FOCUS ON: COASTAL ECONOMICS

INTERNATIONAL NEWSLETTER OF COASTAL MANAGEMENT

Intercoast Network

Narragansett, Rhode Island, U.S.A. • #32 • Fall 1998

This is the Last FREE Issue of Intercoast

Dear *Intercoast* Readers:

In the past two years, Intercoast has expanded both its size and readership. *Intercoast* is currently sent to readers in more than 130 countries. The result has been an increase in printing and mailing costs. In turn, this has made getting *Intercoast* to our readership very expensive.

To help defer these increasing costs, beginning with the Winter 1999 issue, there will be an annual scription fee of US$10.00. The fee can be paid by check, money order or international money order ONLY. To receive the Winter 1999 issue, your payment must be cleared by December 31, 1998. *Intercoast* will not be mailed until bank clearance of payment is received.

For readers from developing countries who cannot afford the subscription fee, *Intercoast* will be provided free of charge. Please write or E-mail a request for a fee waiver to Noëlle F. Lewis, *Intercoast* Newsletter, Coastal Resources Center, University of Rhode Island, Narragansett Bay Campus, Narragansett, RI 02882 USA. FAX: 401-789-4670. E-mail: noelle@gso.uri.edu.

If you wish to receive *Intercoast* and are not requesting an exemption, please complete the form below and return it with your payment.

We greatly value our audience and would not like to lose even one reader.

Subscription Order Form

Enclosed is US$_____ for a ____ year subscription to *Intercoast*.

Salutation ____Mr. ____Mrs. ____Miss ____Ms. ____Dr.

Last Name First Name

Organization Title/Position

Address

Telephone FAX E-mail

Coastal Zone Management Good Practice Database–Links to Existing Websites

The European Union for Coastal Conservation (EUCC) is currently developing a database and website that will provide useful information to regional planners, local authorities and natural resource managers on the European coastal zone. The services will be developed in various steps. Key topics for the first stage (1999) will be:

- Good practice examples
- Codes of conduct for coastal zone management
- International policies and conventions
- Ecological assessments
- International funding opportunities

The website will provide summary information, references and training information, and more. For this, the EUCC is looking for websites describing or summarizing good practices, success and failure stories in coastal zone management (to be hyperlinked to the group's website), and experts already working in (or preparing) coastal zone management projects.

Please contact: Albert Salman at the EUCC, The Netherlands. E-mail: salman@eucc.nl.

FOCUS ON: COASTAL ECONOMICS

INTERNATIONAL NEWSLETTER OF COASTAL MANAGEMENT

Intercoast Network

Narragansett, Rhode Island, U.S.A. • #32 • Fall 1998

Economic Values of Ecological Services from a Mangrove Ecosystem

By Miguel A. Cabrera, Juan Carlos Seijo, Jorge Euan and Eduardo Pérez

With an area of 2,500 km^2, the Terminos Lagoon, Campeche, Mexico, is Mexico's most important estuarine/lagoon system. This enormous wetland has numerous ecological subsystems (e.g., estuaries, mangroves, swamps, etc.). Their use and exploitation tied to activities such as cattle raising, fishing, forestry, oil extraction and ecotourism are important economically and also affect the environment. For example, conversion of mangroves to alternative uses has decreased the habitat quality for species living there. Thus, the economic benefits generated by the economic activities in the lagoon have been achieved at a considerable ecological cost. It is important to assess these costs, since generally human activities in mangrove areas do not include in their accounting the economic value of the ecological services that could suffer from these activities.

In 1995 the CINVESTAV-IPN Unidad Merida and the EPOMEX Program of the Universidad Autonoma de Campeche, joined forces to assess the value of some uses and ecological services rendered by this mangrove ecosystem to the inhabitants of Ciudad del Carmen. The valuation techniques used and the estimated economic values are summarized below. Results are expressed in terms of the economic value of one hectare (ha) of mangrove for each one of the uses and ecological services identified.

Value as a Timber Resource

The mangroves of Terminos Lagoon are dominated by three species and cover an area of 127,000 ha: *Rhizophora mangle*, *Avicennia germinans* and *Laguncularia racemosa*. Their wood is used to produce charcoal and rustic housing. Their economic benefits were estimated through the Net Revenue Method. The basic stages and production methods in their exploitation and processing were identified. Surveys on cut rates, landing places, distribution channels, production costs and sales price were carried out to estimate total costs over a year (fixed costs, variable costs and opportunity costs of capital and handwork) and revenues (Table 1).

The results show that 86.7 percent of wood was used in charcoal production. Considering that 600 ha of mangroves are annually exploited, the economic value of one mangrove ha for charcoal production was estimated at US$451/year and for rustic housing at US$631/year. In the case of charcoal production, discounting at 8 percent (over a 30-year period), gives a present value per ha of US$5,528 and discounting at 3 percent gives a present value of US$9,291. In the case of rustic housing production, discounting at the same rates gives US$7,735 and US$12,999, respectively.

It should be mentioned that the rates of cutting and wood production have been increasing as a result of more activities that use charcoal as a fuel (chicken and meat restaurant grills). There are no controls to ensure proper harvesting methods which minimize impacts, nor are there recovery programs to ensure sustainability of the resource.

Table 1. Total costs and revenues associated with mangrove exploitation, per one hectare of mangrove.

Mangroves Use	Total Production (ton/yr)	Price (US$/ton)	Total Revenues (US$/yr)	Total Costs (US$/yr)	Net Revenues (US$/yr)
Charcoal	14,760	21.6	318,816	84,175	234,641
Rustic Housing	2,256	32.4	73,095	22,562	50,533
Total	**17,016**		**391,911**	**106,737**	**285,174**

(continued page 2)

Theme Advisor:

Thomas Grigalunas

Economic Values

(continued from page 1)

Value to the Fisheries

The Productivity Approach was used to evaluate the economic impact on the ecological services associated with changes in the surface area of mangroves. The mangrove's ecological services are defined as their support as a natural habitat and food supply to fisheries. This methodology attributes the possible changes in catches to changes in fishing effort and mangrove covering. In other words, it does not have species biomass as an input of the production function.

Species considered were those where a cause-effect relationship exists between abundance and mangrove surface (e.g., shrimp (*Penaeus setiferus*), blue crab (*Callinectes sapidus*), grunts (*Lutjanus synagris* and *Lutjanus griseus*) and oyster (*Crassostrea virginica*)). Results in Table 2 show that catches decreased when a mangrove ha was converted to an alternate use. The economic value of one mangrove ha was estimated at US$1,578/year. Discounting at 8 percent and 3 percent gives a present value per ha of US$19,350 and US$35,520, respectively.

Table 2. Effect of reduction of one ha of mangrove surface in the catch of mangrove dependent species and the corresponding values of this indirect use.

Mangrove Dependent Species	Catch (tons)	Economic Value of Catches ('000 US$)	Ecological Dependence Degree	Expected Catch Decrease (ton/ha/yr)	Indirect Use Value (US$/ha/yr)
Shrimp	1942.4	9,250.0	0.21	0.321	1529.0
Blue crab	164.4	131.0	0.11	0.014	11.2
Grunts	43.4	83.0	0.14	0.005	9.0
Oyster	120.4	134.0	0.28	0.026	29.4
Total Value		**9,598.0**			**1578.6**

Value as a Water Filtering Service

The Alternative Cost Method was used to value the ecological service of filtering residual waters. Essentially, the method uses the cost of an alternative or similar project as a reference for determining the economic value of that ecological service. The cost of cleaning residual waters carried out by a tertiary treatment plant was considered as the alternative.

Surveys were conducted in Ciudad del Carmen in order to estimate the total volume of residual waters that are directly discharged on mangrove areas by houses with no sanitary services. As a result of the survey, the volume of residual waters discharged in the mangrove areas was estimated to be 10,208 m^3/year. In Campeche State the savings for this service was US$190,973/year. The annual value of this ecological service for one ha of mangrove was obtained by dividing the total annual cost by the mangrove area receiving residual waters (160 ha). Therefore, the economic value of this filtering mangrove service was about US$1,193/year. Discounting at 8 percent and 3 percent in the same time horizon gives a present value per ha of US$14,631 and US$24,589, respectively.

Value as a Critical Habitat for Threatened Species

The mangrove ecosystem as a critical habitat was evaluated by assessing the willingness of Ciudad del Carmen inhabitants to pay for maintenance, i.e., to pay a fee to support conservation and monitoring activities of this ecosystem.

The methodology used was Contingent Valuation. It was based on survey information collected from 16 colonies of Ciudad del Carmen. A total of 262 individuals (96 percent) responded to the questionnaire. Respondents' ages were between 14 and 84 years old, an average age of 35 years. The survey showed that those who would pay (48 percent) and the dollar amount they were willing to pay (US$14/year) were greater in those with higher incomes. Thirty-three percent of the individuals in the medium income level were willing to pay US$6/year, and 22 percent of the respondents in the lower income level were willing to pay US$4.60/year. Independent of their willingness to pay, 10 percent of the respondents were willing to use part of their free time in activities related to mangrove conservation: cleaning, surveillance and environmental education.

These results, when extrapolated to all houses at Ciudad del Carmen, estimated the value of the mangroves at US$128,873. Keeping in mind that the total mangrove area of Terminos Lagoon is 127,000 ha, the economic value of one ha of mangrove as a critical habitat was US$1.02/year.

Other goods and services, which could be classified as subsistence, rarely are considered in studies of mangrove valuation. They will be incorporated as we better understand this particular mangrove ecosystem.

For further information contact: Miguel A. Cabrera. Fisheries Bioeconomics and Modelling Laboratory. CINVESTAV-IPN Unidad Mérida. A.P. 73 Cordemex. C.P. 97310. Mérida, Yucatán, México. FAX: 99-812917. E-mail: mcabrera@kin.cieamer.conacyt.mx.

Environmental Economics in Estuary Management: The Peconic Estuary Program

By James J. Opaluch, Thomas A. Grigalunas, Jerry Diamantides and Marisa Mazzotta

Coastal environments provide many amenities that make them popular places to live, work and play. Yet, development can lead to degradation of the very same natural assets that initially attracted people to coastal areas. Members of the University of Rhode Island's department of environmental and natural resource economics are helping estuary managers assess management options, as part of an integrated coastal area planning effort for the Peconic Estuary, New York, USA.

Located on the east end of Long Island, New York, the Peconic estuary system comprises more than 100,000 acres, with over 100 distinct bays, harbors, rivers and tributaries. Most have good to excellent water quality. The Peconic estuary system provides the public with many important benefits. However, rapid development of the surrounding area threatens water quality and other important amenities.

The Peconic Estuary Program, created as part of the National Estuary Program, is an alliance of federal, state and local interests working to develop a Comprehensive Conservation and Management Plan (CCMP) to restore, protect and maintain the natural resources in the Peconic estuary system. Because a limited budget does not allow all environmental problems to be addressed, priorities must be established that are based, at least in part, upon obtaining greatest public benefit for a given budget. The project will help managers develop the CCMP by assessing public values for resources of the estuary.

Project Description

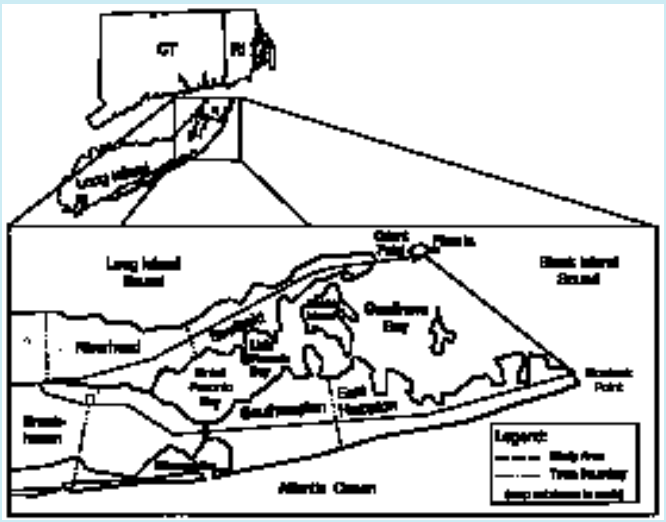
The project has three phases. Phase I considers estuarine-dependent economic sectors and their impacts on the local economy. Phase II focuses largely on non-market values of natural amenities. Phase III will use the information developed in Phases I and II to analyze and prioritize policy options for the CCMP.

Phase I: Phase I was designed to identify estuarine-dependent economic sectors and their impacts on the local economy. Using very conservative (low) estimates, we found that the 29 estuarine-dependent sectors include over 1,010 establishments, employ more than 7,000 people, pay wages in excess of US$117 million and have total revenues of over US$400 million. Overall, estuarine-dependent economic activity conservatively accounts for a minimum of 20 percent of the local economy. As a group, tourism and recreation establishments dominate estuarine-dependent activity and comprise over 80 percent of the identified estuarine-dependent economic activity.

Phase II: Phase II focuses largely on non-market values of natural amenities and recreational services provided by those amenities. Phase II is comprised of a recreation study, a resource valuation analysis, a property value study and a wetlands productivity analysis.

The recreational study is based on a survey asking respondents about their recreational activities on the east end of Long Island, the area surrounding the estuary. An estimated total of 8.4 million recreation days occur each year on the east end. Swimming constitutes the single largest activity, with an estimated 2.4 million recreation days, closely followed by bird/wildlife viewing (2.3 million recreation days).

Depiction of the Peconic esutary system



Monetary values (consumer's surplus) for key recreational uses were estimated. Preliminary estimates of value per person per day are about US$9 per day for swimming, US$19 per day for boating and US$40 per day for fishing. These numbers imply total values of US$12.1 million for swimming, US$18.0 million for boating and US$23.4 million for fishing.

Also estimated was how recreational values are affected by environmental quality. This information can be used to estimate the values to recreational users from policies that influence these attributes. Thus, given estimates of changes in water quality due to a policy initiative, e.g., upgrading a sewage treatment plant, one can estimate the resultant increase in value of recreational activities. For example, the results imply that US$1.3 million in annual benefits to recreational swim-

(continued page 4)

Peconic Estuary

(continued from page 3)

ming result from a 10 percent improvement throughout the estuary in all water quality parameters considered (nitrogen concentrations, coliform counts, brown tide cell counts and water clarity).

The resource survey identified public priorities for preserving or enhancing local natural resources (farm land, open space, salt marsh, eel grass and unpolluted shellfish areas). The results can also be used to estimate monetary values of these amenities, but it is believed that the relative amenity values are more reliable measures of public values. Relative values can be used, for example, to determine the best set of restoration or enhancement actions to implement with a fixed budget.

The estimates from the resource survey indicate public values for general levels of amenities provided for the Peconic area as a whole. However, people living immediately adjacent to these amenities may be affected in different ways. For example, it was found that the public places high values on farmland as an amenity. However, living immediately adjacent to a farm was found to be undesirable, perhaps due to odors from fertilizers or threats of contaminating wells by agricultural chemicals. In contrast, parks or conservation areas provide open space amenities to the region as a whole, and also provide additional benefit to those living in the immediate vicinity.

A property value model was used to quantify benefits to residents living in the immediate vicinity of amenities. The property value model is a statistical approach that relates property attributes to selling prices, not unlike real estate appraisals. The idea is that the premium paid for houses in the immediate vicinity of an amenity indicates a willingness to pay to live near the amenity, and is a measure of benefits received by those living nearby.

