (Table 2.1). These illustrate the range of environmental properties which are valued, from utilitarian, which relate to the provision of a resource, through to less tangible values, such as spiritual. Some values are easier to quantify than others, such as those resources with a market value. Financial values may not accurately reflect the cost of removing the resource on ecosystem health; for example the price of a fish stock does not include a measure of habitat damage and the wider ecosystem values which may be lost (Ojea and Loureiro, 2010).

There are various ways to value a marine region, but fundamental to ensuring most of these values is the ecological health of the system: the ecosystem needs to perform functions and processes to deliver the goods and services humans value (Beaumont et al., 2008).

Value	Definition	Function
Utilitarian	Practical and material exploitation of nature	Physical sustenance/ security
Naturalistic	Direct experience and exploration of nature	Curiosity, discovery, recreation
Ecologistic/scientific	Systematic study of structure and function	Knowledge, understanding, observation
Aesthetic	Physical appeal and beauty of nature	Inspiration, harmony, security
Symbolic	Use of nature for language and thought	Communication, mental development
Humanistic	Strong emotional attachment and 'love'	Bonding, sharing, cooperation, companionship
Moralistic	Spiritual reverence and ethical concern for nature	Order, meaning, kinship, altruism
Dominionistic	Mastery, physical control, dominance of nature	Mechanical skills, physical prowess, ability to subdue
Negativistic	Fear, aversion, alienation from nature	Security, protection, safety, awe

Table (2.1). Typologies of values expressed for nature and the environment, from Kellert (1996).

2.1.2 Unsustainable use of the seas

Halpern et al. (2008) estimate that no area of the marine environment is unaffected by human influence. The most severely impacted areas are mainly found in the shallow coastal seas, where human activities are most intense. However, remote regions with relatively little direct human activity are also suffering damage. In polar regions, ecological impacts are recorded from local pressures such as marine resource exploitation as well as global pressures such as climate change and ozone depletion (Clarke and Harris, 2003), despite the low density of the local human populations.

A wide range of activities, occurring in both terrestrial and marine systems, cause impacts which are detrimental to marine ecological health. The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP, 2001) describe some of the most significant of these:

- *Overfishing* is impacting the oceans at all scales. Global fish landings peaked in the 1980s and are now declining, despite increasing fishing effort (Millennium Ecosystem Assessment, 2005). Globally, 60% of stocks are fully or over exploited with 6% depleted (GESAMP, 2001). As traditional target stocks

are exhausted, populations in lower trophic levels are being targeted (Pauly and Palomares, 2005, Pauly et al., 1998). Similarly, as technology improves, habitats previously protected by their inaccessibility, such as the deep sea, are now being fished (Morato et al., 2006). Beyond the destruction of target species populations, ecosystems are being impacted by bycatch, discards and habitat destruction as a result of overfishing.

- *Loss and degradation of habitats* is occurring in many coastal regions, with many causes and consequences. Approximately 35% of mangroves and 20% of coral reefs are estimated to have been destroyed, with a further 20% of coral reefs degraded globally since 1960 (Millennium Ecosystem Assessment, 2005).

- *Sewage and chemical pollutants* are causing considerable deterioration in water quality. Despite an increase in treatment of waste, sewage release continues to be a risk to human health.

- *Land-based activities* such as agriculture are contributing to eutrophication causing disruption to ecosystems such as coral reefs and seagrass beds, and to human health impacts through harmful algal blooms (Vitousek et al., 1997).

- *Coastal and terrestrial developments* are impacting on hydrology and the flow of sediments, which in turn can degrade habitats.

The consequences of these activities and impacts are numerous. Reduced habitat and species diversity is linked to a decline in the ecological health attributes of marine systems (Tett et al., 2007, Elmqvist et al., 2003). Additionally, many human impacts do not act in isolation (Lotze et al., 2006, Lenihan and Peterson, 1998) and synergistic effects of multiple pressures can lead to unexpected and greater damage than single pressures (Halpern et al., 2008).

Changes to the types and intensity of activities which are currently causing damage are required but need to take account of social and economic, as well as ecological pressures. Although ecological health underpins social and economic health, changes in practices, such as closing areas to certain activities to allow vulnerable habitats to recover, must be done with an understanding of the effects on social and economic needs.

2.1.3 Marine Policy

Developments of marine legislation at both the European and UK level are currently being carried out to deliver a holistic approach to marine management, providing a

more integrated approach than currently exists. The EU Marine Strategy Framework Directive (MSFD, EU, 2008) identifies the potential social and economic gains to be made from appropriate development of marine and coastal resources, whilst holding at its heart the target to achieve Good Environmental Status (GEnS) of regional seas by 2021. Member States are required to define GEnS suitable to their own waters and within the broad guidelines the framework provides. In the UK, the Marine and Coastal Access Act (MCAA, Defra, 2009) brings together many marine activities under the coordination of the Marine Management Organisation where previously a more sectoral management was delivered. The MCAA will increase the number of marine protected areas through the designation of Marine Conservation Zones (MCZs). It also aims to increase public access to the coast by providing pathways around the entire English coast. Currently, only 66% of the English coast is accessible to the public and this figure is predicted to decline due to erosion (Natural England, 2009).

The MSFD and MCAA aim to deliver a holistic approach to management through the implementation of the Ecosystem Approach (Table 2.2). The Ecosystem Approach is a strategy for the integrated management of resources through modern scientific adaptive management practices (CBD, 2005). It recognises humans as integrated parts of the ecosystem. The Ecosystem Approach was adopted as the primary framework for action under the Convention on Biological Diversity (CBD) in 1995; this is was then defined through the development of the five points of Operational Guidance and 12 Principles which are now widely accepted (CBD, 2000, Table 2.2). Implementation of the Ecosystem Approach through these guidelines aims to provide a framework for holistic management and achievement of the integration of social, economic and ecological needs into management. It engages the widest range of sectoral interests in order to lead to the optimum benefits for society, the economy and the ecosystem (Smith and Maltby, 2001).

An example of how this will attempt to be implemented under the MCAA is the approach for identifying potential Marine Conservation Zones (MCZs). For English seas, four regional projects will coordinate local stakeholder engagement in the identification of potential areas to designate as MCZs. This aims to protect important ecological features without causing unnecessary impacts on local activities. This method implements several of the Ecosystem Approach guidelines and principles to engage society and users in identifying which areas are valued for what uses.

Operational Guidance
1. Focus on the functional relationships and processes within ecosystems.
2. Enhance benefit-sharing.
3. Use adaptive management practices.
4. Carry out management actions at the scale appropriate for the issue being addressed, with decentralization to lowest level, as appropriate.
5. Ensure intersectoral cooperation.
Principles
1. The objectives of management of land, water and living resources are a matter of societal choice.
2. Management should be decentralized to the lowest appropriate level.
3. Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
4. Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should: • Reduce those market distortions that adversely affect biological diversity; • Align incentives to promote biodiversity conservation and sustainable use; • Internalize costs and benefits in the given ecosystem to the extent feasible.
5. Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.
6. Ecosystem must be managed within the limits of their functioning.
7. The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.
8. Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.
9. Management must recognize that change is inevitable.
10. The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.
11. The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.
12. The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

Table (2.2). Five Operational Guidance and 12 Principles of the Ecosystem Approach which form the basis of activities carried out under the Convention (CBD, 2000).

2.2 Ocean Citizenship

Public engagement is a strong theme in both the Ecosystem Approach and the UK sustainable development strategy (Defra, 2005b). Public or stakeholder engagement in management decisions can lead to increased ownership of an environment, better relationships between stakeholders, and integration of scientific knowledge with local expertise which can strengthen decision making processes (Evans et al., 2008). An effective participatory process can lead to management decisions which are better suited to the community, have increased longevity and are more widely supported (Reed, 2008).

An engaged public, in addition to contributing to decision making processes, is also more likely to take action to reduce its impacts on the environment. Fletcher and Potts (2007) identify this relationship between everyday life and the marine environment as Ocean Citizenship. They recognised the need for the public to connect with the marine environment and understand their roles as agents of change. This term describes the various ways in which a public can participate through facilitated action such as the MCZ projects: structured engagement to glean local knowledge and values of the seas, combined with ecological expertise, to identify areas for potential protection. Individual actions include consumer choices, where a person has sought out a more environmentally sound purchasing option. Participation through the support of policies, targets and actions allows individuals to contribute to addressing global environmental issues through achieving political objectives. Participation can be a tool - as with the MCZ projects, or a conceptual principle (Buchy and Race, 2001). Participation and engagement in this project relates to both these features.

Participation in environmental decision making can require a certain level of knowledge on the part of individuals or groups. This enables individuals to make contributions which meet the needs of the process - and will not get dismissed (therefore disengaging the individual) on grounds of lack of understanding the issue at hand (Reed, 2008). Gigliotti (1990) states that there is an emotionally charged citizenry, but this emotion is not supported by basic ecological knowledge. At a fundamental level, Ocean Citizenship requires society to understand the ecological value of the seas and why they need better management. Society values the goods and services provided by the seas, but as described below, lacks the knowledge to make connections between healthy marine environments and these provisions. This results in a society which may misdirect its concern, failing to be engaged with real threats to the marine environment, and an absence of Ocean Citizenship.

An example of where an engaged public has led to a change in behaviour is with use of plastic carrier bags. Sea turtles, such as the Green turtle (*Chelonia mydas*), are known to die from ingesting carrier bags which they mistake for their main prey, jellyfish (Bugoni et al., 2001). In Ireland, an informed public has supported a recent policy and achieved a significant change in behaviour through the reduction in the use of plastic carrier bags. In 2002, a 15 Euro cent tax was added to the use of each plastic bag in Ireland. Since then, there has been a 90% reduction in their use (Convery et al., 2007). It is not possible to predict how successful this policy would have been without public support, but the result of publicity and policy combined has been a public willing to make a significant behavioural change.

2.2.1 Public engagement for behaviour change

Much research has been done on the factors which influence environmental behaviour change, particularly in reference to activities related to emissions of carbon dioxide such as car usage and household waste recycling (Lorenzoni et al., 2007, Barr, 2003). Understanding these factors can aid in the identification of opportunities to engage citizens in more aspects of environmental behaviour change.

Pro-environmental behaviours are defined as behaviours which 'consciously seeks to minimise the negative impact of one's actions on the natural and built world such as minimising resource and energy consumption' (Kollmuss and Agyeman, 2002, p240). Early models of how to engage the public in pro-environmental behaviour focused on the Information Deficit Model. This is based on the assumption that a deficit of knowledge about an issue is the main, if not only, reason for lack of action; therefore, educating people will lead to pro-environmental attitudes and bring about behaviour change (Burgess et al., 1998). This is extended to other behaviours, for example health campaigns, which use the links between smoking and lung cancer to encourage people to give up smoking. Evidence found the relationship between knowledge and behaviour change is not this simplistic, and more complex models of behaviours were developed to include other influences.

A more detailed model was proposed by Ajzen and Fishbein's (1980) Theory of Planned Behaviour, which included the influence of social factors on behaviour choices. Ajzen and Fishbein (1980) suggested that attitudes influenced people's intention to act, but also that other factors were important. Social norms, the responses and expectation of society and cultures to particular behaviours are also influences on a person's actions. As this model was tested, it became evident that the inclusion of social factors was valid, but situational factors such as economic constraints and opportunities to select alternative behaviours, as well as the existence, level or absence of enabling infrastructure (e.g. recycling facilities or doorstep collection of recyclables) which were not included in the model, were also proposed to influence behavioural decisions.

Many further models have been proposed to decipher the complex relationships between the many factors which positively or negatively influence behaviour. A review of these factors has led to Kollmuss and Agyeman's (2002) model (Figure 2.1). This differentiates between internal factors such as knowledge and values, and external, situational factors and uses these to identify barriers which block or encourage pro-environmental behaviours. This model is introduced here as a framework for understanding the barriers to engaging society with the marine environment. The influence of particular barriers is now reviewed, followed by a consideration of some

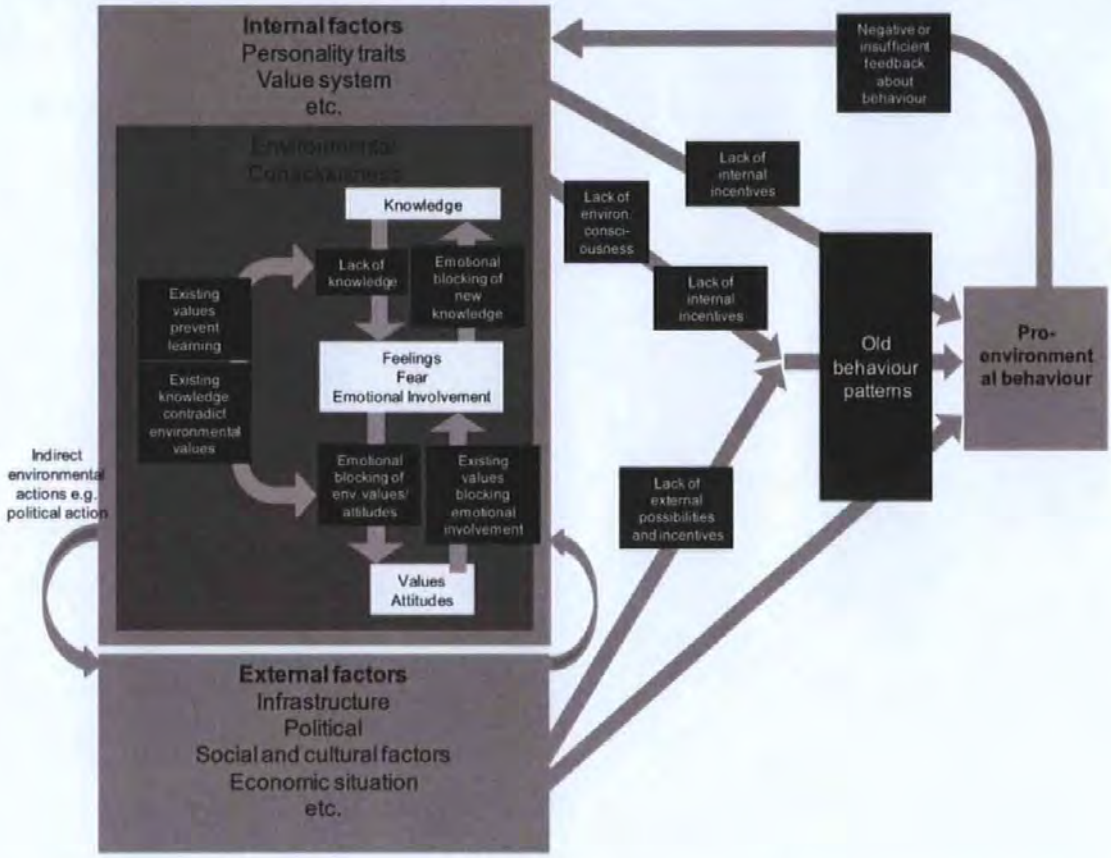


Figure (2.1). Model of pro-environmental behaviour showing the main barriers to pro-environmental behaviours from Kollmuss and Agyeman (2002, p257). Black boxes show barriers. The model groups factors as internal or external. Internal factors are shown as complex relationships between values, emotions and knowledge.

of the critiques of this model.

The rejection of the Information Deficit Model is not the rejection of a role of knowledge in pro-environmental behaviour. The internal factors of the model, including knowledge, values, attitudes and emotional involvement, contribute to pro-environmental consciousness; a complex of factors which have indirect influences on behaviour. A study by Hunter and Rinner (2004) showed values to have the greatest effect on reasons; people with ecocentric views were more likely to support species protection than those with anthropocentric views. Knowledge of the species had no effect on responses, illustrating the need to include additional internal factors.

The Information Deficit Model works from the assumption that if a population is not concerned about a given issue it is due to lack of knowledge about the existence or threat posed by an issue. An assessment of knowledge of global warming found that those who had the greatest knowledge of the subject felt less concerned and had less responsibility to act than those who knew less (Kellstedt et al., 2008). This striking result appeared to be due to an increase in knowledge of global warming leading to a

reduction in personal efficacy; the more a person knew about the issue, the less they felt their behaviours would make a contribution to solving the problem. In contrast, Kaiser et al. (1999) found both environmental knowledge and environmental values have a strong influence on ecological behaviour intentions, which had a strong effect on ecological behaviours.

These examples illustrate the importance of both knowledge and values on behaviour, but also may show that the contribution of a factor can vary with what is being measured. The study by Hunter and Rinner (2004) found underlying values to be more important than knowledge in prioritising the protection of species. People with ecocentric values prioritise the natural world for its intrinsic value; this value is shown to be strong when associated with any species, even an unfamiliar one. Specific behaviours, such as choices of car use, were shown to have greater influence from knowledge, in addition to values (Kaiser et al., 1999). This is a more specific behaviour than species protection; it requires respondents to understand the consequences of their decisions in addition to being able to act on their values.

The example from Kellstedt et al. (2008) illustrates that knowledge can influence behaviour and perceptions, but it is not necessarily in the direction predicted by the Information Deficit Model. Different types of information can be used to relate to particular situations or evoke particular responses. Jensen (2002) describes the dominance of scientific based information which describes environmental issues and their current and future dangers; the identity of a problem. This type of information does not necessarily stimulate behaviour change in the audience (in Jensen's case the audience was school pupils), and can disengage them through creating worry and negative emotions. Jensen (2002) argues that a broader review of an issue which encompasses not only the identity of the problem and effects but also discusses strategies for change and visions of alternative scenarios creates a more positive knowledge landscape which can better engage an audience in an action and change perspectives.

Environmental values are an important internal factor. As shown by Kellert's (1996) value typologies (Table 2.1) these relate to the perspective from which a person interprets situations and issues. The examples above show these to have a strong effect on behaviour with different values leading to different behavioural responses. Where the Information Deficit Model implies a linear relationship between knowledge and behaviour, the many variables which actually influence behaviour produce a complex series of interrelations (Barr and Gilg, 2007). Different values can trigger the same behavioural response; environmental values were found to be important drivers of minimisation of waste and reuse behaviours but these were due to different motivations (Barr et al., 2001). Ecocentric values correlated with

waste minimisation and reuse behaviours due to the importance of protecting nature, and reducing resource use, whereas more human centred values resulted in the same behaviours but driven by the benefits of creating a better environment for local populations through the reduction of litter. By understanding the values of respondents, it was possible to identify the different motivations behind the same behaviour. Social segmentation models are tools which enable a person's values to be measured and identified, providing a tool to investigate how these factors influence behaviours or perceptions (Defra, 2008). These will be investigated further in Chapter 5 to show how this approach can be applied to the analysis of perceptions of the marine environment.

Factors which influence environmental values are also indirectly related to behaviour. Education level has been found to affect a person's values (Kellert, 1996). Adults whose education finished at school age expressed much stronger utilitarian, dominionistic and negativistic values, showing fear and alienation from nature and strong acceptance of using nature to meet human needs. Those who had a university education are much lower in these values, expressing greater moralistic, naturalistic and scientific values. This shows a greater concern and interest for nature, however, there is still no simple link between education and actual behaviour, with other factors still being important.

Personal experience of an environment or environmental issue has been found to have a considerable effect on environmental values and behaviour. Experiences facilitate stronger emotional connections to natural environments, which in turn increase the willingness of the person to protect that environment (Miller, 2005). Experience of species in their natural environment increases children's awareness and interest in those species (Lindemann-Matthies, 2005), which can also positively affect environmental knowledge and action (Bogeholz, 2006). Maiteny (2002) describes the importance of experiences within the Kollmuss and Agyeman model, recognising the positive effects of emotional involvement as essential to sustained pro-environmental values and behaviours. The need to reconnect people and nature is considered as one of the current priorities for conservation biology, ensuring that behavioural change is rooted by a connection to the wider environment (Balmford and Cowling, 2006).

A further factor influencing behaviour is locus of control. This is not specifically listed in the model, but is identified as an important internal factor (Kollmuss and Agyeman, 2002). Locus of control is the extent to which an individual believes their actions will have an influence on the environment. People with an internal locus of control believe their actions will have some impact, whereas those with an external locus of control feel that their actions will make no difference - the situation is beyond their control. This describes the perceived powerlessness in a situation, which varies

with the issues and how it is perceived. It can also vary with particular behaviours where other factors, such as situational factors, also influence its strength (Cleveland et al., 2005). This factor is particularly relevant to the marine environment due to the spatial scale and hidden nature of many marine issues.

The Kollmuss and Agyeman (2002) model includes some important factors affecting behaviour. A number of criticisms of the model illustrate that this is an area of considerable debate which is continually evolving; this model does not claim to provide a definitive solution to understand the relationships between the many factors influencing pro-environmental behaviour.

The concept of pro-environmental behaviour forms the basis of this model, together with the provided definition. Examples above have shown that this can be interpreted as a specific behaviour such as waste minimisation, or perceptions of a global scale issue, with these different scales of interpretation resulting in different effects from factors. Gough (2002) questions this concept, identifying that the definition supports different interpretations leading to uncertainty of what is being investigated through the model. In contrast, Jensen (2002) suggests the definition is too narrow as it does not portray the importance of environmental action as a pro-environmental behaviour. Environmental action can be direct or indirect; direct action includes behaviours such as beach cleans and actions which have an obvious impact whereas indirect actions are those such as supporting a petition or demonstration. Whether delivered by individuals or collectively, both direct and indirect actions can be a catalyst for environmental changes, and therefore need to be reflected in the concept of pro-environmental behaviour (Jensen, 2002).

The model attempts to show the relationships between many complex factors, but, as Kollmuss and Agyeman (2002) note, the inclusion of all factors into a single diagram would result in the loss of function or meaning from the model. The exclusion of the complex, intermeshed relationships between humans and the natural world is criticised by O'Donoghue and Lotz-Sisitka (2002). They suggest that by factoring out these complexities the model perpetuates conceptual gaps between knowledge and action rather than stimulating a new, inclusive perspective that could be focused on closing the gap.

The factors influencing pro-environmental behaviour are undoubtedly interrelated and complex and it is unlikely that any model will be able to comprehensively integrate them all. However, Kollmuss and Agyeman (2002) propose a model which provides a clear identification of the links between direct and indirect factors which can become barriers to engaging with an issue, environment or behaviour. It thus provides a useful general framework for understanding parts of the relationship between society and an environment, and for identifying at what stages, how and why,

engagement in marine environmental health is curtailed.

2.3 Public perceptions

2.3.1 Perceptions of the marine environment

There are many positive links between the public and the marine environment. Recreational opportunities on the UK coast range from extreme sports such as kite surfing through to gentler experiences such as walking, or simply enjoying the seaside experience. In 2006, 22.5 million UK residents took holidays at the coast (UK Tourism Survey, 2006). These associations are predominantly limited to the coast, with the majority of visitors staying on or close to the beach. Even active sports tend to occur in shallow waters close to the shore. This leaves most people with limited experience of regional scale seas.

The high number of visitors points to the attraction of the UK coast. A 2005 study found that 65% of respondents considered visiting the coast important to their quality of life. A third of respondents often daydream about the coast during their everyday life, whilst 49% said their happiest childhood memories were by the sea (A. Woodhall, National Trust, Pers. Comms, 2010). These positive associations are connected to experiences of the coast; associations below the intertidal zone are limited, and perceptions past this point show a distinct change.

This coast-dominated experience is reflected in the way people think about the seas. When asked about the undersea environment, people instinctively talk about the coast: the part of the sea which they have personal experience of (Rose et al., 2008). When pushed to think or talk about the broader seas, respondents perceived three distinct regions: the coast, the sea surface which was thought to be cold and grey, and the seabed which was thought to be about the same as the surface, just covered in water (Natural England, 2008). This lack of connection to the marine environment beyond the coast is reflected in respondents' confidence in understanding it: when asked about the health of coastal waters 73% of respondents were able to answer, but when asked about the health of deep oceans only 53% of respondents gave an answer (Ocean Project, 1999a). The subtidal marine environment is very much out of sight, out of mind.

When encouraged to think about the 'undersea landscapes' around England, the public describe negative perceptions of disgust, shame and sadness (Natural England, 2008). These are expressed as disgust relating to fear of a cold, dark, dangerous environment. Shame is expressed particularly at the pollution and litter in our seas, but also shows an association that any reference to the natural world will

mean bad news. Sadness comes from comparing English seas either with how they used to be - things are thought to have been better in the past - or in comparison to seas in other countries. Within England, the seas in the south west are thought to be the ones most likely to have something worth talking about. Negative perceptions lead to an avoidance and dissociation with the sea beyond the coast and make the task of engaging the public with this valuable environment particularly challenging.

Negative emotional responses are reinforced by the lack of awareness of the sea life in English seas: 44% believe the English undersea environment to be utterly, generally or mostly barren (Rose et al., 2008). A barren environment will have no perceived benefits: it provides no utilitarian value from the provision of seafood or intrinsic value in sea life, therefore providing no reason for people of this opinion to support improvements in protection or management of the marine environment.

The lack of public association with the marine environment beyond the coast is a key obstacle to overcome when communicating regional scale marine health. Lack of experience of an environment does not mean people cannot identify with issues or feel passionately about its conservation, but it does present a challenge when inspiring interest.

2.3.2 Spokes Species for UK Seas

Individual species are used to aid conservation goals through a number of methods, and are often a main component of communication campaigns (Jacobsen, 2000). A species can be selected for various reasons, ranging from social appeal through to ecological roles.

Flagship species are employed with the main aim of being socially appealing (Caro and O'Doherty, 1999). These are often large vertebrates: for example the giant panda (*Ailuropoda melanoleuca*) is used globally as the emblem of the World Wide Fund for Nature. In the US, policy spending on single species is positively correlated with the charisma of the species, rather than its ecological need (Getzner, 2002). This illustrates the importance of selecting species which attract societal support for allocation of public spending on environmental campaigns and the political benefits of being seen to support something perceived as worthwhile as defined by society. Campaigns based around flagships are structured to engage people to support conservation of a species, often in a distant country, which the majority of donors will never experience first hand. This shows the broad appeal and power of using charismatic species as tools for communication.

Umbrella species are selected based on the size of the habitat area the population requires to remain viable. Protection of a species with a large area requirement will

facilitate the protection of all species within that area (King and Beazley, 2005). Umbrella species are likely to be large, and may also be flagships; however flagships may hold no value as umbrella species (King and Beazley, 2005). Umbrella species can be used to aid the designation of protected areas, making them an appealing management tool (Zacharias and Roff, 2001). The umbrella concept can also be adapted to protect key locations for migratory animals. For example, the semi-palmated sandpiper (*Calidris pusilla*) is not a suitable umbrella species: its range includes breeding grounds in the Canadian Arctic, feeding in the Bay of Fundy and overwintering in South America. It would be practically and politically impossible to protect the entire range (King and Beazley, 2005). However, by understanding the life history of the bird, it is possible to protect key locations such as feeding and breeding areas, thereby protecting migration routes.

In terms of tools for ecosystem management, these approaches receive mixed reviews. Flagships have no ecological criteria as a basis for their selection so are of limited use. Umbrella species appear to be based on achieving conservation targets. Simberloff (1998) criticises this single species focus for not necessarily translating into broader protection. The links between umbrella species and their communities are often little understood (Zacharias and Roff, 2001), causing a further challenge in assessing their success as ecosystem scale protection.

Species selected wholly on ecological criteria are indicator species and keystones. Indicator species are used to simplify monitoring of larger scale processes. Keystone species have impacts which are greater than expected relative to their abundance or biomass (Simberloff, 1998). For example, the sea star (*Pisaster ochraceus*) consumes mussels (*Mytilus edulis*). The mussel is a competitive dominant and in the absence of the sea star would become dominant (Paine, 1969). Removal of a keystone species has a significant impact on a community. Keystone species are potentially the most suitable types of totem species to be used as determinants of management decisions (Zacharias and Roff, 2001, Simberloff, 1998). Keystones are selected on ecological merit, however, and may hold no social significance, potentially limiting their use for inspiring public interest.

Another application of individual species successfully combines the charismatic appeal of a flagship with the science of an indicator species to produce a socially relevant communication tool. The polar bear (*Ursus maritimus*) has become a publicly recognised symbol of climate change (Slocum, 2004). Increasing sea temperatures are causing sea ice to melt faster, which reduces the feeding season of the polar bears. This shorter feeding season is linked to a decline in the condition and fecundity of polar bears (Derocher et al., 2004). Greenpeace Canada in particular have used the polar bear as a tool to communicate the global scale effects of climate change in a

socially relevant, local message (Slocum, 2004). Polar bears are also a familiar and charismatic species. Through use of various communication techniques and support of sound scientific evidence, they have become a bridge for linking the complex and distant effects of climate change to local public actions.

In the UK, there is currently no 'polar bear' to communicate the links between human activities and damage occurring in the sea. When asked to name a feature of the undersea landscape or creature or plant likely to be found on the UK seabed, 50% of respondents cited generic sealife groups such as crabs, fish or seaweed (Rose et al., 2008). Very few people associated the UK seas with traditionally charismatic species. This may show a limited knowledge of the charismatic species in UK seas, the lack of an iconic species associated with our seas, or both.

The species chosen as flagship and umbrella species are often large vertebrates, particularly mammals and birds (Simberloff, 1998). These species elicit positive social responses towards the conservation issue in question (Czech et al., 1998). A number of features of birds and mammals explain their charismatic appeal; Kellert (1996) identifies size, aesthetics, intelligence, sentinence and similarity to humans as being important to shape attitudes towards a species, with birds and mammals scoring highly in aesthetic value (Knight, 2008). The biological similarity to humans appears to give a measure of whether a species has the capacity to feel pain and suffering (Kellert, 1996); such a feature is important for a flagship, and certainly for an umbrella species to potentially prompt an empathetic response to the conservation threat it faces.

In contrast to birds and mammals, reptiles, amphibians and invertebrates generally evoke negative responses. These responses are due to the lack of human similarity, presumed mindlessness and number of pest species which cause financial loss (Kellert, 1993). This financial loss represents an anti-utilitarian role where a species compromises profitability. Invertebrates are viewed with fear, antipathy and aversion (Kellert, 1993). These negative attitudes towards invertebrates are a considerable barrier for their use in marine communication campaigns.

There are exceptions to these generalisations. The bat, a mammal, is disliked, possibly due to its social associations with blood sucking vampires (Knight, 2008). Turtles, tortoises and butterflies defy the reptile and invertebrate dislike by being adored and often receiving high conservation status (Czech et al., 1998). Butterflies are insects which, despite potential pest association as caterpillars, are appreciated for their aesthetic value (Kellert, 1993) with many artistic and fashion interpretations. Bees have a considerable utilitarian value as pollinators; their current decline is receiving much media attention and an anecdotal increase in awareness is evident within the UK population.

The use of one, or a small group, of single species as a key component of a campaign may appear to contradict the current move towards regional scale and whole ecosystem management. However, the technique of using a Spokes Species to hook public interest can be a powerful tool for inspiring this public interest (Jacobsen, 2000). Spokes Species will be part of a broader campaign; as people become more interested and involved more ecologically based messages will be delivered. Species are discrete units which experts and non-experts can easily identify with (Simberloff, 1998). The benefits of using single species in this context should not be disregarded because of a paradigm shift towards ecosystem scale management. Species remain a valuable tool for communication, as long as the target message is clearly identified and they are linked to broader ecosystem processes and threats. This first stage is about inspiring interest, and a charismatic Spokes Species to champion UK seas is an opportunity to engage the public, an approach which is currently not being widely applied.

2.3.2.1 Conservation issues in the marine environment

Public perception of conservation issues can be measured by identifying those issues that cause greatest concern. Few environmental surveys compare marine concern against other issues, often categorising aquatic issues together. The Eurobarometer survey examines opinions of European citizens to a wide variety of issues. Their environmental study asks respondents to select five issues they are most worried about from a list of 15 (European Commission, 2008). Marine pollution is ranked second, but this is as part of the category of water pollution, defined as seas, rivers, lakes and underground sources. A similar result was found in a Scottish survey where pollution of seas, lochs and rivers was rated as the 4^{th} most important environmental issue out of 23 (Hinds et al., 2003). Due to the broad aquatic category, it is not possible to conclude from the results whether concern for the marine environment is perceived as one of the most important environmental issues, or if the results reflect concern for one of the aquatic environments, which likely feature more heavily in people's experiences, such as rivers or lakes.

A number of surveys have investigated perceptions of particular marine issues, showing that there is some concern for marine environments. In Wales, the WWF surveyed opinions of the Welsh coasts and seas. 78% of respondents believed that increasing pressures on our seas are damaging the marine environment (WWF, 2007 cited in Rose et al., 2008). This shows that a considerable proportion of the population are aware of marine threats from human activities. When asked what threats were considered the most important, the top three issues were sewage and industrial pollution, oil spills and litter on beaches and in the seas. A separate survey

in Scotland asked respondents to rate how concerned they were about a range of 23 environmental issues, including a number of specific marine issues. Respondents rated raw sewage discharged into the sea as the greatest worry, overfishing as 15th and fish farming as 23rd (Hinds et al., 2003). Finally, a survey in the US of attitudes towards the marine environment found that 81% of respondents thought oil pollution was the most serious problem in the ocean (Spruill, 1997). This survey then provided respondents with a series of nine statements about the marine environment and asked them to say how much each statement made them think the oceans are in trouble. Of nine statements, 'approximately 3.25 million tons of oil enter the oceans every year' signified the greatest amount of trouble for the oceans, whilst 'in the last 20 years, an estimated 50% of the world's mangrove forests have been cleared for shrimp farms' signified the least trouble for the oceans (Spruill, 1997). Fletcher et al. (2009) found that the most pressing issue facing the oceans was considered to be pollution (40% of respondents) with climate change and overfishing joint second most important (both with 17%).

These surveys show a tendency for pollution - particularly sewage, oil and litter - to dominate public concern of issues in the marine environment. These are issues which are aesthetically unpleasant, have obvious negative impacts for marine wildlife and habitats, and potential impacts for human health or use of coastal regions. These features may be perceived as most important to the public, but may not actually reflect the most severe ecological impacts. In terms of ecological impacts, overfishing is one of the greatest threats to the marine environment (GESAMP, 2001) and the loss of mangrove habitats has caused significant damage to coastal ecosystem functioning (Primavera, 2006). The survey by Fletcher et al. (2009) was the only survey which found climate change and overfishing to be of relatively high concern, although still considerably less so than pollution. This is the most recent survey, perhaps reflecting increasing media attention to these issues. The respondents in this survey (n=138) were visitors to the National Maritime Museum in London, rather than being representative of the wider UK public. This may suggest that these respondents are already interested in marine issues and potentially show greater interest in marine topics than the wider population.

2.3.2.2 Social and ecological defined conservation priorities

Issues such as oil, sewage and litter which are high on the public agenda do compromise marine health, for example through entanglement, smothering or chemical toxins (Piatt and Ford, 1996). However, when considered against all other impacts of human activities, and in terms of the damage to attributes of ecological health, these are not deemed to be the most serious issues. A number of these issues are the

focus of policy action. For example the US Oil Pollution Act (1990) implemented measures for better prevention and response to oil incidents and a reduction in the size and volume of oil spills has been recorded since 1990 (Kim, 2002). This illustrates that improvements are being made in management of these issues, reducing the risk of damage to the environment; however, this is not reflected in a change in public opinion (Leschine, 2002), suggesting that the factors underlying the social perceptions of environmental risks are subjective. In the case of oil spills this includes a lack of recognition of the benefits of oil as a primary product, a perceived corporate negligence in allowing disasters to occur, and media hype (Lowden, 1997).

Oil, litter and sewage pollution are conservation issues which require little expert opinion to interpret them as being 'bad'. Photos of oil soaked seabirds or seals prompt an emotion-based response to the suffering of an animal. Issues which cause greatest threat to ecological health often occur over larger temporal and spatial scales (Halpern et al., 2008) and are less easily illustrated through hard hitting images conveying clear lines of good or bad. There is, as yet, no 'oiled seabird' image for ocean acidification.

The potential to use a striking image to represent an issue creates the opportunity for media attention. Media hype about an issue can skew public opinion, whilst issues which may be of greater threat but lack the potential for sensationalist reporting suffer from less attention, and consequently less public concern (Leschine, 2002). The clear messages of visually represented, high profile issues are interpreted by the public through subjective and value-laden judgements, rather than an assessment of potential harm (Lowden, 1997). Therefore, those issues which are not represented by a clear image of damage, or are not associated with particular communities or livelihoods which personalise the effects of the issue, struggle to attract media or public attention. The implications of this for marine issues which cause the greatest ecological health threat is that the current lack of a visual representation is a considerable barrier for better public engagement with these issues.

In the US, the Ocean Project (1999b) used focus groups to discuss what the public were concerned about in the oceans and why these issues were a concern (Ocean Project, 1999b). Pollution was considered to be the most direct threat to ocean health, and in part this opinion was due to ease of understanding how it caused damage. A number of more complex issues of less concern were explained to the participants, including coastal developments and overfishing. This led participants to express greater concern about these issues and the research concluded that the lack of knowledge about ecologically important issues led to a lack of concern. This shows the importance of knowledge as a fundamental step in engaging the public, but additional factors must also be recognised (Figure 2.1).

Roberts (1990) describes the implications of a mismatch of the opinions of scientists and the public on which environmental issues are most important. His discussion refers to how the priorities for the US Environmental Protection Agency spending should be allocated, either through what the tax paying public considers most important or trusting expert opinion to deal with those issues which will cause most damage to environmental and human health. Although public perceptions of marine environmental issues are mainly dominated by visual issues, there is an awareness of the marine environment being vulnerable to human activities and a desire to protect it, particularly for future generations (Spruill, 1997). This means that although there is lower concern for ecologically important issues, there is potential, with appropriate engagement and communication, that these more complex issues can be explained to the public, and an increased value put on protecting those less visual ecosystem functions and processes.

When the concerns of society parallel a science priority, the outcome can have multiple benefits. An example from Australia illustrates how public opinion can influence research direction. In the early 1970s, proposed developments to drill the Great Barrier Reef for oil, coupled with early evidence of the effect of the crown of thorns starfish (*Acanthaster plancii*), led to a public campaign in support of increased conservation effort. As a result, the Great Barrier Reef Marine Park Act was passed in 1975, implementing better protection and management of the region. This also led to a dramatic increase in coral reef research, focused on the Great Barrier Reef (Kelleher, 1986, Ward and Saenger, 1984). This is an example of where public opinion and expression of values forced environmental management of vulnerable habitats, influenced the direction and volume of research and has led to a continually high social profile of a marine ecosystem.

2.3.3 Communication for Engagement

Existing surveys, as described above, suggest that the public have limited knowledge of the ecological value of UK seas, overwhelming negative emotions created from it and suggest a mismatch between ecologically and socially defined marine health concerns. To enhance public engagement with UK seas, and facilitate support for better management of the marine environment, a combination of knowledge, reasons to value and opportunities to build positive associations is required. This section considers how messages can be delivered to engage the audience, and shows examples which develop from scientific studies into socially relevant communication strategies.

The framing of environmental messages can have important effects on how an audience respond to a subject. Climate change messages are often framed within

fear, for example a special issue of Time Magazine used an image of a polar bear on a small piece of ice and the headline 'Global Warming: Be Worried, Be VERY Worried'[1]. Such messages can translate to fatalism and powerlessness within the audience, disengaging rather than connecting with people (Nisbet, 2009). The dominance of 'doom and gloom' surrounding environmental issues creates pessimism and perpetuates lack of connection to issues (Johnson, 2005). Constructing messages which build positive associations, and illustrate the potential for damaging situations to be changed, can give a realistic assessment of an issue but in a way which engages the audience and encourages public participation.

2.3.3.1 Change4Life

A strategy which applies the ethos of positive messages to encourage results is the UK Department of Health Change4Life campaign (www.nhs.uk/Change4life). Where most public health campaigns create fear, this campaign uses positive messages and a shared ownership of the problem instead of placing blame on individual's current actions. The justifications for the campaign are based on a study which predicted that 90% of adults and 65% of children will be overweight or obese by 2050 (Department of Health, 2008). The different approach adopted in this campaign aims to promote behaviour changes which prevent this prediction being realised. The campaign is structured to engage and connect with the audience, identifying the cause of the problem and the potential health risks, whilst offering achievable solutions which relate to everyday life.

2.3.3.2 Healthy Waterways - Brisbane, Australia

The South East Queensland Healthy Waterways Partnership consists of state government, industry and research groups, who provide annual reports on the health of local catchments, estuaries and coastal waters. Health assessments are based on monitoring at over 380 sites within 21 catchments. Scientific data are used to grade each region for an Annual Report Card, communicating the data in a format accessible by non-experts. The programme and the committee who maintain it have become recognised as a reliable, trustworthy source of information on environmental issues in the region, being contacted if issues are raised requiring input of expert opinion. The annual publication of the report cards gathers media attention and TV coverage of catchments which have seen improvement or where particular issues are important within the community (Courier Mail, 2007, ABC, 2006). There have also been wider social impacts such as the desire of the partners to become more involved

[1]Time Magazine, Volume 167, Number 14, April 3 2006.

in the scientific process - illustrating the keen interest and ownership of their local area, and willingness to invest time in being involved (Ecosystem Health Monitoring Program, 2005). Public and stakeholder input has been a vital component of the programme from the outset (Dennison and Abal, 1999) and is probably part of the key to its achievement. The programme successfully informs local society about key environmental issues and has established a functional bridge between experts and society. Although it is not known if individual behaviours are changing, it is possible to see the increased presence of environmental awareness in the region.

2.3.3.3 Chesapeake Bay Program

Chesapeake Bay is North America's largest and most biologically diverse estuary. The Bay catchment area includes six US states and is home to over 16.6 million people, and has around 150 major rivers and streams. The Program structure includes a detailed communication plan using various methods such as a detailed website and various public engagement opportunities (Chesapeake Bay Partnership, 2000). Indicators are chosen to show the progress being made to restore water quality and living resources and communicate complex ecological aspects of bay health. These are updated annually and are presented with an overall 'percentage of goal reached' score, which provides non-experts with a visual, easy to interpret picture of what progress is occurring within the Bay. The annual Chesapeake Bay Health and Restoration Assessment is a map based assessment which presents the information for the Bay area for public understanding. This assessment is structured to deliver information about management actions, ecosystem health and the ecological links between the indicators. This is supported by a five year technical report which provides more detailed information and the opportunity to review the effectiveness of the communication strategy.

2.4 Conclusion

The marine environment provides a diverse range of goods and services which are valued by society. Maintaining the health of the marine environment ensures the ecological functions and processes which provide these goods and services can continue. Improved management and protection of the marine environment, needed to maintain health, requires a holistic approach which integrates social, economic and ecological values. Society is poorly engaged with the marine environment beyond the coast, with strong negative associations and a lack of awareness of the ecological value it provides. The issues which attract most public concern are often not those which are ecologically most serious. To encourage more positive associations with

the marine environment, it is important to gain a better understanding of current perceptions and values, thus identifying how ecologically sound health assessments can be used to engage the public. This project aims to connect ecological, social and policy values in order to develop communication strategies which promote stronger social connections with UK seas.

Chapter 3

Marine Ecological Health Analysis

3.1 Background

The Ecosystem Approach places a clear focus on understanding the ecosystem functions and processes which underpin the provision of valued goods and services associated with a healthy marine environment (Chapter 2; Table 2.2). Existing marine management is supported by monitoring which focuses on the effects of human activities rather than assessment of regional marine health. At the EU level, monitoring programmes are neither integrated or complete (Borja, 2006), with most monitoring being sector, rather than system, driven (Laffoley et al., 2006). Current marine monitoring is focused towards assessing single species' health and relatively small scale impacts: it does not deliver the assessments needed to monitor ecosystem functions and processes. The EU Marine Strategy Framework Directive (MSFD) and the UK Marine and Coastal Access Act (MCAA) require assessment and monitoring of regional sea health to support the implementation of the Ecosystem Approach. This will require a different approach to monitoring in order to deliver a more holistic perspective on marine management.

This chapter establishes the criteria of ecologically defined marine health and identifies single species which may be suitable to monitor marine health at the regional scale by encompassing ecosystem functions and processes, as required by the Ecosystem Approach. The application of single species to assess marine health, as is currently seen, does not deliver the ecosystem scale perspective required. However, species are a useful ecological component for assessing and communicating the marine environment: they can be monitored more easily than other biotic components and are publicly understood (Simberloff, 1998). By assessing which species relate most closely to the attributes that underpin marine ecological health, it may be possible to identify species which can be relevant to both the assesment and communication of regional marine health, conecting to both science and social values.

The Ecosystem Approach incorporates economic, social and ecological values to deliver healthy socio-ecological systems. The ecological components will be measured against the criteria of Good Environmental Status (GEnS) within the MSFD and Marine Ecosystem Objectives through the MCAA, guided by the vision of 'clean, safe, healthy and productive seas' (Defra, 2002). Rogers et al. (2007) define a hierarchical framework from these high level objectives to the operational requirements of monitoring marine environmental health. The MSFD requires this approach to be applied to implement the stages of achieving GEnS through an initial assessment of regional seas and development of indicators and criteria for monitoring. This health-based assessment requires a change from the traditionally species-focused monitoring to regional scale indicators at the operational level which more accurately reflect the targets of health identified in the high level objectives. This requires a review of monitoring needs to ensure that existing science is not just relabelled when it may be unsatisfactory to meet the criteria identified (Gubbay, 2004), and to identify gaps in current monitoring. To address this need, this chapter:

1. Reviews what system attributes underpin marine ecosystem health
2. Assesses a suite of marine species to identify those suitable to measure these attributes and deliver monitoring of marine ecosystem health
3. Identifies how these species can be used to optimise health assessment and deliver GEnS
4. Compares these findings against existing policy protection for species

3.1.1 Marine ecosystem health

Social and economic judgements of the health of a marine system are often driven by the goods and services provided (Boesch, 2000). This can lead to different definitions of what constitutes health, e.g. a system which has plenty of fish, or one without chemical contaminants (Rogers et al., 2007). The analysis in this chapter focuses on the ecological health which underpins the health of the social and economic components of the system through the provision of goods and services. This focus does not remove the potential for contrasting definitions of health, but focuses on the ecological attributes which provide the goods and services which society values.

Costanza (1992) describes a healthy ecosystem, like a healthy human body, as a system which functions well and is able to resist or recover from disturbance. Quantifiable components of this are vigour, organisation, resistance to disturbance and resilience. These ecosystem attributes are widely accepted as underpinning

ecosystem health (Rogers et al., 2007, Tett et al., 2007, Gubbay, 2004, Rapport et al., 1998).

Vigour relates to the activity, metabolism or primary productivity of an ecosystem (Rapport et al., 1998, Gubbay, 2004). These are the biologically mediated changes in energy and materials within a system (Tett et al., 2007). At optimal vigour, the system is able to respond to changes, for example an increase in input of organic matter. If the input is greater than the ability of consumers to deal with, an unhealthy, eutrophic state occurs (Tett et al., 2007).

The organisation of a system comprises the biodiversity, food web and biophysical structure (Tett et al., 2007). It relates to the diversity and number of interactions between species components (Rapport et al., 1998). Greater diversity and interactions alone may not denote health; for example a coral reef has high diversity and complex physical structure compared to the low diversity and little physical structure of a subpolar pelagic system, but both may be healthy systems. This illustrates the structural variety of marine ecosystems (Tett et al., 2007): an important factor when identifying the health of a region or subregion is to recognise and understand the particular features of the area in question.

The third attribute is that of persistence, the combination of resistance and resilience (Carpenter et al., 2001). This describes the adaptive capacity of a system: its ability to maintain structure and functions under stress (Gunderson and Holling, 2001). A healthy, resistant system will be mostly unchanged under stressed conditions. After a threshold point, it will no longer be resistant and is likely to undergo rapid change (Tett et al., 2007, Figure 3.1). Resilience is the ability of the system to recover from a disturbance. Figure 3.1 shows these attributes in a system under pressure from increased nutrient loading and illustrates the non-linear responses and recovery. Monitoring of ecosystem health needs to detect changes within a system before the system reaches the hysteresis point and a state shift occurs. An unhealthy system which has undergone a state shift is likely to require more than just the reduction of a pressure to facilitate recovery to a healthy state. Monitoring the resistance and resilience of a system allows measurement of the ability of the system to handle risk and uncertainty (Laffoley et al., 2003). This incorporates an awareness of the long term health of the system in the face of new challenges (Boesch and Paul, 2001), providing a more temporally relevant application of monitoring than that which currently exists.

Despite the diversity of marine ecosystems, the signs of poor health, measured as system distress, are remarkably similar (Rapport et al., 1985). These attributes are therefore reliable as defining measures of health in marine systems. Monitoring based around the attributes of vigour, organisation and persistence can be used to

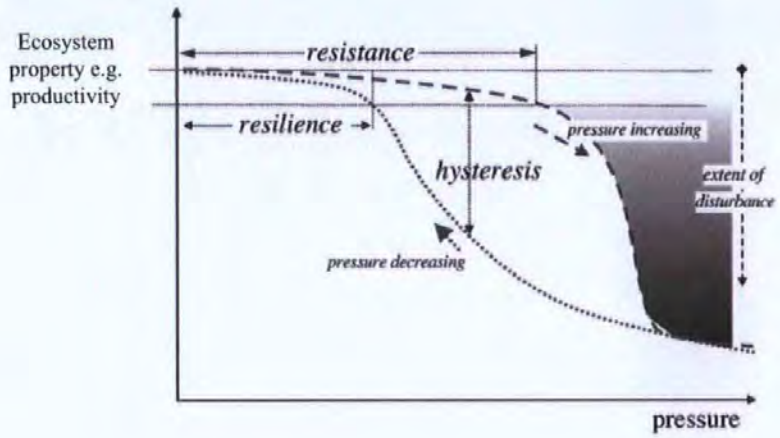


Figure (3.1). Ecosystem response to pressure (from Tett et al., 2007, p283). Arrow shows deterioration of ecosystem health along the dashed line, and recovery returning along the dotted line.

assess what a system looks like, how it is organised and what it produces (Boesch and Paul, 2001). This allows ecologically determined marine health assessments to be interpreted in terms of the goods and services which underpin social and economic values of the system.

