Sustainable Coastal Development: The Dual Mandate and a Recommendation for "Commerce Managed Areas"

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Abstract

Pitting the dynamicism and uncertainty inherent in undisturbed coastal ecosystems against the stability and predictability required of human-dominated landscapes creates the paradox of the dual mandate. We describe a gradient of estuarine types ranging from systems that experience little human intrusion—*conservation* estuaries—to those that are dominated by people or extractive uses—*production* and *urban-industrial* estuaries. Future approaches to managing these estuarine resources will require a division of the concept of marine protected areas into at least two subcategories: "conservation" managed areas ($C_{Conservation}$MAs) and "commerce" managed areas ($C_{Commerce}$MAs). The latter includes conditions where humans are not only a core feature of the landscape but also where extractive uses drive a large part of the local, regional, and even national economy. System reliability and predictability of ecosystem services are integral components of any management scheme in $C_{Commerce}$MAs. By recognizing this division managers can construct appropriate baselines that encompass the biodiversity and ecological integrity inherent in relatively undisturbed estuaries (or portions thereof), or the ecosystem health and system reliability that characterize urban-industrial systems. The terms ecosystem restoration and ecosystem rehabilitation are also distinguished; the former term is used to describe practices that return ecosystems to optimum biological integrity, whereas the latter term is applied to the health of human-dominated estuaries where the goal is to manage natural processes and functions. Our proposed approach *does not* mean that ecosystem quality is sacrificed in urban-industrial or production systems; to the contrary, contaminant source control, suitable sediment and water quality, and the human endeavors to address them are just as important to sustaining commercial activity as they are to the well-being of extant biota. So too, are the conservation and preservation of existing critical habitat (proximate reservoirs of biodiversity) in urban-industrial systems, and rehabilitation of habitats that support species coadapted to the presence of humans.

Key words: dual mandate, marine commerce managed areas, sustainability science.

Introduction and Background

To achieve sustainable development—that is, fostering adaptive capabilities while creating opportunities (Holling 2000)—scientists and decision-makers must abandon the *environment* versus *development* psyche and move together toward integrated ecosocietal goals or norms. From the perspective of science and technology, which have been increasingly isolated from a largely societal and political process shaping the global sustainability agenda, calls for such change are already emerging, e.g., the new "social contract" for science (Lubchenco 1998). The latter presupposes that a sustainable biosphere is not only ecologically sound but is economically feasible and socially just. Rather than the traditional investment in science that is expected to bring economic return, or other beneficial outcomes (e.g., conquering disease), Lubchenco (1998) suggests an equally important role of science in today's society is the application of new scientific knowledge to inform policy and decision-making. Under the new social contract, the science and technology community would devote a larger portion of its research and development agenda toward addressing societal goals for sustainable development (Clark et al. unpublished manuscript). Some of this is being put in place today, but more needs to be done (U.S. Commission on Ocean Policy 2004).

New institutions are required: those that provide incentives for protecting ecosystems for their intrinsic values, and those that establish criteria for evaluating the research community's contribution to sustainability and environmental quality (Ludwig 1996; Orians 1996; Risser 1996). The emerging discipline of sustainability science attempts to overcome the present shortcomings by focusing multidisciplinary research (perhaps more often conducted in the future by scientists with *interdisciplinary* training) on the fundamental character of interactions between nature and society, and addresses society's capacity to guide these

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interactions along sustainable trajectories (Kates et al. 2001). In a more practical context Kaufman and Cleveland (1995) suggest that to truly adopt sustainability science in the development of international policy will require at least three steps: (1) identifying the nonsustainable aspects of society; (2) quantifying their impacts on natural and social systems; and (3) quantifying the impacts of corrective actions. Whereas these steps are precursors, rather than restoration activities, the successful application of sustainability science is essential to avoid the tragedy of the commons in coastal ecosystems (Hardin 1968). Resolving key coastal issues on this basis stands as the great management challenge of the twenty-first century.

