AN ECOSYSTEM MANAGEMENT APPROACH FOR THE SANTA BARBARA CHANNEL ISLANDS

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ABSTRACT

Scientists have documented the general decline in the health of marine ecosystems. The human impacts on marine ecosystems are forcing resource agencies and scientists to rethink how society manages ocean and coastal systems. Since the 1960s, the scientific and intellectual basis of an ecosystem-based approach to manage and restore landscapes has been developing with state and federal resource agencies. With new data and insights, an ecosystem approach has been embraced by the Executive Office of the White House and 18 federal agencies. Similar views are increasingly evident at state and local government levels, as well as within the non-government sector. With the Channel Islands as a backdrop, this paper analyzes the role of science and values in the development of an ecosystem-based approach to marine systems. Even at the purely technical level, an ecosystem approach will require an integrated and adaptive approach that recognizes the social, cultural, economic, historical, ecological, and biogeographical character of particular marine systems.

Keywords: Ecology, Santa Barbara, Channel Islands, Channel Islands National Marine Sanctuary, ecosystem, management, culture, values, boundaries, adaptation.

INTRODUCTION: FROM THE LANDSCAPE TO THE MARINE ECOSYSTEM

There are those who are completely satisfied with the sea. -- Gregory Corso

The human impacts on ecosystems are forcing resource agencies, the public, and scientists to rethink how we manage our precious natural resources. The intellectual, philosophical, and scientific basis of ecosystem management and planning has developed since the 1960s. One need only refer to the several hundred watershed-based organizations and plans that are developing in California and the American West to deal with such issues as water quality (in southern California) and the plight of wild salmon (in the Pacific Northwest). These proposals and plans are derived from new ecological insights, biological inventories, and scientific data, and, according to some social scientists, an "environmental" world view that is more ecologically-oriented and holistic (Olsen et al. 1992). An ecosystem-based approach necessarily implies a move beyond the more conventional ways of managing "natural resources" or the "environment." Indeed, nature is more than a resource to be developed, exploited, managed, or used. Ecosystem-based management requires a kind of vision across boundaries-across the political, administrative, and economic boundaries that govern and ultimately separate inland ecosystems from human environments (cities) from coastal/marine ecosystems. This culturally-ingrained form of "spatial apartheid" has been shown to lead to habitat fragmentation, and the loss of native diversity. Because human beings and nature are interconnected and interdependent entities that shape the overall health of an ecosystem, an ecosystem-based approach coupled with what Aldo Leopold referred to as a "land ethic" is slowly becoming part of the mainstream lexicon.

An ecosystem management approach has recently been embraced by the Executive Office of the Presidency and at least 18 federal agencies (Haeuber 1996). Similar views are increasingly evident at state and local government levels, as well as within the non-governmental sector.

Ecosystem management and planning involves both the recognition of the importance of diverse values and science. Cultural and organizational values, beliefs, and perceptions play an important role in the process of decision-making and planning. Moreover, because of the uncertainties associated to the dynamics and functions of ecosystems, values inevitably influence the role of science in management and planning. Ultimately, ecosystem management and planning requires the integration of both scientific and place-based local knowledge. A reliance on only scientific knowledge will not suffice because there are sociocultural, ethical, contextual, historical issues and concerns that shape the development and implementation of ecosystem plans.

We focus on four concerns expressed by scholars who are interested in the development and implementation of ecosystem management plans: 1) the inevitable boundary conflicts that emerge in ecosystem management and planning, 2) the values of industrialism are incompatible with

biological conservation, and 3) the pitfalls in a naive faith in science and scientific information. With these issues in mind, we discuss the application of the values of ecosystem management to the Channel Islands Ecosystem. We identify a number of challenges to the development of marine ecosystem management. We conclude with a discussion of general goals and objectives that support marine ecosystem management.