These attributes relate to the ability of an ecosystem to function; in turn, functions and processes provide the goods and services valued by society. Beaumont et al. (2007) review the extensive nature goods and services provided by the marine environment such as food, raw materials, gas and climate regulation, bioremediation of waste and leisure and recreation. This illustrates the broad range of ways in which a healthy marine environment supports societies and economies. Under conditions of stress, ecosystems are less able to perform the functions which deliver the goods and services we require.

These attributes are easier to theorise than to quantify, however, and the development of indicators which enable the measurement of these concepts is a current area of discussion. Figure 3.2 illustrates the changing requirements of monitoring from single species and small scale impacts towards ecosystem health monitoring: integrating multiple levels of biotic organisation along the ecosystem perspective axis and increasing complexity of impacts on those systems (Laffoley et al., 2006). From measuring species which are the structural components of a system, further measures of food web dynamics and distribution of life history strategies are needed to understand and monitor the more complex ecological processes related to health (Rogers et al., 2007). These interactions would be monitored by indicators in group d (Figure 3.2). The current concentration of indicators mostly fall within group a.

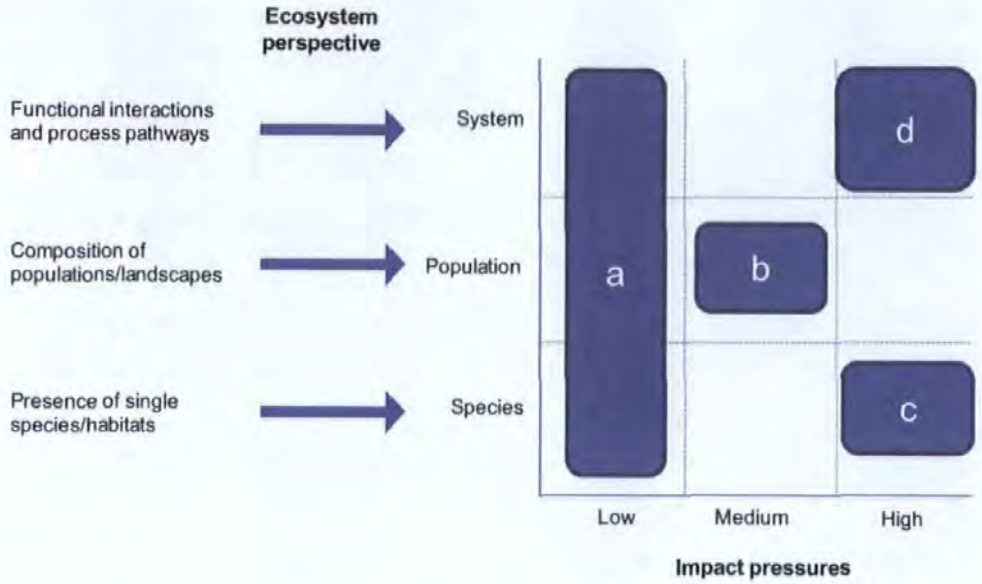


Figure (3.2). Changing perspectives of monitoring shown by groups of indicators which reflect specific aspects of the marine environment. a) Regulatory based indicators, b) species indexes, c) long term species monitoring and d) ecosystem function and process measures. Impact pressures relate to the increasing complexity of human pressures on marine ecosystems, from small scale to broad impacts and longer time periods. (From Laffoley et al., 2006, p24.)

3.1.1.1 Biodiversity

The relationship between biodiversity and health is complex and can relate to properties beyond the number of species present (Duarte, 2000). Increasing diversity has been positively related to higher productivity, increased complexity of system organisation and greater resilience (Tett et al., 2007, Elmqvist et al., 2003), suggesting that it has potential as a measure of marine ecological health. For example, Worm et al. (2006) found an increase in the rates of resource collapse and an exponential decrease in recovery potential, stability and water quality with declining diversity across a number of temporal and spatial scales. To explain evidence for a generally positive relationship between biodiversity and ecosystem processes and services, Palumbi et al. (2009) suggest complementary resource use, positive interactions among species and the insurance capacity of species redundancy as possible mechanisms.

This relationship does not translate to an overall indicator for health: low diversity does not necessarily indicate poor health. For example, second-growth forest often has higher productivity than old growth forest of greater diversity (Tracy and Brussard, 1994). There is also evidence that functional, rather than species, diversity may have greater influence on ecosystem functions (Bolam et al., 2002). If

biodiversity is used to judge trade-offs for management, systems which are healthy at low diversity, would be be less likely to be recognised as healthy systems, affording less protection to the goods and services they provide.

There is no doubt that biodiversity is a vital ecological concept in understanding and measuring the health of ecosystems and underpins many processes and services; it contributes a considerable amount to the understanding of systems and their activities, and is recognised as a key conservation priority for good reason (Edgar et al., 2008). However, this should not override the understanding of the attributes defined as pertaining to health; biodiversity alone will not measure health. Assessment of health should be made directly on the attributes of health, not the proxy of biodiversity to ensure marine health is adequately assessed.

3.1.1.2 Current marine monitoring

The majority of the marine indicators in the UK are performance indicators (Gubbay, 2004, Defra, 2005a)). Performance indicators are often tightly linked to particular activities and thresholds, and involve measuring single species to understand single impact pressures, for example, compliance monitoring of coliforms under the EU Bathing Water Directive (Crowther et al., 2001)(performance indicators are shown within group a in Figure 3.2). This provides measures of the marine environment which guide specific management responses, but are inadequate for the assessment of the health and functioning of marine ecosystems (Gubbay, 2004). This is illustrated by the impact factors in Figure 3.2, increasing from single impacts at local scales to impacts across larger spatial and temporal scales. To assess marine health, monitoring of whole ecosystem function and interaction between various components is needed (Rogers and Greenaway, 2005).

The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) have developed a series of Ecological Quality Objectives (EcoQOs) to test an indicator based approach to monitoring the health of the North Sea. EcoQOs are based on human values, and link human use of the marine environment to a particular ecosystem component (OSPAR, 2002). The intention is that meeting the defined targets for each EcoQO will result in the overall health of the system. Oiled guillemots are recorded as a measure of oil pollution (OSPAR, 2006), for example. Whilst oil is detrimental to the health of the marine system beyond the guillemots, and therefore increased presence is likely to indicate greater pressure, these indicators are still defined by a human activity based assessment; they are not assessing the ability of the system to deal with stress, or the underlying attributes of marine ecosystem health.

Assessment of marine ecosystem health based on health attributes is being ap-

plied in North America. Chesapeake Bay is the largest estuary in the United States, with tidal areas over 11,400km^2, a drainage area of 166,000km^2 and is home to a population of 16 million people (Boesch, 2006). The system has undergone a state shift due to nutrient input from human activities, leading to deterioration in ecosystem health (Boesch, 2006). This is exemplified as a system which now has lower productivity of valuable fish and shellfish, is less diverse and well organised and slower to recover from stress (Ulanowicz, 1997).

The Chesapeake Bay Program has the aims of improving the health of the bay and engaging the public through scientifically robust assessment (Chesapeake Bay Partnership, 2000, Chapter 2). This is delivered through health monitoring which attempts to integrate measures of vigour, organisation and resilience (Boesch and Paul, 2001). The Bay Health Index (BHI) is calculated from three water quality measures (chlorophyll-a, dissolved oxygen, Secchi depth) and three biological measures (phytoplankton index of biotic integrity, benthic macroinvertebrate index of biotic integrity, area of submerged aquatic vegetation). This multimetric index gives a robust indicator of ecosystem status facilitating assessment of bay health (Williams et al., 2009). This has been applied to the development of an annual report card for a public audience, as well as establishing scientifically valid data.

Chesapeake Bay is a large system with many human activities, with the predominant deterioration in health due to eutrophication. This programme is making considerable progress on its targets to integrate scientific data into publicly accessible formats and encourage behaviour change required to achieve improvements in system health. The bay benefits from a high level of understanding of this system over several decades. This case study shows the effectiveness of defining health monitoring on health attributes. The application of similar monitoring in European seas is required to make a larger scale assessment in seas affected by multiple pressures may prove more difficult.

3.1.1.3 Summary of sections

This chapter firstly details the methods of the ecology and policy analysis. The ecological results detail the health scores and indicator groups of the suite of analysed species. The policy analysis investigates these results, identifying which species are currently most protected by conservation legislation, how well the species meet the GEnS criteria and what level of monitoring is currently delivered. These results are then integrated in the discussion.

3.2 Methods

3.2.1 Ecological analysis

A suite of UK species was selected to be tested against a series of marine health criteria. Species were selected to be: geographically representative - either regionally or nationally; predominantly subtidal; taxonomically and functionally representative including plants, invertebrates and vertebrates; habitat representative - benthic (sediment and rocky benthos, sessile and mobile) and pelagic; relatively common, commercial and non-commercial species. Certain species were not included: those only found in the intertidal, introduced, rare or deep sea species. Plankton and microbial species were not included in the analyses.

Data limitations meant that it was not possible to conduct analysis on all species from the same data source. This resulted in slight variations in the how attributes were assessed between the groups. Plants and invertebrates were analysed using the Marine Life Information Network (MarLIN; www.MarLIN.ac.uk) database. Fish were analysed using the FishBase resource (www.FishBase.org). A series of conservation status assessment reports were used to analyse the mammals JNCC (2007a,b,c,d,e). Two key assessments of vulnerability were used to assess seabirds (Garthe and Huppop, 2004, Furness and Tasker, 2000).

Three criteria were measured for each species to assess its role in representing marine health. Each species was assigned a score for each criteria (scores shown in brackets).

Vulnerability: a species which is susceptible to more pressures will give a better measure of marine health because it will show reduced function or presence under a wider range of conditions that compromise health. A species which is not vulnerable to many pressures will not indicate changes in the health of the region as it will continue to function under many conditions which threaten other species. The score was calculated by establishing the number of pressures each species is vulnerable to and ranking the species in each group. From the ranked list, the range of pressures was calculated and divided by three to rate each species as having low (1), medium (2) or high (3) vulnerability. These data were not available for seabirds, but two studies provided assessments of vulnerability of seabirds to two pressures, wind farms (Garthe and Huppop, 2004) and fisheries interactions (Furness and Tasker, 2000). Vulnerability of the species on each list was averaged, ranked and scored. The FishBase database provided a vulnerability rating for each species which was ranked and scored.

Ecosystem role: this relates to the function of the species in the system and is a measure of system structure and organisation. Species are not equal in their

roles within ecosystems: some are directly or indirectly essential to the survival of other species (Figure 3.2). The loss of such species would have a greater effect on regional health as it would indicate damage beyond that of the species being monitored. Species were scored according to their role: species (1), population (2) or system/process (3).

Recoverability: a species which recovers slowly after damage will be more likely to show effects of reduced regional health in longer term monitoring. A species which recovers quickly from disturbance could recover before monitoring detects any threat to health. Recovery timescales were those used by MarLIN: less than 10 years (1), 11 - 20 years (2), more than 21 years (3). For plants and invertebrates, a recoverability score is provided for each pressure the species is listed as being vulnerable to. The recoverability for each pressure was summed and divided by the total number of pressures to give an average recoverability per pressure. Fish recoverability was defined by FishBase based on the population doubling time: less than 4.4 years (1), 4.5 - 14 years (2), more than 14 years (3). These data were strongly correlated with the vulnerability data (as shown by the scores in Appendix B). Birds and mammals were all scored at the slowest (3) recoverability because they are much slower than most fish, invertebrates and plants to recover from stress due to their life history strategies (Tasker et al., 2000). For each species, regional distributions and habitat were recorded to ensure adequate representation of marine flora and fauna.

From the data collected, two outputs were calculated:

1. An overall **ecological health score** was calculated for each species by multiplying the scores for all three criteria: vulnerability x ecosystem role x recoverability = ecological health score. Species with the highest score are most relevant to assessing and monitoring marine ecosystem health.

2. The second output is a **grid score** based on the indicator analysis presented in Laffoley et al (2006, Figure 3.2); species were plotted into one of nine categories based on their vulnerability as a measure of impact pressures, and their ecosystem role. This allows interpretation of which species best inform the group of indicators which is most relevant to health assessment but underrepresented in UK marine monitoring (group d, Figure 3.2).

3.2.2 Policy analysis

Two analyses were used to assess the current protection of high scoring species and assess their relevance to future policy applications.

1. Each species was assessed to see how much legislative protection it currently

received, in comparison to the health score. The JNCC database of species legislation (JNCC, 2009) was used to identify which UK and EU conservation designations named each of the species analysed.

2. The second analysis compares each species to the GEnS criteria of the MSFD (Annex 1 and 3, EU, 2008, Appendix A). This allows an interrogation of a) how well the species identified as being most related to health assessment fit the criteria of the directive - and could therefore be effective indicators, and b) how well the policy-defined health criteria reflect ecologically defined health criteria.

3.2.3 Existing monitoring and supporting science

This final section assesses how much existing monitoring is conducted on species and what background knowledge is known about the groups of species. It identifies the particular gaps in knowledge relating to those species which are found to provide the greatest potential to marine health monitoring and assessment. These data are necessary to define baselines, interpret monitoring and ensure the correct responses are prescribed. Absence of these data is not grounds to disregard a high scoring indicator species, but highlights a barrier in implementing the findings of this analysis.

3.3 Results

3.3.1 Ecological analysis

A total of 72 species were analysed (Table 3.1; Appendix B) resulting in a range of health scores from 1 to 22.5 (Figure 3.3). Due to data availability, between group comparisons of scores is only directly possible with the plants and invertebrates (Figure 3.3a). The plants and invertebrate analysis allowed an assessment of health attributes across a considerable range of species (n = 45). Within the bird, fish and mammal analyses, the species are more similar to each other; a puffin is more similar to a fulmar in health attributes than an algae is to a lobster. Despite this similarity, a range of scores is recorded for species in the fish, bird and mammal groups. This is partly due to the ranking process for the vulnerability and recoverability criteria, rather than in the plants and invertebrates where it is more reflective of different health attributes. This means that the differences between the lowest and highest scoring species in each group does not reflect the same scale of ecological difference and therefore health difference. This ranking effect is also evident in the results

Group	Number of species
Plants	12
Invertebrates	33
Fish	14
Birds	8
Mammals	5

Table (3.1). Number of species analysed in each group. Full species list in Appendix B

(Figure 3.3b-d). The differences in source data limit the direct comparisons which can be made between these groups, and the particular scores of species, but some relative comparisons can still be made.

Within the plants and invertebrates analysis, three clear groupings of species emerge (Figure 3.3a). The seven highest scoring species (health scores over 15) are the most structurally complex: mainly plants including maerl (*Lithothamnion corallioides*, *L. glaciale* and *Phymatolithon calcareum*), seagrass (*Zostera marina*) and kelp (*Laminaria hyperborea*). The two invertebrates are biogenic reef species, horse mussel (*Modiolus modiolus*) and native oyster (*Ostrea edulis*). The remaining species fall into two groups; a mid scoring group (6-9) and a low scoring group ($\leq$4) with the majority of species.

It is likely that the nature of the data in FishBase used in the fish analysis led to an overstatement of species such as the basking shark (*Cetorhinus maximus*) in contribution to health attributes (Figure 3.3b). The analysis scores it as a 9, the same as the kelp *Laminaria digitata*, a structural species which is significant at both the system and process scale. Basking sharks have a species scale ecosystem role, but are more vulnerable and slow to recover in comparison to other fish in the analysis. These high scoring criteria reflect the K-selected characteristics of the life history of the basking shark and other species which score high in this fish group, such as the common skate (*Dipturus batis*), rather than the broader ecosystem health attributes which are represented in the highest scoring plant and invertebrate groups[1]. These life history traits are visible in the bird and mammal analyses (Figure 3.3c, d), both as evidence of the similarity within the groups and the health attributes their

[1]The life history strategy of a species relates to the characteristics of its reproduction and survival, and can be described along the r/K spectrum (MacArthur and Wilson, 1967). A typical K-selected species has a long life span, is slow to reach sexual maturity and produces few young, for example, an elephant. A typical r-selected species has a short life span, reaches sexual maturity at a young age and produces many young, for example a mouse.

monitoring potentially informs.

The relatively high scores of the bird analyses (Figure 3.3c), compared with that of the fish and mammals are a result of their higher ecosystem perspective due to their role as top predators, and their slow recovery from disturbances. Similarly, mammals have a greater range of ecosystem perspectives than fish, and slow recovery (Figure 3.3d).

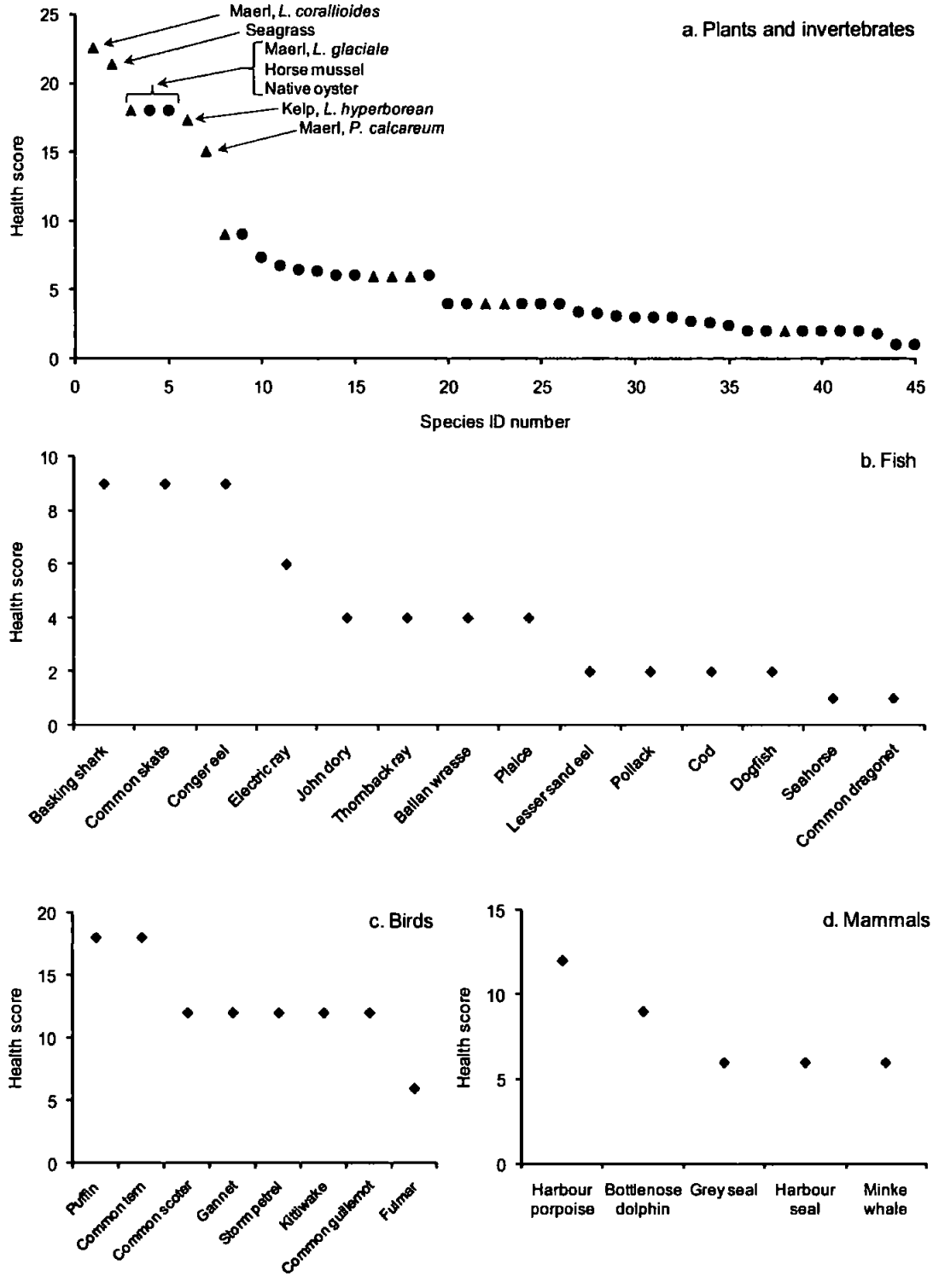


Figure (3.3). Ecological health scores for a) plants (triangles) and invertebrates (circles), b) fish, c) birds and d) mammals. Supporting data and plant and invertebrate species lists in Appendix B. Note the variable ranges on the health scores.

The MarLIN database includes comprehensive data on some fish species. Two fish species included in this analysis (common skate and short snouted seahorse *Hippocampus hippocampus*) were analysed using MarLIN data and compared to the FishBase results. Both fish scored low in comparison to the range of health scores: common skate 2.3 and short snouted seahorse 3.8. This result would put both these species in the lowest health score group (Figure 3.3a). In the FishBase analysis, the common skate was one of the three highest scoring species (9), whilst the seahorse was the lowest (1). The comparison between the two methods suggests that the highest scoring fish species are not equal to those species with similar scores in the plants and invertebrate results.

The second ecological analysis assessed species against the criteria defined by Laffoley et al. (2006) for the identification of potential indicators which measure the attributes of ecosystem health (group d, Figure 3.2). The results of this (Figure 3.4), reiterate the results in the health score analysis by showing the systems level importance of the high scoring plants and invertebrates, with no vertebrates recorded in the systems layer of the grid. The only species found in group d are plants; maerl (*L.corallioides*), seagrass and two kelp species (*L. hyperborea* and *L. digitata*) (Figure 3.4, box a). Those species close to group d, with system level ecological perspective but medium vulnerability include a greater range of organisms; maerl (*Phymatolithon calcareum*), furbelows (*Saccorhiza polyschides*), coral weed (*Corallina officinalis*), and invertebrates horse and common mussels (*Mytilus edulis*), native oyster, Norway lobster (*Nephrops norvegicus*) and edible sea urchin (*Echinus esculentus*) (Figure 3.4, box b). This group are also potentially useful as health indicators but further interpretation is needed to understand what the particular species can measure and their limitations in monitoring ecological health. For example, a number of these species score comparatively low in the health analysis (the common mussel and edible sea urchin score only a six due to their high recoverability).

Three maerl species were included in the analysis and scored differently across the two ecological analyses. *L. corallioides* has the highest health score of all species (22.5; group d); it is vulnerable, slow to recover and relevant at the system scale. *L. glaciale* is also vulnerable, slower to recover than either of the other species but less dominant in the benthic assemblage so only relevant at the population scale. It has a high health score (18) but is of less relevance in the grid analysis (Figure 3.4). *P. calcareum* is less vulnerable, accounting for the lower health score (15) and also not a group d indicator.

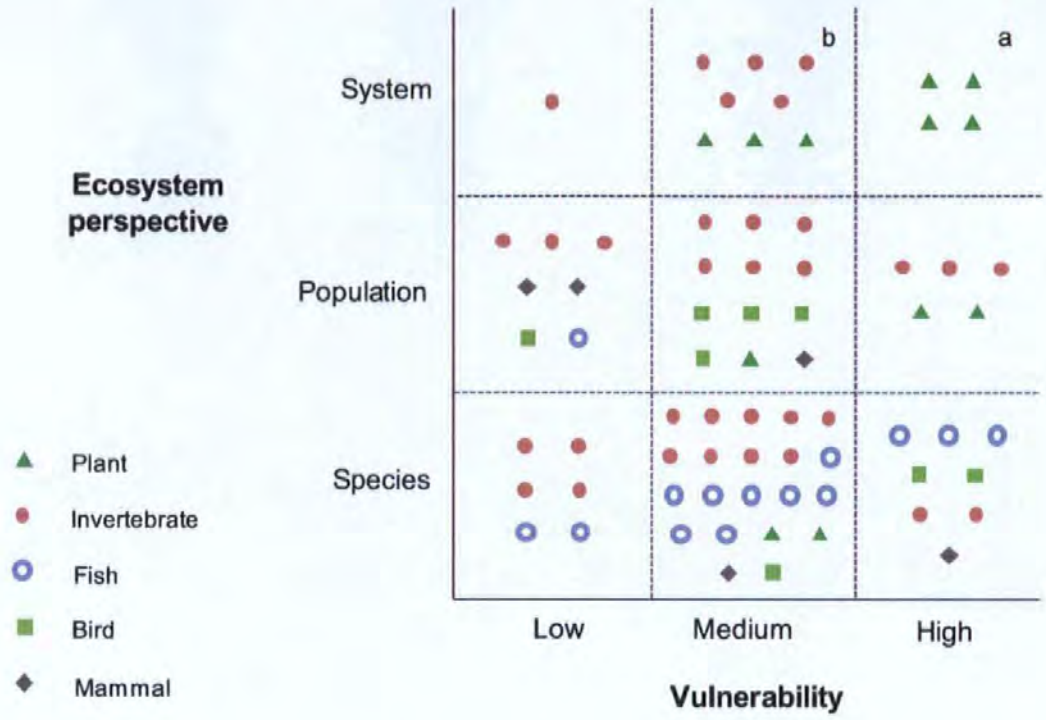


Figure (3.4). Grid analysis of vulnerability and ecosystem perspective of species. The ranking process for the vulnerability analysis means that the species will be distributed across the three vulnerability categories, regardless of between group comparability of vulnerability. Note that location within segments is not relevant to score. Boxes labelled a and b refer to text description of current marine health monitoring gap. See also Figure 3.2. Vulnerability is used here as a proxy for impact pressures described in the original model. Full results shown in Appendix B as Grid Scores.

3.3.2 Policy analysis

Policy protection of high scoring species

This analysis allowed comparison of the ecological results against a series of policy criteria. The JNCC database was used to identify the number of policies which specifically name the species analysed above, identifying them as important for conservation action (Table 3.2, Figure 3.5, JNCC, 2009). Of the 72 species analysed (of which 27 are vertebrates), 27 are listed under one or more conservation policies. This includes three plant species, four invertebrates and 20 vertebrates. The dominance of vertebrates clearly shows that policy protection is not reflective of those species identified as contributing the greatest input to marine ecological health. This is further illustrated in Figure 3.5 which compares policy protection against ecological health score.

Those species with high levels of protection, but relativley low ecological health scores include bottlenose dolphin (*Phocoena phocoena*), minke whale (*Balaenoptera*

Species	Number of policies	Ecological health score	Policies
Harbour porpoise	8	12	Bern, BAP, BL, Bonn, CITES, Hab, CR, WCA
Bottlenose dolphin	8	9	Bern, BAP, BL, Bonn, CITES, Hab, CR, WCA
Common scoter	7	12	BAP, BL, Birds, BCC, Bonn, WCA, NI
Minke whale	7	6	Bern, BAP, BL, CITES, Hab, CR, WCA
Harbour seal	6	6	BAP, BL, Bonn, Hab, CR, NI
Common tern	5	18	Bern, BL, Birds, BCC, NI
Leach's storm-petrel	5	12	Bern, BL, Birds, BCC, WCA
Pink sea fan	5	9	BAP, BL, IUCN, NRS, WCA
Basking shark	5	9	Bern, BAP, BL, IUCN, NI
Short-snouted seahorse	5	1	Bern, BAP, BL, CITES, WCA
Maerl *L. corallioides*	4	22.5	BAP, BL, Hab, NRS
Grey seal	4	6	Bonn, Hab, CR, NI
Maerl *P. calcereum*	3	15	BAP, BL, Hab,
Fan mussel	3	6	BAP, BL, WCA
Cod	3	2	BAP, BL, IUCN
Seagrass	2	21.4	Bern, IUCN
Native oyster	2	18	BAP, BL
Common skate	2	9	BL, IUCN
Plaice	2	4	BAP, BL
European spiny lobster	2	2.7	BAP, BL
Puffin	1	18	BCC
Gannet	1	12	BCC
Kittiwake	1	12	BCC
Guillemot	1	12	BCC
Fulmar	1	6	BCC
Thornback ray	1	4	BL
Pollack	1	2	BL

Table (3.2). Legislative protection for species (or species designated as habitats) included in the health analysis. Bern = Convention on the conservation of European wildlife and natural habitats, BAP = UK Biodiversity Action Plan species, BL = Biodiversity lists, Species of principal importance in England, Scotland or Wales under the Natural Environment and Rural Communities Act 2006, Birds = EU Birds Directive, BCC = Birds of Conservation Concern, Bonn = Bonn Convention, CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora, Hab = EU Habitats Directive, NRS = Nationally Rare/Scarce species, CR = The Conservation (Natural Habitats) Regulations 1994, WCA = Wildlife and Countryside Act 1981, IUCN = IUCN Red List of Threatened Species, NI = Northern Ireland Wildlife Order 1985. (JNCC, 2009)

acutorostrata) and the short snouted seahorse. This is despite the potential for these species to have been over scored on their ecological health scores as described above. Those species with high ecological scores but low protection include seagrass, maerl (*L. corallioides*), native oyster and puffin (*Fratercula arctica*). These results

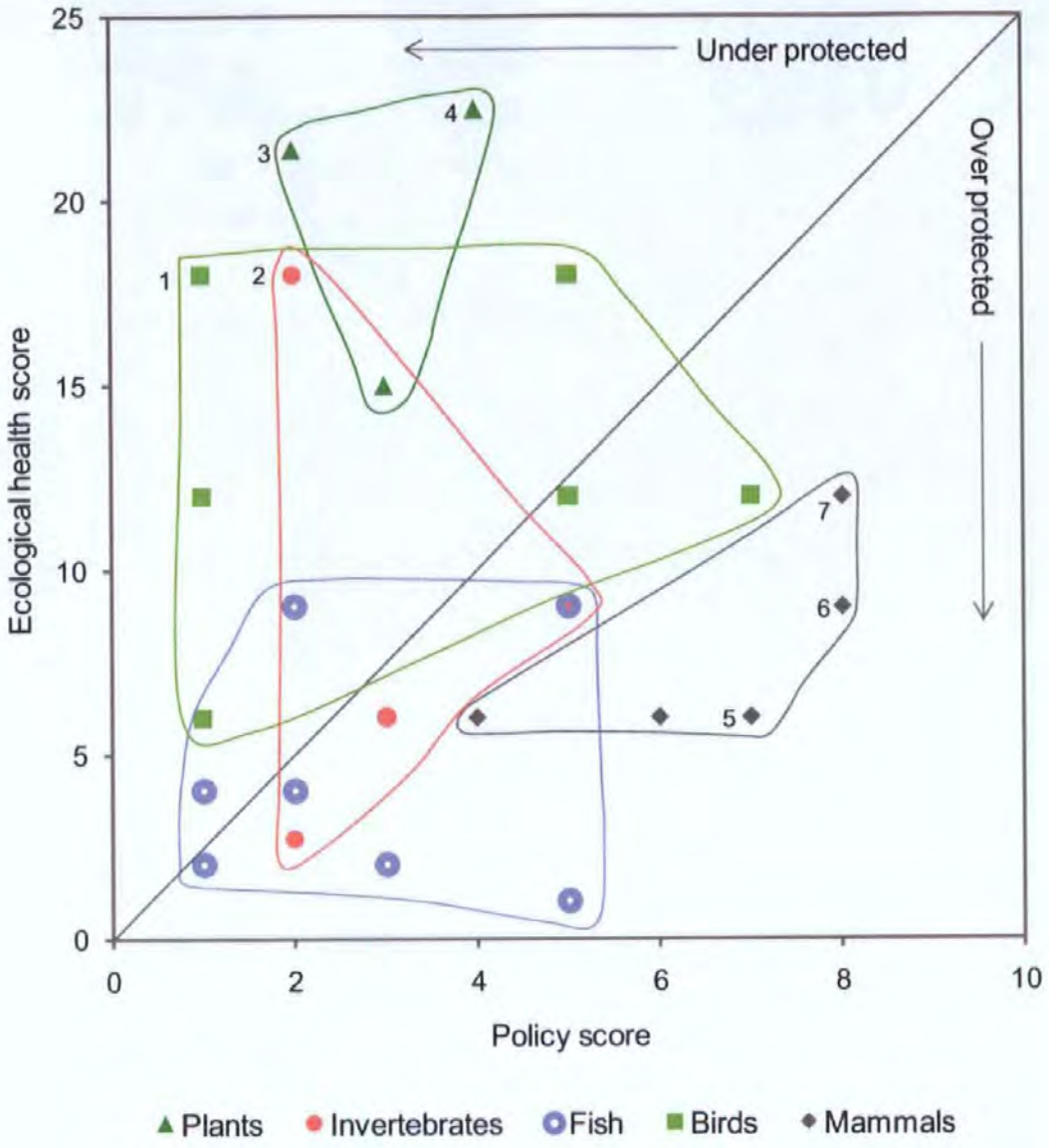


Figure (3.5). Species policy protection and ecological health scores of analysed species. Species with no listed protection not shown. Numbered species: 1. puffin, 2. native oyster, 3. seagrass, 4. maerl (*L. corallioides*), 5. minke whale, 6. bottlenose dolphin, 7. habour porpoise.

show mammals as overprotected, whilst habitat forming species are underprotected (Figure 3.5). This does not suggest that species which contribute less to health should not be protected, or have protection removed, but to identify that the target of achieving healthy seas is not being implemented through the current policy focus on vertebrate species. The comparison of these species needs to be done with caution due to the nature of the data available and the different data methods used to calculate health scores. The remaining 53 species were not named under these policies. Their ecological health scores included 31 species 1 - 4, 11 species 5 - 9 and three species 10 - 18.

A number of the high scoring plant and invertebrate species are not named specifically under these policies. However, biogenic reefs are protected under Annex 1 of the EU Habitats Directive which enables Special Areas of Conservation to be designated where these species form areas of habitat.

It is important to note that the conservation policies included in this analysis do not necessarily provide the same level of protection to species listed. The effectiveness of these policies to conserve species has not been assessed. However, the analysis provides a useful measure of the types of species valued within policies. Further research is needed to assess whether the implementation of these policies leads to a bias in conservation efforts towards large vertebrates, as suggested by the results shown above.

Health species and GEnS criteria

The MSFD provides a series of criteria to guide the initial assessment of GEnS in regional seas, and to develop appropriate monitoring (EU, 2008). The criteria include a set of 11 qualitative Descriptors (Annex 1; Appendix A1) a table of indicative Characteristics (Annex 3; Appendix A2) and a table of Pressures and Impacts (Annex 3; Appendix A3). The criteria are broad categories which allow each Member State to identify the important features relevant to their regional seas.

The Annex 1 Descriptors (Appendix A1) are a mix of specific (litter, contaminants in fish and shellfish) and broad (healthy marine food webs) statements. In terms of monitoring health attributes, the high scoring health species are relevant to three of these descriptors; (1) maintenance of biodiversity, (4) marine food webs, and (6) safeguarding sea-floor integrity.

The Characteristics criteria (Appendix A2) are too broad for particular species in this analysis to be identified as more or less important within a category. The groups analysed, rather than the variations of the species within the groups, are more relevant. Within the table there are 4 categories of characteristics: the Biological features category is relevant here, which consists of 7 sub-categories. The first of these includes all benthic and pelagic components (including plankton) and the second encompasses all other plants and invertebrates. Fish, mammals and reptiles, seabirds, other protected species and exotic species are represented within a sub-category each (3-7). This reiterates the vertebrate focus, the relegation of plants and invertebrates to two groups, and a failure to identify those species most relevant to marine health assessment.

The criteria for Pressures and Impacts (Appendix A3) are described by the effect of activities on the marine environment, which in turn can be detrimental

to health, rather than through listing the activities that cause that effect. These pressures are closely matched to many of the MarLIN listed pressures used in the vulnerability analysis for plants and invertebrates. This allows for identification of indicators relevant to particular pressures (Hiscock et al., 2004, MarLIN, 2010, Appendix C). By specifying the ecological impacts of activities, the GEnS criteria aim to reduce impacts irrespective of the activity which causes them; rather than defining every activity which may cause damage (and activities which fall outside these definitions being excluded), the criteria applies a different perspective focused on the ecological implications. This detail of data is not as easily available for fish, bird and mammal groups; the vulnerability in this analysis was assessed through activity, rather than impacts in the vertebrate groups. These can be linked to the pressure criteria indirectly through an understanding of the effects of an activity. The analysis in this study is more focused on wider health and the analysis scores species which are vulnerable to multiple pressures, making them less suitable for identifying particular pressures. The ecological impacts approach is better suited to supporting marine ecological health than the pressures approach.

These MSFD criteria provide a very broad description of the components of the marine environment which need to be assessed in the GEnS process. They do not specifically identify the groups of species most relevant to ecosystem processes and health and potentially undervalue the importance of plants and invertebrates in this role. Instead the criteria reflect the dominance of vertebrates as highest priorities. Rogers et al. (2007) describe the hierarchy of levels from high level objectives through to operational actions: the GEnS criteria effectively create a further layer in this hierarchy but are too high to ensure delivery of the new perspective of health assessment. In order to achieve this, further guidance will be needed for Member States to interpret the criteria in a way which ensures the attributes of ecosystem health are adequately monitored.

3.3.3 Existing monitoring and supporting science

It is important that the process of identifying indicators of marine health is not driven by the indicators already in use or data availability, but by their appropriateness to the task of monitoring ecosystem health attributes. However, a first step in development of an indicator is a background understanding of the species: their distribution, knowledge of responses to pressures, interactions in the system and identification of baselines to gauge changes against.

UK marine plants and invertebrates are well understood in comparison to many other countries; however, there are still considerable gaps in our knowledge. Maerl

beds are a BAP habitat but a lack of data means that the extent of beds is not well known and in many places the best data consist of presence/absence records and baselines are not adequately known (BARS, 2010b). This gives no ability to measure the changing trend of the maerl beds and is insufficient to establish an informative monitoring programme. There is a good understanding of the effects of activities on plants and animals (Hiscock et al., 2004, Langmead et al., 2008), but without baseline distribution data it is difficult to apply this knowledge to regional health assessment.

As illustrated by the ecological analysis, for many species data exist to understand the vulnerabilities and biology of marine plants and invertebrates. In relation to indicators, links between which species can be used to measure which pressures are well documented (Hiscock et al., 2004, Langmead et al., 2008). Without better distribution data, it is difficult to apply this knowledge to regional health assessment.

For commercial fish and shellfish, data are available on landings, spawning stock biomass and recruitment, collected to inform the definition of quotas by the International Council for the Exploration of the Sea (www.ICES.dk). Commercial data are supplemented by data such as the Marine Biological Association and Cefas standard trawls which have been used to separate the effects of fishing and climate change on fish stocks (Araujo et al., 2006). Some non-commercial species which are BAP species are reported on, but not all. For example the short snouted seahorse and basking shark are both lacking enough data to identify baselines within BAP assessments.

A number of seabird species have been monitored around the UK since the mid 1980s, providing a good understanding of population fluctuations. The JNCC Seabird Monitoring Programme provides data for most of the species in this analysis (and additional species) on parameters including population estimate, breeding rates and feeding activity (Mitchell and Parsons, 2007). Research on the effects of human activities is supported by this thorough baseline data and can facilitate better application of research findings to the wider UK population. Investigation into the conservation relevance and adequacy of current seabird monitoring has to be conducted, identifying the gaps in the current system to be addressed as monitoring develops (Mitchell and Parsons, 2007).

Legislation for conservation of marine mammals is a key driver for existing monitoring. Data on seals around the UK are available and used, for example, in the identification of potential Special Areas of Conservation to protect harbour seal breeding sites. Seals are also identified as an EcoQO in the North Sea pilot. Annual data on seal populations are provided under the requirements of the Conservation of Seals Act (1970). These data provide population trends and also measures of pup

production and fish consumption to varying degrees of confidence and coverage.

The Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS) identified the need to establish monitoring baselines which would underpin further conservation measures of the agreement (ASCOBANS, 1992). This was fulfilled and data have been collected providing a good coverage of abundance of key species, including harbour porpoises and bottlenose dolphins (Hammond et al., 2002). A further study, Small Cetaceans in the Atlantic and North Sea (SCANS, 2006), provided additional data for areas in UK seas not covered by ASCOBANS and also included minke whales. These national scale population data are supported by locally intensive studies of mammal behaviour which add detail to the larger scale data (Embling et al., 2010, Wilson et al., 2004, Ingram and Rogan, 2002).

3.4 Discussion

3.4.1 Ecological analysis

The highest scoring plant and invertebrate species identified in the health analysis are related by the common feature of their role in providing habitat complexity. Biotic habitat complexity is a key factor in functional diversity and species richness (Eriksson et al., 2006, Thrush et al., 2006). Loss of structural complexity, through loss of these species, has effects beyond this individual species and is recognised as being detrimental to the vigour, organisation and persistence of whole systems (Steneck et al., 2002).

The effects of the loss of these species is not limited to the effects of homogenisation; these are dominant species within assemblages and the processes they perform often influence other processes. For example, horse mussel and native oysters are filter feeders, and perform an important role transferring energy from plankton to the benthic community (Hiscock et al., 2006). Large populations of filter feeders have also been shown to be a controlling factor of plankton biomass in potentially eutrophic areas (Cloern, 1982), removing toxic dinoflagellates and improving water column conditions (Noren et al., 1999). Beyond their structural role, algae and angiosperm dominated communities such as kelp forests and seagrass beds are major contributors to primary productivity, function as carbon sinks (Duarte et al., 2005), and are involved in element cycling (Larkum et al., 2005). Assessing these species therefore allows monitoring of processes relevant to wider marine health due to their importance at all scales of ecological compexity. This illustrates the links of these high scoring species to health-related attributes of marine ecosystems and suggests that the analysis has successfully highlighted the optimum species for this purpose.

The application of these species, (and other similar functional species not analysed here) to monitoring marine health, is likely to be more complex than an assessment of their distribution and changes. The changes occurring need to be understood, and to do this other ecosystem components will need to be monitored. For example, in addition to kelp distribution and density, monitoring of sea urchins and their predator populations will be needed in order to identify changes in population of these grazers (Jackson et al., 2001b). Development of a suite of indicators around a key health species will give the assessment the power to not only detect changes in health but should allow interpretation of why the changes have occurred (Hiscock et al., 2006). The existing understanding of the interactions occurring in these species is well understood, but also highly complex. Where interactions are not understood, monitoring should still be carried out, and there is the potential for monitoring to be developed to assist research to understand these gaps. In practical terms, it can be very difficult to measure health attributes such as resilience, despite their importance (Langmead et al., 2008). Given the role of the high scoring species in wider regional health functions and processes, with adequate development and supporting data, these species could form the basis of an effective monitoring framework which assesses broad processes of regional seas over long time scales. Such a framework would require a suite of supporting species to understand interactions, which in turn could be developed into a health index.

Further investigation of the application of these species to monitor regional seas is needed, firstly to assess the appropriate scale of monitoring to detect regional health. Secondly, an investigation is needed into the comparability of regions or subregions which may be dominated by different health species, e.g. whether a kelp forest health assessment is comparable with a seagrass health assessment. Consideration also needs to be given to regions or subregions which do not have these types of species within their boundaries, and the assessment of pelagic systems. Structural species, particularly low growing species such as maerl, are very focused on benthic activity. Further investigations could identify whether functions such as plankton control, nursery grounds and food supply for mobile species can be used to link benthic health to pelagic and regional health.

In addition to the plant and invertebrate based health assessments, the analysis showed that certain characteristics of the vertebrate groups could be beneficial to health assessment. Although, as described, the complexity of the functions of fish, birds and mammals is not as great as the structural plant and invertebrate species, their K-selected traits, and focus of existing monitoring and research, can contribute to the long term assessment of marine health. These roles have already been recognised through the use of seabirds as sentinels of the marine environment,

with particular references to sensitivity to prey species and accumulation of pollutants such as mercury (Furness and Camphuysen, 1997, Frederiksen et al., 2006).

The results of these analyses direct monitoring focus towards benthic structural species. Resource and logistic limitations restrict what can realistically be monitored in the marine environment. The high scoring species here could be used to implement monitoring which assesses different levels of ecosystem complexity, including ecological functions and processes. Through appropriate development, these have the potential to contribute significantly to long term, broad scale assessments of regional marine health.

3.4.2 Policy analysis

The importance of a policy-defined focus in directing understanding of the marine environment is shown by the UK Marine Monitoring and Assessment Strategy, which structures the 15 year UK marine science vision around the need to efficiently meet the multiple requirements of OSPAR and MSFD (JNCC, 2008) and the 2010 Marine Science Strategy (Defra, 2010). This commitment to policy targets relies on policies being developed from sound science. This also shows the power of policy, which, if appropriate guidance is provided, can promote delivery of the best available science which supports other ecosystem components within the social and economic arenas.

The domination of vertebrates in species protection through current legislation does not reflect the importance of ecological attributes which underpin marine health. Further investigation is needed to show how this imbalance in policy is reflected in practice. Those high scoring species which are recognised in current policies are still relatively poorly understood in terms of the data available to aid their protection, for example, the comparison of seal and maerl distribution data described above. This is illustrative of the gap between current management response foci and the requirements of a marine ecosystem health perspective.

The MSFD attempts to redress this imbalance of vertebrate and pressure focus. The Ecosystem Approach is at the heart of the policy and the need to understand marine ecosystems from a health perspective, is integrated into the assessment of GEnS of regional seas. This provides the opportunity to drive implementation of monitoring which gives a long term, process view of regional seas needed to understand the ability to manage systems for greater resilience and optimum functioning.

The framework of GEnS begins this process by providing criteria for health assessment, and the freedom for Member States to define their own health assessment structure, thus allowing the policy to be adapted to the particular needs of the seas under assessment (Tett et al., 2007). However, these criteria are broad, and

non-specific, potentially enabling the current imbalance of assessment of marine components to persist. The 'distance' between these criteria and the selection of indicators is considerable and leaves Member States with little guidance on what to monitor. There is a need for monitoring under the MSFD to be effective alongside existing monitoring and marine assessment. However, if it is to deliver a new perspective on marine health understanding it must also drive the development of monitoring which can understand ecosystem processes and health attributes at appropriate temporal and spatial scales and not repeat existing monitoring protocols and bias towards species less relevant to marine health.

In order to overcome this, the analysis here highlights an opportunity to provide guidance which can be applied to fill the gap between broad GEnS criteria, and the operational scale of assessment. This would add more detail to the existing framework by recommending monitoring of structural species, understanding the limitations of monitoring vertebrates and overcoming data gaps.

A further area for guidance is how to interpret and apply the new type of data which will be gathered, and how managers respond to trend based, broad scale process data. Current indicators are clearly defined as being tightly linked to particular pressures to enable precise management responses (Mazik et al., 2008). The approach investigated here moves away from this, identifying species which would deliver trend based information, rather than being measured against a defined limit and to inform policy rather than management responses (Laffoley et al., 2006).

Current data gaps, particularly in the availability of baseline distribution or understanding of species should not be a deciding factor in what to monitor. Where appropriate, the MSFD can drive the collection of missing data, as ASCOBANS did for seal data (Hammond et al., 2002), and facilitate the development of important understandings. Norton (1998) describes the potential of the Wetlands legislation in the US which failed to fulfil its potential to deliver protection and guide good management decisions because of a lack of scientific evidence. No science based assessment existed which allowed the ecological valuation of wetland areas. As a result, managers were not supported in the decision making process which could have facilitated the optimum implementation of the policy, and through identification and protection of the most valuable wetlands. This mistake need not be repeated with the MSFD; rather it is an opportunity to drive forwards understandings and sustainable management of European seas through the development of a more holistic assessment of marine health.

3.4.3 Limitations of the study

Some limitations of the study are recognised. The analysis could only be conducted on species of which a reasonable amount of data already existed. This led to data poor species being excluded from the analysis, e.g. jellyfish and nudibranchs. Despite this potential for bias to species already studied, the analysis has identified common characteristics of species relevant to health assessment which could be applied to species outside the analysis. The species included were representative, if not comprehensive, examples of UK marine flora and fauna.

Plankton and microbial communities are not included in these analyses but are fundamental to ecosystem functioning and health. Substantial existing data for plankton come from the Continuous Plankton Recorder datasets and satellite data of chlorophyll providing important data to support understanding of wider ecosystem health. These are ephemeral in time and space which restricts their application as indicators of marine health.

Within the definitions of the health criteria, each pressure in the vulnerability assessment was given equal weighting. It was not possible to quantify the relative importance of each pressure to each species, but this may have led to some under or over estimation of vulnerability.

3.5 Conclusion

This assessment analyses 72 marine species to identify those which most represent the attributes of ecological health: vigour, organisation and persistence. Plants and invertebrates which create habitat complexity, such as seagrass and biogenic reef species, are found to be most important. Current policy does not reflect this importance, with much greater legislative protection being provided to large vertebrate species which make a lesser contribution to regional marine health. These policies are focused on individual species, and the direct threats to their health. They do not integrate the indirect threats to the listed species, which may occur through degradation of marine health. Existing data availability reinforces this vertebrate focus. In order to assess regional seas, over the necessary temporal and spatial scales required to understand and respond to global environmental changes, monitoring must be developed which places greater emphasis on those species which contribute most to marine health.

Chapter 4

Survey One: Issues of concern in the marine environment

4.1 Background

As described in Chapter 2, public and scientific defined priorities for marine conservation can differ, or even contrast. Social concern for marine issues is dominated by visual issues such as oil pollution, whilst the most major threats to marine ecological health identified by marine science attract relatively little public concern (Hinds et al., 2003).

Perceptions of the risks presented by environmental issues has been found to vary with employment, where the employment is associated with the particular issue. Employees of a port in Slovenia considered the port to have less environmental impact than the general population in the area (Peterlin et al., 2005). Employees considered the air, noise and marine water pollution impacts of other, non-port related activities in the area to be of similar or greater risk than was rated by the general population. This variation in the risk from activities is attributed to the increased knowledge of port employees about the functions of the port, and also potentially influenced by their financial links with the port.

Place of residence, in terms of proximity to a natural environment, can also influence environmental perceptions. The Ocean Project (1999a) found that people living further than 2 hours from the coast were less likely to make a judgement on the health of the coasts (33% compared to 17% of people living within 2 hours of the coast). When asked about the health of the deep oceans, a greater proportion of both groups were unable to make a judgement, and the difference between the groups reduced; 40% of those living closer to the coast and 50% of those living inland had no opinion or did not know. This shows that a greater distance from a particular environment reduces the confidence of respondents to make an assessment of it,

possibly due to lack of familiarity or direct experience to support their judgements.