The Paradox of the Dual Mandate

Pitting highly adapted natural systems where change (dynamicism) is the norm against human-dominated systems where stability and predictability are not only necessary, but also essential, creates the paradox of the dual mandate (Roe & van Eeten 2002). In this thought-provoking paper the authors described the paradox as the challenge of preserving ecosystem functions while "guaranteeing" the reliable provision of ecosystem services. Because the former thrives on complexity and uncertainty, whereas the latter requires a high level of predictability (Dailey 1997), we are left with a perplexing conundrum. Here we will adopt the descriptors of Roe and van Eeten (2002) and apply some of the concepts of others (e.g., Costanza et al. 1977) to posit three management categories for estuarine landscapes based on the human density in the shore zone and the degree of human extractive uses. Roe and van Eeten's (2002) ecosystem *functions* are those factors tending to create central tendency in an otherwise highly dynamic system—regulating the chemistry of the atmosphere, temperature, and precipitation; decomposing organic compounds; creating biomass; facilitating recovery from disturbance; and biogeochemical cycling of nutrients and other substances. Ecosystem *services* on the other hand include commodities such as timber, fish and wildlife, minerals, and petroleum products or other services that include, for example, pollution abatement, hydropower, industrial cooling water, recreation, and aesthetics. In formulating management policy, decision-makers, scientists, and stakeholders are faced with the seemingly insurmountable task of simultaneously rehabilitating ecosystems (optimizing functions) while ensuring the continuity of reliable services for human use. While managing the continental shelf (coastal zone), we will hopefully apply the hard lessons of the land, and while seeking to buffer our core technologies from "external turbulence" (natural variability), reverse the damage to coastal ecosystems that clearly has accelerated in the past century.

We also agree with Roe and van Eeten's (2002) remarks on the distinction between ecosystem restoration and rehabilitation, and suggest that the difference is critical to achieving sustainable development. Rather than using the National Research Council's context for restoration—the desire to return an ecosystem to a close approximation of its undisturbed state, or the *historic condition* (NRC 1992)—we have adopted the notion of a shifting baseline (see below) and use the authors' general concept of restoration/rehabilitation as "renewing an ecosystem's vitality by reuniting its functions," but for us, to the extent practical as determined by consensus among stakeholders in human-dominated systems. Roe and van Eeten (2001) also acknowledge this need for practicality when they discuss the role of active adaptive management in managing urban and agricultural ecosystems: "real-world adaptive management, while respecting the pre-settlement template, may be less whole-ecosystem focused than centered around restoration, preservation or stewardship of *selected* [emphasis added] ecosystem services and functions, regardless of experimentation." In human-dominated systems, moreover, we also recommend going beyond solely ecological performance criteria to also include economic efficiency, historical, cultural, social, moral, and aesthetic points of view (Higgs 1997).

Such an approach should also include performance goals for success, including quantitative criteria codified in formal agreements or international treaties. Clark et al. (unpublished manuscript), however, warn us that a major hurdle to integrating science and technology into sustainable development will be to support agenda setting at appropriate local scales ("place-based") rather than only at the global or national level. The emergence of place-based integrative frameworks that apply knowledge based on specific understanding of local processes to establish operational contexts for sustainable development not only addresses the important question "what does each region have to teach" but also contributes to fundamental knowledge and insights that link science and technology in support of sustainability. Moreover, science-based knowledge is crucial to advancing sustainable development goals only when it is acceptable (credible), relevant to decision-makers (salient), and addresses the key uncertainties and concerns of both groups (legitimate).

In this paper we argue that environmental baselines are permanently shifted in human-dominated estuaries, and consequently so are the performance criteria and goals that are used to manage them. Although we are cognizant of the current debate on the "functionalist" versus "compositionalist" approach to ecosystem management (Woodley et al. 1993; Angermeier & Karr 1994; Meffe 1995; Callicott et al. 1999; Goldstein 1999), and suspect that we are ultimately dealing with punctuations of a continuum (Weinstein & Reed, in preparation), we use the terms ecosystem health and biological integrity to distinguish among the desired management end points in systems that range from human dominated to those with minimal human intrusion. Similarly, we use the term *restoration* for practices that attempt to return ecosystems to some optimum biological integrity (Angermeier & Karr 1994), whereas the term *rehabilitation* is used in human-dominated estuaries where the goal is to return degraded/altered portions of the system to a renewed state of ecosystem health (Callicott et al. 1999). The dual mandate is used to suggest ways in which the diametrically opposed notions of reliability and uncertainty can be reconciled. We also invoke the existing concept of ocean zoning in managing the continental shelf, and suggest that the concept of marine protected areas (MPAs) be extended to human-dominated systems by introducing a new term, "commerce" managed areas ($C_{Commerce}$MAs).