Thus, it can be identified how having an amenity nearby affects housing prices by estimating how different attributes affect the sales price of a property. Our estimate considers attributes of the property, like square footage of the house, square footage of the yard, number of bedrooms, number of bathrooms and the age of the house. Also considered were neighborhood characteristics, like zoning and distance to schools. Finally, to capture the effects of amenities, characteristics such as whether there is parkland or farmland in the immediate vicinity of a property were assessed.

It was found that having adjacent parkland adds to the value of a house, while adjacent farmland detracts from the value of residential houses. Thus, the amenity value of parkland needs to consider both the general value to the Peconic region as a whole, as estimated in the resource analysis discussed above, plus the amenity value to those who live in the immediate vicinity, estimated in the property value study. The amenity value of farmland needs to consider the value as a general amenity to the Peconic region as a whole, minus the impact to those living in the immediate vicinity.

Finally, a wetlands productivity study was carried out. This study views wetlands as assets that produce various outputs that are valued by society. For example, wetlands serve as habitat that contributes to fish, birds and other biota that are directly or indirectly valued by society.

Wetlands productivity was valued at US$600 per acre for mud flats, US$3,300 per acre for salt marsh and US$9,800 per acre for eelgrass. Note that this represents only one component of services provided by wetlands. For example, these estimates don't consider services like storm protection, nutrient filtering, visual amenities, 'non-use' values or other possible values.

Phase III: The primary goal of Phase III is to use the estimates of uses and values developed in Phases I and II to analyze policies for the CCMP. This assessment involves several steps, including:

1. Identifying a set of resource preservation and restoration actions.
2. Determining the costs of these programs.
3. Using the results from Phases I and II to identify benefits of the programs.
4. Identifying and evaluating a set of alternative means for financing actions.

Financing is an especially challenging task, as the public increasingly rejects the notion of raising taxes as a quick fix to fund programs. More creative means of financing management actions must be developed through means such as charging those who create problems, using the 'polluter pays principle,' or charging those who benefit from a policy action through user fees.

Conclusions

In an era of tight budgets, expenditures of public funds for research and management are under increased scrutiny. Thus, agencies must demonstrate that expenditures of public funds achieve goals that benefit the public. This project represents a major effort to integrate public values with research in the natural sciences to help assess policy options for coastal area management. A hallmark of this work is the close collaboration of environment economists with scientists, resource managers and citizen groups. Collaborative effort among researchers of various disciplines, resource managers and members of the public is essential in addressing important and difficult issues in coastal management.

For further information contact: James J. Opaluch, Environmental & Resource Economics, Lippitt Hall, University of Rhode Island, Kingston, Rhode Island, 02881 USA. Tel: 401-874-4590.
FAX: 401-782-4766.
E-mail: jimo@uriacc.uri.edu.
Website:
http://www.uri.edu/cels/enre/.

Predicting the Effects of Habitat Change on Marine Populations

By Kenneth R. Hinga

Human societies change marine environments. Many changes are unplanned consequences of other actions and are viewed as detrimental; others result from deliberate actions taken to make a particular area more suitable or useful to a group of people.

Whether considering a single project that will alter the marine environment, or developing an overall multifaceted plan for a marine area, it is important to consider the changes that will result from the proposed actions. However, it is often impractical in the planning phase to undertake detailed biological studies and exercises of predictive ecological models for each of potentially numerous options that may occur. It would be helpful to have a few guiding principles to quickly estimate the biological consequences, especially in the early phases of planning.

The purpose of this article is to list a few principles that can be used to estimate biological impacts when extensive ecological studies are not practical.

Three general types of changes to marine environments are considered here:

- Alteration of the physical properties of habitat (such as the introduction of hard substances or changes in water properties).
- Loss of the total amount of habitat (such as through filling of wetlands).
- Fragmentation of habitat (barriers dividing marine ecosystems into smaller contiguous parcels of like habitat).

General principles, posed as theorems, are given to describe the general response of marine ecosystems. One theorem is given for each of the alterations listed above. These theorems should be regarded as working hypotheses as there is still much to learn about the responses of marine ecosystems to change. These theorems will be verified, altered or perhaps rejected as understanding of the marine environment increases.

Theorem 1. An alteration of the environment will result in a change in the biological community.

A basic tenet of ecology is that each species is adapted to a particular niche. Every environment provides a number of niches that may be inhabited by corresponding species. If an environment is altered such that different niches are available, the species inhabiting that environment will change in response. The time it will take the assemblage of species to change depends upon the rate of introduction and establishment of new species.

Of course, minor changes to an environment may not result in a readily observable change in the community structure. Many marine populations have a very variable abundance in both space and time. This property often makes it hard to observe changes in the community brought about by alterations to the environment. (Community is used here to mean simply an assemblage of species and not with a more restrictive meaning that implies interconnectedness or interdependence between populations.)

Theorem 1 puts a different perspective on physical alteration than is commonly taken. It is often assumed that a section of the marine environment, say a portion of an estuary, which has been altered is under stress. The original community that inhabited the estuary may be under stress when the conditions in the estuary were first altered. However, if a new community of organisms is established, which are adapted to the new conditions, then the new community is not under stress, it is just a different community.

A consequence of the theorem is that one cannot safely state that any anthropogenic alteration is undesirable. Indeed, the concept put forward by this theorem is the foundation for actions where an environment is deliberately altered to accomplish a desired change. Desired changes include restoration actions to return an environment to what it once was (or at least perceived to have been), and actions taken to create an environment with a more desirable assemblage of species. An example of the non-restorative alteration is the introduction of hard substrates and three-dimensional structure, e.g., artificial reefs, to a soft-bottomed environment to create a desired community. The hard substrates and the new structure provide new niches.

Theorem 2. The sustainable size of a population is directly proportional to the amount of habitat available.

Expressed differently, if half a population's habitat is lost, the steady state population size will be reduced by half. This is also assumed to be true where the adult population size is limited by breeding or nursery area. A reduction in the amount of a breeding or nursery area could reduce the standing stock of the adult population in a different area. A problem in the ready application of this theorem is often a lack of knowledge as to whether the size of a population is limited by the amount of breeding, nursery or adult areas.

Given the complex and varied life histories of marine populations, and the general problems in accurately establishing population sizes, testing and validation of this theorem will not be easy. Still, the theorem seems a reasonable working assumption to make when

(continued page 6)

Habitat Change

(continued from page 5)

faced with establishing the consequences of filling wetlands or undertaking similar actions.

Theorem 3. Habitat fragmentation is not usually a problem for marine species.

To state the theorem as a practical example, a one-hectare mud flat is pretty much the same as a 10-hectare mud flat, when viewed on a per-square-meter basis. Certainly, this would seem so from a clam's point of view.

This theorem does not imply that structures dividing marine habitats will not cause changes to the communities. It is hard to imagine that a structure dividing a marine environment could be built which would not affect the physical properties of the habitat. However, it is the change in physical properties, addressed in Theorem 1, which is responsible for the alteration, not the change in contiguous habitat size.

A corollary accompanies this theorem:

Corollary 3.1 The need for transportation corridors is unlikely to be important in the marine environment.

If one has followed the trends in habitat protection and conservation biology for terrestrial ecosystems, this theorem and corollary seem at odds with current thinking. However, marine ecosystems have properties that make them fundamentally different from terrestrial ecosystems. Marine ecology textbooks invariably point out major differences including:

- The marine environment is a three-dimensional fluid environment with inhabitants in the fluid itself. (Few terrestrial organisms actually live in the air and, high-soaring birds excepted, the third dimension in terrestrial environment is only as high as the vegetated canopy.)
- Marine environments often have a heavy reliance on planktonic primary production (i.e., phytoplankton vs. trees).
- Dispersal of planktonic larvae is a means of reproduction and dispersal for most benthic marine animals (few land animals disperse by wind-driven transport).

With such fundamental differences, perhaps it is reasonable to expect guiding principles to be different for marine and terrestrial environments.

The corollary dismissing the need for transportation corridors in the marine environment is a consequence of the typically high dispersal capacity of most marine species. Plankton and nekton species are either passively dispersed by water movements or are able to swim to suitable habitats. Even among the bottom-dwelling sessile (attached) species about 80 percent have pelagic larvae which are readily dispersed by water movements. Dispersion while in the planktonic form will provide opportunities for larvae to be introduced to new areas.

Locally important exceptions to the corollary might be found among sessile or slow-moving benthic organisms that do not have planktonic larvae. Examples of these include some gastropod mollusks (snails and whelks) which lay a small number of eggs firmly attached to hard substrate. One may expect these slow moving and non-larval-dispersing organisms to be ineffective, or at least very slow to surmount significant artificial barriers.

It is important that this theorem only be applied to truly marine species. Marine species are defined here as those with gills, and marine plankton too small to need gills. Marine-related, air-breathing species are not covered by this theorem and probably can be viewed as terrestrial species. Marine and brackish environments with emergent vegetation, such as salt marshes and mangroves may be thought of as a transition between marine and terrestrial environments and may be expected to incorporate properties of both.

Conclusion

This short set of theorems, or working hypotheses, should provide some simple guidance to the types of impacts that may be expected when actions are proposed which will alter marine environments. The theorems are no substitute for a detailed examination of local species present, and their population dynamics. However, in the planning stages of a project it is often useful to have a glimpse of the nature of the impacts that may be expected.

(A discussion of other changes not considered here, especially the effects of additions of chemicals or other substances to marine environments, can be found in Hinga, K.R. (1995) "Predicting the effects of changes to the marine environment: the effects of multiple changes." Appendix C in: B. Vestal et al., *Methodologies and Mechanisms for Management of Cumulative Coastal Environmental Impacts.* Part 1–Synthesis, with Annotated Bibliography, NOAA Coastal Ocean Program Decision Analysis Series No. 6. Silver Spring, MD, USA, upon which this article was based.)

For further information contact: Kenneth R. Hinga, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI 02882 USA. Tel: 401-874-6888. FAX: 401-874-6889.
E-mail: khinga@gso.uri.edu.

Use and Value of Coastal Wetlands in Korea

By Heung-Dong Lee

Korea is a relatively small, densely populated country, with a very important marine sector. The value of coastal land is very high, creating substantial economic pressures to fill in intertidal and nearshore areas. Filling of these lands has long been a controversial coastal management issue in Korea. These pressures are greatest along the west coast where landfilling is relatively inexpensive. At the same time, there is an increasing awareness of the value of the productive natural services provided by coastal wetlands. These services include habitat for fish, shellfish and marine birds; waste assimilation; and natural environments of aesthetic appeal. A major issue hindering sound coastal management decisions has been the lack of information about the economic value of the natural services of coastal areas. Due to the lack of such information, landfilling and development pressures have dominated until recently.

Recognizing these concerns, the Korea Maritime Institute (KMI) was asked to assess the economic value of wetlands services. The work focused on identification of services provided by wetlands and quantification of their economic value. This article provides a brief background on the issue, outlines the services considered, and methodologies employed, and presents results and their implications.

Korean tidal wetlands totalled 240,000 hectare (ha) in 1998, with 83 percent of Korea's tidal wetlands located along the west coast. Kyunggi Province, including Inchon City (located near Seoul), has 84,000 ha, or 35 percent of the total wetland area. Wetlands in this area of Kyunggi Province alone have been reduced by 40,000 ha over the last 10 years.

Landfilling has occurred for many years and has increased in scale. Some 1,795 coastal sites with an area of about 969 km^2 have been converted, starting from the colonial period of Japan, up to 1998. Up until the end of the 1960s, the average size of filled sites was fairly small (15 ha), but during the 1970s increased to 83 ha. Large-scale landfilling along the west coast started in the 1990s, with the average area filled being 1,230 ha.

A recent economic evaluation of coastal wetlands in Korea describes the rapid evolution of the national program for Korean coastal wetland utilization. It also analyzes the functions provided by Korean wetlands and their value, using methods for valuing market and non-market services. Four functional values of domestic wetlands were assessed in the pilot areas (Hongbo, Kunchang, Daebu and Yongchong):

- Fishery production–Market price is used to value the fishery products harvested in tidal wetlands. These products include fish, shellfish and sea plants produced by aquaculture.
- Habitat–The habitat function for the commercial fishery was estimated (spawning and grow out) in the tidal wetlands. The evaluation uses the market price of commercial fish catch.
- Waste assimilation–This evaluation uses the replacement cost (cost to build and operate) based on the treatment of biological oxygen demand (BOD) of the waste treatment facilities.
- Aesthetics–This estimate is based on benefit-transfer of the result of a willingness to pay survey for recreational activities in Louisiana and Florida, USA.

Other potential economic values, such as passive use value and others, were not considered due to lack of time and resources, but may be included later.

Productivity value of coastal wetlands in Korea

Region	Size (ha)	Value (US$1,000)	Productivity (US$1,000/ha)
Fishery production(a)			
Hongbo	781	8156.1	10.4
Kunchang	40	384.2	9.6
Daebu-do	286	2,397.2	8.4
Yongchong-do	310	3,284.3	10.6
Total	**1,418**	**14,222.2**	**10.0 (aver.)**
Habitat function(b)			
Hongbo	1,644	11,354.4	6.9
Yongchong-do	1,224	10,601.1	8.6
Total	**2,872**	**21,955.5**	**7.6 (aver)**
Waste treatment (c)			
Waste Facility			**4.2**
Aesthetic function (d)			**0.2**
Total value of wetlands (a+b+c+d)			**US$22,000/ha**

For the fisheries productivity and habitat functions, gross values, not net values, were calculated, and the estimation is an annual value, not a discounted value.

Fisheries production and habitat. The value of fisheries production is estimated according to the licensed fishery rights in the four areas. Average production value in these areas is US$10,000 annually per ha.

The functional value of fish habitat is evaluated for the large-size wetlands in areas like Hongbo and Yongchong area; these average US$7,600 annually per ha.

(continued page 8)

Korean Wetlands

(continued from page 7)

Waste assimilation. The value of waste assimilation in tidal wetlands is assessed using the replacement cost method, i.e., the cost of constructing and operating facilities for waste treatment. This cost implies an average assimilation value of tidal wetlands of US$4,200 annually per ha.

Aesthetic value. This value is based on 'benefit transfer' and uses the results from the United States which show a value of US$200 annually for recreational usage in tidal wetlands. Current recreational usage of Korean wetlands is not high; however, the aesthetic value of wetlands would be increased with ecotourism and seabird watching in the tidal wetlands (the value may be viewed as akin to an 'option price'). A value of US$200 per ha does not seem unreasonable.

The total economic value of sustainable use by preserving tidal wetlands is estimated to be US$22,000 annually per ha (see table). This estimate reflects the fact that Korean tidal wetlands are used intensively for production of fishery products. Further, the fishery values are gross values, i.e., costs of production or harvesting have not been considered.

As noted at the outset, landfilling in Korea to date has been based on market pressures for development. Resource policy has focused on reclamation for industrialization, urbanization and self-sufficiency of food production. There has been a lack of full appreciation of the value of natural services wetlands provide. Economic analysis as described in this article can contribute to establishing protection goals and the design of institutional reforms to improve the management of coastal areas. Assessing the economic value of wetlands, however, clearly is difficult and many refinements and additional research are needed. By improving and extending assessments of the value of wetland services, coastal resource managers can base decisions on more accurate evaluation of the resource services wetlands provide. With this information, these scarce resources could be managed, taking into account both market and non-market values.

