Toward New Paradigms in Coastal Resource Management: Linkages and Institutional Effectiveness

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ABSTRACT: Explosive population growth is expected to continue in coastal regions, and growth rates many times the national average are expected in many coastal counties in the next two decades. Most shallow-water marine habitats now exhibit “stress” from human activities and linkages between adverse environmental impacts and coastal development are apparent. These linkages are complex, often not well understood, yet are expected to increase in strength as coastal populations expand. Sound science-based management strategies are essential if we are to preclude continued deterioration of coastal environments. Environmental management is a politically mediated activity, however, and a broad array of organizations, both public and private, collectively determine societal response to management decisions. While our current regulatory infrastructure has an exemplary record of achievement in environmental protection, the fact remains that adverse impacts to shallow-water marine habitats continue at significant rates. Both lack of scientific information and structural problems in our current institutional infrastructure are identified as impediments to better management performance for coastal habitats. Seven structural impediments to efficient science-based management in our current institutional infrastructure are identified. The issues are complex and comprehensive reform is politically difficult. Nonetheless, the magnitude, geographic scale, and temporal urgency of anticipated impacts from future growth and development scenarios argue strongly for the implementation of sound practical solutions to environmental protection on a sustained basis. Factors affecting management performance will also be amplified in an environment of limited investment in research and management infrastructure. Among the central themes are that science-based management practices in the future will require holistic approaches in which environment and economic development are inseparable. To work effectively large-scale, regional management schemes must build political consensus and integrate knowledge at unprecedented rates. Processes that increase rates of dissemination of scientific information into the public policy arena can significantly enhance management performance. Serious doubts are raised as to whether the current regulatory infrastructure can adequately respond to the complexity, scale, and urgency future coastal management will demand. While comprehensive institutional reform will be difficult, a number of ideas are advanced in the context of improving institutional performance to a level necessary for large-scale, sustained management of coastal ecosystems.

Introduction

A great deal has been written about the importance of shallow marine habitats and the coastal ocean in general (Walsh 1988a; Coker and Richards 1992). Much of the ecological value of such habitats derives from the high productivity of associated ecosystems (Day et al. 1989; Nixon 1992). For instance, Walsh (1988a) estimates that coastal zones contribute 95% of the world’s fisheries yield. Coastal areas, of course, are of enormous economic importance to society and today over 2.5 billion people worldwide live within 100 km of the ocean (Myers 1993). It is precisely because of this economic importance that coastal margins have been subjected to extensive development activity, particularly over the last two decades. That development has led to direct human-induced changes (e.g., habitat alteration, eutrophication) that are chronic to virtually every shallow marine environment in this country. While we are far from an adequate understanding of the effects of these anthropogenic changes, it is abundantly evident that they continue to occur at a rapid rate (Walsh 1988b; Safina 1994), and high rates of coastal development and population growth are expected to continue well into the next century. It is nowhere more true than in coastal areas that science-based management (SBM) decisions and effective public policy are absolutely critical to both ensuring human health and preserving ecological systems in states that will not preclude or severely reduce their productive use.

The sheer magnitude, scale, and short time periods implied in future growth scenarios should give us all cause for re-examining the effectiveness of current management practices. Of major con-
cern is the performance of those institutions, public and private, that are concerned with environmental protection. There appear to be a number of structural problems in our institutions of governance that act as impediments to the timely and effective management of coastal environments (Cicin-Sain 1992; Water Quality 2000 Committee 1992; Van Dyke et al. 1993). In this paper I review a number of the major impediments to the implementation of science-based management decisions for shallow marine habitats that involve those institutions of governance that determine society's response to management decisions. The issues are complex and effective solutions will be difficult. The objectives here are to frame the issues, put them in the context of continued explosive growth and development in coastal areas and suggest new avenues for improving management performance in the protection of coastal ecosystems.

**Linkages and Economic Development**

The last two decades have seen unprecedented population growth and development in coastal regions. Virtually every shallow marine environment exhibits some degree of "stress" from that development (see for instance, the National Oceanic and Atmospheric Administration's Estuary of the Month Seminar Series or technical reports of the United States Fish and Wildlife Service's National Coastal Ecosystem Team). More importantly, it is expected that these high rates of growth will continue for the next several decades. Summarizing demographic trends compiled by Kiplinger and Kiplinger (1993), it is expected that by the year 2010, 40 million people will be added to the United States population. Coastal states will receive much of that growth; a few examples of expected population growth rates for Atlantic coastal states follow: Delaware 14%; Florida 45%; Georgia 29%; Maryland 20%; North Carolina 23%; South Carolina 26%, and Virginia 23%. Moreover, coastal populations are not randomly distributed but occur in large concentrations. Over 14 million people now reside in the Los Angeles Basin and, in the Northeast, there are four states with coastal population densities of at least 1,000 persons mi⁻² (Bender et al. 1992). The environmental impacts to contiguous coastal ecosystems from such population densities are immense (Walsh 1988b; Greer 1991; Van Patten and Klauber 1993). For instance, New York City's sewage system alone deposits 500 tons d⁻¹ of suspended matter in the Atlantic Ocean (Jewell 1994).

In addition to population growth in coastal regions, there is economic development as well. While the contribution of the coastal margin to the gross national product (GNP) is not well documented, it is, nonetheless, considerable. For instance, in nine coastal states studied by King (1992) over half of total state GNP originated in the coastal zone. Economic growth, then, generally accompanies population growth and coastal regions will remain prime locations for development, ranging from tourism, to large, metropolita-industrial complexes, to intense agricultural activity. The point is that in addition to population growth, coastal areas face enormous pressures for economic development in its many forms with associated political and environmental consequences for the management of contiguous shallow-water habitats.

Strong linkages now exist between population growth, economic development, and adverse environmental impacts to shallow marine environments. The general nature of such linkages and the growing degree of interrelatedness of development processes with adverse impacts in an increasingly integrated global economy have been treated recently by Myers (1993). These linkages are complex, many are not well understood and yet can be expected to grow stronger. As the magnitude and extent of various anthropogenic impacts increase, their observed effects on coastal ecosystems increase, often nonlinearly and at increasingly larger scales. In some cases one impact works in conjunction with another to generate a synergized or mutually amplified impact (referred to by Myers 1993 as "synergized" linkages). Small impacts that are not significant by themselves (such as nonpoint source pollution) can, in the aggregate, create cumulative impacts on coastal ecosystems that result in significant environmental degradation (Odum 1982; Rieser 1992).

Figure 1 illustrates the nature of some of these