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Educating for the governance of coastal ecosystems: the dimensions of the challenge

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Abstract

There is a fundamental shift in how the problems confronting a practicing coastal manager are being defined. Coastal zone management began as an expression of an environmental protection strategy and has evolved into a promising vehicle for progressing towards more sustainable forms of development. The contemporary practice of coastal management requires integrating within a curriculum a diverse mix of knowledge and skills that emphasize the two defining features of adaptive management. These are a governance process rooted in the principles of participatory democracy and the application of the scientific principles that can produce reliable knowledge.

1. The coming transformation

This paper accepts the proposition that our species is at the initial stages of a major transformation. Meadows et al. [1], quoting Ruckelshaus compares the enormity of the coming change in human behavior, values and perceptions to those that accompanied two other turning points in the evolution of human society — the transformation from hunting/gathering to agriculture and the transformation brought by industrialization. The transformation that is fast approaching has been termed "sustainable" forms of development. It will require replacing the current imperative of growth — growth in consumption, growth in material wealth, growth in profits and

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growth in population — with types and intensities of human activity that are in a dynamic and long-term balance with a finite planet. Thus, Herman Daly [2], an economist and particularly lucid thinker on this topic, has suggested that the defining feature of sustainable development is the replacement of quantitative expansion (growth) with qualitative improvement (development) as the path of future progress.

For those who believe that such change is both desirable and eventually inevitable — and many do not — the implications for education, and most specifically the education of those who will work to practice integrated coastal management (ICM), are profound.

Coastal regions can be the crucible where the concepts of sustainable development are made tangible. It is here, along the world's coastlines that we urgently need to discover how the transformation foreseen by such authors as Meadows and Daly can be encouraged. The alternative is to resist the rising tide of change, a process that is most likely to increase both human conflicts and suffering and the needless destruction of the qualities that have helped make coastal regions a primary habitat of our species. Coastal regions can be a laboratory for confronting the challenges of sustainable development because the 100 km wide strip of land along the world's oceans, seas and great lakes today contain almost half of the current human population [3,4]. The predictions of demographers suggest that the total human population will increase from the current 5.8 to 9.3 billion by 2050. Most of the increase will be in the tropics and by then the proportion of the much larger global population that will live in coastal regions, on less than 20% of the inhabited land space, will probably have increased even further.

The qualities that have made coastal regions so critically important to our species are already under great pressure. The pace of change is accelerating as fresh water inflows from many rivers to estuaries decline as a consequence of dams and spiraling demands for fresh water, as populations of the more desirable fish and shellfish collapse, as such important habitats as wetlands, coral reefs and seagrass beds are destroyed, and water quality declines as the loadings of nutrients and a diversity of pollutants increase. So far, attention on expressions of anthropogenic change at the global scale has focused on that portion of the biosphere where anthropogenic change at the global scale is manifested most quickly. This is in the atmosphere. Other processes of anthropogenic change are at work at this biggest scale, including for example, the rapid declines in biodiversity, but, so far, they have received less attention among the public.

A decade ago the Intergovernmental Panel on Climate Change (IPCC) identified integrated coastal management (ICM) as the most promising approach for a response to the change that is upon us as expressed by the symptom of rising sea level. This endorsement of ICM was reinforced by the United Nations Conference on the Environment and Development (UNCED) in 1992 when it considered the broader social and environmental consequences of the mounting pressures on the world's coastlines. The calls for ICM as an important feature of the governance of all coastal states have been repeated frequently since then. However, the accomplishments of coastal management are as yet modest and have only modulated some of the localized impacts of the issues brought by the contemporary processes of anthropogenic change

[5–7]. Furthermore, we can reasonably hypothesize that the next fifty years will be marked by:

- Continuing anthropogenically driven ecosystem change, much of which will be judged as undesirable and an erosion of the ecosystem qualities that exist in many coastal regions today.
- Continuing demographic, social, political and institutional change that will offer greater institutional and political challenges to coastal managers than we have confronted thus far.
- The costs of ecosystem restoration will rise, as will the demand for remediation.

This suggests that any strategy to promote effective coastal management should adopt an explicit dedication to learning and adaptation. We will not approach the goals of sustainable development in a single leap. Teaching and learning the concepts and tools of ICM must reflect these fundamental features of future change.

