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Conflicts in some of the World harbours: what needs to happen next?

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Abstract

Harbours are a focus of intensive and diverse activities and thus have a high potential to become centres of conflict between users. Reviewing the multiple uses associated with harbours provides important insights into maritime communities and the management of conflict. In this paper, seven international, multi-disciplinary groups provide their expert synthesis of individual harbours. After a detailed discussion experts from Sydney, Qingdao, Vigo, Auckland, Jakarta, Crete and Plymouth synthesised and shared their harbour's characteristics, user conflicts and how such conflicts have been researched and managed. The paper addresses an omission of "conflict" in most of the research literature about harbours, and ports and scopes a research agenda that includes integration, risk appreciation and other approaches to these increasingly contentious maritime environments. This process provided an opportunity for global researchers to share the ways harbour conflicts are mitigated and the kinds of adaptations that are possible.

Introduction

Harbours, the lands and water around constructed ports, are a scarce resource and the focus of a variety of uses and users of land and sea. Harbours are critically important social and environmental places imbued with cultural meanings and complex values that attract diverse users and generate conflict. Harbour users seek to access a common pool of natural resources for different ends so there are often conflicts of interest.

There is a gap in the literature of harbours and port-related conflict research that has limited the research and adoption of new solutions. Generic coastal conflict research (Stepanova and Bruckmeier, 2013) does contribute to understanding harbours, however studying the ways that conflicts are solved in a specific harbour shows something important about the harbour users themselves and their situation. The situations, values, actions, and decisions that lead to conflicts in the harbours known to the experts in this paper provide insights and opportunities for further understanding and improved management. Using existing knowledge (including traditional and scientific research), and knowledge of the institutions, governance, markets, legal frameworks, spatial zoning, suasion and other measures provides a useful synthesis. How conflicts are resolved shows important economic, social and environmental characteristics of

harbours and identifies where research opportunities exist and this is the focus of this comparative synthesis paper.

The explicit omission of "conflict" in most of the research literature about harbours and ports (Ng et al., 2014), is interesting and stands in contrast to other literature about commons and natural resource conflicts such as in fisheries, forestry and air pollution (Dietz et al., 2003). Perhaps the research gap is linked to the complexity of harbours and the inability of single disciplines to identify, understand and manage conflicts in harbours. Single discipline approaches sometimes can cauterize the problem with a specific 'fix', such as heritage, or zoning uses out of the area or optimising for a specific set of port efficiency measures. Yet the enduring and emerging complex problems appear to require involvement of multiple disciplines and stakeholders. Approaching harbours from different perspectives means that engineers, ecologists, economists and other researchers have realised the need to integrate their knowledge in order to understand and provide actionable knowledge. In this paper researchers' integration of human and biophysical science perspectives from case studies of conflicts in world harbours shows that options do exist for opening-up to new modes of science and knowledge production.

Over the last three decades the failures in Integrated Coastal Zone Management (IZCM), of which harbours can be an example, can be partly attributed to ICZM's inability to resolve conflicts (Stepanova and Bruckmeier, 2013). Avoiding or postponing natural resource management conflict often relies on; allaying public concern using strategic plans, protected areas and environmental impact assessment, public assurances (Jacobson et al., 2014) funding research that do not negatively influence policy or management, applying strong top-down strategies, spatial planning tools or transferring governance to market-like mechanisms. Research can open-up some opportunities for systemic change. Deliberative and discursive approaches that enhance collaboration are more important when and where there are knowledge gaps, complexity, uncertainty and rapid change (Bammer, 2013). By these criteria, harbours are a focus of contest and provide a new kind of research opportunity in natural resource and environmental management more broadly.

The literature about harbour conflicts

Researchers studying fisheries, forestry and other natural resources find recurring patterns of conflict around the world (Martinez-Alier, 2009). Given that harbours and ports, those parts of harbours modified by logistic facilities, are the focus of so many users with different interests the authors of this paper were surprised that harbours have so few conflicts reported in the literature. The conflicting and dynamic values projected on harbours have not been subject to as much research as other places. Resources such as coastal and urban areas (for example the Solutions to Environmental Contrasts in Coastal Areas (SECOA) program with outputs such as Morf et al., 2013) have shown the promise of directly addressing conflict through research. No papers reporting research on harbours and their conflicts or syntheses were found, yet there are good examples of coastal conflict literature (for example SECOA's synthesis is published by Stepanova and Bruckmeier, 2013). Charlier and Vigneaux (1986) observed a general pattern that:

> It has been a common occurrence, over the last decades, for conflicts and competition to develop, among existing and potential users of the coastal zone. An agonizing choice has been forced in many instances upon governing bodies, even private enterprises, involving frequently considerable economic, social and ecological impact.

Green and Penning-Rowsell (1999) described why conflict is inherent from coastal systems and Biliana Cicin-Sain's (2003) comparative analysis of coastal conflict is seminal. The methods used to describe coastal conflict, such as the matrices used to compare NW Europe estuaries (Cutts and Hemingway, 2013), have now been widely applied. Stepanova and Brukmeier (2013) provided the most useful review of coastal conflict literature and identified four theoretical concepts; environmental conflict (Homer-Dixon, 2010), resource conflicts caused by scarcity in distribution, Malthusian depletion conflicts, and common pool dilemmas. In a review of European coastal conflicts, Stepanova (2014) showed the potential of knowledge integration and the necessity of conflict resolution in sustainable resource management. Yet conflict research in harbours has not been on either the policy or the research agenda.

Harbours are intense concentrations of users who compete and collaborate and both of these require information and can benefit from new knowledge and research. For example, Elinor Ostrom's (governance) framework of ownership, allocation, distribution and exchange of resources (Dietz et al., 2003) appears promising and harbours may be an ideal test environment for adaptive management approaches. Harbours may serve to examine power, different values, and knowledge that are seen as hindrances to cooperation in other environments.

Harbours have particularly difficult governance problems connected to intractable management problems. Normative questions about reducing resource damage, sharing and justice are controversial in these highly modified ecosystems. While more science is both necessary it is also insufficient for improving harbour governance. Proposals for adaptive management often seek to reframe the intractable problems and conflicts as simpler information deficit and cooperation problems rather than competition problems. Yet the dominant paradigm, especially for innovative ports, is to achieve commercial, national and corporate interests and some sustainability or green results (Acciaro et al., 2014).

