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Review

How good is good? Human values and Europe's proposed Marine Strategy Directive

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Abstract

The adoption of the proposed European Marine Strategy Directive is an opportunity for a comprehensive policy for protecting, improving and sustainably using Europe's environmentally degraded seas. It calls for an ecosystem-based approach to management where humans are regarded as a key system component. Although the proposed wording has been the subject of fierce debate, the central policy goal remains achieving "Good Environmental Status". The interpretation of "good" is key to implementation and relates to human values and worldviews. We demonstrate how these vary widely across Europe. Solution of fundamental considerations such as the assignation of reference states, the balance between precautionary and evidence-based action, the degree of subsidiarity, and conservation strategies including marine protected areas, will ultimately depend upon public understanding, involvement in and support for the Directive. The social element, critical to effective adaptive management, requires greater attention within the context of a regional seas geographical framework.

Keywords: Marine policy; Marine Strategy Directive; Ecosystem approach; Worldviews; Values; Europe; Regional seas; Sustainable development; Precautionary; Marine protected areas; Adaptive management

1. Introduction: a new policy framework

The continued expansion of the European Union has provided unprecedented opportunities for more rational approaches to the use of its landscapes. There has been considerable debate on how to balance agendas for achieving economic growth with the need to conserve biological, landscape and cultural diversity and relatively strong terrestrial environmental policies and laws have developed. This has not been the case in the marine environment however as evidenced by overexploited fish stocks, limited protection of habitats and species, continued concerns about pollution, the spread of opportunistic alien species and eutrophication affecting semi-enclosed seas. The global scale of human alteration of the natural environment has led to the suggestion that we are living in a new geological era, the "Anthropocene" (Steffen et al., 2002).

Though regional seas conventions have existed since the 1970s (OSPAR in the North Eastern Atlantic, the Helsinki Convention in the Baltic, the Barcelona Convention in the Mediterranean, the Bucharest Convention in the Black Sea), these mostly originated from concerns about pollution in the 1970s, lack enforcement mechanisms and do not cover fisheries. Indeed, fish and their environment are managed by entirely separate policies, laws and institutions. Only recently have these agreements expanded to take an holistic, ecosystem approach and be concerned about habitat protection (e.g. Article V of the OSPAR agreement). Whereas European policies until the 1990s were sectoral, i.e. each Directive considered a particular problem (e.g. the Bathing Beach Directive), only recently

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have they taken a wider, whole system view (e.g. Apitz et al., 2006). As an example, the European Union's Water Framework Directive (WFD) provides a integrated policy tool aimed at achieving Good ecological and chemical status (GEcS, GCS) for rivers, their basins and estuaries (termed 'transitional waters') but it only covers the narrow band of coastal waters extending either one or 3 miles (depending on country) from high water. Most notably, the Habitats and Species Directive (HSD) applies to all seas in Europe over which states have claimed rights. In practice it extends as little as 3 miles from the coast in some EU states, to the median line in the case of the North Sea, and to 200 nm in the UK (as a result of legal action by a coalition of NGOs to protect cold water corals). The HSD requires that designated areas attain favourable conservation status (FCS). As with the WFD, if this is not achieved by a coastal country (as measured against a reference) then sanctions can be applied unless a satisfactory socio-economic case is made to the Commission for a derogation.

The apparent policy and legislative gap for the sea areas of the EU triggered calls for new environmental legislation matching the WFD, and ultimately led to the development of a draft Marine Strategy Directive (MSD) (Borja, 2006). The public process leading to the MSD began with a stakeholder workshop in Køge, Denmark in December 2002 that focussed on the so called "Ecosystem Approach" (see CBD, 1998) as a promising new policy paradigm for marine management. It defined this approach as

> ...the comprehensive integrated management of human activities, based on best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of the marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity.

More recently, following the Lisbon Agenda for economic development, there were parallel calls for a new development strategy for Europe's seas and a maritime "green paper" is currently under consultation. Together, these two emergent policy tools (the maritime green paper and the MSD) have been described as a "two pillar" approach to marine and maritime policy in the EU; on the one hand a policy designed to maximise the economic benefits from the rational use of the marine environment and, on the other, legislation designed to conserve the flow of economic goods and services from marine ecosystems whilst maintaining their resilience and biodiversity.

This duality is shown in Fig. 1, where the text of the Køge definition is expressed as a flow diagram illustrating the interrelated roles of the MSD and policy proposed in the maritime green paper. It is clear that an integrated policy framework would depend upon the parallel development of both initiatives, a matter of obvious concern to environmentalists.

The ecosystem approach accepts that humans and their natural environment form coupled social and ecological systems (SES; also referred to as socio-ecological systems). Of the 12 principles of the ecosystem approach laid down by Malawi Declaration of the CBD (CBD, 1998), the first five relate to social-economics and managements rather than ecological diversity per se (Elliott et al., 2006a). At the core of this approach is the growing recognition that there is a need to find ways to ensure human welfare and wellbeing without unsustainably appropriating the earth's natural capital and destroying biological diversity.

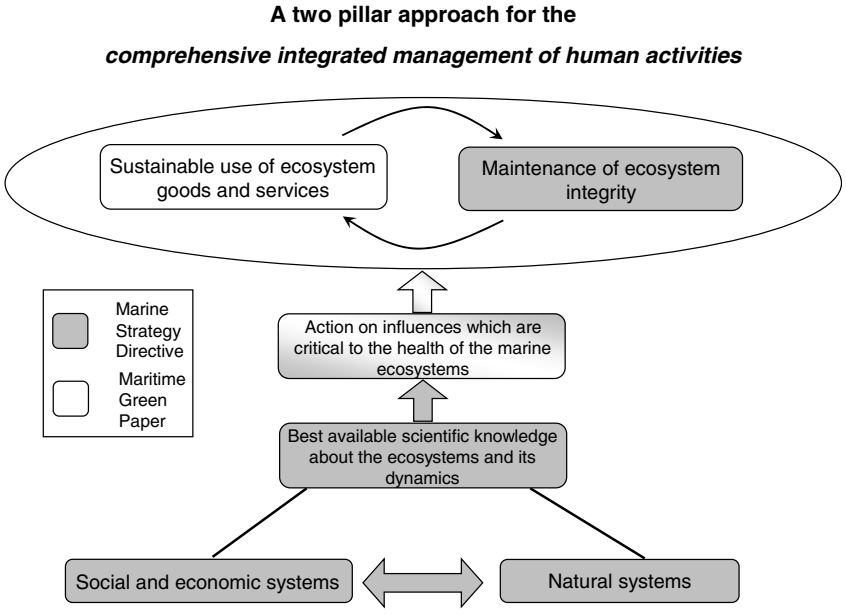

Fig. 1. Definition of the ecosystem approach agreed at the Koge stakeholder workshop (see text for details) mapped onto the emergent EU legislation in this area.

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At the heart of current proposals for the MSD is the requirement to achieve "Good Environmental Status" (GEnS) by 2021. On December 18, 2006, the European Council reached a political agreement on the text of the MSD and agreed that EU Member States will develop and implement their own marine strategies within the overall MSD framework in a cooperative manner in order to reach the common GEnS target. According to Council (Council of the EU, 2006):

> "good environmental status means that seas and oceans are ecologically diverse and dynamic, clean, healthy and productive, their use is at a sustainable level, safeguarding the potential for uses and activities by current and future generations"

This sets a challenge to European scientists to finds ways to measure GEnS. Together with public officials they will need to examine compatibility with GEcS and FCS (a logical requirement if the Directives are to be harmonised) and whether or not approaches developed for the land (in the case of the HSD) and freshwaters (for the WFD) can be extended to open and more dynamic marine areas.

In the current paper, we will explore the proposed approach to GEnS, consider options for how this concept might be articulated and discuss whether or not it is likely to deliver sustainable seas.

2. Incorporating value judgements in European marine policy

The definition of GEnS adopted by the Council is open to multiple interpretations, an issue of concern to many NGOs who had been lobbying hard for stronger common goals (NGO Coalition, 2006). Apart from what they perceived as a sequential "watering down" of the MSD, they were particularly incensed that the revised first article of the draft MSD states that marine strategies shall be developed and implemented with the *aim* of achieving or maintaining GEnS and consider that such an aspirational statement (the use of the word "aim") is not a binding commitment. The NGOs were not alone in their criticism; Table 1 illustrates how attempts by the European Parliament to strengthen the text of the MSD were thwarted by the Council of Ministers. Just as this article went to press though, the Environment Committee of Parliament reached a new compromise, reinstating amendments that may bring the GEnS implementation date forwards to 2017, set specific and legally binding criteria for GEnS and improve integration with the CFP. The debate continues.