Boundary Conflicts and Cultural Barriers

Ecosystem boundaries are "fast" and not hard. In *Policy Paradox and Political Reason*, Deborah Stone (1988:309) agrees and writes, "In a world of continua, boundaries are inherently unstable. Whether they are conceptual, physical or political, boundaries are border wars waiting to happen. At every boundary, there is the dilemma of classification: who or what belongs on each side? In policy politics, these dilemmas evoke intense passions because classifications confer advantages and disadvantages—rewards and penalties, permissions and restrictions, or power and powerlessness." There are certainly many boundaries that will need to be crossed if industrial society is to successfully adopt and implement an ecosystem-based approach to governance. There are the physical boundaries of ecosystem scale. Ecosystems are complex systems of relationships that include a range of communities and functions which transcend current political, economic, and conventional administrative boundaries and jurisdictions. Political and resource management institutions (both private and public) have not evolved along the same lines as ecosystems. Ecosystem management involves a central recognition that natural resource agencies have ignored the spatial hierarchy of ecosystems (Keiter 1993). Indeed, scientists have shown that this biogeographical disconnect has led to the degradation in the overall health of ecosystems and the decline in native species diversity (Noss et al. 1995). For example, past and present development of California has affected virtually every ecosystem in the state. California is facing an ecological crisis which is exemplified by the sharp decline in aquatic species diversity (Allendorf 1988). Among the 50 states, California ranks second in numbers of freshwater fish species that are declining (McGinnis 1999b).

There is also a fundamental cultural barrier. The transition to an ecosystem management approach requires that industrial society overcome three cultural barriers. Let's first examine the emphasis on "resource" management. A resource is a source of nature redirected for human use (McGinnis 1994). Nature is more than a natural resource to be managed, ordered for use, rationally categorized as if it were merely a multiple use. Ecosystem management requires more than a view of nature as a resource. The multiple-use mentality—pervasive throughout government and industrial bureaucracy—makes impossible a collective experience with nature on its own terms, as a network of relationships and communities. Although we typically think that the problem is in the mind of the beholder, our point is that the problem is even greater in the prevailing culture of resource management. The transition to an ecosystem management approach involves both a structural problem in society and a cognitive problem involving personal believes. The question is not whether bureaucracy can make and keep life human, or humane, but whether bureaucracy can make and keep life natural. Can we redesign administration to encompass the natural values that are not merely instrumental, but also intrinsic to ecosystems? Can we pass from an administration of multiple uses to an administration that sensitizes to, protects, and conserves the multiple values that are carried by natural systems, integrating human culture with these values? Asking such questions is frustrated by the intense allegiance of the techno-bureaucratic myths to control and manage natural "resources."

Another problem is the deeply ingrained institutional bias for single-species management. The focus on single-species management impedes the development of a comprehensive, multiple-species approach to ecosystem management.

A third barrier to the development of a comprehensive ecosystem management approach is the value of private property and the history of over-use of nature in industrial society (McGinnis and Proctor, In press). The ways in which society distributes, allocates, manages, and uses its precious "natural resources" is an indication of the choices and values of institutions and the general public. More often than not, economies based on ecological exploitation are supported by development interests in institutional arenas. Conservation biologists show that historical uses of species as "natural resources" has led to tragic outcomes—the biological collapse or extinction of species (Ludwig et al. 1993). As Kai Lee (1993:192) writes in *Compass and Gyroscope*, "[I]f resources are traded in markets, the value of conserving them for ecologically significant lengths of time is set by markets, not by biology; usually, biological conservation turns out to be worth very little." Given the political and economic values of global economy, the integration of capitalistic and bureaucratic values with an ecosystem management approach is unlikely (McGinnis 1999a: Chapter 4).

Situated Knowledge and Ecology

Generally, an ecosystem management approach is based on the need to link ecological systems, human activities and institutions. Even at a purely technical level, the development of an ecosystem management approach is predicated on social and institutional conditions. Ecosystem management is more than a scientific enterprise. A range of values are associated with ecosystems and species diversity, such as recreational, cultural, historical, aesthetic, sacramental among others. Scientists and policymakers would benefit from a greater understanding of the relative places of values and science in shaping ecosystem management.

Ecosystem management should be understood as both a scientific and an ethical enterprise. This is due, in part, to the complexity and uncertainty inherent to the physical sciences, especially the field of ecology. The politics of integrating scientific information in ecosystem-based planning,

decision making and implementation often takes place within the context of a highly charged and contentious intergovernmental process. The problem is that scientific information is likely to enter the process at unpredictable times and in unidentified areas. There is also the likelihood that "unfavorable" information will be forgotten or remain marginalized during the process. In such a process, "good" scientific information is that which supports one's position in the decision making situation.