The relatively high estimated values for coastal wetlands reported here suggest that policies that have exclusively pursued economic growth may require modification, if the value of natural services is taken into account. Now, the focus can be expanded to encompass environmental policy. Viewed this way, wetland policy might shift from regarding wetlands as private assets to considering wetlands as valuable regional and national assets in need of protection.

In conclusion, economic evaluation of tidal wetlands has an important role in contributing to well-informed policy decisions. Still, much uncertainty remains concerning wetland services and their value. More research is needed to expand and refine estimates to contribute to decisions about whether to preserve the wetlands for the benefit of present and future generations or use them for their benefits from development.

For further information contact: Heung-Dong Lee, Marine Environment & Safety, 154-10, Samsung-dong, Kangnam-ku, Seoul, 135-090, Korea. Tel: 82-2-553-1530. FAX: 82-2-565-7097. E-mail: hdlee@suji.kmi.re.kr.

The Value of Open Space in a U. S. Coastal Community

By Robert J. Johnston

Coastal resources provide a wide array of goods and services that are highly valued by residents and tourists, yet are not generally traded in organized markets. These goods and services include scenic views, unpolluted surface and ground water, public access to the coast, outdoor recreation opportunities and natural resources used for subsistence by local residents. Due to the lack of a measurable market value for these services, their economic importance is often overlooked. However, the non-market value of services provided by coastal resources is no less important than traditional economic value measured through market activity. In many cases, non-marketed resource services substitute for goods and services that would otherwise be purchased, or augment the value of marketed goods, leading to a higher quality of life for local residents and visitors. Non-market values reflect this measurable increase in quality of life.

Given the importance of non-market goods and services, economists have developed a variety of methods to measure non-market values. These methods allow coastal managers to account for the value of non-marketed resources when considering policy options, and to include non-market values in benefit-cost analysis. One of the most common of these methods is the property value, or 'hedonic' method. This method takes advantage of the relationship between non-marketed services of open space, water quality, or other coastal resources, and the measurable market value of local homes. For example, protected open

space (a valued resource in many coastal environments) provides a wide variety of services including scenic views; outdoor recreation; insulation from noise and other aspects of the urban landscape; and protection from erosion, flooding and other physical hazards. These services are valued by homeowners, making communities with a large quantity and/or quality of open space more attractive than similar communities without such amenities. As a result, home buyers are willing to pay more for local housing, reflecting the values of the services (and increased quality of life) provided by open space. The property value method uses economic statistical tools to estimate the positive impact of environmental amenities (such as open space) on the actual value of local property, thereby estimating the non-market value of these amenities to local residents. Past analyses of this type have demonstrated significant economic values associated with a wide range of coastal resources, including open space, undeveloped beaches and unpolluted air and water.

An economic study completed in the coastal community of Middletown, Rhode Island (United States) illustrates the use of the property value method. The community of Middletown is located on Aquidneck Island, the largest island in Rhode Island's Narragansett Bay. The town has a current population of approximately 19,184, distributed over 33.6 square kilometers. Between 1980 and 1990, the town's population increased 13 percent, while the number of housing units increased by 9.6 percent. Since 1990, the town's population has remained relatively stable. However, construction of new houses has continued, with 456 new housing units authorized since 1990, representing an additional increase of 6.4 percent. The rapid rate of housing growth has led to significant losses in the natural amenities associated with farms, forestland and undeveloped open space.

To illustrate the value of open space protection in this rapidly growing coastal community, researchers at the University of Rhode Island, in cooperation with the Aquidneck Island Partnership, conducted a property value analysis using data from the Aquidneck Island Geographic Information System. Results of this analysis illustrate the positive impact of protected open space on Middletown property values, and the substantial value of non-market services provided by open space (see table). For example, Middletown properties located within 400 meters of a 50-acre tract of open space are expected to have per-acre values at least 12 percent higher than similar property without nearby open space. Properties located within 400 meters of a 10-acre tract of open space are expected to have per-acre values at least 3 percent higher than similar property without nearby open space. These results illustrate that large areas of protected open space lead to increased property values in Middletown, and that larger impacts are associated with larger tracts of open space. This increase reflects the increased quality of life gained by residents who live in close proximity to open space and represents a legitimate economic value of this coastal resource. In the policy arena, the results of the Middletown property value analysis have illustrated the economic importance of open space to local residents and officials and have contributed to a major initiative to sustain valued open space land uses on Aquidneck Island.

Non-market valuation research, such as the property value analysis, allows coastal managers to consider the economic values of wide classes of coastal resources, even if those values are not reflected in traditional markets. Such information can help managers recognize the full range of benefits provided by coastal resources and make more informed policy decisions. Although coastal managers must consider a wide range of factors when developing policy, non-market research can ensure that the full economic importance of non-marketed coastal resources is not overlooked.

Property value increases associated with open space

	Impact on Average Property Value		
	Average land value within 400 meters	**Average land value within 800 meters**	**Average land value within 1,200 meters**
Baseline Scenario: Minimal open space and no open space tracts >1 acre	No Increase in Property Value	No Increase in Property Value	No Increase in Property Value
Ten Acre Scenario: Open space characterized by one, ten acre tract	3 percent Increase in Property Value	1 percent Increase in Property Value	<1 percent Increase in Property Value
Fifty Acre Scenario: Open space characterized by one, fifty acre tract	>12 percent Increase in Property Value	10 percent Increase in Property Value	1 percent Increase in Property Value

For further information contact: Robert J. Johnston, Department of Environmental and Natural Resource Economics, Lippitt Hall, University of Rhode Island, Kingston, RI 02881 USA. E-mail: johnston@uriacc.uri.edu.

Managing a Coastal Freshwater Marsh as Sea-Level Rises: What is the Preferred Option?

By Richard Klein and Ian Bateman

The shoreline management plan (SMP) for the coast of North Norfolk, England identifies managed retreat as the preferred option for the Cley Marshes Nature Reserve. The Cley Reserve–one of the oldest nature reserves in Britain–is a reclaimed salt-marsh in which a unique freshwater habitat has developed, fed by springs and diverted river water and protected from the sea by a semi-natural shingle ridge. It covers some 1.8 km^2 and is an internationally renowned birding site, where 357 bird species have been recorded.

Flooding Vulnerability and Managed Retreat

Over the past few years, it has become clear that current protection levels of the reserve are insufficient. In February 1996, a combination of high tides and strong northerly gales caused the shingle ridge to breach. The reserve was inundated by seawater for a period of about 10 days. The inundation caused substantial damage to the reserve and its unique freshwater habitat. The combination of salt penetration in the soil and subsequent lack of rain prevented most of the vegetation from fully developing during the following spring. Norfolk Wildlife Trust (NWT), which owns and manages the reserve, felt that if the present situation were to deteriorate, the number and diversity of birds would decline, thus reducing the recreation value of the site.

The SMP argues that continued re-profiling of the shingle ridge is not a viable option as it increases its susceptibility to erosion and breaching. The SMP concludes that in the medium and long term a managed retreat is most preferable for the Cley Reserve. This conclusion corresponds with the overall philosophy of the Ministry of Agriculture, Fisheries and Food (MAFF), which recognizes that rigid protection of the coastline often prevents the occurence of natural coastal processes.

MAFF has presented a managed retreat as an environmentally sound and economically efficient alternative to hard-engineering methods. Managed retreat aims to enable the shore to develop under a more natural regime and attempts to maximize the use of natural processes for coastal defence rather than oppose natural forces. For this reason, nature conservation organizations have generally been supportive of managed retreat.

In essence, there are three arguments for managed retreat as a favorable option for lesser developed coastlines:

- **Economic efficiency**. The costs of maintaining flood-defense structures may not be justified by the benefits that are accrued from the land that is protected.
- **Nature restoration and development**. Managed retreat allows natural processes to dominate, which could enhance natural values.
- **Resilience to stress and shock.** In view of its capacity to absorb wave energy, a natural coastline is considered less vulnerable to extreme events such as storm surges and to anticipated sea-level rise.

Arguments Against Managed Retreat in Cley

Managed retreat is considered particularly desirable when low-lying agricultural land can be converted into salt marshes. However, the prime function of the Cley Reserve is not agriculture, although parts are used for grazing cattle. The reserve is first and foremost a bird sanctuary, and thus represents an important value. The SMP has not considered this value, other than acknowledging its existence, and therefore it is premature to assume that managed retreat at the Cley Reserve will be economically efficient.

The second argument for managed retreat–the potential to enhance natural values–can also be questioned in the case of the Cley Reserve. In its present form, the reserve is considered to posses great natural values, which is confirmed by a range of national and international designations (e.g., Ramsar Site and EU Habitats Directive, among others). Considering that the seawater flood of February 1996 was widely perceived as detrimental, one can question if it would be possible at all to enhance natural values in the reserve by means of managed retreat. Moreover, freshwater marshes are rare along the North Norfolk coast, while salt marshes are more common.

The Cley Reserve Visitor Survey

In their guidelines for the SMP, the MAFF recommends that a cost-benefit analysis (CBA) be used to identify the preferred management option for any given coastal location. In addition, they recommend that a CBA include those costs and benefits that cannot be readily expressed in monetary terms. Given the significance of the Cley Reserve to birdwatchers, it is assumed that the direct-use value of recreation will be particularly important in this respect.

The two environmental valuation methods that are highly applicable to valuing recreation are the contingent valuation (CV) and travel-cost (TC) methods. Both techniques are based on human preferences, as these should reflect the value that people attach to non-marketed goods. However, the CV and TC approaches differ with respect to the type of preferences they analyze.

The CV method relies on individuals' expressed preferences, by means of survey questionnaires. Typically, such surveys ask respondents questions

regarding their willingness to pay (WTP) for some provision of the good under investigation. In the Cley Reserve Visitor Survey, on-site, face-to-face interviews were conducted with visitors to the reserve, who were asked about their WTP both as a (higher) entrance fee and as increased taxes to preserve the site in its present, unflooded state.

By contrast, the TC method relies upon those preferences that are revealed by visitors' actions, rather than by their statements. The method examines the travel costs (both in terms of their associated expenditures and the amount of time devoted to travelling) incurred by visitors, using these to estimate the demand curve for visits to the site. The demand curve, or trip-generation function, maps out the relationship between travel costs and the frequency of visits. The area under this curve then gives a measure of the recreation value of the site under investigation.

As stated, both the CV and TC methods require information on visitors behaviour and preferences. Accordingly, a questionnaire was developed from which all necessary data could be obtained.

Results

Of the total sample of 160 visitors, 113 were willing to pay some (or higher, as appropriate) entrance fee, while 121 were willing to pay at least some extra taxes.

The uniqueness of the Cley Reserve is illustrated by the fact that one respondent was willing to pay £2,000 (£1 approximates US$1.65) of extra taxes per year to preserve the reserve in its current state, while another stated that he had visited the reserve 500 times in the past year. Again another respondent had twice travelled 710 km for a day trip to the reserve.

The table summarizes the annual, aggregate recreation-value estimates derived from the various valuation analyses. It should be clear that there is no single true measure of the reserve's annual recreation value. First, the value depends on the assumed number of visits per year. Estimates are between 25,000 and 100,000, and recreation values have been calculated using both estimates. Second, different valuation methods have been applied, which cannot be expected to yield exactly the same results. Third, the results depend on fundamental assumptions and methodological decisions made prior to the analysis. For example, the inclusion of zero-WTP responses in the analysis is an as-yet unresolved methodological issue. Zero-bids are sometimes excluded on the basis that such visitors may be deliberately understating their WTP in order to free-ride; that is, avoid paying for a good that they clearly value. The table reports both the whole-sample means and the means excluding zero-bids.

Aggregated annual valuation results, based upon mean estimated values per household per annum.

(Figures in brackets represent 95 percent confidence limits.)

Valuation measure	25,000 visits/year	100,000 visits/year
WTP fee (incl. zero-bids)	£39,500 (32,910-46,085)	£158,000 (131,640-184,340)
WTP fee (excl. zero-bids)	£55,500 (48,135-63,018)	£222,000 (192,540-252,070)
WTP tax (incl. zero-bids)	£119,956 (43,573-196,338)	£479,821 (174,290-785,351)
WTP tax (excl. zero-bids)	£154,659 (56,788-252,549)	£618,635 (227,153-1,010,197)
Travel-cost measure	£113,403 (98,783-133,101)	£453,612 (395,130-532,436)

Further, open-ended surveys have often been observed to yield lower estimates than those suggesting a WTP to the respondent. This is not to say that one of the two approaches is flawed, but that various economic and psychological factors are involved that influence the outcome. As the Cley Reserve survey used an open-ended format, the CV results could best be considered as the lower bound of an envelope of uncertainty.

The TC results can be considered to be conservative, too. First, no monetary value has been attributed to the time visitors spent travelling to the reserve. Second, four visiting groups from overseas countries could not be considered in the analysis, as insufficient information was provided to assess their travel costs. Third and most importantly, the large value attached to the reserve by local residents who have moved house in order to live in the vicinity of the reserve is not reflected in their travel costs.

Conclusions

In spite of the caveats outlined above, this relatively inexpensive and modest survey has yielded some important and useful information. Important conclusions from this survey are:

1. Reasonable yet conservative estimates of the Cley Reserve's annual recreation value are on the order of £40,000-£120,000, assuming 25,000 visits per year, and £150,000-£480,000, assuming 100,000 visits. In addition to these estimates being conservative, it should also be noted that recreation value is only one component of the total economic value of the reserve.
2. The obtained values are considerably higher than the present annual maintenance costs of the shingle ridge that protects the reserve and adjacent land and property, which are normally £20,000-£30,000. Thus, if the above results would be used in a CBA, as recommended by MAFF, it would

(continued page 27)

Tourism, Pollution and the Marine Environment in Malaysia and the Mediterranean

By Richard Tapper

Coastal tourism is one of Malaysia's top income earners. With the popularity of scuba diving and snorkeling increasing in Malaysia, its coastal environments are under increasing pressure from inappropriately planned tourism.

On the eastern coast of Malaysia, the islands of Pulau Tioman, Pulau Tinggi (a marine park) and Pulau Redang are being developed for tourism. Sediments from the construction of resorts and related infrastructure, poor sewage and waste disposal, and pollution from nutrients, fuel and chemical runoff are causing significant problems. These will grow as development outstrips service and management capacity to address these issues. The widespread use of fertilizers to manage hotel grounds and recreational areas, the boom in coastal hotels with golf courses, and phosphate-containing detergents used in hotel laundries all contribute to eutrophication. Water quality is affected and high bacterial counts in some areas are a health risk to swimmers. As a result, the tourism industry, fisheries, mangroves and corals all suffer.

In the Mediterranean, tourism is also a major source of pollution, adding to burdens from other sources. The resulting cocktail of pollutants damages wetlands, fisheries and coastal ecosystems; poses a threat to human health; and reduces the tourism experience. Algal blooms occur in the Mediterranean in some tourist areas. These blooms are a highly visible and economically damaging consequence of pollution.