The aspirational definition of GEnS (Council of the EU, 2006) elaborates the basic criteria:

(a) structure, functions and processes of the marine ecosystems, together with the associated physiographic, geographic and climatic factors, allow those ecosystems to function fully and maintain their resilience. Marine species and habitats are protected, human induced decline of biodiversity is prevented and diverse biological components function in balance;

(b) hydro-morphological, physical and chemical properties of the ecosystems, including those properties resulting from human activities in the area concerned, support the ecosystems as described above. Anthropogenic inputs of substances and energy into the marine environment do not cause pollution effects.

Table 1
Conflict between the European Parliament and Council

Issue	Parliament	Council
Binding vs. non-binding "good environmental status"	Asked for a legally-binding objective to achieve good environmental status	Wants the law to only require that Member States "aim" to achieve or maintain this status
Definition and assessment of "good environmental status"	Added a definition of good environmental status to the Commission initial text and proposed a detailed annex with conditions for assessment	Rejected this notion and called instead for "generic qualitative descriptors"
Deadlines	Sought to shorten the timetable for implementation to 2017 (from 2021) in order to bring the law into line with the existing EU WFD	Rejected bringing any implementation deadlines forward
Marine strategies	Wanted Member States sharing a Marine Region to produce a single, joint marine strategy per region or sub-region	Proposed the development of a marine strategy in each Member State, taking account of each marine region or sub-region concerned
Marine protected areas (MPAs)	Introduced the compulsory designation of MPAs	No obligation to establish MPAs (they are only part of programmes of measures to be developed)

Many attempts by the Parliament to strengthen the MSD have been rejected by the European Council (in which government ministers from the Member States are the decision makers).
Based on the status of negotiation until August 2007 (Information source JNCC, 2007).

It is difficult to imagine a world where these criteria are entirely fulfilled. It would certainly be very different from the status quo and one that would require a massive – currently unplanned – overhaul of the EU's common fisheries policy, amongst others. Apart from recognising the physical and chemical alterations of the system, these criteria evade the key issue of ecological disturbance that is locked into current human lifestyles.

Under the provisions of the MSD, countries will have to agree on how to articulate, define and measure good environmental status (GEnS) for each regional sea and in many ways the Council decision has merely postponed the really difficult discussion for four years to follow the eventual

entry in force of the Directive. This has been the major point of contention in the negotiations on the various drafts. At one point, it was proposed that individual countries should propose definitions of GEnS for their waters and the European Commission should act to resolve differences. Following objections, this process was modified to return most of the responsibility to groups of countries working on a regional sea basis. This disagreement over the level of involvement of a central authority is more about the distribution of power than differences in values. However, disputes reflecting differing values began to emerge when definitions were proposed.

The underlying philosophy of the MSD suggests an aim, either by accident or desire, to build on the WFD (Apitz et al., 2006). In the WFD, GEcS relies on the concept of the ecological quality ratio, the ratio between defined biological parameters in a water body and relevant reference conditions (European Commission, 2003). The choice of ''environment'' rather than ''ecological'' for the MSD appears to move away from the emphasis on the state of the ecosystem (in which humans are not explicitly included) that characterises the WFD, to an assumed emphasis on the environment as ''all that surrounds us'' in incorporating societal aspects, *pace* the 12 CBD principles. This wider conceptual framework was the central pillar in the UN Conference on the Human Environment, in Stockholm in 1972. However, the interpretation in the overall definition of GEnS agreed in the current draft MSD barely mentions the human dimension and this suggests a move towards the WFD approach in all but name. Indeed, whereas the conceptually different terms ''ecological'' and ''environmental'' are employed in the WFD and MSD texts in English, there are no such differences employed in the official translations into such languages as Spanish and French (i.e. GEnS is the same as GEcS in some countries, but not all).

As with the HSD and WFD, the MSD is conceptually very simple: comparing the current state of an area with that which would be expected if there were minimal human alteration (i.e. a good state) and then making interventions to bring it back to the desired good state. Where the HSD and WFD have proven more complicated is in developing effective mechanisms for implementation, and this has led to accusations of ''gold-plating'' Directives.

It can be argued that ''goodness'' is not a property that is intrinsic to nature but an extension of our human value system. A naturally eutrophic lagoon is ''good'' for jellyfish or small pelagic fish, for example. A similar system fuelled by nutrients introduced by humans could be regarded as ''bad'', but only in the context of those animals that humans value and consider to be part of the natural system. The difference between the two systems is the extent of human disturbance, the label ''bad'' refers to the level of disturbance that is deemed as unacceptable or undesirable (see Tett et al., 2007). In the example chosen, it would be difficult to determine which of the systems were good or bad by measuring a set of state indicators. Rice (2003) has extensively reviewed ecosystem health indicators and warns that improperly applied they could fail to inform about events that have occurred in the real world, or can provide false alarms about events that did not happen. For GEnS, indicators would require detailed knowledge of what the natural state should be, why the system is in a particular state, and the value-based criteria for applying the ''good'' or ''bad'' label.

Insomuch as it involves value judgements, GEnS could be regarded as an ethical concept, highly dependent on collective worldviews. Science will be required to determine the level of alteration of a particular marine environment but this must be measured against societal expectations based upon values. Thus while the scientists charged with defining terms and implementing the Directive can advise on the nature and desirability of ecosystem changes, it will be society that has to consider if these are sufficiently large to warrant action. Unfortunately, the scientific understanding of human environmental values is in its infancy and is particularly weak in the context of the sea.

3. Changing values

The degree to which values vary with time and space is obviously important though not necessarily explicit when negotiating new marine policy and implementation measures, especially for large transboundary water bodies such as regional seas. Outcomes of these processes are often difficult to understand in terms of scientific research. For example, Dogterom (2001) revealed major differences in the way different countries and transboundary river authorities defined target values for freshwater quality corresponding to UN/ECE Class 1 (sustaining the ecological function). In the case of lindane, for example, the Elbe Commission set a value of 100 ng/l, whereas the neighbouring Rhine Commission set their values at 2 ng/l. Similarly, Belarus set a target value of 1 ng/l whilst its neighbour Poland, set theirs at 50 ng/l. This huge range of target values is unlikely to reflect major differences in research on the effects of lindane but is either related to the degree of risk that each authority is prepared to accept (and the associated cost of reducing the risk) or to their interpretation of a normal ''ecological function''. Either explanation ultimately reflects different human value judgements.

Human tendencies, dispositions and worldviews have been the subject of numerous studies that provide context for policy decisions. Douglas and Wildavski (1982) developed Cultural Theory, for example, and suggested that everything that humans do or want is culturally biased. This and alternative theories based upon psychometric analysis have proven controversial as they risk misinterpretation, using them in order to predict the behaviour of individuals on the basis of cultural stereotypes. Cultural theory has demonstrated some explanatory power however, particularly with large groups of individuals (e.g. UK bathing water case study in Langford et al., 2000).

The World Values Survey (WVS) is a major international study which attempts to integrate a regularly

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updated globally coherent information base on people's values (Welzel, 2006), and similarly the 2004 "Eurobarometer" survey shows European citizens' attitudes towards the environment (European Commission, 2005). Each of these studies was based on statistically comparable population samples; the latest WVS data are from 1999 to 2000, whereas the EC data are for 2004. Neither study includes specific data related to human attitudes toward the sea but both provide information enabling valuable insights that demonstrate how environmental perceptions, attitudes and underlying values vary from place to place and how these attitudes influence policy preferences.

The EC survey examined interviewees' environmental concerns by asking them to indicate their five major worries from a list of 15 issues. Data were aggregated at a country level and the top five concerns were water pollution (47%), man-made disasters (46%), climate change (45%), air pollution (45%), and the impact on our health of chemicals used in everyday products (35%). The diversity of levels of concern is illustrated in Table 2 where three issues of particular importance to the marine environment are highlighted for coastal countries grouped by regional sea. These are water pollution (1st concern overall), natural resource depletion (9th) and biodiversity loss (11th). The original questionnaire was not explicitly focussed on the marine environment, but the results may serve as a proxy for a wider discussion.

The relatively low priority given to natural resources depletion and biodiversity loss contrasts with strong scientific evidence (e.g. from the Millennium Assessment or OSPAR and HELCOM reports) that these issues are critically important; the huge gap between public and scientists' perceptions may reflect an ineffective information flow. Indeed the change of emphasis in the regional seas agreements (OSPAR, etc.) from the original pollution basis in the 1970s to habitats and biodiversity in the 1990s reflect scientists perceptions. Throughout Europe, water pollution is a consistent concern, slightly higher in the Baltic than the other regions. Depletion of natural resources is of greater concern to those in the NE Atlantic region and concern over biodiversity loss is evenly distributed but only about half of that of water pollution. These results are consistent with surveys in the Baltic conducted for the Global International Waters Assessment (Mee and Bloxham, 2005) where experts were asked to rate a number of concerns as "no observed impact", "slight", "moderate" or "severe", employing commonly agreed criteria. Aspects of pollution, habitat and community modification and unsustainable fishing scored similarly as "severe" problems from an environmental perspective but only pollution was deemed as "severe" when assessed in terms of its socio-economic impact.