A recent synthesis of 28 conflict cases in EU coastal environments is particularly useful (Morf et al., 2013), because it provided typologies of conflict, detailed analyses and generated forecasts of conflict. The authors found that coastal conflicts involved entities (individuals or collectives) that want to make use of resources - either directly or indirectly - and that an important driver of conflict was the perception that one user could benefit by excluding others (Reed et al., 2009). When more than one use was involved, there was generally conflict. Harbours are scarce resources, a place of safety that offers spatial and temporal advantage to many uses, so conflicts that relate to perceptions about incompatible goals and interference between users are inevitable. These perceptions are framed by culture, history, knowledge and institutions so the management of harbours may benefit from a mixture of existing and new knowledge.

Cutts and Hemingway (2013) suggested six kinds of information necessary to understand and manage estuaries and it seems reasonable to extend these to harbours:

1. *users* and uses of the system (legal and illegal, desirable and undesirable);
2. *sectoral* areas that most require management (or improved management);
3. *spatial* areas that most require management (or improved management);
4. *synergies* that occur and how they might be expanded or better used; and
5. areas where conflict is less than expected (e.g. systems are in place that may be particularly good at managing multi-user issues); or
6. areas of unusually high conflict (needing further research to avoid management failure).

Coastal and ocean-use planners often use conflict matrices (e.g. Fig. 1) to organize information about resources and to identify incompatibilities of uses. This is followed by the development of a spatial management (zoning) plan in an effort to avoid conflict or formally allocate uses through spatial and temporal restrictions or market-like instruments. Additional information (and more complexity) can be incorporated into models and multi-criteria approaches to inform stakeholders and decision-makers. These have been used in European coastal conflict transformation (Stepanova and Bruckmeier, 2013) and making these information management tools for communities and decision-makers were a highlight of the SECOA program. However, there is a danger that these matrices and tool become overly complex such that they fail to engage stakeholders. Therefore ensuring a trade-off between sufficient complexity to describe and explain conflicts effectively, while remaining interpretable, engaging, and supporting planner decision-making in conflict resolution should be of primary consideration when developing tools.

	Category		Landscape	Conservation			Archaeology	Access		
Category	Location's Conflict Level Assessment		High value landscape feature	Protected area adjacent to system	Protected subtidal area	Protected intertidal area	Historical Protected site	Recreational access on water	Recreational access on banks and intertidal	Commercial
Landscape	High value landscape feature			0	0	0	0	0	0	0
Conservation	Protected area adjacent to system				2	4	0	-3	-4	0
	Protected subtidal area		0	2		2	2	0	0	0
	Protected intertidal area		0	2	4		2	-3	-8	0
Archaeology	Historical Protected site		0	0	0	0		0	0	0
Access	Recreational access on water		0	0	-3	-3	0		0	0
	Recreational access on banks and intertidal		0	-4	-4	-8	0			0
	Commercial		0	0	0	0	0	0		0

Key
Actual Conflict Level Assessment (Combination of Sensitivity & Significance)

Negative Very High (-10 to -12)		Positive Low (1-3)
Negative High (-7 to -9)	Zero (0)	Positive Moderate (4-6)
Negative Moderate (-4 to -6)		Positive High (7-9)
Negative Low (-1 to -3)		Positive Very high (10-12)

Fig. 1 Extract of a conflict matrix showing the sensitivity and significance of conflict between categories of different uses in one estuary (Cutts and Hemingway, 2013: 10)

Method

To determine if the gap in harbour research that explicitly considered conflict was international, and if research contributions could be helpful, we used a combination of workshops and follow-up discussions involving multiple experts. We gathered case studies of conflicts in seven selected harbours. Table 1 provides some of the characteristics of the harbours to contextualise the variety of harbours considered in this synthesis. The aim was to briefly provide context for future research considerations and to provide insights into the nature of harbour problem-based research that could potential support adaptive governance or other management approaches. The authors shared their insights on the important or interesting conflicts that have emerged and how they were resolved.

This is not a systematic literature review, but an elicitation of information from researchers and experts from each harbour. The short description in each case reflects what the expert thinks is important about the harbour, the conflicts that exist and the way research, and knowing more about the harbour conflicts, might help more widely harbour managers and researchers.

This method discovered useful options for conflict management that are worthy of sharing and further exploration such as ecosystem and cultural mapping, strengthened resolve of government to enforce legal provisions, spatial planning, extra-national environmental and food quality standards and improved integration of research and knowledge management efforts. Each harbour made unique contributions and there was not evidence that new discoveries were declining with additional harbours being considered. Table 2 provides the highlights that each case makes to the overall understanding of harbours and conflict management. The method is necessarily exploratory. In a subsequent project, we hope to develop stand-alone case studies for harbours and further analyse the existing conflicts and the way harbours of the future could be informed by research.

Harbour case studies

Sydney Harbour, Australia, conflicts within an iconic harbour

Sydney Harbour's deep-dropping shores provide great anchorages and few opportunities for foreshore reclamation. As a result, most of the rocky and cliffed shoreline remains relatively natural with about 7 % percent being beaches, mudflats and mangrove stands (Mitchell and Silver, 1989). Although seawalls and beach modifications have occurred widely, the marine assets are exceptional and the biophysical characteristics provide abundant and variable landscapes that require sensitive management. Sydney Harbour has more fish species (586) than the entire coast of the UK and 'astonishing biological diversity' inhabiting diverse habitats from sub-tidal rocky reef to soft bottoms and beaches (Hutchings et al., 2013).

Sydney Harbour is a global icon, an important tourist destination and the site of Australia's largest city. The Harbour is enjoyed by residents and visitors alike for its natural beauty, accessible beaches, and iconic structures (the Opera House and Bridge primarily) (Banks et al., 2016). Commuters use ferries and water taxis, while yachtsmen and recreational boaters enjoy the sheltered waters, bay, and marinas (see Table 3) (Hoisington, 2015; NSW Government Maritime Management Centre, 2013). Some dry goods and oil

Table 1 Summary of selected harbour characteristics

	Greater metropolitan area		Bio-physical characteristics					Social & economic indicators					
	Population (M)	Density (km^{-2})	Type of estuary[b]	Area (km^2)	Catch-ment (km^2)	Tidal range (m) [b]	Biodiversity (sp. no.)	GDP of city (US$ B)	Vessel visits pa	Total trade (tonnes, M)	Total trade (US$ B)	Imports (US$ B)	Exports (US$ B)
Sydney, Australia	4.63	372.4 2000	Large, Drowned river valley	50	500	1	>3000	74	540	4	27	45	10
Ria de Vigo, Spain	0.4	1113[a]	Drowned river valley	179	751	2	>3000	7.7 (2012)	1540 (2014)	4.1	13.1	Not available	7.2
Qingdao, China	9.0	1100 3900	Large Shallow gulf	362	>6000	4	>513	129	Not available	468	157	77	80
Jakarta, Indonesia	30.5	9500	Large, Coastal Breakwater	514	>2,000	1	>700 (fish, echidnoderms and molluscs)	143.67	17,800	45.7	64.85	49.04 (Jan-Jul 2014)	15.81 (Apr-Jul 2014)
Plymouth, United Kingdom	0.3	3,459.5 4400	Small, Drowned river valley	64	2,295	5.9	~8,400	Not available	~1,500	2.1	14	Not available	
Auckland, New Zealand	1.6	2500	Large river valley	80	390	2	unknown	74.7	1600	4.4	26	16.8	9.6
Heraklion (Crete), Greece	0.30	444.6	None	0.87	684.3	~0	>300 (meio- and macrobenthos)	6.3 (2011)	2,629	0.23	Not available		