The United Nations Environmental Programme's (UNEP) Blue Plan for the Mediterranean highlights tourism development along 2,000 km of coast as a major factor in destruction of dune systems. Tourism development has contributed to near extinction of the monk seal and the sea turtle in the Mediterranean. The Blue Plan also emphasizes serious water shortages worsened by increased coastal tourism.

So what can be done to address these serious problems in these two widely separated regions? A comparative study of coastal tourism impacts in Malaysia and the Mediterranean suggests that the cause of problems in both areas lies in inadequate policy frameworks, insufficient environmental management and planning, weak monitoring and enforcement, constraints on public finances and lack of public awareness.

Ultimately, the public and private sectors (local and national level) determine how marine pollution from tourism is controlled. However, international and regional agencies must play an important role in defining, coordinating, supporting, implementing and monitoring actions by groups of countries.

In Malaysia, strategies for tourism development and controlling environmental impacts are addressed in various national plans. Regional agreements, such as the UNEP Regional Seas Programme: Action Plan for the Protection and Development of the Marine and Coastal Areas in the East Asian Seas, also address tourism.

In Italy and the Mediterranean, a similarly diverse range of plans, including the UNEP's Blue Plan and Priority Action Plans, and various European Union and national legislation cover marine pollution, environmental protection, and the effects of development and economic activity, including tourism.

Local authorities have a key role in managing development, including tourism, but their management and technical capabilities are often inadequate. Furthermore, local communities whose livelihoods depend on the coastal resources and who are often the day-to-day managers of those resources are often not involved. For strategies to be effective this must change.

Environmental codes of conduct are one means of raising awareness of the link between tourism and the environment, and they contribute to the development of sound business practices. But voluntary codes of conduct need real commitment coupled with adequate administrative support. They must also address siting issues and some of the adverse socioeconomic and environmental consequences of siting the wrong type of tourism in the wrong place.

In the short term, the private sector developers benefit from coastal tourism, and while they often have the financial resources to install clean technologies, they often fail to anticipate and adequately invest in environmental protection. While some in the private sector are coming on board, greater cooperation with government at all levels is necessary to minimize impacts from tourism.

In the long term, for strategies to be effective, there must be consensus between all governments at all levels, administrative departments and enforcement agencies.

(This article is drawn from "Tourism, Pollution and the Marine Environment," a report for World Wildlife Fund.)

For copies and further information contact: Richard Tapper, Environment Business & Development Group, 16 Glenville Road, Kingston upon Thames KT2 6DD, U.K. Tel/FAX: +44 181 549 1988. E-mail: rtapper@dircon.co.uk.

The Rhode Island Hazard Mitigation Program: A Public/Private Partnership

By Diana L. McClure

Nobody wants natural disasters. Along the coast of Rhode Island (RI), USA, those living and working in shoreline communities are not alone in their concern about minimizing the effects of a hurricane, flood, earthquake or other hazardous event. Property insurers want to keep insurance affordable and available. Government wants to avoid paying again and again to respond, rescue and rebuild. Environmental organizations want to preserve environmental health and protect natural resources.

How can these diverse entities agree on actions to protect communities from natural hazards, taking into account the often competing interests of those concerned about property rights, insurance affordability and availability, use of financial resources, and the natural environment? The philosophy is that one must link respect for nature with respect for people. People's relationship with nature–either the view that people must live in balance and harmony with nature, or the view that nature is a force to be controlled–translates into the relationship between the two. Thus, the relationship is approached with an attitude that emphasizes cooperation or emphasizes antagonism. Humans' interdependence with nature, and by extension, with each other, is the cornerstone of the concept of sustainability.

A widely used definition of sustainability is that as we meet the needs of the present generation, we cannot compromise the ability of future generations to meet their own needs. In a coastal state like RI, one also must think about how coastal processes and coastal development might be affected by a natural hazard event, and what impact the severity of losses might have on the long-term economic vitality, environmental health and quality of life, e.g., fisheries, tourism and the enjoyment of property rights.

Natural disasters can affect our jobs, our homes and our children's ability to one day have a home. The extent to which a community can recover in a sustainable way is related to the decisions that are made pre-disaster, and to the decisions made during recovery. Part of that planning must take into account the role of insurance, since recovery from disasters to a large extent hinges on the availability of insurance payments. Availability, in turn, is dependent upon the continued solvency of insurers. Measures taken now to reduce the likelihood of catastrophic losses improve insurers' ability to keep insurance available, and therefore improve the community's ability to recover.

An interest in natural hazard loss reduction and the importance of the sustainability concept brought together four organizations to form the Rhode Island Hazard Mitigation Project: Rhode Island Sea Grant at the University of Rhode Island's Coastal Resources Center, the Rhode Island Emergency Management Agency (RIEMA), the Federal Emergency Management Agency (FEMA) and the Institute for Business and Home Safety (IBHS). The purpose of the project is to create a disaster-resistant state, where communities take responsibility for incorporating mitigation into daily practices; the state supports the communities through its own actions, policies and regulations; and the private sector organizes to exchange information, prioritize operational issues during a natural disaster and establish a direct link with the public sector for mitigation, response and recovery.

The catalyst that brought these groups together was a relatively weak hurricane (Hurricane Bob) that made landfall on the southern shore of RI in 1991. Twenty-one of Rhode Island's 39 municipalities have coastal shoreline, a total of 420 miles of coastline. Two-thirds of the state's population of just under one million people live in these 21 communities. From 1980 to 1993, insured residential and commercial coastal property grew in value by 153 percent, from US$33 to US$83 billion. Hurricane Bob was a wake-up call for the devastation that could occur to the coastline and coastal development.

Coastal erosion in Charlestown, Rhode Island.

Following Hurricane Bob, Rhode Island Sea Grant decided to join hands with other interested parties–not their traditional partners–using as the common theme the devastation a major hurricane could cause to coastal processes and development, and the state's economy.

Rhode Island Sea Grant first started working with RIEMA and FEMA, and later with IBHS, to create a public/private partnership to find ways to support the often conflicting goals of coastal

(continued page 28)

Paying the High Price of Overfishing

By Anne Platt McGinn

Globally, fisheries–and the economic and social benefits they offer society–are under siege. By recent United Nations' estimates, a majority of marine fish stocks and all of the world's primary fishing grounds have reached peak production and are in decline. At the same time that fish populations are being overexploited, the areas that serve as natural fish farms–coral reefs, tidal estuaries and ocean floor environments–are being ravaged by damaging fishing gear and methods, and life on land.

Much of the global commercial catch depends on the 320-kilometers coastal zone for the most vulnerable stages of life. An estimated 90 percent of commercial fish in the Bay of Bengal, for example, rely on healthy mangroves as a nursery for their young, while in East Africa and Sri Lanka, 95 percent of shrimp and marine fish live out their entire existence in coastal areas. As these valuable habitats are filled in to make room for fish farms, industries and expanding populations, the species that live there suffer precipitous declines. Once abundant along the U.S. Atlantic coast, stocks of menhaden have declined by 26 percent in 10 years, in large part due to the loss of coastal wetlands.

Besides storing and cycling much-needed nutrients, coastal areas also collect pollution, wastes and nutrient-rich effluent from upstream cities, farms and industries. Although some nutrients are necessary, having too many is harmful. A growing threat to fish in many urban coastal areas is a process known as eutrophication, whereby excessive levels of nutrients build up and essentially suffocate the marine environment. In addition, seasonal algal blooms erupt off the coasts of China, Japan and South Korea, and in the Black and Baltic seas, often harboring toxic phytoplankton that poison and sometimes kill fish and shellfish. Even non-toxic blooms block sunlight, absorb dissolved oxygen, and disrupt food-web dynamics, thereby robbing marine organisms of needed food. Because of agricultural runoff in the Mississippi River basin, the Gulf of Mexico has a biological 'dead zone' about twice the size of Puerto Rico that has in effect starved bottom-dwelling marine organisms and forced fishers further offshore in search of catches.

Given an ever-growing human populace that gravitates more and more to coastal areas, the health of these areas is likely to worsen. Already, some 2.5 billion people (nearly 40 percent of the world's population) live within 100 kilometers of a coastline. In the next 30 years, more than 6.3 billion people are expected to make their homes in these densely populated corridors, further stressing the seams between land and sea.

The source of damage to valuable underwater habitats does not stop at the shoreline. Fishing gear and methods can also cause direct harm to the marine environment by damaging habitat areas, reducing cover from predators, depleting food supplies and lowering local biological diversity. Some areas of the world's oceans are fished more than others, and therefore take a harder hit from gear. A third of the North Sea is intensively harvested each year, for instance, whereas Georges Bank off New England, USA, was trawled with huge nets three to four times a year between 1984 and 1990, until it looked like a 'parking lot,' according to one researcher. By recent estimates, all the ocean's continental shelves are trawled at least once every two years, with some areas impacted several times a season.

In tropical reefs, a growing threat to marine species and their habitat is the use of cyanide poison to capture fish for a growing US$1 billion annual live-fish trade. Fishers dive down and squirt just enough sodium cyanide at the reef to stun fish, making it easy to trap them alive. Though it involves too little poison to harm people who later eat the fish, over time this practice can kill most reef organisms and convert a productive reef community into a graveyard. Fueled by high profits, cyanide fishing is expected to drive valuable tropical species to collapse in coral communities worldwide. Cyanide fishing is now reported from Fiji to Eritrea, according to a recent study by the Philippines-based International Marine Life Alliance.

An ever present danger to marine species worldwide is the capture of innocent bystanders. In the process of taking fish, unwanted species are often brought on board and then thrown back into the sea, often dead or dying. Few of them survive the process of being yanked out of their habitat and then later dumped overboard. Known as discards, these unwanted fish are wasted either because they are undersized or a non-marketable sex or species, or because a fisher does not have a permit to catch them. The United Nations Food and Agriculture Organization (FAO) estimates that discards of fish alone, not counting marine mammals, seabirds and turtles, total 20 million tons, equivalent to one fourth of annual marine catch. Global bycatch–the sum of discards and unintentionally caught species that are retained–was estimated at more than 28 million tons in 1994.

Underlying the biological signs of excessive fishing effort, from high rates of bycatch to damaged ecosystems, is the fact that world fishing fleets today are simply too large for the available resources. Wielding more than twice the gear and equipment needed to extract available resources, fishers have wiped out many individual fisheries and prompted a freefall in global fish stocks–and their own prof-

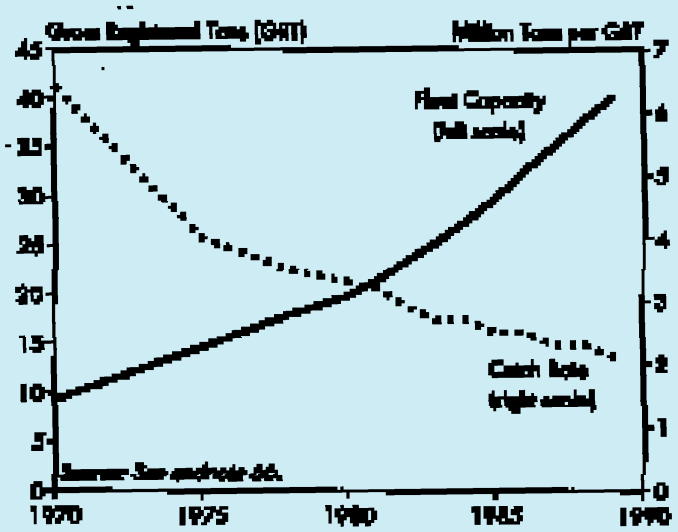
its. Undergirded by a system of government bailouts that has propped it up for the last several decades, too many big boats and too many fishers are taking too much from the sea. Although becoming more evident among smaller-scale outfits, the problem is far worse in the commercial sector of top fishing nations, which field the world's largest vessels and the greatest share of the fishing technology.

During the 1970s and 1980s, the gross registered tonnage of world fleets, a measurement of volume, increased by 90 percent, while the technical capabilities of the world fleet as a whole increased more than three times as fast, by 330 percent, signifying a massive escalation of fishing power and effort. Despite the investments and improvements in fishing technology and harvesting capacity and the growth in world fish catches, landings per gross registered ton (catch rate) declined by 62 percent overall during these two decades (see figure). Large boats were catching less and earning less for the same amount of effort–a direct consequence of overcapitalization.

Rising costs and falling revenues have made the industry financially vulnerable. In 1989, worldwide losses from overfishing amounted to roughly US$54 billion, based on estimated global fishing costs of US$124 billion and fishing revenues of US$70 billion, according to the FAO. Since 1989, the situation has grown even more precarious. Additions to the world fleet still exceed deletions and technical capacity continues to mount. Current fleets now have at least 50 percent more capacity than they need for world fishery resources, according to FAO. The World Wildlife Fund concludes the problem is much worse: the world's fleets are 155 percent over capacity. Finding themselves caught in an economic trap of mounting debt and declining yields, fishers have pressured governments to keep fishing quotas intact and to provide short-term economic support.

Many fishers remain afloat because governments bear a growing share of the losses, through tax incentives, low-interest loans and direct subsidies. Despite the losses in the late 1980s, many governments today continue to give fishers immense amounts of subsidies. Using data from the few governments that keep track of these expenditures–China, the European Union (EU), Japan, Norway, Russia and the United States–the U.S. National Marine Fisheries Service estimated that global fishing subsidies in 1995 totaled US$14 to US$20 billion. About one third of all revenues from fisheries come not from wild catches, but from government coffers in the form of subsidized loans, preferential tax rates and other means of economic support. Primarily bestowed by industrial countries on failing fleets that continue to operate under open access conditions, subsidies encourage recipients to remain in the industry and to continue overextending themselves financially, thus further straining the resource base.

Global fleet capacity and catch rate, 1970-89



Another government response has been to encourage fishers to shift effort to other fishing grounds. With severe overfishing in the northern hemisphere, industrial countries are now willing to pay a high price for access to southern waters and exclusive economic zones (EEZs). In 1996, the EU paid US$229 million–or 43 percent of the EU's annual monies earmarked for addressing overcapitalization–for access agreements with Africa, primarily for the benefit of French, Portuguese and Spanish fishing companies–thereby exporting the overcapacity problem from North to South. The vessel owners themselves pay only a fraction of the cost.

In June 1996, the EU signed a US$70 million-a-year fisheries access-for-trade agreement with Mauritania. This latest arrangement expands European rights along the 750-kilometer coastline considerably. It stipulates a 45 percent jump in the number of boats and a 140 percent increase in allowed catches as well as first-time capture rights for highly prized squid and octopus–despite the fact that Mauritania's fisheries are already fully fished and some species are overexploited. In both Mauritania and its neighbor to the south, Senegal–two countries whose populations are growing faster than 2.5 percent per year–the domestic fishing industry and local fishermen's associations protested the terms of these agreements. But their governments have largely ignored their opposition. The EU currently subsidizes similar arrangements with 14 other nations in West and East Africa–paying less than 10 percent of the value of the

(continued page 28)

Aquaculture in Dagupan City, Philippines

By Michael A. Rice and Arthur Z. DeVera

The Dagupan City, Pangasinan, Philippines area consists of the city and two municipalities, Binmaley and Lingayen, situated in the river-delta estuary system of the Agno River at the head of the Lingayen Gulf. The region is an important transportation center and fishing port. A number of secondary industries have developed including boat and fishing gear manufacturing and fish processing.