Overall, access to information is a function of how well information flows within institutions, among institutions, and between institutions. This has been a major problem for many resource agencies that are currently developing ecosystem-based strategies and plans. Under conditions of high scientific uncertainty (such as the assessment of the ecological impacts of decommission/abandonment/disposal of offshore oil and gas structures off California), ecosystem management requires that institutions do more than merely acquire information.

In a comprehensive analysis of the history of California coastal and ocean studies from 1945 to 1973, Harry Scheiber (1995) describes four factors that influence the use of science in ocean and coastal policy making: 1) the dilemma of incomplete information, 2) the frustration of political entanglement, 3) the minefield effects of multi-level government, and 4) the pitfalls of naive faith in science to resolve political and value-based conflicts. Ecosystem-based management and planning takes place in an intergovernmental context of overlapping and competing administrative jurisdictions. Moreover, ecosystems are mosaics of privately held and "publicly" managed land. This private land-public land relationship will also shape the development of ecosystem management and planning.

In a scientifically-oriented society like that of the West, there is the real problem that to resolve disputes between government agencies, private land owners, and industry and environmentalists, the government will rely on scientific information that is speculative at best. The politics of scientific integration will likely be a major concern for participants involved in ecosystem-based planning and management. This is an issue that we now turn to.

Shrader-Frechette (a philosopher) and McCoy (an ecologist) received funding from the National Science Foundation to evaluate the role of ecology and ecological information in conservation policy. Their findings and analysis are based on both recommendations from the National Academy of Sciences and the National Research Council. Shrader-Frechette and McCoy (1994) describe the pitfalls of a naive faith in ecological science in ecosystem management. Ecology is both a science and a sensibility. Ecology is a "situated" science that is often shaped by cultural values and ethical choices. This is hardly a "post-modern" position. Shrader-Frechette and McCoy are realists. Ecosystem management should be understood as a "transcientific" process which involves the intermingling of facts and values, science and culture, society and nature. Shrader-Frechette and McCoy (1994) show the following: First, ecologists do not agree on what the basic principles or ecological laws are. Second, scientific facts are laden with epistemic or cognitive values. Values can be divided into three categories—bias values, contextual values, and methodological values. Scientists may not agree on the methodologies to be employed in the scientific process or the scientific claims made by scientists during the process of ecosystem planning and management. Third, ecology cannot dictate ends or goals but can act as a guide to good public policy. Four, ecologists and laypersons do not share the same uncontroversial and unambiguous goals. Five, ecological applications arise when and because scientists have a great deal of knowledge about the qualitative and quantitative natural history of a specific ecosystem. This is rarely the case. Six, ecology cannot tell us what is "natural."

We would like to briefly focus on this last point because the ambiguous notion of "real" nature poses a paradox for the development of ecosystem managers. One paradox of ecosystem management and planning is that "real" nature no longer exists. The natural world is no longer original or real. Let us return to the prevailing notion of nature as a resource. Nature is denatured when we value it only as a resource. A natural resource is a dead nature, a mere shadow of an original form. The wolf is not a wolf but a "predator control unit." Lacking the real, the boundaries between the forested landscaped of the past and the present forest is not a clear one because the past has been partially destroyed and reconstructed by simulation and material production, Jean Baudrillard (1995:97) explains, "We might believe we exist in the original, but today this original has become an exceptional version of the happy few. Our reality doesn't exist anymore." Original nature, like the rose of Gertrude Stein, has changed meaning (i.e., a rose is a rose is a rose). The secrets of nature, the past and the rose have been lost for good it seems.

Original nature lingers as a distant photograph in the mind. The photograph takes on alternative cultural meanings and values. Ultimately, the substance of the photograph becomes meaningless when it is separated from its contextual significance. Because denatured nature is a shadow of its preexisting forms and functions, human beings will find it difficult to reveal its past secrets. We are left with a modern sense of nature after our wars and industrial developments. In many places, only the allegories and metaphors of a previous state of nature remain—as reflected in the writings, texts and earthy poetry that speak for nature.