Place of employment and residence affects the interactions an individual has with the natural environment. The examples above show that these differences in interactions can affect perceptions of the marine environment, and identify, variations within the assessment of the environment as a result. This survey explores these trends further by assessing the perceptions of five groups of respondents. The groups include marine scientists to test for differences between experts and non-experts, two groups of marine professionals employed in marine related industries, coastal management and marine recreation, and respondents living in coastal and inland locations. The survey investigates concerns of marine environmental issues and interest in the marine environment. The research questions are:

- Do marine environmental concerns of groups of respondents with different marine associations differ?
- Is there an awareness gap of the most ecologically important issues between scientists and other respondents?
- Is there any interest in learning and how do people want to hear about the marine environment?
- Which organisations or individuals are most and least trusted to communicate marine messages?
- What has inspired people's interest in the marine environment? Can these experiences be applied to develop successful communication strategies?

4.2 Methods

4.2.1 Surveys

Three surveys were developed, each tailored to one or two of the target respondent groups (Appendix D). The three surveys included one aimed at coastal and inland residents, one for marine professionals - defined as those working in a marine related industry not including active research, either recreation or coastal management, and a third survey targeted at marine scientists.

4.2.2 Design

The majority of questions were open ended. Using this style of question was intended to ensure respondents gave instinctive answers, rather than being prompted by, for

example, a tick list of issues they may be concerned about (Moser and Kalton, 1971, Oppenheim, 1966).

The surveys shared a common question about issues in the marine environment which are of concern. This was then followed by a question relating to informing, specific to each group. Coastal and inland residents were asked how information should be presented to the public; marine professionals were asked how they would like to be informed; and marine scientists were asked how they would illustrate the issues to the public. Further questions specific to each survey were also asked. Coastal and inland residents were asked how far from the coast they worked. This allowed identification of the coastal (located within 10 miles of the coast) and inland (located more than 40 miles from the coast) respondent groups. Marine professionals were asked to describe the remit of their organisation and their role. This allowed identification of respondents as coastal managers or recreation employed. Marine scientists were asked which area of marine science they worked in from a given list of disciplines. All respondents were also given the option to complete contact details, and those who included their email addresses were sent a 'Thank you' email. The full surveys are included in Appendix D.

4.2.3 Survey distribution

The surveys were developed as web pages using Perseus software, a programme which uses a web format. A home webpage provided an invitation to complete the survey, giving links to the three surveys with a description allowing respondents to select the category best suited to them. This link was then distributed as part of an email with a brief explanation of the project through a number of channels. When the survey has been completed, the respondent clicks a submit button. This emails the survey response to a predetermined email account. The Perseus software is then used to transform the data from the emails into usable formats such as Microsoft Excel, Access or Word documents. The survey was delivered between August - October 2006.

The coastal and inland residents were targeted via a 'snowball' effect email to friends and family, asking people to complete the survey and send the link to all those in their own contacts list. A potential flaw of this method is the restricted sample it will target and a low response rate. To target marine professionals, the email was distributed on the mailing list of Coastal Management for Sustainability, an organisation which reaches over 4000 individuals working in various marine and aquatic related employments. This email is also likely to reach a number of marine scientists. A number of other smaller scale sources were used, including the

CoastNET network, and contacts of colleagues, also targeting marine professionals. Marine scientists were found by conducting a UCAS search of universities offering marine biology or ecology courses in the UK. From these, a search of the university pages was used to identify individuals teaching on these programmes, who were directly emailed.

4.2.4 Data analysis

Responses were analysed using NVivo7, text analysis software which is suitable for application to open ended questions. Survey responses are coded by selecting the relevant text and assigning it to a predefined node. Nodes can be arranged to establish a hierarchy. This technique was used for question responses which had a headline issue and a more detailed level. Headline and detail nodes were defined during the text analysis process, and therefore reflect the issues raised by the respondents. Table 4.1 shows the headline and detailed issues nodes in answer to Q1 (issues of concern).

Coding text allows all the responses for a particular issue to be grouped together providing a number of analysis options. Counts of the respondents coded at each of the nodes can be exported from NVivo7 into SPSS and analysed using appropriate statistical tests. These outputs replace the text response with a numerical response, for example using binary code to identify what proportion of respondents cited which issues. This method was used in the analysis of issues of concern, to compare the opinions of the groups. A Kruskal-Wallis test was used to identify if there were any significant differences between the responses of each group. Where differences were detected, a post hoc test was used to identify which groups the differences were between. Tukey's Honestly Significant Difference (HSD) was selected as it is a reliable post hoc test being not too liberal or conservative for the analysis.

For analysis of the detailed issues within each headline issue, a visual check was used to identify the greatest differences in opinions, which were tested for significance using a Tukey HSD test. The detail issues include a category similar to the headline issue, i.e. pollution is a detail listed under the pollution headline issue. The proportion of respondents in this category may differ in the detail analysis than from the headline analysis. This is because some respondents cited pollution, whereas others cited a specific pollution, e.g. oil pollution. All respondents who cited pollution or a pollution related issue would be coded in the headline at the pollution node. To analyse the detail layers of issues, these descriptions were separated. Two respondents, one citing oil pollution and one citing pollution would be coded under the same headline node, but different detail nodes.

Headline Issue	Details of Issue	
Fishing	Overfishing Management and policy Bycatch Dredging/trawling Long lining	Other specified fishing method Lost or discarded fishing gear Aquaculture Discards
Pollution	Pollution/All pollution Litter – general Oil Sewage Chemical	Shipping related Beach or coast litter Noise Nutrients
Climate change	Climate change/global warming Sea level rise Flooding Weather patterns	Changes in biota Changes in temperature Ocean acidity Ocean scale issues
Habitat and biota related	Water quality and cleanliness Coral reefs Habitat loss Biodiversity loss or change Marine mammals Alien species	Estuarine issues Sea birds Turtles Sharks and elasmobranchs Cold Water Reefs
Human impacts (excluding fishing, pollution or climate change)	Resource exploitation and lack of controls Recreation activities Impacts from land based activities Renewable energy activities Tourism	Aggregate removal, dredging and dumping Coastal developments Oil and gas exploration
Management	Achieving sustainable development Integrating management across sectors	Guidance from policy Lack of conservation measures

Table (4.1). Categories of issues defined by the answers given to Q1 'In the marine environment, what environmental issues, if any, are a concern to you?', answered by all respondents.

Question response for some questions can be relatively easily categorised, for example pollution as a headline issue, which can be sub-categorised into the type of pollution (oil, rubbish, sewage etc.) without reducing the quality of the data, and enabling quantitative analysis. The open-ended questions result in many complex responses, for which such an approach would not capture the quality of the data recorded. In these cases, for example the management headline issue in Q1, a different analysis is used. NVivo7 produces a text report, selecting all the text coded under a defined node, from defined respondents. From this report the text can be read and emergent themes identified.

4.3 Results and discussion

4.3.1 Sample profile

In total 445 completed surveys were returned via the Perseus email system, including 130 residents, 141 marine professionals and 174 scientists. These respondents were refined by discarding non-UK respondents, duplicate surveys and then classifying the remaining respondents into the five required groups (Table 4.2). Residents were identified by their distance from the coast, with 40 categorised as coastal residents (within 10 miles of the coast) and 39 as inland (greater than 40 miles from the coast). Further responses from residents about their interests in the marine environment showed both inland and coastal residents to have a variety of interests such as natural history, environmental awareness, recreation and holidays. These data do not give a measure of frequency of coastal interaction, which would influence how these interests specify the particular associations these groups have with the marine environment. Marine professionals represented a diverse cross section of marine related industries; final numbers were 21 coastal management and 24 recreation employed. The largest group of respondents were marine scientists. Analysis of the disciplines showed biology, ecology and conservation to be the most represented; possibly due to the targeted approach. The remaining 7 disciplines were not well represented and respondents from these disciplines, and those not from the UK, were removed from the analysis.

Survey	Number of respondents	Analysed Groups	Number of respondents
Residents	130	Coastal Residents	40
		Inland Residents	39
Marine Professionals	141	Coastal Managers	21
		Recreation Employed	24
Marine Scientists	174	Marine Scientists	113
Total	445	Total	237

Table (4.2). Overview of respondents to Survey 1.

4.3.2 Headline issues of concern

Figure 4.1 shows the issues of concern to each group. Five significant differences in concern were recorded. Coastal managers were more concerned about management issues than other groups. Of the five respondent groups, the coastal managers were likely to have the best understanding of management issues, and therefore most likely to identify the possible failings of management within the marine environ-

ment. Other respondent groups were likely to be less familiar with management issues, so therefore may be less aware of any issues to cause concern. The other significant result was marine scientists being more concerned about fishing than the recreation employed group. This may reflect a lack of understanding on the part of the recreation employed to the threats caused by fishing, but it may also be due to a focus of recreation employed concern on visual issues, such as pollution - which is cited by 79% of respondents; twice as many as cited fishing.

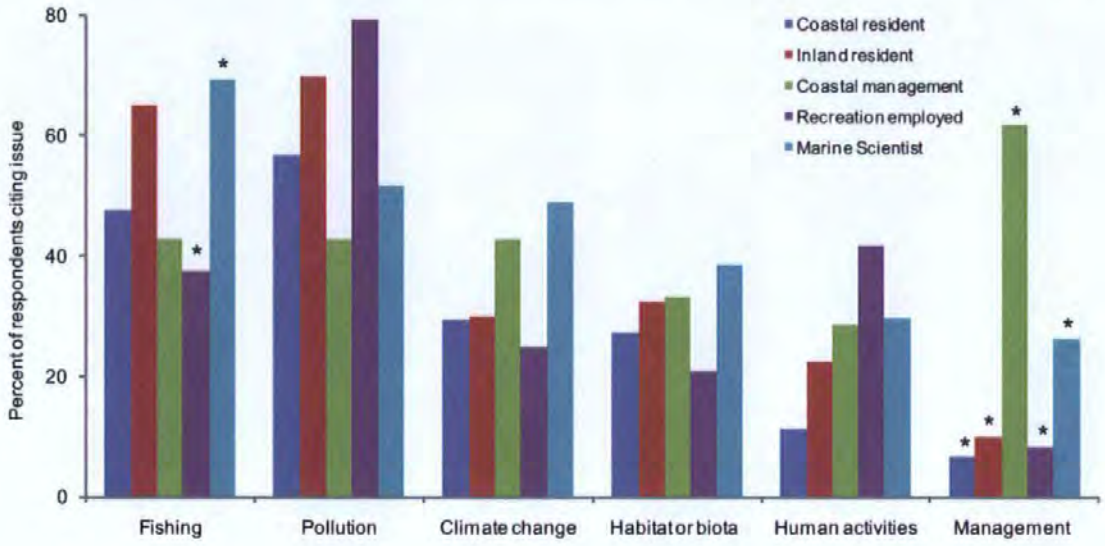


Figure (4.1). Issues of concern for each of the five surveyed groups, for the six headline categories in answer to the question 'In the marine environment, what environmental issues, if any, are a concern to you?' Significant differences marked with *. Categories ranked by Scientist responses. Coastal resident n = 40, Inland resident n = 39, Coastal managers n = 21, Recreation employed n = 24, Marine Scientists n = 113. Fishing: Marine Scientist > Marine recreation employed P = 0.032, F = 3.276, df = 4. Management: Coastal managers > Inland residents, Coastal residents and Recreation employed all P <0.001, Coastal managers > Scientists P = 0.002. F = 8.909, df = 4.

These results suggest that, for most headline issues, concern is relatively similar between experts and non experts. There were some differences between respondents' opinions, for example, 15 - 25% more scientists and coastal managers cited climate change as a concern than the other three groups, but this was not statistically significant. Patterns in these data may be limited due to the small sample sizes of each respondent group; in a larger study which was more widely representative, it is possible that these differences may have been significant.

Other notable patterns emerge in these results. No significant difference is detected between the coastal and inland residents, although a higher percent of inland

residents than coastal residents cite all six issues. From other questions in the survey, it was found that both resident groups shared many similar interests in the marine environment, and also that approximately 20% of inland residents, and 30% coastal residents cited having a university education, in many cases in a marine or environmental related course. This shows that the respondents in these two categories may have similarities which were greater than any differences which may have existed due to distance from the coast. They are also likely to be relatively well informed about marine environmental issues. Their interests in the marine environment are likely to provide both groups with strong associations with the marine environment, reducing the effect of inland residents having less marine association due to their distance from the sea. This explains why concern for many of these headline issues is similar between marine professionals and both resident groups.

This similarity of concern about issues is also seen in Table 4.3. The ranks of issues compares which headline issues are perceived as most important by each group. With the main exception of the coastal managers, who cite management as the most important issue, three pairs of issues are seen as most, middle and least important by all the groups. The two most important issues are pollution and fishing, the middle concerns are climate change and habitat or biota related, and the two least important are human impacts and management. This shows strong similarity in the concerns of the respondents groups.

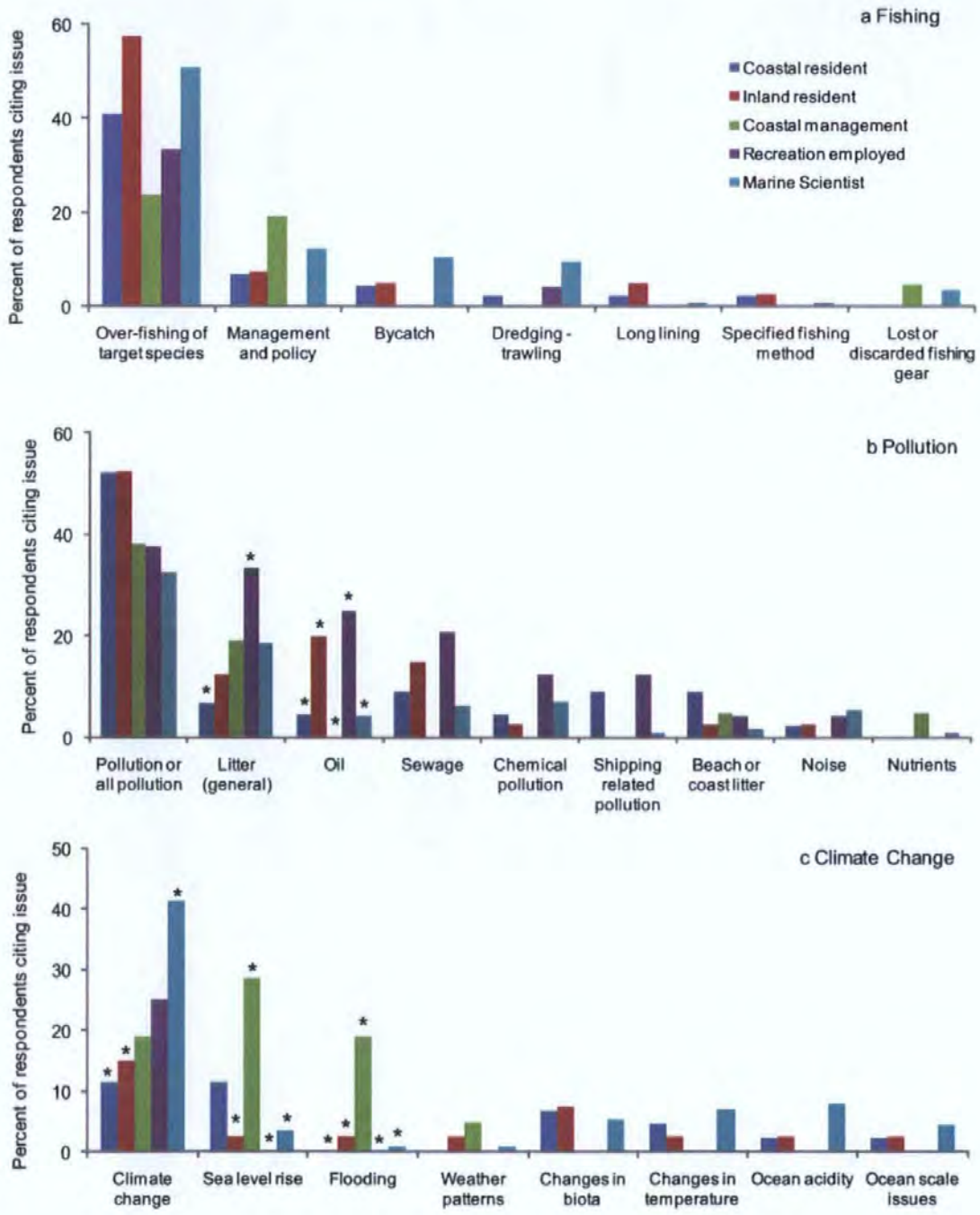
Rank of issues	Coastal resident	Inland resident	Coastal management	Recreation employed	Marine scientist
1	Pollution	Pollution	Management	Pollution	Fishing
2	fishing	Fishing	2. Climate change 2. Fishing 2. Pollution	Human impacts	Pollution
3	Climate change	Habitat or biota		Fishing	Climate change
4	Habitat or biota	Climate change		Climate change	Habitat or biota
5	Human impacts	Human impacts	Habitat or biota	Habitat or biota	Human impacts
6	Management	Management	Human impacts	Management	Management

Table (4.3). Headline issues raised by each group in rank order. Three issues for coastal management all recorded the same score and are ranked joint second.

4.3.3 Details of issues of concern

The open ended style of this question meant that respondents often provided more detail on the issue (or issues) they cited beyond the headline issue itself. For example, the following quote would have coded under climate change '*Global warming affecting sea levels and the introduction of new/warm water species around our*

coasts this will change the balance of life in the affected areas - it may affect me if sharks or more dangerous jelly fish/fish become an issue' (Coastal resident). The richness of this data is lost in the headline issues analysis; to capture these responses, a further level of analysis assess the details of each headline issue described by each group. Table 4.1 details the categories of details given under each of the headline issues, as defined by the coded responses. This further analysis shows differences in the perceptions and understanding of issues of concern by each group of respondents (Figure 4.2). Management is described as a separate issue due to the different nature of the analysis.



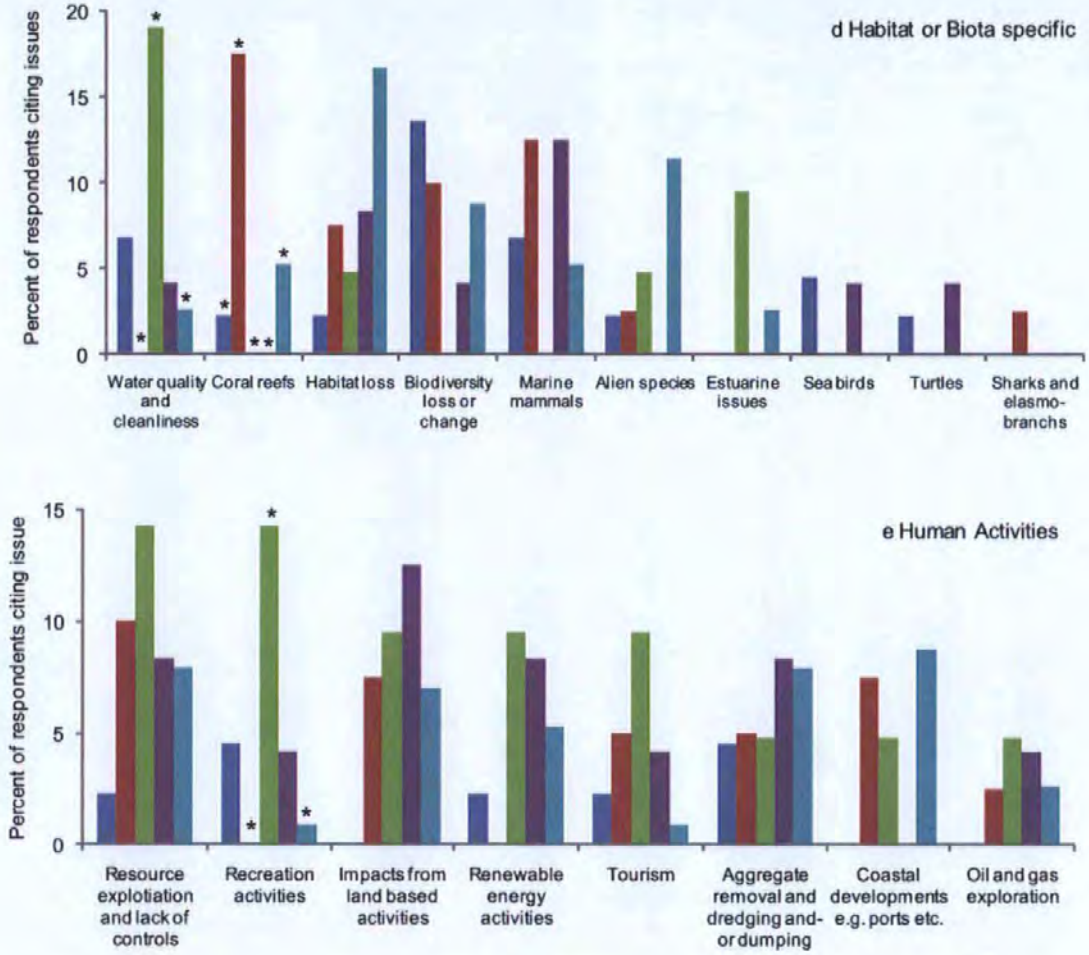


Figure (4.2). Details of headline issues of concern. * shows significant result. P values shown in Table 4.4. Note variable scales on y axes. Coastal resident n = 40, Inland resident n = 39, Coastal managers n = 21, Recreation employed n = 24, Marine Scientists n = 113

Marine Scientists

Of the 43 details of issues cited, marine scientists mentioned all but three (seabirds, turtles and sharks under the Habitat or Biota headline issue were not mentioned), showing the greatest range of responses. The greatest difference in perception of a single issue was climate change (Figure 4.2c) where scientists showed a significantly greater concern for climate change than either inland or coastal residents. This may reflect that the marine specific effects of climate change are not well recognised by residents, possibly due to them not being separated from the general effects of climate change. This represents a considerable difference in opinion between residents in scientists due to the multiple threats to marine health posed by climate change (Halpern et al., 2008).

Headline Issue	Detail Issue	Difference	P value	F value
Pollution	Litter (general)	RE > CR	0.042	2.188
	Oil	RE > CR RE > CM RE > MS IR > MS	0.027 0.020 0.008 0.017	5.397
Climate Change	Climate Change	MS > CR MS > IR	0.001 0.010	5.406
	Sea level rise	CM > IR CM > RE CM > MS	0.001 0.001 <0.001	6.122
	Flooding	CM > CR CM > IR CM > RE CM > MS	<0.001 <0.001 <0.001 <0.001	7.203
Habitat or biota	Water quality	CM > IR CM > MS	0.006 0.007	3.536
	Coral reefs	IR > CR IR > CM IR > RE IR > MS	0.021 0.039 0.027 0.032	3.621
Human activities	Recreation activities	CM > IR CM > MS	0.012 0.006	3.408

Table (4.4). P values for Figure 4.2. Coastal resident (CR) n = 40, Inland resident (IR) n = 39, Coastal managers (CM) n = 21, Recreation employed (RE) n = 24, Marine Scientists (MS) n = 113

Residents

Coastal residents were less concerned about oil pollution than inland residents, perhaps due to a greater frequency of visits to the coast and not seeing oil on beaches. Inland residents may be more reliant on TV images and draw perceptions from the media which are not as likely to be mediated by personal experience. Coastal residents were less concerned about general marine litter than recreation employed, but this may be due to an increase in their concern for beach litter, identifying a specific issue experienced more frequently due to living close to the coast (Figure 4.2b). Inland residents are particularly concerned about coral reefs (Figure 4.2d) suggesting a connection to marine environments outside the UK and possibly being informed via media coverage of marine issues, rather than those who live closer showing greater connection with the local marine environment.

Marine Professionals

Recreation employed were the most concerned about pollution issues, particularly oil (Figure 4.2b). Although this is different to the low concern shown by coastal residents, potentially as a result of personal experience, there is the possibility that there are greater financial risks during an oil incident for those in recreation related employment. There is also the possibility that fear of oil pollution may deter inland residents as potential customers - negative perceptions of UK seas having economic impacts. Recreation employed, although citing climate change as a headline concern, raised none of the details which the other groups described (Figure 4.2c), showing no association with the details of this issue.

Coastal managers expressed increased concern about those issues most related to their work. These include sea level rise and flooding effects of climate change (Figure 4.2c); high profile issues in the coastal environment. Water quality was a particular concern (Figure 4.2d), with references made to monitoring and the Water Framework Directive identifying specific aspects of management responsibilities. The high concern of recreation activities (Figure 4.2e) was from the perspective of safety for sea users, and of the effects on the natural environment.

Details of Management

The respondents in the management headline issue were predominantly scientists and coastal managers; 6% coastal residents, 8% inland residents, 25% coastal managers, 4% recreation employed and 58% marine scientists (n = 52) (Figure 4.1). Coastal managers are dealing with these issues through their work, often experiencing firsthand the effects of insufficient structures to enable better protection or use of the marine environment, so it is logical that they would cite these issues more

than other groups. This, in part, suggests a lack of knowledge and experience of management issues outside those employed in this field, leading to them being of less concern to other groups. This structure of respondents is reflected in the nature of the themes described.

The main theme to emerge relates to the integration of multiple factors to achieve sustainable management of the marine environment. At the broadest scale, this concern is about how to integrate aims to achieve the best social, economic and environmental outcomes, '*sustainable development - shouldn't be looking at environmental issues in isolation from economic and social issues*'. The difficulty of integrating management of conservation and policy across the different habitats of the marine environment '*integrated stakeholder development of the estuarine, coastal and oceanic environment, conservation, policies*', and alongside this, how to meet the needs of the wide diversity of stakeholders '*increasing number of stakeholders who have a call on marine resources*'. These concerns are focused onto the management of particular resources in a manner which meets all these needs, and is balanced against environmental protection. '*Lack of (integrated) management in place to control activities that impact on marine biodiversity/functioning such as fishing activity and also cumulative impacts generally from the diverse uses we have for our seas.*' (All four comments from marine scientists.)

There is a strong response that a key concern within the management issue is that the necessary policy and government support is not adequate to support the integration described above. Respondents describe a '*lack of clear rules on marine exploitation*' (coastal manager) which leaves them without guidance on how to manage activities. An example from Scotland shows how this leads to failings for all several sectors '*abysmal support for marine renewable energies. No marine bill for Scotland, weak and ineffectual support from Scottish government to protect and defend Scottish marine environment*' (marine scientist). The opinions of this respondent show how a lack of government support leads to both the industry and the environment suffering. These opinions are echoed by other respondents who cite the '*absence of policy of sustainable use*' (coastal manager) and the '*lack of any real marine sustainability planning*' (marine scientist) to encompass the failings of current management to deliver sustainable use of the marine environment.

On a more specific theme, the management issue responses also described the lack of protection of the marine environment as a key concern. This was the main concern of the less well represented respondent groups (coastal and inland residents and the recreation employed) but also cited frequently by coastal managers and marine scientists. This illustrates a particular perceived weakness of current management in protecting the ecological components of the marine environment. This was cited as

both a lack of general protection '*conservation of marine wildlife*' (coastal resident) and '*preservation of natural habitats*' (recreation employed) but also specified as a lack of marine protected areas. These comments show a desire to ensure the sustainable balance of activities, and ensure that management is able to provide the optimum outcomes, particularly by protecting valuable habitats.

These results show differences in perceptions between groups of respondents who have different associations with the marine environment. There appears to be similar awareness of the broad issues, but limited depth of knowledge about the implications of the issues, compared to that of the scientists or specialists within a particular field (e.g. coastal managers), with a tendency towards issues most within the experience of the respondent group. This highlights two important conclusions; firstly that perceptions vary between groups with different associations with the marine environment. This could affect the features of the marine environment, or particular issues which attract greatest concern from an audience. Secondly, despite a good general awareness, there is still a need for better understanding of the wider effects of headline issues in the marine environment.

4.3.4 Learning more about the sea and marine issues

Marine professionals were asked if they felt they knew enough about the issues they raised as a concern. Only 33% said they did, showing that a large proportion of respondents felt under informed. Dissemination and interpretation of expert information was a particular reason for this. Experts were familiar and comfortable with the concept of scientific debate, that development of theories and understanding is driven by a process which involves arguing for and against ideas proposed by others. This process was less familiar to other respondent groups, who may have a perception based more on scientists having a definitive answer, rather than dealing with the uncertainty which often surrounds issues. This unfamiliarity was clear in responses such as '*lack of scientific consensus on global warming predictions*' (coastal manager), '*there's always more to learn and many sides to every discussion and argument*' and '*the complexity of arguments*' (both recreation employed). This process of debate and uncertainty creates a barrier for engaging marine professionals, possibly due to lack of consensus and creation of confusion which conflicts with a task oriented approach.

The process of debate is fundamental to science, however, communicating the debate of issues to society needs to be done in a manner which does not create confusion or disengage marine professionals. The UK Marine Climate Change Impact Partnership aim to provide a relevant, concise overview of the most current issues

relating to climate change in the marine environment, which is accessible to a broad audience of professionals, which is supported by robust science (MCCIP, 2008). The positive reception of this publication shows the potential to deliver clear messages about findings which have high scientific confidence, informing marine professionals without causing confusion.

Marine scientists were asked how to inform the public about the issues they had cited as concerns. In contrast to the majority of the respondents, one scientist cited a less positive opinion: '*not my job; I couldn't give a sod what the public think, if they think at all, which I doubt. If I were in charge I'd just legislate to protect and let 'the public' wallow in their ignorance and apathy.*' This comment highlights the opinions of those scientists who do not see communication as an important part of the role of experts (Royal Society, 2006). The results from this survey find most non-experts to be far from ignorant about the marine environment; the many passionate and interested responses show little sign of apathy. Although it is likely that such informed answers do not represent the wider public, there are many examples of intelligent and active support of many environmental issues, and no reason to believe, that with appropriate public engagement strategies, this could not also be the case for marine specific issues. Many models of sustainable development support the idea of engagement and participation alongside legislation as a successful method to implement social change and achieve sustainable use of natural resources (e.g. Defra, 2005b).

A general reference to informing made by marine scientists was that issues should be illustrated in a simple and understandable manner, '*scientific evidence communicated in layman's terms*'. There is recognition that the public need information which is understandable '*examples that people can see for themselves and draw their own conclusion from*' and '*as much fact as possible - the public are becoming increasingly sceptical about the press and whether or not they are getting the 'whole story*''. These responses suggest recognition on the part of the scientists of the complexity of the information available to them and the need to ensure that this is shaped to be appropriate to a non-expert audience whilst still providing thorough messages

Both marine professionals and residents were asked what channels of information they would prefer (Table 4.5). The residents favoured TV and media informing whereas the marine professionals preferred the internet based informing. This closely relates to their associations with the information. Residents are more likely to be interested on a personal basis, with a hobby type interest, relating the marine environment to leisure time and enjoyment. Marine professionals need to be informed for work purposes, and therefore may be less inclined to be informed about work

related topics in personal time.

	% Residents		% Marine Professionals	
	Coastal	Inland	Coastal management	Recreation employed
Internet/email	11	18	48	38
TV	32	45	10	17
Newspaper/press	20	28	5	25
Media	20	13	5	13
Radio	14	15	10	4
News	11	13	0	4
Other	55	50	43	42

Table (4.5). Results from resident survey Q3: How should information be presented to the public on the state of the marine environment? And from Marine Professional survey Q4: How would you most like to be informed about marine environmental issues? Percent of each group citing each category.

A number of 'other' types of informing were raised (Table 4.5). These included passive informing such as in journals, publications, leaflets and newsletters. More participatory based information included exhibitions, beach signs, and media coverage which provided a local relevance. Many of the residents cited public education, and in some cases specified particular bodies such as the Environment Agency as those who should be responsible for delivering messages.

Residents were asked who they trusted to provide accurate information about the marine environment (Figure 4.3). Scientists were the most widely trusted (92%), whilst particular political parties were least trusted (7%). This trust in scientists is echoed in other studies (European Commission, 2008). A study by the Royal Society surveyed the factors affecting science communication by scientists and engineers (Royal Society, 2006). Although many respondents identified a variety of positive reasons for the scientific community to engage the public, there were also a number of negative opinions associated with this process. The report showed the major barriers to engaging with the public was the reduction of time available to spend on research, and the potential impact on RAE results. A fifth of respondents also stated that contributing to public engagement activities was considered to be a barrier to career progression (Royal Society, 2006). These concerns create barriers against informing by the most trustworthy group of communicators. Informing strategies need to use scientific expertise in a manner which appeals to scientists, but which is also clearly recognisable by society as being sourced from current scientific research.

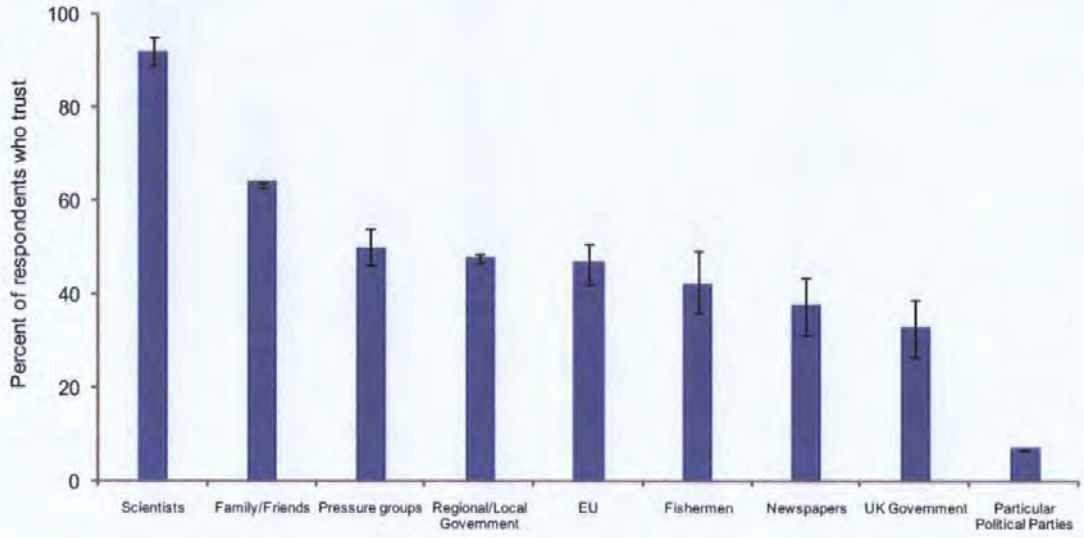


Figure (4.3). Combined coastal and inland resident responses to the question: What groups or individuals do you trust and not trust to give you accurate information about the marine environment? Error bars show spread of responses between coastal and inland residents.

4.3.5 Interest

The last question asked all respondents what event or experience had triggered an interest in the marine environment. The opinions of coastal and inland residents are considered here as these are particularly relevant to understanding how to inspire interest through communication strategies. This section describes some of the emergent themes from these results.

Childhood experiences were mentioned by all groups as particularly positive associations. These often involved an interaction with the natural history of the coast '*Catching a ballan wrasse at 8 years of age - almost 50 years ago*' (recreation employed), '*the discovery of the great diversity of marine life (at some unspecified early age)*' (marine scientist). Rockpooling was also frequently mentioned, highlighting this accessible form of interaction with marine biota, despite most likely being dominated by seaweed and invertebrate species, can have a lasting effect on a person's connection to the marine environment. In a similar theme, general marine connections over a long period of time, either through growing up by the sea, currently living or wanting to live by the sea, were also cited; '*my youth, spent in esturine mud and shingle*' (coastal resident). Family connections were often made in reference to this theme, '*grandparents owned a farm by the sea where we spent most of our holidays*' (coastal resident) showing that 'informal' experiences of the marine environment can have an important function in developing marine values. Further

childhood experiences cited include subjects and activities related to school; '*I was very lucky as a child to go on many school trips to the beach, and being taught by very enthusiastic science and geography teachers about the coastal environment*' (coastal resident). This reflects a more formal interaction which was also considered to be an important step in building marine connections.

Environmental interests were raised, with both positive associations through general awareness of the wider environment through to specific conservation events triggering interest. '*As part of our global ecosystem we all have a responsibility to all other parts,*' '*Seeing the effects of man's lust for consumerism whilst swimming offshore in the pollution and litter in the coastal waters of Britain*' (both coastal residents) and '*the Torrey Canyon*' (recreation employed). The negative effects of seeing environmental damage is recognised in some cases to cause people to disengage from an issue or environment (Jensen, 2002). In these cases, seeing these events first hand has prompted an interest in the marine environment rather than disengaging.

A small number of respondents cited media connections as being their strongest influence. These included several references to Hans Hass and Jacques Cousteau and also to BBC wildlife documentaries.

A range of themes are described across the respondent groups which have triggered interest and connections to the marine environment. The strongest themes were those connected with childhood memories and personal experiences, or discoveries, of marine natural history.

4.4 Conclusions

This survey has found that there is broad awareness across many non-expert groups of the headline issues which threaten marine environmental health, but that this awareness is not supported by an awareness of the specific details of issues. This suggests that there is still a gap between the understanding of ecological consequences and non-expert awareness of marine issues. The different focus of concerns in the groups illustrates the need to understand the opinions of the audience and recognise how opinions can vary within a population.

An important finding for the development of communication strategies includes the need to ensure that scientific debate is not construed as uncertainty. Communications need to be built on scientific consensus to ensure that confusion does not disengage the audience. Despite this element of confusion from marine professionals, the residents still considered scientists to be the most trusted group to provide accurate information about the marine environment.

Various triggers of interest were described as driving connections to the marine

environment, with many of these linked to positive, often childhood, experiences of the coast. These reinforce the need for communication strategies which apply a variety of techniques, appealing to all age ranges and can maximise on the resource provided around the coast.

Chapter 5

Assessing Social Values

5.1 Chapter structure

This chapter provides the background of the social segmentation model applied in Survey 2 (Chapter 6) which enables identification of how perceptions of the marine environment vary with social values. The model is developed from Maslow's Hierarchy of Needs (Maslow, 1968) and a substantial supporting data set, as described in Section 5.3. This is followed by a comparison of the Maslow model against other social value models. Finally, a review of two previous studies of perceptions of the marine environment is provided, illustrating the benefits of the Maslow model in practice.

5.2 Maslow's Hierarchy of Needs

Social value models allow a population to be segmented on social values, rather than socio-demographic factors such as age or income. Socio-demographic factors can correlate with some values, but a more precise understanding of the different opinions held within a population can be gathered through applying models which measure values, and therefore the motivations of behaviour. The model used in this project has been developed by an organisation called Cultural Dynamics and is developed from Maslow's Hierarchy of Needs.

Abraham Maslow was an American psychologist who studied the role of needs as a determinant of human behaviour. He argued that most behaviour is motivated, and that motivations have a number of determinants including biological, cultural and situational factors (Maslow, 1943). His focus was on the role of needs, and his theories underpin the methodology use in the Maslow Group model.

Maslow developed the Hierarchy of Needs; a pyramid model which consists of several layers of needs (Figure 5.1). Each layer, starting from physiological needs

must be satisfied in a person in order for them to progress to the next level. Maslow argued that a person's motivations were driven by their particular set of needs at that time. Maslow's original model consisted of five needs groups (Maslow, 1943). Later developments of the model gave greater detail to the highest layer, self-actualisation, dividing it into the four needs described below, giving a total of eight needs levels (Maslow, 1968, 1973). The needs are (from Maslow, 1987, 1973, 1968, 1943):

1. *Physiological needs* relate to the need for air, food, water; those requirements which allow the body to maintain homeostasis. This need has many components.

2. *Safety needs* include security, stability, dependency, protection, freedom from fear, anxiety and chaos, need for structure, order, law and limits.

3. *Belongingness and love needs* involve giving and receiving affection, interacting with others, being part of a social unit, family, neighbourhood, those constructs which avoid loneliness, rejection, friendlessness and rootlessness.

4. *Esteem needs* are the desires for a stable level of self-respect or self-esteem and for the esteem of others. Satisfaction of the self-esteem need leads to self-confidence and a feeling of being useful to the world.

5. *Desire to know and understand.* In part, the achievement of previous needs requires knowledge and understanding; however, this layer is concerned with the satisfaction of curiosity needs, to know, to explain and to understand which go beyond the application of knowledge to achieving earlier needs.

6. *Aesthetic needs* are the least understood needs. Maslow describes an importance of beauty with some evidence of people who crave beautiful surroundings, and without them they experience particular types of 'illness'. There is evidence of these impulses in every culture in every age as far back as cave dwellers. The overlapping between conative and cognitive needs make it impossible to precisely separate them, but they seem to relate to a need for order, symmetry, completion of acts and system.

7. *Self-actualisation* is the achievement of self-fulfilment and realising one's potential. If they are a musician, they must make music, and an artist they must paint. The specific form of this need shows the greatest variation between individuals. This relates to a person being true to their own nature.

8. *Transcendence* is the most inclusive, holistic level of human consciousness where a person behaves and relates to oneself, other human beings, other species, to nature and to the cosmos.

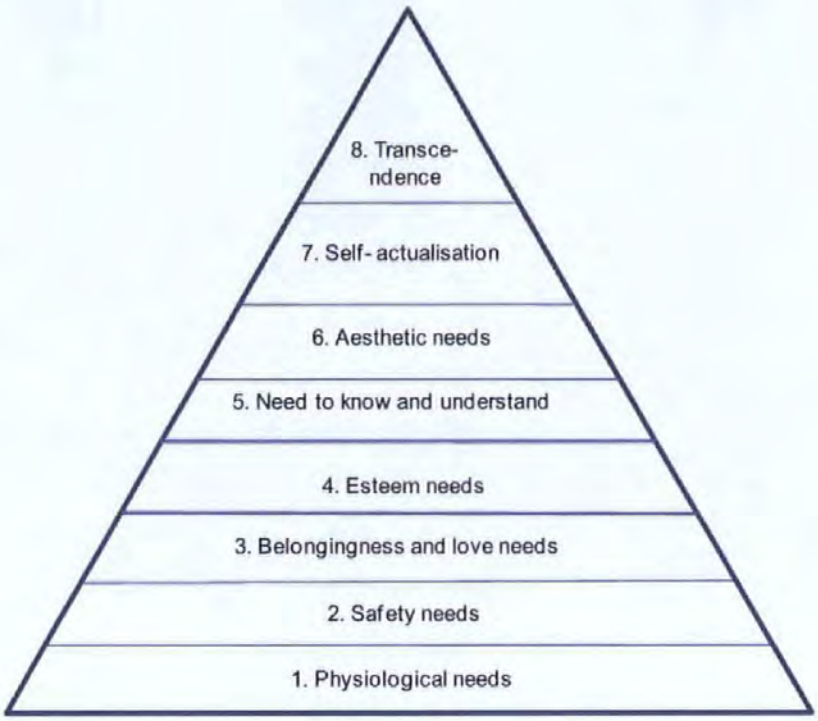


Figure (5.1). Maslow's Hierarchy of Needs, Maslow (1968)

Maslow's opinion was that everyone has the same set of needs which they strive to satisfy through their life, generally in the order above (Maslow, 1943). If all the needs of a person are unsatisfied, the person will be dominated by physiological needs; all other needs become non-existent or low priorities. The person's conscious thoughts and actions will then be dominated by the satisfaction of hunger or thirst. Once the physiological needs are met, the safety needs emerge. As each successive layer of need is satisfied the higher level need emerges as the dominant driver of behaviour. More than one need may be present in a person at any time, but one or other is likely to dominate. Different needs will require different responses from the person, leading to variation in attitudes and behaviours of people at different levels of the hierarchy.

This description of the model implies that each layer of need must be completely satisfied for another need to emerge; that there is an exclusionary nature between the layers. This is not the case. Maslow (1943) suggests that most members of society are likely to be partially satisfied in all their basic needs and partially unsatisfied at the same time. Rather than being focused on a particular need, a person is more likely to experience varying percentages of satisfaction of each need, for example, 85% in physiological needs, 70% in safety needs, 50% in love needs, 40% in esteem needs and 10% in self-actualisation needs. The emergence of each need will occur gradually as the previous need is increasingly satisfied. For example, using arbitrary

figures, if need A is satisfied 10%, then need B may not be visible. As need A is satisfied to 25% need B may emerge at 5%, when need A is 75% satisfied, need B may emerge 50% and become dominant (Maslow, 1943). Therefore, all needs may be present in varying degrees, but a person will be dominated by one need. It is also likely that a person's behaviour will have multiple motivations, therefore satisfying more than one need through one behaviour. Rather than being a rigid structure, Maslow's hierarchy of needs provides a broad heuristic device to recognise the variations in motivations of individuals within a population.

Maslow's theory provides the foundation for a wide discussion of motivations of behaviour and has inspired much debate. This section is intended as an overview to the model which underpins the social value model applied in later chapters. However, it is necessary to briefly address some of the criticisms of Maslow's Hierarchy of Needs, recognising the limitations of the model.

The use of the Maslow's theory to identify human needs has created controversy within the debate of development in less developed countries. By stating that physiological and safety needs must be met before higher needs can emerge restricts those people who are without essential provisions of water, food or shelter to being unable to experience love, belonging and achieving self-actualisation. An alternative needs model has been proposed, to address this criticism and aid the theory of development. Manfred Max-Neef's Human Scale Development (Max-Neef, 1991) model is based on a classification of needs which does not exhibit the pyramidal structure, and therefore the restriction of higher needs found in Maslow's hierarchy. This model recognises the needs of subsistence as the only prerequisite; other needs are constructed in a matrix which exhibits none of the structure found in Maslow's theory. Max-Neef identifies needs as being few, finite and unchanging through time and cultures; seven categorise of needs are classified in the model. The way these needs are satisfied is the article which changes; the matrix is populated with examples of satisfiers which meet each of the needs according to four existential categories. This matrix interprets needs using a systemic approach, rather than the linear approach used by Maslow. Max-Neef describes the importance of this differentiation for the influence this has on development. A linear approach leads to the more conventionally understood methods of tackling poverty through interpreting needs as deprivations. A development strategy under systemic assumptions understands needs as deprivations and potentials, generating synergic satisfiers (Max-Neef, 1991).

A number of critiques of Maslow's theory focus on specific details of the needs layers and the relationship between layers and emergence of each layer. For example, Neher (1991) describes the anecdotal evidence which questions the requirement of satisfying physiological and safety needs before love and belonging needs can emerge.

There is evidence that when physiological needs are compromised, a greater cooperation can occur between people, providing some satisfaction of love and belonging needs whilst physiological needs remain unfulfilled. An example of this is the many young couples who state that shared financial struggles promoted strong bonds between them (Neher, 1991). This conflicts with Maslow's theory as it suggests that deprivation at lower needs can facilitate satisfaction of higher needs. Further to this, the scenario of developing countries is also relevant, as above, undermining the application of Maslow's theory to developing communities which lack basic resources but where community spirit and belonging may be strong.

These critiques raise important questions of the limitations of Maslow's theory and show that there is a need for theories to be readdressed in light of new evidence, as Max-Neef (1991) states. Maslow also recognised a number of the limitations which have been made against his theory (Neher, 1991), and that the theory was not fixed and there was a need for ongoing review. Maslow's theory may not be as immutable as initial interpretations suggest; more that it has a flexibility, providing a framework from which to interpret motivations of behaviour. This theory can be credited for being a significant contribution to understanding the role of needs as determinants of behaviour motivations. This in turn has been structured into the method described below, providing a simple assessment of social values, and the ability to interpret behaviour and opinions whilst understanding the motivations which drive them. From this point of understanding, its application to the challenges of this thesis can be explored in more detail. Later research directions may enable a comparison of the application of the Human Scale Development matrix to a similar method as is now described for Maslow's theory, however this is not within the remit of this research.

5.3 Cultural Dynamics; Applying Maslow's Hierarchy of Needs

The layers of needs within the hierarchy reflect something about the values a person has, and their motivation for interest, or type of interest in a particular issue. Cultural Dynamics is an organisation which has developed this feature of the Maslow Hierarchy to identify which needs group individuals are within. Through extensive research into social values across the UK they have developed an understanding of the typical characteristics which can be generalised across people within three broad groups based on the needs layers: Settlers, Prospectors and Pioneers. The profiles of the three groups are now reviewed (Cultural Dynamics, 2009, Rose et al., 2007).

Settlers

- Also called Sustenance Driven, Settlers are those people whose dominant needs are in the physiological, safety or belonging layers (1-3).
- They have a strong desire to protect and hold onto what they have, including protecting themselves, and have a high fear of crime.
- A clear sense of right and wrong with a respect for rules, which are not broken.
- Traditional values with a strong importance of community. 'Home' is very important.
- Family is an important concept. In the absence of family, a close community or group of friends provides a protective environment in which to belong.
- Leisure time is for socialising with close friends or family in generally quiet activities.
- Money is a serious issues; Settlers tend to be thrifty.
- There is a resistance to change, routine is an important coping strategy against the uncertainty of the world.
- Although there is a measurable bias towards Settlers in lower socio-economic groups, a significant proportion are found in higher groups.
- Within society, the Settlers have a natural caution, with a no-nonsense orientation, providing a level of control.

Prospectors

- The Outer Directed or Prospector group are dominated by esteem needs either in the esteem of others or self esteem layers (4).
- This group is driven by a need to be recognised.
- Optimistic about life and enthusiastic for the opportunities it provides them with.
- They are proactive and ambitious in work.
- They believe it is ok to bend the rules if they need to.

- Need to make their success visible and do so through their home, car and holidays.
- Strong social aspect to leisure pursuits - often sport based which allow them to look and feel good.
- Important to earn and spend money, driven by consumer desires.
- Prospectors are diverse in terms of their socio-economic groups. Most strongly represented in C1C2 women but also important in teen years. Wealth and jet-set lifestyle are relative and aspirational.
- In society, Prospectors are the motive power, driving markets and society onwards.

Pioneers

- Inner Directed people, also called Pioneers, are those whose needs lie in the aesthetic, cognitive and self actualisation layers (5-8).
- This group has a fascination and curiosity with the world and everything in it - which they want to share.
- Their world is not just about them but extends globally. They recognise the connectivity of the planet, a particularly holistic viewpoint.
- There is an acceptance of some larger purpose to existence; beyond the individual or nation.
- They desire knowledge; believe that knowledge generally leads to better questions, not just better answers.
- Have a practical, pragmatic approach to life, adaptable to the flexibility of what works, not really minding if it doesn't look quite right.
- Need activity, variety and a degree of ongoing change. They have a wide range of leisure pursuits and interests.
- Tend to be ordinary people who get on with what is important to them in their own way.
- They have a people focused outlook.