Humans in the Coastal Landscape

Humans are as dependent on the coastal zone as any of the marine transient nekton of recreational and commercial importance that use estuaries during their first year of life (McHugh 1967; Weinstein 1979; Weinstein et al. in press). By the middle of this century, 5.5 billion people will live in the coastal zone, clustered into "mega-cities" of 8 million people or more, on only about 11% of the earth's land surface (National Ocean Conference 1998). Moreover, every addition to the coastal population will require about one-half acre of land to provide living space and associated social services: schools, hospitals, libraries, supermarkets, and emergency services, among others (Greer 1991). Coastal areas in the United States are the destination for 180 million visitors yearly; and ports commerce is expected to nearly triple over the next two decades, with more than 90% of international trade waterborne. As noted in their recently released draft report, the U.S. Commission on Ocean Policy (2004) commented that the coastal counties contribute fully half of the Nation's gross domestic product (GNP), or approximately 4.5 trillion dollars, and more than 60 million jobs.

Doubtless, humankind is one of the most coastally dependent species in the biosphere (Schubel & Hirschberg 1978). Humans use the shore zone for activities that may be, and indeed frequently are, in conflict. The continental shelf margins are exploited for their extractable resources, both organic and inorganic: for shipping and transportation, for military activities, as a repository for human and industrial wastes, as a source of cooling water for power generation, and as habitats for recreation and living space. As with human habitation in the coastal zone, human extractive uses in estuaries and the nearshore environment are patchily distributed, and depending on the commodity of interest, may be more concentrated in urban areas where people reside in high density (e.g., shipping), or utilized where human population density and, consequently, human intrusion is less (e.g., traditional fishing grounds).

Shifting Baselines and Ocean Zoning

Many estuarine areas, that have long offered services of great value to local populations due to their specific geography, can only reasonably be considered for rehabilitation (vs. restoration). Landscape changes in the past several hundred years have been so dramatic that current society has little or no institutional memory of the pristine conditions that once existed, and the target for rehabilitation then becomes some "remembered," tangible condition already far removed from the natural state. For example, an engineering survey of lower Manhattan circa 1767 (United Kingdom Hydrographic Office 2003) documents the presence of extensive wetlands, an indication of the *historic* baseline in this region of the United States (Fig. 1), one that we can no longer realistically aspire to as a goal for restoration.

Recognizing the role of habitat in recruitment success of marine transients—marine taxa whose young appear to be estuarine dependent during their first year of life (Deegan et al. 2000)—we understand and sympathize with the stress engendered in the scientific community by the shifting baseline syndrome (Pauly 1995; NMFS 2003). The latter is defined as each generation of scientists accepting the stock size and species composition that was present at the beginning of their careers as a baseline, and so on through succeeding generations. However, rather than accepting the historic condition as defined by early anecdotes and limited studies, we adopt the "functional" valuation concept of Swart et al. (2001) for urban-industrial dominated ecosystems, recognizing the virtual impossibility of returning to the historic condition (Fig. 1), and where the landscape is adapted to current utilization and dominant species are represented by taxa that typically follow human settlement. Moreover, such cultural landscapes are thought to contain intrinsically valuable and sustainable forms of interaction between humans and nature. Therefore, it is clear that rehabilitation efforts must provide for the sustainability of these cultural signatures in estuarine landscapes.