Typical 5x7 meter net pens used to culture milkfish in the town of Binmaley

The entire economy of the Agno River estuary region is based on fishing and aquaculture. Small trawlers and boats rigged with nets or longlines land their catch in Dagupan City. In recent years the gulf has experienced severe overfishing, leading to diminished catches and fewer large boat landings. To restore the commercial fisheries, the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) proposed a ban on commercial trawling in the gulf. Public hearings have been ongoing since 1996, with no resolution as of June 1998. Interestingly, the commercial fishing vessels owners have aquaculture enterprises in the area.

Aquaculture in the Region

The Dagupan City region is well known for the culture of bangos or milkfish, (*Chanos chanos*). Milkfish are typically grown in shallow extensive ponds reclaimed from mangrove wetlands. Approximately 8,700 fish ponds of this type cover about 11,300 hectares (ha). There are typically 4,000 fingerlings per ha and the ponds require minimal supplemental feeding, as ponds are fertilized to promote the growth of *lab-lab*, a complex of filamentous algae and phytoplankton that serve as food. Fish require a three-month growing period before reaching market size, and two or three crop cycles per nine-month growing season are common. Starting in the mid-1980s, a number of progressive pond operators modified their extensive ponds by deepening and aerating them. In these semi-intensive ponds, milkfish are stocked in excess of 25,000 fingerlings per ha, and require supplemental feeding. In 1992, pond production of milkfish was reported to be about 12,000 metric tons in the estuary. Several pond operators have diversified their crops by growing shrimp in monoculture with crop rotation or as a polyculture species with milkfish.

In 1983 the culture of serranid groupers, known locally as *lapu-lapu*, was introduced. Small-scale trials demonstrated the commercial viability of grouper culture, leading to increased production. Markets in Hong Kong and Singapore were developed, and by 1993 grouper production in Dagupan City reached about 15,000 kg per year.

Until the early 1990s, aquaculture production had a high degree of species and technological diversity. Most aquaculture operations were local to the province and, to some extent, these operations were well placed due to community pressure. Initially, multiple uses of the waterways occurred with minimal conflicts. For example, oysters, milkfish and groupers were often cultured in close proximity to fixed nets placed to capture migrating fish and crustaceans. This polyculture form of aquaculture management optimized output of the estuary. Some fishers profited from polyculture practices; one example is fishers with oyster farming plots that also employed spat collectors that acted as miniature reefs or fish aggregating devices.

Changes in the Estuary

In the early 1990s, two events changed the way fisheries and aquaculture were conducted. First, on July 16, 1990, an earthquake of intensity 7.8 on the Richter Scale struck the region with devastating consequences. The commercial center of the city was heavily damaged and subsided by approximately one meter. Many low-lying fishponds were inundated. Rebuilding of the city, which included its fisheries and aquaculture infrastructure, was very costly.

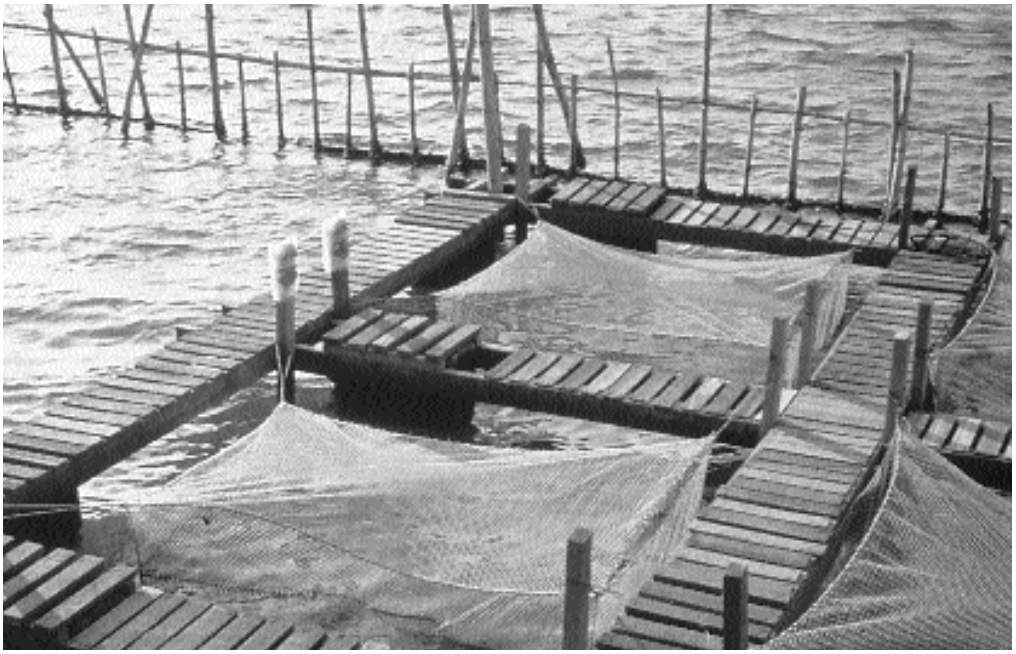
The second event was the decline in the shrimp industry due to over-intensification, sub-optimum management and disease outbreaks. The shrimp industry had grown rapidly due to

innovations in hatchery and feed technologies. The decline resulted in an over-production of aquaculture feed. To maintain their markets, some feed manufacturers developed forms of aquaculture that would decrease their dependence on shrimp feeds. In the Dagupan City region, the type of aquaculture to expand rapidly was the net pen culture of milkfish. Typically, after a municipal permit is granted, the net pens are placed in the estuaries and fish are fed on a commercially prepared diet for approximately three months until they reach market size. In the early years, returns on investment of 300 percent or more in just a few months were not unheard of. In just one 35 m^2 net pen, as many fish could be reared as in a 0.5 ha extensive fishpond, without expenses associated with real estate or rebuilding due to the earthquake.

News of this success precipitated a rapid expansion of the industry. By 1996, in the town of Binmaley alone, records showed that there were more than 800 registered milkfish pens, producing an estimated 1,600 tons of fish per year. This figure may be low because it does not count unregistered pens.

The rapid growth of the industry was not without its down side. The nearly unrestrained establishment of the milkfish pens led to degraded water quality, resulting in economic losses for operators using the more sound polyculture methods. An example is the halt of all grouper culture in the estuary in 1995 after hypoxic conditions killed some groupers. Likewise between 1993 and 1995, oyster production declined by nearly 50 percent according to BFAR.

Eventually, degraded water quality began to affect the milkfish pen operators themselves. By 1996, overnight fish kills occurred regularly in the fish pens in the town of Binmaley. Unpublished BFAR data indicated that surface waters in the vicinity of the fish pens often went below 1 mg/l, the lower limit for survival of young milkfish. There is also preliminary evidence of phytoplankton species composition shifts in the estuary during hypoxic events.



Floating net pen for serranid groupers in the Tapuac District of Dagupan City.

Emergency Government Action

The severe economic effects of the fish kills have drawn the government's attention. In early October 1997, the House of Representatives of the Republic of the Philippines passed a resolution requiring an investigation of the fish kills. The severity of the situation precipitated an Executive Order by the president of the Philippines on October 17, 1997 which mandated that all fish pens be removed from the estuary until the cause of the fish kills was determined, and that a procedure for limiting the density of fish pens be instituted. Ironically, the overall economic productivity of the estuary may be increased by aquaculture growth restriction policies which promote the 'old fashioned' multi-species methods with managed stocking densities.

Picking up the Pieces

In general, the academic community in the Philippines has done an excellent job of solving production-related problems such as feeds and nutrition and reproductive biology of fish and other cultured species, but research on environmental and economic impacts is lacking. Around 3,200 tons per year of wastes from the milkfish pens are deposited into the estuary, but no data are available on their effects. Data are needed to determine the carrying capacity of fish pens in a particular river or estuary based on hydrography and carbon and nutrient loading. Likewise, resource economists need to quantify the effects of the loss of diverse aquaculture production methods on the overall economic yield of the estuary.

Ever since the 1986 devolution of power to local officials, management responsibilities have rested primarily with the local government in Binmaley, Lingayen and Dagupan City. Each are now in the process of developing local ordinances regarding fish cages and pens. It is recommended that future ordinances restrict the number or size of fish pens by setting a hard and fast top number and size of allowable pens, and also initiate an annual open auction system. An auction system will allow the market forces of demand for permits to simultaneously maximize municipal income, while serving as a means to protect the estuary.

(continued page 29)

Maximizing Sustainable Financial and Economic Benefits of Coastal Resources

By James Spurgeon

Coastal resources are increasingly recognized for the immense value they provide in the form of both products and services. However, their utilization is generally far from efficient and sustainable. A few recent studies have attempted to expand the overall economic benefits of using coastal resources on a sustainable basis.

Saundersfoot Harbour, Wales

Before the economic returns from coastal resources can be maximized, it is essential to have a complete understanding of the full range of potential uses and values of the resources and the driving forces behind their utilization. Economic values occur both within and outside of organized markets. An appreciation is required of both the financial and economic values that coastal resources can generate.

Market valued benefits are realized through transactions in the market place, and are of concern to anyone interested in the commercial viability of activities. This includes the owners, operators and employees of businesses or other enterprises. It also includes the public that consumes or otherwise uses the goods and services provided.

Non-market values, on the other hand, are generally not realized within commercial markets. As a result, special studies are required to estimate the value of these goods and services, where value is measured in terms of individuals' willingness to pay for the items or services involved. Common examples of non-market benefits include recreational uses of public beaches or parks, amenity services of attractive vistas and the value of coastal habitats acting as fish nursery grounds. In addition, economic benefits include the value people attach to knowing that a resource is maintained for its potential future uses (option value) and for its continued existence (passive-use value). Maintaining non-market economic values provided by resources are of concern to anyone benefiting from a resource, and because many non-market benefits are for public goods under the management of government, local and national governments play an important role in managing these resources on behalf of society.

Maximizing overall economic returns from coastal resources requires the right balance between encouraging income-generating activities and maintaining or protecting the resources to continue providing economic but non-income-generating products and services. This trade-off must be achieved bearing in mind the long term, and hence should be based on the concept of sustainability.

A study carried out for English

Financial values generated by coastal resources, United Kingdom (1996 prices).

Sector	Lundy (£000/year)	Holy & Farne Islands (£000/year)	Morecambe Bay (£000/year)	North Norfolk (£000/year)	Isles of Scilly (£000/year)
Direct Recreation	50	400	400	1,000	300
Indirect Recreation	850	5,500	150,000	15,000	20,000
Fisheries	10	1,300	2,300	960	470
Agriculture	-	-	275	250	-
Ports	-	s	>10,000	s	s
Industry	-	-	>100,000	s	-

s = some revenues generated but not valued.

Nature assessed the overall financial value of coastal resources at five sites in the United Kingdom recognized for their importance to marine wildlife. The study involved developing a basic framework to identify and categorize all coastal related activities. Ball-park estimates were then made for each sector as to the annual financial revenues generated by activities dependent on the use of coastal resources (see table).

The results clearly reveal the huge financial revenues generated from a range of activities dependent on coastal resources. Recreational benefits make up a significant proportion of the overall financial values for the sites, especially when indirect expenditure relating to accommodation, food and travel are taken into account. Significant recreational activities included, among others, sailing, recreational fishing, SCUBA diving and visiting wildlife sites. When considered together with fisheries, the importance of maintaining the quality of the coastal environment becomes apparent. Both activities are ultimately dependent on maintaining biodiversity, the integrity of habitats and controlling pollution of the environment.

The study for English Nature did not determine the non-market value for the different sites, although it did allude to their potential significance. However, another study, partly funded by the Scottish Natural Heritage, does briefly review the overall economic benefits relating to a range of coastal habitats. This study provides an initial examination of the full costs and benefits relating to the rehabilitation of seven different coastal habitats. It indicates the relative importance of the components of the total economic value (direct and indirect uses plus non-use values) for each habitat, and draws together a number of attempts at valuations from available literature.

The review of benefits highlights several points: 1. that few studies have attempted to value the full range of uses (and non-use values) relating to coastal habitats; 2. that those studies that have been undertaken generally reveal potentially high use and non-use values. Coral reefs, for example, have been shown to have very substantial use values for recreational and coastal protection benefits; areas like the Great Barrier Reef may also have substantial non-use value. Quantification of such value can be important for benefit-cost analyses in particular cases, however, a greater understanding of environmental values and the techniques used for their valuation is needed.

As our understanding of both the financial and economic values of coastal resources advances, our ability to improve decisionmaking over their optimal utilization will improve. Decisions regarding the management and exploitation of coastal resources can then be made with the knowledge that aspects of both market (financial) and non-market economic values are being fully addressed. The following two ongoing projects are examples of this.

Saundersfoot Harbour, Wales

The first phase of a feasibility study was recently completed to investigate the potential for developing the shellfish industry in Carmathen Bay, Pembrokeshire County, and the potential role of Saundersfoot Harbour. Part of the study is to assess the economic aspects associated with developing the harbor. One issue is the relationship between changes in fishing activity and the views of recreational boat users, locals and visitors. Increasing fishing activity, particularly the whelk fishery, may conflict with the enjoyment of the boat users due to the smell and mess that it is alleged to cause. At the same time, it was recognized that increased fishing activity may add to the enjoyment of visitors to the harbor. To help assess the situation, two questionnaire surveys were conducted to assess the views of harbor users, local residents and visitors.

A sheltered bay in County Mayo, Ireland

The Phase 1 investigation revealed that the opportunity for long-term sustainable exploitation of the shellfishery in Carmathen Bay using Saundersfoot Harbour is limited. However, the surveys did provide information relating to the future development of Saundersfoot Harbour. Ninety-eight boat users and 63 locals and visitors completed the questionnaires. The analysis revealed that over 50 percent of boat users objected to expanding the existing whelk fishery, while over 50 percent approved of increasing yachting and commercial boating. Expanding other fishing activities was not seen as a major issue.

Information was also gathered on

(continued page 29)

CORAL: A Least-Cost Management Decision Support Model for Coral Reef Ecosystems

By Richard M. Huber and Stephen C. Jameson

Throughout the world, both in developed and developing nations, we face complex coastal zone management challenges associated with our attempt to achieve economic growth without destroying the ecological systems that support human existence. Coral reef ecosystems are valuable for many reasons. They provide thousands of people with food, tourism revenue, coastal protection and new medications for increasingly drug-resistant diseases. Nevertheless, coral reef ecosystems are among the least monitored and protected natural habitats in the world.

Coastal zone management decisions often require the integration of numerous parameters–frequently more than the human mind can handle effectively. In coral reef ecosystems, these parameters include: the location of industrial and tourist facilities, water quality issues such as nutrient concentrations and sedimentation, fishing pressure and socioeconomic concerns, to name a few. To assist the island states of The Maldives, Curaçao and Jamaica (Montego Bay) in effective coral reef management, The World Bank recently created a model (*CORAL*) using multivariate statistical procedures that show the result of integrated coastal management (ICM) decisions when a variety of parameters interact together. Costs are incorporated into the model to help decision-makers choose least-cost solutions–without making mistakes that are, in many cases, irreversible.