2. Environmental protection or ecosystem governance?

The early stages of the coming transformation are reflected in the past and current practice of coastal management. The goals and practice of coastal management are shaped by the world view of the people involved. Today approaches to coastal management can be grouped as coming from two distinct world views. One calls for environmental protection, the other ecosystem governance. When coastal management projects and programs are designed and implemented these two world views are often represented among those working to shape the approach and the outcomes. The point is not that one is right and the other is wrong, but rather that they are significantly different and that those who are educated for careers in coastal management need to understand the differences and their implications. One school of coastal management is an expression of a world view that calls for environmental protection. The other sees the endeavor as a form of ecosystem governance and a vehicle for progressing towards sustainable forms of development.

Those that believe that coastal management should be no more than a form of environmental protection share a world view that assumes that the future will be a more-or-less smooth and logical extension of the present. This world view does not question the fundamental beliefs of a consumption-driven society nor the trajectory of a contemporary development process. It sees a fundamental separation between human society and an environment that is "out there." It seeks to identify, mitigate and sometimes control environmentally harmful activity within a business as usual context [8]. Kenneth Boulding, an economist and systems theorist, described the world view that gave rise to the environmental protection movement in the 1970s as "frontier economics" [9]. It rests upon an unbridled faith in human ingenuity, the benevolence of technical achievements and our ability as a species to deal with any environmental problem that may arise, often through the substitution of one natural resource for another. Market economies are seen as essentially benevolent.

As a resource becomes scarce because it is over-exploited or misused, its value rises and the market therefore makes the necessary corrections. This world view dismisses any possibility that the combination of accumulated damage and depletion of resources can eventually limit production or human opportunity.

Environmental protection is defensive or remedial in practice. This indeed characterized the first coastal zone management programs developed by individual states in the U.S.A. following the guidelines of the Federal Coastal Zone Management Act of 1972. Within an environmental protection framework this form coastal management relies heavily on such strategies as the use of environmental impact statements to identify environmental costs and weigh them against the specific benefits of a proposal. Environmental impacts considered undesirable are mitigated, predictable development "mistakes" are identified and, if possible, avoided and where the trade-off between the proposed activity and its environmental costs are too high, the proposal may be rejected. The environmental protection approach relies primarily upon regulations and zoning to set limits on environmental damage. The setting aside of small areas for preservation in their natural or largely undisturbed condition as a park or reserve is an important strategy. The privatization of common property, as for example in fisheries, is seen as an attractive option for avoiding the overuse and misuse of natural resources. This is the form of coastal management that is most familiar. It works fairly well in politically stable societies where governments have the resources and the will to impose regulations, build infrastructure and society accepts the financial costs of both.

Those that believe that the challenges of mounting pressures in coastal regions require systems of ecosystem governance that lead towards sustainable forms of development have a different world view. This view is rooted in the perception that there are limitations to the capacity of our planet's living systems and therefore to the quantity and the quality of human activity that it can sustain. Rather than perceiving the world as essentially empty, this world view sees it as essentially full. For those who share this perspective the goal has changed from the modest attempts in CZM to avoid development mistakes and to mitigate some of the undesirable impacts of the contemporary development process to a far more ambitious and complex undertaking that firmly unites ecosystems and human societies into fully integrated, interdependent systems. ICM programs designed under the banner of sustainable development place greater emphasis upon social equity, social process, and redefining the objectives of development than upon technological and regulatory fixes to specific problems. Thus, ecosystem governance and the objective of sustainable development struggles with such concepts as:

- The optimal, long-term utilization of ecosystems, and
- Equity in the distribution of resources not only within a given society but also across regions (and therefore among the wealthy and poor nations) and across generations.

However, those who conceive of ICM as a pioneering effort in ecosystem governance are building upon the principles and experience of an endeavor that began in

the U.S. CZM program as an expression of environmental protection. A centrally important feature of CZM in the USA has been its emphasis upon involving the public as well as government in all steps of the management process. This requires dealing overtly with social values as well as objective scientific information. The recognition of the central role of societal values in all forms of coastal management is the bridge that leads to governance and the recognition that the process is incremental and the result of a dynamic, organic process.

> ICM is a continuous and dynamic process that ... requires the active and sustained involvement of the interested public and many stakeholders with interests in how coastal resources are allocated and conflicts are mediated. The ICM process provides a means by which concerns at local, regional and national levels are discussed and future directions are negotiated [10].