Density of Humans in the Landscape Defines Estuarine "Types"

We have previously identified three estuarine categories (Fig. 2) based on the population density of humans in the shore zone and the level of human extractive uses. Following norms discussed by Callicott et al. (1999), we propose that estuaries (either in their entirety or in part) be managed along a spectrum ranging from humans as an integral part of the landscape, no less natural than any other species—the functionalist approach—to the compositionalist ideal of man apart from nature in self-sustaining systems that experience few extractive uses. Thus, estuaries would be cataloged by their reliability in the level of goods and services they provide, and/or by their degree of self-sustainability, uncertainty, and dynamic nature. Although any estuary may provide a multitude of benefits to local communities, settlement patterns and industrial and commercial land uses must necessarily constrain the baseline for rehabilitation or sustainable development goals, as well as identifying the level of extractive uses that an estuarine environment can support. We suggest that the functionalist–compositionalist spectrum include at least

Figure 1. Engineering survey of lower Manhattan, New York City completed in 1767 showing the extent of tidal salt marsh (red fill) in the area.

three distinct types of estuarine environments (but see also Swart et al. 2001 and Roe & van Eeten 2002 for additional discussion on human-dominated vs. natural ecosystems).

Urban-industrial estuaries (Fig. 2; Tables 1 & 2) are systems whose physiography and geomorphology support intense human uses, principally living space, navigation, marine transportation, and associated commercial activity. Ecosystem functions are often altered or degraded and subjected to pressures and stresses from urban run-off, wastewater, physical disturbance associated with dredging or marine traffic, and direct recreational pressures. Because baselines have shifted so dramatically in urban-industrial estuaries, and concomitant losses in habitat and biodiversity are likely real and lasting, we suggest that management goals for these systems be focused on a return to general ecosystem health, with ecosystem rehabilitation goals (Table 1) rather than ecosystem restoration serving as the targeted performance end point(s). We are clearly not alone in this feeling because much has been written recently about the present attempts to decouple ecosystem management from human managers at a time when society is demanding just the opposite, that is, the coupled policy goals of restoring ecosystem integrity while retaining high ecosystem services reliability (Roe & van Eeten 2001). We must, and can, have it both ways.

Consequently, sustainable development priorities in urban-industrial systems should focus on reliability criteria imposed by predictable navigation depths, stable shorelines and berthing areas, cost-effective methods for dredged materials management, transportation infrastructure and storage facilities, *and* for managing species adapted to human presence. This approach *does not* mean that ecosystem health is sacrificed; to the contrary, contaminant source control, suitable sediment and water quality, and the human endeavors to address them are just as important to sustaining commercial activity as they are to the well-being of extant biota. Concomitant goals in developing policy for management of urban-industrial estuaries are improved water and sediment quality, the

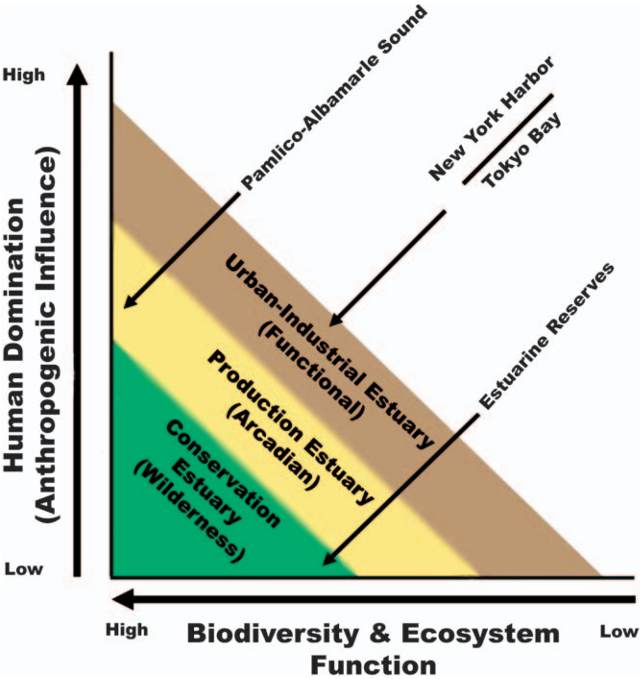

Figure 2. Estuarine landscapes as a function of human population density and degree of extractive uses.

conservation and preservation of existing critical habitat ("proximate reservoirs of biodiversity"; Callicott et al. 1999), and rehabilitation of other habitats that support species coadapted to the presence of humans. Species of commercial and/or recreational value and their forage base comprising this list might include the percichthids, striped bass (*Morone saxatilis*) and white perch (*Morone americana*), American eel (*Anguilla rostrata*), winter flounder (*Pseudopleuronectes americanus*) and the forage species, Atlantic silverside (*Menidia menidia*) and mummichog (*Fundulus heteroclitus*). Although the scientific documentation is scanty, these species appear to sustain their populations in human-dominated systems, unlike others that have suffered the effects of habitat loss and alteration, and water quality perturbations (e.g., oysters, river herrings, shad, Atlantic and Pacific salmon). Ecosystem services in urban-industrial estuaries also include flood control, public access to the waterfront and outdoor activities, cultural and maritime heritage, aesthetics, recreational fishing, wildlife sanctuaries, and other human goods and services to the local community or society as a whole.