Creating *CORAL*: Integrating Scientific Data and Expert Opinion

The team: Creating *CORAL* required a true team effort. Richard Huber (The World Bank) supervised the project, Stephen Jameson (Coral Seas Inc.) provided ICM and scientific advice; Frank Rijsberman and Susie Westmacott (Resource Analysis) provided the *CORAL* user friendly interface; Steve Dollar and Mark Ridgley (University of Hawaii) developed the fuzzy logic; H. Jack Ruitenbeek (H. J. Ruitenbeek Resource Consulting Limited) provided the valuation/economics; Leah Bunce (NOAA) researched the social science; and countless other coral reef scientists reviewed the model assumptions and final product.

The primary question the model asks is: What is the most cost-effective means for achieving a given level of coral reef quality as expressed by percent coral cover?

The technology: *CORAL* runs on a PC laptop computer. The user-friendly interface is created using Microsoft Word and Excel software. The fuzzy engines are in CubiCalc, the linkage models are in MATLAB and all the statistical work was done with SPSS software.

The science: The decision support model exhibits two key features. First, it represents existing knowledge of reef ecology at a detail and within the bounds of accuracy sufficient for project evaluation. To achieve this aim, the model has the ability to show the effects of nonlinear relationships among pollutants, coral reefs and the reefs' larger marine environment. Second, the model is operable and provides useful results with the information available at the location of potential application. Modifications to the set of variables to consider, and how such elements and interactions are represented, differentiate site-specific models.

A few examples of the many ecological test-case scenarios that have been simulated with the model are:

- Algae abundance as a function of the interaction of reef fish grazing pressure and effective nutrient concentration
- Influence of algae and relief on coral cover
- Influence of algae and suspended sediment on coral cover
- Influence of suspended sediment and sediment deposition on coral cover.

The logic: Coral reef data deficiencies, coupled with marked limitations on resources for reef research and management in the developing tropics, led to the adoption of a fuzzy-logic (or fuzzy-sets, fuzzy-systems) approach. Fuzzy methods possess a number of features making them particularly applicable to the prediction and management of ecological systems. First, they enable rigorous, quantitative system modeling even though the variables and their interrelationships are described initially (i.e., as inputs to the model) in qualitative terms. This is especially appropriate when human knowledge about the behavior of systems, such as coral reef ecosystems, is approximate and imprecise at best, making the defining of parameters all but impossible. The ability to accommodate qualitative data about reef systems means that more information about them, from more and different kinds of sources, is likely to be available. Since fuzzy logic allows systems to be described as sets of if-then, linguistically-specified rules relating inputs to outputs, it offers great potential for utilizing human judgment and experiential knowledge, rather than being dependent upon mathematical theory or quantitative databases. Finally, relative to conventional control systems, those using fuzzy methodologies have proven easier and quicker to develop and more robust in operation.

The economics: Improved methods for deriving estimates of coral reef benefits, which are used in conjunction

with the model's cost function, are continually being developed. This work adapts and refines existing valuation methods so they take account of the key characteristics of coral reefs, and derive more accurate estimates of coral reef benefits for selected sites. To keep the analysis tractable, the model focuses on three methods for valuing the benefits:

1. Direct use valuation–estimating the lost productivity or value in the absence of proper protection or conservation

2. Contingent valuation–estimating the benefits derived from "public goods"

3. Marine system biodiversity valuation (lower relative importance to the above)–assessing marine biodiversity values using bioprospecting as the primary technical basis for valuation. Our modeling research applies each of these valuation methods, and then develops a synthesized benefits function based on the data collected during site-specific economic surveys.

The sociology: The sociocultural impact assessment facet of the modeling program examines the sociocultural framework of the reef user groups and determines the sociocultural costs and benefits of management alternatives and changes in reef quality. The outputs are an assessment of user group activities related to coral reefs and recommendations for management alternatives based on the sociocultural costs and benefits of alternatives. These results are then incorporated into the larger economic valuation of the costs and benefits of coral reef management and protection for the model.

Using *CORAL* for ICM Decision Support

The integration: The model guides users through a generic approach to planning that structures the development, analysis and evaluation of sustainable management plans. The model is interactive, allowing user input with respect to setting of objectives and criteria, definition of scenarios, selection of measures and strategies, and evaluation of impact.

- In Curaçao, the model shows that the most cost-effective solution to maintain the current level of coral cover is a combination of deep-ocean outfalls for the residential and hotel waste water, and a reduction of the discharges from the oil refinery. Such measures also have the potential to increase the average coral cover by up to 5 percent, and in specific sections by 8-12 percent. In contrast, the status quo scenario shows a continuing decline in coral cover.
- In The Maldives, the model shows that the most cost-effective solution would be to prevent or limit the direct and indirect effects of land reclamation (island enlargement) inside the reef, and prevent or limit the construction of harbors and access channels.
- In Montego Bay, Jamaica, modeling workshops have helped focus government officials and Montego Bay Marine Park managers on critical water quality and fisheries issues, and have shaped action plans in the new park management plan that include a new park zoning plan; a watershed management program; alternative income programs for fishermen; merchandise, user fee and ecotourism programs for revenue generation; education, volunteer and public relations programs; research and monitoring programs; and more.

The accuracy: The accuracy of the model is dependent on the quality of the expert opinion and best available quantitative data. While it is impossible to validate the model precisely, the accuracy of the model was assessed via peer review of the fuzzy rules and by comparison of model outputs with observed field data.

ICM Capacity Building with *CORAL*–Helping Stakeholders

Benefits to policymakers, managers and other stakeholders: The integrated socioeconomic and ecological model, framed with a user-friendly computer interface will benefit stakeholders by:

- Assisting the communication between the various stakeholder groups
- Facilitating the planning process required for successful ICM
- Providing a powerful tool to managers and stakeholders for demonstrating the need for coastal zone management–and the impacts of status quo management on valuable coral reef resources and the local economy
- Identifying appropriate policy and institutional reforms for improving the capture of resource values associated with coral reefs in developing countries
- Clarifying the potential operational role of The World Bank and other development assistance agencies in helping to effect these reforms.

The dissemination strategy: The dissemination strategy for this work focuses on in-country workshops and seminars for user groups and stakeholders, government agencies, and private and nongovernmental organizations involved in ICM. It also includes activities to foster cooperation among countries on coordinated environmental policies, strategies and action plans in the coastal zone; and provides a consultation mechanism for formulating, strengthening, harmonizing and enforcing environmental laws and regulations.

For further information contact: Richard M. Huber, The World Bank (LCSES), 1818 H Street NW, Room I-6025, Washington, DC 20433 USA. Tel: 202-473-8581. FAX: 202-522-3540. E-mail: rhuber1@worldbank.org. or Stephen C. Jameson, Coral Seas Inc. E-mail: sjameson@coralseas.com.

REPORTS FROM THE FIELD

ASIA

INDONESIA

Crown-of-Thorns Cleanup Brings North Sulawesi Communities Together

Over 250 people from North Sulawesi joined forces on February 25, 1998, to undertake a Crown-of-Thorns (*Acanthaster planci*) (COTs) cleanup operation on coral reefs near Bentenan-Tumbak. The COTs cleanup was the result of a partnership between the village communities, local government, university faculty, students, local dive and resort operators, and nongovernmental organizations who came together to address a pressing coral reef management issue. Volunteer divers and snorkelers removed 766 COTs from locations experiencing the most severe infestations.

The COTs are naturally occurring starfish feeding on coral reefs. At times, the number of COTs exceed the capacity of a coral reef ecosystem. COTs are efficient predators and can consume 5-13m^2 of living coral a year. While COT outbreaks do occur naturally, some scientists have suggested that human activities, such as overfishing of the COTs predators, increase the severity and frequency of infestations, but COTs outbreaks are still a poorly understood phenomenon. One COTs infestation in the Togean Islands of Central Sulawesi devoured 80 percent of living coral on a single reef in less than a year.

Proyek Pesisir, a project implemented through a cooperative agreement between the U.S. Agency for International Development and the University of Rhode Island, is also planning to train community members of the Bentenan-Tumbak communities to monitor coral reefs with special emphasis on observing COTs populations. Through community monitoring, appropriate actions can be taken to keep the COTs population under control. The cleanup is an excellent example of how communities can forge partnerships with public and private sectors. It also demonstrates how early action can be taken to address a pressing management concern which cannot or need not wait until long-term management plans are completed.

Why a COTs cleanup on Bentenan-Tumbak coral reefs? During an environmental baseline survey of the coral reef areas around Bentenan-Tumbak in June 1997, several reef areas were noted as having a large population of COTs. In October, a Proyek Pesisir team noted a potential outbreak close to Bentenan Island–an increase in numbers from June surveys. A detailed follow-up survey by two Proyek Pesisir staff was conducted in December to assess the situation. The number of COTs was found to exceed the normal level and had increased rapidly in just six months. After receiving advice from specialists, Proyek Pesisir consulted with the community and recommended the COTs cleanup.

While the cleanup was a success, additional cleanups are being planned for reefs not fully cleared of COTs during this cleanup.

(Excerpted from *NRM News*, Newsletter of the Indonesia Natural Resources Management Program, Volume 1/No. 1, Jakarta, Indonesia. FAX: 327-5502. May 1998.)

LATIN AMERICA/ CARIBBEAN

GLOBAL

Marine Ecotourism Guidelines Project Nears Completion

An initiative by The Ecotourism Society (TES), funded by Royal Caribbean Cruiseline, is two-thirds complete with the completion of three stakeholder meetings in the Caribbean. The meetings were preceded by a literature review focused on tourism guidelines and sustainable tourism management, and by an international survey of coast-based ecotourism operators. The survey gathered data on attitudes towards guidelines and implementation of best practices in the tourism industry.

The stakeholder meetings were held in St. Kitts, St. John USVI and Akumal, Mexico. Meeting co-hosts included the St. Kitts & Nevis Ministry of Tourism, Virgin Islands Environmental Resource Station (VIERS) and Centro Ecologico Akumal. TES and Lakehead University of Canada, co-facilitators with TES of the stakeholder meeting, organized meetings that brought together government officials, fisheries and tourism business owners and managers, conservation group representatives and community members to discuss issues associated with coastal tourism, and identify existing and proposed coastal tourism best practices in their region. Participants were encouraged to focus on small-scale, low-consumption forms of tourism and recreation. However, invariably larger issues such as impacts on the cruise line industry and mass tourism resort developments did arise.

The main issues identified by representatives of the three Caribbean destinations participating in the project included: enforcement and government regulations, education (of both tourist and local community members), water and waste management, coastal access by local people, the

decline of local fishery, coral and mangrove populations, and the role of the tourism industry in sustainable tourism.

TES will summarize the information from the participants, along with the international survey of tour operators collected by Lakehead University, to develop a set of guidelines for ecotourism businesses in coastal areas.

An initial draft of the guidelines will be available for comment by late October. TES invites interested parties to review the document.

A final draft of the guidelines will be available in March 1999 and will incorporate other industry guidelines including Ecotourism Guidelines for Nature Tour Operators (1993) and Ecolodge Guidelines (1999).

For more information contact: Elizabeth Halpenny, Workshop and Marine Program Coordinator, The Ecotourism Society, PO Box 755, N. Bennington, VT 05257, USA, Tel: 802-447-2121. FAX: 802-447-2122. E-mail: ecomail@ecotourism.org. Website: http://www.ecotourism.org.

LATIN AMERICA/ CARIBBEAN

ECUADOR

Coastal Resources Center to Help Ecuador Combat Damage Caused by El Niño

The Coastal Resources Center (CRC) at the University of Rhode Island's Graduate School of Oceanography, Narragansett, Rhode Island, USA, has been awarded a US$225,000 contract by the Government of Ecuador's Coastal Resources Management Program. CRC will provide technical assistance in coastal management to the country as it undertakes an ambitious program to implement special environmental plans in seven critical regions of the country. In 1985, CRC helped initiate the Ecuador coastal program in partnership with the U.S. Agency for International Development (USAID), and CRC was also responsible for the design of the Inter-American Development Bank's funding of current coastal conservation and management activities in Ecuador.

"This extension of CRC's ongoing work in Ecuador provides an excellent opportunity for the country to realize the goal of managing its coastal resources for everyone in the country's benefit," said Don Robadue, project coordinator. "In the face of the problems created by El Niño, Ecuador can serve as a model for other countries struggling with how to protect and preserve their coastal areas. CRC is proud to continue its contribution to the initiative."

CRC will share its expertise in storm hazard mitigation techniques, which are now being applied in Rhode Island and throughout the United States. CRC will focus its work in Ecuador on helping local experts prepare shore use regulations and plan for storm damage recovery, after the most severe El Niño event in memory. Ecuador's beaches are severely damaged, coastal roads and bridges have been washed away, and coastal agriculture has been disrupted, leading more people to move to Ecuador's overcrowded coastal cities. The lessons learned in both Ecuador and Rhode Island will be shared to aid future hazard mitigation planning initiatives.

The new contract is the second awarded under a four-year agreement with the University of Rhode Island as part of its ongoing work as USAID's flagship for advancing effective coastal management internationally. CRC has published a book on its work in Ecuador, "Eight Years in Ecuador: The Road to Integrated Coastal Management," which is used in coastal management training courses worldwide.

For further information contact: Don Robadue, Coastal Resources Center, University of Rhode Island, Narragansett, RI 02882 USA. Tel: 401-874-6128. FAX: 401-789-4670. E-mail: robadue@gso.uri.edu.

EUROPE

UNITED KINGDOM

Implementing the European Community's Habitats Directive: Keeping it Simple!

In 1992, United Kingdom marine conservation was given long overdue impetus by the adoption of the Habitats Directive by member states of the European Community (EC). The aim of this legislation was to strengthen the United Nations' 1992 Convention on Biodiversity by protecting rare and threatened habitats and species, through the designation of sites called Special Areas of Conservation (SACs). Together with Special Protection Areas (important areas for birds designated under the Birds Directive), SACs form a network called Natura 2000. The aim of this network is to maintain 'favourable conservation status' for the rarest wildlife across the EC.

This was an important step for marine conservation because the Directive included estuarine and marine areas. For a coastal nation, the UK has had very limited success in establishing marine protected areas. While numerous voluntary marine management areas exist, there are currently only three sites with statutory protection. By implementing the Habitats Directive, approximately 50 sites will be protected as SACs or 'European marine sites' by 2004, representing significant progress in the management of the marine assets.

There are several hurdles to overcome before these candidate sites are formally designated, but UK government policy is to tackle implementation now. Due to the piecemeal way in which maritime issues are currently

regulated, new mechanisms are necessary to facilitate implementation. Organizations which have not traditionally been allies are establishing new and effective working relationships bound by their common duty to implement the Habitats Directive.

A good working model for the development of this process is in place at one of the smaller SAC sites, the Fal and Helford estuaries in southwest England. This area was previously covered by a voluntary coastal zone management project in which many of the key organizations participated. Without this groundwork, implementing the Habitats Directive would have been far more arduous, as shown by many other sites. The aim is by March 1999, to have the Fal and Helford candidate SAC be the first operational SAC, certainly in the UK and possibly in Europe.