- In society, Pioneers find the new possible routes through life. Where they lead, others tend to follow.

These profiles are built from a database of the responses of tens of thousands of people to over 1000 questions, collected by Cultural Dynamics. From the surveys, a series of 90 attributes are analysed, each attribute being established from four or five survey questions. From the 90 attributes, a 'map' of the attributes within UK society is constructed, showing how closely the attributes relate to each other. Within the map, 50% of the attributes and 50% of the people plot into the middle region. Attributes towards the centre of the map are more normal and less controversial than those further from the centre. The map is dynamic and by continually assessing the attributes it is possible to observe changes in society. For example, since the 1970s the ozone friendly attribute, representing environmental concern has moved from being a strongly Pioneer attribute found in the bottom right hand corner of the map, reflecting its controversial nature, towards the centre, becoming a norm which is widely accepted and no longer particularly remarkable (Rose, 2004).

The map is used to identify the particular attributes most and least likely to be expressed by each of the groups (Figures 5.2, 5.3 and 5.4). Attributes coloured red or orange score significantly higher in that Maslow Group than the general population, whilst attributes in blue or green score significantly lower. Attributes shown in white occur at the same level as within the general population. The three maps show the different groupings of attributes found in each Maslow Group, with the high and low scoring attributes grouping into different regions of the map. Within each of the red regions, it is possible to identify attributes which are particularly expressed in one Maslow Group, i.e. the attributes which are strongly expressed (red) in one Maslow Group but least expressed (blue) in the remaining groups. For example, conformity and security are expressed in Settlers, reflecting their requirement for safety and security needs with the Hierarchy of Needs to be met (Figure 5.2)[1]. For Prospectors, a cluster of attributes on the far left of the map includes Looking Good and Pleasure which reflect their emphasis on appearance, fun and an active life (Figure5.3)[2]. The holistic worldview of Pioneers is reflected by attributes such as

[1]Each attribute is described by Cultural Dynamics (2009) to give the broader description. These descriptions are provided for the cited attributes (as detailed in Cultural Dynamics (2009)). **Conformity**: These people believe it is important to behave properly, in the way that society defines. They achieve this by following the rules. They believe that people should do what they are told. **Security**: These people need to feel secure and avoid danger. This extends from the personal level to society and the national level.

[2]**Looking Good**: These people value appearance and do so not just for their own self-esteem

Figure (5.2). Settler Attribute Map. Attributes coloured red or orange score significantly higher for Settlers than the general population, whilst attributes in blue or green score significantly lower. Attributes shown in white occur at the same level as within the general population. n = 1888. Figure reproduced with permission from Cultural Dynamics (2009).

caring and universalism (Figure 5.4)[3].

Each of the three groups can be subdivided into four Value Modes (Figure 5.5). These represent different 'shades' within the larger group, each with a characteristic set of typical attitudes. According to Maslow, a person's course through the needs layers takes them to the top of the pyramid. This is illustrated in the Cultural

but also for approval from others. They believe that spending time on their appearance is important. **Pleasure**: These people believe that the pursuit of pleasure is what life is all about. They enjoy giving themselves treats and seek pleasure from their bodies (e.g. through sports).

[3]**Caring**: It is important for these people to help people around them. They want to care for others. **Universalism**: These people are open to hear opinions and ideas, even if they contrast with their own. They believe that everyone should care for nature and look after the environment.

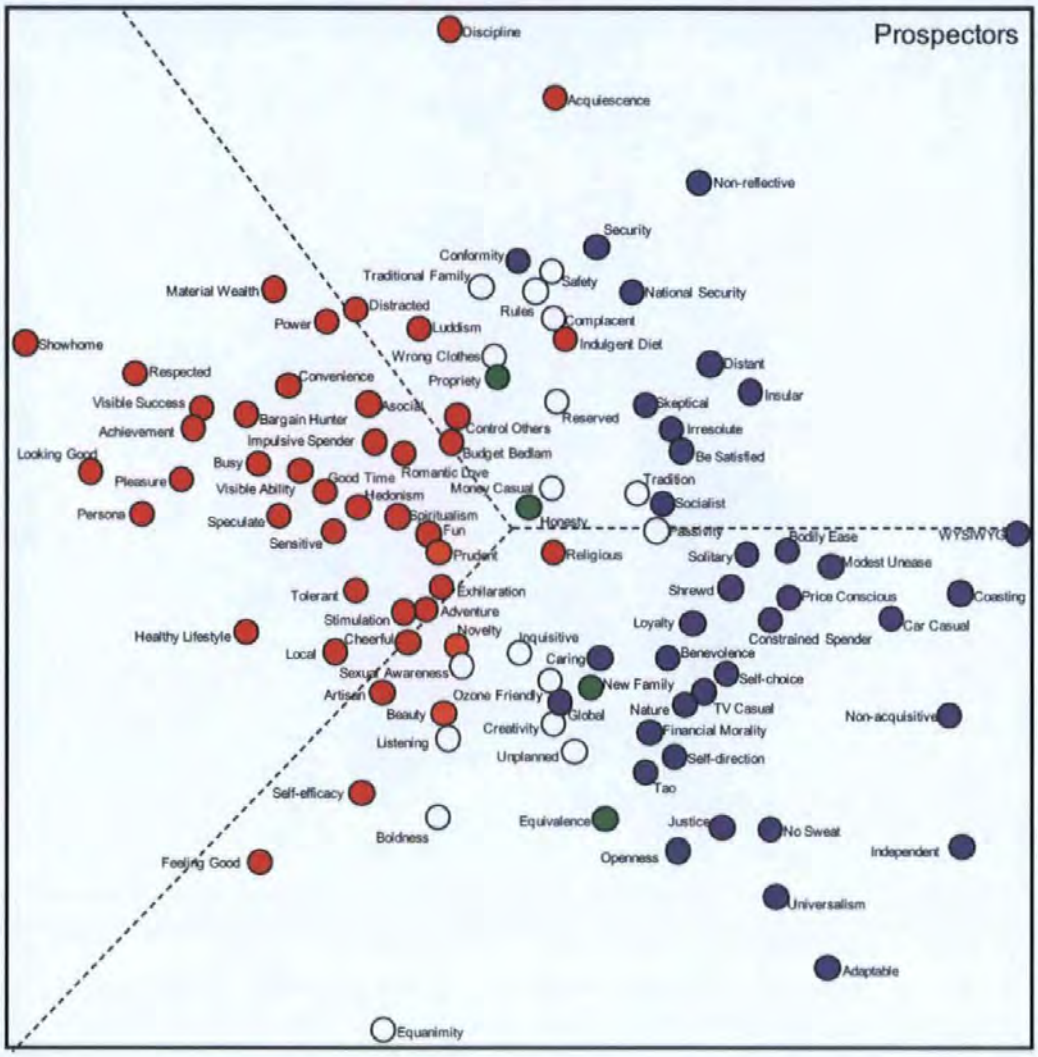


Figure (5.3). Prospector Attribute Map. Attributes coloured red or orange score significantly higher for Prospectors than the general population, whilst attributes in blue or green score significantly lower. Attributes shown in white occur at the same level as within the general population. n = 1608. Figure reproduced with permission from Cultural Dynamics (2009).

Dynamic's model of Value Modes (Figure 5.5) showing this process as an individual moves through each of the 12 Value Modes from Roots in the Settler group through to Transcender in the Pioneer group (Rose and Dade, 2007). The specific details of each Value Mode provide a finer level of detail for understanding a population's variations of attitudes and values. For the purpose of this research, only the main groups will be considered. This is because the communication structure based on these groups will provide significant benefits and the additional complexity required to target specific Value Modes is not justified in the increased quality of the outputs in the requirements to meet the aims of the thesis.

In contrast to the movement of an individual's needs through the Cultural Dy-

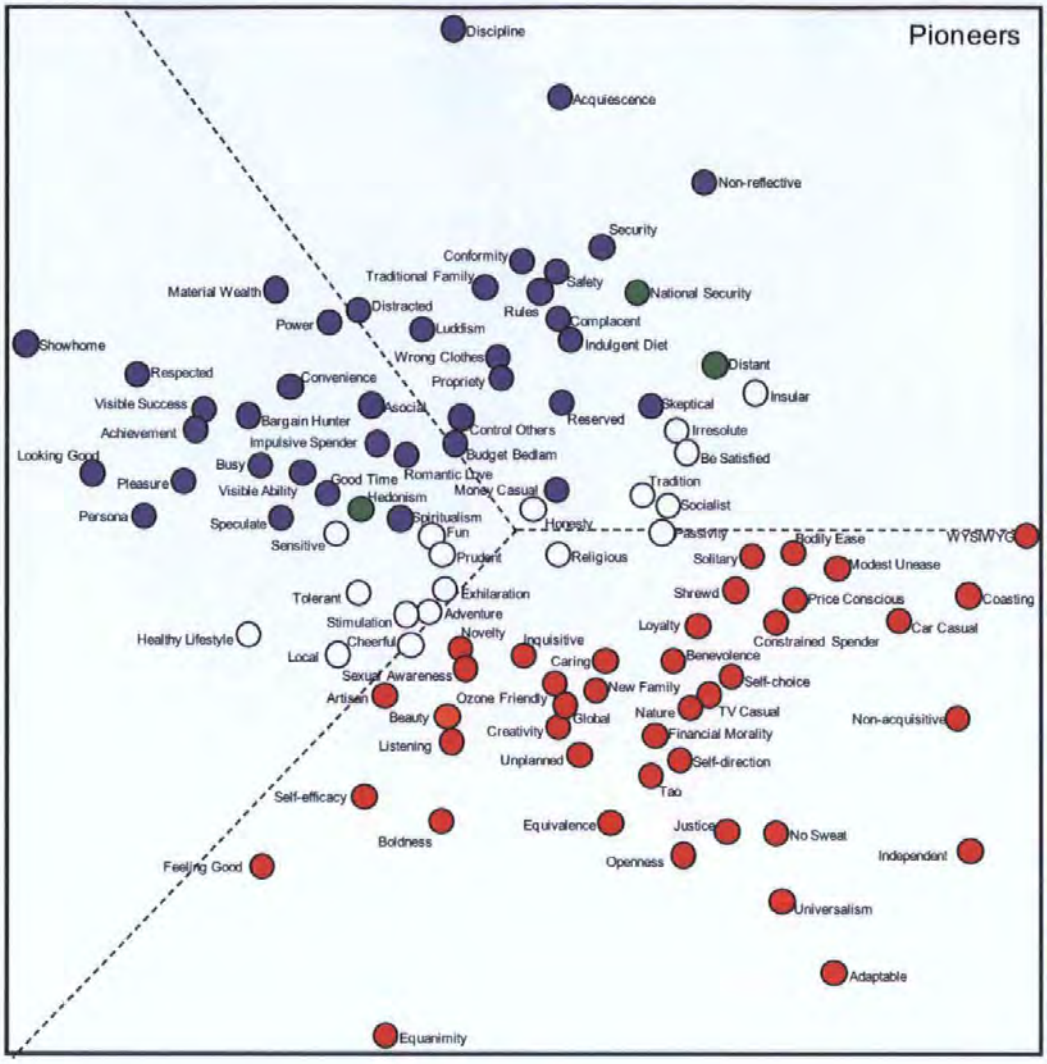


Figure (5.4). Pioneer Attribute Map. Attributes coloured red or orange score significantly higher for Pioneers than the general population, whilst attributes in blue or green score significantly lower. Attributes shown in white occur at the same level as within the general population. n = 1964. Figure reproduced with permission from Cultural Dynamics (2009).

namic model (Figure 5.5), new ideas or concepts move in the opposite direction, being first adopted by the Pioneers. Their curiosity and thirst for knowledge means they will explore new ideas, be innovative and embrace change. For an idea to be taken on by Prospectors, it needs to become 'cool'; where the Pioneers are interested in something which is ethically sound or has curiosity value, Prospectors will be hooked by something which looks good. Once both these groups have accepted an idea, a large enough proportion of the population have shown it to be safe, or normal. At this stage it is no longer new and uncertain and is therefore 'safe' for Settlers to adopt; they will not adopt an idea which is unusual or goes against the current routine. This pathway of new ideas is an important process to be aware of

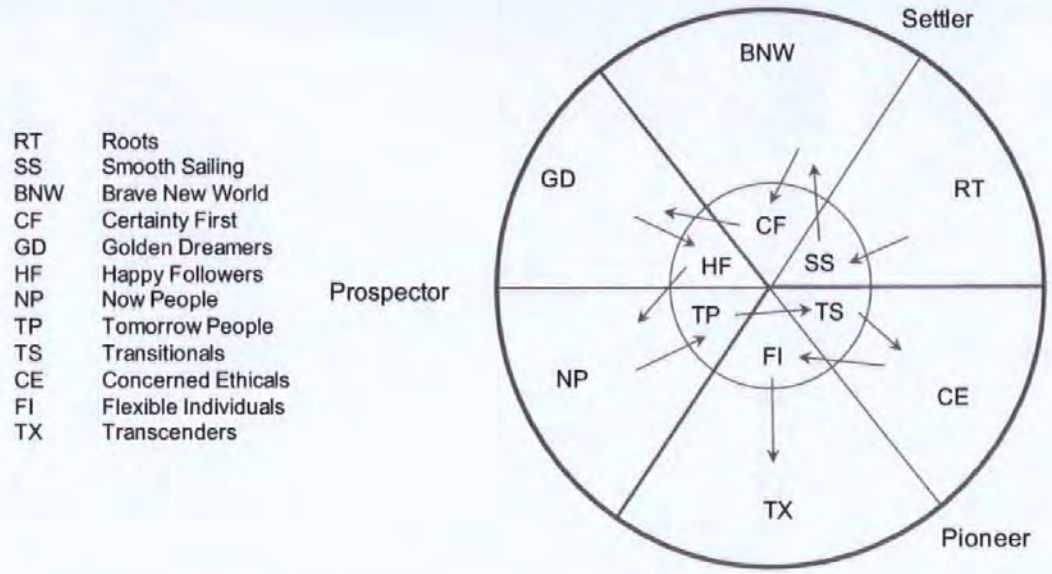


Figure (5.5). Value modes within each of the Maslow Groups. Arrows show general transition through the Value Modes and Maslow Groups. Figure adapted and reproduced with permission from Rose and Dade (2007).

in communication, and has been observed with the progress of environmental and climate related topics since the 1970s (Rose et al., 2007).

It can be tempting to try to fit the Maslow Groups to more widely recognised population classifications such as socio-economic classifications. Despite some correlations with certain demographic data, these can be tenuous and there is a danger of misinterpretation of the profiles by attempting to interpret a greater pattern than actually exists. A key strength of the Maslow Group model is that it facilitates measurement of the social values of a population, providing a more detailed understanding of the motivations of behaviour and interest than solely socio-demographic data allow.

5.3.1 Applying the Cultural Dynamic model to communication

By understanding the characteristics of each group, the Cultural Dynamics model allows the identification of styles of messages, interpretations and motivations driving each group's interest in communication. The profiles of each of the groups are extended to provide some general rules of communications structures which particularly appeal to each group, and illustrates the considerable differences between the groups (Rose, 2004, Table 5.1). Certain types of messages will appeal better to some groups than others; some messages will be dismissed regardless of content if they do not appeal to the drivers of interest of a particular group. Applying this, within

the general understanding of the profiles, and subject specific knowledge gathered about a particular product or message means of communications can be structured to resonate with the target audience.

	Settlers	Prospectors	Pioneers
Dominant motivation	Being safe and belonging	Status and esteem of others	Exploration
Action mode	'Someone should do something about it'	Organise	Do it yourself
Desire	Safeguard against external threat	Answers	Better questions
Why I would save the dolphins in Seatown	So long as dolphins keep coming back, Seatown will be Seatown	Good for the town's image and economy (and my house price)	I feel I could be one myself – and for their own worth
I want a brand to	Make me secure	Make me look good	Bring new possibilities
I like to meet	People like me and people I know	Desirable and important people	New, challenging and intriguing people
I connect through	Clubs and family	Big brands, systems and organisations	My own networks
I like to be associated with	Tradition	Success	Good causes that put my values into practice
I most respond to threats to	My way of life	What I've worked for	Visions and causes
I	Know my place	Am successful	Am me

Table (5.1). Profiles of Maslow Groups from Rose (2004).

To attract each Maslow group, a message needs to be offered in a specific way in order to link to the target group's particular motivations. The same behaviour change can be triggered in each group, but may driven by a different motivation. An example of this is the US Detroit Project, a campaign to dissuade Americans from using sports utility vehicles (SUVs) (Rose, 2004). Typical campaigns delivering this message would rely on links with damage to the planet or society; messages which strongly appeal to Pioneers. The Detroit Project (www.thedetroitproject.com) aimed their advertisements at Settlers. The advertisements made links from SUVs using a lot of gas, gas dollars going to Arabs pictured with AK47s, and Arabs with money meaning that some of their gas money funds terrorism. Therefore, in order to keep America safe, people need to drive cars which use less gas. This message conflicts with the national and personal safety needs of Settlers, undermining the safety drivers for driving an SUV. This campaign was seen by some as encouraging behaviour change for the 'wrong' reasons (Rose, 2004). However, the decision has to be made whether the aim of environmental campaigns is to achieve behaviour change, or behaviour change which people do for wholly ethical reasons and no others.

Some very specific groups can be targeted. The RSPB recently used the Maslow Group approach to assess their members and structure a new campaign. The majority of their members are Pioneers, people interested in birds and the environment for curiosity reasons, whilst only a small proportion of their members were Prospectors. In order to appeal to a wider market, and increase membership levels, the RSPB are designing a publicity strategy which appeals to those people in the bridge between the Pioneers and Prospectors. This method uses the finer value modes approach to target a particularly difficult transition in the communication pathway (Pers comms, Les Higgins, Cultural Dynamics).

This model has been applied to a wide range of market research, product development and communication scenarios by Cultural Dynamics over the last 30 years. Haagan Dazs, the Environment Agency, Bedfordshire Police and Arsenal Football club are examples of the wide range of organisations which have applied the Maslow Group model for a variety of benefits (Rose and Dade, 2004). This experience has provided a wealth of knowledge on how to structure communication campaigns to resonate with particular audiences. A key theme in this thesis is to develop messages about UK marine environmental health which will appeal to each of the three Maslow groups. As has already been described, Pioneers are more inclined to adopt new ideas. To act on this, one strategy for a campaign, particularly if resources are limited, is to focus communication for Pioneers, developing a sound understanding within the group most interested in new information. A later stage of the strategy could then be applied to crossing the bridge into Prospector interest. This strategy may be applied for some specific messages, but the research here will make recommendations for communication strategies for all groups.

5.4 Maslow groups and other value typologies

This structuring and application of the Maslow hierarchy allows a better understanding of the values of groups within a population. Other social segmentation models exist which can also be used to investigate social value structures, and continuities with the Maslow model are evident. The Schwartz value model (Schwartz, 1994) has ten value types and four higher value along two axes which conform well to the three Maslow Groups. Schultz and Zelezny (2003) found that people with self-transcendent life goals cared more about environmental problems and engaged in more pro-environmental behaviour than those with self-enhancement life goals. Maslow describes that altruism increases with each higher layer of needs (Maslow, 1987), which fits well with these findings and also with the profile characteristics of Pioneers. This is both in the specific interest of the environment, but also in the

more altruistic attributes such as justice which are more strongly associated with Pioneers[4].

Kellert's (1996) value typologies are a useful tool for understanding the drivers of interest in the natural world (Chapter 2, Table 2.1). Although no formal comparison of the Kellert typologies and Maslow model has been conducted, it is possible to identify parallels between the values listed by Kellert (1996) and the typologies. These connections are supported by the interpretations of the profiles, but have not been directly tested. However, the identification of particular traits of within each Maslow group with specific value typologies shows the comparability between these models of social values.

Kellert Values	Maslow Group
Utilitarian	Settler/Prospector
Naturalistic	Pioneer
Ecologistic/scientific	Pioneer
Aesthetic	Pioneer
Symbolic	Pioneer
Humanistic	Pioneers/some Settlers
Moralistic	Pioneer
Dominionistic	Prospector
Negativistic	Prospector

Table (5.2). Parallels between Kellert's (1996) value typologies and Maslow Group profiles (Pers. Comms, Les Higgins, Cultural Dynamics).

The Defra social segmentation model (Defra, 2008) was developed by Defra to better understand specific pro-environmental behaviours, with a view to recognising how carbon emissions can be reduced, identifying themes which have broad and general appeal and those which target more specific audiences. The aims of the study delivered in this thesis relate to understanding the perceptions of the marine environment and their implications for engaging with marine health, and are not as precisely defined as those in the Defra study. The Maslow model is better suited to this study as it measures the values, and therefore the motivations behind the responses given by each group.

The Maslow Group model provides a method for assessing social values of respondents which is supported by extensive understanding of the profiles, facilitating an in depth assessment of the survey results. The model (described below) has been developed for use in large scale surveys, and therefore is known to be well-suited to this type of study.

[4]Early misinterpretations of Maslow's model led people to suggest that self-actualisation showed an increase in selfishness as the person became more focussed on their own achievements (Maslow, 1987).

5.5 Natural England studies of marine perceptions

Natural England have applied the Maslow Group model in two pieces of research into the public perception of the English undersea environment; a qualitative study based around a series of focus groups (Natural England, 2008) and a quantitative survey (Rose et al., 2008). The findings of each of these studies will now be reviewed to provide an illustration of the strength of the Maslow Group model at understanding the values measured. This is relevant to the wider study of this thesis as it provides details of existing studies on how the public perceive the marine environment and how perceptions differ between the Maslow Groups.

The data presented here were collected and initially analysed by Natural England as part of their Marine Campaign (Natural England, 2008, Rose et al., 2008). The data were provided by Karen Mitchell, Natural England, for inclusion in this chapter. The results of the focus groups are described in the following section, describing the relevant findings detailed in Natural England (2008). Further interpretation drawn from analysis of the raw data provided by the survey is included here (Section 5.5.2).

5.5.1 Natural England Focus Groups

Eighteen focus groups were carried out across England with parents of school age children, divided into groups according to their Maslow group. A considerable amount of data was recorded measuring perception of the English undersea environment (Natural England, 2008). The findings from three main themes are described here; experience and opinion of the sea, motivation for family trips to the beach, and appeal of three proposed communication strategies (Table 5.3). A strong theme throughout all the focus groups was the initial tendency for respondents to talk about the coast when asked about the undersea; this is the familiar marine environment and dominated people's primary discussions. When pushed to discuss the undersea, subtidal environment, respondents had knew very little about it and thought it likely to resemble the surface of the sea, being flat and featureless except for seaweed and fish. This shows a disconnect from the subtidal environment; where the intertidal and coastal environment was described from personal experience, the undersea was out of the range of participant's experience.

The perceptions of the English sea and motivations for family visits to the beach differed between the groups. Settlers felt a sense of national pride towards the sea and recognised it as a natural boundary which provides protection. There was a nostalgic association with coastal towns, and often strong employment links with

	Settlers	Prospectors	Pioneers
Focus groups:			
Associations with the English seaside and undersea.	National pride. A natural boundary which protects them. Nostalgic view of coastal towns. Often have close employment links with marine industries. Maritime history is interesting	No interest in undersea; the sea is somewhere to enjoy on holiday, where it would be clear, blue and warm.	Intrigued by the undersea, in particular the flora and fauna. Drawn to the complexity and otherworldliness. Opportunity to learn and explore. An exciting place.
Motivations for a family visit to the seaside	A cheap, practical and relatively safe place to visit. Enjoyed by the whole family.	Coastal towns, rather than the sea hold the appeal: piers, food and fun. Big marine attractions such as aquaria shark tanks. Enjoy energetic, impressive activities and the opportunity to spend money.	Fun and healthy opportunity for education escaping the TV/commercial world for the wider world.
Survey:			
% who think the seabed in their region is quite/very well covered with plants and animals	52	48	63
% who are fairly or very sure that there is something worth saving on their local seabed	61	55	74
% who can name one or more biological feature of the seabed	51	51	60

Table (5.3). Overview of marine perceptions by Maslow Group. Results from Natural England (2008) and Rose et al. (2008).

marine industries with Settlers who lived close to the coast. There was also an interest in maritime history. Visits to the beach were seen to be a cheap, practical and relatively safe activity which could be enjoyed by the whole family. These associations reflect the traditional values of Settlers, their family focus and importance of community and national identity.

Prospectors had no interest in the undersea; the sea is something to be enjoyed on holiday, where it would be warm, clear, blue and lapped a sandy beach. In seaside towns, the resort rather than the sea was the attraction; English seas are considered cold, dirty and dangerous. Piers, food and fun attract Prospectors to the seaside. Big marine attractions such as aquarium shark tanks provided a visually impressive interaction with something marine. These results reflect the importance of appearance to Prospectors; English seas were not considered to look as good as foreign seas, and therefore are not as good. Activities are energetic, impressive or provide a spending opportunity.

Pioneers are intrigued by the undersea, in particular the flora and fauna. They were drawn to the complexity and 'otherworldliness' of undersea areas, and wanted more information and an opportunity to explore. The coastline was seen as rugged and romantic and the sea is seen as captivating and rousing curiosity. Pioneer family trips to the beach are a fun, healthy opportunity for education. They enjoy the escape from the TV/commercial world which gives them an opportunity to explore the wider world and gather new knowledge.

The focus groups were shown three different ideas around which potential communication about the undersea environment could be based. A topographic idea inspired awe through the use of large topographic features of the undersea landscape such as Dogger Bank. The individuals and communities idea was based around the herring community of the River Thames, showing the interrelations between species and inspiring sympathy as herring 'struggle against the odds' to survive. The beauty spot concept used an image of a kelp meadow to inspire intrigue in its complexity and mystery.

The topographic idea appealed to all groups as an exciting idea with a broad interest in features which were national treasures. This was the only positively received concept for the Prospectors; the grand scale and awe being enough to overcome their negative perceptions of English seas. Settlers were particularly compelled by the individuals and communities, the appeal of the struggle for survival linking with their importance of safety in an uncertain world. Pioneers were also interested in this idea, but for different reasons. This links to their understanding of the connectedness of the world and an opportunity to increase their knowledge of how the world works. The beauty spots were potentially worrying to both Settlers and Prospectors. The image showed much that was unknown and out of their experience, which was seen as threatening for Settlers, whilst the Prospectors saw an environment which may conceal dangerous animals or currents. In contrast, Pioneers were fascinated by this image. Its complexity provided many opportunities to explore and learn about new things and gained a much more positive response.

These first results illustrate the differences between these three groups and how the model can be used to understand each group's perceptions. The beauty spots idea, if developed by Pioneers, could seem like a very positive concept, but the intended message will only be received by other Pioneers. Other groups in the population could interpret negative messages from this which further dissociated them from the English seas by reinforcing their fears. This reiterates the need for developing a selection of messages which are positively received by each group.

5.5.2 Natural England National Survey

The qualitative study above revealed some interesting differences in how the three Maslow groups associate with the English undersea environment. The quantitative study (Rose et al., 2008), investigated perceptions of the health of the English undersea environment. The survey data are presented here to further investigate these findings. The raw data were provided by Natural England (Pers. Comms, Karen Mitchell, Natural England) and the analysis, as detailed below, has been carried out to identify the main differences in perceptions between the three groups, providing a background understanding of marine perceptions.

5.5.2.1 Methods

This survey was conducted by the Natural England Marine Campaign to measure public perception of the English undersea environment and ran during March 2008. The survey was delivered by Global Market Insight (GMI) as an internet survey during March 2008. Internet surveys are delivered by companies such as GMI, specialising in market research. This is a similar approach to the more widely recognised MORI poll, although it does not target random respondents. Respondents register with GMI and, for each survey they complete, they receive points or credit as a form of payment. GMI constructs the questions into their survey format and emails potential respondents, within the defined target market, sending them a link to the survey. GMI is able to monitor which demographic groups have competed a survey and make it unavailable to those respondents which are adequately represented, helping to ensure a balanced response. As with any survey method there are limitations to internet surveys. These surveys are only available to people with internet access who have registered with survey companies. The increasing rate of internet access in the home means this limitation is lessening. However, certain demographics will always be easier or harder to reach with this method. There is also an issue of auto-self selection where people completing surveys are more likely to be those interested in the subject, with those who find it uninteresting choosing not to complete surveys which they find uninteresting. This can lead to responses being skewed in favour of an interested audience, rather than representing broader opinions. However, internet surveys are successfully applied as a tool for market research, and are seen as a valuable tool equal to or better than more traditional survey methods (Knapp and Kirk, 2003). The advantages over face to face or telephone surveys include low time requirements for a high response rate, no variation in surveyor delivery, and relatively low costs.

Four questions from the survey are analysed here; three closed and one open

ended (Appendix E). The closed questions each had five options along a Likert scale from negative to positive descriptions aspects of the marine environment and required respondents to think of their closest regional sea when considering their answers. The categories are ordinal as each describes a more positive scenario than the previous. Analysis in SPSS 16.0 is carried out by assigning the categories a numerical value ranging from -2 to 2 with the neutral third category as 0. Due to the structure of the text descriptions, the categories both within and between these three questions can not be defined as equal, and therefore the comparison of quantitative results between the questions is limited to the trends measured. An Analysis of Variance (ANOVA) was used to identify if there were significant differences between the responses of groups, with a Tukey HSD Post test used to identify where any differences occurred.

The fourth question was an open ended question asking respondents to name a biological or topographic feature in their regional undersea environment. The interests of the thesis are in the perceptions of marine health, therefore the biological answers have been selected from the results provided. Respondents could provide a maximum of five responses. These responses were coded using Microsoft Excel to identify the proportion of respondents citing particular biotic components.

Maslow Group is measured through the inclusion of 10 statement questions, determined by Cultural Dynamics to be the most concise but accurate application of the model.

5.5.2.2 Results and Discussion

5.5.2.3 Overview of Respondents

3003 respondents completed the survey. Respondents were reasonably representative of key socio-demographic variables. 48% of respondents were male, 52% female. The spread of age was satisfactory, with between 15 - 20% of respondents in each age category with the exception of the youngest age category, 15-24 years only having 11% of respondents. Maslow Group representation was 32.5% Pioneers, 28.5% Prospectors and 39% Settlers which reflects the distribution within the UK population at that time.

5.5.2.4 Perception questions

Qs1-3 provide a measure of how ecologically diverse and valuable the English undersea is perceived to be. The survey found differences between the perceptions of respondents by Maslow Group, with Pioneers being the most distinct group (Table 5.4). Pioneers show the most positive perceptions of the undersea environment,

considering it to have more ecological life, less damage and more confident that it is worth protecting. This supports the knowledge of the profiles of the Maslow Groups and previous findings. Pioneers have the greatest interest in the natural environment, shown in the focus groups by their intrigue of the coast as a place to explore the flora and fauna. The more pessimistic responses of Prospectors and Settlers show their disconnect from the undersea as a place of biological value. The results show Prospectors and Settlers to be similar in their responses to Q1 and Q2. As described above, Pioneers are the first group to adopt a new idea, whilst Settlers will be the last, waiting until it is shown to be safe. Settlers are unlikely to have opinions which differ considerably from the general population; this is reflected by their mean scores (Table 5.4) which fall between those of Pioneers and Prospectors. The lack of a significant difference of opinion between Prospectors and Settlers for Qs 1 and 2 show the Settlers tending towards the pessimistic responses of the Prospectors. The reasons for the differences in Q3 are discussed further below.

	Q1 Seabed features	Q2 Seabed characteristics	Q3 MPAs
Pioneers	0.73 *	0.49 *	0.93 *
Prospectors	0.37	0.18	0.50 *
Settlers	0.43	0.26	0.65 *

Table (5.4). Overview of marine perceptions by Maslow Group. Results from Natural England (2008) and Rose et al. (2008). * indicates significant difference, all $P < 0.001$. df = 2 for all analyses. Q1, $F = 27.825$. Q2, $F = 22.294$, Q3, $F = 41.523$. Pioneer n = 975, Prospector n = 855, Settler n = 1173.

Further investigation of the responses within each question show where these different perceptions exist between the Maslow Groups. Qs 1 and 2 showed Pioneers to be significantly more positive about the seabed features and characteristics than either Prospectors and Settlers. This is evident in Figures 5.6 and 5.7 which show a greater proportion of Pioneers to select to the positive statements. In Q1, this increase is evident in both the positive categories, but in Q2 this only occurs one of the positive statements; all three groups score the most positive statement approximately the same (9-11%). This last, most positive, statement contains no reference to damage of the seabed, implying a relatively pristine environment. The results suggest that Pioneers make the distinction between areas of seabed which have suffered damage, and other areas which may still be of high diversity, whilst Prospectors in particular, and also Settlers, consider damage to be the overriding feature. They consider the damage to overwhelm any likelihood of marine biota

being present.

The third question shows differences between all Maslow Groups (Figure 5.8. Pioneers are again the most positive, translating their more positive perceptions of the diversity of the undersea environment into a reason to find something of value. A notable result is the significant difference recorded between Prospectors and Settlers (Table 5.4). Prospectors are the most pessimistic group, being least likely to consider the English undersea to be worth protecting. The profiles above describe the Settlers greater tendency for conformity and security; they like rules and order. This last question describes the potential for Government to impose rules on who can use particular areas of the sea, something which would appeal to these Settler values. Therefore, this difference in perception between Settlers and Prospectors may not directly reflect a greater optimism of Settlers in the value of the marine environment, but their support of Government intervention.

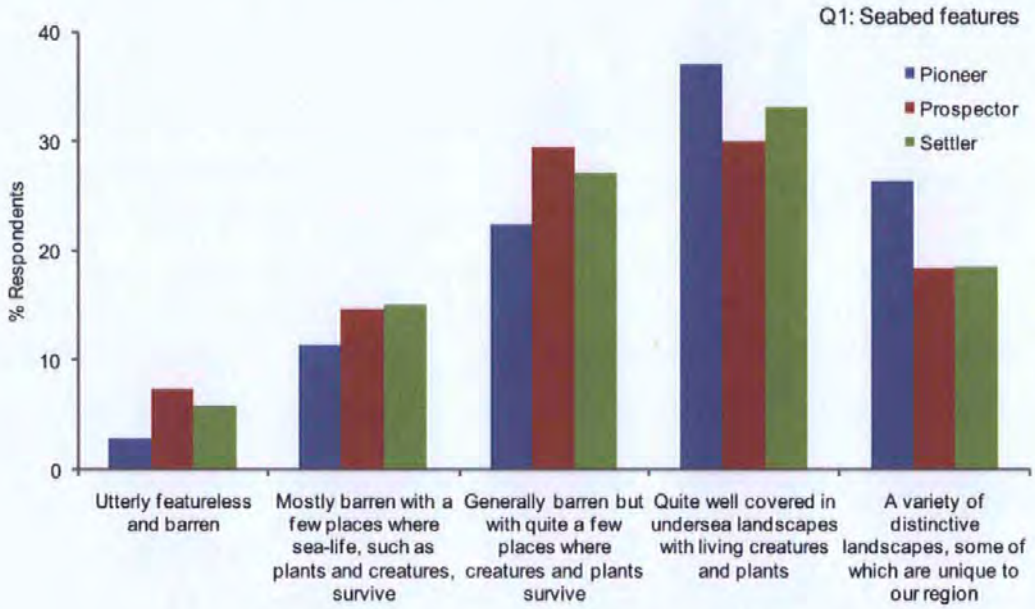


Figure (5.6). Results of Natural England Survey Q1: 'Thinking of the seabed and landscape beneath the sea in your region, or off the coast where you visit the seaside, do you think it is most likely (to be):'. Pioneer n = 975, Prospector n = 855, Settler n = 1173

5.5.2.5 Q5 Biological features of the undersea

This was a qualitative question, asking respondents to name features they associate with the English undersea environment[5]. This question was open ended, and respon-

[5]Q5 Can you name any specific features of the undersea landscape or creatures or plants likely to be found on the seabed in the seas in our region?

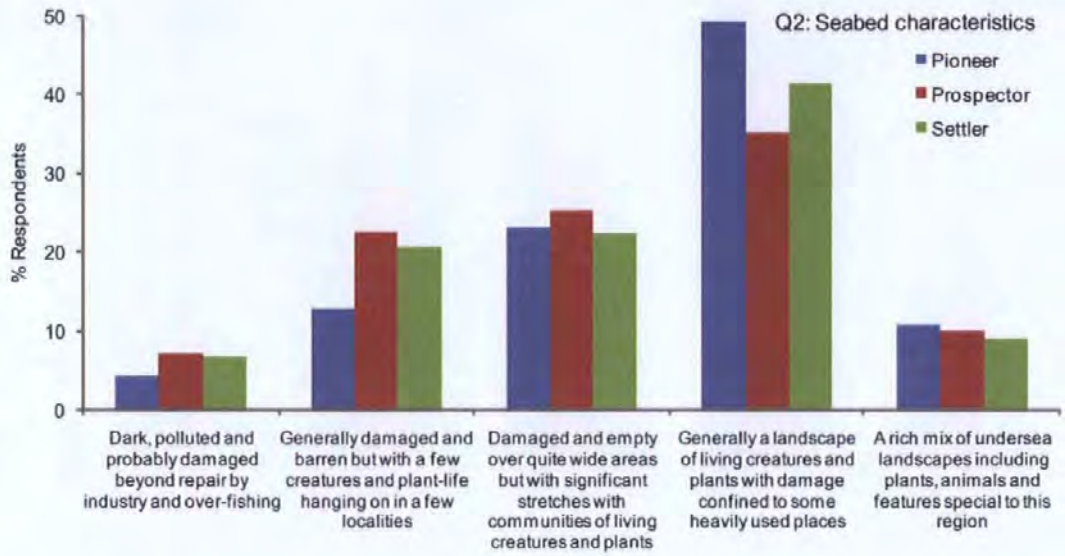


Figure (5.7). Results of Natural England Survey Q2: 'Which best characterises the undersea landscape in the seas in this region?'. Pioneer n = 975, Prospector n = 855, Settler n = 1173

dents provided some interesting responses. Many coastal locations were mentioned, such as Brighton and Flamborough Head, showing the strong links to the coast, rather than the undersea. Victoria train station at Southend-on-Sea was also mentioned. Undersea features included a Roman fort, ship wrecks and plates from ship wrecks, illustrating the historical associations with the sea; the Lost city of Dunwich, a Suffolk town lost to coastal erosion was also recorded. A number of respondents also recorded various types of 'unnatural features' such as cars, supermarket trolleys and sewage.

The responses considered here are the biological responses; 57% of respondents named a plant or animal they considered to be a feature of their regional sea. The most mentioned biota were crabs, fish and seaweed; of the respondents that named a biological feature, 71% named these generic biota. This illustrates the high level of familiarity of these biotic groups, which are easily seen on the beach, or as food products and suggests a lack of identification of specific marine organisms. A similar terrestrial study has not been conducted, but these responses are equivalent to a dominance of groups such as trees, plants and birds being used to describe terrestrial biotic features. Other biotic groups mentioned include species frequently seen in the intertidal zone, starfish (8% of respondents citing a biological feature), prawns and shrimps (4%) and anemones (2%). A number of large vertebrates were named; seals (6%), dolphins (4%), sharks (2%) and whales (1%). These low figures for both invertebrates and large vertebrates suggest a low association of any plants or animals with English seas, with the largest biotic component considered to be

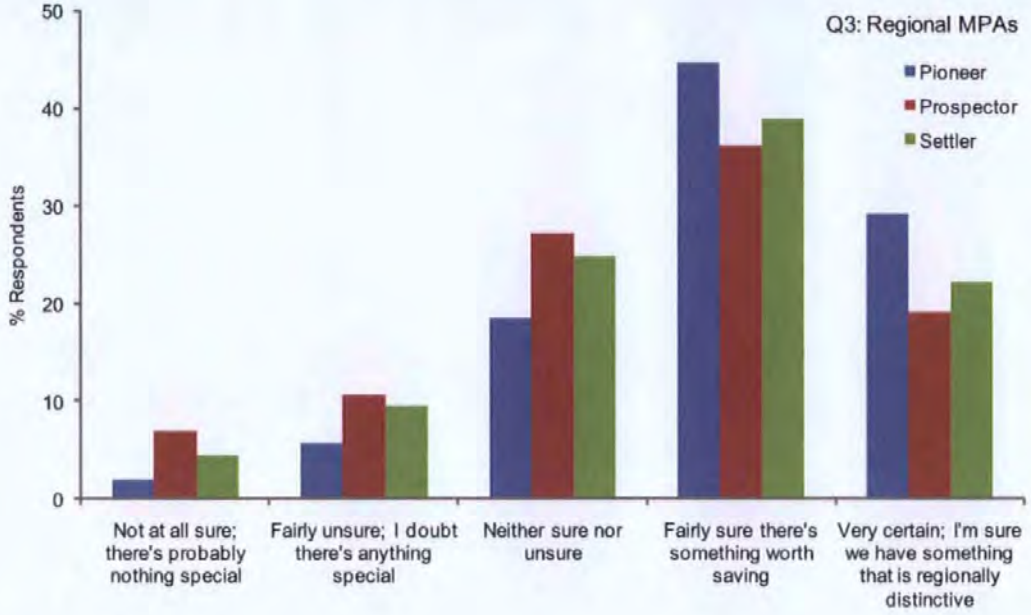


Figure (5.8). Results of Natural England Survey Q3: 'The government plans to set up more marine protected areas in the seas around the coasts of England. Thinking about the seas off the coast in this region, how sure do you feel that there would be undersea landscapes worth protecting here?'. Pioneer n = 975, Prospector n = 855, Settler n = 1173

generic species.

Further biota mentioned included some non-native, or non-marine species; walrus, pike, newts, sealions, lily pads, terrapin and water voles. This suggests either a misreading of the question, or an extension of freshwater knowledge into the unfamiliar marine environment. In addition to these unusual responses, a number of ecologically complex responses were provided such as '*cold water coral reefs*', '*whale migration routes*' and '*spawning grounds*'. These two sets of results show the contrasts of respondents who have little knowledge of undersea fauna, and those who have a more detailed knowledge of marine biota. These represent the broad spectrum of current understanding of the marine environment and illustrates the variation of perceptions within the population.

Maslow Group analysis of the Q5 results shows a further variation within the population, with Pioneers being more likely to provide a biotic response than Prospectors or Settlers. 60% of Pioneers cited one or more biological feature, compared to 51% of both Prospectors and Settlers. Pioneers have stronger environmental values so may be more likely to engage with the marine environment and therefore may have a higher knowledge of marine biota. However, the specific English focus of the question also suggests that these results support the findings above, with the greatest pessimism of the English undersea being exhibited by Prospectors and

Settlers.

The results show a low association of biological features with the English undersea, particularly in Prospectors and Settlers, and a dominance of generic biota of crabs, fish and seaweed. This reiterates the negative perceptions of the English undersea as recorded in Qs 1-3.

5.5.3 Natural England studies conclusion

The Natural England studies on marine perception have revealed some distinct differences between the Maslow Groups and their associations with and perceptions of the English marine environment. These differences show Pioneers to be the most optimistic about the biota of the undersea, and also show the greatest curiosity for investigating the marine environment. Prospectors are the most pessimistic about the ecological value of the marine environment, being drawn to features of the coast which appeal to their need for active and impressive looking coastal attributes, something provided by coastal resorts but not perceived to be available from the English seas. Settlers enjoy the traditions associated with the coast, with perceptions of the ecological diversity of the seas being similar to that of the Prospectors.

5.6 Conclusion

This chapter has described the development of the Maslow Group model and illustrated its application to understanding public perceptions of the marine environment. The Natural England studies show the benefits of applying the social segmentation model, as it identified considerable differences in opinions and enabled the values which drove these differences to be understood. Rather than providing a measure of the average perception across the general public, this method has measured these differences and provided a more accurate understanding of the values of the marine environment. The use of this model can enhance the development of communication strategies, through identification of these differences in perceptions and understanding how different hooks of interest will appeal to (or disengage) particular audiences. This was particularly evident with the kelp beauty spot image which evoked a positive response from Pioneers but a negative response from Prospectors and Settlers.

Chapter 6

Survey Two: Public perceptions of marine health

Charismatic megafauna species are often the focus of campaigns communicating conservation issues to a public audience. As described in Chapter 2, large vertebrate species appeal to a wide audience and can attract attention to complex issues. Their use can lead to the simplification of ecological aspects of an issue, focusing attention on a high profile species but not necessarily communicating the wider health aspects of the issue. As seen in Chapter 3, the most relevant species for understanding marine health are structural plants and invertebrates: charismatic megafauna species are often not the most valuable in terms of their contribution to the ecological health of an area.

This chapter describes a UK wide survey which measures public perceptions of 12 marine species, which represent a range of ecological health scores, and investigates public perceptions of marine environmental health. The survey determines the social values of marine environmental health and compares them to the ecological and policy values already identified. Further analysis assesses how perceptions vary with sociodemographic and social value factors. This chapter will identify opportunities to select Spokes Species and develop messages which connect ecologically defined marine health to socially relevant criteria.

6.1 Chapter Structure

The chapter begins with an overview of key concepts of perceptions of species and issues of marine health. The methods describe the development and delivery of the survey which has two main sections: species questions and health questions. The results are presented and discussed, detailing the findings of the two sections of the survey. The social criteria for defining a healthy marine environment are identified,

and the contribution of these findings to the development of the communication strategy are discussed.

6.2 Background

This chapter identifies the social definition of marine health and compares this to ecological and policy definitions, thereby identifying the contrast and convergence of values and perceptions of the marine environment. Chapter 3 presented the concept that habitat forming plant and invertebrate species make the greatest contribution to marine environmental health. Habitat complexity is a key factor in functional diversity and species richness (Eriksson et al., 2006, Thrush et al., 2006), and is important to ecosystem health at all scales, from single species up to ecosystem processes. The policy analysis presented in Chapter 3 showed that ecological values are not reflected in the protection of species, with greater protection being focused on large vertebrate species than plants and invertebrates.

Chapter 2 described the application of different species to communicating conservation messages. The criteria to identify species for communication campaigns can be seen along a continuum from those selected based solely on social values (flagship species) to those selected on ecological values (keystones and indicators). The high social value given to charismatic megafauna (CMF), generally large mammals or birds, was also discussed.

CMF dominate society's connections with the natural world. These species attract high social value due to their aesthetics, similarity to humans and perceived ability to feel pain (Kellert, 1996). CMF are featured in books and films, they are a focus for media coverage of the natural world, and are used as symbol for marketing (Feldhamer et al., 2002). Opportunities to see or be close to CMF species are increasingly available, and can make a considerable contribution to local economies. The number of people whale watching is increasing 12% each year, three times higher than the overall increase in tourism (Einarsson, 2009). In 2008, 13 million people participated in whale watching across 119 countries and territories and generated a total expenditure of $2.1 billion (O'Connor et al., 2009). Beyond the contribution to local economies, these figures illustrate the high value ascribed to the opportunity of seeing such species in the wild. CMF in captivity also attract large audiences, for example SeaWorld, aquaria and zoos. Personal experiences of nature are important in shaping knowledge and values of the environment (Chapter 2). Activities, such as whale watching, combine the high appeal of CMF with the positive effects of these experiences.

CMF are a powerful conservation tool, used to raise funds and awareness, often

for issues which are remote or out of the experience of the target audience. Selection of flagship species is often more strongly influenced by the charisma and marketing value of a species than its ecological function (Home et al., 2009). Mammals are particularly used in fundraising (Leader-Williams and Dublin, 2000), as they provoke a stronger emotional response from the public than an ecological issue such as habitat degradation (Entwistle et al., 2000). This is despite the greater threat to the species being from the ecological issue. In marine examples, whales and dolphins feature as highly appealing species (Leader-Williams and Dublin, 2000). Whaling is an issue which provokes strong social responses at the killing of a highly socially valued species. This receives greater attention and public support than issues which centre on less charismatic lead actors such as the issue of shark finning. Sharks have a strong negative public image, based on fear (Thompson and Mintzes, 2002). Media coverage, such as the documentary film Sharkwater, is changing this by promoting the charismatic features of sharks and their persecution. This attempts to overcome the strongly negative public image of sharks and gain public support for better protection of a vulnerable group of species.

Part of the success of CMF at publicising conservation issues is their ability to provide a focus of attention and to simplify difficult subjects. An individual species is easier to identify with than the fuzzy concepts often associated with conservation issues (Leader-Williams and Dublin, 2000). A notable example of this is the connection between the polar bear and climate change (Slocum, 2004). A temporally and spatially distant issue is condensed into something easier to comprehend by associating it with the suffering of a large, charismatic species. This makes a complex issue easier to interpret by a non-expert audience, allowing the public to draw their own conclusions of whether the situation engages their support. When used successfully, CMF can bridge the gap from diffuse and complex science to something which is publicly accessible.

The high social value of CMF is reflected in the conservation and protection of species. Conservation spending can be prioritised by the public appeal of a species (and the associated potential for fundraising) rather than the need of the species (Home et al., 2009, Leader-Williams and Dublin, 2000). This effect is seen in policy based protection. For example, in the US, protection of species under the Endangered Species Act is positively correlated with charisma, and negatively correlated with how endangered the species is (Getzner, 2002). Mahoney (2009) found a similar pattern, also in the US, where the amount of spending on endangered vertebrates increased with size of the species, but is not affected by the species' level of endangerment. This illustrates the power of social values in the implementation of environmental management decisions.

Chapter 2 described Kellert's nine values of nature (Kellert, 1996, Table 2.1). These values can also be attributed to species, and indicate how perceptions of species vary. Values of nature can differ with socio-demographic or wider value factors, as seen with Maslow Group (Chapter 5). A study of public perceptions of dolphins found that utilitarian values are strongest in younger children, whilst eco-centric values are strongest in those with the highest knowledge of dolphins (Barney et al., 2005). These variations in values correlated with a difference in behaviour towards dolphins: those individuals more likely to engage in activities which could cause injury to dolphins (e.g. frequently boating close to or feeding dolphins) were those with utilitarian values (Barney et al., 2005). A study on public perceptions of sharks also supported the link between education and values, where utilitarian and negativistic views are negatively related to knowledge, whilst scientific and naturalistic values are positively related to knowledge (Thompson and Mintzes, 2002). The relationships between values and education level supports Kellert's findings (Kellert, 1996). The link to behaviours illustrates how understanding values helps to understand the motivations driving a person's actions or responses to a species or subject.