[a] includes surrounding municipalities
[b] (National Geospatial-Intelligence Agency, 2015)

Table 2 Contribution to researchers, managers and others from each case-study to the synthesis of harbours and conflict management

From	Researchers can learn	Managers can learn	Others can learn
Sydney	Biodiversity	Importance of legal standing, social licence, principled approach to planning, Relocation of old port facilities out of the harbour	Growing importance of aesthetic valuation
	PPB contaminants		Relocation of old port facilities out of the harbour
			Historical and natural values
Ria de Vigo	The importance of integrated responses to harbour issues in these highly productive environments.	Pressures of growth in hinterland and fisheries that threaten marine values and fail European directives.	Raft mussels provides an ecosystem service that relies on managing harbour users.
Qingdao	Capacity of land-based pollution receiving waters	Importance of integrated response to major challenges Including legislation and eco-compensation policies	Harbours in very rapid step-wise transition and from primary, secondary to tertiary industry production
	Opportunities for large scale ecosystem restoration and construction		Historical values
Jakarta	pollution impact, social science opportunities and challenges	Social and cultural mapping and use research, principled approach to planning, massive infrastructure projects	Harbours in rapid step-wise transition and from primary, to secondary to tertiary industry production all at once
Plymouth	Monitoring of shallow rock and sand harbours with multiple values	Myriad of multiple heritage and legal measures are unusual compared to other harbours in this paper and reflect an active listing process in the UK.	
	A busy small working harbour of high international ecological value – juxtaposition of sustainable use vs. environmental protection	The high relative value of historical and natural including the history of mining and contamination	
Auckland		Local Māori (Ngāti Whātua and 12 other iwi), the Crown and regional and territorial authorities that collectively manage Auckland Harbour and Hauraki Gulf are working together.	
Heraklion	Monitoring of shallow rock and sand harbours	Intense use in a small harbour	
		Transition from state-owned to majority private ownership	

are shipped commercially from the Harbour but most port functions were transferred to nearby Botany Bay in the 1980s (Sydney Ports Corporation, 2014). Massive international cruise liners visit in increasing numbers; from 119 in 2009–10 to 280 in 2014–15 (Sydney Ports Corporation, 2014).

The shorelines of Sydney Harbour reflect the conflict of private versus public interests. Since European settlement wealthy Sydney-siders have built properties that effectively limit access for the rest of the population (Davies and Wright, 2014). Some beaches narrowed or became inaccessible as foreshore developments and seawalls encroached upon them. In 1925, the government reclaimed some land back into public ownership e.g. Lane Cove National Park (Davies and Wright, 2014), but this was a rare response to the problem of privatising public land through waterfront development. The experience with marinas (Table 3) triggered a more principled approach to planning the changing uses of the harbour and these principles are applicable to many world harbours.

Table 3 Marinas as a microcosm of conflicts within harbours: Sydney

Marinas are the intense use of harbour area for boat storage and, most controversially, often result in the conversion of public areas to private use. Marina decisions in Sydney were so problematic in the 1980s that public inquiries (Mitchell and Silver, 1989) resulted in a *Sydney Harbour Regional Environmental Plan* (2005) with principles that; (a) Sydney Harbour is to be recognized as a public resource, owned by the public, to be protected for the public good, (b) the public good has precedence over the private good whenever and whatever change is proposed for Sydney Harbour or its foreshores, (c) protection of the natural assets of Sydney Harbour has precedence over all other interests.

The Rose Bay Marina, within Port Jackson, is a case study that shows the importance of the legal and regulatory protections offered to residents on the edge of a scenic harbour (Chen and Pearson, 2015). In an effort to improve the certainty of conflict outcomes between existing harbour users, government conservation measures and developers the Department of Planning developed a strategic plan for the Harbour and set nine zones with differing environmental characteristics and potential uses.

Rose Bay was zoned W5 – Water Recreation and this gave preference to public water-dependent development and allowed commercial water-dependent development which provides benefits to the public use of waters. Although the public appeared disinterested during the strategic planning phase, the public became acutely aware of the impacts of the new marina development on their use of the harbour. Subsequently development applications met with public protest. Government and court decisions between 2006 and 2013 delayed, modified and finally rejected further development. The legal and regulatory framework, that had allowed public input into the decision-making, specifically tested the processes of the decision and held public officers to account, while the process and the result was not popular with the developer, it provides a useful example of harbour conflict management.

The ability of the public to participate; to have knowledge of planning, express views on specific development applications, to appeal government process and decisions in specialised courts is a key characteristic of Sydney Harbour (Chen and Pearson, 2015). Discussions comparing Sydney and China's environmental courts highlight the importance of public standing (Mei et al., 2013) and participation in decisions; this is especially true in the dynamic harbour environment.

Tenure of the harbour and remaining adjoining lands is vested predominantly in government and managed by various public agencies (Banks et al., in press). There is little scope for new uses to emerge without redundancy of others, such as closing port-side hardstand areas, finger wharves or Navy areas with replacement by residential, commercial and tourism uses. Often these land use transitions are conflicted and slow, in part due to the time required to clean-up, re-zone and approve any changes (Waitt and McGuirk, 1997).

The managers of Sydney Harbour face a difficult challenge in balancing the changing requirements and aspirations of residents, visitors, industry, shipping and other users (Banks et al., in press; Hedge et al., 2014). Legislation and regulations have addressed environmental issues (*NSW Protection of the Environment Operations Act 1997*, the *NSW Coastal Protection Act 1979* and the *Environment Protection and Biodiversity Conservation Act 1999*) and Local Environmental Plans regulate development, however in the past their implementation may have fared more on political and community will rather than sound scientific principles (Hedge et al., 2014). In response, in 2013 the NSW Government created the Marine Estate Management Authority (MEMA) to review the effectiveness of conservation strategies and to introduce a new Risk Assessment Process (Banks et al., in press). The new system incorporates community values assessments to more fully engage the community in conservation and management plans for Sydney Harbour and allow greater consideration of environmental issues alongside its socio-economic values (Banks et al., in press).