Overall, ecosystem management plans will need to include human beings, with their various values, beliefs and perceptions. It is unlikely that science alone will provide the foundation for a policy or program. People often act out of their perceptual and place-based understandings of the world. This is referred to as the emerging political of place and bioregionalism (McGinnis 1999a) which necessarily influences the development of ecosystem management and planning. Ecology and scientific information alone cannot provide policy makers with goals or values for policies, but can guide policy makers regarding the means to attain or the

reasons to attain ends or goals. Overall, the ends and are based on the relevant categorical judgment of values held by individuals and institutions. In the case of ecosystem management and planning, place-based and regional values will influence the role that scientific information plays. The politics of ecosystem management will also vary from one region to another.

The Fluid Medium of the Sea

As we move from the landscape to the seascape other boundaries will arise. Human beings have just begun to understand the multifaceted character and function of marine ecosystems. The boundaries of the seascape are vertical and horizontal, and ultimately require an alternative cognitive, perceptual and ecological lens. These same issues and concerns noted above will likely influence the politics of marine and coastal ecosystem management and planning. But the boundaries of the seascape will likely pose new challenges and dilemmas as well.

There exists a number of concerns. One of the limits of the existing scholarship and literature on ecosystem management and planning is that relative lack of focus on marine and coastal ecosystems. Two decades of literature on ecosystem management has focused primarily on the landscape. Many scholars have merely used landscape-based strategies for aquatic ecosystem planning. There are numerous examples of ecosystem management approaches and practices in the terrestrial ecosystem while there is a paucity of examples and information for marine ecosystem planning (for a recent sample of examples on the relationship between marine fisheries and ecosystem management, see Mooney 1998).

In a joint project between the University of Michigan and the Wilderness Society, 105 ecosystem management projects from around the country were reviewed. This study focused primarily on landscapes. How can the concept of ecosystem management be applied to marine ecosystems? There is an emerging debate over the relevance of terrestrial designs and general planning/strategic/management procedures to marine and coastal ecosystems. Our goal is not to provide an overview of this debate. Suffice it to say that it is very difficult for human beings to think in terms of the diverse and complex spatio-temporal and functional scale of the seascape, let alone develop strategies that can successfully incorporate the needs of species that are migratory and depend on a number of diverse systems (e.g., the blue whale or the arctic tern). If we are to successfully develop integrated, comprehensive, long-term ecosystem plans that include the cultural and human (maritime) needs for marine systems and species, we need to better understand the fluid and dynamic character of aquatic boundaries.

Many of the principles and guidelines proposed by Yaffee et al. (1996) in their inventory of ecosystem projects can be employed in an initial move toward the development of a general theory of ecosystem management for marine and coastal managers and planners. Yaffee et al. (1996) propose six principles for ecosystem planning: research, stakeholder involvement, ecosystem restoration, promotion of compatible (marine and coastal) uses, education and outreach, (marine and coastal) protection through set asides, development of a management plan, and use of existing state and federal programs.

APPLICATION TO THE CHANNEL ISLANDS ECOSYSTEM

With these general principles in mind, we focus on the Channel Islands. In the designation of a National Marine Sanctuary, the Secretary of Commerce considers the area's natural resources and ecological qualities, including its contribution to biological productivity, maintenance of ecosystem structure, maintenance of ecologically or commercially important or threatened species or species assemblages, maintenance of critical habitat of endangered species, and the biogeographic representation of the site (16 U.S.C. 1431 Section 303(b)(1)(A)). With respect to this mandate, we describe major barriers to the development of an ecosystem-based planning approach for the Channel Islands. These barriers are: 1) defining ecosystem boundaries, 2) understanding natural disturbance, 3) anthropogenic threats, and 4) the intergovernmental and multi-jurisdictional character of the management regime. Overall, the challenge is how to integrate the diverse cultural needs of the surrounding coastal communities (e.g., commercial and sports fishermen, recreationists) with the needs of the rich and noble species and habitats found in the Santa Barbara Channel.