Production estuaries (Fig. 2; Tables 1 & 2) are systems whose dominant ecosocietal service is vested in sustainable harvest or culture of estuarine-dependent species. These estuaries support, or recently supported, extensive commercial and recreational fisheries or aquaculture operations; for example, Pamlico–Albermarle Sound, parts of the Chesapeake Bay, and the estuaries of the Mississippi Delta region. Swart et al. (2001; see also Swart & van der Windt this issue) refer to these systems as arcadian, seminatural, and extensively used cultural landscapes where humans steward cooperation with nature. In such areas priority is given to restoration/rehabilitation and fishery optimization approaches that focus on habitat or other factors directly affecting economically and/or culturally important fish and shellfish production. Ecosystem management would incorporate the use of artificial reefs, bycatch reduction methods, turtle excluder devices, and "crop rotation" techniques to allow the live bottom to recover from fishing gear impacts. Other important societal uses of arcadian systems include recreation, education, ecotourism, and landscape aesthetics.

Conservation estuaries (Fig. 2; Tables 1 & 2) are largely undisturbed, self-sustaining systems that have virtually no extractive uses. Nature and culture are largely separated, and natural processes dominate (Swart et al. 2001). Swart refers to these sites as "wilderness" estuaries. Estuarine reserves are an example of conservation estuaries in the United States. They support nonconsumptive uses on a moderate scale such as research, education, ecotourism and/or provide aesthetic and cultural benefits to both local communities and society as a whole. In these areas priority must continue to be given to conservation and restoration efforts focused on habitat to support finfish and shellfish, wildlife, including endangered or threatened species, migratory birds, and resident species of the estuary.

Extending the Concept of MPAs

MPAs have been proposed as components of an ecosystem-based approach to conserving the ocean's natural resources (NRC 2001). The concept is analogous to set-aside of lands for national parks and wildlife refuges; although generally embraced in terrestrial environments MPAs have not yet gained widespread acceptance, let alone adaptations in the marine environment. There appears to be a recent shift of the operational definition of MPAs to that of marine managed areas (MMAs) (T. MacDonald 2004, Coastal States Organization, personal communication), and we will adopt this revised connotation. As the context for MMAs has "matured," its practical use appears more and more to be incorporated into integrated coastal zone management as a means for resolving conflicts in use of coastal resources. In a draft report to Congress, the committee tasked with preparing *Technical Guidance for Implementing an Ecosystem-Based Approach to Fisheries* (NMFS 2003) suggested that we not attempt to manage entire ecosystems per se (a daunting challenge whatever the current state of knowledge) but rather endeavor to manage people's behavior as a means of achieving sustainable goals and objectives for coastal ecosystem services. Earlier, we discussed sustainable development goals in the context of humans in the landscape, and it is clear that the authors of the NMFS report, despite their mandate to protect ecosystems, recognize that humans are an integral part of the landscape; thus the desired outcome of any ecosystem approach is not only to restore and rehabilitate the health, productivity, and biodiversity of ecosystems but also the overall quality of human life through a natural resource management approach that is fully integrated with social and economic goals. Perhaps this is an example of utopian idealism at its best!

If we accept a largely functionalist approach to sustainable development of urban-industrial and production estuaries (Fig. 2; Table 1), then it is reasonable to subdivide MMAs into at least two additional categories: "conservation" managed areas ($C_{Conservation}$MAs)(including marine reserves) and $C_{Commerce}$MAs, where humans are not only a core feature of the landscape, but where extractive uses drive a large part of the local, regional, and even national economy, e.g., it has been reported that nearly one-half of the GNP is vested in the coastal zone (U.S. Commission on Ocean Policy 2004). We suggest that $C_{Commerce}$MAs include major ports, marine security zones, aquaculture farms, and traditional commercial and recreational fishing grounds.