Vigo, NW Spain a harbour needing cleaner water for aquaculture

The coastal city of Vigo is in the Ria de Vigo (Evans and Prego, 2003) bathed by the Atlantic Ocean in NW Spain and close to the Portuguese border. Vigo is the largest fishing port in Europe—in 2015, 745,087 tons of fish were loaded—and a coastal city where industrial and urban uses coexist with local fisheries and shellfish mariculture. Situated on the

northern boundary of the Eastern Atlantic upwelling system, Vigo has a highly variable and highly productive marine ecosystem that is vulnerable to global change.

Vigo is a popular tourist destination, with an average of 100 cruise liner visits per year, which translates on an average of 215,000 passengers. Besides fish landings, the Port of Vigo also handled approximately 600,000 tons of new car shipments (manufactured at nearby plants) and two million tons of container traffic in 2015. Recreational boating is popular and several marinas offer approximately 1000 berths (http://www.turismodevigo.org/en/marinas).

The population surrounding the Ria grew rapidly from 266,000 in 1961 to 414,000 in 2014 and now has a high population density (Table 1). Intense urban development coexists with areas valued for their high environmental qualities, such as the stringently protected maritime Atlantic Island National Park. However, the growing population has led to increasing impact on the marine environment, particularly the supply of particulate organic carbon (POC) from rivers and sewage plants located along the shoreline. Ria de Vigo is also located next to an area of intense marine traffic such as the Traffic Separation Scheme of Finisterre. This results on increased environmental risks such as oil spills. An oil spill in 2002 caused great environmental damage and civil unrest.

The dependence of the local economy on marine renewable resources together with the degradation of the water quality status of the Ria lies behind the major conflicts in this harbour throughout the past two decades. An analysis of local newspapers shows social conflicts occurring in the Ria de Vigo throughout the past 20 years are most frequent related to pollution, fish or shellfish exploitation. These activities account for 36 % of the total number of conflicts published, followed by those associated with urbanization of the coastline, coastal landfills and regression of natural protected áreas (12 %) (Fernández et al., 2016).

A recent conflict (Table 4) has arisen due to the increasing use of the shores of the estuary for harbour-related purposes. As a result, Vigo citizens miss the aesthetic and recreational benefits of the shoreline. There have been attempts to change shore urbanisation, the latest one "Abrir Vigo al Mar" resulted in some areas being opened to the public and a large commercial mall and harbour authority new headquarters being built next to the ocean.

Table 4 Aquaculture and water quality, an ongoing problem: Vigo

The Ría de Vigo's ca. 500 mussel rafts produce in the order of 37000 t/year (Fernández et al. 2016). Mussels actively filter feed on the suspended organic matter are susceptible to incorporating undesirable pollutants and pathogens. Aquaculture of bivalves is, therefore, very sensitive to the water quality of the environment and enhanced inputs of nutrients, organic matter or pathogens substantially affect the yield of these cultures. The policy conditions, in *European normative 854/2004*, detail the zones and treatments necessary as a result of *E. coli* risks. The risk and costs increase from: A zone, with low *E. coli* levels where mussels can be commercialized directly after extraction; to B zones, with intermediate *E. coli* levels where shellfish must undergo a purification process prior to consumption and; C zones, with high *E. coli* levels, where shellfish consumption is only allowed after reallocation of organisms to other sites for an extended period of time.

In December 2005, the European Commission declared that Spain had failed to fulfil its obligations under the *European Directive 79/923/CEE* of 1979. It found that the measures to reduce pollution and improve water quality standards required for mussel aqua culture in the Ria de Vigo had not been implemented. This declaration initiated intense social responses from shellfish producers and environmental organizations demanding the managers make a stronger commitment to the effective and rapid decline of organic pollution levels at the Ria. A stronger flow of information between stakeholders and the different administrations responsible for water quality in the Ría could improve the understanding of both the complex environmental problem and the political and administrative procedures involved.

This is a strong example of a local conflict based on environmental degradation that would require a smart and integrated management of the human settlements conditions, the economic activities sustaining these populations and the ecological integrity of the harbour ecosystem of the Ria de Vigo.

Qingdao, China, a planned transformation of a harbour

Qingdao is a rapidly growing (economic growth 18 % per annum) large port city in north-east China with a marine sector that provided US$21.57 billion in revenue in 2013 (Xie, 2014). Qingdao's harbour, on the edge of Jiaozhou Bay, records the history of transitions from coastal abandonment, colonial port, communist industrial powerhouse, naval port, manufacturing centre, cycles of aquaculture development, bulk port and emerging research, high-tech and tourist centre. The most obvious conflicts are now between industrial users, port users, residential developers, and government conservation efforts. The various government and government-owned business users struggle to manage the harbour's natural resources, protect the environment, sustain various fisheries, maintain or grow port operators and use land reclamation to fund provision of government services (Chen and Pearson, 2015).

Many of the high-level conflicts are managed strategically and often overseen by Communist Party of China officials. Conflicts between individuals and industry are managed by direct compensation and government intervention, using its clear central mandate and local legal and regulatory powers.

The environmental condition of the Bay has continued to deteriorate since the 1980s, natural areas have been converted to aquaculture, hard land surfaces have replaced wetlands and a large population has grown around it; all depending on the Bay to receive and process their waste. As just one example, chemical fertilisers used in the hinterland rose from 1.9×10^3 tons/year in 1949 to 350×10^3 tons/year in 2011 (Qingdao Municipal Statistics Bureau, 2011).

Long ongoing scientific measurements, government strategic land-use planning, target (total discharge control of land based pollutants) setting, more anti-pollution legalisation and stronger public appeals (Wang, 2013) have not altered the trend. The Bay's ability to process nutrients is over-capacity (Liang et al., 2015) and the Bay rests over the thresholds set to avoid algal blooms. The people expect improvement as a part of harmonious development and even with clear government support the data suggests ongoing deterioration (Qingdao Municipal Government, 2013).

The various conflicts between users are mainly resolved outside of the courts through a process that ends with direct payment of compensation. This kind of resolution relies on users being able to present a successful case and the goodwill (and perhaps a sense of self-preservation) of the more party. User conflicts in Jiaozhou Bay are often asymmetrical meaning the winner's benefit greatly exceeds the cost of compensation to the loser, and rarely do decisions reflect the estimates of the total value of ecosystem services of JZB wetlands (estimated to be 527 million CNY (Zheng et al., 2012). Already the total loss of value of marine ecosystem services of JZB is 331.86 million CNY/year with the most important loss being in the provisioning (food) function (accounting for over 68 % of the loss), followed by losses in the regulation function (about 33 %), smaller loss values relate to lost support and cultural functions of the ecosystems (Wu et al., 2013).