The EC survey rankings may well reflect the immediacy of the perceived threat to the welfare of individuals responding and is compatible with the economic concept of discounting future costs. It has also been shown in other regions that factors such as personal income and social status heavily influence perceptions of the marine environment (Cinner and Pollnac, 2004; Steel et al., 2005). Atkins et al. (in press) found that social status, income and background have a large bearing on the public's willingness to pay to tackle eutrophication problems in Denmark, as much as their personal links with uses of the fjordic environment. The range of responses by different countries within each region is particularly large for depletion of natural resources and biodiversity. Very low levels of concern are unlikely to result in pressure for political action necessary to solve the environmental problems. Furthermore, differences in concern between countries sharing a water body are likely to make it difficult to negotiate political agreements.

Elliott et al. (2006b) suggest that successful marine environmental management requires actions which satisfy the seven tenets of environmentally sustainable, economically viable, technologically feasible, socially desirable or tolerable, administratively achievable, legally permissible and politically expedient. Thus in order for public awareness to be translated into concrete actions and an improvement in the environment, all of these facets have to be in place.

The world values survey has illustrated how values are changing markedly with time in the majority of countries. People are exercising greater self-expression, a factor that may be related to economic growth (Welzel, 2006). More research will be needed before this trend can be related to attitudes towards the environment. Attitudes regarding who is trusted as a source of information and who should be responsible for paying clean-up costs will be discussed later in this paper.

4. Reference states: the slipping baseline

The draft MSD approved by the December 2006 Council contains a new annex (Annex VI) listing 11 generic qualitative descriptors to be used to define GEnS at a regional level. These include many items that will require additional

Table 2
Percentage of interviewees citing amongst their top five concerns selected issues that also relate to the marine and coastal environment

	North-East Atlantic		Baltic		Mediterranean	
	Median (%)	Range (%)	Median (%)	Range (%)	Median (%)	Range (%)
Water pollution (seas, rivers, lakes, underground sources, etc.)	49	39–57	56.5	44–66	51	38–71
Depletion of natural resources	29.5	17–36	25	16–48	21	8–30
Loss in biodiversity (extinction of animal species, flora and fauna, etc.)	24.5	14–33	23	14–33	24	12–33

The original data is re-aggregated by regional sea: NE Atlantic (BE, DK, DE, FR, IE, NL, PT, UK); Mediterranean (EL, ES, FR, IT, CY, SI, MT) and Baltic (FI, SE, EE, LV, LT, PL, DK, DE).

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research and quantification if they are to be operationally useable. Examples are:

(1) All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity;
(2) Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem.

Given the present state of marine knowledge, statements such as these will clearly need value judgements on the basis of reference conditions. This is happening in the case of the WFD where elaborate indicator systems have been devised by large numbers of scientists across Europe in order to create multimetric indicators of deviation from a normal and expected condition (e.g. Devlin et al., 2007) but "normal" remains a value-laden expression. In the case of non-indigenous species, there is the questionable underlying assumption that a particular non-indigenous species present at low levels will not find appropriate conditions, such as through rising sea temperatures, to undergo a population explosion.

The issue of reference states is a particularly contentious one in marine systems. There is growing evidence of continuing degradation of many European marine habitats as a consequence of physical destruction of habitats, eutrophication, marine pollution, invasion by alien (introduced, invasive and opportunistic) species and the removal of physical and biological resources (e.g. aggregate extraction and overfishing) (EEA, 2005). Despite this, there are indications of improving systems, for example,

- the quality of many beaches and estuaries has improved as a consequence of environmental regulations and point source urban and industrial pollution control supported/demanded by the general public;
- the levels of some toxic pollutants have declined because of increased regulation and the closure of many heavy industries (as production shifts to Asia);
- economic collapse of many Eastern European countries led to reduced fertiliser applications and reduction of animal herds and this in turn resulted in decreases in some nutrient loads to the sea (e.g. Black Sea, Mee, 2006).

As shown by the implementation of the WFD, it is often difficult to quantify the magnitude of change because of an inherent high variability or inconsistent baseline information in time and space. The WFD, and perhaps the MSD after it, suggest that such baselines can be derived by physical controls (i.e. locating a high quality area comparable to the area in question), hindcasting, predictive modelling and, as a last resort, "expert judgement". Of these, in a highly developed area such as Europe, undisturbed control areas are rare, any historical analysis is hampered by poor data and the fact that the system has changed, and predictive modelling for highly dynamic marine physical, chemical and biological systems is still at an academic rather than an operational level. Hence, "expert judgement" may have to be used as a first rather than last resort. Against the poor data and information base, management decisions still have to be taken and so these may be often based upon human perceptions of change; consequently these are notoriously unreliable. Each generation tends to set its own reference state or "baseline" employing the information from the period it felt to be "the best". In this manner, baselines slip from generation to generation (Pauly, 1995) and perceptions of quality, i.e. what is "good status" may decrease as the public (and scientists) get accustomed to a lower level of quality. None of these concerns are new in that the UK has had quality assessments and classification schemes since the 1970s but even since then perceptions of good quality have differed between those working in the urbanised and industrialised southern parts and the pristine northern areas. Policymakers seek to use reference values and turn to scientists for advice, but reference values converted to "baselines" for political action imply judgements of what is "good" or "bad" about the natural environment. Three examples from UK waters illustrate this problem:

(1) *Current legal catches of cod are at an all time low.* The International Commission for the Exploration of the Sea (ICES) has recommended setting zero quotas for its capture for several years but these calls have been systematically overruled by the European Council of Ministers (Delaney et al., 2007). One of the arguments sometimes employed for this seemingly illogical decision is that stocks have dipped in the past and recovered, and 1998 is often quoted as a "good year" in this context. Fig. 2 illustrates how the catch in 1998 was actually lower than a "bad year" (1977) two decades earlier during the period know as the "Gadoid outburst".
(2) *Beaches in the UK are reported to be the cleanest they have been in at least 50 years* (BBC, 2003). This is certainly undeniable when considering compliance with EU bathing water standards. Current levels of coliform bacteria would have been unimaginable in the 1960s. A broader view however, might include solid waste (garbage), a problem that appears to be worsening (see Fig. 3), particularly due to plastic waste that in turn follows the irrational consumption of water sold in disposable bottles (tap water in the UK is also produced to high standards and charged accordingly). Litter previously associated with antisocial behaviour in the 1960s (people were branded as "litter louts") is not widely recognised as a major problem for the sea because it has few immediate implications for human health. By all definitions of pollution that refer to a biological effect however (McLusky and Elliott, 2004), litter is clearly a pollutant as it can have considerable impact on marine life.

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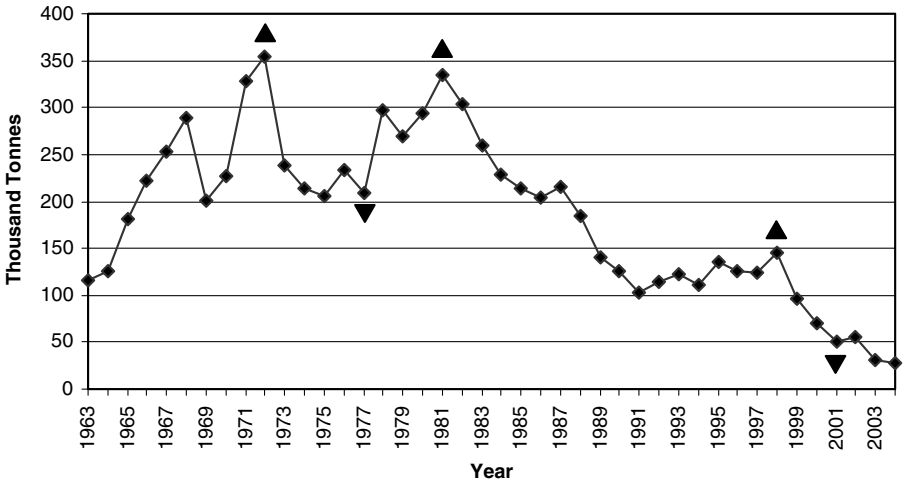

Fig. 2. North Sea Cod Landings, 1963–2004 (*source*: Defra, 2004). Arrows show "good" (▲) and "bad" (▼) years.