In urban-industrial systems $C_{Commerce}$MAs would comprise MPAs that exhibit permanently shifted baselines accommodating human presence that drive local economies, and whose rehabilitation goals are vested largely in ecosystem health focusing on contaminant reduction, sediment and water quality and supply, and whose remaining natural areas would serve as source habitats for certain species and contribute to local aesthetics and recreational uses. On the other hand, in production estuaries management tools might focus on habitat conservation and preservation, habitat restoration to maximize biological integrity, watershed management, restraining excessive land development and sprawl, and developing an ecosystem-based approach to managing local fisheries.

$C_{Commerce}$MAs are not without precedent; competition for commercial fishing rights and other extractive uses has already led to international designation of underwater lands as "territorial seas" and/or "exclusive economic

Table 1. Estuarine categories as a function of human population density in the shore zone and the level of extractive uses and ecosystem services provided.

Estuary Type	*Name*	*Population Density (no./km²)*	*Management Approach*	*Performance Goals (Degraded Areas)*	*Primary Extractive Uses and/or Ecosystem Services*	*Ecosystem Functions and/or Processes*
Urban-industrial	NY–NJ harbor estuary	5,512	Functionalist[a]	Rehabilitation[b]	Human habitation; maintained navigation channels; options for dredged materials management (beneficial uses); deep berthing areas; stable shorelines; shoreline infrastructure (piers and platforms, storage areas, roadways); industrial cooling water; waste repository; sand mining; recreation	Habitats that support secondary production of species adapted to presence of humans; sediment and water quality that meets acceptable standards and/or criteria; pollution abatement and prevention (source control); maintenance/recovery of threatened or listed species
Production	Pamlico–Albemarle sound, NC	68	Primarily compositionalist	Primarily restoration[c]	Sustainable yields for species of recreational and commercial value; aquaculture; aesthetics recreation	Habitats that support native biota in a near self-sustaining state; maximizing secondary production of valuable species; "set-aside" of underwater lands for aquaculture
Conservation	Mullica River Reserve, NJ	229	Compositionalist[d]	Restoration	Education, research, aesthetics, recreation, ecotourism (minimal extractive uses)	Classic for undisturbed systems—biogeochemical cycling, biomass decomposition, biomass production, resiliency, species interactions, keystone species, etc. (Roe & van Eeten 2002)

[a] Functionalists perceive the biosphere in the context of ecosystem ecology; that is, a process-oriented, energy-driven approach that includes but is not limited to biota (Callicott et al. 1999).
[b] Rehabilitation refers to the process of restoring ecosystem health; the latter includes and incorporates human habitation, economic exploitation, and cultural management (Callicott et al. 1999).
[c] Restoration refers to the process of returning a biotic community to a self-sustaining state, characterized by native biota (Angermeir & Karr 1994; Society for Ecological Restoration 1997).
[d] Compositionalists perceive the biosphere in the context of evolutionary ecology, interacting populations of organisms, and biodiversity and adopt an autecological approach to biotic communities (Callicott et al. 1999).

zones" with all the rights and privileges of sovereign ownership. Such zoning is currently being extended to MPAs as noted above, and should be applied in the development of proposed $C_{Commerce}$MAs. Although fully establishing the formal basis for designating $C_{Commerce}$MAs is beyond the scope of this article, a comparison with $C_{Conservation}$-MAs constitutes an illustrative first step (Table 2). The table is only a "speaking piece" from whence additional information and refinements would be incorporated into the concept.

Concluding Thoughts

We live in a human-dominated world. On land, *Homo sapiens* have diverted approximately 40–50% of biological production to human uses (Vitousek et al. 1986, 1997) and with it degraded regional environments. But degradation is in the eye of the beholder, and one individual's visual pollution, e.g., a city skyline on the waterfront, is another's aesthetic delight. People are here to stay, and we suggest that managing the coastal resources necessarily requires a *conscious* baseline shift to include humans in the landscape, and to address our estuarine dependency including the need for system reliability and extractive uses. Clearly, there are commonalities along the gradient from urban-industrial to conservation estuaries (Fig. 2); clean air, water and sediments, waterfront access, recreation, aesthetics, and passive uses are universal goals. But just as clearly, are the sacrifices that will be required in biodiversity, biological integrity, and natural habitat extent. Here is where the dual mandate meets its greatest challenge.