The role of gender as an influence on environmentalism is a much debated topic, with studies finding conflicting evidence (Smith, 2001). Zinn and Pierce (2002) summarise studies on perceptions of environmental risk to show that females are more concerned than males when risk is in regard to a specific issue e.g nuclear power, or is a local, rather than global scale issue. Investigating gender values as an explanation of gender differences in envrionmentalism, Dietz et al. (2002) found that females place greater importance on altruistic values than males. Altruism is a key value in relation to environmental perceptions as environmental issues require an appreciation of wider impacts on society and surroundings. Kellert (1996) reports considerable gender variation in values and that females have greater humanistic and moralistic values, emphasising a stronger emotional connection and ethical concern for the environment, congruent with strong altruistic values. Males place a greater utilitarian value on nature, being more supportive of practical exploitation and domination of wildlife. The relationships bewteen gender, environmental concern and environmental perception are complex and not always clear.

Any species which engages a community with an issue or activity can be defined as a flagship species: these are not always vertebrates. Species which connect society with ecologial concepts do not always fall within the criteria of traditional CMF (Home et al., 2009). In local communities, the particular ecology and values of the region may result in a smaller, less aesthetically appealing species being suited to the role of flagship. In southern Belize, the conservation project Golden Stream

Corridor Preserve aims to protect forests and enhance quality of life for the mainly Mayan Indian communities. The jaguar (*Panthera onca*) is a traditional CMF, attracting international funding for the project. In the local area, there is fear of this predator and the risks it poses to humans and livestock. Community engagement identified an alternative species, the ceiba tree (*Ceiba pentandra*) as a more positive icon for the conservation activities. This species has strong cultural links and an important ecological role. The ceiba tree has proven to be a more successful tool to engage local communities in the aims of the project and wider conservation activities than the jaguar (Bowen-Jones and Entwistle, 2002). Sloan (2004) reviews a similar scenario where he proposes the northern abalone (*Haliotis kamtschatkana*) as a flagship species based on its potential to be a nexus of culture, conservation and commerce. These examples illustrate that the important features of high profile species are that they link to the values of the target audience. For large scale, national campaigns, it may be that the traditional values associated with CMF are more relevant, but at regional or local scales, or to target a specific audience, there may be potential for less 'glamorous' species to be better suited to promote the marine environment.

As with species, marine environmental issues which prompt an emotional response, or can be quickly identified as causing suffering, tend to create greater social concern. As described in Chapter 2, issues which present the greatest threat to marine ecological health are often not those which are considered to be the greatest concern by society. Patel et al. (1999) assessed public perceptions of forest health and found that the most frequently mentioned environmental issues were those which had direct implications for human health: water quality, chemical contaminants and air pollution. The authors recommended that clear messages which link forest health to human health and well being may yield the optimum response from local communities. These findings parallel the high concern for marine health issues such as oil or sewage pollution where it is possible for a non-expert to make a clear connection between an event and a negative effect. This may be because of the ease of understanding such issues, or due to an anthropocentric perspective which prioritises issues which cause potential harm to humans. Marine ecological health issues, such as habitat degradation and loss, loss of biodiversity or the effects of climate change, do not have these clear, direct, human health connections. They do not fit within the existing social perceptions of environmental concerns, making them invisible to the public (Nassauer, 1992), creating a barrier to communicating their importance. The ability of high profile species to connect social attention to complex issues may provide an opportunity to raise awareness of invisible marine environmental health issues.

6.2.1 Chapter Aims

Social values of both species and issues appear to contrast with ecologically defined marine health values. This chapter uses a national survey to assess the gap between these two value sets. The survey is developed around a series of species questions and health questions which address the following research questions:

1. What are the public perceptions of UK marine species?

2. What implications do these perceptions have for selection of Spokes Species and communication messages?

3. How does the high profile of CMF influence perceptions of marine environmental health?

4. Do visual issues dominate public perceptions of marine environmental health?

6.3 Methods

6.3.1 Survey delivery

The survey was delivered by ICM research as an internet survey (see Section 5.5.2.1). The survey was conducted over two days in February 2009. The survey was piloted on 180 respondents in a face to face questionnaire in the University of Plymouth Student Union. Although the method of pilot survey delivery differed from the final method, the pilot survey still gave the opportunity to test the questions and revealed a number of changes included in the final survey.

The pilot survey had a high response rate allowing a series of different surveys to be tested; these included a range of species from which the final suite selected, and the limit to four species in Q6 was set. The health questions included in the final survey (Q7 and 8) include nine statements; this was reduced from the 12 included in the pilot study due to respondents commenting on an excess of information. Statements were also made as concise as possible in the final survey. The pilot survey also identified which questions were essential to retain for the final survey with some questions being removed.

6.3.2 Survey Questions

The full survey can be found in Appendix F.

6.3.2.1 Interaction

The survey opened with three questions based on respondent interaction with the coast. This provides background information about factors which may influence respondent familiarity with the marine environment. These questions introduce the subject of the marine environment and are easy for respondents to answer as they relate to something about the individual, before asking more knowledge based questions.

6.3.2.2 Species questions

The species questions were based around twelve UK marine plants and animals (Table 6.1). A series of criteria were defined with the aim of selecting a group of species which would be representative of UK marine life, whilst reflecting ecological, economic and charismatic values. The selection criteria included being taxonomically and functionally representative, species which were commercial, non-commercial, charismatic, or ecologically important (determined by ecological health score in Chapter 3). All species are found subtidally, although some are also intertidal. Most species are UK wide in distribution. Table 6.1 details the species and justification for inclusion.

Species	Latin name	Justification
Brittlestar	*Ophiothrix fragilis*	Echinoderm, similar to familiar intertidal starfish
Cod	*Gadus morhua*	Commercially important, fish
Dahlia anemone	*Urticina felina*	Subtidal anemone, anemones familiar from intertidal
Harbour seal	*Phoca vitulina*	Mammal, charismatic
Kelp	*Laminaria hyperborea*	Plant with typical seaweed appearance, keystone, high health score
Maerl	*Lithothamnion corallioides*	Biogenic reef species, keystone, high health score, unfamiliar
Native oyster	*Ostrea edulis*	Bivalve, commercially important, familiar food item
Norway lobster	*Nephrops norvegicus*	Crustacean, commercially important
Puffin	*Fratercula arctica*	Charismatic bird species
Sand mason worm	*Lanice conchilega*	Annelid, unfamiliar, mid health score
Seagrass	*Zostera marina*	Plant, linked to seahorse, keystone, high health score
Seahorse	*Hippocampus hippocampus*	Non-commercial and charismatic fish

Table (6.1). Justifications of species included in Survey 2. Species represent a particular taxonomic group and a range of values are reflected by the whole group, including: ecological (high health score in Chapter 3 analysis), commercial importance, charismatic and unfamiliar species

The three species questions were selected to give data on opinions and judgements of species, investigating whether prior knowledge of a species influenced interest. Q6 identifies the most interesting species: those which have the widest appeal as potential Spokes Species. The data gained from Qs 4 and 5 allow a more thorough interrogation of the interest results. Photos were accessed through the Marine Life Information Network (www.MarLIN.ac.uk) webpage with direct correspondence with the copyright holders to gain permission for use.

6.3.2.3 Health questions

The health questions opened with a short description of what was meant by healthy in this application. This was necessary in order to give the respondent an understanding of what was being asked, but a challenge to do accurately without leading the answers.

Respondents were presented with a set of nine statements as potential descriptors of a healthy marine environment (Q7), and a further nine unhealthy statements (Q8; Table 6.2). As with the species questions, the statements aimed to reflect a variety of value perspectives of the marine environment. Ecologically important concepts and the MSFD GEnS descriptors were a key source to develop statements (EU, 2008, Appendix A1). Marine factors recorded as important in previous public surveys were also included, in addition to socio-economical factors which reflect the breadth of socio-ecological systems. Some of the statements were paired, having a version in both the healthy and unhealthy question. Table 6.2 outlines the statements and justification for inclusion.

6.3.2.4 Socio-demographic and value questions

Maslow Group was measured through the inclusion of ten statements, as provided by Cultural Dynamics (see Section 5.5.2.1 and Appendix F for statements). Standard socio-demographic questions were also included by ICM. Answer options for questions 2 and 4-8 were randomised to remove any potential for sampling bias.

6.3.3 Data analysis

SPSS 16.0 for Windows was used for analysis. T-tests were applied to gender data. Variables with more than two categories were analysed using a Kruskal-Wallis test, with a Tukey HSD PostHoc test to identify any differences found. A Spearman Rank correlation was used to test for a relationship between distance lived from the coast (Q3) and frequency of coastal visits (Q1), and species interest (Q6) and ecological

Q7 Healthy – full statement	Abridged statement	Justification
Clean beaches – no litter or sewage	*Clean beaches*	Marine litter GEnS descriptor (10), visual issue
Clear or blue water	*Clear water*	Visual issue
Many different plants and animals live there	*Diversity*	GEnS descriptor (1) and ecological health
Thriving local fishing industry	*Fishing*	Socio-economic, ecosystem approach, GEnS descriptor (3)
Big animals like whales and dolphins can be seen	*Megafauna*	Charismatic species
Parts of the sea are nature reserves– like the National Parks we have on land	*MPAs*	Policy and conservation
Enough plants and animals for the food chain to work properly	*Food chain*	GEnS descriptor (4) and ecological health
Areas which scientists say is healthy or important	Scientists	Public trust of scientist opinion over personal judgment
Having plants or animals which are regionally, nationally or globally important	Endemic species	Ecological importance, regional identity

Q8 Unhealthy – full statement	Abridged statement	Justification
Lots of litter on the beach or out at sea	*Litter*	Marine litter GEnS criteria (10), visual issue
Murky or brown water	*Murky water*	Public perception issue from NE survey
Not many types of plants and animals live there	*Low diversity*	GEnS descriptor (1) and ecological health
High unemployment in local fishing industry	*Fishing unemployment*	Socio-economic, ecosystem approach, GEnS descriptor (3)
No big animals like seals or whales	*No megafauna*	Charismatic species
No areas of the sea protected from human activities	*No MPAs*	Policy and conservation
Fish/shellfish not fit for humans to eat due to contamination	*Contaminated seafood*	GEnS descriptor (9)
The habitats where the plants and animals live have been damaged	Habitat damage	GEnS descriptor (6)
Close to a large city	City	Urban areas possibly linked with poor environmental health

Table (6.2). Justification of health statements included in Q7 and Q8. Statements in italics show linked pairs. Food chain (Q7) is linked to contaminated seafood (Q8) due to human place in the food chain but also relates to the ecological importance of the food web. GEnS criteria statements in Appendix A1.

value. Maslow Group data were sent to Cultural Dynamics for analysis using their established model.

6.4 Results

6.4.1 Overview of respondents

A total of 1047 respondents completed the survey. Analysis of socio-demographic variables showed these respondents to have a good representation of the UK adults. Gender was well split with 48% male, 52% female, whilst age and geography showed similar distribution to the most recent UK data (Office for National Statistics, 2007).

The Maslow Group analysis showed a slight variation from the current data for the UK population. This survey was 43% Pioneers, 19% Prospectors and 38% Settlers; the UK average is approximately 40/30/30% respectively. This variation from the UK distribution is possibly an artefact of the survey method. Analysis comparing responses of each group was conducted using proportions of each Maslow Group, therefore making the data viable for analysis. 13 respondents could not be analysed for Maslow Group reducing the sample size to 1034 for Maslow Group analysis.

The first questions revealed a reasonable mix of interactions with the UK coast. Respondents ranged in frequency of visits to the UK coast (Q1; Figure 6.1). Frequency of visits to the coast was positively correlated with distance lived from the coast (Q3; rho = 0.362, P <0.001, n = 867 (excluded respondents who selected 'I live on the coast' in Q1)). No relationship was found between frequency of visits to the coast, or distance lived from the coast and the types of activities done at the coast. The most popular activities are walking (74%) and visiting the seaside (71%). A quarter of respondents reported 'looking for wildlife' on UK coasts. Those activities which involve an individual being on or in the sea, rather than just on the beach or coastline, were selected by 18%. 13% do no activities at all.

6.4.2 Species questions

The species questions revealed a high level of familiarity with UK marine species (Q4; Figure 6.2). Charismatic species were most familiar with puffin (recognised by 95% of respondents), seahorse (93%) and seal (78%). Cod was also well recognised (89%), most likely due to its strong commercial value and its presence as a staple in the British fish and chip shop. Two of the three plant species were well recognised; kelp (74%) and seagrass (65%). Maerl is the third plant species in the survey but has a less typical seaweed appearance; it was the least familiar of all the species

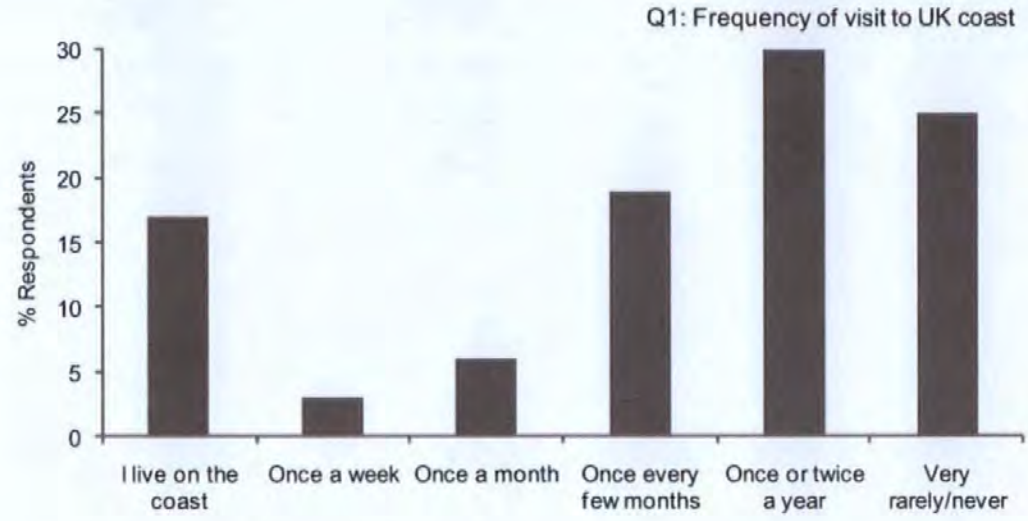


Figure (6.1). Results of survey questions Q1 'Approximately how often do you visit the UK coast or sea?' n = 1047

(6%). Invertebrates were the least familiar group with the Native oyster (60%) and Norway lobster (49%) being most familiar. Alongside maerl, brittlestar (10%) and sand mason worm (8%) were the least recognised species.

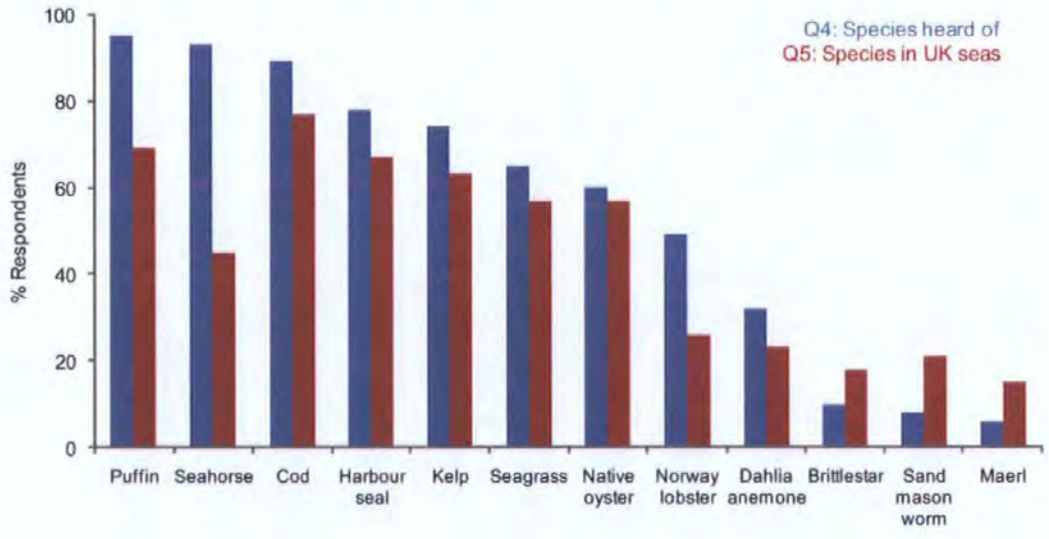


Figure (6.2). Responses to Q4 'Which of the following plants and animals have you heard of or recognise?' (blue bars) and Q5 'Which of the following plants and animals do you think can be found in the seas around the UK?' (red bars). n = 1047

The results to Q5, asking respondents which species were thought to be found in UK seas, show a distinct pattern (Figure 6.2). Species which were recognised in Q4 by over 30% of the respondents all show a lower percent of respondents citing them

as being found in UK seas, whereas those species heard of by less than 10% were thought to be in UK seas by a higher proportion of respondents than had heard of them. Puffin and seahorse are of particular note, being heard of by over 90% of respondents, but with only 69% and 45% of respondents thinking they are found in the UK. Norway lobster is recognsied by 49% of respondents, but only thought to be in UK seas by 26%, likely due to its name.

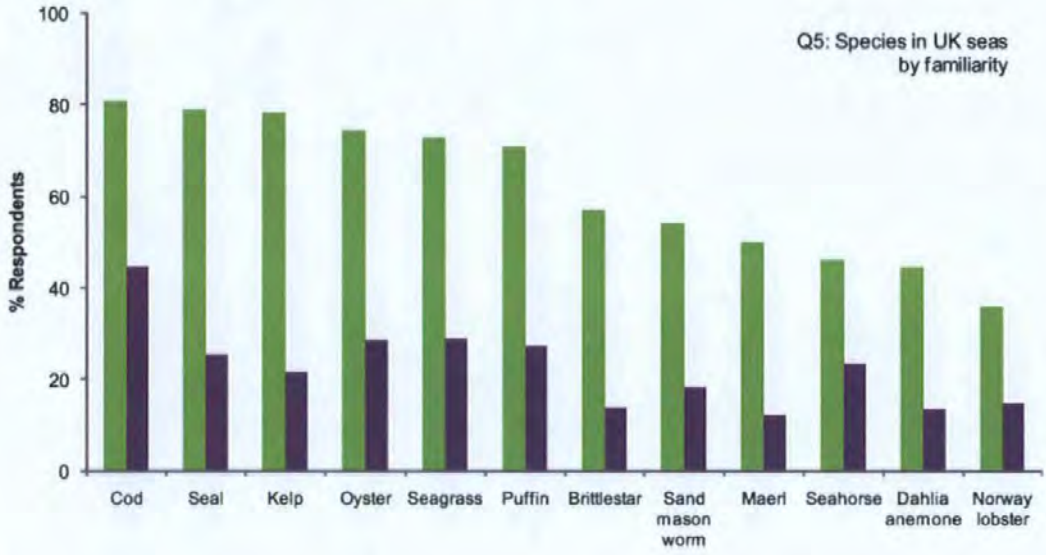


Figure (6.3). Responses to Q5 ('Which (if any) of the following plants and animals do you think can be found in the seas around the UK?') based on whether the respondent had heard of the species (answer in Q4). Respondents who had heard of the species and also selected it as being found in the UK (green bars). Respondents who had not heard of the species but selected it as being found in the UK (purple bars).

Familiarity of a species may influence awareness of its presence in UK seas. Figure 6.3 shows the proportion of respondents who had heard of each species who also thought it was found in UK seas (green bars) compared to the proportion who had not heard of a species but did think it was found in UK seas (purple bars). Two key results are shown; firstly, people who had heard of a species are more likely to know it is found in the UK than those who had not heard of the species, and secondly, respondents who had not heard of a species were willing to make a judgement about something unfamiliar. The Norway lobster was lowest for both these groups, possibly due to its name.

Figure 6.4 shows the results of Q6 asking which species respondents would be most interested to learn more about. Respondents could select up to four of the twelve species. Three groups are evident; the top scoring charismatic species of seal, puffin and seahorse, all with approximately 60% of respondents selecting them.

Secondly, a lower interest group consisting of Norway lobster, cod, dahlia anemone and native oyster selected by 20 - 25% of respondents. Thirdly, an 'uninteresting' group of plants and invertebrates selected by fewer than 13% of respondents. 13% of respondents selected none/don't know, showing no interest in any of the species.

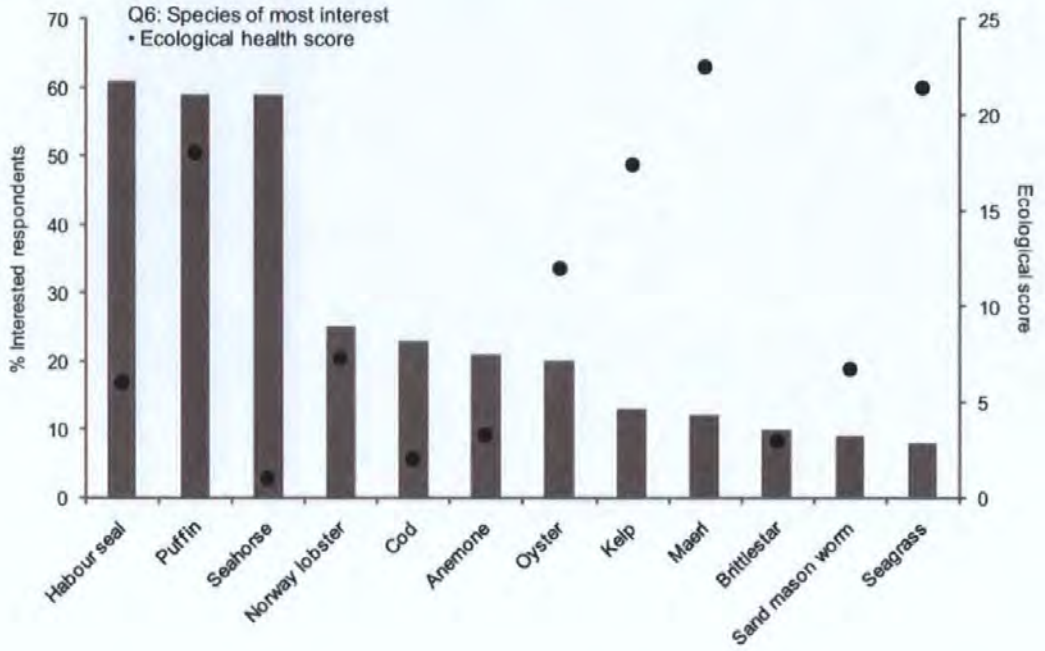


Figure (6.4). Results of Q6 (grey bars) 'Please select up to four pictures to show which plants and animals you would be most interested to learn more about.' n = 1047. Black circles show ecological health score (from Chapter 3).

The findings of Q6 show a strong pattern of interest, led by the charismatic and megafauna species (Figure 6.4). In Chapter 3, species were analysed for their ecological health score. Figure 6.4 shows that the lowest interest species are generally those with the highest ecological score, reinforcing that ecological value is not currently interesting in comparison to charismatic species. (Note the limitations of comparability of health scores between plant and animal groups, as described in Chapter 3.) A Spearman rank correlation found there to be no significant relationship between these results (rho = -0.361, P = 0.249, n = 12).

Differences in knowledge of species, recorded in Q4 and Q5 was compared with differences in interest (Q6) to investigate whether socio-demographic or value factors infleuenced perceptions of species. This revealed three patterns of responses relating to education level, gender and Maslow Group.

Anaylsis of perceptions by highest completed education level showed a number of differences in knowledge but only one difference in species of interest (Table 6.3). Respondents who had a university level education had heard of more species and were more likely to think a species was found in UK seas. These show that the

different groups had quite different knowledge about the species. However, these differences were not reflected in the interest of species which found only one significant difference (Table 6.3); knowledge difference in species as a result of education had no effect on interest in species.

Q4 Species heard of		F value	P value
Seahorse	Post > Sec	3.896	0.016
	Post > Deg		0.041
Dahlia anemone	Deg > Sec	2.997	0.032
Native oyster	Post > Sec	9.512	<0.001
	Deg > Sec		0.004
Kelp	Deg > Sec	3.711	0.035
Maerl	Post > Sec	5.429	0.003
	Post > Deg		0.01
Sand mason worm	Post > Sec	3.938	0.041

Q5 Species in UK		F value	P value
Harbour seal	Post > Sec	4.444	0.023
Puffin	Post > Sec	5.494	0.009
Seahorse	Post > Sec	3.089	0.045
Norway lobster	Post > Sec	3.752	0.018
Dahlia anemone	Deg > Sec	4.269	0.015
Native oyster	Post > Sec	7.728	0.004
	Deg > Sec		0.009
Kelp	Deg > Sec	3.312	0.031
Maerl	Post > Sec	3.323	0.03

Q6 Species of interest		F value	P value
Maerl	Deg > Sec	4.006	0.037

Table (6.3). Significant differences of species knowledge (Q4 and Q5) and interest (Q6)of respondents categorised by highest acheived education level. Respondents still in education omitted from analysis (n = 71). Secondary (Sec) n = 548, university degree (Deg) n = 327, postgraduate (Post) n = 101. df = 973. No P value indicates no significant result.

In contrast, the opposite pattern was found in analysis by gender (Table 6.4 and Figure 6.5). There are few differences in the knowledge of species between males and females (Q4 and Q5). However, considerable differences exist in what species were of greatest interest to males and females (Figure 6.5). Firstly, a significantly larger proportion of females answered Q6; 91% of females compared to 83% of males (P <0.001). Seven significant differences between species interest were recorded; males were more interested in Norway lobster, cod and native oyster, all the edible species; females were more interested in puffin, seahorse, dahlia anemone and maerl.

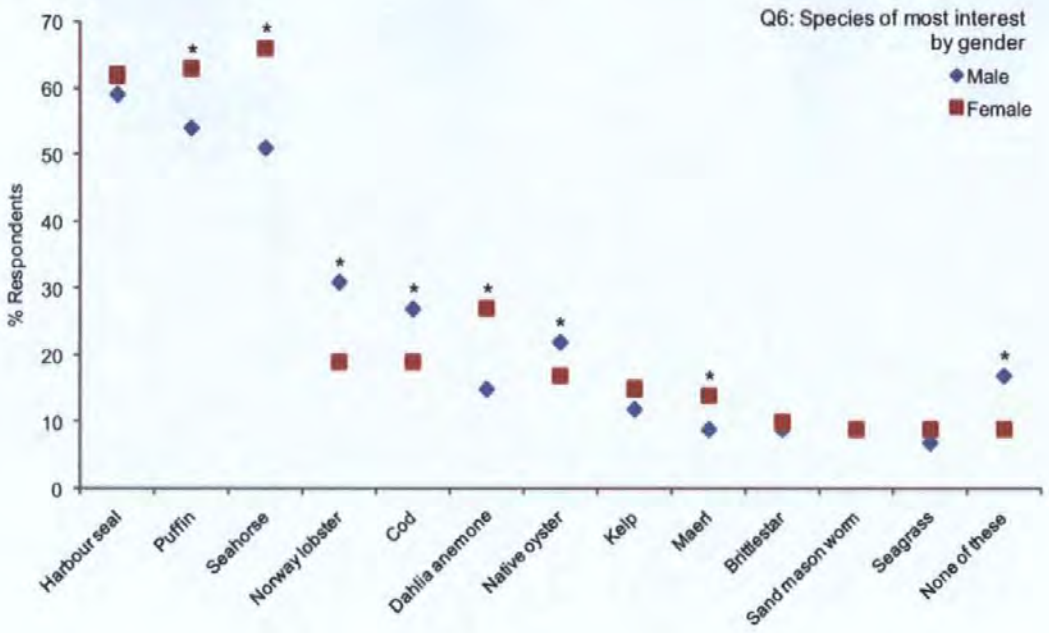


Figure (6.5). Results of Q6 'Please select up to four species which you would be most interested to learn more about' by gender. Male n = 499, female n = 548. * Indicates significant result; see Table 6.4 for P values

The results above show clear patterns in perceptions varying with gender and education level. Analysis of differences in perception by Maslow Group are not as clear but some key differences were recorded (Table 6.5). Overall, Pioneers were most different on all three questions. Three species had notable differences in Q4: Pioneers were more likely to have heard of seal and oyster than either Prospectors or Settlers, whilst all three groups were different for kelp. Pioneers were more likely than Settlers to have heard of brittlestars. The differences in Q5 were greatest in the more popular species - five of the six significant differences were in the top six scoring species. Pioneers are more likely to think that a species was found in the UK than either Prospectors, or in some case both Prospectors and Settlers. The only significant difference of the lower scoring species in Q5 was dahlia anemone which Pioneers were more likely to think was found than Prospectors. In Q6, asking species interest, the Settlers were significantly more likely to select none/don't know than the Pioneers - 17% of Settlers, compared to 8% of Pioneers (Prospectors 12%). Of those respondents who did answer the question, the usual pattern of interest emerges with seal, seahorse and puffin considered the most interesting to all three Maslow Groups. This is despite differences being recorded in the familiarity and association with UK seas relating to the puffin and seal between the Maslow Group respondents. However, differences in species interest between the groups is found in the lower scoring species, with the Pioneers being more interested in the less well

	Q4 Heard of	Q5 Found in UK	Q6 Interest
Harbour seal		Male > female F = 23.2, df = 1043, P = 0.016	
Puffin			Female > male F = 27.4, df = 1032, P = 0.003
Seahorse			Female > male F = 58.6, df = 1026, P <0.001
Norway lobster			Male > female F = 76.7, df = 989, P <0.001
Cod			Male > female F = 36, df= 1005, P = 0.003
Dahlia anemone			Female > male F = 85, df = 1030, P <0.001
Native oyster			Male > female F = 16.6, df = 1014, P = 0.042
Maerl			Female > male F = 23.2, df = 1036, P = 0.018
Seagrass	Female > male F = 37.3, df = 1021, P = 0.001		
None/ Don't know	Male > female F = 30.4, df = 764, P = 0.008		Male > female F =67.3, df = 931, P <0.001

Table (6.4). Significant differences of species knowledge (Q4 and Q5) and interest (Q6) of respondents categorised by gender. Male n = 499, female n = 548. No P value indicates no significant result.

recognised and ecologically higher scoring species. The result for Dahlia anemone shows Pioneers (more likely to think they are found in the UK than Prospectors) are more likely than the Settlers to be interested. Pioneers are more likely to be interested in maerl, brittlestar and sand mason worm than either the Prospectors or Settlers, these being the three lowest recognised species in Q4. The only previous difference in these species is that more Pioneers had heard of brittlestars than Settlers (14% of Pioneers vs 8% of Settlers).

A final analysis of the species data shows that those respondents who do not engage with the marine environment, through visiting or doing activities when at the coast, are more likely to answer none/don't know to the species questions. Table 6.6 shows the figures for those not answering the species questions to be considerably higher in the unengaged groups.

6.4.3 Health questions

The final two questions measured perceptions of the health of the marine environment. The paired nature of some of these descriptors allowed the responses to be triangulated (Table 6.2). The highest scoring statement for both healthy and unhealthy questions related to beach and sea cleanliness, 62% healthy and 61% unhealthy (Figure 6.6). Contaminated seafood, an unpaired statement, was selected by 60% of respondents in the unhealthy question (Q8). These answers form a set of

Q4 Species heard of		F value	P value
Harbour seal	Pio > Pro	7.762	0.003
	Pio > Set		0.029
Native oyster	Pio > Pro	9.811	0.002
	Pio > Set		<0.001
Kelp	Pio > Pro	9.053	<0.001
	Pio > Set		0.001
	Pro > Set		0.036
Brittlestar	Pio > Set	2.439	0.019

Q5 Species in UK		F value	P value
Harbour seal	Pio > Pro	7.762	<0.001
Puffin	Pio > Pro	9.671	<0.001
	Set > Pro		0.028
Dahlia anemone	Pio > Pro	3.117	0.035
Native oyster	Pio > Pro	9.811	<0.001
	Pio > Set		0.001
Kelp	Pio > Pro	9.053	0.002
	Pio > Set		0.001
Seagrass	Pio > Pro	8.932	0.001
	Pio > Set		0.001

Q6 Species of interest		F value	P value
Dahlia anemone	Pio > Set	5.031	0.007
Maerl	Pio > Pro	11.562	<0.001
	Pio > Set		<0.001
Brittlestar	Pio > Pro	6.414	0.007
	Pio > Set		0.009
Sand mason worm	Pio > Pro	8.347	0.002
	Pio > Set		0.002
None	Set > Pio	9.04	<0.001

Table (6.5). Significant differences of species knowledge (Q4 and Q5) and interest (Q6) of respondents categorised by Maslow Group. Pioneer n = 449, Prospector n = 189, Settler n = 395. df = 1032. No P value indicates no significant result.

responses linked by a visual/human judgement based factors.

The second highest set of answers are those relating to ecological concepts and GEnS criteria; in healthy (Q7) food chain (55%) and diversity (50%) and in unhealthy (Q8) damaged habitat (48%) and low diversity (46%). In both the healthy and unhealthy questions, megafauna was considered to be the least important indi-

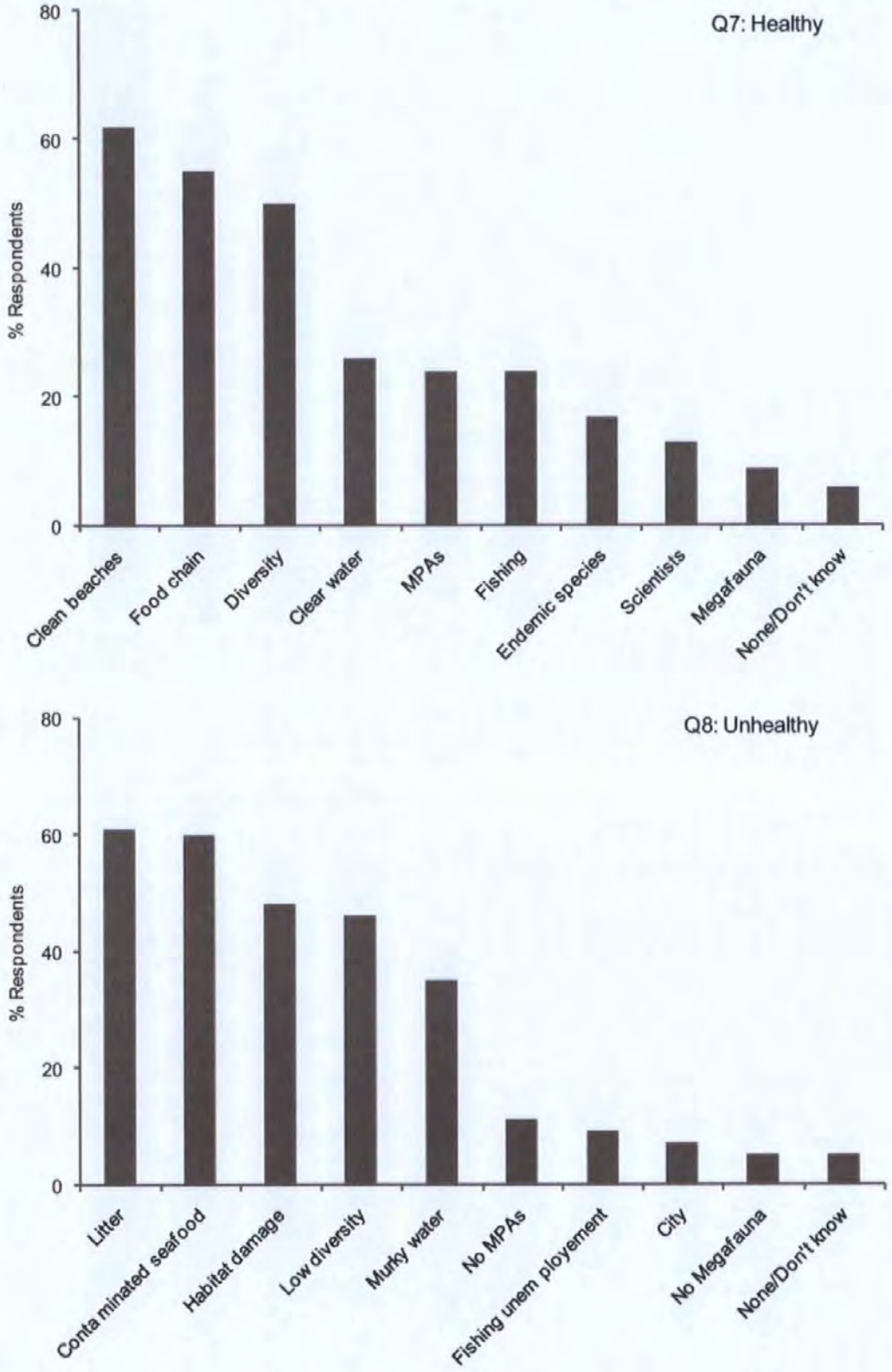


Figure (6.6). Responses to health questions, Q7 'Select up to three statements which you think best show a healthy marine environment.' Q8 'Select up to three statements which you think best show an unhealthy marine environment.' n = 1047.

	Visit coast rarely/never	Visit at least once a year*	No activities	One or more activities*
Q4 Heard of	8	0-2	13	0-4
Q5 In UK	17	5-9	27	2-10
Q6 Interest	23	9-11	36	4-10

Table (6.6). % of respondents answering none/don't know to species questions (Q4-6) categorised by interaction with the coast. Diamond shows the range of responses from all other categories, respondents visitng the UK coast once or more during the year.

cator of marine health (<10%).

Answers which were paired ranked similarly in both questions. Differences in rank are explained by the presence of the non-paired statements (Figure 6.7). The presence of the non-paired statements has influenced the statement ranks in each question - the two single statements in Q7 (regionally important species, scientists) both scored low (17% and 13%), but contaminated seafood in Q8 scored very highly (60%). Respondents were limited to three responses; therefore the presence of a high scoring unpaired statement influenced the ranks of the other statements. When this is taken into account, the middle scoring paired statements of clear/murky water, presence/absence of MPAs and fishing industry are evenly ranked in both the healthy and unhealthy questions.

There was a greater consensus in healthy statements, with three over 50% and the rest under 25% of respondents. Responses to the unhealthy statements did not result in a clear top scoring set. Five statements were selected by over 35% of respondents, and the lowest four selected by less than 11% of respondents (Figure 6.6).

The analysis of socio-demographic variables showed weaker patterns than those in the species questions, however, differences are found between Maslow Groups (Figure 6.8; Table 6.7). Pioneers are again the most different group showing more recognition of ecological concepts. Pioneers are more likely to select food chain (Q7) and habitat damage (Q8) than both Prospectors and Settlers and are more likely than Prospectors to select low diversity (Q8). The fourth ecological statement of diversity as a healthy descriptor (Q7) found no differences in opinion between the three Maslow Groups.

In the paired clear water/murky water statments, Pioneers were significantly less likely than the Prospectors or Settlers to think these showed a healthy or unhealthy environment (Table 6.7). There was also a recorded difference in the contaminated

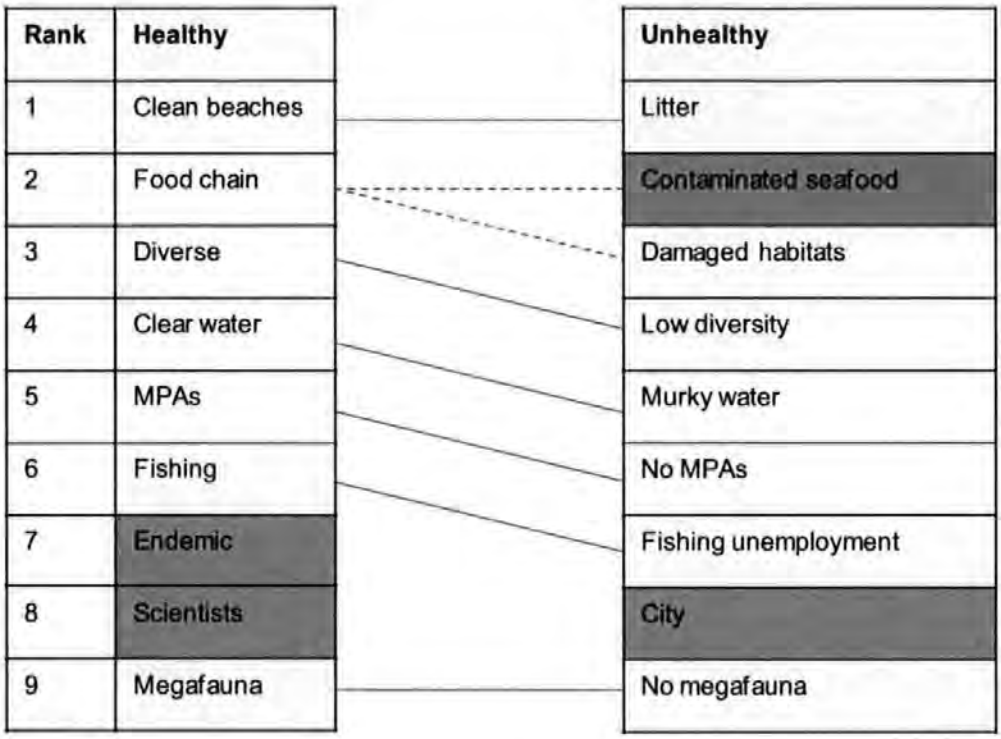


Figure (6.7). Ranked order of healthy (Q7) and unhealthy (Q8) statements, showing pairs. Shaded statements unpaired.

seafood score, with Pioneers being more likely to select this than Prospectors. The highest scoring statements of clean beaches and litter had no significant differences in opinions between the three Maslow Groups. Although a low score response for all three groups, Pioneers were twice as likely ($P < 0.001$) as Prospectors or Settlers to judge health on scientific opinion.

6.5 Discussion

This survey has revealed some contrasting patterns in public perceptions of the marine environment. The results from the species questions show a domination of interest in CMF over those species with the greatest ecological value. The results from the health questions show that there is a strong public awareness of the importance of diversity, habitat integrity and ecological concepts vital to marine environmental health, whilst megafauna are comparatively unimportant. These results show an interesting contrast between aesthetic appeal and ecological value.

6.5.1 Species questions

Q4 showed a good level of familiarity with UK marine species. Unsurprisingly, charismatic and commercially important species were most recognised. The famil-

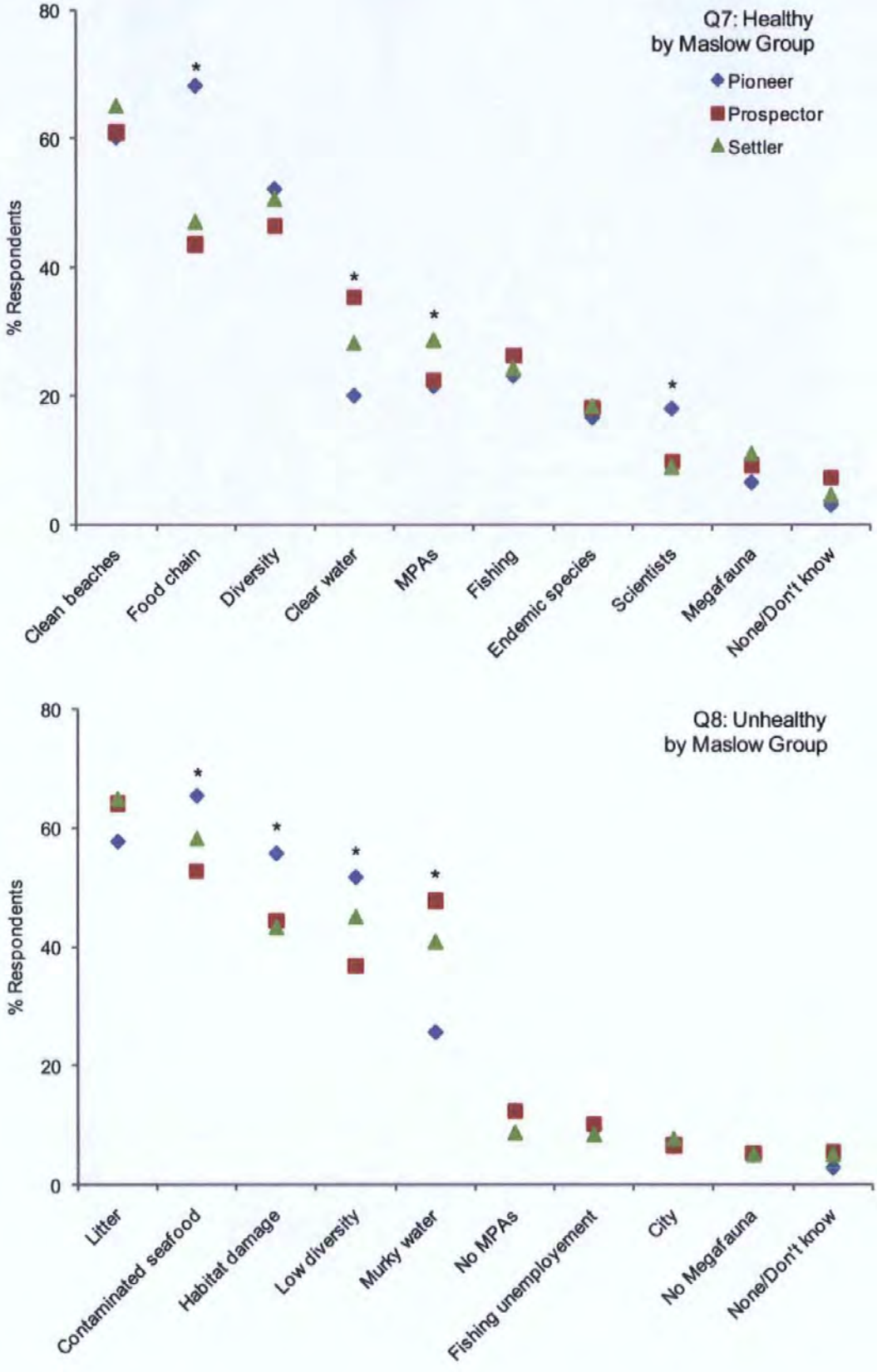


Figure (6.8). Responses to health questions by Maslow Group. Q7 'Select up to three statements which you think best show a healthy marine environment.' Q8 'Select up to three statements which you think best show an unhealthy marine environment.' Pioneer n = 449, Prospector n = 189, Settler n = 395. * Indicates significant result; see Table 6.7 for P values

Q7 Healthy		F value	P value
Food chain	Pio > Pro	26.685	<0.001
	Pio > Set		<0.001
Clear water	Pro > Pio	8.74	<0.001
	Pio > Set		0.02
MPAs	Set > Pio	3.109	0.047
Scientists	Pio > Pro	9.145	0.012
	Pio > Set		<0.001

Q8 Unhealthy		F value	P value
Contaminated seafood	Pio > Pro	4.948	0.009
Habitat damage	Pio > Pro	7.384	0.025
	Pio > Set		0.001
Low diversity	Pio > Pro	6.032	0.002
Murky water	Pro > Pio	18.511	<0.001
	Set > Pio		<0.001

Table (6.7). Significant differences in results to health questions of respondents categorised by Maslow Group. Pioneer n = 449, Prospector n = 189, Settler n = 395. df = 1032. No P value indicates no significant result.

iarity of kelp and seagrass fits with the results from the Natural England survey, where over 50% of respondents cited seaweed as something they would expect to find in the English undersea environment (Rose et al., 2008). These results suggest that seaweeds are a well recognised component of British sea life.

The results also give a measure of perception of the diversity of UK seas. Figure 6.3 shows that unfamiliarity with a species did not prevent respondents making a judgement of whether they thought the species was found in the UK. Previous studies have found the opinion that UK seas are not seen to be as 'good' as seas in other countries (Natural England, 2008). This perception may lead respondents to associate exotic and charismatic looking species with something not likely to be found in the UK, whilst those less colourful or impressive looking species, for example the sand mason worm, may be perceived as more likely to exist in UK seas due to their unremarkable appearance. Both puffin and seahorse were thought to be in the UK by a low proportion of respondents compared to their familiarity. This reflects a knowledge gap in the diversity of UK marine species, and also reveals a particular pessimism relating to CMF in UK seas. The seahorse is a small, subtidal species and may be more strongly associated with warmer seas. Puffins can be seen from land and are promoted as local icons, but there is still a large difference between the familiarity and association of this species with the UK. This was not found with the Harbour seal, which was both well recognised and strongly associated with the UK,

possibly due to their visibility on beaches. I speculate that a similar result to the puffin and seahorse would have been found if a dolphin or whale species, rather than seal, had been used to represent marine mammals, due to their pelagic nature. CMF represent the most visually impressive species of the sea; Prospectors, in particular, need species such as these to overcome their strong negative perceptions and connect with the marine environment. This low association of familiar CMF species with UK seas is an opportunity to promote marine life to a wide audience, in particular those who currently have more pessimistic perceptions.

As predicted, the pattern of species interest (Q6) was dominated by the three charismatic species: harbour seal, puffin and seahorse. This fits with the factors described by Kellert (1996) as being important for positive species attitudes. It reinforces the success of megavertebrates used as flagship species and the importance of consideration of these factors when selecting Spokes Species. Familiarity with a species seemed to have little relevance to interest; interest in cod may be influenced by diminishing stocks, either making it less appealing as there is thought to be few left, or more interesting due to concern to prevent extinction. Seagrass and kelp were in the lowest interest category, reflecting the low appeal of plants compared to animals (Wandersee, 2001). The interest in the top three suggests a considerable curiosity value: a zoo-like appeal. Larger animals attract greater attention from zoo visitors (Ward et al., 1998) reflecting the greater interest in vertebrates over other species. This survey suggests that this focus of curiosity value translates to wild animals.

The survey did not measure knowledge of species or understanding of their ecological functions; however, these results do not suggest that concern for marine environmental health is being expressed through interest in ecologically important species. This is likely to be due to a number of factors such as lack of knowledge of ecological role of species or lack of concern for marine environmental health, both leading to a detachment of single species from any broader environmental issues. It is possible that the impacts of human activities on marine health are easier to associate with charismatic species, partly due to interpretation of these species as more similar to humans and their capacity to feel pain, but also due to the visual nature of their suffering. Strangulation from plastic wastes and damage caused by oil spills are related to seals, birds and other mega vertebrates; the 'out of sight, out of mind' nature of impacts which undermine ecological functioning are less direct in their links to these species, and less likely to promote an emotional response. The relationship between knowledge of an issue and response is complex; being in possession of knowledge does not necessarily lead to concern or behaviour change (Kollmuss and Agyeman, 2002, Chapter 2). However, absence of awareness and understanding

of an issue will certainly lead to an absence of concern. Species interest is driven by curiosity, and either due to lack of knowledge, lack of concern or more likely a combination of the two, ecologically important species are not deemed interesting.