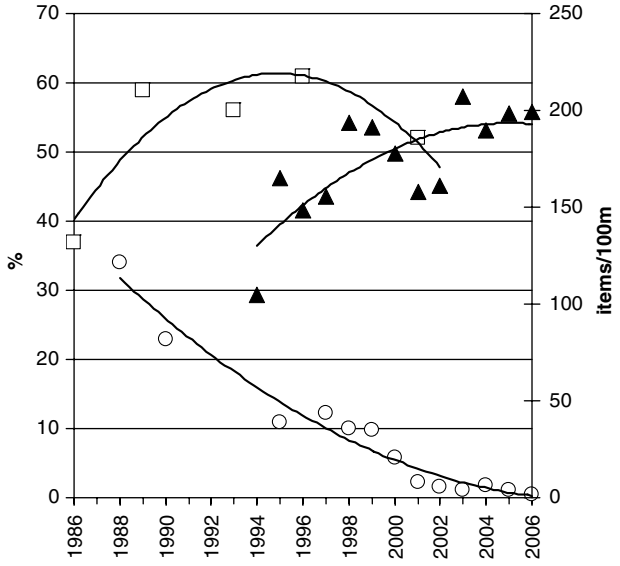

Fig. 3. Relationship between UK bathing water quality, measured as non-compliance with EU Bathing Waters Directive (○), the percentage of British people very concerned with pollution in bathing waters and beaches (□) and the average amount of plastic on Britain's beaches (▲). Data source: Defra (2007a,b) and MCS (2007).

One baseline, for microbial pollution, is lowering whereas the other – for plastic waste – appears to be rising. A further concern is the fate of the plastic debris in our waters, which is broken down through mechanical action to form microparticles of plastic. These are widespread, easily ingested by a variety of animals, and have the potential to have considerable consequences on many marine organisms (Thompson et al., 2004).

(3) *For over a century, aggregates have been extracted from the seabed off the Southern coast of Britain*. With accelerating urbanisation, the industry is flourishing and eager to extend its operations. Its immediate local impact is obviously severe and there have been a number of studies demonstrating that benthic systems recover very slowly (Boyd et al., 2004). However, this raises two questions: how to determine a baseline or degree of recovery in a highly mobile system, such as mobile sands and gravel on the seabed, which are developed by having constant reworking of their sediments, and secondly what should systems recover to? Two centuries ago the English Channel had extensive oyster beds – a completely different habitat than any current one. Oyster beds were destroyed by overexploitation and pollution in the 19th Century (BBC, 2000) but, at that time, the more mobile flatfish flourished. Since then, the entire area has been subjected to heavy trawling, another major source of impact, and flatfish populations have dwindled. Should a baseline be a seafloor abundant in oysters or one having large populations of flatfish?

There have been a number of serious attempts to define baselines such as the Dutch AMOEBA system that defined a 1930 baseline for marine components (birds, seagrasses, cetaceans, etc.) (Ten Brink et al., 1991). Apart from difficulties for this system to take account of inherent inter-annual variability, it also makes the assumption that the selected reference year is sufficiently "undisturbed". While 1930 is arguably less disturbed than today, it is not so compared to pre-industrialised/urbanised eras. Turnhout et al. (2007) suggest that ecological indicators, *although they are highly dependent on scientific knowledge, cannot be solely science-based, due to the complexity of ecosystems and the normative aspects involved in assessing ecosystem quality*. Elliott and Quintino (2007) have identified the difficulty of determining reference conditions in inherently variable systems and in marine and coastal systems which are naturally poorly diverse and naturally populated with opportunistic and stress-tolerant organisms, hence already fulfilling the accepted paradigms associated with human-induced stress.

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Thus the terms "baseline" or reference state, though entirely appropriate for stable and specific xenobiotic contaminants, creates the illusion of "nature stable" at some period in time and space when viewing disturbances in the wider ecosystem. This also reflects weaknesses in human memory, particularly intergenerational memory. In temperate northern seas, especially the Baltic for example, the comparatively low biological diversity is partly a consequence of recent emergence from an ice age; during human history there would have been considerable changes in the ecology of these systems irrespective of anthropogenic forcing. Our current, rather short, information base on changing species and communities makes it very difficult to understand the longer term dynamics. Holding natural succession still would be an unreasonable demand and conservation policy has to be developed carefully to avoid trying to do so. Ideally the information base for management would be to understand how human activities are perturbing systems beyond their natural rates of change. This invokes the concept of "naturalness", equally difficult to define but less value laden than "pristine" (Derous et al., 2007).

One practical solution to some of the difficulties of using existing data to define "baseline" or even "natural" conditions is to develop a network of marine protected areas covering representative systems and sufficiently large so as to be effective. These could serve as reference sites for many system components (issues of scale would need to be considered carefully) providing that they were fully protected from local scale human disturbance (destructive fishing, pollution, dredging, etc.) and thus serve for benchmarking sustainable development in marine ecosystems. Improved public awareness and understanding of MPA ecosystems and their links with adjoining marine areas could help to create a new value base for marine systems and ultimately lead to more meaningful definitions of GEnS (Laffoley et al., 2006).

5. Going back to the future?

An important feature of the MSD is that it places a moral – and ultimately legal – obligation to restore damaged ecosystems to GEnS. To achieve this there are many hurdles to overcome. Until recently, marine ecosystems were often regarded as functioning in isolation from humans rather than being part of coupled social and ecological systems. This understanding gradually changed, firstly with the re-setting of management boundaries for regional seas conventions and action plans (OSPAR for the NE Atlantic, HELCOM for the Baltic, the Mediterranean Action Plan and the Black Sea Action Plan) to incorporate relevant land-based activities. In most cases however, neither these plans and conventions nor the corresponding EU legislation included fisheries, a human activity that has enormous impacts. This situation should change with the widespread adoption of "The Ecosystem Approach" and the MSD could be instrumental in making this happen.

Policy goals for system restoration will need to be easily understood by the general public and may include reference points for a system some time in the past. Furthermore, the adoption of policy goals, objectives and indicators of change are worth little unless supported by concrete actions and plans for a series of measures designed to return to those conditions once thresholds have been passed. Just how far back to set the reference points is a societal decision, often left in the hands of government scientific and legal advisors, or at least negotiated between them and public officials. Even where reference states can be defined, this target is often practically unachievable for practical reasons. Some of these are:

(1) *Marine socio-ecological systems operate at often highly variable nested scales and are interconnected.* This has major implications for management. Coral reef conservation through the creation of MPAs may be ineffective if there is heavy logging in a nearby catchment – leading to high turbidity – or if the surrounding sea becomes eutrophic. Boundaries for a management plan would have to be much larger than the reef itself in order to deal with these problems and the social system in the larger area may have different management priorities than that neighbouring the reef. On an even larger scale, systems have become increasingly interconnected as a consequence of globalisation (a social system driver). One consequence is the increased transport of species between seas as a result of discharges of ships' ballast water. This sometimes leads to "invasions" by alien species that may cause practically irreversible changes in ecosystems. As a similar, and currently intractable, indication of the scales to be considered, the influence of the North Atlantic Oscillation on rainfall and hence run-off patterns thousands of kilometres inland is still poorly understood and thus difficult to factor into management systems.

(2) *Many systems respond to change in a non-linear manner.* A particular system will demonstrate resistence to change and resilience (the ability of the ecosystem to recover from disturbance) and, when the resistence is exceeded, the system may change to another state (Elliott et al., 2007; Tett et al., 2007). Such changes, sometimes termed "regime shifts", may occur as emergent properties of the system; the complex product of a number of different causes. Such a change occurred in the North Sea and NE Atlantic c.1987 (McQuatters-Gollop et al., 2007). These changes are not always completely reversible, especially where decreased resistence has led to invasions by opportunistic species (e.g. Black Sea; Mee, 2006, or the catastrophic bloom of the comb jelly *Mnemiopsis leidyi* in the Caspian Sea, Dumont, 1995). The degree of resilience in marine systems and their ability to recover

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from any natural or anthropogenic perturbation is poorly understood especially where there is a degree of hysteresis in the system (Elliott et al., 2007).

(3) *System memory effects and ''locked-in'' change.* System components and the processes that link them operate at different time scales. For example, inorganic nitrogen discharged into a catchment with low relief and permeable soils may remain in the underlying aquifer for decades. Under these circumstances, it could similarly take decades to experience benefits from policy actions designed to alleviate eutrophication in adjacent sea areas; this difficulty is shown by the introduction of Nitrate Vulnerable Zones as a response under the European Nitrates Directive (Apitz et al., 2006). In a similar manner, despite action to ban the global use of PCBs, they continue to accumulate in Arctic ecosystems because of the slow pathways from source to sink.In some cases, the imperative for human survival may make remedial action virtually impossible. For example, a pristine Mediterranean would require a freely flowing Nile river but the continued existence of the entire human population in its catchment depends on the near total abstraction of its freshwater flow. Loss of freshwater to the Mediterranean is therefore ''locked in'' by the current social system. Similarly, levels of marine populations and chemical determinants for industrialised areas such as the North Sea pertaining to the pre-industrialised times cannot be reached without a reduction in urban and industrial areas throughout the catchments as well as on the coasts.