The emerging view on sustainability science increasingly recognizes the need for integrating knowledge gained from ecology, economics, technology, and the social sciences into a management scheme designed to keep human impacts at sustainable levels and prevent ecocatastrophes

Table 2. A comparison of the "mandates" for conservation and commerce managed areas.

$C_{Conservation}$MAs	*$C_{Commerce}$MAs*	
Conservation (wilderness) estuary	Production (arcadian) estuary	Urban-industrial (functional) estuary
• *Compositionalist* approach based on preserving biological integrity and biodiversity (Callicott et al. 1999)	• *Compositionalist/functionalist* approach based on *biological integrity and species population dynamics*, with emphasis on species of commercial and recreational value	• *Functionalist* approach based on ecosystem health (Callicott et al. 1999)
• Emphasis on ecosystem functions	• Management addresses the dual mandate—*constraining growth* in the shore zone, *optimizing fishery yield* (including use of artificial reefs, bycatch reduction, turtle excluders, "crop rotation" to allow live bottom to recover from gear effects, etc.), watershed management, and *restoration*, *conservation and protection of habitat and species*, provision made for *sustainable aquaculture*	• Emphasis is on ecosystem services
• Management emphasizes the undisturbed condition; extractive uses are *minimized*, largely restricted to research, education, and passive use	• Restoration goal is the *historic condition* to the *extent feasible*	• Management emphasizes economic vitality and extractive uses
• Restoration goal is the *historic condition* focusing on habitats		• Rehabilitation goal is a return to *ecosystem health* at a *postindustrial baseline*; contaminant control, water and sediment quality are key elements, but habitat should be addressed as opportunities arise
• Marine reserves are designated as "no take" areas to additionally serve as source of propagules (recruits) to heavily exploited areas		• Natural resource goals emphasize species adapted to the presence of humans, and the conservation and preservation of remaining habitat

(Dailey et al. 1996). To "win the game" as envisioned by the authors requires elucidation of the playing rules (by natural scientists), the best strategies for winning (economists), the best tactics for winning (technologists including engineers), and ultimately the best methods for getting people and nations to play the game (political and behavioral scientists, and the law). Also required is investing in the crosscutting issue of need for multiscaled monitoring of ecosystem processes and/or functions, *and* indicators of demand by society (Arrow et al. 1996; O'Neill et al. 1996). Stated succinctly, people must recognize that resource bases are finite, accept accountability, and be willing to pay for their actions and the consequences that follow. Maintaining *balance* is the key; so too is education (National Ocean Conference 1998). Similarly, nations must invest in institutional reforms that would compel private users of natural resources based in ecosystem functions to account for the social and landscape-wide costs of their actions and adopt appropriate indicators of environmental change that will create thresholds for action (Arrow et al. 1996; Roe & van Eeten 2001). Finding this political will to develop and adopt these institutions and *pay for them* will not be easy.

Current ecosystem management practices appear to be weighted toward preserving natural functions (see Swart & van der Windt this issue) and decoupled from system reliability. In human-dominated systems, however, ecosystem-based management policy should be redirected toward goals and mandates to rehabilitate the functions associated with service reliability while preserving natural ecosystem functions and health in the context of *realistic* baselines. The U.S. Commission on Ocean Policy (2004) recognized the ensuing conflicts yet to be resolved, but made few recommendations to deal with them other than acknowledging their existence: "Where multiple desirable but competing objectives exist, it is not possible to maximize each" (p. 36), and "as in any system with multiple competing objectives, it will not be possible to meet every one" (p. 242). As the United States overhauls its approach to ocean governance and policy formulation, we urge the adoption of *realistic* integrated coastal zone management goals recognizing humans in the landscape, and the incorporation of ocean zoning and ecological and commerce management areas to be an unequivocal part of any future ecosystem-based management framework.

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