The limitations of the selected list of twelve species is an unfortunate restriction of this survey method but does not detract from the strength of the findings. It is possible that the species have implications for their wider animal group. For example, the Norway lobster was the fourth most interesting species (25%). Although this is lower than the interest in the top three species, this still shows a reasonable level of interest, particularly when considering the strong dislike and fear of inverterbrates (Kellert, 1993). The previous chapter describes crabs as being a well recognised component of the English undersea environment. Norway lobster may have scored lower in all the species questions because of its name; perhaps the same picture with 'scampi' would have been better recognised or of more interest. However, any increase may then have been due to food rather than species interest. The recognition of crabs as part of the English undersea (Natural England, 2008), and the relatively high interest in Norway lobster, suggest that crustaceans are potential Spokes Species which could improve the attitudes towards marine invertebrates. This supports the use of species which are not traditional CMF, but could still be successful communication tools if they appeal to particular social values (Bowen-Jones and Entwistle, 2002).

The themes found in education show that respondents with a higher level of completed education were more positive about the species found in the UK seas, recognising a greater number of species and identifying more species as living in UK seas. It is unlikely that this is due directly to being taught about marine environments, as the number of university educated students in the survey who attended a marine course is likely to be relatively small. Familiarity with species was also found to lead to a more positive perspective of species with UK seas (Figure 6.3). Previous studies have illustrated the links between education level and values (Barney et al., 2005, Thompson and Mintzes, 2002, Kellert, 1996)). The differences in education and optimism of UK seas did not influence respondent's interest in species, suggesting that there were no differences in values expressed as a result of different knowledge. It is possible that the high appeal of the charismatic species overwhelmed any underlying values differences, or that the motivations for interest in the species differs between the groups. This warrants further investigation.

Respondents reporting limited interaction with the coast more often selected the none/don't know options in the species questions, showing a lower knowledge, disinterest and greater pessimism of the seas. Personal experience of an issue, place or environment provides informal education; primary rather than secondary informa-

tion is received. This has been found to build greater attachment to an environment, a particularly strong influence in early years, with research showing that children who play in and experience wild environments having a greater affinity and appreciation for wild areas as adults (Miller, 2005). Although it is unlikely that respondents who visited UK shores had encountered most or all of the species in the survey, they are likely to have encountered some form of marine life. Those who rarely or never visited the coast do not have such an experience to guide their opinions of UK marine life and therefore may be more likely to make uninformed, pessimistic judgements. Falk et al. (2007) describe the importance of free-choice learning, i.e. learning through activities which an individual chooses in order to pursue personal interests and curiosity, as a powerful source of science information. This also suggests that those choosing to visit the UK coast may extend this interest into secondary channels of information, for example, TV programmes on the local marine issues. It is not possible to know whether those respondents not choosing to visit the UK coast do so because they are less interested, have less interest in the marine environment because they lack the personal experience to inspire their interest, or live further away. The recognition of experience as a factor in forming environmental values, and the results from those respondents who visit the UK coast, suggests that there are potentially positive outcomes from these personal experiences. Barriers which currently limit coast visits, whether they are due to a lack of interest or other factors, need to be investigated and opportunities to increase interactions identified.

The high appeal of experiences with CMF was described above (background to this chapter). The most encountered CMF species on UK shores would most likely be birds and seals. Far more frequent, and easy to observe, are invertebrates and plants, particularly in rockpools. It is likely that a large proportion of the 25% of respondents visiting the UK coast to look for wildlife did not see many CMF species but did see less charismatic species. Given the results discussed above, it is possible that these species are also providing important wildlife viewing opportunities, which, in turn, may support more positive associations with the UK coast. This illustrates the importance of both experience and non traditional CMF species for developing environmental awareness and values (Lindemann-Matthies, 2005).

The findings of the gender theme showed a pattern which supported a number of previously recorded findings from surveys in non-marine environments. There would be no reason to expect that gender would lead to considerable difference in the knowledge about marine species. The increased male interest in cod, oyster and Norway lobster reflects the more utilitarian views more frequently held by males (Thompson and Mintzes, 2002, Miller and McGee, 2000). These species are popularised

through their use as food species which can be fished or farmed.[1] Males were also significantly less interested than females in the puffin, seahorse, dahlia anemone and maerl; species with no obvious utilitarian value. These species are also aesthetically appealing, with intricate detail and potentially more feminine colours. In general females appear likely to show more humanistic and moralistic values (Thompson and Mintzes, 2002, Kellert, 1996); the increased female interest in these species reflects these less utilitarian values, and interests driven by more intrinsic values. Knight (2008) found no difference in opinion of aesthetic attitudes between genders. However, the survey was carried out only on undergraduate students, suggesting that the university education influence may be greater than the gender influence. When the university respondents in this survey were analysed for gender differences some were found, but only half the number of those for the whole survey.

These findings suggest that there may be different motivations for males and females to be interested in marine species. These differences may in turn influence the perceptions of species by males and females, causing different and potentially conflicting interpretations of species based communications. Further investigation of the motivations for species interest, and the values males and females attribute to species, is needed to guide the development of Spokes Species communications.

The variance in opinions found between Maslow Groups reflects existing profiles of the groups established from previous surveys of marine perspectives and general characteristics (Chapter 5). Pioneers were most different; they are the first group to be interested in new ideas and issues. Pioneers are also the most optimistic about UK marine species (Q5) which would be expected from the results of the previous survey where they showed the most positive responses in relation to English undersea environment. The variations in species interest showed Pioneers to be more interested in the least recognised species, again reflecting Pioneer intrigue in new and unusual items. In contrast, Settlers preferred the familiar whilst Prospectors were drawn to things which look 'the best'. There were no significant differences in interest in the top three species. This shows the strength of the charismatic appeal of these species. However, unlike in most other results, Prospectors showed the highest interest. Prospectors are a potentially difficult group to engage with UK seas due to their pessimism and fear (Natural England, 2008, Rose et al., 2008); their interest in the marine environment appears to be driven by form rather than function. This marginal increase in Prospector interest warrants further investigation of how charismatic Spokes Species could be used to engage Prospectors in the marine environment.

[1]Only 4% of respondents cited recreational fishing as a leisure activity they pursue at the coast (Q2).

Perceptions of species reflect many influences, knowledge, values, experience, culture, history and biology (Kellert, 1996). The pessimistic perceptions of UK marine flora and fauna are a reflection of poor information and lacking awareness of diversity. Overwhelmingly, the results from the species questions showed that the charismatic species attracted most attention and interest. Ecologically valuable species attracted little interest despite many being familar. Particular factors may make less charismatic species suitable for delivering particular messages or appealing to paricular audiences, for example, unusual species which appeal to Pioneers. These findings suggest that charismatic species will attract the widest public attention, but that there is also scope to develop less traditional species if they connect to specific interests or audiences.

6.5.2 Health questions

As would be implied by previous research (Hinds et al., 2003, Spruill, 1997), it was predictable that the litter and sewage issues were likely to score highly in the health perception questions. However, in contrast to the species questions, the ecological statements were also highly recognised as being relevant to marine environmental health: species diversity, habitat degredation and intact food chain were thought to be some of the best indicators of the health of a marine environment. A similar finding was recorded by Montgomery (2002), who asked respondents to rank importance of hypothetical species each having a particular attribute. Ecological functions were rated as most important over utilitarian, aesthetic, symbolic and humanistic values. This was both in a statement of a specific ecological function (a tiny species whose function is improving soil structure) and also a general ecological statement (a species whose function we do not understand, but think it could be important in an ecosystem). These were rated as the top two factors to define species' importance. Czech et al. (1998) also found that, despite negative perceptions of certain animal groups, respondents recognised the ecological importance of all species. Apparent ecological importance and rarity were considered the most important factors to prioritize species for conservation. These examples show that there is good public recognition of the importance of general ecological principles. The ecological statements in this survey, however, show that this recognition exists at a more detailed level. The ecological statements described, in lay-terms, ecological principles, but did not state that they were ecologically important. Therefore, the high selection of the ecological statements in this survey illustrate a deeper level of understanding and value. These results show a convergence in the social and ecological values of marine environmental health.

A surprising result in the health questions is the lack of importance given to the presence of megafauna as indicators of marine health. This is in contrast to the earlier results from the species questions which showed CMF to be the most widely appealing species. This is also in contrast to the links between high profile marine conservation issues and CMF, such as litter and oil pollution effects. This adds to the evidence that public recognition of the factors which underpin ecological health is higher than may previously have been thought. It also suggests that the interest in species (Q6) is driven by curiosity value, and not through a link to concern for marine health. This suggests that less charismatic species may be more suitable to communicating ecological messages of marine health than CMF.

To optimise the delivery of ecological messages, it would be beneficial to identify if there is any variation in perceptions of the measures of health of the marine environment, and if so, which groups show the greatest importance of which factors. Maslow Group analysis showed that that Pioneers were more likely to select the ecological statements (Figure 6.8). Pioneers have a greater understanding of the holistic nature of the world and the interactions between components and processes: they may be less likely to depend on direct connections to an issue in order to understand it as having detrimental implications. This is evident in the differences between the food chain statement (Q7, healthy) and the contaminated seafood statement (Q8, unhealthy). Pioneers are more likely to select food chain as an indicator of marine health than either Prospectors or Settlers. Pioneers appear to identify that the benefits of a functioning food chain go beyond the plant and animal components within it, potentially identifying humans as needing the species to support their own food supply. In Q8, the contaminated seafood statement makes a connection with human food supply being damaged due to poor marine health. This receives a similar proportion of Pioneer response to the food chain statement, but a higher proportion of Prospectors and Settlers. This shows that Prospectors and Settlers are more reliant on a direct human connection than the Pioneers. This direct contact is made with the importance of visual indicators signifying marine health. Prospectors and Settlers put greater importance on the state of the water as a measure of health than the Pioneers, interpreting murky water as poor health. This illustrates an important misconception, as water clarity is not an accurate measure of ecological health; estuaries are usually murky due to their slow flow rate and heavy load of fine suspended sediment, but this is not due to poor ecological health. These findings suggest the importance of clear and direct connections between an environmental issue and human health as a measure of environmental health (Patel et al., 1999) may be more applicable to the perceptions of Settlers and Prospectors than to Pioneers, who are more able to make connections between themselves and the wider ecosystem. This

is an important finding for the development of communication strategies, and selection of Spokes Species to deliver ecological messages. Species which make direct connections between the marine environment and provision of goods and services to society will be most relevant to Prospectors and Settlers. Pioneers may show greater interest in more ecologically relevant species, particularly given their interest in unusual species (Q6; Table 6.5) which include those with a higher ecological health contribution.

A number of health statements were similarly rated by all three Maslow Groups, illustrating those issues which have wide relevance. The clean beaches statements were equally scored by all three groups; however, these were the most important statements selected by Prospectors and Settlers in each question, but the second for Pioneers (behind food chain and seafood contamination). The healthy statement describing diversity was highly, and equally, scored by all groups. This is the only ecological statement which had no differences between groups, perhaps showing a greater understanding of the importance of diversity over other ecological statements. The fishing statements were equally selected, but perceived to be relatively poor indicators of marine health (ranked 6^{th} and 7^{th} out of nine statements). This suggests that the socio-economic links between marine health and fisheries are not being made, or their magnitude not well understood. This is despite of the importance placed on contaminated seafood. The links between ecological health and socio-economic health influence many industries in the UK and therefore these connections may be a key theme for communication. These links also provide an opportunity to illustrate the direct, humanised effects of ecological health, which may be of particular interest to Prospectors and Settlers.

6.6 Conclusion

This survey aimed to better understand public perceptions of the marine environment. The results showed a considerable familiarity with UK marine species, but also a pessimistic perception of UK diversity, particularly with reference to CMF. Interest in species is driven by curiosity value and does not appear to reflect wider marine health understanding. Experience of the UK coast and knowledge of species led to a greater awareness and interest in marine species. Differences in interest also reflected a number of other values, particularly evident in different values of males and females with males driven by utilitarian and female by aesthetic interests. Pioneers also showed a particular interest in unfamiliar species, being more interested than either Prospectors or Settlers in the three least recognised species.

Ecological indicators of health were considered more important than previous

studies of concern would suggest. These results also illustrated an understanding of some specific ecological concepts rather than recognising the general importance of ecological issues. Further investigation into why these concepts are considered important indicators of marine health would reveal how closely the social and ecological values overlap. Health indicators with clear, direct human connections were particularly important, although the Pioneers showed greater understanding of those issues which had less obvious human implications. Despite the focus of interest in species being on CMF, megafauna were not considered to be important measures of marine health.

These findings suggest that a range of species would be suited to selection as Spokes Species, and could be used to deliver various marine environmental health messages. These would need to link to the curiosity value which makes CMF appealing to a broad audience, connect the marine environment with direct human benefits and services, and also link to the intrinsic and aesthetic values of the wider ecosystem.

Chapter 7

Species Focus Group

7.1 Introduction

This section of the project investigates the findings of Survey 2 by using focus groups to further understand the associations made by participants with each of the species. The Survey 2 results provide a UK representative study of perceptions of marine species, but do not show why the species are perceived as interesting, or not. Focus groups were therefore used to investigate the following questions:

1. What associations do participants hold with each species?
2. How do these associations differ between males and females?
3. Are there any existing links from these species to ecological health concepts?

Answering these questions can provide further insight into how species are perceived by non-expert audiences, which can highlight opportunities to connect Spokes Species to ecological health concepts.

A number of the findings from Survey 2 (Chapter 6) are relevant to this chapter. The species questions (Qs 4-6) revealed a high level of familiarity with UK marine species, but a low association of certain species with UK seas (seahorse and puffin, Figure 6.2). The most interesting species to respondents were charismatic vertebrates; harbour seal, puffin and seahorse, with species of most ecological value being seen as least interesting (Figure 6.4). Considerable differences in interest in species between males and females was recorded, with males showing greater utilitarian values and females greater aesthetic values (Figure 6.5). Maslow Group also showed some variation in species interest, most notably with Pioneers being particularly interested in unfamiliar species (Table 6.5). Assessment of criteria to indicate the health of a marine environment showed contrasting results to the species questions; charismatic megafauna (CMF) were considered to be the least relevant

indicator of health, whilst ecological concepts were rated as second most relevant. The different values shown by males and females were explored in the focus groups, along with other findings relevant to understanding further associations made with the species.

In addition to the 12 species included in Survey 2, the focus groups include phytoplankton and zooplankton. Plankton are an important component of marine ecosystems because of their involvement in many ecological functions and processes. They were not included in Survey 2 as they represent a group, rather than individual species, making comparison against other single species difficult. Despite their high ecological importance, plankton have not been studied for use as communication tools or to assess public perceptions. Plankton are a group of organisms which can potentially relate to many values; their many forms create a variety of images, they have biogeochemical importance, and they also play an important role in the food chain. Their inclusion in the focus groups thus allows an assessment of whether plankton may be a useful direction for future work on public perceptions of the marine environment.

Due to resource limitations, it was only possible to conduct two focus groups to investigate these themes. It is recognised that this limits the applicability of these results to the wider population. However, this chapter is useful as a pilot study and highlights the validity of applying this approach in the future to further investigate the findings of Survey 2.

The chapter details the methods of the focus groups, describing the tasks undertaken by participants. The results and discussion section details the subjects discussed during the focus groups, identifying themes according to the questions above: the associations made with the species; responses by males and females; and links between species and ecological concepts. Other themes which emerged during the focus groups are also discussed. The contribution of these findings to the development of Spokes Species is discussed throughout.

7.2 Methods

7.2.1 Participants

The focus group participants were a group of neighbours, most of whom knew each other socially. The group consisted of five married couples, aged between 45 and 64, living in the same postcode in a suburb of Nottingham. Most were educated to university level although one participant had no higher education. None had a biological or conservation background. The groups were divided by gender, with

each group having 5 participants. Maslow Group analysis showed the male group to be four Pioneers and one Settler, whilst the female group was three Pioneers and two Prospectors.

This group represented a very specific demographic compared to Survey 2, which the survey profile suggested was representative of general public opinion. This allowed many variables to be held constant to investigate the effects of gender on perceptions of the species presented. This group structure nevertheless limits the applicability of the results to the wider population; this process would need to be repeated with groups representing wider socio-demographic factors and a broader geographic range in order to provide a nationally representative context in which to investigate these research questions fully. However, the selection of these participants provides the opportunity for tentative examination of differences in opinions between males and females, whilst controlling for other variables.

7.2.2 Group format

The two groups completed the same tasks, involving showing four sets of photographs to the participants in succession, one group at a time (Table 7.1; photographs as in Survey 2, Appendix F, and printed A4 size). Participants were then asked to discuss or record their associations with species in that set and to comment upon things they thought were interesting about the species. Participants were told that all species shown were found in UK seas. Paper and post-it notes were provided to record comments. Additional notes were taken by the facilitator. The photographs included the species name but gave no additional information. Prompt questions were asked by the facilitator only when discussions stopped, for example, if there were particular negative or positive associations with the species. All discussions were audio recorded. Following an introduction to the process, an example was given of a photograph of an earthworm with various comments around it to illustrate the task.

Set	Species
Vertebrates	Cod, harbour seal, puffin, seahorse
Invertebrates	Brittlestar, dahlia anemone, Norway lobster, native oyster, sand mason worm
Plants	Kelp, maerl, seagrass
Plankton	Phytoplankton, zooplankton

Table (7.1). The four sets of species. Each set was given to the groups in the order shown, with discussions recorded by species within each set.

For the plankton groups, the photographs were composites of several major phy-

toplankton and zooplankton orders. Participants were given a short introduction to the photographs: 'This last group has two photographs which show groups of organisms. Plankton are small, often microscopic organisms which live in the sea. Phytoplankton are small plants, zooplankton are small animals.' This was to ensure differences between the two plankton groups were known and, therefore, that discussions would explore the different perceptions of each.

7.2.3 Data Analysis

Transcriptions of the focus groups, in addition to notes made by participants and facilitator, provided a comprehensive text record of the discussions. These were analysed using QSR NVivo7 qualitative analysis software, which allows coding of themes within a hierarchical arrangement. The coding allowed an analysis of the types of understanding, issues and values expressed by the groups in association with the species (Table 7.2).

Value/association	Detail of value
Aesthetic	Positive Negative Neutral/descriptive
Utilitarian	Direct e.g. provision of food Indirect e.g. benefits from an ecosystem function recognised
Personal association	Experience of the species Association with the UK/locations named Know nothing of the species
Species – understanding or questions relating to what the species did or where it was found	Specific location identified Particular habitats cited Species functioning – related to an aspect of the what the plant or animal did (but not ecological) Eating method Structure
Ecological – description of role of the species within the ecosystem	Food chain Other specified ecological function
Conservation issues	Climate change Pollution Habitat damage Fisheries

Table (7.2). Hierarchy of coding of associations discussed by participants. This method allows identification of particular values or themes expressed by a group, or in reference to particular species.

7.3 Results and Discussion

This section details the results and discussion of the focus groups in response to the three questions above (Section 7.1) and gives an overview of how the focus groups functioned. The species associations are described by species group (vertebrates, invertebrates, plants and plankton) and a discussion of the key themes raised. This is followed by a discussion of the differences and similarities recorded between the species associations made by the male and female focus groups. The connections between single species and ecological health concepts are then discussed, followed by a series of emergent themes relevant to species associations.

7.3.1 Overview of the focus groups

The groups were both given the same guidance as to the functioning of the focus group but differences emerged in the way the groups ran. The females quickly agreed to discuss the photographs between them. The males were less keen to discuss, preferring to record their own opinions on post-it notes. Some comments were discussed after participants had finished thinking about each photograph in the group but not as much as the females, despite prompts from the facilitator. After all the photographs had been seen a more relaxed discussion developed. It seemed the males were concerned about saying the wrong thing in front of their peers. This is possibly an artefact of the familiarity of the group, but also of the relatively high achieving nature of the individuals.

Despite their different operating styles, each focus group lasted around 1.25 hours and a considerable amount of data was gathered from both groups. Comments were made about all species, even those which were unfamiliar. Species which were unfamiliar to the participants were also those which were least familiar in Survey 2 (Figure 6.2). Much of the discussion about unfamiliar species was based on interpretations of the photographs. During these discussions, participants would often state that they were not confident that their comments were accurate.

For most species, participants asked questions to the facilitator relating to the species. Although these questions were not answered during the discussions, they are still recorded as they illustrate the thoughts associated with the species. They also illustrate the types of connections people make from the species to other parts of the ecosystem or aspects of the sea, highlighting the types of knowledge they would like, but do not currently have. Females tended to ask more questions.

7.3.2 Species Associations

7.3.2.1 Vertebrates

The male and female groups discussed many similar issues for these four species (Table 7.3), but there were more ecologically related comments from the female group. Personal encounters with harbour seal, seahorse and puffin (the three most interesting species in Survey 2, Figure 6.4) was mentioned frequently, either from seeing them in the wild, in aquaria or as a desire to see them. Strong UK associations were made with the harbour seal (South West Wales, Isle of Skye), cod (North Sea, UK fishing industry) and puffin (Skomer Island Reserve, Hebrides), although the puffin was thought to be rarely seen. Particpants knew that seahorses were found in the UK, but were still surprised at this; they were considered to be exotic and more strongly associated with tropical seas. This supports the findings of Survey 2 which identified the puffin, and particularly the seahorse, as having low association with the UK compared to their high familiarity (Figure 6.2). These associations can be used to develop particular messages: Settlers are interested in tradition and regional or national identity and therefore may be more interested in the harbour seal and cod due to their strong UK associations. Prospectors may be more interested in seahorses due to their exotic associations.

The three most interesting species in Survey 2 (harbour seal, puffin and seahorse, Figure 6.4) all prompted positive aesthetic comments as the primary response from participants. These often included anthropomorphic comments, such as puffins being described as funny. Seals were noted for their looks and behaviour: '*live in families and looks after their young, so we can relate to them*' (female). These aesthetic and human associations support Kellert's (1996) reasons for high social value of CMF.

Although one might predict that interest in CMF is dominated by aesthetic appeal, further discussions around all vertebrate species included a number of conservation issues. These included references to climate change, food chains, habitat loss, fisheries and management, covering some of the most ecologically important marine health issues (GESAMP, 2001). This shows that species which are initially appreciated for their aesthetic value and appeal to a wide audience are connected to ecological health issues. A considerable challenge for the marine environment is that the complexity of marine systems and human pressures makes it difficult to find a 'polar bear' to make connections from a behaviour change to an environmental benefit. Discussions in both groups referred to climate change influencing sea temperature, sandeel prey availability and (the final effect of) declining puffin populations. The puffin thus provided a vehicle for the discussion of a complex

Species	Females	Males
Cod	Good as food. Human health risk as cod are bottom feeders/eat rubbish. Expensive. Discuss farming of cod and overfishing – local extinctions overcome with food source of farmed cod, but food chain impacts in North Sea. Cold waters.	Good as food. Recognition of overfishing and need to protect. Statement that there were plenty worldwide so local population extinctions wouldn't mean we couldn't eat it. Reply about local implications for change in food chain. Change in size of cod being caught - now smaller and too young, implications for population. Management of breeding grounds and breeding individuals.
Harbour seal	Positive aesthetics - cute, pet like, appealing, humans can relate to them due to human faces. Intelligent, inquisitive, family groups. Common animal (as in not rare). Negatives: culling/clubbing, dead seals on beaches after oil slicks, food for killer whales, susceptible to disease and disasters, vulnerable to fish shortages.	Sleeping, sunbathing, good swimmers, endangered/probably increasing in numbers. Seal clubbing/culling. Eat fish. Unsure of harbour seal - know common and grey seal.
Puffin	Positive/aesthetically appealing. Comical. Face adversity in nature. Colonies/crowds. Climate change. Particular locations. Wide appeal. Decreasing numbers.	Positive/aesthetically appealing. Comical. Face adversity in nature. Colonies/crowds. Climate change. Particular locations. Wide appeal. Decreasing numbers.
Seahorse	Positive initial response. Desire to see them. Exotic association. Males look after young. Unusual creature - particularly in movement. Fragile. Surprise at being in the UK. Aquarium link. Dragon like, unreal. Declining numbers due to habitat loss.	Positive aesthetical response. Rarely seen. Elusive. Don't know where in UK seen. Usually seen abroad. Only likely to see in aquarium. Exotic/warm water link. Different from other sea creatures; strange swimming action. Males raise offspring. At risk due to habitat destruction.

Table (7.3). Key discussions from focus group participants by vertebrate species

set of relationships (Slocum, 2004, Leader-Williams and Dublin, 2000), illustrating the potential to develop scientifically complex messages through high profile species among a certain (albeit selective) segment of the population. Marine monitoring data might therefore be used to strengthen the association of some marine species and climate change. From this, connections may be made from reducing carbon emissions to the benefits for puffin populations.

7.3.2.2 Invertebrates

Discussions of the invertebrate species included many positive associations (Table 7.4), in contrast to the overwhelmingly negative responses to invertebrates recorded in previous studies (Knight, 2008, Kellert, 1993); when negative associations were made, they were rarely based on fear or aversion. Most negative responses related to the vulnerability of species to human activities showing greater similarity to the negative perceptions expressed for the marine environment in general (Natural England, 2008) than those recorded specifically for invertebrates. The Norway

lobster attracted sympathy from both groups due to them being kept in tanks and cooked alive in restaurants. This identification of suffering is closer to Kellert's (1996) reasons for stronger associations with CMF than with invertebrates. The dahlia anemone was feared by one respondent who had been taught as a child that anemones sting; however this fear was countered with positive descriptions of its appearance. Respondents who did not like eating native oysters expressed the most negative responses '*don't like the look, wouldn't ever eat, won't touch*' (female).

Species	Females	Males
Brittle-star	Surprise at being in UK. Quickly linked to starfish. Exotic/tropical appearance. Seen in UK rockpools - but probably less now than there used to be. Concern that people take them out of rockpools. Discussed eating habits.	Colourful, camouflaged. Starfish relative? Ungainly out of water. Rockpool link. Cornwall. Not sure how they eat, if they do.
Dahlia anemone	Aesthetically positive. Looks tropical/exotic - colour. Lots of different anemones exist. Lots of questions: What eats it? How big is it? Where is its mouth? How does it eat? Would it suffer from pollution? Clearly deep water. Might sting.	Sting - won't touch them. Rockpools - not in deeper water. Beautiful colours. Not sure how they survive. Pretty.
Native oyster	Eating - some loved some loathed them. Poetic description of the eating experience, tasting the smell of the sea etc. Contrast of don't like how they look, wouldn't touch or eat them. Eat them live - difficult to open for this reason. Appearance off-putting, but have pretty shells. Historically cheap and almost a staple diet. Aphrodisiac. Indicator of water health.	Discussion about location - Ireland and SW link. Fossil link. History - used to be very cheap. Aphrodisiac. Good to eat/don't like divide. Vulnerability to pollution.
Norway lobster	Food association - assumption that it is the same as common lobster (which it isn't - different species). Aesthetically positive. UK found - Cornwall, rocky shores - but we export a lot rather than eat them. Strong cultural link - lobster pots at the coast. Farming discussion. Padstow/Rick Stein link/Coast TV series. Pain and cruelty from tanks in restaurants/transporting/cooking them live - but maybe they don't register pain due to their small brains.	Food association - discussion about whether it was common lobster. Discussion of different claws and colour. Feel sorry for them in tanks. Caught in pots. Most exported to Europe. Is it a Viking invader? Cornwall.
Sand mason Worm	Never heard of. Aesthetically positive. Casts on beach. Pembrokeshire/rockpooling link. What do they do? Are they prey? Doesn't look like a worm, more like an anemone or plant. Nocturnal.	Never heard of. Looks fragile. Scary if under feet. Not sure if shoreline or deep water. Maybe responsible for casts on beach. Looks like a hair brush.

Table (7.4). Key discussions from focus group participants by invertebrate species

Positive associations were made in reference to the aesthetic values of the inver-

tebrates. Several were considered to be colourful, exotic or tropical and there was surprise at their presence in UK seas. A number of the species were described as being indicators of the quality; '*must be healthy as I associate it with clean pristine beaches - another indicator of clean environment*' (female, sand mason worm). Although indicator comments were made in relation to the need to be aware of damage done by humans, there were associations that beaches where these species had been seen were healthy beaches, with invertebrates being used to make positive interpretations of the UK shoreline. Many references were made to seeing particular invertebrates (or similiar variants of the species shown) on UK beaches and in rockpools, which were often happy memories. The intertidal zone provided an important component of experiences in the marine environment, giving a glimpse of the subtidal zone from the safety of a terrestrial viewpoint; the positive associations recorded here are mainly based on personal experiences of this environment.

In contrast to the knowledge of complex processes associated with the vertebrate species, many questions were asked about functions and survival of the invertebrates, such as how they ate or moved, or where the organism's mouth was. This suggests less knowledge about the fundamentals of the animals - people know what the more familiar animals do; birds fly about and make nests, seals swim around, but the invertebrates are less well understood. This suggests that communications about invertebrate species would need to show different types of information than that for vertebrates, providing more details about the life history of the species.

Invertebrates in Survey 2 were scored as relatively uninteresting compared to the vertebrates (Figure 6.4). As shown from the diverse discussions (Table 7.4), invertebrates attract a wide range of associations, which are predominantly positive. The sand mason worm was not recognised by either group, and the brittlestar was interpreted as a starfish with some uncertainty around its identity. These were the two least familiar invertebrates in Survey 2 (Figure 6.2). These unfamiliar species were a source of curiosity and intrigue; although participants acknowledged uncertainty around their interpretations, they enjoyed describing the appearance and possible functions of the mystery species. This reflects a typical Pioneer characteristic of showing interest in unusual things, a phenomenon also recorded in Survey 2 (Table 6.5). The discussions of the invertebrates here suggest that there is the possibility to develop Spokes Species which do not meet the traditional characteristics of high profile species.

7.3.2.3 Plants

The three plant species were considered among the least interesting species in Survey 2 (Figure 6.4), supporting the idea of lower public interest in plants compared to

animals (Wandersee and Schussler, 2001). As with the invertebrates, the focus group revealed a variety of associations and discussion topics relating to these species (Table 7.5). The discussions had a focus on the plants as structures, for example, the size and scale of kelp forests, (also thought to be whale food, possibly due to its size), and to seagrass as '*a good habitat for fish to hide in and get protection*' (female).

Species	Females	Males
Kelp	Kelp forests. Definitely UK but also associated with US. Coastal. Sensitive to water, temperature or toxicity changes. Sources of iron. Can be eaten - particularly eaten in Wales. Is it seaweed? (Followed by discussion where they confused kelp with *Fucus spp.*, another seaweed). Don't want to touch it. Smell association - fresh, pleasant and like the sea but stinky and has flies on it when it's been on the beach a while. One of those things you only appreciate when you get older and think about its [ecological] relevance and beauty - not just as slimy seaweed.	Underwater forests. Very long and strong. Seen it washed up on shore. Associate with deep water. Rocky shores. Scotland. Equivalent of underwater trees. Only seen in aquarium. Can be in cosmetic products - so must be beneficial. Contains iodine and source of alginate. Fertiliser use. Crofting. Food - lava bread, Gower.
Maerl	Never heard of. Colourful - and therefore clearly not found in the UK. Exotic. Looks important in the food chain - questioned what else lives on it or eats it. May live at depth. Decided they were just guessing so didn't want to make any more comments.	Never heard of. Descriptions as Bombay mix, twiglets, stirfry. Wonder if it's mostly dead stuff - perhaps the krud from the bottom of a rock pool, mix of shells and bits of other animals. Rock looking. Looks like roots. Collective term. Is it a damaged/destroyed habitat?
Seagrass	Good habitat to hide in. Where are the animals [in the photo] - are they hiding or is it too late, have they been lost? (Also referred this comment to kelp.) In UK shallow waters. Seen washed up on beach. Odd to have grass underwater - oxygenates the water. Associate with matting. Negative: Think a lot has been destroyed already, think it could be damaged by anchors or trawlers. Don't like it in rivers - don't know what's in it.	Knew *Zostera*. Bottom cover - what does it root into? Hidden environment - eels/fish. Sandy waters. Indicator of water currents. Like land grasses. Seen on shore. Cosmetic claim. Protects seashore from erosion. Don't like when swimming.

Table (7.5). Key discussions from focus group participants by plant species

Maerl was unfamiliar to the participants, but as with the unfamiliar invertebrates, this led to the use of imagination rather than disengagement with the species (Table 7.5). Some observations of maerl were quite accurate, showing an application of wider environmental understanding. References were made to maerl providing a habitat, possibly due to the other organisms in the image. One comment also linked maerl to climate change '*a lot of coral is being destroyed through warmer water*

and different light - maybe the same as that?' (female). Maerl is a coralline algae, which forms a calcareous structure and is in fact also sensitive to temperature changes (Jackson, 2007).

Negative associations with these species were mostly linked to seeing (and smelling) rotting seaweed on beaches[1]. Seaweed on a strandline is possibly the most frequently seen example of marine plants; when it at its least attractive. An interesting statement described how perceptions of kelp (and possibly other seaweed) had changed over time '*it's the sort of thing you appreciate when you're older. As a child it's the stuff big brothers throw at you and it's wet and horrible and been on the beach for a while. But when you're a bit older, you learn more about it, you realise how important it is*' (female). This greater understanding of the ecological functions of the species, not direct human uses, led to a more positive association with the species. This again suggests that there are aspects of interest relating to marine plants, despite the traditional perceptions of them as essentially dull. The ecological importance of plants was raised by both groups and is discussed further below.

7.3.2.4 Plankton

Phytoplankton was described positively by both groups, particularly the male group (Table 7.6). Both groups recognised the diversity of the group, but without using the term biodiversity; '*incredible variety*' and '*lots of different patterns*' (males) were used instead. The female group in particular related their aesthetic appeal to suggestions of products using their images - floor tiles, placemats, jewellery and wallpaper. A male participant suggested that these would be just as good as puffins to headline a marine awareness campaign. This prompted responses about '*save the green slime*' and the lack of the ability to pat a phytoplankton on the head, highlighting the desire to experience something in order to identify with a bigger issue. The females cited this as a reason to be less concerned about phytoplankton '*Don't have any strong feelings about any of them because they don't look alive, they're just there as something for other things to eat. Too small for us to see in water*'. Their lack of size for some meant they lost appeal, but for others, their beauty outweighed their size.

Both groups thought that some of the photographs looked more like animals than plants, particularly dinoflagellates, which are colourful and have feathery appendages. Females thought they looked more like crystals or pebbles than something alive. They were described as being '*very small but very important*' (female, phy-

[1] An extreme example of this is the 'green tide' of sea lettuce (*Ulva lactuca*) which washed onto French shores during summer months due to nutrient input from agriculture, requiring considerable cleaning to maintain the tourist attraction of the beaches (e.g. BBC, 2009).

	Females	Males
Phyto-plankton	'Shows nature's amazing designs' - potential application as floor coverings, place mates. Looks like jewellery. Like little pebbles. Discussed shapes and influence of microscopy. No strong feelings. Some could be animals.	Very positive aesthetic descriptions - desperately attractive, stunningly pretty. 'Just as good as puffin or starfish for environmental campaign'. Lower down the food chain than zooplankton. Variety. Some look like animals. Long fossil record: 'good for dating'.
Zoo-plankton	Pretty. Intriguing shapes. Surprise at colour. TV link - awareness of diversity and as essential food for whales. Implied food chain but didn't say it - said it was vital. Questions of what it tastes like - different to fish. Negative appearance - similarity to nits, bed bug etc. Sci-fi. Not loveable/positive response. Modern technology discussion re recent plankton discoveries.	Some positive aesthetic associations, fascinating, 'good to engage children if they could be shown what's out there'. Some link to bed bugs, house mites - negative insect likeness. Do they bite? Don't look like they can swim particularly well. Diverse. Food chain importance. Whale/fish food. How many stay microscopic, how many grow up into recognisable/familiar creatures? Colourful.

Table (7.6). Key discussions from focus group participants by plankton group

toplankton). This wasn't expanded on, but the comment suggests that there is an unstated understanding of a food chain role. The male group recognised that these were the bottom of the food chain, and certainly below the zooplankton.

Both groups made similar observations about the zooplankton resembling insects; '*looks like a nit*' (Female), '*big fleas and little fleas*' and '*like house mites*' (Males). This gave more negative associations particularly with reference to biting insects. On a positive note, they were seen as fascinating and had aesthetic appeal due to their intriguing shapes. Further discussions considered the structures of the species, with attempts to identify the heads, tails and 'flippers'. This again shows a desire to understand how a species functions, and that something unfamiliar is a source of interest.

The features which inspired enthusiasm for plankton were linked to their structures and aesthetics. This is not the traditionally appealing aesthetics of CMF, but a fascination with something intricate and beautiful for a different reason. This is not why a panda is appealing, but perhaps is more akin to the aesthetic appeal of a cathedral or rock formation, but with the surprise that this is a living being.

No previous studies have been found which investigate public perception of micro organisms such as plankton except for in reference to biotechnology. In these surveys, there is a focus on perception of the risk of technology, rather than perception of the micro organism (where males are more positive about technological developments and females consider greater risks (e.g. Siegrist, 1998). These species are key to many of the ecological concepts described in this thesis, and potentially could be used as Spokes Species for ecological processes, particularly in reference to climate

change. The results from these focus groups suggest that this is a valid avenue for futher research to identify how to make such communications relevant to public interest for such unusual species.

7.3.3 Species Associations and Gender

Survey 2 found significant differences between interest of males and females in seven species (Figure 6.5). Differences were recorded in the discussions of the two focus groups for some, but not all, of these species. Discussions of the cod (greater interest to males in Survey 2) included a greater diversity of issues in the male group, with particular attention given to the management and status of cod stocks. Both groups recognised the dahlia anemone (greater interest to females in Survey 2) and were uncertain about it; the male group did not pursue this but the females asked many questions both about the functions of the species and the connections to the wider ecosystem. Similar discussions occurred in both groups for some species, such as puffin and seahorse, which had different interests in Survey 2. Factors other than gender were shown to influence perceptions of species, but were very similar across these two focus groups, e.g. Maslow Group and education level. The similarity recorded in previously distinct interest of species may be due to these factors, identifying that there are many variables which influence perceptions and interest.

A review of all the answers provided by each group, rather than the analysis by species, revealed some similarities and differences in the values expressed. Both groups made utilitarian references, particularly for the food related species. Males tended to focus more on the species itself: what it ate and how it moved, focusing their interest on understanding the functions of the species. Females made more aesthetic references. Females also quickly considered the species as part of the ecosystem rather than only focusing on the species itself which males tended to do. This often related to how the species fitted within the food chain and how it linked to other species. These discussions support the findings of Survey 2 (Chapter 6; Figure 6.5), which showed different values being held by males and females. These results add to this finding by illustrating the contrasting associations and reasons for interest in marine species. This provides an insight into the types of information which may be of greatest interest, and the need to develop messages around Spokes Species which relate to the survival of the species, but also the connections to the wider ecosystem.

In Survey 2, males were significantly less interested in all the species (Figure 6.5). In the focus groups, the males were more likely to state that they knew nothing about the species in question. Males also made several comments about how the experience

of the focus group had highlighted their ignorance to them; participants were able to give simple comments but felt that they had little actual knowledge. Although these are not direct measures of interest, and certainly both groups showed interest in the subject matter, it is possible that the males were more concerned about their lack of knowledge than the females, and this disengaged them from discussion. This may be an artefact of these participants that would not be recorded if the group were replicated, but also supports the Survey 2 findings.

7.3.4 Ecological Health Concepts

The focus groups were not structured to test participants' understanding or awareness of ecological health concepts; however, throughout the species discussions, a number of concepts were raised. The most frequently cited concept was the food chain, which was the most selected ecological statement in Survey 2 (Figure 6.6). Discussions about the food chain during the focus group were frequently in reference to the connections between species, discussing what each species ate or was eaten by, as well as an identification of human overexploitation of local populations damaging food chains. A conflict of utilitarian, conservation and ecologistic values emerged in both groups relating to cod stocks, based around the effects of population extinctions. In each group, one participant stated that it is not a problem if North Sea cod becomes extinct because it can be sourced for food from farming (females) or from other global cod populations (males). This was met by discussion about the implications of population extinction beyond providing a human food source. '*They're part of the chain, aren't they, so it has a knock on effect on the other species in the great scheme*' (female). The following section of transcript from the male group shows how this was developed between two participants:

Participant 1: Isn't it the case that it's only North Sea cod which are being fished to extinction? Plenty of other cod, Australian, Pacific cod, so if you want to eat cod you can.
Participant 2: What about food miles?
P1: Well it's available but at the extra cost
P2: But at what cost to other environmental parameters?
P1: My point is that on a world scale there's no shortage of cod, probably no shortage of anything really, it's just a question of where you want it from - not so easy from the North Sea or Newfoundland
P2: But what you don't know is what the knock on effect of not having that population, if it's part of the food chain and if that part of the food chain disappears

The implications of compromised cod stocks differed between participants within each group. It was recognised that the loss of a population could have negative impacts on the local ecosystem; this was an important consideration despite the specific details of such an impact not being known. The utilitarian view discounted these ecological impacts by viewing cod as a global population and prioritising the human food supply role.

Makatouni (2002) showed that consumers are aware of the health implications to themselves when choosing to purchase organic food, but that connections are also made to the well-being of animals and the health of the wider environment as part of the food production process. A consumer's selection of organic food is a mechanism which allows them to express various values including ecological citizenship values, reduction of perceived ecological footprint and human health benefits (Seyfang, 2006). This suggests that the food chain is a concept which connects direct human health effects (recorded by Patel et al. (1999) as a frequent connection to identifying environmental health risks) and wider ecological health.

Biodiversity was also referenced in the focus groups, through the diversity of particular species groups, for example the recognition of different anemones. This understanding of diversity within an animal group is an opportunity to use familiar species groups such as crabs, fish and seaweed (Natural England, 2008) as examples of marine biodiversity, illustrating the variety of functions and behaviours of different species.

Plant discussions referred to the provision of habitats as an important function; for example, kelp was described as '*supporting a myriad of sea life*' and therefore important to protect (female). This provides a link to those species identified as most important to ecological health (Chapter 3, Figure 3.3). This discussion also brought in a human connection with references made to trawling or anchors damaging seagrass and removing habitat. This shows participants making connections between ecological functions beyond the presence of a species and human influences. It is an opportunity for monitoring of ecological parameters, for example annual assessments of seagrass, to be used to communicate both the ecological value and effects of human behaviour choices. Both the Chesapeake Bay and Healthy Waterways public communication programmes (Chapter 2) use a group of submerged aquatic vegetation for this purpose (Chesapeake Bay Program, 2000, Ecosystem Health Monitoring Program, 2005). For example, the Chesapeake Bay Partnership website (www.chesapeakebay.net) provides fact sheets about 16 species of Underwater Bay Grasses described in terms of their links to the health of the Bay, and

ecological connections to other parts of the system with annual monitoring of their abundance.

The ecological concepts described by participants echo the high relevance of the ecological statements as indicators of health recorded in Survey 2, particularly evident in the Pioneer respondents (Figure 6.8). This illustrates an awareness of many important components of marine ecological health. In Survey 2, the invertebrate and plant species most important to these ecosystem functions were considered least interesting (Figure 6.4); however, the discussions here suggest that there is potential for ecological functions of less charismatic species to be a source of intrigue by illustrating how species survive and how they interact.

7.3.5 Further Emergent Themes

Personal experiences of marine life or environments were a strong and recurring theme, often expressed quickly as a person used them as a basis for their reference to the species being discussed. This was particularly true of rockpooling which was described as fond memories of childhood, which were then repeated as parents, and grandparents. Participants expressed enthusiasm when discussing species such as starfish (linked to brittlestar photograph) and anemones based on things they had seen, in some case 40 or 50 years previously. Aquariums were also mentioned as important experiences of species, such as seahorses or kelp, which are not easily seen in their natural habitat. Survey 2 found a similar result with respondents who interacted with the marine environment having greater interest in marine species (Table 6.6). Personal experience is recognised as important for developing developing environmental values and awareness (Miller, 2005) and the selection of recreational activites has been shown to be an important factor in post-education science learning (Falk et al., 2007). These findings reiterate the importance of developing communication strategies which facilitate personal experiences that encourage long term associations with the marine environment.

Negative associations came from a perception that biota were declining or suffering from pollution and damage from human activities. There was an overwhelming sense that things are not as good now as they used to be, '*Probably if I went back to those rockpools now there would be fewer of those species than there were a number of years ago*' (female). There was also a recognition of sessile species being vulnerable to pollution or contamination events. These responses echo the negative perceptions recorded about the wider marine environment and shame at the state of English seas and an association of environmental subjects with threats from human activities ultimately leading to 'bad news' (Natural England, 2008). These percep-

tions did not dominate species associations; there were many positive associations made with the species. However, development of Spokes Species needs to include an awareness of potential negative links that may be made with species to ensure positive messages are not diluted.

Colour was a theme within aesthetic descriptions which was important to the interpretation of a species, particularly its association with UK seas. Species which were brightly coloured were perceived as exotic or tropical, and were more likely to be associated with non-UK seas. Despite being told that all species were from UK seas, females agreed that maerl was not found in the UK on the basis of colour, and were surprised that UK seas were home to species which had a much stronger association to foreign, tropical or exotic shores. Colour was also important in Survey 2 where Prospectors favoured clear, blue water as a sign of marine health (Figure 6.8). These findings support the Natural England data (Natural England, 2008) where UK seas were seen as grey and not as diverse as tropical seas. This suggests an association of colour with marine environmental health. Many areas of UK seas may be healthy but are never blue, whereas many native flora and fauna are colourful and can be used to highlight the aesthetic appeal of UK seas, particularly in invertebrate based campaigns.

A number of current marine environmental issues were raised during the focus groups. Females made specific references to the role of television, particularly topics covered in series such as Coast and the Blue Planet, for example the export of UK lobsters, as a source of information on these issues. They commented that they felt they had retained more information than they realised from the programmes, but still felt there was a lot they had forgotten. Other media such as BBC Radio 4 was cited as a source of discussion on the state of cod stocks.

7.4 Conclusion

This study has further invesigated the findings of Survey 2 by identifying particular associations with marine species. In contrast to the different levels of species interest recorded in Survey 2, all species presented in the focus groups promoted discussions and aroused curiosity. Differences were noted between the associations made with various species groups. CMF were initially discussed in terms of their aesthetic values, illustrating the instinctive and positive responses to these species. Discussion quickly moved on to link these species to various conservation issues. This suggests that these species may have potential to be developed as a focal point for complex marine issues. This is a particularly positive result given the existing high interest in these species shown in Survey 2, and identifies the opportunity to develop marine

'polar bears'. Further investigation would be needed to identify if these associations are representative of the opinions of the wider population, in particular across broader socio-demographic and Maslow Group audiences.

Conservation links were made indirectly to invertebrate and plant species, with negative associations of these species predominantly related to the degradation of the marine environment due to human activities. This supports previous findings where assumptions of environmental damage contributed to negative perceptions of the marine environment (Natural England, 2008). This factor was not tested in Survey 2, but these results differed from the fear and aversion responses to invertebrates previously recorded (Kellert, 1993), and imply a complex set of associations with these species.

In contrast to the low interest in plants and invertebrates in Survey 2, many positive personal associations were made with these species. These included aesthetic, a use as environmental health indicators, positive experiences (e.g. rockpooling) and a general curiosity for the species. These findings are particularly positive for the development of communications about species which have greater ecological importance than those CMF species which can dominate public interest, but score relatively low on marine health attributes. In addition to this, the positive discussions around plankton suggest that this is a valid route for further investigations of perceptions and the potential development of communications around species particularly relevant to ecological processes.

The significant differences between species interest by gender were less evident in the focus groups than in the results from Survey 2. A number of species were discussed in particularly similiar terms, perhaps due to socio-demographic and values similiarities between the groups which were stronger than differences due to gender. Differences which were recorded suggest a different perspective between the two groups, where males concentrated on the functioning and use of the species in questions whilst females were more likely to connect the species to the ecosystem. This reflects the need to include a variety of messages connected to species which support an understanding of the individual species and also its wider ecosystem role.

The recognition of ecologial concepts as indicators of marine health in Survey 2 was a particularly surprising result. This was reinforced here through the awareness of concepts such as habitat formation and biodiversity. The food chain was the most frequently mentioned concept, as found in Survey 2. The discussions suggest that this was not entirely due to the direct human connection through consumption of seafood species, as many of the discussions related to the interactions between species as prey items. This is a reflection of the Pioneer's holistic worldview which values non-human components of the ecosystem. The food chain is a relatively simple

concept which is perhaps easier to identify with than others such as biodiversity. This concept can be used in communications to show the interconnections between species, in addition to the direct human connections with marine populations.

During the discussions, other themes emerged which gave an insight into factors contributing to participant's perceptions of species. Personal experiences of species, generally at the coast, but also through aquaria and TV, provided an anchor to the species from which it could be discussed. These included both positive experiences, such as rockpooling as children and parents, and negative perspectives such as seeing the effects of an oil spill first hand. Survey 2 also recorded an influence of experience with respondents who rarely or never interacted with the UK coast having less knowledge and interest in species. These results suggest that opportunities for people to connect directly with the coast are important for building stronger associations with the marine environment.

Survey 2 provided a representative measure of public perceptions of the marine environment, yielding some interesting results which are particularly relevant to the development of communication strategies. Further application of the survey findings can be made through the use of techniques such as focus groups to interrogate the findings in greater detail. The results gathered here suggest this is a viable method for the development of the Survey 2 findings into Communication Themes and Spokes Species.