Qingdao, at the centre of the Peoples Republic of China's modernisation and Blue Economy development, confronts the challenge of user conflicts with a combination of strict policy, substantial offsets and ecosystem construction. The growing interest of the government, with its over-arching goals of setting targets and investing in resources, enforcement and accountability, research investment in public and private

uses, seeking to achieve Jiaozhou Bay's environmental health and security (Wang, 2013) opens a unique opportunity for an integrated response.

Jakarta, Indonesia, a growing megapolitan harbour city

Jakarta is the capital city of Indonesia with a population of about 10 million in 2014 and, if considered as a megapolitan with other surrounding cities, its total population is about 28 million with a total area of approximately 7500 km^2. The dramatic development of Indonesia and the rural–urban in-migration to Jakarta has raised economic, environmental, and social tensions demanding policy and infrastructure responses. This is a very complex situation and the complicated interrelationships between various interest groups in this developing harbour need to be understood. The potential and actual conflicts between these groups are shaping this megacity and its harbour area will help to craft the new image of Jakarta as one of the leading megacities of South East Asia. The harbour must also provide means of sustainable livelihoods, protection, and progression for Jakarta and its people in the future.

About one-third of the megapolitan area is low-lying below 10 m above mean sea level and with slopes of 0 to 5°. Thirteen natural and artificial rivers flow through Jakarta into Jakarta Bay. The Jakarta Environmental Management Agency categorized all rivers in Jakarta as polluted in 2012 and 73 % of them were described as "heavily polluted" (BPLHD, 2012).

Jakarta is very vulnerable to flooding and it occurs almost every rainy season (December-March). The historical record shows flooding has occurred since the colonial era in the 17th century with major or severe flooding in Jakarta in 1621, 1654 and 1918, then in 1976, 1996, 2002, 2007 and 2013. The master plan of the city flood prevention and its implementation started in 1854 and continues. It includes building canals, dykes and reservoirs however in spite of this due to ongoing land use changes in the catchments, increased population and value of developments in the megapolitan area, land subsidence (1–15 cm/year in Jakarta with some parts 26 cm/year (Abidin et al., 2011; Ng et al., 2012)), rapid river sedimentation and trash damage caused by flooding has increased. In addition, based on some research, there is also a significant sea level rise occurring in the Java Sea. Windupranata et al. (2014) using both altimetry satellite data and in-situ tide observation observed a sea level rise of up to 7 mm/year between 1992–2014.

Land subsidence is driven by four factors; groundwater extraction, loading by construction, natural land consolidation and tectonic factors. Groundwater extraction is shown to be the driving factor of land subsidence (Abidin et al., 2011).

The government has a developed plan to eliminate or reduce flooding and started construction in 2015 of a 35 km giant sea wall on the offshore side to function as a dyke controlling water levels of Jakarta Bay and protecting the Jakarta megapolitan area. Furthermore, the water inside the wall will also be used as a water supply. Reclamation is planned between the wall and the existing coastline to be used as new residential and business areas for 3 million peoples. Transportation infrastructure and facilities to link throughout Jakarta will also be developed. The wall is expected to protect about 4 million people and US$ 103 Billion in economic value from future flooding. It is projected to be in full operation by 2030 at a projected cost of US$ 9–10 billion. Initial conflicts emerged over the overlapping of governance of the central

government, represented by the Ministry of Marine Affairs and Fisheries, and the regional government, represented by the government of Special Capital of Jakarta, this resulted in debates about the authorisation of the projects already underway and they were shut-down.

While this mega project promised a technical solution to floods and fresh water shortages they introduced more demand on spaces for multiple users and new conflicts are emerging. The potential impacts of losses of important natural habitats (mangrove and coral reefs), increased sedimentation and further water quality degradation behind the sea wall due to changes in water circulation patterns (Pranowo et al., 2014), social-economic consequences, particularly for the Bay's fish and mussel dependent communities (Zulham et al., 2014) who will be inevitably displaced by these reclamations (and are expected to cause new conflicts (Putri et al., 2015).

Mitigating these conflicts through governance, integration of science and community-based approaches and recognition that emerging problems are likely is critical. For example, the giant sea wall itself will be neither sufficient nor effective in managing flooding in Jakarta without also controlling ground extractions water that drive land subsidence. Similarly, riparian inputs contain pollutants that are likely to contaminate fresh water storages unless wastewater management and inter-state cooperation along the watershed is dramatically improved. The people living around the Bay require new livelihoods, alternative jobs and support to ensure they have the capacity to adapt and transform their communities.

Jakarta harbour shows conflicts emerging when a rapidly growth pressures the current multiple competing uses and is multiplied by uncertainties about the possible futures. This rapid change, largely informal urbanisation and massive infrastructure projects compete for space in areas subject to subsidence and flooding. For these reasons, of all the harbours in this paper, Jakarta would appear to be the one that faces the greatest challenges and risk of worsening conflict.

Plymouth Sound, United Kingdom, a lasting heritage

Plymouth is a coastal city in the southwest of the United Kingdom, located on Plymouth Sound; a drowned river valley with steeply sloping sides and rocky coastline to the east and west. It has a long maritime history starting in the Bronze Age (2,500-800 BC) before becoming a trading post of the Roman Empire (27–476 AD), and major trade port during the 16th Century. In the 17th Century, a naval base was established which today is the largest in Western Europe (Knights et al., 2016). Plymouth also serves as commercial docks, coaling station, shipbuilding yard, and cruise liner terminal. Its commercial and recreational importance has led to the area becoming densely populated despite its relatively small size (Table 1)).

Non-maritime industry has left a lasting legacy on Plymouth Sound and its rivers. Notably, the mining industry is of historical and continued importance; peak production during World War II supplied two-thirds of global copper and in recognition, the region was listed as a UNESCO World Heritage Site in 2006. As a result, high levels of residual contamination by arsenic, copper, lead and zinc in the rivers continue to flow into Plymouth Sound at an order of magnitude greater than other regions of the UK (Colbourn et al., 1975). Nutrient loads are also high as a result of diffuse sources

including sewerage and agricultural run-off, in some instances, levels in the surface waters reach 3,477 kg N km^2/year (Tappin et al., 2013), greatly exceeding legislated levels (Burt et al., 2011; Howden and Burt, 2009). The harbour continues to be heavily used by recreational, commercial and military vessels (>1,500 visits yr^{-1}, QHM, *pers comm*) leading to leaks of polycyclic aromatic hydrocarbons into water and sediments at concentrations exceeding 200 μg l^{-1} in some instances (Dissanayake and Bamber, 2010; King et al., 2004).