(4) *There are choke points in systems that do not allow recovery.* Even when a recovery plan is devised, it may not be possible to convince key holders of power to implement it. Successive annual meetings of the EU Fisheries Council for example, have chosen not follow technical advice on stock recovery from scientists and the European Commission. There are many such examples where there are trade-offs between conservation and resource appropriation or other social interests.

6. Sustainability as a moving target

If the satisfaction of societal needs makes full ecosystem recovery to a pre-industrial position impracticable, what are the available options for the future? Currently, sustainability appears to be compromised by factors such as overexploitation of marine resources, pollution, habitat loss, introduced species and the consequences of climate change. Some parts of Europe's marine environment can still be conserved for their biodiversity, function or beauty (Article 12 of the MSD has a non-binding requirement for Member States to develop MPAs) but most of our seas will need to be maintained as ''fit-for-purpose'', once that purpose has been defined. Hence the importance of quantifiable objectives associated with GEnS. Not only will society need to modify its actions to achieve the defined GEnS but it should restore or maintain natural system resilience so that the marine environment can adapt to changes occurring at larger scales such as climate change and increasing nitrogen deposition.

All of this is an unprecedented challenge for society, especially as most of the marine environment is unseen or considered remote by the general public. For those areas not subject to special protection, a starting point will be to agree on a vision of what a sustainably developed (or sustainably used) marine environment would look like. A number of countries including the UK are currently engaged in a wide debate on how such a vision can be attained on a scale that includes significant human communities. Despite this, public involvement remains limited and the concept of sustainable development means different things to different people.

Without further definition, the term ''sustainable development'' therefore does not provide society with a simple formula for managing the marine environment. It could encompass a range of possible actions, some of which could polarise those that gather under its banner. At a recent ''brainstorming'' meeting called by an environment minister one of us witnessed how different sectors responded to the question ''What trade-offs do we need to make to sustainably develop our marine environment?''. Conservationists present were outraged by such a question (and what they presumed would be wanton damage to the marine environment) whereas those representing ''green'' industry felt comfortable with discussing this approach. All were declared advocates of sustainable development.

Such contrasting worldviews have made it difficult to translate sustainable development into legally binding actions. Turner et al. (1998) described sustainable development as ''the maximum development that can be achieved without running down the capital assets of a nation which are its resource base''. This base encompasses man-made capital K_m, natural capital K_n, human capital K_h and moral capital K_c. Proponents of ''soft'' sustainable development regard these forms of capital as largely interchangeable. This would imply that the partial loss of natural capital (habitats, wildlife, etc.) is an acceptable way of achieving growth in human and man-made capital, provided the total resource base remains constant. Those advocating ''hard'' sustainable development require each form of capital to remain constant, a goal that may be incompatible with growth in economies or population. In practice, neither of these extremes would usually be acceptable in the marine environment – soft sustainability could easily justify an airport construction on a wetland or reef (provided that the natural system was not entirely eliminated), hard sustainability could not – and our current approach lies (and has to lie) somewhere in between.

Ideally, sustainable development and the ecosystem approach, would allow K_h and K_m to increase in line with societal aspirations but without a reduction in K_n and a

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compromise to K_c. Clement (2000) contests the common assumption that economic development automatically leads to environmental degradation, especially in many developed countries where efficiency gains are possible through improvements in technology. Economic, environmental and social sustainability are all required components of sustainable development. This implies more than just a compromise between the different players but cooperation to satisfy mutually recognised needs.

The epistemological difficulties with sustainable development are clear from current scientific advice on marine policy. Amongst many viewpoints, one major group focuses on nature as a provider of goods and services (e.g. Beaumont et al., 2007), whereas another (e.g. Derous et al., 2007) focuses on nature's intrinsic value, something that cannot be quantified in monetary terms. The two groups are not mutually exclusive, both believe in conservation but the former has greater emphasis on humans as primary beneficiaries. People associate themselves with a particular viewpoint because of their value base, expressed as worldviews, but this fact is rarely recognised in marine science or policy, perhaps because of the predominance of natural scientists in these fields and the absence of social perspectives in formal science education. Predominant worldviews stem from a mosaic of individual perspectives and vary in space and time; it should follow that visions of a sustainable marine environment also vary. Capture of a process by one value set will automatically alienate the others, but merely seeking a common denominator between the two generally leads to "toothless" statements of intent. We suggest that the key to moving forward is to establish a clearly defined and properly managed pluralistic process that is more heavily focussed on understanding and satisfying needs than achieving fixed outcomes.

7. Throwing precaution to the wind?

There are many different approaches that can be taken in the quest for achieving GEnS. Table 3 outlines two extremes, based on different worldview sets and most emerging policy and legislation sits between these two extremes. Policy and legislation based upon mechanistic thinking tends to favour evidence-based action though policies developed in this way are often reactive (i.e. responding when a problem happens or the evidence is overwhelming). This is the approach being taken by the drafters of the recent UK Marine Bill White Paper which aims to be evidence-based. The precautionary approach however aims at anticipatory action by removing or reducing threats with the assumption that if they are not removed or reduced then the system will deteriorate. Its origin can be traced to marine environmental policy from the 1970s – such as the London Dumping Convention (now the London Convention) – but, in the wider policy context, it was first clearly stated in Principle 15 of the Rio Declaration at the 1992 United Nations Conference on Environment and Development (UNCED):

Table 3
Comparison of alternative visions for achieving GEnS

	Evidence-based action (comprehensive understanding of the system)	Precautionary approach (removal of all tangible threats)
Advantages	Reduces scientific uncertainties	Anticipatory; acknowledges the scientific uncertainty
	Attractive to legislators and industry	Ensures capacity to adapt to unforeseen problems
Disadvantages	Science and information base may be insufficient	A hard sell as costs of implementation may be high
	Reactive	Difficult to assess areas where precaution is warranted
	Costs of monitoring are high and require long-term government buy in	Makes an assumption that impacts are inevitable
Public face	Science-based indicators often difficult to understand	Public may seek alternative products and services when costs spiral

> In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Chapter 17 of Agenda 21 (on "Protection of oceans, all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas and the protection, rational use and development of their living resources", UNCED, 1993) calls for and recommends "new approaches to marine and coastal area management and development, at the national, subregional and global levels, approaches that are integrated in content and are precautionary and anticipatory in ambit". Both evidence-based and precautionary approaches require comprehensive scientific support through research and monitoring, though the scientific emphasis differs between the two (Mee, 1996).

The assumption that environmental deterioration occurs as an automatic product of human stress discounts the inherent ability of most systems to absorb certain amounts of stress without significant damage, a feature termed environmental homeostasis (Elliott and Quintino, 2007). It may be argued that, because of the uncertainty of prediction in the highly variable marine system, no development is acceptable if a comprehensive precautionary approach is adopted. Because the scales at which stressors can act in a highly dynamic system may be large and uncertain, precaution would similarly need to be extended over a wider area. For example, the proposed extension to the Port of Rotterdam (Maasvlakte 2) at the south-west of the Netherlands has the potential (albeit difficult to prove) to influence the Wadden Sea Special Area of Conservation at the northeast of the country. A precautionary approach would

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question this development, although national and European interest would probably allow it to proceed, especially as it could never be conclusively demonstrated that the development will not have an impact. This suggests that the precautionary approach helps to frame the questions that can only be answered through social choice.

Most marine policy in the decade following the Rio Summit in 1992 included specific reference to the precautionary approach (or to its legal definition as the precautionary principle). This always caused discomfort to developers because of the implicit "reversal of the burden of proof" away from regulators and environmentalists and on to those potentially damaging the environment. A key difference between the two approaches is that the precautionary principle puts the onus on the developer to demonstrate there will be no impact whereas the evidence-based approach puts the onus on the legislator/competent authority. The precautionary approach is gradually influencing international fisheries agreements however, underpinning recent developments on fisheries regulations in the deep sea. The evidence-based approach, still dominating fisheries management, often suffers because of a lack of evidence or disagreements between enforcement agencies and fishers on the quality of the evidence.

Surprisingly, there is no reference to the precautionary approach whatsoever in the MSD although it is mentioned in background documents. Does this mean that caution has been thrown to the wind in favour of an entirely evidence-based strategy? The MSD is a Framework Directive that is light on details (as a result of some Member States demanding greater subsidiarity) and it expects countries and regions to prepare and regularly update strategies for attaining GEnS. As with many Directives, and under the principle of subsidiarity, it is required to leave the Member States freedom to define the precise implementation but while staying within the spirit and the letter of the Directive. Hence, as with the WFD, it is likely that the MSD will lead to many discussions on the meaning of the wording. Similarly, as a framework, it does discuss the need to determine the pressures on the marine environment and their resultant impacts. This strongly suggests that action will depend on understanding the nature of these pressure-impact links leading to strategies that are more evidence-based than precautionary. As VanderZwaag (2002) explains, the precautionary principle is facing "rough seas" *. . . with strong political and economic waves hindering strong precautionary courses*.