3. The knowledge, skills and attitudes required by the practice

If anthropogenic change to the world's coastlines continues over the next five decades at a similar pace to the one we have seen during the 20th century, measurable progress towards sustainable development as suggested by such thinkers as Daly will continue to lie off in the future. Even if the pace of change slows, ICM will have a long path to climb from its current scattering of isolated efforts to initiatives of sufficient scope to significantly impact the well entrenched patterns of change that produce reductions in the qualities of the coastal regions. The strategy should be to adopt an overt and explicit approach based upon learning. What better place than the region's universities to set the foundations for such a sustained learning process? This approach has been termed adaptive management. It rests upon two pillars:

- democratic process, and
- reliable knowledge [11].

If the goal of ICM is progress towards sustainable development and if the practice is a form of adaptive management, then university programs designed to prepare professionals to practice ICM must teach integrated thinking and integrated analysis. This is not how the great majority of academic programs are currently structured. Most forms of integration must currently occur in the heads of the individual students and are too seldom reflected in the design of the curriculum itself. The forms of integration that need to occur in the design and practice of ICM have many dimensions:

- The integration of good science with good governance that is expressed by the strong emphasis on transparent democratic process.
- The integration of governance practices and supporting tools (permits, zoning, impact assessment, etc.) within the societal and institutional context in which they must function.

- The integration of governance at small geographic scales with regional and global endeavors with similar goals.
- Integration across scales of time so that short-term needs and immediate desires do not compromise the ability of future generations to meet their needs.
- Integration across sectors and disciplines — particularly among the natural and social sciences.

In a previous paper [12], I suggested that two concepts can help guide the structure and content of a curriculum. The first is that we should be educating coastal managers to manage ecosystems. As used here, the term "ecosystem" implies an overt, systems approach in which human societies are viewed as one element of the planet's living systems. The focus is therefore upon coherent, self-defined and self-organizing units comprising interacting ecological, economic and social components. This requires system thinking, focusing upon the interconnections among the parts and understanding the processes that govern living systems, including human economies. The second fundamental concept is that the practice is governed by a continuous process of learning rather than the application of technological and regulatory "solutions" to individual "problems."

If we are to view ICM as both an expression of ecosystem management and as a means for progressing towards the goal of sustainable development, we must recognize that the endeavor is at the initial stages of formulation and is not a "mature" field and profession.

Let us now consider what we are learning about the practice of ICM as it applies to an educational program. I will consider these learnings as they relate to the two pillars of adaptive management.

3.1. ICM as a democratic governance process

ICM requires initiating a process that is inclusive, participatory and responds to the values and concerns of the people and the place. Today the factors limiting the advance of ICM are the capacity of existing institutions to make such practices operational and the weakness of constituencies both within and without government that will actively support ICM initiatives. Yet we continue to behave as though the limiting factor was scientifically valid information. The reality is that in most instances our coastal management strategies in practice lag far behind what a prudent interpretation of existing scientific knowledge suggests we should do.

A university program needs to impart an understanding of the strategic analysis that is required to balance an agenda of action with the existing institutional capacity available. Students should learn how to best apply limited financial and human resources to complex and well-entrenched problems. Anyone with experience in the practice of ICM quickly learns that the institutions that must collaborate with one another are concerned primarily with protecting what is commonly known as their "institutional turf," and thereby protecting their power, internal culture and traditions. These narrow interests must be overcome if the initiative is to feature cross-sectoral integration and therefore interagency collaboration. The public, on the other

hand, is usually concerned with issues of equity and with the accountability of those who make decisions on how coastal resources are allocated and how conflicts are addressed. For these reasons, the growing number of documents that provide guidance to those involved in the practice of ICM place great attention on the phases by which programs evolve and the stepwise progression from small demonstration projects to more comprehensive and sustained programs that can address large geographic areas and a diversity of issues. [6,7,13,14].

If these learnings are to influence how we educate people to practice ICM as a governance process, several themes emerge as particularly important.

(1) *Leadership.* The ICM programs that are successful have strong leadership and contain the individuals who are able to articulate a vision and inspire the collaborative action required to achieve a program's objectives. The need here is not only to convey and interpret a sound technical advice but for the moral leadership that can attract and sustain the constituencies that are essential if an ICM program is to take root in a place and maintain a sustained effort extending over several decades. Leadership skills can be taught and enhanced and this needs to be a feature of an educational program.