Despite this, Plymouth Sound and its associated estuaries are of considerable biological importance and provide one of the finest examples of salinity-graded communities in the UK. Sedimentary and reef habitats are of international marine conservation importance, and the Sound is home to a number of rare or unusual species for the UK (Knights et al. in review) and species rich (Table 1). As such, the estuary is protected by UK and EU legislation including as: a Site of Special Scientific Interest (SSSI) for its coastal cliff exposures of slate and limestone; Special Area of Conservation (SAC) and European Marine Site (EMS) under the *EU Habitats Directive* (92/43/EEC) for its sandbank, estuarine, marsh, reef, shallow bay and inlet communities; Special Protection Area (SPA) under the *EU Birds Directive* (79/409/EEC); and Site of Community Importance (SCI; UK byelaw) to protect bedrock reefs from damage by fishing gear.

Conflict in the 1990s involving the changing interests of the Royal Navy, commercial shipping, recreational boaters, scientific researchers, fishermen and public generally were largely resolved by the Dockyard Port of Plymouth Order 1999 (regulated by the Queen's Harbour Master). This explicitly recognised the needs of multiple end-users and places a number of controls on them to ensure public health and safety. In addition, the Tamar Estuaries Consultative Forum (TECF; see http://www.plymouth.gov.uk/tecf) has an important facilitative role for dialogue and consultation between stakeholders. The members of TECF are afforded statutory powers, who together, develop and deliver integrated management of the Tamar estuaries and surrounding coasts by way of 'partnership action'. In this relatively small harbour, consultation of stakeholders coupled with transparent action underpins the decision-making process (Knights et al., 2014), such that conflict is minimal.

Plymouth Harbour provides an example of an older harbour, steeped in historical and natural values and a contamination legacy. The multiple heritage and legal measures are unusual compared to other harbours in this paper and reflect an active listing process in the UK. The methods and approaches to minimise conflict appear successful such that the harbour remains commercially successful while the important biological, chemical, and physical features of the harbour are protected. It may therefore provide an ideal approach that could be effective in harbours worldwide.

Auckland, New Zealand, participation as an approach

Auckland Harbour (also known as Waitematā Harbour), is a drowned river valley, reshaped by volcanic craters and lava flows, to form tidal flats and mangroves in the upper reaches and sandy bays with sandstone cliffs along the eastern shores (Aguirre et al., 2016). The Harbour is widely used both recreationally and commercially, with a diverse range of stakeholders and an adjacent population of 1.42 million who contribute to a waste water disposal problem that has profoundly damaged the natural

environment (Kelly, 2014). Other uses include recreational boating, agriculture, commercial and recreational fishing, volunteer restoration projects and military and port activities. The Port of Auckland provides container, conventional, and passenger facilities and handles 37 % of New Zealand's total seaport trade (Kelly et al., 2014). The port has expanded through reclamation and its managers plan further reclamation, prompting considerable local debate and controversy. Auckland is also the gateway for international tourism and the waterfront rejuvenation is a showcase for Auckland's diversity as it transitions from industrial and maritime work to mixed-use areas that combine traditional fishing, port and marine uses with residential and business areas and new public spaces and facilities (Xie and Gu, 2015).

Māori are Tangata Whenua, or first nation peoples of New Zealand, and have traditional roles as Kaitiaki or guardians of natural resources for future generations that are increasingly recognized in New Zealand's resource management laws and co-governance. In this area local Māori (Ngāti Whātua and 12 other iwi), the Crown and regional and territorial authorities that collectively manage Auckland Harbour and Hauraki Gulf are working together.

The latest State of the Gulf report indicated that the Auckland Harbour and greater Hauraki Gulf Marine Park are experiencing ongoing degradation and depletion of resources (Kelly et al., 2014). The range of management actions and differing jurisdictions in the gulf results in diverse governance with a lack of integration. Policies range from those that are either focused on reducing impacts or some perversely increase pressure on the marine resources and potentially speed-up environmental degradation. In response, the Sea Change – Tai Timu Tai Pari planning process is currently being developed to deliver a spatial plan for the region by September 2015 to conserve the environment, mitigate degradation, and "inform how the Hauraki Gulf is shared, used and stewarded for future generations"(Sea Change - Tai Timu Tai Pari, 2014).

Sea Change—Tai Timu Tai Pari is a stakeholder-led process in partnership with mana whenua. This approach recognises how communities already have the knowledge and capability to solve pressing ecological problems, and aims to coordinate input from stakeholders and the public that will shape the development of the spatial plan (www.seachange.org.nz). One approach for enhancing stakeholder input is Voluntary Geographic Information (VGI) Systems. VGI is becoming increasingly used around the world by non-experts to provide spatially explicit information on how different people use and relate to conservation landscapes (Brown, 2012; Raymond et al., 2009; Whitehead et al., 2014). Through VGI, survey participants are asked to drop markers on a map to indicate areas that are important to them and they assign values to these locations. These spatial data layers can be combined with ecological and economic data to better account for the social dimensions of conservation and enhance group decision making (Haklay et al., 2002).

Jarvis et al. (2015) conducted an extensive VGI survey of visitor use, values, and local knowledge across Auckland Harbour and the greater Hauraki Gulf Marine Park to provide high resolution participatory data to inform the Sea Change planning process. Users identified areas that were important to them, and indicated how they used and valued different areas across the region. This data was used to highlight hotspots of good and degrading environmental health (Jarvis et al., 2015), and hotspots of biocentric and anthropocentric values that can be used to assist managers in decision-making

(Jarvis et al., 2016). The incorporation of diverse local knowledge and values can be used to better balance multiple-use across the planning space and identify areas of potential conflict and collaboration across the planning space. In addition, incorporating social data in spatial decision-making can assist in bridging management planning with local efforts while providing the opportunity to identify and address citizen concerns.

By encouraging a participatory approach to planning in Auckland Harbour and Hauraki Gulf Marine Park, planners can broaden engagement and inclusion. Such an approach can be used to minimise potential conflicts where stakeholders may have otherwise felt marginalised from the decision process. In addition, a participatory approach can also increase scientific awareness and promote environmental stewardship. Furthermore, by integrating local knowledge, use and values in planning processes, decision-makers can identify new management opportunities with strong social support.