An example of this tendency is the current difficulty in Europe to develop and legislate for fully protected marine protected areas (MPAs) that will help to achieve the commitments made in the Johannesburg Declaration (2002) for a global network of MPAs and sustainable use of marine resources. Part of the problem is often the insistence to weigh the quantified benefits (in financial or equivalent terms) of such areas against the financial benefits that come from alternative uses (e.g. to fishing or the provision of goods and services). Precaution for the proper longer term protection of marine ecosystems is usually immediately excluded to the benefit of short-term (and not necessarily reliably stated) financial gains claimed by various industries. The situation is further hampered by the fact that the research needed for calculating the financial or equivalent benefits for fully protected MPAs is precluded by the fact that few if any examples are allowed to be established through which to obtain the necessary empirical data. Set alongside the shifting baseline issue it becomes all too clear why we fail to generate new human values by learning from our experiences gained from such areas – the odds are heavily stacked against such a precautionary approach from the outset to the real detriment of delivering sustainable development.

The rather non-committal statement about MPAs (the word "should" makes the commitment non-binding) in the MSD and the focus on multiple-use regimes such as Special Areas for Conservation (never intended to fulfil the function of MPAs) probably reflects pressure by Member States to steer away from such precautionary measures.

8. "Quality and the birthday cake"

As with the implementation of the WFD, there are two alternatives in attempting to determine "goodness" – either to create a fully rigorous, mechanistic approach in which "good" is defined in numerical terms, again probably based on a multimetric approach (see Devlin et al., 2007), or to employ best (expert) judgement. Either way, and especially as the boundaries of any metrics have to be set against a background of present understanding, there will be a large or small element of subjectivity and quality judgement. Hence, the concept "good" when referring to marine systems implies a science of qualities. Annex VI of the MSD provides generic descriptors of many of these qualities and an earlier annex contains a long list of measurable elements of the system that may be employed in an assessment. This is likely to require additional criteria that must be value explicit and represent an important ethical challenge. A birthday cake analogy helps to understand the problem:

> Can you judge the quality of the cake entirely by the ingredients used?
> Are some ingredients more important than others?
> How do you compare today's cake with last years?

Unlike the birthday cake, not all of the ingredients are known or measurable, have not been measured in the past and new ingredients are sometimes added (when the cook's back is turned). In addition, all of this refers to the structure of the system (how much of something is present) whereas it is now acknowledged that the functioning of the system is at least as important (i.e. and continuing the analogy, does the cake do what it is supposed to ("taste good") despite the precise identification of the ingredients).

Tett et al. (2007) and Elliott et al. (2007) emphasise that with respect to maintaining and/or attaining sustainable ecosystem structure and functioning, there is the need to

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quantify aspects of ecosystem health such as vigour, organisation, resistance to disturbance and resilience. In the case of marine systems, qualities such as resilience – included in the overall definition of GEnS but not in the descriptors of the annexes – are emergent system properties but not yet sufficiently quantified. As pressure on a system increases, resistance may be overcome and the system suffers a regime shift, reorganising itself to another state, also demonstrating resistance to change. Its resilience then is the ability to regain a state which may or may not be identical to the original (Elliott et al., 2007). Resilience is not limited to natural systems but is a property of coupled social and ecological systems where there is interdependence between humans and natural ecosystems (Holling et al., 1998). Indicators based on emergent properties are, however, not yet defined and still require considerable research. Rice (2003) commented that it may not even be possible to establish the performance rates for complex indicators, particularly emergent properties of models, except through trial and error.

For managers, one of the biggest challenges is to keep on the right side of pressure thresholds for regime shifts (e.g. Mee, 2005; Tett et al., 2007). In many cases, scientists would regard changes to systems that result in lost resilience – by exceeding a threshold – as ''bad''. Once thresholds are exceeded, the system will change but within its resilience may still have an ability to recover, even though the recovery trajectory may differ from the degradation trajectory, i.e. systems may demonstrate hysteresis. In other words, lowering or removing the pressure may not result in their immediate recovery (because the new system also demonstrates resilience). Currently it is very difficult to predict where thresholds occur on the basis of system state indicators; the difference between ''good'' and ''bad'' may stem from a relatively small change in human pressure. Hence with the present incomplete knowledge of the way in which marine systems respond to stressors, precautionary limits are necessary for pressures arising from human activities. The science that allows these limits to be set is still inadequate however and will only improve with better science and if managers become more aware that cause-effect relationships are rarely linear. Furthermore managers have to be aware that it is necessary to invest in an improved understanding of the behaviour of coupled social and ecological systems in the marine environment. They also need to be reminded that it is likely we will never have such a complete, fully quantitative, perfectly modellable knowledge of the marine systems to demonstrate conclusively the repercussions of activities, especially cumulative impacts. Hence we will always require an adaptive and pragmatic but precautionary approach.

9. No going back: adaptive management as a strategy for implementing ecosystem-based management

We frequently refer to ''marine environmental management'' although what are really being managed are humans and the pressure they exert on the environment. Moreover, there is limited capacity to manage all of the activities and pressures on the marine system in an integrated way and so the sectoral approach still persists despite many agreements and policy documents advocating integration. Ironically, visions for the environment are often expressed in terms of ecosystems without humans although it is of note that many countries have not defined their vision for their waters and without such an aim, and its associated quantitative objectives, it is not possible to determine whether such a state has been reached.

If going back to reference conditions may not always be an option for a planet dominated by one species of (charismatic?) megafauna hungry for resources and obsessed with technology, then what are the options for designating and achieving GEnS? One approach is adaptive management, a participatory process originally conceived by Holling (1978) that enables society to move towards a long term vision by successive steps, gathering information to refine the vision as it progresses. It has sometimes been described as ''learning by doing''. Mee (2005) proposed a practical mechanism for its implementation in Europe's Seas to the first stakeholder meeting on the MSD in Koge, Denmark and this was further elaborated in connection with the ecosystem approach by Laffoley et al. (2004). The approach is explicitly cited in Article 2a(5) of the MSD as a basis for practical policy implementation: *Adaptive Management on the basis of the ecosystem approach shall be applied to move towards good environmental status*.

Fig. 4 shows how adaptive management may ultimately be planned under the MSD and the areas where more research and development will clearly be required. Since there are no methodological details in the draft MSD, details of the scheme have yet to be decided and may be left to the Member States during implementation, hence giving cause for concern through the joint implementation of the MSD in adjacent sea areas. The main point is that a periodic assessment (Article 7) will have to be conducted in each agreed region (and sub-region) and that this will be used as the technical basis for defining GEnS. Attainment of GEnS will depend upon national-level strategies and targets (Article 9). The national strategy will consist of a programme of measures (Article 12) that will lead to the attainment of GEnS in national waters. This will inevitably be quite complex where issues are at different scales (e.g. fisheries, invasive species) and where the resource straddles boundaries. Key to the entire scheme will be a statutory monitoring programme (Article 10) and an evaluation and reporting mechanism (Article 19). Currently the cycle for re-examination of GEnS at a regional level is proposed as 6 years, with overall GEnS (for the EU) attained by 2021. The national environmental targets are meant to be ''hard'' targets whereas, under current wording of the MSD, the GEnS appear to be ''soft'' or aspirational, making it difficult to prosecute countries that are not contributing adequately.

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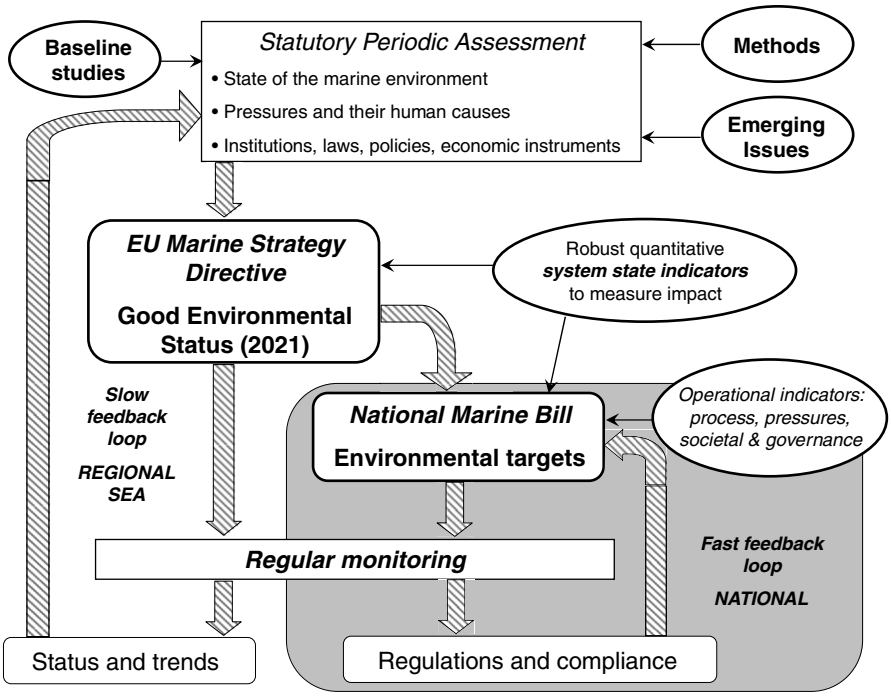

Fig. 4. Scheme for adaptive management that follows the approach outlined in the Marine Strategy Directive. Areas where further research is required are summarised in ellipses. The diagram is modified from Mee (2005).