Chapter 8

Final Discussion

8.1 Chapter Structure

This chapter draws together the findings of the previous chapters to inform the outputs of the thesis detailed in Chapter 1. Section 8.2 reviews the barriers and opportunities for engaging society with the marine environment. This incorporates the results of Surveys 1 and 2 and the focus groups in addition to findings from previous studies, and assesses them against the barriers to pro-environmental behaviour recognised by Kollmuss and Agyeman (2002). Section 8.3 then details a series of recommendations to operationalise these findings through the development of Communication Themes and Spokes Species. These seek to apply the findings of the thesis into communication strategies which will connect the different values of marine environmental health. Two Spokes Species are discussed as case studies to illustrate how this can be done for some of the most divergent values recorded. The final section considers the broader implications of the communication strategies and whether they address the barriers of engaging society with the marine environment.

8.2 Barriers and opportunities to engaging society with the marine environment

Previous studies have shown that negative associations dominate the public perceptions of the UK marine environment, both in terms of the emotional responses and the associated biota (Natural England, 2008, Rose et al., 2008). The scale and inaccessibility of marine environments mean most people's experiences are limited to the intertidal zone, with many ecologically valuable habitats remaining beyond consideration. Many of the greatest threats to marine health occur over large areas and long time scales, and are also relatively unseen from this vantage point. This

lack of visibility leads public audiences to have little connection with the marine environment beyond the coast. Participants asked about the undersea environment described it as looking like the surface of the sea, but under the water; flat, uninteresting and barren (Chapter 5, Natural England, 2008). These challenges make the marine environment a difficult subject either to promote the benefits or threats to its health.

Chapter 3 identified the characteristics of those species most relevant to monitoring regional marine environmental health from an ecological perspective: structural plants and invertebrates which create complex habitats and contribute to ecosystem processes. Survey 2 (Chapter 6) found that these species attracted the least public interest, showing the contrasting values of marine species. Further questions in Survey 2 found that, despite low interest in ecologically high scoring species, the concepts which underpin their ecological importance were considered to be important indicators of marine environmental health.

This identifies the challenges faced in communicating marine environmental health:

1. How to use species which are socially interesting to communicate ecological concepts to make them more relevant to socially uninteresting species.

2. Using existing positive perceptions of ecological health concepts to communicate the ecological importance of species currently regarded as uninteresting.

In Chapter 2, Kollmuss and Agyeman's (2002) model of barriers to pro-environmental behaviour was described (Figure 8.1). This model is used here as a framework for identifying individual barriers of engaging the public with the marine environment, and investigating how different barriers interact. The barriers are numbered, corresponding to Table 8.1, which describes how the research findings of this project, and other existing surveys, clarify these barriers in the marine environment. This section describes the barriers and opportunities, whilst the next section describes strategies to apply these findings, as detailed through the last column of Table 8.1.

8.2.1 Barriers

Survey 2 showed public pessimism of UK seas through the low association of species, particularly charismatic species, with UK marine environments; a result that was particularly evident in the Prospectors. This illustrates how the negative perceptions of the undersea in general are also relevant to discussions of particular species

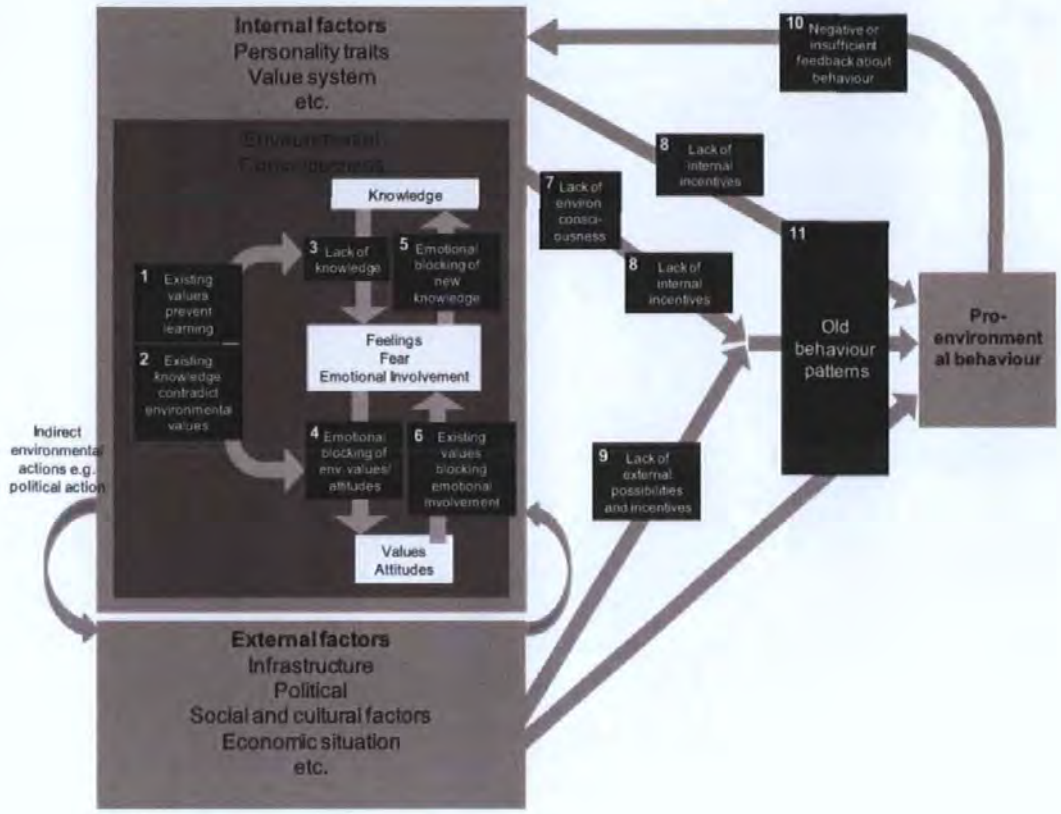


Figure (8.1). Barriers to pro-environmental behaviour (from Kollmuss and Agyeman, 2002). The model reviews the main barriers found to prevent pro-environmental behaviours, as illustrated by the black boxes. Numbers in the boxes are used to detail the barriers in Table 8.1.

(Natural England, 2008). The particularly low association of the puffin and seahorse with UK seas suggests that UK seas are not thought to be of high enough quality to support an aesthetically appealing species. This was also recorded in the focus groups, where species which were thought to look tropical or exotic were not thought to be likely to exist in UK seas. This identifies a lack of knowledge of the diversity of UK seas which may be due to the lack of experience of the particular species and environment. If this was the case, it would be less likely that a difference between the Maslow Groups would be detected as the opportunities for seeing these environments should be equally limited for all. This suggests that the results reflect the particular values of the groups, with Prospectors being more pessimistic than the Pioneers. This supports the findings of previous studies of general undersea perceptions (Rose et al., 2008). It is possible that this pessimism could reinforce the negative emotions created by the undersea (Natural England, 2008), therefore the lack of knowledge further disengages the public, particularly Prospectors. This illustrates the interaction between knowledge, values and emotions which create a series of barriers within the environmental consciousness component of the model

(Figure 8.1, barriers 1-6), showing how the 'out of sight, out of mind' nature of the marine environment results in particular barriers to engagement, and how these differ with social factors.

A particularly important result from Survey 2 was the contrast between interest in species, which showed Charismatic Megafauna (CMF) to be most interesting, against the indicators of health which recognised the importance of ecological health concepts. It is possible that the curiosity driven interest in CMF overwhelmed any

Barrier	Detail of barrier in marine - findings from thesis and other sources	Strategy to overcome barrier
1 - existing values prevent learning	Maslow Group analysis shows different interests in species e.g. Prospectors and Settlers more interested in familiar species (although for different reasons – Prospectors due to the aesthetic value and Settlers because they are familiar) whereas Pioneers are more interested in unusual species (often those with higher ecological value).	Tailor messages with different Maslow Groups in mind. Spokes Species include the familiar (puffin, cod), impressive (basking shark) and unusual (seagrass)
	Different values reflect more positive (Pioneers) and negative (Prospectors) perceptions of UK seas and associated life. Settlers fall between the two opinions, but closer to the Prospectors.	This influences the fundamental messages delivered; Prospectors and Settlers need reasons to be positive – Theme 1 Diverse Seas
	Implied lack of value due to lack of awareness of sea life (high proportion think under sea is barren).	Overarching positive messages that the seas are not barren. Theme 2 Marine Connections includes goods and services.
	Gender was found to have a strong influence on the values associated with the marine environment. There is also a suggestion that gender may influence the perspective from which the marine environment is interpreted.	A mixture of utilitarian and aesthetic values are used. Messages relate to both the particular activities of individual species and the wider ecosystem relevance of species.
2 - existing knowledge contradicts environmental values	Oil, sewage and litter are perceived as the biggest threats to the marine environment	Marine Connections begins to address these.
	People are not informed about the unseen issues such as habitat loss. Potentially a lack of connectivity of marine to climate change	
	Complex; providing new knowledge does not just replace the old knowledge, but can cause greater confusion. Discussion will be part of the solution	Theme 3 People's Seas, People's Science provides the beginnings of debate opportunities and two way communications and provides clear, accessible information.
	Perhaps links to the complexity of making debate/uncertainty of science more widely recognised	
3 - lack of knowledge (this underpins some of the negative perceptions)	Lack of knowledge of UK sea life e.g. presence of puffins and seahorses. General lack of awareness of UK marine diversity	Diverse Seas and Spokes Species: UK seas are still full of life.
	Awareness of issues, but little depth of understanding of how it undermines marine health	Marine Connections will describe issues with relevance to ecological and social impacts
	Lack of knowledge about interactions between species and ecological concepts	Stories within Spokes Species show connections e.g. seagrass as a habitat for other species.
	Lack of knowledge of how human activities impact the seas, and what functions are at risk - general background, referenced from a variety of surveys.	Marine Connections

Emotional blocking of (4) environmental values and attitudes and (5) new knowledge.	Negative responses and general pessimism for UK seas is a major barrier.	Defines the overall, positive stories to be used. Opportunities to reinforce communications with positive experiences.
	The most negative respondents in Survey 2 species questions were those who rarely or never visited the coast.	Theme 4 Coast Proficiency provides positive experiences at a young age.
	Large scale issues in a relatively unseen environment mean there is potential for a low locus of control.	Marine Connections needs to provide achievable changes and reporting structures to show any improvements or benefits
6 - existing values block emotional involvement	Variations between Maslow Groups show what each group values about the seas e.g. for personal experience at the coast	Experience based parts of the strategy need to identify the best way to appeal to each of the Maslow Groups (using existing knowledge from CD)
	Gender differences reveal stronger utilitarian values in males and intrinsic values in females	Stories in Themes and Spokes Species must identify with a variety of values
7 - lack of environmental consciousness and 8 - lack of internal incentives.	Other internal barriers contribute to these barriers. By addressing other internal barriers of knowledge, emotions and values, will these lead to great marine consciousness in individuals and ocean citizenship in society?	Engaging individuals and communities in decision making processes and as agents of change increases the locus of control.
9 - Lack of external possibilities and incentives	MSFD and MCAA provide opportunities for engagement and participation	Overarching aim is to encourage positive marine associations so society can act on their own decisions, if they wish.
	Wider social changes such as increasing availability of MCS seafood Using existing climate change possibilities to have positive marine impact	Marine Connections provides unbiased information to aid consumer decision making/behavioural changes
10 - negative or insufficient feedback about behaviour and 11 - Old behaviour patterns	Current disconnect between benefits from marine goods and services and how these are damaged by human activities	Marine Connections provides information on how to make changes and why they are needed.

Table (8.1). Review of barriers from Kollmuss and Agyeman (2002) applying the findings of previous research and the project to understanding how these block better engagement between society and UK seas. Recommendations of how Spokes Species and Communication Themes are shaped to address these barriers. Barrier numbers link to Figure 8.1.

interest in species which are recognised as contributing to marine health. However, it is also possible that the connections are not made between recognised ecological concepts and individual species which underpin particular functions. For example, seahorses require seagrass as a habitat. In Survey 2, both seagrass and seahorses were well recognised but attracted contrasting levels of interest (seahorse 59% and seagrass 8%), suggesting little association between the two. After the CMF, the species of greatest interest were the Norway lobster and cod; species well known as seafood for human consumption. The high interest in these species suggests

that their strong association as a food led them to be more interesting, despite a potentially lower aesthetic appeal of the cod, and the negative associations often made with invertebrates (Kellert, 1993). This effect of a function of the species making it more interesting does not occur with the seagrass, suggesting that its essential function for seahorse survival, and wider ecological roles are not recognised. The focus group discussions do not entirely support this interpretation, however, as references to plants forming habitats, and other links to ecological health concepts were made (although no references were made between the seahorse and seagrass). It is possible that this is due to the characteristics of the participants in the focus group and their lack of representativeness of the wider population or may reflect a broader trend of partial connections.

Recognised importance of ecological concepts does not, however, necessarily give a robust measure of the depth of understanding of how these affect marine health. Survey 1 (Chapter 4) showed high awareness of a variety of marine conservation issues, but without a supporting depth of understanding. The high recognition of ecological concepts as important may also be a case where there is a perception that something is important but without the knowledge of why. It does, however, show that communication opportunities exist to develop messages around concepts already judged socially as being indicators of 'good' marine health. (It should also be noted that the discussions here describe the concepts using their ecological descriptors, but these are not the specific phrases which respondents selected. For example the concept of diversity was described as 'many different plants and animals live there'. Table 6.2 details the phrases used.)

Consideration also needs to be given to how the public interpret and measure certain concepts. For example, the description of diversity opens questions of how to define 'many' species. There is also the need to highlight that low diversity does not necessarily signify poor health. For example mudflats are highly productive and support significant populations of seabirds (which have a high aesthetic value) (Bolam et al., 2002). This illustrates an example of different judgements of what is diverse and valuable, which need further exploration. Careful construction of messages would be required to ensure that examples which contradict generalisations of a concept, in this case that higher diversity implies good health, do not cause confusion. This could be done through focusing messages around other components such as the large populations of seabirds supported by mudflat biota.

The most important indicators of health for the public were those related to beach cleanliness and contamination of seafood. These are issues which have clear human connections but are lower ecological health concerns. The high interest in litter can nevertheless, be used as an opportunity to engage communities in taking ownership

of their coastlines. Beach clean events are run by various organisations and provide opportunities for local communities to contribute to making beaches look healthier. This is a behaviour which has an instant reward; organisations such as the Marine Conservation Society also use the collected material to assess the sources of litter, meaning that the beach cleaners are contributing to the data collecting process providing a larger scale benefit to participants (Marine Conservation Society, 2007).

8.2.2 Opportunities

The pessimism of UK marine biota is based on the perceptions that UK seas are of poor quality and a lack of association of aesthetically impressive species with these waters. UK seas support a diverse fauna and flora (Defra, 2004), including many charismatic vertebrates and colourful species. These present the opportunity to address the pessimism of UK diversity through developing appropriate channels to showcase the biota which is currently unseen. That this pessimism exists illustrates that there is not currently a successful method for overcoming this challenge of the marine environment. If it can be addressed, it can be used to target the pessimisms of UK marine species and begin to overcome some of the negative perceptions which currently exist.

The results of Survey 2 which showed the high awareness of ecological concepts as important to marine health are a considerable opportunity for engaging society with marine health. Previous studies have recorded a general awareness and value placed on ecological functions (Montgomery, 2002), but this result showed an understanding of the concept rather than identifying an important 'buzz word' such as diversity. This existing awareness of these concepts suggests that, despite a low awareness of the general biota of UK seas, there is an awareness of how species contribute to marine health. Therefore, communications can be developed which connect with this existing awareness and be used to promote species whose current functions are less well known. The existing awareness of ecological concepts also shows a potential hook for plant and invertebrate species which are least interesting but have high ecological value by connecting the species to their functions in supporting marine health. Pioneers showed a particular interest in unusual and unfamiliar species, which also included a number of species which had high ecological functions. Combining this source of curiosity with the increased Pioneer awareness of ecological concepts shown in Survey 2 provides a potential mechanism to develop messages of marine health. The focus group discussions imply that there is potential interest in these species for various reasons, including recognition of their ecological functions, showing the Pioneer curiosity and broader interest in these less glamorous species.

Personal experience of marine environments emerged in all three studies of perceptions. For many people, experience of marine environments is limited to the coast, with chances to see marine life limited to the intertidal zone. This is shown in Survey 2 where only a minority of respondents did activities which required them to be in or on the sea, with most remaining on the coast. This predominantly intertidal experience was found to influence knowledge and perceptions of subtidal species. This suggests that despite a lack of experience of subtidal environments, the intertidal zone can still provide a positive marine experience and increase optimism about UK seas. A possible application of this would be to use the intertidal as a familiar setting from which to promote discussions about marine life below the low tide mark. The Natural England (2008) study showed that people do not connect with the seabed beyond the coast; this positive connection may be a method with which to address this barrier.

The vast scale of the marine environment also makes it difficult to connect with but the use of a high profile species can be used to give disparate issues a focus, as seen with the polar bear and climate change. Around the UK, there are many different biogeographical conditions, with different associated biota. This provides the potential to develop regional identities by using different species to profile particular regions. This type of approach could use species which are more visible and have an intertidal, as well as subtidal, presence, meaning they can be found and observed with relative ease but also connect local to larger scale marine environments. Such an approach may be of particular appeal to Settlers who place particular importance on community and local identity.

An opportunity to combine the positive effects of personal experience and localising the marine environment are events such as beach cleans (Marine Conservation Society, 2007). Beach litter scored highly on perceptions of marine health, therefore these events provide a chance for local communities to 'improve' their local beach. This also creates an internal locus of control as individual efforts are instantly rewarded by the visual effect of bagged rubbish and a cleaner beach at the end of the day. However, increasing quantities of marine litter make it possible that such events may have the opposite effect whereby participants who return to annual events see this increase as a sign of the scale of the problem, externalising the locus of control through experience of a worsening scenario. Despite this, beach cleans currently offer an opportunity for connecting local communities with the health of their marine environment, and potentially to personal waste actions with their marine consequences.

The results of Survey 1 (Chapter 4) showed marine scientists to be the most trusted body to communicate marine environmental health issues. Current high

profile events such as 'Climategate' may have reduced this trust (discussed below, Section 8.5), but the Survey 1 results imply there is potential to develop communication channels between science and society with regards to marine issues. Communication would need to be two way; ensuring scientists engage with social interests and connect with social values to avoid assuming an Information Deficit perspective.

Situational factors are not assessed during this study but are noted as a barrier in the model (barrier 9). The UK Marine and Coastal Access Act (MCAA) implements a number of opportunities to reduce this barrier, including increasing public access to the coast and therefore the chances to visit and experience the coast. Further to this, the structure of the Marine Conservation Zones Projects will engage individuals, groups and industries which use the marine environment and use their opinions and perspectives to develop a series of Marine Protected Areas. These create opportunities for increased ownership of regional seas, and will be likely to promote debate and awareness of conservation features and ecological values.

This review of the recorded barriers suggests contrasting levels of understanding, values and connection with the UK marine environment. The pessimism about marine biota suggests a lack of knowledge of the ecological value of UK seas, and creates negative perceptions which block engagement. A conclusion from this is that the initial connectivity to the marine environment is missing; UK seas are not identified as a place of value due to a lack of knowledge of species diversity found there, reinforcing a misconception that they are of poor quality. Without this initial connection, there is a risk that other marine communications, such as detailing specific marine health threats, will further disengage society by strengthening negative perceptions. In contrast to this knowledge gap, the results also showed an understanding of several ecological concepts which underpin marine health. This shows that complex ecological concepts are recognised as important, despite the lack of association of these functions with species which provide them.

Jensen (2002) describes the need for a new approach to communicating environmental behaviours which includes four dimensions of knowledge; the effects of an environmental problem, the causes of the problem, the strategies for change available, and the alternatives and visions of different courses of action. The current barriers to engaging society with the marine environment recorded here suggest that a foundation dimension is required which supports a connection to the threatened environment, which is currently lacking in relation to UK seas.

8.3 Communication Themes and Spokes Species

The previous section identified features which are important for engaging society with the marine environment; this section applies these findings through the development of communication strategies. These are used to address particular barriers, and are targeted to general or specific audiences. The Communication Themes integrate factors such as the colour of marine species and the role of personal experience which were shown to be opportunities to establish connections between society and the marine environment. The four Communication Themes suggest how such factors can be facilitated. As described in Chapter 1, the Spokes Species are particular species used to connect different values. In contrast to high profile species used in other conservation communications, such as flagship species, Spokes Species are selected to represent and connect social and scientific values. These species are then developed to be the 'Spokesman' of the UK seas, providing a focus to particular aspects of marine environmental health. The suite of four Spokes Species described represent different components of the marine environment and aim to provide an insight into the various levels of ecological complexity of marine systems.

The assessment and monitoring of Good Environmental Status (GEnS) under the EU Marine Strategy Framework Directive will produce data on the health of the marine environment. As detailed below, the connectivity between social and science values of marine health provides the opportunity for such assessments to be relevant not only to policy requirements, but as a tool to support wider engagement of the marine environment. It is unlikely that all components of GEnS assessments would appeal to social values, but this as an opportunity for a communication strategy which connects the best available scientific data to recognised social interests.

8.3.1 Delivery mechanisms

The recommendations described here are mainly focused on the content of messages: how to communicate ecologically important marine messages which are socially relevant. The delivery of the Spokes Species and Communication Themes would be likely to require specialist input from marketing bodies to identify the optimum strategies and ensure effective communication channels are used, but initial suggestions are made here.

Launching the Spokes Species would be a high profile campaign, perhaps through a teaser campaign to create mystery and interest. For example billboards and newspaper advertisements with pictures of the Spokes Species but not text or explanation of what the image means. Such campaigns are often accompanied by media coverage to bring attention to the unexplained images and the reason for their presence.

Multiple media channels including TV, radio and internet can then be used to disseminate the reasons for the images.

8.3.2 Communication Themes

Theme 1: Diverse Seas

This theme attempts to show that UK seas are not barren and lifeless but full of interesting and varied life. It aims to create a more positive opinion of UK sea life. This is the foundation to building further connections to the marine environment. It is particularly aimed at Prospectors and Settlers, and primarily uses familiar species groups including crabs, fish and seaweed to show the diversity within these groups. This can then be developed to include other species groups which are colourful and exotic and may not typically be associated with UK seas. It will look at the general diversity of seas and be focused on the activities of species.

Messages which appeal to Settlers will draw on the familiar creatures of the sea, and the stories of how they survive and exist in communities. Prospector interest will be attracted through the use of familiar animal groups which are presented through brightly coloured, exotic or visually impressive species.

Strategies would include linking species found in rockpools to the species found in the nearby subtidal habitats. For example, providing information about snakelock anemones (*Anemonia viridis*), commonly found in rockpools and comparing it to a Dahlia anemone (*Urticina felina*). This would also include links from other beach finds such as cuttlefish bones and elasmobranch egg cases (mermaid's purses). These types of links are intended to encourage beach visitors to connect the parts of the marine environment which are easy to experience to the life in the seas which is nearby but out of sight.

A further strategy would focus on a particular animal group, for example crabs, and illustrate the diversity of crabs in UK seas. This would include details such as the number of species, where they are found, how they differ in appearance and behaviour and where to see them. This uses a familiar group to introduce the idea of biodiversity and show what diversity means for performing different functions, thereby supporting different values: not all crabs are for eating. This would be developed to have national, regional and local messages.

Theme 2: Marine Connections

This theme delivers messages about the relationships between society and the marine environment. The theme is based on the ecosystem approach principles and consists of two strands: 1) the goods and services provided to society by a healthy marine environment and 2) the impacts human activities have on marine health and how to make decisions which prevent or alleviate these. It is aimed at Pioneers, as it applies a holistic perspective and engages them in opportunities for behaviour change.

It also creates knowledge and incentives for action by developing a locus of control and clear messages about how individual actions can make a positive difference. The messages are about bringing society together with the environment, not just through the damage that human activities do, but through the benefits it provides.

Delivery mechanisms would include illustrating the principles of the ecosystem approach, something which is also likely to be useful for stakeholder engagement processes. This would use images and text to explain what the ecosystem approach principles mean in practice and what benefits they provide. Information about how individual activities impact the marine environment would create the opportunity to show how changes can lead to lower impacts.

The messages would be honest in terms of the damage and threats to marine environmental health, but structured so that opportunities to achieve positive outcomes are given, rather than focusing on negative scenarios.

Theme 3: People's Seas; People's Science

This theme creates opportunities for two way dialogue between society and science. It is about addressing the barriers of public confusion around scientific debate by providing a platform for discussing science which has high confidence, but also showing how the scientific process of debate is used. It will create opportunities for scientists to get a better understanding of social interest and support of particular issues or subjects.

The main aim is to build connections between the public and the diverse and globally relevant marine science which occurs in the UK. This is an opportunity for a positive association of UK seas and scientists as making a contribution to addressing a variety of issues and scientific advances.

Delivery would involve different time scales; some event-based engagement would be short term, but over the long term there would be a need to look at how the public are engaged in science processes. A coordinating body may be needed which is trusted to deliver unbiased information. This is similar to the function of the partnership in the Brisbane Healthy Waterways example above where the partner-

ship developed from a communication body to a source of expertise (Chapter 2). Potentially the partnerships built in the MCZ projects across England could be developed to do this as they will have existing connections with a wide range of stakeholders. This would depend on the perceptions of these partnerships following the consultation processes.

National events like the Big Read and the Big Event are models of how a large audience can be engaged with a particular topic, reading and art in these cases. This could be developed into an interactive process where people submit their questions about UK seas which can then be used to identify themes of social interest. Questions can then be categorised and answered by groups of scientists, perhaps through TV events like the Royal Institute Christmas lectures.

There is currently a paucity of media opportunities for UK marine science and marine issues in general. The BBC series Coast uses marine experts as do some other media channels, but there are few opportunities which encourage scientists and the public to engage in discussions. Appropriate skills training for scientists interested in public engagement would be needed to support this process.

The National Co-ordinating Centre for Public Engagement (www.publicengagement.ac.uk) was established in 2008 with the aim of inspiring a culture change in how universities engage with the public. By increasing links between Higher Education institutes and the public, they aim to support the public through strong partnerships to successfully engage with current issues and social decisions. This is beginning the process of bridging the current gaps between science and society.

Theme 4: Coastal Proficiency

This theme is built on the importance of experiential learning, particularly experiences at a young age as opportunities to connect with the marine environment. It creates opportunities for schools and youth organisations to experience the UK coast and seas, building long term skills and values but within the requirements of Health and Safety guidelines.

Many schools run a Cycling Proficiency course for children to understand the basics of road and bicycle safety. A barrier which prevents many schools from taking children to the coast is the dangers associated with the visits (Fisher, 2001). This theme would investigate how to structure coast visits within Health and Safety guidelines.

Coastal experiences would deliver the key message to students that UK seas are great and provide many goods and services from which we benefit. This could then be linked to different subjects or activities such as ecology, conservation, ge-

ography, culture or society and citizenship. Coast visits could be supported by engaging partners such as the Marine Conservation Society, the RNLI, local universities and aquaria to conduct school visits. This may be particularly relevant for inland schools. Mobile aquaria, such as a 'Rockpool Lorry' would provide a substitute coast experience.

8.3.3 Spokes Species

Spokes Species 1: Puffin, *Fratercula arctica*

The puffin is a well recognised and widely appealing species. Its presence in the UK is relatively underestimated and therefore gives an opportunity to promote a familiar species as a UK resident. Its strong K-selected characteristics link to the long term perspectives of marine health, supported by a well established monitoring programme at various sites. A key message will be the relationships between puffin and sandeel (*Ammodytes tobianus*) populations, as a way of providing examples between the interactions of climate change effects and fisheries pressures on food chain components.

This targets the barrier of general pessimism of UK seas through the use of a charismatic, colourful species. It also begins to make some connections between human uses of the seas and the impacts this has on the most charismatic species. Development of the Spokes Species could include using existing opportunities to see puffins in their habitats around the country.

Spokes Species 2: Cod, *Gadus morhua*

Cod is well recognised and reasonably well associated with UK seas. It is a high profile species for the public due to its use in fish and chips. It is a species of high utilitarian value, reflecting an important reason for male interest. There is scope to develop debates around the management of an overfished resource and the role of consumer decisions. There are strong food chain links, both for impacts on human food supply and the ecological impacts of local population extinctions. Links to climate change can also be made, to show how multiple factors are influencing cod populations.

This species is about connecting people directly to marine health through their food. This species could be used to engage people with inquiring about the source of their seafood through involvement with fish and chip shops and other seafood outlets.

This would provide consumer choice information by putting a food species into the wider, ecological perspective; explaining the effects and causes of the problem, the alternatives available and the long term implications of changes today (Jensen, 2002). Fisheries issues integrate public concerns relating to both environmental concern and the economic and social effects of changing fishing practises. This species would provide an opportunity to present the different sides of this issue. The protection of local industries and cultures represents an important Settler concern, due to the importance they place on community identity and maintaining tradition. The threat to jobs and livelihoods, and the traditional identity of seaside towns associated with fishing, would directly connect to Settler values. This Spokes Species would investigate the links between socio-economic and ecological sustainability and present alternative seafood species as part of the process of protecting the traditional image of fishing. Alternative fish choices may be less familiar, and therefore of less interest to Settlers, but by linking a change in consumption to sustainability of cod, the unfamiliar is presented in a message which would appeal to Settlers.

8.4 Spokes Species case studies

High profile species are often selected based on the success of what has been used before, and the assumption that a public audience will respond best to particular characteristics of a species. At a community scale, it has been shown that this is not the only way to apply single species as an engagement tool, and that less traditionally charismatic species can be successfully employed in this role (Bowen-Jones and Entwistle, 2002). Survey 2 (Chapter 6) showed that charismatic species are not necessarily the main drivers of marine understanding. The Survey 2 findings are integrated into the selection of the suite of Spokes Species, alongside a number of ecological and policy needs. The suite of Spokes Species represents a range of marine environmental components, benthic to pelagic, micro and macro organisms and correspond to a variety of values.

The following sections describe two of the Spokes Species in detail, identifying how different values are integrated and how these species lead to engagement in different aspects of marine environmental health. The two species are selected for very different reasons; seagrass is a particularly important species for ecological health, whereas the basking shark embodies many of the typical characteristics of CMF.

8.4.1 Spokes Species Case study: Seagrass, *Zostera marina*

Seagrass is one of the highest scoring ecological health species and relates to important ecosystem processes and services (Figure 3.3; Chapter 3). It is relatively well heard of (65%) and thought to be in the UK (60%) but is the least interesting of all species (8%) (Figures 6.2 and 6.4, Chapter 6). Despite the low value of the species itself, a number of the functions and processes performed by seagrass are valued as indicators of marine environmental health (Figure 6.6); this suggests a gap in association between this understanding of ecological health, and the species which provides these. Through appropriate presentation of seagrass, it is possible to highlight these functions of seagrass and promote public interest in an ecologically valued species.

8.4.1.1 Seagrass ecology

Seagrasses are a group of flowering plants which grow in intertidal and subtidal sediments. They are globally distributed but exhibit relatively low taxonomic diversity of only around 60 species. Despite this low diversity they have a wider distribution than other coastal marine habitats such as kelp or mangroves (Orth et al., 2006). The predominant seagrass species found in UK seas is *Zostera marina*. Dwarf eelgrass (*Z. noltii*) is a less common species of seagrass and is not included as a Spokes Species.

Seagrass grows as large clonal plants, formed from extensive root networks as rhizomes grow horizontally through the sediment (Duarte, 2002). Although vegetative reproduction is responsible for a large proportion of seagrass population increase, sexual reproduction is also important in this species (Olesen, 1999). Seagrass is an angiosperm, meaning sexual reproduction occurs through the production of flowers and seedpods: this is a plant which flowers underwater. Above the sediment, dark green leaves, or blades, which are narrow 20-50cm in length form the seagrass bed, with the appearance of an underwater meadow (Tyler-Walters, 2008). Light availability is a requirement for seagrass growth, and limits the depth at which they can survive. At the upper end of their distribution, seawater immersion and wave action are the limiting factors (Duarte, 2002).

The physical structure of seagrass beds also influences hydrological patterns. The blades reduce wave speed, thereby reducing the energy of water reaching the shore and encouraging the deposition of suspended sediment and organic matter (Gacia et al., 1999). The structure of the rhizomes also stabilises sediment, reducing resuspension of particles. During the 1930s, when large areas of seagrass were lost due to disease, considerable shoreline changes were recorded, due to the loss of this

protection (Fonseca and Bell, 2006).

Seagrass beds support a diverse range of microbial, plant, invertebrate and vertebrate biota (Duffy, 2006). The habitat provided by seagrass is more complex than bare sediment which often surrounds seagrass bed. For mobile species, this habitat provides protection from predation (Shoji et al., 2007), and can also be preferred over algal habitat potentially due to camouflage or food availability (Burfeind et al., 2009). Seagrass also provides increased surface area which can account for higher diversity (Attrill et al., 2000). Epiphytes, species growing on the blades of seagrass, represent an important component of the seagrass system (Cambridge et al., 2007). Epiphytes include micro and macro algae, and invertebrates such as bryozoans. Seagrass beds are highly productive ecosystems, due to both their above and below ground biomass (Duarte, 2002). This provides a food source for grazers within the seagrass bed (as do epiphytic algae), and also contributes to the supply of detritus of habitats beyond the seagrass bed through transport of plant material (Hyndes and Lavery, 2005).

Seagrass beds are thought to be particularly important for the juvenile stages of mobile species, serving as nursery grounds (Heck et al., 2003). Nursery grounds provide conditions which lead to an increase in the survival rates of juveniles; high densities of juveniles of commercially valued species are found in seagrass beds (Jackson et al., 2001a). Reduced predation rates for seagrass compared to bare sediment and selection of seagrass habitat over non-vegetated areas supports this hypothesis (Shoji et al., 2007). The nursery function shows a link between the health of a benthic habitat and the health of pelagic populations as these species will migrate away from the seagrass bed as adults.

Marine plants are becoming increasingly recognised for their contribution to the global carbon cycle, with seagrass accounting for around 15% of ocean carbon storage (Kennedy and Bjork, 2009). Due to their considerable above and below ground biomass, seagrasses are an important carbon sink: the carbon sink capacity of seagrasses, salt marshes and mangroves exceeds that of undisturbed rainforest (Nellemann et al., 2009). Seagrasses are one of the most productive biomes on earth and are also important for oxygenation of sediment and water column and nutrient cycling (Duarte, 2002).

Seagrass is complex and performs many ecological functions and processes which provide important goods and services; these have been valued at US$19,004 per hectare, per year, making them one of the most highly valued biomes (Costanza et al., 1997). This value is likely to be an underestimate due to lack of available data; the value is calculated mainly on nutrient cycling functions. Other valuable services include protection of coastlines and coastal infrastructure, sediment stabilisation

and water transparency, nursery role for commercial species, carbon storage and trophic transfer to other ecosystems (Orth et al., 2006, Duarte et al., 2005, Duarte, 2002).

Seagrasses are one of the most threatened ecosystems worldwide (Waycott et al., 2009). The loss of seagrass or deterioration in seagrass health reduces ecosystem functions, and therefore the provision of goods and services (Orth et al., 2006). An estimated 2-5% of seagrass area is lost annually (Duarte et al., 2008). Direct damage to seagrass beds can occur from fishing or recreation, such as anchor damage (Hastings et al., 1995). Areas of sediment exposed by the removal of seagrass are more vulnerable to erosion than sediment inhabited by seagrass. Erosion can lead to channels occurring between fragments of seagrass; due to the horizontal growth of the rhizomes, the seagrass cannot regrow across this channel. Seagrasses are particularly sensitive to changes in the water clarity through increased turbidity and suspended sediments (Orth et al., 2006). Increased nutrient loading can drive an increase in epiphyte biomass, reducing light availability and photosynthetic capacity of the seagrass (Cambridge et al., 2007). Removal of predatory fish by commercial fisheries can cause grazer populations to increase and overgrazing to occur, resulting in seagrass loss (Eklof et al., 2008). Seagrasses are vulnerable to a number of introduced species, with largely detrimental effects; disturbance has been found to increase the vulnerability of seagrass beds (Williams, 2007). The synergistic effect of multiple pressures on seagrasses result in an increased trajectory of seagrass loss when more than one pressure is present (Orth et al., 2006).

The effects of climate change on seagrass are unclear, due to the complexity of abiotic and biotic factors involved in seagrass systems. Increased temperature will alter growth rates and physiological functions of the seagrass (Short and Neckles, 1999). Sea level rise will reduce the depth limit of seagrass, which will not be countered by increased landward colonisation due to coastal developments, causing coastal squeeze (Airoldi and Beck, 2007). Increased storminess and wave action (Lowe et al., 2009) could also reduce the upper limits of seagrass beds. Acidification of seawater is likely to cause reduction in the calcifying epiphytes, reducing associated species diversity and affecting biogeochemical processes (Martin et al., 2008).

8.4.1.2 Developing communications

As shown above, the components of seagrass ecosystems, and the factors influencing their health are multiple and complex. Chapter 3 identified seagrass as a potential species whose monitoring could contribute to the assessment of regional marine health. This section identifies a series of seagrass parameters which could be used

to monitor their ecological health and are relevant to policy needs. The following section will then discuss the relevance of these parameters to social values of the marine environment.

There is an imbalance in the attention given to coastal ecosystems, with a lack of charismatic appeal of seagrass beds seen as a barrier to greater public engagement (Duarte et al., 2008). This imbalance is realised in both scientific and media coverage of seagrasses; 60% of publications on threatened coastal habitats are about coral reefs compared to 11% on seagrasses. Seagrass receives only 1.3% of media coverage on threatened coastal habitats, reflecting the lower scientific output, but also a lower proportion of reports per scientific paper, suggesting a lack of charismatic appeal leading to low public interest in seagrass beds (Duarte et al., 2008). This conclusion is supported by the responses to Survey 2 (Chapter 6) which shows seagrasses to be the least interesting species (Figure 6.4). The scientific valuation which rates seagrasses as one of the most valuable systems in the world (Costanza et al., 1997) is reflected by their high ecological health score (Chapter 3). This section draws on the other findings within this thesis to challenge these perspectives of seagrass as irrelevant and uninteresting to social values.

Monitoring marine health

The parameters in Table 8.2 show some of the key components of seagrass ecosystems. Seagrass area is a logical baseline for assessing the extent of the habitat within a region, similar to providing a population assessment for a mobile species. Measures of seagrass area need to be supported by assessment of the configuration of the seagrass bed. Configuration relates to the patch size, distance between patches and the length of patch edges, all of which can affect the distribution and movement of associated animals Bostrom et al. (2006). A further important factor is the lower depth limit of the seagrass bed which can shift in response to certain pressures. Deeper seagrass beds have higher associated species diversity and tend to have greater stability than shallow beds (Jackson et al., 2006). All these parameters provide assessment of the habitat quality which supports the GEnS assessment process. A baseline of the distribution of seagrass beds in UK seas is needed to accurately begin this process.

Inclusion of human activities allows the possible interpretation of any changes recorded in the configuration of seagrass beds. Seagrass loss or deterioration is often a symptom of a larger problem, therefore, it is an imperative of seagrass health monitoring, particularly within the definition of GEnS, to assess factors beyond ecological changes (Orth et al., 2006). Without such information it is difficult to identify management responses or interpret ecological responses. Relevant data may

Seagrass parameter	Ecological	Social	Policy
Seagrass area and configuration	Includes assessment of patchiness, area, edges of seagrass	Measures the amount and quality of the habitat provided	GEnS descriptors 1 and 6. Describes the habitat (Characteristic)
Activities in seagrass area	Identifies the potential causes for changes in seagrass area and configuration. Could allow forecast of effects on other biota.	Marine connections – provides the links between humans and seagrass health showing how human actions positively or negatively impact seagrass	Interpretation identifies the Pressures and Impacts causing damage. Can lead to potential management responses
Epiflora	Top down or bottom up changes can be identified	Shows diversity of seagrass and how one species supports existence of others	GEnS descriptor 4 and 5.
Mobile species	Assesses grazing intensities and higher trophic levels	Crabs and fish are highly recognised species. Shows the diversity of associated fauna.	GEnS descriptors 1 and 4 and biological features (Characteristic)
Nursery species	Identifies links between benthic and pelagic health – data opportunity	Commercial/utilitarian values	GEnS descriptors 3 and 4. Fish populations (Characteristic)
Genetics	Identifies genetic diversity within the population	A measure of difference in the habitat type and introduces resilience and resistance of the population.	Characteristics Biological features 7. Identifies protection priorities for including resistance in any MPA network.
Seahorses	Assessment of rare species	Charismatic species of high interest	UK BAP species
Processes	Provides the long term, large scale perspective required to adequately assess marine health – data opportunity	Identifies the important functions of species, gives an insight into how functions of an individual species contribute to wider issues such as climate change	Assesses marine health at a scale currently not included in ecosystem monitoring

Table (8.2). Potential messages for communications about seagrass, showing relevance to ecological, social and policy values. The existing knowledge about feeding and distribution is already integrated into policy interests on seagrass.

already be collected by different agencies or bodies; for example, the number of boats anchoring in an area may be monitored by local sailing clubs or harbour master, and requires appropriate integration with other parameters.

Damaged habitats were recognised as an important indicator of marine health, particularly for Pioneers (Figures 6.6 and 6.8). The two parameters above relate to the quality of the habitat, relying on the presence of a high quality habitat to be recognised as being an indicator of health. This requires important distinctions from land grass in terms of the associated functions and processes it performs. These

developed through further parameters.

Changes in epiphyte communities can result due from bottom-up changes, caused by an increase in available nutrients, or top-down caused by change in grazing pressures, for example if the predator of a grazer has been removed due to overfishing, the grazer population will increase causing a decrease in epiphytes. Both these factors need to be included in assessment of epiphyte communities (Hughes et al., 2004), which in turn can allow greater understanding of the factors influencing the seagrass bed. Epiflora are strongly associated with eutrophication effects, which is named as a GEnS descriptor; assessing both grazing and nutrient effects on epiphytes allows the potential for community changes to be interpreted correctly.

The species associated with seagrass beds are diverse, including crustacean and fish species. These include grazers and predatory species whose distributions can be influenced by seagrass configuration (Connolly and Hindell, 2006). These parameters measure the complex trophic interactions which occur within seagrass beds. This parameter, together with the epiphytes, relate to diversity and the food chain, both of which were important health indicators in Survey 2 (Figure 6.6). The use of familiar species such as crabs and fish (Natural England, 2008) to illustrate the diversity of species associated with seagrass beds can also be used to describe functional diversity. The links between epiphytes, grazers and predators also relates to seagrass food chains, which are an important point of interest in the focus groups (Chapter 7).

The role of seagrass beds as nursery grounds is complex and varies between species (Jackson et al., 2002). However, the concept of nursery grounds and the development of species specific messages provide a number of opportunities to develop health and communication messages. In ecological terms, there is a need to further investigate this function, in particular the links between juvenile populations in seagrass beds and the destination of adult populations. With regard to monitoring GEnS, this relationship is important for understanding whether assessment of benthic ecosystems reflects aspects of pelagic health. Various communication messages can be developed around this ecosystem function. Nursery grounds provide a clear, utilitarian value of seagrass beds, likely to have strong appeal to males. Commercial species are also connecting this function to the food chain which has high social awareness as a health concept. The connection from seagrass beds to pelagic ecosystems is likely to appeal to Pioneers, whilst the survival of species in a safe place when they are particularly vulnerable will appeal to Settlers. This wide range of values associated with this one function supports the better understanding of the use of seagrass beds as nursery grounds and the connections to adult populations.

Genetic and phenotypic diversity within seagrass populations has important in-

fluences on ecosystems (Duffy, 2006). The low species diversity of seagrass results in a low variability within the range of the species leads to genetic and phenotypic becoming increasingly important to identify differences between seagrass beds. Increased genetic diversity can support more stable systems, which have greater resistance to disturbance (Duffy, 2006). This is an important component of marine health from an ecological perspective; genetic analysis of seagrass beds would identify those which have the greatest genetic diversity or distinctness and recognise particular areas for protection. However, this aspect of diversity was not included within the studies of public perception. This parameter could be developed into a communication strategy when other more fundamental seagrass functions have been described, and when it is supported by UK data.

The seahorse is one of the most interesting species, particularly to females (Figures 6.4 and 6.5), but scores relatively low on ecological health score (Figure 3.3b). They provide the charisma which is currently lacking in seagrass beds and are also a policy relevant species due to their UK BAP status. Despite this protection, insufficient data is available to establish baselines (BARS, 2010). The social and policy interest in seahorses makes them a high profile species in the seagrass Spokes Species strategy. Any descriptions of seahorses are an opportunity to show the requirements of a healthy seagrass habitat for seahorse survival; as well as having particular appeal to females, the concept of seahorses in their seagrass 'home' will have strong Settler appeal.

The importance of assessing ecosystem processes in order to achieve large scale, long term assessment of marine health has already been discussed (Chapter 3). This is currently lacking, in part due to the complexity of this task. Processes such as carbon and nutrient cycling can be hypothesised to be affected by the health of seagrass beds, but considerable investigation is required to draw solid conclusions. Development of techniques to better understand these relationships are relevant to the high level objectives of achieving marine health, despite not being recognised within the GEnS criteria. Survey 1 (Chapter 4) suggested that climate change is identified as a general issue and not directly connected with the marine environment. The Marine Connections theme can overlap here, showing a 'good news' story of the potential for a marine ecosystem to provide a further utilitarian function.

Further to these parameters, seagrass monitoring can be developed which involves local communities in health assessments. Seagrass-Watch is a program delivered in Australia which identified particular aspects of a structured health assessment which could be delivered by community groups and volunteers (McKenzie et al., 2000). This connects local communities directly with the nearby seagrass beds through personal experience, creating ownership of the habitat, whilst contributing

fine scale data to the larger health assessment. Marine Conservation Society Beach cleans attract thousands of visitors (Marine Conservation Society, 2007); this enthusiasm to connect with, and improve local environments can be maximised to deliver additional monitoring data whilst creating strong local links with seagrass beds.

It could be argued that the seahorse would make a more successful Spokes Species than seagrass; the high social appeal could attract attention to seagrass and its other functions. This would replicate the dominance of charismatic species being used to simplify ecological messages, prioritising the function of seagrass as a seahorse habitat over its other, arguably more ecologically valued, functions. The results of Survey 2 showed that charismatic megafauna are not considered as important indicators of marine health. Seagrass relates to the ecological concepts which identify with social and ecological definitions of marine health. By using seagrass as the Spokes Species, many fundamental ecological principles can be communicated, which include a range of recorded social values.

This set of parameters outlines seagrass ecosystem components for assessment at all scales of ecological complexity, from single species to processes, all of which connect to social and policy values. Seagrass is a familiar, but uninteresting species; it is possible that the familiarity removes some mystery which may be associated with unfamiliar species such as maerl. By developing communication strategies around the parameters described here, seagrass can be shown to be more than just 'grass under the sea' (as described in the focus groups).

8.4.1.3 Seagrass as a Spokes Species

The recommendation of a species such as seagrass as a champion of the marine environment is in contrast to many of the traditional selection critieria for high profile species. This Spokes Species has been selected for its potential to deliver a new perspective to the use of species to communicate environmental messages, through the connection of multiple values of marine health. The risk of using a species such as seagrass is that the audience will not be engaged due to the low general appeal of plants (Wandersee, 2001). As has been illustrated, this species identifies with social, science and policy values; therefore, the potential for this species to connect these often divergent values is in the communication of messages which show the many functions of seagrass and overcome this currently socially overlooked species.

8.4.2 Spokes Species Case study: Basking shark, *Cetorhinus maximus*

The basking shark is selected as a Spokes Species based on the high social appeal of charismatic megafauna and the low association of charismatic species with UK seas, as found in Survey 2 (Figure 6.2). The basking shark is a large, visually impressive species: characteristics which particularly connect with Prospector values to potentially overcome their considerable negative perceptions of the UK marine environment. It will be important to show that this is a shark which does not pose a risk to humans. This species does not represent a high ecological health value (Chapter 3); however, this section illustrates the potential for developing ecological understanding through focusing on a single species which attracts a high social value.

The basking shark was not included in Survey 2 but has been selected here to represent the CMF of UK seas. The harbour seal was included in Survey 2 was well recognised, strongly associated with UK seas and of high interest to respondents. This suggests that the use of the harbour seal as a Spokes Species would be less impressive as it is already identified as living in UK seas. The basking shark has been selected to trigger a surprise reaction; the low association of puffins and seahorses with UK seas show a particular pessimism of CMF in UK seas, which this species targets.

8.4.2.1 Basking shark ecology

The basking shark is the second largest fish in the world, ranging between 8 and 11 metres in length (Figure 8.2). They are found circum-globally in temperate latitudes (Hoelzel et al., 2006). However, they have been recorded swimming at depth through tropical latitudes, where water temperatures are similar to surface temperatures in the north-east and north-west Atlantic, suggesting that their distribution is not limited to temperate seas (Skomal et al., 2009). Within UK seas, they are mainly found along western coasts. Movements occur between regions, for example Cornish and Scottish seas (Sims et al., 2003). Greater distances are also travelled, for example from UK waters across the Atlantic (Gore et al., 2008). Data are not available which could allow a reliable population estimate to be made (Sims et al., 2005). Between 2005 and 2008, nearly 2,000 basking shark sightings were recorded off the Isle of Man, with an estimation of over 5,000 individuals being seen (Manx Basking Shark Watch, 2009). The majority of sightings occur within summer months; basking sharks are thought to move to deeper waters during winter months, supported by this lack of sightings which tend to be in waters relatively close to the coast (Sims et al., 2005). Sightings data do not accurately reflect the geographical range of this

species, which occurs across the continental shelf, beyond the area where sightings are most common, or in areas where individuals are below the surface (Sims et al., 2005). There is little knowledge of the winter distribution or behaviour of basking sharks.

The basking shark is planktivorous, feeding mainly on calanoid copepods. Whilst swimming at the surface, the basking shark opens its mouth (Figure 8.2a) allowing the gill rakers, a series of plates, to sieve the zooplankton from the water as it passes over the gills. It appears that they feed when density of zooplankton reaches a threshold making it energy efficient (Sims, 1999). Feeding in this way results in the species spending time at the surface, making them highly visible to sea users when in coastal waters. Basking sharks identify the most productive feeding regions, such as shelf edges where upwelling increases zooplankton density (Sims et al., 2006). This choice of feeding site can also trigger larger scale movements leaving feeding grounds in Cornish waters (despite adequate prey density) to arrive in Scottish waters at peak zooplankton density (Sims et al., 2003). Movements of basking sharks are recorded using a variety of high-tech tagging devices which allow location, dive behaviour and other factors to be recorded. These data allow maps of the 'journey' of an individual basking shark to be plotted. Through integration of movement data with prey availability, it is possible to identify behavioural patterns.