Heraklion, SE Mediterranean, Greece, an intensely used port

The harbour of Heraklion is the midpoint of the main navigation route linking the Atlantic and Western Mediterranean with the Red Sea and Indo-Pacific Ocean for over 5,000 years. Heraklion has a population of over 304,000 inhabitants and its economy has growing over the last decade peaking in 2008 with a GDP of 6,510.30 M€ and then decreasing in the years of recession (5,786.33 M€ in 2011). It is one of Greece's largest cities and third in order of port traffic with annual passenger traffic of 2 million and 300,000 vehicles (MAPMED Consortium, 2014).

The port of Heraklion is a relatively small harbour (0.87 Km^2, Table 1) hosting the activities of several different and often contradictory users in tight proximity. There are leisure boats, sailing boats, artisanal and medium scale fishing boats, large cruise boats, cargo boats and cranes, military ships, as well as a shipyard. Furthermore, the port receives a significant impact from Heraklion city. Officially no fresh water inflows to the port exist, however a couple of old sewage pipelines and an old seasonal stream seem to flow inside the port (Heraklion Port Authority, personal communication). The frequency and the composition of these effluents is completely unknown and there is no control or monitoring about their impact in the marine environment.

The few studies on the environment inside the port of Heraklion have investigated the effects of the organic enrichment to the soft-bottom meiofaunal communities (Papadopoulou et al., 1998), reported the water column and sediment chemistry (Lampadariou et al., 2000) and has described the soft-bottom macrobenthic communities and related them to physical and chemical environment of the water column and sediments (MAPMED Consortium, 2014). Areas used by tourist ferries, cruise boats and cargo ships had a relatively good environmental status, indicating that such activities have no significant negative environmental impact on the water and sediment quality of the port and the surrounding areas. In contrast, the more enclosed sector of the port, where the leisure and fishing boats are moored had a higher organic and hydrocarbon pollution. The far end (east side) of the port was damaged by untreated effluents and wastes of the shipyard activities detected as increased organic, heavy metal (Al, As, Fe, Ni and Zn), hydrocarbon pollution and damaged macrobenthic communities (MAPMED Consortium, 2014).

The Heraklion Port Authority, which is responsible for the management of the port, attempts to highlight the high aesthetic value and the rich archaeological and cultural heritage of the harbour (i.e. Venetian harbour, Koules castle) and at the same time to combine them with the currently increased rate of economical and touristic development. The port is divided in five operational sectors from west to east: 1) leisure and small-scale fisheries boats, 2) passenger ships/ferries, 3) maritime and cargo ships, 4) military and naval ships, and 5) shipyard. Although the defined port sectors are separating all these diverse activities, several conflicts are often arising between the different users. One important issue is the competition for space: the demand for berthing places in the docks for sailing boats is greater than the available space, thus resulting in the loss of a valuable source of income from the touristic sector and an increase of the docking costs for the existing places.

The number of stakeholders involved in the port activities contributes to conflicts that require resolution. The Heraklion Port Authority acts as the general management body of the port and develops a contingency environmental plan to deal with any possible accidents, the Coast Guard deals with the security of the coastal area, the Region of Crete is the local governmental body working on the touristic development of the port and the maintenance of its environmental quality and the Decentralised Administration of Crete represents the Ministry of the Environment. Also involved in port activities are the Tourist Authority, the Greek Navy, the Industrial and Commercial Chamber of Crete, the Maritime and Shipping Companies and Trusts and the Fisheries Association. Therefore, when a conflict arises between the different user groups there is a delay in resolution until all the involved stakeholders, one at a time, find a solution that brings less harm to as many user groups as possible.

A synthesis of the existing environmental sustainability knowledge in the Mediterranean Sea Basin by MAPMED consortium (2014) was to help Heraklion through the promotion of a long term cooperation between Institutions, users, scientists and new management tools. The project started with an integrated multidisciplinary approach, based on the skills and expertise of the scientists, technicians, socio-economic and legal experts, to generate a transferable model for the Mediterranean. The project activity included learning about the social, cultural, economic and political conditions of different stakeholders and resulted a more efficient and concrete management plan for the Heraklion port informed by the scientific experts, more effective protection of the marine environment, additional docking areas and modifications to increased circulation in the fishing port. The new management plan of Heraklion port has been approved by the Greek State but its implementation has not yet started.

The Greek state has been the sole owner, manager and provider of port services through the operation of limited liability companies supervised by the Ministry of Mercantile Marine. It has recently transferred the ownership of many ports. including Heraklion, to the Hellenic Republic Asset Development Fund on a pathway to majority privatisation and is currently gathering expressions of interest. So far the Heraklion Port Authority, the Coast Guard and the Region of Crete are all involved in the balancing of the emerging conflicts of interests.

Concerns are rising about how the privatisation and concessional agreements will impact the different users and conflict may be avoided or ameliorated by additional research, careful legislative protections and adequately resourced institutions. Additional

research is required in order to assess the ecological status of the marine habitats hosted in the port area and to establish standards regarding the point of ecological quality that should be achieved in the port. An inter-stakeholder body with a conflict resolving mandate should be legally established to facilitate the transformations involved in privatisation. Heraklion is an example of a small but intensely used harbour that is being changed by international forces.

Discussion

Each of the harbours in this synthesis contributes insights to harbours' conflict and management. Jakarta Bay, Qingdao's Jiaozhou Bay and Ria De Vigo highlight the difficult conflicts between land-based pollution and traditional fisheries. Plymouth and Sydney are dealing with the legacy of pollution while managing new user expectations. Auckland's governance system is reengaging with traditional owners.

In preparing this paper the authors reached a strong consensus: understanding conflict amongst harbour users through comparison shows that many of the patterns, conflicts, and threats are shared. Harbours geographically focus uses and conflicts of interest. There are new research opportunities to integrate existing conflict frameworks such as conflict matrices (Fig. 1) and other systemic frameworks, risk management, and more participatory approaches. Sharing this knowledge with the maritime community will improve research and management. The evidence elicited from experts shows that, to understand and manage conflict, requires knowledge of harbours that integrates the history of management, the values, powers and roles of conflicting agents and the dynamics of conflicts. Research done through synthesis of coastal zones case studies showed the power of explicitly considering conflict and transferring that knowledge to even more pressured environments (Stepanova and Bruckmeier, 2013).

The integration and implementation of research on harbours could be organised using the systemic driver-pressure-state-impact-response framework (Sekovski et al., 2012) because the framework appears to capture the key processes and be flexible enough to adapt to this additional aspect. This approach improves the understanding and emphasis on linkages, indicators and benchmarks, giving managers the confidence to manage undesirable environmental trends or situations (Jennerjahn and Mitchell, 2013; Knights et al., 2014; Knights et al., 2013) and opens opportunities for users to participate in and contribute to more of the strategic and operational decisions that dominate harbours.