Defining the Channel Islands Ecosystem

One of the most difficult challenges to ecosystem management is defining the parameters or boundaries of an ecosystem. Chapin et al. (1992) provides three criteria to consider: 1) the physical linkages involving currents, freshwater hydrology, weather, source-sink models, 2) biological linkages involving important predator-prey relationships, migration, breeding and spawning movements, factors, affecting productivity, and 3) sociological linkages, including cultural ties between communities, political or management infrastructure and others.

The Southern California Bight (SCB) is commonly delineated as the region extending west and south of Point Conception to the International Border with Mexico. Water transport within the SCB is largely dictated by the southern flow of the California Current and the prevailing winds from the northwest. Together these forces drive cold water from the north directly into the Northern Channel Islands. This mass movement of water also fuels an upwelling of cold, nutrient-rich water, usually in the late spring to early summer period. The California Current is forced offshore near Point Conception creating a large eddy current referred to as the Santa Barbara Gyre. This gyre system generally flows in a counter-clockwise direction between the Santa Barbara mainland coast and the Channel Islands in the Santa Barbara Channel. Another large water transport system in the SCB is the Southern California Counter Current that draws

warmer water from the south and forces the water northwest through the Channel Islands.

The confluence of these major currents has created, and continues to shape, a diverse and rich system of habitats and species comprised of open ocean and nearshore habitats that provide refuge to 26 species of marine mammals, over 60 species of seabirds, the state's most valuable fish and invertebrate species and giant kelp forests. The diversity of species found here is punctuated by the presence of several threatened and endangered species, represented by gray whales, peregrine falcons, bald eagles, brown pelicans, the largest concentration of blue whales along the west coast of North America, and numerous endemic plant species. In addition to the abundance of natural resources, historical and cultural resources include over 200 documented shipwrecks and numerous Chumash Native American sites and artifacts dating back over 10,000 years.

Anthropogenic Threats to the Channel Islands Marine Ecosystem

The Southern California Bight is one of the most densely populated coastal regions in the country. Nearly 20 million people inhabit coastal southern California, a number which is expected to increase another 20% by 2010. The water transport system, described above, moves large volumes of water, sediments and other materials in the SCB, including potentially harmful pollutants from the mainland coastline. The following list of human impacts to this region is not intended to be exhaustive, but merely representative of the more prevalent impacts that must be considered in the development of an ecosystem management structure

Clearly, one of the largest threats is an oil spill resulting from the transportation and production of hydrocarbons in the region. Similarly, point sources of discharge in the SCB include fifteen municipal wastewater treatment facilities, eight power generating stations, 10 industrial treatment facilities, and 18 oil platforms. Non-point source pollution from urban and agricultural runoff, storm-drain and creek runoff and atmospheric transport of pollutants to the ocean is one the largest, least understood and hardest to manage input of pollution to the marine environment.

Military operations associated with the Vandenberg Air Force Base and the Pacific Missile Test Range, which encompasses a majority of the SCB, must also be considered in the array of possible threats to this area. Part of the economic engine in this region is fueled by vessels transiting to and from the Ports of Long Beach, Los Angeles, and Hueneme. These ships represent the globalization of a market economy and import and export products, some hazardous, from around the world. Impacts associated with vessel traffic range from the potential introduction exotic species through ballast water exchange, air emissions, and collisions (Environmental Health Center 1998).

The commercial and recreational harvest of marine species including kelp, is deeply ingrained in the cultural heritage of this region. The revenue generated from these activities pumps millions of dollars into California's economy. The ability of the resource management agencies to effectively manage the direct and indirect impacts associated with these harvests, and the sustainability of the extraction is questionable.

Natural Disturbances to the Channel Islands Region

In addition to human caused impacts to the marine environment, natural variations and disturbances have profound effects in this region. For example, the El Niño Southern Oscillation (ENSO) events have had dramatic effects, which we are only recently able to recognize. Likely ENSO impacts include: population shifts in commercially harvested species, such as squid, rockfish and lobster; transport of enormous volumes of sediments and suspended materials from the mainland to coastal and offshore waters, disturbance to critical marine habitats, notably storm and water temperature damage to kelp forests. ENSO events might be considered short-term variations, while decade-and even century-long cycles need to be factored. Both anthropogenic and natural impacts to the environment can send a rippling effect through an ecosystem, and it is rare that only one species is affected.