The management issues covered at the Fal and Helford sites relate to one of the four habitats for which the site has been selected as a SAC, its subtidal sandbanks. These consist predominantly of unattached calcareous algae, commonly called maerl, which are present in both live beds and dead deposits. In addition, there are areas of eelgrass (seagrass), another threatened marine species. Despite the fragility of these areas, they are subject to recreational and occasionally commercial anchoring, which is especially damaging to eelgrass and live maerl. The dead maerl is also suction dredged for use as a soil conditioner. The management scheme will need to address the impacts of these activities within the context of both nature conservation and their socioeconomic role within this area.

To integrate these competing objectives, an open and pragmatic process has been adopted, building on the trust that already exists. Above all, simplicity is stressed in what can be an overwhelmingly complex process. The true value of this approach is being measured in the speed and relative ease in which these management issues are being resolved. While in the USA and Australia these principles are nothing new, coastal zone management in the UK is still struggling to find its feet. In the Fal and Helford estuaries, the UK is perhaps showing something of its true potential to effectively manage the marine environment.

For further information contact: Samantha Davis, Falmouth Bay & Estuaries Initiative, Lander Building, Daniell Road, Truro, Cornwall, UK TR1 2DA. Tel: +44(0)1872 323607. FAX: +44(0)1872 240423. E-mail: sdavis@rmplc.co.uk.

Intercoast on the Worldwide Web

The most recent issues of *Intercoast* are now available on the Coastal Resources Center's Worldwide Web site at http://crc.uri.edu. Beginning with Issue #30 on Coastal Zone '97, the full text of *Intercoast*, as it appears in the printed version, will be available in PDF format to be downloaded. In addition, *Intercoast* #28, #29 and *Intercoast's* Special Edition #1 are also available, however not in downloadable format.

Intercoast #30–Coastal Zone '97 (Winter 1998) (PDF)
Intercoast #29–Indicators (Fall 1997)
Intercoast Special Edition #1–Mangroves (Spring 1997)
Intercoast #28–Gender (Fall 1996)

INTERCOAST SIDER FORMATION

Electronic Resources

Aquaculture Network Information Center. Publications, newsletters and links to other aquaculture sites are found here. Address: http://ag.ansc.purdue.edu/aquatic.

Aquanet. This site covers a variety of topics including aquaculture, conservation, fisheries, maritime heritage and ocean engineering. Address: http://www.aquanet.com.

Aquatic Sciences and Fisheries Thesaurus. A list of terms used by ASFA indexers to describe the contents of publications in a consistent, comprehensive and concise manner. This on-line thesaurus is a rudimentary version of a fully interactive thesaurus that will be completed in the near future. The present version does not reproduce the printed thesaurus in its entirety. Address: http://www.csa.com/craig/cd.html.

Department of Fisheries and Oceans of the Government of Canada. This site provides useful information and links to the three priority areas under Canada's new Oceans Act including Marine Protected Areas, Integrated Coastal Zone Management, and Marine Environmental Quality as well as links to a number of other related subjects. Address: http://www.OceansConservation.com.

Estuarine Research Federation (ERF). ERF is an international organization whose purpose is to promote research in estuarine and coastal waters, to promote communication between members of affiliated societies, to conduct meetings and to be available as a source of advice in matters concerning estuaries and the coastal zone. Address: http://www.erf.org.

FAO Report on Climate Change Impacts. This site contains a publication that focuses on the potential impacts of sea level rise on the world's coastal populations and agriculture. This is a global study mostly based on national data. Address: http://www.fao.org/sd/EIdirect/EIre0045.htm.

H. John Heinz III Center for Science, Economics and the Environment. At this site is the United States National Oceanic and Atmospheric Administration and the Heinz Center's report "Our Ocean's Future: Themes and Issues Concerning the Nation's Stake in the Ocean" and other information for improving the scientific and economic foundation on environmental policy. Address: http://www.heinzctr.org.

Index of Watershed Indicators (IWI). This site is the U.S. Environmental Protection Agency's first national picture of watershed health. The Index organizes and presents aquatic resource information on a watershed basis. Address: http://www.epa.gov/surf/iwi.

International Ocean Institute (IOI). The IOI is an independent, nongovernmental organization devoted to studying and preserving the world's oceans. The IOI has its headquarters in Malta, and Operational Centres in Canada, China, Costa Rica, Fiji, India, Japan, Malta, Senegal and South Africa. This page is sponsored by IOI-Canada. Address: http://www.dal.ca/ioihfx.

Sustainable Ecosystems and Communities. This is a U.S. Environmental Protection Agency web page designed to promote "Community–Based Environmental Protection." It addresses environmental priorities and economic well-being of communities. Tools, financial resources, case studies, publications and documents, and links to related sites are provided. Address: http://www.epa.gov/ecocommunity.

Water Quality Information Center at the National Agricultural Library. This site has an annotated listing of funding sources related to water resources. Address: http://www.nal.usda.gov/wqic/funding.html.

Publications

Canada's Oceans Strategy. Coastal Zone Position Paper. The Province of British Columbia (Canada) has now formally stated its position on coastal management in a position paper released in June 1998. It is downloadable at http://www.luco.gov.bc.ca/news/whatsnew.htm.

Coastal Seas: The Conservation Challenge. 1998. By John R. Clark. A succinct, technical reference of coastal zone resource management deals mostly with methodology and provides practitioners, scholars and student with the ideas, tools, materials and strategies needed to manage coastal resources. ISBN 0-632-04955-3. Blackwell Science, Osney Mead, Oxford OX2 0EL, England. Tel: 01865 206206.

Economic Valuation of Natural Resources: A Handbook for Coastal Resource Policymakers. This handbook is a result of a series of workshops on environmental valuation. Workshops of this sort are currently being offered (see Training section of Insider Information). National Oceanographic and Atmospheric Administration Coastal Ocean Program Decision Analysis Series No. 5. Contact: NOAA, Coastal Ocean Office, 1315 East West Highway, Sta. 15140, Silver Spring, MD 20910 USA. Tel: 301-713-3338. FAX: 301-713-3338. E-mail: dscavia@hq.noaa.gov.

Indonesia Natural Resources Management Program Newsletter. NRM News. May 1998. Quarterly Newsletter. Volume 1/No. 1. Contact: NMR News, Jl. Madiun No. 3, Menteng, Jakarta 10320 Indonesia. Tel: 230 5502. FAX: 327 301.

La Niña is on the Way. The 1997-98 El Niño was one of the most significant climatic events of the century. As it finally disperses, La Niña conditions are now developing. La Niña features colder than normal sea surface temperatures in the tropical Pacific Ocean. The cooling trend is likely to continue with the development of La Niña conditions during the next three to six months. The long-lead climate outlooks are available at: http://nic.fb4.noaa.gov. For further information on La Niña, visit our website at http://www.publicaffairs.noaa.gov/lanina.html.

Large Marine Ecosystems of the Indian Ocean: Assessment, Sustainability, and Management. 1998. K. Sherman, E. Okemwa and M. Ntiba (eds.). Marine experts from countries of East Africa and southern Asia describe the conditions of marine resources of the large marine ecosystem of the Indian Ocean. 394 pages. Contact: Marston Book Services Ltd., PO Box 269, Abingdon, Oxon OX 14 4YN, England. Tel: 44-01235-465500. FAX: 44-01235-465555.

Conference proceedings from the combined conference of the 13th Australasian Coastal and Ocean Engineering Conference and the 6th Australasian Ports and Harbours Conference. Christchurch, New Zealand, September 1997. Copies of the two 550-page volumes which contain 180 papers on research and practical examples covering topics related to coastal management, engi-

neering, ports and harhors. The international price is $NZ195 or $US125 (packing and postage included). Details of the contents can be seen on the WWW at http://www.cae.canterbury.ac.nz/coastal/pacific.htm, where on-line ordering is available. To order directly contact: Una O'Grady, Centre for Advanced Engineering, University of Canterbury, Private Bag 4800, Christchurch, New Zealand. E-mail: u.ogrady@cae.canterbury.ac.nz. Tel: 64 3 364 2474. FAX: 64 3 364-2069.

Perverse Subsidies: Tax Dollars Undercutting Our Economies and Environments Alike. 1998. By Norman Myers and Jennifer Kent, 200 pages plus charts and tables. Price $20. ISBN 1-895536-09-x. Further information about this publication can be viewed at: http://iisd.ca/about/prodcat/govern.htm#perverse. International Institute for Sustainable Development, 161 Portage Ave. East, 6th floor, Winnipeg, Manitoba R3B 0Y4 Canada. Tel: 204-958-7700. FAX: 204-958-7710. E-mail: reception@iisd.ca.

Rocking the Boat, Conserving Fisheries and Protecting Jobs. 1998. By Ann Platt McGinn, Worldwatch Paper #142, An in-depth analysis concerning the status and future of global fisheries, including the potential economic and social benefits and losses, as well as possible solutions to the problems facing us. Worldwatch Institute, 1776 Massachusetts Ave., NR, Washington, DC 20036 USA. Tel: 202-452-1999. FAX: 202-296-7365. E-mail: wwpub@worldwatch.org.

Swedish Environmental Protection Agency. The Swedish EPA has recently published "Criteria for the Selection of Marine Protected Areas," 1998 Swedish EPA Report #4834. Contact: Customer Services, Swedish Environmental Protection Agency, SE-106 48 Stockholm, Sweden. E-mail: kundtjanst@environ.se.

United States Environmental Protection Agency's State Water Quality Standard. On June 18, EPA released a national strategy outlining the process and approach for the development and adoption of numeric criteria for nutrients for state water quality standards. EPA will develop nutrient guidance documents for various types of waterbodies (e.g., rivers, lakes, coastal waters and wetlands) over the next several years. The Nutrient Strategy is available at http://www.epa.gov/ostwater/Rules/nutrient.html or contact Bob Cantilli. Tel: 202-260-5546.

Voluntary Industry Codes of Conduct for the Environment. This technical paper provides guidance on how to develop and effectively use codes of conduct. It identifies how these codes can be used as a tool to contribute to sustainable development. Contact: SMI (Distribution Services) Limited, P.O. Box 119, Stevenage, Herfordshire SG1 4TP England. FAX: +44-1438-748-844. E-mail: unepie@unep.fr.

SEACAM Publications. For free copies of the following publications contact E-mail:Seacam@virconn.com.

Linden, O. and Lundin, C. (eds) 1997. *The Journey from Arusha to Seychelles: Successes and Failures of Integrated Coastal Zone Management in Eastern Africa and Island States.* Report published by Sida (Stockholm) in cooperation with the World Bank and the Government of Seychelles.

Lundin, C. and Linden, O. (eds). 1997. *Integrated Coastal Zone Management in Mozambique.* Report published by Sida (Stockholm) in cooperation with the World Bank and the Government of Mozambique.

Moffat, D. and Kyewalyanga, M. (eds). 1998. *Local and Community Integrated Coastal Zone Management. Experiences from Eastern Africa.* Report published by SEACAM in cooperation with WIOMSA, GTZ and Sida. Contact SEACAM (E-mail: Seacam@virconn.com) for free copies.

Humphrey, S. and Francis J. (eds). 1997. *Sharing Coastal Management Experience in the Western Indian Ocean.* Published by Western Indian Ocean Marine Science Association (WIOMSA).

Proceedings from Secretariat for Eastern African Coastal Area Management (SEACAM), March 1998 Zanzibar Workshop. On March 4-7, 1998, over 60 stakeholders from Eastern Africa and beyond met to discuss what constitutes a successful local and community integrated coastal management project.

Conferences

November 8-13. 51st Annual meeting of the Gulf and Caribbean Fisheries Institute. U.S. Virgin Islands. Fort Pierce, FL, USA. Contact: R. LeRoy Creswell, Harbor Branch Oceanographic Institution, 5600 U.S. 1 North, Fort Pierce, FL 34946, USA. Tel: 516-465-2400 ext. 405. E-mail: creswell@hboi.edu.

November 8-14. Second International Conference on Wetlands and Development. Dakar, Senegal. Contact: Maria Pierce, Wetlands International, Marijkeweg 11, PO Box 7002, 6700 CA Wageningen, the Netherlands. Tel: 31-317-474711. FAX; 31-317-474712. E-mail: pierce@wetlands.agro.nl/wetl_sen.html.

November 11-14. Fifth Asian Fisheries Forum. Chiangmai, Thailand. Contact: Aquatic Resources Research Institute; Ninth Floor, Institute Building No. 3; Chulalongkorn University; Bangkok 10330; Thailand. Tel: 011-662-2188-1603. E-mail: ardic@chulkn.car.chula.ac.th.

November 16-19. Confronting Uncertainty in the Evaluation and Implementation of Fisheries Management Systems. Cape Town, South Africa. Contact: Dr. T.K. Stokes, CEFAS, Lowestoft Laboratory, Lowestoft, Suffolk NR33 0HT, England, UK. E-mail: kevinstokes@compuserve.com or t.k.stokes@cefas.co.uk.

November 23-27. Biodiversity, Biotechnology and Biobusiness. Perth, Australia. 2nd Asia–Pacific Conference on Biotechnology. Contact: Biodiversity, Biotechnology and Biobusiness, Congress West Pty Ltd, P.O. Box 1248, West Perth WA 6872, Australia. FAX: 61-8-9322 1734. E-mail: biodiversity@science.murdoch.edu.au.

November 29-December 3. Annual Conference of the International Ocean Institute. Halifax, Nova Scotia, Canada. Theme: The Crisis of knowledge. Contact: IOI—Canada, Dalhousie University, 1226 LeMarchant Street, Halifax, Nova Scotia B3H 3P7, Canada. Tel: 902-494-1737. E-mail: ioihfx@dal.ca.

December 8-10. Marina 98. Cape Town, South Africa. Contact: Liz Kerr, Conference Secretariat, Marina 98, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton, SO40 7AA, UK. Tel: 44 01703 293223. FAX: 44-01703-292853. E-mail: liz@wessex.ac.uk. Web site: http://www.wessex.ac.uk/conferences/marina98/.

January 25-28, 1999. 16Th Annual Pacific Basin Coastal Zone Management Conference. Tumon Bay, Guam. Theme: Getting The PICTURE. The art of combining Partnerships, Information, Communications and Technology in Usage and Responsible Management of the Environment. Contact: Michael L. Ham, Guam Coastal Management Program, P.O. Box 2950, Hagalna, Guam 96932. E-mail: mham@kuentos.guam.net.

February 13-18, 1999. Glacial-Interglacial Sealevel Changes in Four Dimensions. Albufeira (Algarve), Portugal. Contact: Josip Hendekovic, European Science Foundation, 1 quai Lezay-Marnesia, 67080 Strasbourg Cedex, France. Tel: 33 3 88 76 71 35. FAX: 33 3 88 36 69 87. E-mail: euresco@esf.org. Web site: http://www.esf.org/euresco.

May 17-21, 1999. 6th International Symposium

on Model Estuaries, Biogeochemistry of Tropical Estuaries: Human and Natural Changes. Rio de Janeiro, Brazil. Contact: 6th International Symposium on Model Estuaries, Dpt. De Quimica-PUC/RJ, Rua Marques de Sao Vicente No. 225, Rio De Janeiro, Brazil CEP:22453-900. FAX: 55 21 529 9569. E-mail: estuary@rdc.puc-rio.br.

J**uly 24-30, 1999.** Coastal Zone '99 (CZ'99). San Diego, California USA. The 11th biennial international symposium on coastal and ocean management. FAX: 617-287-5575. E-mail: cz99@umbsky.cc.umb.edu. Web site: omega.cc.umb.edu/~cz99.