Very little is known about basking shark reproduction. Mating, births and juvenile basking sharks have not been recorded. Some behaviours are thought to be courtship related, such as nose to tail following observed during summer months (Sims et al., 2000). Many recorded sightings are of more than one shark (Manx Basking Shark Watch, 2009), suggesting aggregations to be relatively frequent during these months.

Basking sharks are vulnerable to a number of human activities. Basking sharks have been targeted in numerous locations around the world, particularly for their fins, skin and oil but fisheries tend to undergo rapid boom and bust cycles (Camhi et al., 2009). The rapid depletion and slow recovery of these populations illustrates their vulnerability to human activities. Targeted fishing of basking sharks in EU waters was ended in 2006 when a zero catch was imposed at the recommendation of ICES (Camhi et al., 2009); however, bycatch and illegal fishing still pose a threat (Poisson and Seret, 2009). The effects of climate change on basking sharks are uncertain, but projections of increasing sea storminess, wave and temperature (Lowe et al., 2009) are likely to have an impact. Sea surface temperature is known to influence large scale distribution and movement of basking sharks (Cotton et al., 2005) and is predicted to influence the abundance and distribution of key prey species (Helaouet and Beaugrand, 2007), suggesting that changes in abiotic conditions will

a)

b)

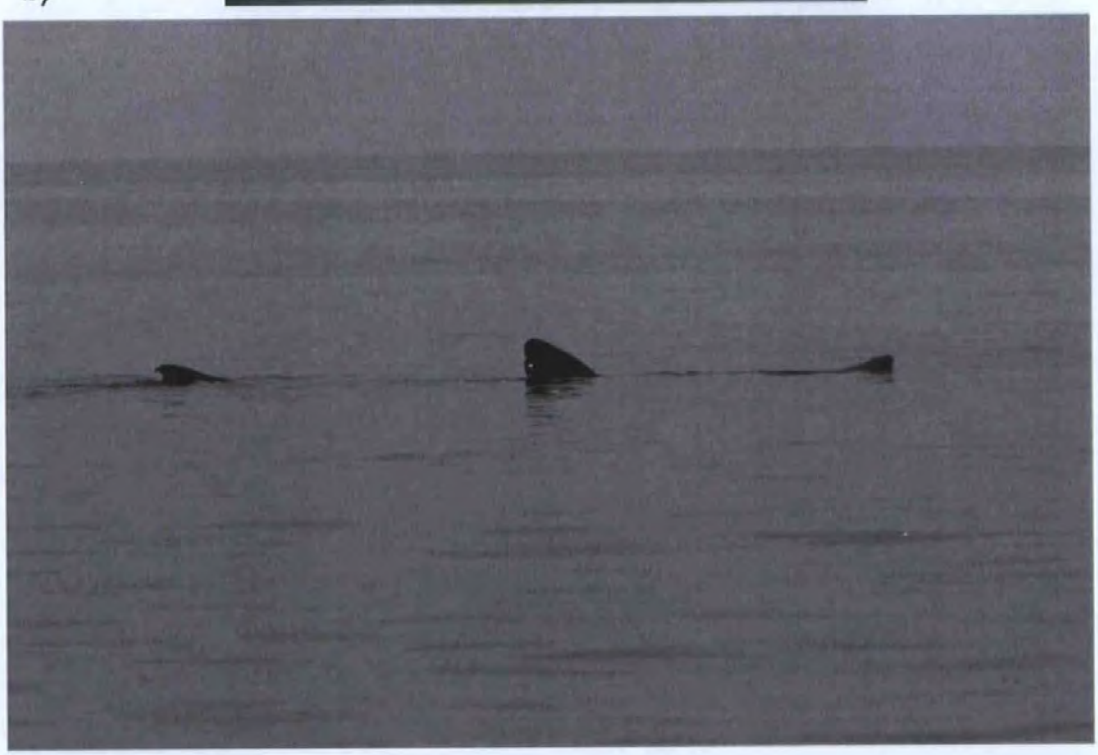


Figure (8.2). Basking shark a) feeding with mouth visible, and b) seen in profile at the surface. Photo produced with permission, copyright Colin Speedie.

have some effect on basking sharks.

The lack of data to establish a population estimate, and other basic ecological understanding, prevents a sound understanding of the conservation status of this species. Basking sharks exhibit typical K selected life history traits, taking 12 - 20 years to reach maturity, having a long gestation periods of between 1 and 3 years and giving birth to few young (Sims et al., 2005). This makes basking shark populations particularly vulnerable to human activities, as illustrated by the rapid decline in targeted populations (Camhi et al., 2009). Whereas other K-selected species, such as seabirds, offer the potential to act as indicators for particular ecosystem health attributes (Chapter 3), these data gaps prevent this from applying here. The high vulnerability of basking sharks and lack of population estimates has justified their designation under a number of conservation policies. As a Biodiversity Action Plan species, the need for better data and assessment of populations is recognised (BARS, 2010a).

8.4.2.2 Developing communications

Potential ecological messages

The basking shark as a Spokes Species offers different communication opportunities to seagrass. The selection of this species is mainly due to its potential for high social interest; this would focus messages at the single species scale of ecological complexity. There is potential to link the single species to more ecologically complex messages; population scale through research to address the current paucity of data, ecological functions by introducing food chain links with plankton, which in turn, connects to processes such as biogeochemical cycling, and development of messages around the ecological roles of plankton. By focusing on the individual species, more fundamental ecological messages, such as behaviour, are developed. Survey 2 (Chapter 6) also showed that there is no connection between presence of megafauna and the health of the marine environment (Figure 6.6). The interest in large species is not based on concern for ecological health, supporting the ecological perspective (Chapter 3), but is as an intrinsic value of the species itself. Therefore, messages about the basking shark do not need to be focused on ecological health, rather provide an insight into existence of the particular species. This is reflected by the messages shown in Table 8.3 which are more descriptive, rather than the data based indicators developed in the seagrass case study.

As a large vertebrate, the basking shark represents a number of the features of the most interesting species (Figure 6.4). As a fish, it may have less of the traditional charismatic appeal which may be associated with cetaceans or birds. However, its

Messages	Ecological	Social	Policy
Feeding behaviour	Applies existing studies of feeding strategies and behaviours	Functions of species – understanding the species	-
Food chain links	Connections between different species and the importance of less charismatic species to maintain more appealing ones	Illustrating how a large, charismatic species survives in UK seas – what the UK waters have to offer Interest and understanding of food chain concept.	GEnS Descriptor 4 – food web
Distribution and migration	Applies data from existing tagging studies	Striking visual images showing the proximity of basking sharks to particular UK regions	-
	Potential to fill data gaps such as winter distributions	Real time updates on locations of basking sharks in UK seas	Better data to support protection and management

Table (8.3). Potential messages for communications about basking sharks, showing relevance to ecological, social and policy values. The existing knowledge about feeding and distribution is already integrated into policy interests on the basking shark.

size, body shape, and tendency to be visible at the surface differentiate it from a more typical fish appearance. Media representation of sharks has reinforced negative public perceptions of these animals as dangerous to humans (Thompson and Mintzes, 2002); as a planktivore, the basking shark does not present this stereotypical shark danger. Despite the negative perceptions, sharks attract a public fascination (Thompson and Mintzes, 2002); the presentation of the basking shark as a gentle giant, rather than a man-eater may be the opportunity to deliver a new public perspective on this animal group.

It is arguable that a marine mammal could be used to replace the basking shark and would present a Spokes Species which delivers the CMF in UK seas message without the risk of the negative perceptions associated with sharks. The aim of this Spokes Species is to develop species level interest and an understanding of the interactions between a single species and other ecosystem components. Other large marine vertebrates, although potentially powerful Spokes Species for other messages, may be strongly associated with particular conservation issues, for example whaling, creating a strong emotional response which detracts from the aim of the communications. The message of the basking shark as a non-dangerous shark will need to be clearly made to ensure the focus of the communications is not lost.

Opportunities to address barriers

The main barrier this Spokes Species addresses in the pessimism of charismatic megafauna (CMF) residing in UK seas (Survey 2), representative of the broadly negative perceptions of the undersea (Natural England, 2008, Rose et al., 2008). The basking shark and associated messages can be used to attract interest from all three Maslow Groups. Prospectors, in particular, will be attracted to the aesthetics of the basking shark - it delivers the 'wow factor'. The focus on a single species, and stories about how it survives will appeal to Settlers, particularly when associated with a regional area, rather than a UK scale perceptive. Pioneers often feel that environmental stories are disaster stories; although the basking shark is a highly vulnerable species, the communication strategies here will not highlight the conservation status but will focus on the functions of the species, rather than connecting it directly to a public behaviour change.

The feeding activities of basking sharks are one of the better understood behaviours and provide the opportunity for discussing why individuals travel to certain locations, and identifying how UK seas sustain CMF. The contrast in size between the basking shark and its zooplankton prey (calanoid copepods are only a few millimetres in length (Michaud and Taggart, 2007) compared to the maximum 11metres for a basking shark), presents the possibility for interesting visual representations of basking sharks and their food, as well as promoting the importance of the unseen components of marine ecosystems.

The studies of distribution and movements of basking sharks rely heavily on telemetry, such as devices attached to sharks which transmit data to satellites (Sims et al., 2005). Tagging methods have already been used to draw attention to basking shark studies, where tags are attached to basking sharks and detach after a predetermined length of time. When these tags reach the surface, they connect via satellite and send an email containing the data[1]. The application of this technology, to a wide range of animals, is leading to rapid development in the availability and presentation of data (Block, 2005). This presents two communication opportunities. Firstly, the use of maps which show the location of basking sharks presents a powerful visualisation of data which can be easily recognised as show that these creatures do inhabit UK seas. Secondly, improvements in tagging methods are providing data location on a more frequent basis than the email tags. Such data have already been

[1]A similar approach has been used in Western Australia where over 70 great white sharks (*Carcharodon carcharias*) have been tagged. When these individuals swim past buoys located near popular beaches, the tag sends a text message to beach lifeguards alerting them to the presence of the shark (Telegraph, 2009)

used to update publicly available websites for other species such as birds, mammals and reptiles (www.wildlifetracking.org). With the current development in mobile phone technology, such data have the potential to be developed into products which allow people to follow sharks on a daily basis, using the interest in personal gadgets (particularly high in Prospectors) to connect people to the marine environment.

Experience of species and environments is described above as being important for developing associations and pro-environmental values. The feeding behaviour of basking sharks means they are often seen at the surface (Figure 8.2), visible by people in boats or from the coastline, for example from the Minack Theatre in Cornwall (Figure 8.2b). This presents the opportunity for people to experience basking sharks first hand, seeing them in their natural environment. Guidelines for responsible interactions with basking sharks are publicised through the Wildlife Trusts' WiSe project. These are needed to ensure that interactions with basking sharks do not cause injury, and run the risk of 'loving the animal to death' (Barney et al., 2005).

Although it is possible to see basking sharks in the wild, this will be an experience with a limited audience. This cannot be supplemented with aquarium exhibits, as is possible with other large marine vertebrates. A key appealing feature of the basking shark is its size. Although the use of documentation and descriptions of the size of the species would communicate this fact, it would lose some of the impact of this species. The use of actual size images in communication products would be the optimum solution. A potential canvas for such images could be bus advertisements; the average London bus is approximately the same length as a basking shark. A wrapped advert, one which encases the bus in the image, would enable UK marine life to be brought to a large audience. Such buses also offer further advertisement space inside for more detailed posters, and the possibility to include Bluetooth downloads which could provide videos and further information for passengers.

8.4.2.3 Basking shark as a Spokes Species

The two main benefits of using the basking shark as a Spokes Species are to show that large vertebrates live in UK seas, and to promote a better understanding and interest in the ecology of a species. As a highly protected species, the basking shark has high policy relevance at the single species scales. The potential to connect a number of science and social values to achieve better understanding of the species, and inspire wider marine associations, whilst also potentially developing social support for the establishment of better population and winter movement data to address data gaps. Any application of this species must address the potential fear and negative perceptions of sharks by communicating clear messages that this species is not a

threat to human safety.

The basking shark can be presented in ways which appeal to all three Maslow Groups, in particular the Prospectors through visually impressive presentation, and the use of cutting edge technology. Real time monitoring of tagged individuals can be used to create an 'oiled seabird' image, delivering clear, unbiased message of the marine environment. The current understanding of feeding behaviours and target prey species can be used to develop messages around the basking shark food chain, meeting both GEnS criteria, communicating a fundamental ecological concept, and building on an existing component of public understanding of marine environmental health. This also provides the basis for recognising how different marine organisms are interrelated; a theme which is used in more detail in other Spokes Species. This gentle giant can be used to present a positive perspective of UK marine life, whilst developing better understanding of the ecological concepts which are fundamental to the survival of all species.

8.4.3 Case study conclusion

These two case studies show that it is possible to unify different values of the marine environment to find common ground relating to all interests. This is done without diluting the opinion of one perspective, but by recognising the possibilities through the emergence of common values in the analyses.

8.5 Wider implications

The studies delivered in this project identified many perceptions of the marine environment which were influenced by various factors. The application of Kollmuss and Agyeman's (2002) model of pro-environmental behaviour provided a framework to understand how these perceptions may become barriers or opportunities to engaging society with the marine environment. The differentiation between internal factors which contribute to the environmental consciousness was particularly useful in applying the findings of knowledge questions and differences in perceptions between Maslow Groups. External factors were not tested in these studies but are an important component of the model, and are also relevant to the wider application of these findings.

The barriers reviewed suggest that a fundamental connection between society and the UK marine environment is missing, and undermines engagement opportunities. It could be argued therefore, that the aims of the Communication Themes and Spokes Species, to facilitate positive connections to the marine environment,

fall outside the definition of pro-environmental behaviour applied by Kollmuss and Agyeman (2002) which describes behaviours with a more direct effect on reducing negative environmental impacts[2]. It has already been noted that the specificity of this definition potentially underestimates the benefits of actions beyond the definition (Jensen, 2002). The application of the model in the current scenario shows that it has validity in interpreting the multiple factors influencing perceptions of an environment, as well as links to specific consumer behaviours as intended in its original function. This multiple application of the model beyond the specific definition intended potentially dilutes the value of the model for understanding the relationships between knowledge of an environmental problem, and an action in response, therefore perpetuating the gap (Gough, 2002). By applying the model under an unspecified definition of behaviour, the relationships between barriers will inevitably vary, restricting the likelihood that a clear picture of how various factors affect pro-environmental behaviour can be established. By broadening the definition, the model becomes a tool to address particular scenarios, rather than addressing the conceptual issue of the factors influencing the gap between knowledge and behaviour. By applying the model here to understand the relationship between society and the marine environment, it has shown that factors of values, knowledge and emotions were leading to a lack of marine environmental consciousness, and identified particular opportunities to address these barriers.

The recommendations of Communication Themes and Spokes Species target particular aspects of marine perceptions, having identified specific barriers. When considering the more general barriers of engaging people with the marine environment, these recommendations are also valuable. The scale and inaccessibility of the marine environment is a considerable barrier to engaging society with marine issues (Natural England, 2008). This is addressed in the recommendations through the use of particular species as focal points for the understanding of complex interactions. There is also scope for regionally specific messages and Spokes Species, which develop the identity of particular regional seas by promoting the particular characteristics of that region. This highlights the distinctive nature of different areas of the UK marine environment, reducing the perception of the undersea as a large, featureless expanse of seabed. A general theme of all the recommendations is to bring the 'out of sight' marine environment into sight, therefore reinforcing through various methods the vision of the marine environment as diverse, and ensuring it is present in people's consciousness.

[2]This definition of pro-environmental behaviour is behaviours which 'consciously seek to minimise the negative impact of one's actions on the natural and built world such as minimising resource use and energy consumption (Kollmuss and Agyeman, 2002, p240).

Survey 1 showed scientists to be the most trusted group to communicate marine environmental health issues. The connection between science and social values can be supported through the use of GEnS assessment data as a method for communicating current information about regional and national marine environments, again developing the identity of the marine environment. High profile environmental issues are leading to an increasing amount of scientific information being in the public domain, which can cause confusion, particularly when it is reinterpreted in different ways by the media (Lorenzoni et al., 2007). It is possible that the high trust in scientists as communicators can be used to reduce the confusion associated with the inherent uncertainty of scientific information. However, recent events such as 'Climategate' will potentially undermine this trust and may alter the role of scientists as communicators. Despite the negative effects of 'Climategate', these events have illustrated that science is not isolated from society. The relationship between science and society requires scientists to engage with the values and contributions made by society in order to develop effective two way communication, and avoid a uni-directional flow of information which resembles an Information Deficit Model approach (Hulme, 2009).

The results of Survey 2 show how perceptions of the marine environment differ between respondents from each Maslow Group. Background understanding about the profiles also shows how the groups differ in their interest in environmental and new information; a strength of the model developed is that this can be used to target messages to appeal to a particular audience (Rose et al., 2007, Chapter 5). Pioneers are the most interested in new information, as shown in their interest in unfamiliar species in Survey 2, and also have a more holistic perspective of the world, more similar to an ecological perspective of marine health. These results suggest that Pioneers may be the audience where most success can be gained delivering ecological messages. The Maslow model suggests that understanding of an issue by Pioneers can eventually filter through the other groups, requiring a transition into the Prospector perceptions, and eventually to Settlers (Rose et al., 2007, Chapter 5). This approach suggests that the drivers which encourage engagement in the marine environment are as important as the actual engagement. In terms of pro-environmental behaviour, a similar scenario is observed with regards to the drivers of a person's behaviour; is it the particular behaviour or the values that drive the behaviour which need to change? Different values can result in the same behaviour (Barr et al., 2001) still causing a reduction in waste, for example, but for different reasons in different individuals. There is evidence that behaviour changes based on values are more stable than those which, for example, are triggered by a financial incentive (Kollmuss and Agyeman, 2002).

The intended behaviour change of the recommendations proposed here is to improve societal engagement with the marine environment, developing a shift in attitudes which supports improved management through policy implementation. (As Theme 2 describes, more specific pro-marine behaviours could be pursued once more positive marine connections exist.) Maslow Group analysis of perceptions does identify those who may currently have more ecological perceptions of the marine environment, but its greatest strength is, perhaps, to identify the particular interest hooks for those groups who are least engaged with these values. This allows strategies to be developed, as described above, which appeal to all social values and identify the opportunity to connect these to ecological values, encouraging greater engagement across society. A strategy which only targeted Pioneers would undermine the aim of connecting divergent values of the marine environment.

It is a considerable challenge to attempt to promote social engagement with marine ecological health through connecting divergent marine values. In reality, species such as seagrass, whilst having high ecological value, are unlikely to attract the same high level of interest and perceived aesthetic values as a puffin or seahorse. The results of this study have, however, illustrated that the connections between society and the marine environment are complex and represent a wide range of interests. Whilst the charismatic species retain their broad appeal, there is the potential to develop positive associations with a suite of other species which connect to the ecological roles in supporting marine health.

Chapter 9

Conclusion

The studies within this project have shown that despite strong negative associations with the marine environment, clear connections exist or can be created between social and scientific values of marine health. Better understanding of what is important to marine ecological health, and how this compares with social perceptions has illustrated how different values can converge. This has provided the basis for developing communication strategies which deliver ecologically defined assessments of marine environmental health in socially relevant messages.

Greater emphasis must be given to those species which contribute most to the attributes of ecological health in order to adequately monitor regional marine health. The current bias towards protection and monitoring of vertebrate species focuses attention at the single species level and does not take account of the functions and processes which support wider marine health. The ecological analysis scored structurally complex plant and invertebrate species as most important to the attributes of marine health highlighting species which have the greatest level of ecosystem complexity. The use of these species for monitoring Good Environmental Status has the potential to provide an assessment of broad scale processes over long time scales which is currently lacking in marine monitoring. This perspective to monitoring is needed in order to interpret the changes occurring within marine systems as a result of multiple and large scale pressures.

The broad appeal of charismatic megafauna (CMF) was, however, evident in the results of Survey 2. The focus of public attention towards CMF was recorded, even when there was evidence of different knowledge of the species due to education level. This shows the ability of CMF to attract interest from a wide audience. The use of CMF for this purpose is a well documented and successful approach to gaining public support for conservation issues. This illustrates the greatest divergence of social and science values, with CMF attracting high levels of social interest, but not reflecting the required level of ecosystem complexity to assess marine health. This

contrast in values is not an insurmountable barrier to communicating messages of marine ecological health. The result that CMF were considered by those surveyed to be least important as measures of marine health was unexpected and showed a reversal of the public interest in marine species. The least interesting species are most relevant to the ecological concepts which were rated among the best indicators of marine health. This shows that social values of the marine environment are not limited to the aesthetic appeal of CMF, but there is potential to build connections with less appealing species which support these ecological concepts.

The application of the Maslow methodology as a social segmentation model proved to be a useful tool to identify particular perceptions and the motivations driving them. As has previously been recorded, Pioneers are the most different and optimistic group. They have a particular interest in unusual species, and their higher selection of ecological health concepts reflects their more holistic perspective of the world. Prospectors were the least optimistic about UK marine species reflecting their strong negative perceptions of UK seas and particularly valued clear, blue water as a sign of marine health. This is an important barrier to have identified, and supports the findings of previous studies (Natural England, 2008, Rose et al., 2008). Responses from Settlers showed their opinions to fall between the Prospectors and Pioneers, tending more often to align closer to the Prospectors. Recognising the different values and perspectives of these groups enables communication strategies to be structured, either with broad appeal such as through the use of CMF, or to connect to the values of a specific group within the wider population. Examples of the application of this feature of the Maslow model are detailed in the Spokes Species (Chapter 8), and include an emphasis on the ecological functions of seagrass targeted at a Pioneer audience, the selection of a visually impressive large vertebrate, the basking shark, to appeal to Prospector interests, and the use of messages about familiar, traditional species, such as the cod to bring marine themes to a Settler audience.

Other factors which influenced perceptions of the marine environment included gender, with males showing greater utilitarian values and females showing greater aesthetic values of marine species, and association with the marine environment. Personal experiences with the marine environment were a recurring theme throughout the study. In Survey 1, experiences due to different locations and employment led to some variation in concerns about marine environmental issues. Experience of the UK coast led to a greater awareness and interest in marine species than those who rarely or never experienced the UK coast. This could be due to those with some interest choosing to visit the coast, or could be the result of limitations of accessibility to the coast. Coastal interaction was repeatedly referred to during the

focus groups as a positive learning experience. These results support the function of free choice learning, described by Falk et al. (2007) as an important science learning process. Creating opportunities for experience of the marine environment is an important component of the communication strategies, with particular emphasis on identifying those groups who may be limited from accessing the coast.

Association of surveyed species with UK seas was low, compared to the familiarity of the species. This reflects a general pessimism of UK seas and was particularly evident with CMF. The focus groups (Chapter 7) made particular reference to the colour of species as a measure of whether a species was likely to be found in UK seas. This shows how the general pessimism and interpretation of the undersea as grey and unpleasant (Natural England, 2008) is also ascribed to marine species. UK seas are home to a considerable diversity of plants, animals and habitats, many of which are brightly coloured and visually impressive. This shows how the current misconceptions of UK seas are creating a barrier to engaging the public, with a lack of knowledge reinforcing negative perceptions. Connecting aesthetically impressive species with local or regional seas is an opportunity to change this misconception and create more positive associations with the marine environment.

The application of Kollmuss and Agyeman's (2002) model of pro-environmental behaviour provided a valuable tool for integrating the results of the current and previous surveys. The survey results have provided a more detailed understanding of the barriers to engaging society with marine environmental health. The model provides a structure from which communication strategies are developed through the increased understanding of knowledge, values and emotions which influence the connectedness of society and the marine environment. The Communication Themes and Spokes Species were developed to illustrate how different values can be integrated in order to overcome the barriers identified. As a suite, the Spokes Species represent a range of UK marine habitats and regions, bringing a mixture of ecological and social values with enough policy relevance to feed into development and support of current policy needs.

Future Work

The themes of research investigated here have highlighted numerous research questions which could be pursued in order to further develop these findings.

- Chapter 3 recommended structurally complex plant and invertebrate species as most relevant to assessing marine ecological health. Two particular points to investigate further would be the relationships between benthic and pelagic

health to assess the capabilities of benthic monitoring to reflect wider system health. Secondly, the comparability of marine health assessments between habitats formed by different plant and invertebrate species, e.g. seagrass, horse mussel and maerl. This would assess whether areas with different biotic composition can be compared.

- Chapter 4 was limited by the small sample sizes, but the detected differences in opinions of marine conservation issues suggest that a larger study could yield relevant results. Perceptions and understanding of conservation issues would inform the development of the Marine Connections Communication Theme. The inclusion of a wider variety of marine professionals, and possibly professionals from non-marine employment, alongside a more representative study of the perceptions of coastal and inland residents would be a valid next step.

- Chapters 6 and 7 suggest many directions for further research. The structure of the focus groups showed the potential of this method to add considerable detail to the Survey 2 findings through the interrogation of the public responses. This could be extended to a nationally representative study which tested the perceptions of marine species by Maslow Group and gender.

- Chapter 7 also identified plankton as a potential source of interest. Very few studies have been done on public perceptions of microscopic life; the role of plankton in climate change processes, and their potential inclusion within the basking shark Spokes Species would make the findings of such a study directly relevant to the development of these communication topics.

- Further investigation of the understanding and perceived importance of marine ecological concepts, as recorded in Survey 2, would be a particularly relevant study with findings applicable to a number of the communication recommendations. These could investigate how such concepts are visualised and could be presented to various audiences.

- The focus group discussions of the vertebrate species implied potential links from CMF to marine conservation issues, with possible development of marine 'polar bears'. Further investigations of whether these associations are made in other Maslow Groups and from respondents from broader socio-demographic backgrounds would identify whether this is a viable avenue of development for marine communications.

- The theme of personal experience recurred throughout the studies. Further

investigation into the connections from intertidal to subtidal biota, and also the role of aquaria to provide experiences which connect visitors to the UK marine environment would help to develop a particularly important component of the engagement process.

Appendices

Appendix A

Good Environmental Status criteria

1. Good Environmental Status Qualitative Descriptors (Annex 1 EU, 2008)

1. Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.

2. Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.

3. Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock.

4. All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.

5. Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters.

6. Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.

7. Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.

8. Concentrations of contaminants are at levels not giving rise to pollution effects.

9. Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards.

10. Properties and quantities of marine litter do not cause harm to the coastal and marine environment.

11. Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.

2. Good Environmental Status Characteristics (Annex 3, Table 1 EU, 2008)

Physical and chemical features	– Topography and bathymetry of the seabed – Annual and seasonal temperature regime and ice cover, current velocity, upwelling, wave exposure, mixing characteristics, turbidity, residence time – Spatial and temporal distribution of salinity – Spatial and temporal distribution of nutrients (DIN, TN, DIP, TP, TOC) and oxygen – pH, pCO_2 profiles or equivalent information used to measure marine acidification
Habitat types	– The predominant seabed and water column habitat type(s) with a description of the characteristic physical and chemical features, such as depth, water temperature regime, currents and other water movements, salinity, structure and substrata composition of the seabed – Identification and mapping of special habitat types, especially those recognised or identified under Community legislation (the Habitats Directive and the Birds Directive) or international conventions as being of special scientific or biodiversity interest – Habitats in areas which by virtue of their characteristics, location or strategic importance merit a particular reference. This may include areas subject to intense or specific pressures or areas which merit a specific protection regime
Biological features	1. A description of the biological communities associated with the predominant seabed and water column habitats. This would include information on the phytoplankton and zooplankton communities, including the species and seasonal and geographical variability 2. Information on angiosperms, macro-algae and invertebrate bottom fauna, including species composition, biomass and annual/seasonal variability 3. Information on the structure of fish populations, including the abundance, distribution and age/size structure of the populations 4. A description of the populations dynamics, natural and actual range and status of species of marine mammals and reptiles occurring in the marine region or subregion 5. A description of the populations dynamics, natural and actual range and status of species of seabirds occurring in the marine region or subregion 6. A description of the populations dynamics, natural and actual range and status of other species occurring in the marine region or subregion which are the subject of Community legislation or international agreements 7. An inventory of the temporal occurrence, abundance and spatial distribution of non-indigenous, exotic species, or, where relevant, genetically distinct forms of native species, which are present in the marine region or subregion
Other features	– A description of the situation with regard to chemicals, including chemicals giving rise to concern sediment contamination, hotspots, health issues and contamination of biota (especially biota meant for human consumption) – A description of any other features or characteristics typical of or specific to the marine region or subregion

3. Good Environmental Status Pressures and Impacts (Annex 3, Table 2 EU, 2008)

Physical loss	– Smothering (e.g. by man-made structures, disposal of dredge spoil) – Sealing (e.g. by permanent constructions)
Physical damage	– Changes in siltation (e.g. by outfalls, increased run-off, dredging/disposal of dredge spoil – Abrasions (e.g. impact on the seabed of commercial fishing, boating, anchoring) – Selective extraction (e.g. exploration and exploitation of living and non-living resources on seabed and subsoil)
Other physical disturbance	– Underwater noise (e.g. from shipping, underwater acoustic equipment – Marine litter
Interference with hydrological processes	– Significant changes in thermal regime (e.g. by outfalls from power stations) – Significant changes in salinity regime (e.g. by constructions impeding water movements, water abstraction
Contamination by hazardous substances	– Introduction of synthetic compounds (e.g. priority substances under Directive 2000/60/EC which are relevant for the marine environment such as pesticides antifoulants, pharmaceuticals, resulting, for example, from losses from diffuse sources, pollution by ships, atmospheric deposition and biologically active substances
Systematic and/or intentional release of substances	– Introduction of other substances, whether solid, liquid or gas, in marine waters, resulting from their systematic and/or international release into the marine environment, as permitted in accordance with other Community legislation and/or international conventions
Nutrient and organic matter enrichment	– Inputs of fertilisers and other nitrogen – and phosphorus-rich substances (e.g. from point and diffuse sources, including agriculture, aquaculture, atmospheric deposition) – Inputs of organic matter (e.g. sewers, mariculture, riverine inputs)
Biological disturbance	– Introduction of microbial pathogens – Introduction of non-indigenous species and translocations – Selective extraction of species, including incidental non-target catches (e.g. by commercial and recreational fishing)

Appendix B

Species list

Common name	Latin name	Vulnerability	Recoverability	Ecosystem perspective	Ecological health score	Grid score
Fish						
Basking shark	*Cetorhinus maximus*	3	3	1	9	3
Common skate	*Dipturus batis*	3	3	1	9	3
Conger eel	*Conger conger*	3	3	1	9	3
Electric ray	*Torpedo nobiliana*	3	2	1	6	3
John dory	*Zeus faber*	2	2	1	4	2
Thornback ray	*Raja clavata*	2	2	1	4	2
Ballan wrasse	*Labrus bergylta*	2	2	1	4	2
Plaice	*Pleuronectes platessa*	2	2	1	4	2
Lesser sand eel	*Ammodytes tobianus*	1	1	2	2	2
Pollack	*Pollachius pollachius*	2	1	1	2	2
Cod	*Gadus morhua*	2	1	1	2	2
Dogfish	*Scyliorhinus canicula*	1	2	1	2	1
Short snouted seahorse	*Hippocampus hippocampus*	1	1	1	1	1
Common dragonet	*Callionymus lyra*	1	1	1	1	1
Birds						
Puffin	*Fratercula arctica*	3	3	2	18	6
Common tern	*Sterna hirundo*	3	3	2	18	6
Common scoter	*Melanitta nigra*	2	3	2	12	4
Gannet	*Morus bassanus*	2	3	2	12	4
Storm petrel	*Oceanodroma leuchora*	2	3	2	12	4
Kittiwake	*Rissa tridactyla*	2	3	2	12	4
Common Guillemot	*Uria aalge*	2	3	2	12	4
Fulmar	*Fulmarus glacialis*	1	3	2	6	2
Mammals						
Harbour porpoise	*Phocoena phocoena*	2	3	2	12	4
Bottlenose dolphin	*Tursiops truncatus*	3	3	1	9	3
Grey seal	*Halichoerus grypus*	1	3	2	6	2
Harbour seal	*Phoca vitulina*	1	3	2	6	2
Minke whale	*Balaenoptera acutorostrata*	2	3	1	6	2

ID	Common name	Latin name	Vulnerability	Recoverability	Ecosystem perspective	Ecological health score	Grid score
	Plants and invertebrates						
1	Maerl	*Lithothamnion corallioides*	3	2.5	3	22.5	9
2	Common eelgrass	*Zostera marina*	3	2.4	3	21.4	9
3	Maerl LG	*Lithothamnion glaciale*	3	3	2	18	6
4	Horse mussel	*Modiolus modiolus*	2	3	3	18	6
5	Native oyster	*Ostrea edulis*	2	3	3	18	6
6	Tangle or cuvie Kelp	*Laminaria hyperborea*	3	1.9	3	17.4	9
7	Maerl	*Phymatolithon calcareum*	2	2.5	3	15	6
8	Oarweed	*Laminaria digitata*	3	1	3	9	9
9	Pink sea fan	*Eunicella verrucosa*	2	2.3	2	9	4
10	Norway lobster	*Nephrops norvegicus*	2	1.2	3	7.3	6
11	Sand mason	*Lanice conchilega*	3	1.1	2	6.7	6
12	Bean like tellin	*Fabulina fabula*	3	1.1	2	6.4	6
13	Sand gaper	*Mya arenaria*	3	1.1	2	6.4	6
14	Furbelows	*Saccorhiza polyschides*	2	1	3	6	6
15	Dulse	*Palmaria palmata*	3	1	2	6	6
16	Coral weed	*Corallina officinalis*	2	1	3	6	6
17	Common mussel	*Mytilus edulis*	2	1	3	6	6
18	Edible sea urchin	*Echinus esculentus*	2	1	3	6	6
19	Fan mussel	*Atrina spp.*	1	3	2	6	2
20	A red seaweed	*Furcellaria lumbricalis*	2	2	1	4	2
21	Sugar kelp	*Saccharina latissima*	2	1	2	4	4
22	Baltic tellin	*Macoma balthica*	2	1	2	4	4
23	Basket shell	*Corbula gibba*	2	1	2	4	4
24	Common starfish	*Asteria rubens*	2	1	2	4	4
25	Dead man's fingers	*Alcyonium digitatum*	2	1	2	4	4
26	Ross worm	*Sabellaria spinulosa*	2	1	2	4	4
27	Light bulb sea squirt	*Clavelina lepadiformis*	2	1.7	1	3.3	2
28	Dahlia anemone	*Urticina felina*	2	1.6	1	3.3	2
29	Hydroid	*Nemertesia ramosa*	2	1.6	1	3.1	2
30	Common brittlestar	*Ophiothrix fragilis*	1	1	3	3	3
31	Razor shell	*Ensis spp.*	3	1	1	3	3
32	Rosy feather star	*Antedon bifida*	3	1	1	3	3
33	European spiny lobster	*Palinurus elephas*	1	2.7	1	2.7	1
34	Edible crab	*Cancer pagurus*	1	1.3	2	2.6	2
35	Great scallop	*Pecten maximus*	2	1.2	1	2.4	2
36	Sea beech	*Delesseria sanguinea*	2	1	1	2	2
37	Blue-rayed limpet	*Helcion pellucidum*	2	1	1	2	2
38	Breadcrumb sponge	*Halichondria panicea*	2	1	1	2	2
39	Brown shrimp	*Crangon crangon*	1	1	2	2	2
40	Harbour crab	*Liocarcinus depurator*	2	1	1	2	2
41	Sea potato	*Echinocardium cordatum*	2	1	1	2	2
42	Star ascidian	*Botryllus schlosseri*	2	1	1	2	2
43	Slender sea pen	*Virgularia mirabilis*	1	1.8	1	1.8	1
44	Plumose anemone	*Metridium senile*	1	1	1	1	1
45	Sea mouse	*Aphrodita aculeata*	1	1	1	1	1

Appendix C

MarLIN Matrix

Matrix of maritime and coastal activities with environmental factors (MarLIN, 2010).
On fold out page overleaf

Coastal & Maritime Activities / Events	Sub-activites /events	ENVIRONMENTAL FACTORS: Physical: Substratum loss	Smothering	Suspended sediment	Desiccation	Changes in emergence regime	Changes in water flow rate	Changes in temperature	Changes in turbidity	Changes in wave exposure	Noise disturbance	Visual presence	Abrasion / Physical disturbance	Displacement	Chemical: Synthetic compound contamination	Heavy metal contamination	Hydrocarbon contamination	Radionuclide contamination	Changes in nutrient levels	Changes in salinity	Changes in oxygenation	Biological: Introduction of microbial pathogens / parasites	Introduction of non-native species	Selective extraction of target species	Selective extraction of non-target species
Aquaculture	Fin-fish																								
	Macro-algae		P	P			P		P		P	P							P		P				
	Predator control														P										
	Shellfisheries																								
Climate change	Current change																								
	Sea level change																								
	Temperature change																								
	Weather pattern change																								
Coastal defence	Barrage														P	P	P								
	Beach replenishment	P													P	P	P								
	Groynes	P	P											P							P				
	Sea walls / breakwaters	P	P											P							P				
Collecting	Bait digging																								
	Bird eggs																								
	Curios										P	P													
	Higher plants																								
	Kelp & wrack harvesting																								
	Macro-algae													P											
	Peelers (boulder turning)																								
	Shellfish																								
Development	Construction phase							P							P	P	P	P							
	Artificial reefs		P												P	P	P								
	Communication cables		P									P													
	Culverting lagoons								P																
	Dock/port facilities							P								P		P		P					
	Land claim																								
	Marinas					P		P								P									
	Oil & gas platforms																								
	Urban																								
Dredging	Captial dredging														P	P	P	P		P					
	Maintenance dredging														P	P	P	P							
Energy generation	Nuclear power generation		P													P		P		P					
	Power stations		P														P			P					
	Renewable (tide/wave)		P	P	P	P		P		P	P						P				P				
	Wind farms														P	P	P								
Extraction	Maerl																								
	Rock/minerals (coastal quarrying)																								
	Oil & gas																								
	Sand / gravel (aggregates)									P					P	P	P	P							
	Water resources (abstraction)				P	P																			
Fisheries/ Shellfisheries	Benthic trawls (e.g. scallop dredging)														P	P	P								
	Netting (e.g. fixed nets)																								
	Pelagic trawls										P	P													
	Potting / creeling																								
	Suction (hydraulic) dredging														P	P	P								
Recreation	Angling													P											
	Boating / yachting								P							P									
	Diving / dive site																								
	Public beach																		P						
	Tourist resort																								
	Water sports															P									
Uses	Animal sanctuaries										P	P	P						P			P	P		
	Archaeology														P	P	P								
	Coastal farming															P					P				
	Coastal forestry															P									
	Education/interpretation																								
	Military														P	P	P	P							
	Mooring / beaching / launching															P						P	P		
	Research	P									P	P	P	P	P	P	P		P			P	P		
	Shipping		P															P							
Wastes	Fishery & agricultural wastes																								
	Industrial effluent discharge																								
	Industrial / urban emissions (air)			P																					
	Inorganic mine and particulate wastes														P	P	P	P							
	Land / waterfront runoff														P	P	P								
	Litter and debris														P	P	P								
	Nuclear effluent discharge																	P							
	Sewage discharge																	P							
	Shipping wastes		P																						
	Spoil dumping														P	P	P	P							
	Thermal discharges (cooling water)																P			P		P	P		
Other	Removal of substratum				P	P	P			P					P	P	P									

PROBABLE EFFECT | - | ■

POSSIBLE EFFECT | - | P

Appendix D

Survey 1

Coastal and Inland Resident Survey

I am currently researching public opinions of the marine environment. It would be very helpful if you could answer the questions below – this should take only a couple of minutes, I am looking for brief, honest answers! Everyone's opinions are important.

Your responses will be anonymous. The overall results of the survey, as well as further information about the research project are available at the end of the survey.

Thank you for your time.

(The term "marine environment" applies to any coastal or oceanic areas in any country, at any scale – basically anything marine.)

1. In the marine environment, what environmental issues, if any, are a concern to you?

2. How have you previously learnt about issues in the marine environment?

3. How should information be presented to the public on the state of the marine environment?

4. What event or experience in your life triggered your interest in the marine environment?

5. What groups or individuals do you trust and not trust to give you accurate information about the marine environment?

	Trust	Don't Trust
European Union	☐	☐
UK government	☐	☐
Regional/ Local government	☐	☐
Particular Political Parties	☐	☐
Pressure groups (e.g. Greenpeace, Friends of the Earth)	☐	☐
Scientists	☐	☐
Fishermen	☐	☐
Newspapers	☐	☐
Family/Friends	☐	☐

6. TV

☐ Trust

☐ Don't Trust

☐ which programs: _____

7. Others - Give details

☐ Trust

☐ Don't Trust

☐ Others: _____

8. How far from the coast do you work?

Distance from coast: _____

9. What country do you work in?

Country: (Click here to choose)

10. What are your interests in the marine environment? e.g. recreational, employment, etc.

Thank you for completing the survey, your opinions are very valuable. If you wish to be included in further parts of this project, please include your contact details below.

Marine Professional Survey

I am currently researching stakeholder opinions of the marine environment. It would be very helpful if you could answer the questions below – this should take only a couple of minutes, I am looking for brief, honest answers! Everyone's opinions are important.

Your responses will be anonymous. The overall results of the survey, as well as further information about the research project are available at the end of the survey.

Thank you for your time.

(The term "marine environment" applies to any coastal or oceanic areas in any country, at any scale – basically anything marine.)

1. In the marine environment, what environmental issues, if any, are a concern to you?

2. Do you feel you know enough about these issues?

☐ Yes

☐ No

3. What, if anything, do you find hard to understand about these issues?

4. How would you most like to be informed about marine environmental issues?

5. What event or experience in your life triggered your interest in the marine environment?

6. How is your own role related to the marine environment and what is the remit of your organisation?

7. How far from the coast do you work?

Distance from coast: [ ]

8. What country do you work in?

Country: [(Click here to choose) ▾]

9. Thank you for completing the survey, your opinions are very valuable. If you wish to be included in further parts of this project, please include your contact details below.

Marine Scientist Survey

As part of my PhD I am looking at the marine environmental issues which are currently of concern to marine scientists, marine stakeholders and the general public. This work will lead into further studies on how best to inform the public and marine stakeholders about the key environmental issues which are threatening our marine habitats. It would be very helpful if you could answer the questions below – this should take only a couple of minutes, I am looking for brief, honest answers!
Your responses will be anonymous. The overall results of the survey, as well as further information about the research project are available at the end of the survey.
Thank you for your time.
(The term "marine environment" applies to any coastal or oceanic areas in any country, at any scale – basically anything marine.)

1. In the marine environment, what environmental issues, if any, are a concern to you?

2. What evidence would you use to illustrate these issues to the public?

3. What event or experience in your life triggered your interest in the marine environment?

4. Which area of marine science do you work in?

- ☐ Archaeology
- ☐ Biology
- ☐ Chemistry
- ☐ Conservation
- ☐ Ecology
- ☐ Geography
- ☐ Geology
- ☐ Microbiology
- ☐ Physics
- ☐ Virology
- ☐ Other: _____

5. What country do you work in?

Country: (Click here to choose)

6. Thank you for completing the survey, your opinions are very valuable. If you wish to be included in further parts of this project, please include your contact details below

Please contact me if you would like to discuss further your opinions on marine environmental issues or informing the public and stakeholders.

Appendix E

Natural England Survey Questions

Q1 Thinking of the seabed and landscape beneath the sea in your region, or off the coast where you visit the seaside, do you think it is most likely (to be):

- Utterly featureless and barren
- Mostly barren with a few places where sea-life, such as plants and creatures, survive
- Generally barren but with quite a few places where creatures and plants survive
- Quite well covered in undersea landscapes with living creatures and plants
- A variety of distinctive landscapes, some of which are unique to our region

Q2 Which best characterises the undersea landscape in the seas in this region?

- Dark, polluted and probably damaged beyond repair by industry and over-fishing
- Generally damaged and barren but with a few creatures and plant-life hanging on in a few localities
- Damaged and empty over quite wide areas but with significant stretches with communities of living creatures and plants
- Generally a landscape of living creatures and plants with damage confined to some heavily used places

- A rich mix of undersea landscapes including plants, animals and features special to this region

Q3 The government plans to set up more marine protected areas in the seas around the coasts of England. Thinking about the seas off the coast in this region, how sure do you feel that there would be undersea landscapes worth protecting here?

- Not at all sure; there's probably nothing special
- Fairly unsure; I doubt there's anything special
- Neither sure nor unsure
- Fairly sure there's something worth saving
- Very certain; I'm sure we have something that is regionally distinctive

Q5 Can you name any specific features of the undersea landscape or creatures or plants likely to be found on the seabed in the seas in our region?

(5 answer boxes provided for answers.)

Appendix F

Survey 2

The following questions are looking at public perception of UK seas.

There are no right or wrong answers; this is based on your opinions.

1. Approximately how often do you visit the UK coast or sea?

SELECT ONE

- ☐ I live on the coast
- ☐ Once a week
- ☐ Once a month
- ☐ Once every few months
- ☐ Once or twice a year
- ☐ Very rarely/never

2. Which of the following leisure activities do you do when you visit the UK coast?

SELECT ALL THAT APPLY

- ☐ Walking on beach or cliff tops
- ☐ Swimming
- ☐ Snorkelling/diving
- ☐ Surfing/body boarding
- ☐ Sailing/boating
- ☐ To enjoy being at the seaside
- ☐ Recreational fishing/angling
- ☐ Looking for wildlife e.g. bird spotting or rockpooling
- ☐ None of these

3. How many miles you live from the coast?

SELECT ONE

- ☐ 0–10 miles
- ☐ 11–20 miles
- ☐ 21-40 miles
- ☐ 41-60 miles
- ☐ Over 61 miles

Species Questions

Species questions, each with an image of 12 species:

Brittlestar	Native oyster
Cod	Norway lobster
Dahlia anemone	Puffin
Kelp	Seagrass
Harbour seal	Seahorse
Maerl	Sand mason worm

4. **Which (if any) of the following plants and animals have you heard of or recognise?**

   SELECT ALL THAT APPLY

5. **Which (if any) of the following plants and animals do you think can be found in the sea around the UK?**

   SELECT ALL THAT APPLY

6. **All of the plants and animals pictured can be found in the seas around the UK.**

   Please select up to four pictures to show which plants and animals you would be most interested to learn more about.

   SELECT UP TO 4 ANSWERS

Health Questions

7. **The term "healthy" is usually used to describe a person. Healthy can also be used to describe a part of the environment, as a description of what condition that environment is in.**

   The list below shows a selection of descriptions of a marine environment.

   Which three do you think are most likely to show a country or region which has a healthy sea environment?
   SELECT UP TO 3 ANSWERS

   - Enough plants and animals for the food chain to work properly
   - Clear or blue water
   - Having plants or animals which are regionally, nationally or globally important
   - Parts of the sea are nature reserves– like the National Parks we have on land
   - Big animals like whales and dolphins can be seen
   - Thriving local fishing industry
   - Clean beaches – no litter or sewage
   - Areas which scientists say is healthy or important
   - Many different plants and animals live there

8. **The list below shows a selection of descriptions of a marine environment.**

   Which three do you think are most likely to show a country or region which has an unhealthy sea environment?
   SELECT UP TO 3 ANSWERS

   - The habitats where the plants and animals live have been damaged
   - Fish/shellfish not fit for humans to eat due to contamination
   - Lots of litter on the beach or out at sea
   - Close to a large city
   - High unemployment in local fishing industry
   - Murky or brown water
   - Not many types of plants and animals live there
   - No areas of the sea protected from human activities
   - No big animals like seals or whales

Maslow Group Questions

These last questions allow us to look at how broad social factors may influence perceptions of the marine environment.

How important are these things in your life?

	Very important	Fairly important	Not very important	Not at all important
To spend time and effort caring for your appearance				
To find out who you are and what you're good at				
To have lots of possessions				
To have a large group of friends and neighbours that you can turn to				

How similar are you to these kinds of people?

	Very similar	Fairly similar	Slightly similar	Not at all similar
People who worry about what others may think of them				
People who enjoy keeping up with the current trends in home decorating				

How do you feel about each of these statements?

	Strongly agree	Slightly agree	Neither agree not disagree	Slightly disagree	Strongly disagree
I can't bear untidiness in the home					
There are too many foreigners in my country					
Criminals should be punished with maximum prison sentences to make them learn their lesson					
I have little to expect from the future					

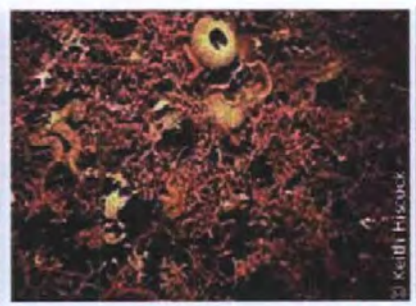
Brittlestar

Cod


Dahlia anemone

Harbour seal

Kelp



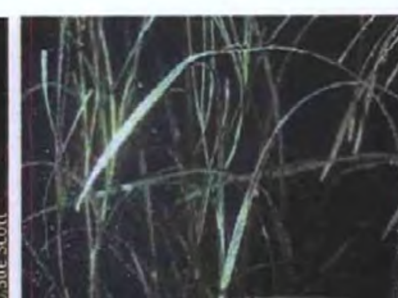
Maerl

Native oyster

Norway lobster


Puffin

Sand mason worm



Seagrass

Seahorse

Socio-demographic variables

- Age
- Gender
- Social grade
- Regional break (x 4)
- ITV regions
- Government office regions (x 11)
- Housing tenure
- Working status
- Marital status
- Cars in the household
- Terminal education age
- Presence and age of children (under 18 years old)
- Main grocery shopper
- Taken foreign holiday in last 3 years
- Ethnicity

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