A Complex and Multi-Jurisdiction Regulatory Regime

The regulatory management systems in the Channel Islands marine region are best described as a complicated, multi-jurisdictional collage of agencies from the international level to the local level. At the international level there is the Channel Islands Biosphere Reserve designated by the Man and the Biosphere program under the United Nations Education Science and Conservation Organization. The federal regulatory agencies include the Channel Islands National Marine Sanctuary, Channel Islands National Park, National Marine Fisheries Service, Pacific Fisheries Management Council, Minerals Management Service, U.S. Fish and Wildlife, Environmental Protection Agency, and the Coast Guard. At the state level, the regulatory regime includes the California Resources Agency, State Lands Commission, the California Coastal Commission, Regional Water Quality Control Board, and the Department of Fish and Game. The Counties of Santa Barbara and Ventura are also part of this management mosaic.

The resource management agencies mentioned above are tasked with balancing multiple, often conflicting goals of resource protection, conservation and providing for compatible uses of the environment. Additionally, the well known litany of agency constraints, i.e., inadequate resources in terms of staff, budget, and technology, are very prevalent in each agency and must be taken into consideration when trying to match the agencies mandate to its actual actions. Nonetheless, the establishment and presence of these agencies and their programs possess the building blocks to creating a comprehensive ecosystem management approach. The challenge lies in agency to agency, and agency to public, coordination and communication.

DISCUSSION

Developing and implementing marine and coastal ecosystem plans requires alternative management approaches, strategies and tools. To begin to deal with the Channel Islands marine region as a number of interdependent ecosystems that include maritime communities, we suggest the following general goals and objectives:

1. Seek out marine ecosystem management examples. Marine ecosystem management strategies in New Zealand, Australia, South Africa need to be carefully reviewed and considered.

2. Carefully examine questions of political, technical and administrative feasibility during the initial phase of the development of an ecosystem management plan.

3. Keep in mind the intergovernmental characteristic of ecosystem management. There are political, statutory and regulatory constraints on our intergovernmental system of ecosystem management. Critical to an effective ecosystem management strategy is coordination and communication among agencies. Focus on a broad system-wide, integrated, collaborative planning efforts.

The Oceans Act of 1992 (P. L. 102-587), which amended the National Marine Sanctuary Act, acknowledged the importance of collaborative efforts in managing National Marine Sanctuaries by adding the following purpose: "The purposes and policies of this title are . . . to develop and implement coordinated plans for the protection and management of these areas with appropriate Federal agencies, State and local governments, Native American tribes and organizations, international organizations, and other public and private interests concerned with the continuing health and resilience of these marine areas."

The Channel Islands National Marine Sanctuary recently created an Advisory Council to foster regional community input into the management and conservation of the marine resources found around the Channel Islands. The Advisory Council seeks a balanced representation of points of view from the local community and government agencies to address Sanctuary issues and make recommendations to the Sanctuary manager. The Advisory Council is advisory only, and does not have any direct regulatory power. However, of the 20 Council members, ten members represent the various federal, state and local government agencies who have jurisdiction and regulatory power in the region. The ten non-government members represent commercial fishing and recreational interests, conservation and public interest organizations, science and education institutions and organization, and the general public. Advisory Council meetings meet regularly in open public forums throughout Santa Barbara and Ventura counties.

4. Ecosystem management is about managing human activity. To create an effective ecosystem management system requires, first, recognition that we can not manage nature. Ecosystem management requires moral and philosophical adaptations that move beyond viewing the environment solely as a resource for human use.

In the northern Channel Islands region, extending from Point Arguello to southern Ventura County, there are 13 different marine protected area designations. These areas, designated under various international, federal and state laws, include marine reserves, ecological preserves, a national marine sanctuary and national park, sensitive species and area buffer zones. Cumulatively these protected areas seek to protect water quality, limit harvests of certain species and minerals, and minimize human threats to natural resources. Members of the regulatory, research and conservation communities are investigating the application of zoning certain marine areas where no commercial or recreational harvests of any species would be permitted. Referred to as no-take areas, marine reserves or marine wilderness areas, essentially this form of designation seeks to establish marine wild areas devoid of direct human impacts. Needless to say, the marine zoning issue is contentious.