(2) *Administrative skills* are essential to those responsible for building a complex program that typically contains a core of professionals drawn from different disciplines, collaborates with a diversity of governmental institutions, business interests, scientific organizations and the public. ICM programs must be financially sustainable as well as politically viable. This typically requires attracting, and then administrating funds from a diversity of sources. Today many of those who are leading ICM programs were educated as specialists in a technical discipline and the administrative skills they possess were learned on the job. This is inefficient.

(3) *The institutional maturation process* is familiar to those who study public and business administration. As institutions mature, they progress through a predictable sequence of stages, each of which has its own particular features and challenges. ICM programs frequently start as short-term projects and then mature into stable but more complex programs. It is important that an ICM practitioner know how to "read" the evolution of an institution and match its capacity to the demands of an advancing coastal management endeavor. The guidelines that emerged from an international workshop entitled, "Lessons Learned From Successes and Failures" [10], the report on the contributions of the sciences to ICM issued by GESAMP [10], and the *Manual for Assessing Progress in Coastal Management* [15] all provide descriptions of the steps and cycles by which ICM projects and programs evolve. Those educated to be ICM practitioners must understand, use and refine such frameworks as constructs that help practice adaptive, learning-based approaches to the coastal governance process.

(4) *Public education and public involvement in the governance process* lies at the very center of all successful ICM initiatives. In a time of accelerating change at all scales it is essential to educate the public and government on what is driving the change, what the implications of the various forms of change are, and the options for doing something about it. At its best, public education is a highly sophisticated and responsible form of social marketing. ICM practitioners have much to learn from

a more mature field such as public health, on how to design and structure programs that are successful in influencing societal behavior, and therefore, societal values. Successfully communicating the implications of coastal management issues is central to the sustained advance of a program. Another benefit of communications, when it is implemented as social marketing is that such programs are designed with explicit feedback loops between those delivering the message and those receiving it. Public education in too many ICM programs today is unidirectional and therefore violates the most fundamental principles for the practice of a governance process in a learning environment.

(5) *Negotiating skills* are essential because much of the day-to-day business of ICM is dedicated to analyzing and mediating among institutions, groups and individuals with different interests and different values. The governance process works to negotiate such conflicts and avoid inequitable allocations of coastal resources or degeneration into violent conflict — a situation not uncommon along too many of the world's coastlines.

3.2. ICM as a generator of reliable knowledge

In the early days, when coastal management was seen as the application of technical fixes to the technical problems posed by the development of shorelines, the roles for science were for the most part limited, unexciting, and routine. But when we attempt to practice ICM according to the principles of adaptive management, we need to make the leap of conceiving ICM initiatives as public policy experiments. This requires a careful analysis of the hypotheses upon which the design of a program is based and data on the expressions of ecosystem and societal change that the ICM initiative is working to influence. We must do this because we assume that we are going to learn and that we are therefore going to make mistakes. If such learning is to be efficient, and is to stand up to the rigors of objective analysis, we need to clearly state as hypotheses the fundamental ideas or theory upon which the design of projects and programs are based. This rarely occurs today. We need to educate the next generation of coastal managers to generate what Lee [11] terms "reliable knowledge" on both the etiology of major expressions of coastal ecosystem change and the conclusions that can be drawn from coastal management initiatives that have been put forward as experiments in public policy. This calls for a degree of intellectual rigor that has been largely absent from the practice of ICM thus far. One outstanding exception is the Chesapeake Bay Program.

The pillar of reliable knowledge calls for educating those who will practice ICM so that they master a body of knowledge, skills and attitudes that compliment those required by the governance process itself.

(1) *Knowledge for how ecosystems function* and how they respond to anthropogenic forces lies at the heart of successful ecosystem governance. Today, however, the fundamentals of such knowledge reside only in some of those with advanced degrees in the natural sciences. Those who have been educated to understand the governance process are usually educated in the social sciences and may be unfamiliar with even

the most basic precepts of how ecosystems function and change. Such knowledge should be a fundamental feature of an education program for all those who hope to practice ICM.

(2) *Experimental design* is a topic usually reserved for those pursuing a career as a research scientist. If ICM is to be practiced as a form of adaptive management, the fundamental features of the posing and testing of hypotheses and the gathering and analysis of data relevant to those hypotheses must be understood.