It is important to note that the basic structure for implementing this management approach are already in place, as shown by the regional seas programmes and agreements (OSPAR for the NE Atlantic, HELCOM for the Baltic and Barcelona for the Mediterranean) and there is a body of knowledge and experience on which to build especially at the European level. Indeed, Ducrotoy and Elliott (1997) questioned whether the development of such ideas within an EU framework could ultimately signal the demise of the European regional seas agreements, partly because the same people and organisations tend to represent their Member States at the European and regional seas level. An alternative view however is that the differences between the regional seas – both in terms of the natural and human systems – will continue to favour regional seas as more coherent management entities.

The main advantage of adaptive management is that it is a learning process and accepts that knowledge of complex systems is always likely to be incomplete. As more knowledge is gathered, targets and GEnS itself can be refined. If the national targets are not delivering the improvements that society expects and expresses as GEnS, then they should be tightened. This implies that targets need to be reviewed more frequently than GEnS (the fast feedback mechanism in Fig. 4). On the other hand, new knowledge and changing values may make it necessary to update GEnS itself, hopefully at the same time making it less "aspirational".

Difficulties and limitations of adaptive management are likely to be the following:

- It assumes that there will be a gradual increase in learning and that this will lead to more sustainable use of the natural environment and to improved conservation (increasing human wisdom). This assumption has yet to be fully tested.
- Success is highly dependent on well-funded and consistent monitoring programmes to provide a continuous flow of information; also that the levels of acceptable change are defined *a priori* and that there is a willingness to act once thresholds have been reached.
- GEnS and monitoring reports have to be fully understandable to all stakeholders including the general public, otherwise the process could be manipulated to serve the interests of particular groups of individuals.
- It is still somewhat reactive; it should not replace the need for precaution in many areas and for studies of emerging issues. Monitoring alone will not provide answers in these areas and should not been seen as a substitute for investigative research.
- Monitoring linked to the management will have to be of several types, as indicated by the WFD – surveillance or condition monitoring to give a general indication of the health of the system, compliance monitoring to indicate change against standards and thresholds, and investigative or diagnostic monitoring which can aim to determine the cause of deviation from an expected state (De Jonge et al., 2006).
- Most importantly, it assumes that once change is detected then there is the political will and sufficient administrative mechanisms to implement suitable responses.

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Is the current draft MSD sufficiently robust to overcome these difficulties? Scientists are still arguing about suitable indicators (Rice, 2003, refers to hundreds of indicators that have been developed) and their correct terminology and there is clearly much research work to be done in this area. Also, arrangements for long-term monitoring need to be improved, as does the exchange of data; social and economic data sets at appropriate scales are particularly weak. The main Achilles heel of adaptive management however is the creation of robust mechanisms for stakeholder participation in setting the goals and targets and the ability/will of managers to act rather than just deciding that further monitoring is needed.

The need for adaptive management to build resilience in social as well as natural systems should not be underestimated. It is a participatory and consensus building process where stakeholder confidence develops through processes such as joint fact-finding, where they actively engage in planning environmental assessments and in target setting (McCreary et al., 2001). These participatory mechanisms create shared ownership of the objectives and outcomes of the management process. McLain and Lee (1996) examined failures in several US case studies where adaptive management was practised and concluded that inadequate attention was paid to policy processes that promoted the development of shared understandings among diverse stakeholders. Walters (1997) considered that many adaptive management schemes had been actively undermined by research and management stakeholders who had shown "*deplorable self-interest, seeing adaptive-policy development as a threat to existing research programs and management regimes, rather than as an opportunity for improvement*".

In Europe, the WFD has been criticised for "focusing on ecosystems status and stability and considering human activities as disturbance factors" (Steyaert and Ollivier, 2007). Their analysis of the WFD and other EU policies suggested that the purpose of provisions for participation was more about ensuring social acceptability of the policy than obtaining a genuine commitment from stakeholders. They suggested adaptive management as a potential way forward, but has this message really been taken on board in the MSD? Two of the three paragraphs of Article 18 deal with Public Consultation. The first of these effectively transfers the responsibility to Member States to ensure that all interested parties are given early and effective opportunities to participate in the implementation of this Directive but offers no guidance on how this might happen. The second paragraph requires Member States to publish and make available for public comments the initial assessment and the determination of GEnS, the environmental targets, the monitoring programmes and the programmes of measures for achieving them. This is designed to ensure transparency but there is no requirement for any real measure of participation in the development of these key operational elements of the MSD. Each of these are embedded in the WFD but as yet there is no indication that the process has been successful, hence the suggestion that the MSD has the opportunity to learn from the WFD. A Member State can comply with this article by a minimalist consultation of the final outputs of their own expert panel (mostly management and government research stakeholders). In this sense, it is no different in its perception of the role of broader stakeholder interests than in the WFD and it is unlikely that the learning outcomes of adaptive management will be met, especially if there is little joint ownership of GEnS.

10. Collective values, subsidiarity and regional seas

Subsidiarity creates a further dilemma for setting and achieving GEnS: if most responsibility is retained by Member States, how will "common pool" issues be dealt with effectively? All of Europe's seas are transboundary (the Black Sea basin includes 14 countries for example) and a wide array of economies and culture need to be brought together to agree on management regimes.

The diversity of views across Europe will probably result in an equally diverse approach to GEnS, targets and measures. In order to explore this further, we examined responses to four of the questions posed in the 1999–2001 surveys of the world values survey (WVS, 2006). Respondents were asked to say whether they *strongly agreed, agreed, disagreed* or *strongly disagreed* to the following statements:

Q1. I would give part of my income for the environment;
Q2. I would agree to an increase in taxes if the extra money were used to prevent environmental pollution;
Q3. The Government should reduce environmental pollution but it should not cost me any money. Respondents were also asked to answer the following question with *almost all, many, some, almost none*:
Q4. According to you, how many of your compatriots throw away litter in a public place?

Q1 probes the respondent's willingness to make a personal financial commitment to a shared issue; Q2 examines how willing he/she is to allow the government to dictate the commitment; Q3 queries whether or not the burden of responsibility should be shared at all; and Q4 investigates the respondents perception of whether or not other (presumably also the respondents themselves) are behaving badly towards the commons.

In Fig. 5, we demonstrate how combinations of responses to these questions can give valuable insights into collective worldviews. By pooling the responses to each question into two groups (agree plus strongly agree, and disagree plus strongly disagree in the case of Q1–Q3, almost all plus all and some plus almost none, in the case of Q4), it is possible to develop a logical matrix with axes reflecting the percentage of those who agree to the two questions.

Fig. 5 illustrates the outcome for combinations of Q2/Q3 and Q1/Q4. It shows a huge diversity in responses from individual countries but that these are often logically grouped according to dominant culture or political tradi-