5. Recognize the limits of science will lend to a more proactive management style, opposed to an entrenched management system unwilling to adapt to a changing world.

Given the inevitable complexities and uncertainties endemic to the physical sciences, today's technology has opened a whole new realm of possibilities for fostering the flow of and application of information and learning. One such example is the Channel Islands Geographic Information System, or CIGIS, a cooperative effort among several government agencies: Channel Islands National Marine Sanctuary, Department of Geography at the University of California, Santa Barbara (UCSB), Channel Islands National Park, U.C. Natural Reserve System, and California Department of Fish and Game Office of Oil Spill Prevention and Response. The complete data archive is housed at UCSB's Department of Geography. Cooperating agencies contribute and exchange data through this archive and each run their own onsite GIS-based on their particular needs.

CIGIS is a powerful geographical management tool that allows agencies to map and study the physical and cultural features within the Channel Island Ecosystem. Understanding the relationships within and between these features is a crucial component in the management of this environment. CIGIS is also lauded as an important aid to the effective administration of limited agency resources.

Data sets on CIGIS include a complete bathymetric/topographic model of the Channel Islands National Marine Sanctuary area, including the Santa Barbara Channel and mainland coast. The model has combined USGS topographic data with NOAA bathymetry data and stitched them together

into a single coverage. CIGIS will undoubtedly improve the ability of resource management agencies to study the land-marine interface, an interesting and important "data layer" within the marine ecosystem.

Another CIGIS project is the generation of virtual flybys of the Channel Islands. These animated views are created using Digital Elevation Models which allow for the generation of real world perspectives of island coastlines. This animation is useful not only as an educational tool, but as aids to important management decisions, such as, oil spill response and mitigation.

CIGIS also houses data from the aerial survey reports of marine mammal sightings and vessel activity carried out by the CINMS aerial monitoring program. The near-real-time geographic coordinate data of marine mammal and vessel sightings is downloaded and instantly generates maps of the surveyed activity. Possible application of this data layer will be the ability to plot and analyze changes in natural and human related activity and their relationships to one another over time.

CONCLUDING THOUGHTS: OCEAN, PLANET, LIVING

People survive and leave offspring to the degree that they learn and adapt to the culture of their society, and the societies themselves flourish or decline in proportion to the effectiveness of their adaptation to their environment and surrounding societies (Wilson 1998:144).

Anyone looking for a sophisticated approach to developing an alternative approach to environmental management of island ecosystems will need to learn from the mistakes of landscape management and make peace with a current view of marine ecosystems and the natural world that are dynamic. Marine ecology and the associated maritime cultures have to be accepted as endlessly evolving through time. Landscape ecologists speak of "internal change," "blurred seccessional patchworks," and "moving mosaics." Marine ecologists will need to develop appropriate metaphors and analogies for the changing patterns and systems of relationships that are part of the seascape. Disturbance in the systems that we depend on and the cultural adjustment to these disturbances should be on-going and is fundamental aspect of life with the sea.

Ecosystem management represents one potential cultural "shift" in terms of scale (time and space) to respect the changing patterns and functional networks of human ecology. It may also represent an attempt to rebuild the bridge that can reconnect our maladaptive industrial society to the natural world and more-than human community. There remains several "borders" and boundaries to cross in the development of a truly adaptive ecosystem management approach. We have described some of these barriers in this essay, with a particular focus on the Channel Islands Marine Ecosystem.

In the late 1970s, Roy Rappaport applied the precepts of ecology and biology to cultural adaptation. Rappaport asserted that adaptation's function is the same whether it occurs in ecosystems or societies. The function of adaptation is to aid in survival and life-production. "Since survival is nothing if not biological," Rappaport (1977:69-71) wrote, "evolutionary changes perpetuating economic and political institutions at the expense of the biological well-being of man, societies and ecosystems may be considered maladaptive." Adaptation is critical to understanding the success of failure of human cultures and institutions. Ecosystem management and planning may represent an attempt to develop a creative, imaginative relationship with the more-than human communities that we depend on. The hope is that marine ecosystem management and planning coupled linked to the coastal landscape can ultimately serve cultural adaptation and sustain the life-producing splendor and diversity of the sea.

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