(3) *Posing appropriate research questions* lies at the root of the successful integration of ICM with science. An effective ICM practitioner must know how to select and frame the scientific questions that will inform management strategies. It is very important to differentiate between such fundamental questions as, "What are the values of coastal wetlands?" from the much more limited but potentially valuable questions that an individual ICM program can reasonably sponsor with the funds and time that are typically available to it. This is a skill that few of those currently practicing ICM possess and this continues to produce frustration and inefficiency. The report by GESAMP [10] details the specific roles and contributions of natural and social scientists in each of the five stages of an ICM cycle. The report concludes:

> There is remarkable consistency in the lessons learned about the contributions of science to ICM. They demonstrate that scientists and managers must work together as a team if scientific information generated for ICM is to be relevant and properly applied for management purposes. Since the two professions have different perspectives and imperatives and approach the solution of problems differently, the objectives and priorities for programs must be derived, tested and periodically re-evaluated by scientists and managers working together.

(4) *Acting on the precautionary principle* is an essential feature of responsible governance, particularly in times of accelerating change. Perhaps as a consequence of the world view that calls only for environmental protection, many coastal managers and those who they serve demand that actions should be taken only when there is clear "scientific proof" that something needs to be done. It is interesting to reflect that this standard is not applied to such major societal endeavors as military policy or business strategy. In these fields, vast resources are unleashed on the basis of evidence far less than a solid scientific proof. Those who will practice ICM must be educated to make important decisions before all the relevant scientists agree on all the details of a given issue. Ludwig et al. [16] after surveying the failures of many attempts to manage fisheries suggested the following principles:

"Act before scientific consensus is achieved."

"Rely on scientists to recognize problems, but not solve them."

"Confront uncertainty. Once we free ourselves from the illusion that science or technology (lavishly funded) can provide a solution to resource or conservation problems, appropriate action becomes possible."

4. Ingredients for regional educational strategies

It is not within the scope of this paper to discuss the specifics of a university curriculum that can provide the kind of education that is suggested by such a reflection on what we are learning from ICM practice. In general terms, however, it is clearly essential that the structure of the curriculum reflect what we are learning about the realities of the coastal governance process. This means that the dominant features of integration across disciplines, strategic analysis and a learning-based approach must be reflected as much as possible in each course. This suggests a heavy reliance upon case studies and simulations. It suggests that the research that is being conducted by the faculty of the program should be addressing expressions of coastal ecosystem change and the analysis of ICM experiments rather than the more specialized and narrowly defined topics that are usually favored and rewarded in many academic institutions.

Since ICM is a new field and one that is rapidly evolving, it would be appropriate for each student to undertake a practicum as an important element of a Master's degree program. Since many of the most important coastal management issues are playing out at a regional and global scale, an international perspective is very important. It would therefore be beneficial if both the faculty of a program draws on people with experience in different parts of the world and if a student's practicum is conducted in a country other than their own.

An important feature of an educational strategy and one that is recognized in the paper by Adalberto Vallega (this volume) is that an ICM program should be directed at two audiences. A coastal management initiative will typically assemble an interdisciplinary team that may include an economist, an anthropologist, a lawyer, a coastal geologist or engineer and several ecologists or biologists. A great source of current inefficiency is that each of these specialists has been educated within the confines of their own discipline. Not only do they operate in distinct languages but also their world views and their values are quite different. An educational strategy to promote ICM needs to reach out to such specialists and provide them with an introduction to the concepts of ICM, adaptive management, learning-based approaches and the potential features of sustainable forms of development. An ICM certification program specifically designed for those pursuing traditional degrees in the natural and social sciences would do much to promote the future efficiency of advances in ICM. Such "enhanced disciplinary specialists" will be as important to the future success of ICM as the professional ICM practitioners steeped in the knowledge and skills outlined in this paper.

A consequence of the youthfulness of ICM is that in most regions of the world few, if any, universities possess all the ingredients for a first rate academic program designed to prepare ICM practitioners. A network program can therefore bring many benefits. It can promote the building of capacity in a number of universities in several countries simultaneously. It can promote the sharing of experience and learning across a region which is very important when the ICM problems themselves often have region-wide expression and require a high degree of collaboration among institutions in different countries. Finally a regional approach can provide the mechanisms for the exchange

of both faculty and students, which is essential if the curriculum is to have an international expression.

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