November 2-6, 1999. Mediterranean Coastal Environment (MEDCOAST'99) and the Environmental Management of Enclosed Coastal Seas (EMECS'99). Antalya, Turkey. This symposium aims to contribute to coastal and Marine conservation in the Mediterranean and the Black Sea, through improved integrated coastal management practices. Abstracts due November 30, 1998. Contact: MEDCOAST Secretariat (MEDCOAST 99-EMECS 99 Joint Conference, Middle East Technical University, 06531 Ankara, Turkey. Tel: 90 312 210 54 29/40/30/35. FAX: 90 312 210 14 12. E-mail: medcoast@rorqual.cc.metu.edu.tr.

Training and Education

Environmental Valuation Workshops. A NOAA Coastal Ocean Program Regional, State and Local Outreach project will provide comprehensive background on the current state-of-the-art in economic techniques for valuing environmental resources and services (environmental valuation) and their applications to regional, state and local planners; coastal zone, marine sanctuaries and estuary managers; and natural resource trustees. The workshop is designed to assist participants in understanding environmental valuation, the tradeoffs society is making, factors that should be considered in making these tradeoffs, data that are useful in making such assessments, and the questions valuation economists can help answer.

National Water Quality Database on Water Navigating the Uncertain Waters of the 21st Century: The Role of New Technologies in Building a Competitive and Secure Maritime Infrastructure. There is a pressing need for a national and international dialog on how the revolution in navigation and information systems will affect the maritime backbone of an increasingly global economy. The Institute of Navigation, the National Oceanic and Atmospheric Administration, and the U.S. Coast Guard Academy Center for Advanced Studies is sponsoring a series of workshops centered on waterways management. For information on the conference series, contact: Steven Flynn, Tel: 860-444-8369. E-mail: sflynn@exmail.usc ga.edu. or Vincent Wilczynski, Tel: 860-444-8678. E-mail: vw@alum.mit.edu.

Nongovernmental Training Courses. The Secretariat for Eastern African Coastal Area Management (SEACAM) will be offering a series of NGO training courses. The objective of all the training courses is to improve the project development and management skills of national NGOs working on local and community coastal management projects. Participants will be representatives from local NGOs implementing local and community coastal management projects. For information contact: SEACAM, 874 Av. Amilcar Cabral, Caixa Postal 4220, Maputo, Mozambique. Tel: 258-1-300641/2. E-mail: Seacam@virconn.com. These will be held on the following dates

Sept. 28-Oct. 2, 1998. NGO Training Course in Tanga, Tanzania. Representatives from Tanzania, Kenya and IUCN's East African Regional Office and Tanga Project.

Nov. 23-27, 1998. NGO Training Course in Cape Town, South Africa. Participants from South Africa, Namibia and Eco-Africa.

February 1999. Moroni, Comoros. Representatives from Comoros, Seychelles, Madagascar and the Indian Ocean Commission.

April 1999. Mauritius. Representatives from Mauritius, Reunion, the Indian Ocean Commission and MACOSS (umbrella NGO).

Training Course for Coastal Management. The Western Indian Ocean Marine Science Association (WIOMSA), in cooperation with the Coastal Resource Center, University of Rhode Island (CRC/URI) and a number of other regional partners, will offer a two-week regional training course for coastal management practitioners from East and South Africa and the Island States including Comoros, Eritrea, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, South Africa and Tanzania. This course will be offered in the region during the first quarter of 1999. See the next issue of *Intercoast* for further details.

Freshwater Marsh

(continued from page 11)

certainly be economically justifiable to continue to maintain the shingle ridge on the current basis.

3. Three important considerations need additional attention. First, following the breaches in 1996, the cost of maintenance of the shingle ridge increased by at least a factor of six. Should such breaching events become more common, then the economic case for protection using the existing approach becomes less clear-cut. Second, the SMP states that the current form of protection is not sustainable in the medium to long term. This relates to the arguments for managed retreat: resilience to stress and shock. This argument remains valid and will become increasingly important as sea level rises. Third, the results of this very localized survey must be considered in the broader context of the North Norfolk coast, as should the potential environmental impacts of any coastal-defense option of the Cley Reserve on the adjacent coast.

4. Additional research is required to address these and other considerations. Irrespective of the outcome of future research, however, the message from this study is clear: a significant recreational benefit can be accrued from a more sustainable defense scheme, designed to protect as much of the Cley Reserve as possible in its present form.

For further information contact: Peter Doktor, Conservation Officer, Norfolk Wildlife Trust, 72 Cathedral Close, Norwich NR1 4DF, United Kingdom, Tel.: +44 1603 625540, Fax: +44 1603 630593, E-mail: nwt@cix.compulink.co.uk.

Author's addresses: Richard J.T. Klein, Vrije Universiteit, The Netherlands. E-mail: richard.klein@ivm.vu.nl and Ian J. Bateman, University of East Anglia, United Kingdom. E-mail: i.bateman@uea.ac.uk.

Hazard Mitigation

(continued from page 13)

stewardship and coastal development in RI. The purpose of Rhode Island Sea Grant is to foster conscientious management of coastal resources in partnership with communities, while RIEMA's goal is to ensure that the state and its communities are prepared to respond to and recover from natural and technological hazard events. RIEMA also encourages communities to take action before disaster strikes, to minimize damage and therefore reduce recovery costs for federal, state and local governments. FEMA is the national agency whose mission guides the work of the state emergency management agencies. The mission of IBHS, a national non-profit organization supported by property insurers in the United States–both personal and commercial–is to reduce deaths, injuries, property damage, economic loss and human suffering caused by natural disasters.

The activities generated from this partnership include:

- Rhode Island Sea Grant is helping RIEMA work at the community level to incorporate mitigation planning into the state-mandated local comprehensive planning process.
- RIEMA is working with IBHS to make RI a 'Showcase State.' This designation will be based on the adaptation of a set of 14 criteria established by IBHS to provide a framework for creating disaster-resistant communities. These criteria reflect the IBHS strategic plan, organized around five key result areas: public education and outreach, land use, new construction, retrofit of existing structures and information management. Following are a few examples of the criteria:
  - Adoption of a statewide building code, enforced without amendment at the local level (affects new construction)
  - A model wind- and flood-retrofitted home, for statewide professional and student education and training (retrofit; public and private sector financial incentives will be developed to encourage homeowners to implement these measures)
  - Non-structural retrofit of child care centers (public education and awareness).

Through their initiatives, Rhode Island Sea Grant and IBHS are both helping RIEMA develop statewide standards for mitigation. IBHS, RIEMA and Rhode Island Sea Grant are working together to establish a statewide Disaster Recovery Business Alliance, which will provide the linkage between businesses and the state for coordinated mitigation, preparedness, response and recovery.

Insurers have long known that mitigation (i.e., action with a long-term impact to reduce risks to human life, property, natural resources and the economic health of our communities) is essential to reduce insured losses and to maintain communities' economic viability. The insurance industry was instrumental in starting fire brigades, creating building codes and pushing for seat belts and air bags in autos. Now, IBHS is articulating a strong natural hazard loss reduction program and is working to make mitigation a national value by helping to create a public demand for safe communities and structures. IBHS is working to reduce the likelihood of future insured disaster losses. The RI Hazard Mitigation Project is a work in progress, one worth following.

For further information contact: Diana L. McClure, Director of Showcase Communities and Special Projects, Institute for Business and Home Safety, 175 Federal Street, Suite 500, Boston, MA 02110-2222 USA. Tel: 617-292-2003. FAX: 617-292-2022. E-mail: dmcclure@ibhs.org.

Overfishing

(continued from page 15)

catch in most cases. The United States and Japan have similar agreements with nations of the South Pacific.

With mounting pressures from both foreign and domestic boats, the terms of access agreements are coming under increasing scrutiny. A key issue concerns the benefits countries forgo by allowing others to extract their own natural wealth and who benefits from the price paid for access.

Perhaps the best way to fathom the full cost of overcapacity and overfishing is to realize that globally, fishers forfeit profits on the order of US$25 to US$30 billion and marine catches of nearly 20 million tons because fisheries are not managed properly.

If the industry is to survive, it will need to move quickly into an era of precautionary management and sustainable fishing. Among the key elements are steps to protect habitat areas, reduced fishing effort and the reform of faulty economic signals. A more fundamental change in fisheries management is also important. The key to sustainable fishing is not deciding who takes how many fish, but how to balance the need to supply food and jobs with the needs of the resource.

(Excerpted from Anne Platt McGinn, *Rocking the Boat: Conserving Fisheries and Protecting Jobs*, Worldwatch Paper No. 142, Worldwatch Institute, Washington, DC, USA, June 1998.)

For further information contact: Anne Platt McGinn, Worldwatch Institute, 170 Fourth St., Providence, Rhode Island 02906 USA. Tel/FAX: 401-861-8031. E-mail: amcginn@igc.org. Web site: www.worldwatch.org.

Aquaculture

(continued from page 17)

Finally, the aquaculture industry members themselves can help their overall long-term economic situation by organizing a local producers organization. Industry organizations of this type can set professional standards, define customary and best management practices and bring their concerns to government agencies with a stronger, unified voice. More importantly, a professional aquaculturists' association in the Dagupan City area can restore the process of informal self-policing by peer pressure. Industry pressure may be the most effective means for controlling unregistered and unlicensed operations that have been alleged to be a key villain in this version of the 'Tragedy of the Commons.'

(This paper is condensed from an article appearing in *World Aquaculture* (1998) 29(1):18-25.)

For further information contact: Michael A. Rice, Department of Fisheries, Animal and Veterinary Science, University of Rhode Island, Kingston, RI 02881 USA. Tel: 401 874-2943 E-mail: rice@uriacc.uri.edu. or Arthur Z. DeVera, Bureau of Fisheries and Aquatic Resources, 860 Quezon Ave., Quezon City, 1103 Philippines Tel: 632 927-7871. E-mail: bfar@vlink.net.ph.

Benefits

(continued from page 19)

the perceived need for other activities and improvements to the harbor. A museum, aquarium, fish market, ferry trips along the coast, and wildlife/bird watching boat trips were requested by 40 percent of locals and visitors. These figures demonstrate that perhaps the existing coastal resources are not fully utilized. In addition, basic harbor facilities such as fueling facilities, showers, toilets, lighting and landscaping were requested by 30 percent of locals, visitors and/or boat users. The fact that locals (87 percent), visitors (75 percent) and boat users (84 percent) said that they were generally willing to pay towards harbor improvements, again indicates unsatisfied economic demand.

A key recommendation from Phase 1 was that a Harbor Improvement Plan should be developed to assess the opportunities for increasing the efficiency and overall economic benefits of the existing harbor. This would be achieved by evaluating the provision of small-scale harbor facilities and infrastructure, and reviewing harbor management practices and charging structures.

Belderrig Harbor, Ireland

In County Mayo, Ireland, a study is looking at opportunities for developing Belderrig Harbor. The existing harbor is a single harbor wall extending into a relatively natural but otherwise unprotected bay along an undeveloped section of coast. The harbor wall currently provides protection to six or seven fishing boats. With declining fish catches, reduced profit margins and further unemployment looming, the local community and harbor users are interested in opportunities to diversify the coastal activities it offers.

The options include building an outer breakwater, inland dredging, providing basic infrastructure and facility improvements, and doing nothing. Again, a questionnaire survey is being used, only this time targeted towards specialists and organizations knowledgeable about both the area and the appropriateness of developing potential coastal activities. Key activities being evaluated include, among others, sailing, sea angling, SCUBA diving, various adventure watersports and specialist educational and pleasure boat trips.

A strengths, weaknesses, opportunities and threats (SWOT) analysis is being used to investigate the full potential of each activity. First impressions suggest that the site would be perfect for developing a safe haven for the rapidly expanding yachting activity in Ireland. It could act as a vital stepping stone linking the northern and southern sections of the west coast of Ireland. However, initial investigations, particularly into site-specific oceanic conditions and weather patterns, reveal significant potential access restrictions.

The economic analysis is currently underway and is identifying both the potential net economic benefits from the full range of development options. An attempt is also being made to address any potential economic losses associated with developing a section of relatively unspoiled coastline. Indications so far suggest sufficient benefits to justify small-scale improvements and facilities to support increased levels and diversity of recreational activities.

An underlying objective of any coastal development scheme or management plan must be to investigate all potential coastal-related uses and non-use values and their associated costs. Through such careful comparisons of benefits and costs, those involved can better understand how best to optimize the net benefits from a combination of market and non-market services provided in coastal areas.

For further information contact: James Spurgeon, Gibb Ltd, Gibb House, London Rd, Reading, England RG6 1BL.. E-mail: jspurgeo@gibb.co.uk.

In the Next Issue of *Intercoast*

Many coastal management initiatives–particularly in regions where the pace of change is rapid and institutions are weak–fail to make the transition from planning to implementation. Why are there so many plans, laws and regulations, and protected areas that look so good on paper but mean so little in practice? Why is compliance with some regulations low when others benefit from energetic self-enforcement? This next issue will explore these questions of **Implementation and Compliance.**

Intercoast also includes articles on general coastal issues and 'Reports from the Field,' summarizing projects and achievements or initiatives. *Intercoast* also includes '*Intercoast* Insider Information;' listing upcoming conferences, new publications, web sites, training and other useful items.

Articles should be 750-1,500 words, and 'Reports from the Field' are 250-500 words. Photos, maps and other graphics are strongly encouraged. We do edit articles as necessary to fit the available space.

To contribute to *Intercoast* #33, contact Managing Editor, Noëlle F. Lewis, Coastal Resources Center, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI, 02882 USA. Tel: 401-874-6870. FAX: 401-789-4670. CRC Web site: http://crc.uri.edu. E-mail: noelle@gso.uri.edu.

Deadline date is December 15, 1998. Articles can be submitted electronically.

Thank you.

Intercoast Network

Editor: Stephen B. Olsen
Managing Editor: Noëlle F. Lewis
Designer: Matt Castigliego

Intercoast is an international newsletter of coastal management, published three times each year by the Coastal Resources Management Project of the University of Rhode Island's Coastal Resources Center (CRC) and the U.S. Agency for International Development (USAID). Funding to publish *Intercoast* is provided by USAID's Global Environment Center, with assistance from the National Institute for Coastal and Marine Management (RIKZ), The Netherlands.

The objective of *Intercoast* is to facilitate information exchange on coastal management. Readers are invited to contact Noëlle F. Lewis, Managing Editor, with questions and comments on *Intercoast* and its effectiveness as a source of information on coastal management.

Intercoast Network
Noëlle F. Lewis
Coastal Resources Center
University of Rhode Island
Narragansett Bay Campus
Narragansett, RI 02882 USA
Tel: 401-874-6870
FAX: 401-789-4670
E-mail: noelle@gso.uri.edu

Intercoast invites others to reprint articles found in *Intercoast*. We would appreciate if you would contact Noëlle F. Lewis, at the above address, for permission.

Coastal Resources Center
University of Rhode Island
Narragansett Bay Campus
Narragansett, RI 02882 USA
Address service requested

Nonprofit
Organization
U.S. Postage
PAID
Wakefield, RI
Permit No. 19