Even in harbours where experts could find little expression of conflict the regulatory frameworks showed governance and power was used to achieve the apparent serenity and further work is needed on how latent conflicts could re-emerge. Comprehensive indicators, for use across the causal framework of Drivers, Pressures, States, Impacts and Responses (DPSIR), are required to enable users and their conflicts to be better understood by researchers and managers. These indicators need to be sensitive to changing conflicts in time and location and will help understand the marginal benefits of specific management activities.

Risk-based approaches (Knights et al., 2015) and management actions that could be developed and tested a priori (Piet et al., 2015) need to be further developed. Users of harbours appear to engage so intensively that management success could be achieved through a robust evaluation of threats. This could enable prioritisation and

subsequently trade-off between those threats (Goodsir et al., In Press; Knights et al., 2014), rather than the overly confident applications of single-focus prescriptions.

Astles (2015) contributes an example of the risk management approach to Sydney Harbour that identified risks around stresses, ecological processes and gaps in the knowledge. She identified shortcomings in previous work that focused on ecological process risk and that generated a management response focused on statistical validity and monitoring rather than integration, actionable knowledge, education, and capacity building. Expanding consideration to humans and the ecosystem scales is fostered by integration, participation, ecosystem and DPSIR based management thinking.

The ability to cope and thrive with inevitable conflict requires advances in both natural and social sciences. Adaptive and innovative approaches (Dietz et al., 2003) to resolve conflicts borne of complexity (Berkes, 2006) are urgently needed. In harbours, where governments are likely be in the roles of developer, polluter, tax-collector, planner, protector and vendor, implementing stronger rules-of-law or market-like reforms tends to reinforce existing trends rather than solve long-term conflicts. The harbour case studies suggest that transformations and opportunities for adaptive government could occur in harbours where new knowledge becomes available, good leadership or volunteerism thrives, where a social licence is revoked or crises open opportunities.

The use of spatial management – the geography of exclusion zoning, marine protected areas and citizen-derived maps may be part of the solution. However over-reliance on one approach can lead to privatization or central government control and loss of community support. So community and self-regulation are also important checks to simplistic responses (Berkes, 2006). Centralisation (Plymouth) and privatisation (such as in the Harbour Heraklion) poses new complexities of ownership, governance and adaptive possibilities.

The sharing of insights between harbours by users and people seeking to manage the changing ownership of harbours would benefit from a global perspective. The importance of anticipating, mitigating, ameliorating and adapting to change are important functions for harbour-based research to inform and support. Building institutional and individual capacities to ensure desirable environmental, economic, social, and sustainable results is a serious test in these massively valuable and dynamic environments. The comparisons showed the nature of harbour investment and use indicates that international research groups are an appropriate way to promote understanding. We are also realistic that some argument and conflict is desirable.

The importance of knowledge gaps about harbours in both research and management alike suggests these are indeed fertile areas for on-going effort (Astles, 2015). There is a need for hard-edged analysis of impact where complex conflicts are managed to a resolution (finding a full and final solution) or adaptation (amelioration or mitigation). Although the environmental problems in harbours were substantial, none of the experts concluded the direction of trend or magnitude of responses were having the desired result. Most found particularly challenging situations for governance, for example the lack of enforcement of regulations was deemed a greater pressure than the lack of regulations. We think that this problem requires diverse participation. DPSIR provides a well-known holistic framework that can report the adequacy

of responses. An adaptive or learning focus is likely to be essential in achieving more desired results in future.

Based on the case studies reported by the expert authors (Tables 1 and 2), and the available parallel literature, we recommend that future research on harbours should be guided by an explicit awareness of conflict analysis. Future research and management should contribute to adaptive management of these domains;

- issues that cross harbour-urban-marine-rural boundaries
- complex problem management
- understanding nested scales - geographically, temporally and administratively
- enhanced quality of stakeholder engagement
- power, asymmetries and relevance
- uncertainties and learning
- scenarios of desirable and undesirable futures

Future work, to develop the descriptions of port and harbour conflicts is needed and this can draw on SECOA dimensions of theme, actors, temporal involvement, phases of management, forums, strategies (exclusion, integration, nesting and prioritising) and management outcomes or outputs (Morf et al., 2013). Although we agree that better description precedes improved diagnosis and prescription of methods and treatment pathways (Morf et al., 2013) we are also aware the imperatives of harbour decision-making demands contemporaneous adaption of scientific research paradigms.

Conclusions

Harbours are the focus of uses that inevitably conflict yet there is a gap in research that informs managers about management options. In this research, there is consensus amongst the experts considering seven quite different harbours that conflict is an important characteristics of harbours. The role of harbours in surfacing the environmental and social systems and the intensity of different and often conflicting uses is not yet matched by research efforts to inform decision-makers, research investors, or researchers. Harbours are included in many coastal conflict analyses, but have not received specific attention to see if extending these coastal research and management solutions into harbours is valid.

This preliminary expert analysis of case studies shows harbours are sites of intense conflict and are less likely to be successfully understood and managed by single disciplinary projects or integrated coastal zone management approaches that exclude analysis of conflict. Further research underway will work with users to focus on shared desirable futures as people prepare for ongoing change in the world's harbours. Explicitly engaging in research about conflict and this first recognition that conflict is both characteristic of harbours and often an opportunity for engaging with different harbour users, sets a new foundational understanding for harbour-related research. Already research about the future of harbour conflict has directed attention to poverty and indigenous users and toward Asian and African harbours. Research using methods of scenario development, futures and participatory engagement are now underway in the World Harbour Project.

There is a worldwide opportunity to share insights and responses to conflicts in harbours to enhance the fair, sustainable, effective, and efficient use of them. It is an urgent challenge especially in rapidly developing harbours like Jakarta and Qingdao. Furthermore, this research synthesis identified in all harbours the challenge of engaging social sciences as researchers and stakeholders in the identification of problems and engaging in the research needed to resolve conflicts. Policies driving rapid development of harbours in this period of maritime globalisation, port privatisation (Ng, 2013) and the expanding maritime ambitions of nations all require urgent attention of researchers.

Competing interests
Stuart Pearson as lead and corresponding author has contacted all the authors and there are no competing interests from the authors of this paper.

Authors' contributions
SP is the corresponding author. SP was the lead author and developed the concept, wrote the introduction and recruited and briefed the expert authors and rewrote the submissions from these other experts. The other expert authors provided material related to specific harbours. JB and PS provided overall comments and JB provided copy edits. AMK made editorial comments throughout. All authors read and approved the final manuscript.

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