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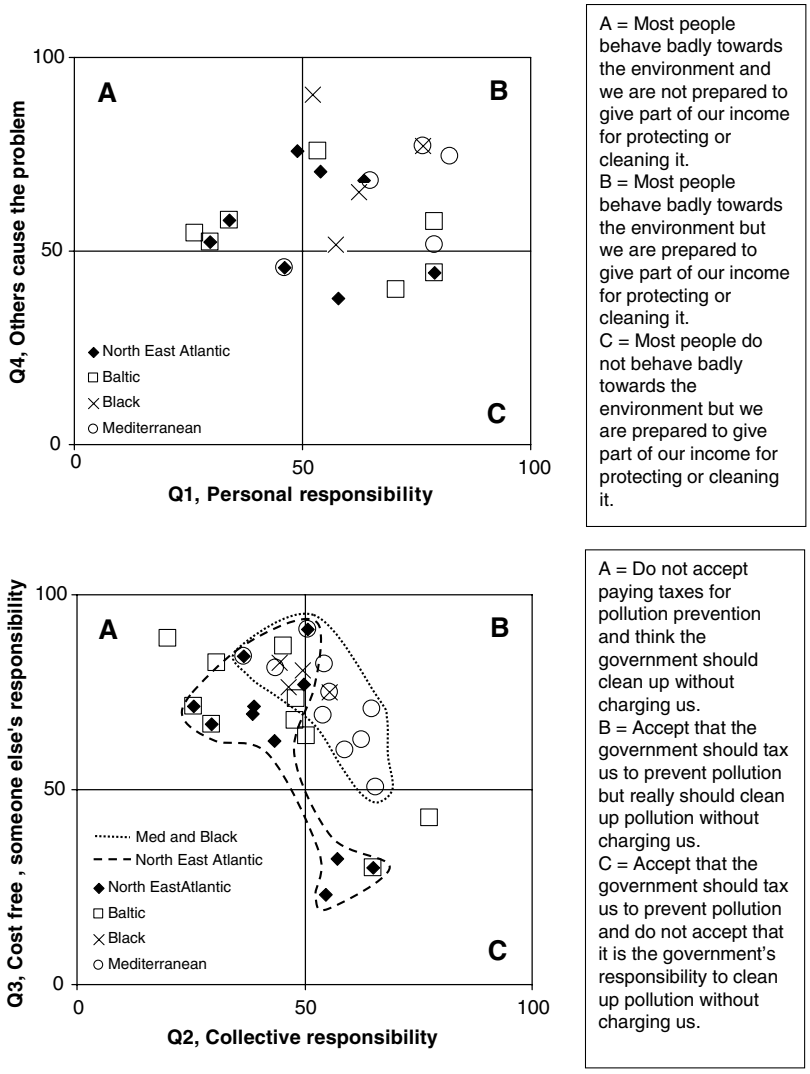

Fig. 5. Public attitudes about environmental protection and pollution in Europe showing major differences in worldviews. Each axis shows the percentage of respondents (n is about 1000 for each country) who are in agreement. See text for detailed explanation. Original data from WVS (2006).

tions. Most countries had a majority of people that thought the government should reduce pollution without charging (Sweden, Denmark and Iceland were notable exceptions and note the two distinct clusters of views across the Baltic) but there was an even split between those that were and were not willing to pay extra taxes to prevent pollution. The Mediterranean countries generally showing greater willingness to be taxed than those in the Baltic (with the exception of the Nordic countries mentioned). The reason for not wanting to pay for pollution reduction (Q3) may be that people consider that the polluters should pay but unwillingness to pay additional taxes for pollution prevention (Q2) may have more to do with mistrust in government. Another factor is that hypothecation, the identification of a tax for a specific cause, is not common in most European countries.

The Q1/Q4 combination examines individual willingness to pay for environmental protection (Q1) and perceived behaviour towards the environment (littering in the commons, Q4). The majority of country surveys suggested that most people would be willing to pay despite knowing that most of their compatriots behave badly to the environment. Respondents from Germany had the strongest opposition to paying.

These results should not be over-interpreted but illustrate the challenge for achieving common GEnS and targets in Europe. It is unsurprising that most Governments, wary of their voters, try to maximise national regulatory control. Acceptable solutions in one country may be completely unacceptable to another. Fig. 5 shows that in many cases worldviews can be clustered better at a regional or sub-regional level and it is at this level that most work will be required to develop meaningful adaptive management frameworks, where possible working with existing structures (Regional Seas Commissions), provided they can be broadened to deal with integrated management, including fisheries and conservation of biodiversity. More emphasis on working with the general public across regional seas might gradually change people's attitudes and increase their interest in collaborative solutions to shared problems.

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11. Communication and trust

The need for targets and measures aimed at securing GEnS which in turn has to be understandable by stakeholders is an important assumption in an adaptive management strategy. In Europe, the North Sea Ministerial Declaration process (NSMD, 2002) and the OSPAR and HELCOM commissions have made efforts to develop publicly understandable headline indicators – Ecosystem Quality Objectives (EcoQOs) – that are similar in purpose to GEnS. The North Sea EcoQOs are intended to engage with public concerns (by reflecting them and informing them) and to lead to a cascade of technical requirements for policy actions, indicators and monitoring. They are good examples of serious attempts to improve public understanding of environmental goals but, despite the adage that any successful management system requires an understanding/quantification of the required endpoint, these have not been entirely popular with scientists or public officials. They have also been poorly communicated, particularly to the general public. A daunting range of technical objectives may be needed to achieve sustainability in an environment as complex and variable as the sea (see Rogers et al., 2007) but these should be contextualised in an understandable and comprehensive framework. In particular, and borrowing concepts from business management, objectives and indicators have to be SMART (specific, measurable, achievable, realistic and time-bounded) such that it will be apparent when they have been met, and thus that any management measures have been successful. Otherwise there will be continued debate on their efficacy.

The consequence of inadequate communication is mistrust that will ultimately undermine the political process. The Eurobarometer survey (European Commission, 2005), described earlier, provides clear evidence of current public confidence in various information sources about the environment. The survey asked respondents in each country to select the three sources they trusted from: National government, regional/local government, European Union, companies, trade unions, political parties standing for environment, environmental protection associations (Greenpeace, World Wide Fund for Nature, etc.), consumer associations and other citizens' organisations, scientists, educators, family/neighbours/friends/colleagues, and the media. The top three were environmental protection associations, television and consumer associations. Regional/local government, the EU and national governments ranked 7, 8 and 9 respectively. Interestingly, in a survey conducted in the USA (Steel et al., 2005), it was found that television, whilst popular as a source of information, actually had a negative effect on knowledge holding about the sea.

In Table 4, we apply the same criteria as in Table 2 to examine trust in NGOs, scientists, the EU and national government, all grouped by coastal countries in regional seas. Results for NGOs and scientists are remarkable consistent between regional seas. Trust in the EU and national governments is lowest in the Baltic region and highest in the Mediterranean. This matches well with the data given above, suggesting a lower level of willingness to be taxed for pollution prevention in Baltic countries (other than Sweden and Denmark) compared to the Mediterranean.

Why should NGOs command as much as four times the trust than governments and the EU? Perhaps it is because they are better communicators and can deal with value explicit issues with much more ease than governments. The survey results are also a reflection of the so called *Democratic Deficit* that affects the EU's legitimacy, partly because of limited public argument over the direction of its policy agenda (Follesdal and Hix, 2005).

12. Conclusions

Laffoley et al. (2006) set out to define the parameters through which GEnS should be developed. In this paper we build on that work and conclude that GEnS should be:

- comprehensive, by covering structural and functional attributes and including the human dimension;
- representative, including sufficient components of the marine socio-ecological system;
- precautionary and threat-oriented, considering all uses and users as well as non-use;
- temporally and spatially relevant, with an ability to accommodate highly dynamic and variable systems;
- consistent across state boundaries for effective management of joint features within regional seas;
- user oriented with due care to avoid excessive sectoral management;
- practicable and management orientated;

Table 4
Percentages of interviewees listing selected sources amongst their top three trusted sources of information on environmental issues

	North-East Atlantic		Baltic		Mediterranean	
	Median (%)	Range (%)	Median (%)	Range (%)	Median (%)	Range (%)
Environmental protection associations (Green Peace, World Wildlife Fund, etc.)	39	36–53	36	28–60	44	30–50
Scientists	38.5	17–53	40	30–53	38	19–45
European Union	9	5–22	6.5	5–22	17	8–38
National Government	10.5	5–26	9.5	3–22	16	9–34

The original data is re-aggregated by regional sea: NE Atlantic (BE, DK, DE, FR, IE, NL, PT, UK); Mediterranean (EL, ES, FR, IT, CY, SI, MT) and Baltic (FI, SE, EE, LV, LT, PL, DK, DE).

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- value explicit, recognising the need for collaborative and transparent decision-making and expert judgement;
- based on robust and defensible science.

The present paper has investigated GEnS in the context of the draft Marine Strategy Directive of the European Union. It also questions whether adequate attention has been given to precaution, particularly in biodiversity conservation. We conclude that the overall definition of GEnS provided in the MSD is entirely aspirational and has limited practical application.

As a Framework Directive, however, the MSD provides an opportunity for Europe's regional seas to develop their own, more pragmatic definitions of GEnS to be employed in the context of adaptive management. This will be a difficult undertaking as there are major differences in majority worldviews in and between each region. Furthermore, the participatory component of adaptive management is poorly defined, exposing the process to the risk of dominance by one or more powerful sectors or Member States. Properly defined through a participatory process, regionally-based GEnS could be a powerful tool to inform the public about the state of health of the seas. By regularly reviewing and revising GEnS, incorporating new scientific information and recognising changing values, it could build learning and resilience in coupled social and ecological systems in the marine environment. In order to achieve this, greater attention will be needed to the fact that managing the environment is mostly about managing humans. Currently there is a rather limited understanding of how human values relate to sustainable development of the commons and how to use this knowledge for more effective governance.

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