

INTERCOAST

N E T W O R K

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As Water Flows, So Goes the Health of Our Coasts

By Richard Volk

Enormous physical and geological forces have conspired over eons to shape and define the world's coasts. The flow of freshwater from the land, the ebb and flow of tides, and, of course, wind and waves dutifully re-charge our coasts with massive energy and essential nutrients, sediments and oxygen. The result is biological productivity and ecosystem services that are virtually unparalleled elsewhere on earth.

In just a few short centuries, and largely in just a few short decades, an additional force of profound enormity has ventured to join the show. Over half of today's global population (about 3.2 billion people) lives within 200 km of a coast. Not surprisingly, the interdependence between human populations and the coastal and marine environment is complex and strong. However, the notion that human well-being is dependent on the integrity of coastal ecosystems is one yet to gain full stature in global debate. Recognition of this interdependence is critical to our ability to forge effective resource management.

Equally important are our understanding and respect for the ecological continuum that is defined by a river basin, its sub watersheds, and its deltas, estuaries, bays, lagoons, and other coastal and offshore fea-

tures. Clearly, the health of seagrasses and coral reefs are dependent on water quality (among other variables) which, in turn, is largely dependent on the quality of water flowing from the land. Although there continues to be substantial loading of pollutants from ship-based activities, the great majority (over 80 percent) of pollution loads to the marine environment originate from human activities on land. Such 'Land-based Sources of Marine Pollution,' as they are known in the international arena, are the focus for this issue of InterCoast.

In 1995, governments of more than 100 countries met in Washington, DC, USA, and declared their commitment to minimize or reduce the environmental effects of land-based activities. The 'Washington Declaration,' as it is now known, further identifies the United Nations Environment Program (UNEP) as secretariat to a Global Program of Action (GPA) for the Protection of the Marine Environment from Land-based Activities (see Vandeweerd, page 3). Momentum is now gathering for the implementation of the GPA, and readers will find herein a good mix of articles on projects dealing with pollutant sources and environmental impacts from land-based activities.

The involvement of stakeholders and the integration of multiple sec-
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Land Use and Growth Management

By Rupert H. Friday II

Land use has an enormous impact on the coastal aquatic system of the Chesapeake Bay, Maryland, USA. The problems associated with land use and land management practices on the Chesapeake Bay are amplified by the high ratio of land to water. Thus, widespread land use changes significantly impact the bay's hydrology, water quality and ecology. These impacts promoted a sequence of management initiatives, each more extensive than its predecessors. The Chesapeake Bay offers a great case study in the challenges and opportunities for managing land use impacts on coastal systems.

Impacts of Landscape Changes on Aquatic Systems

Historically, the Chesapeake Bay watershed was almost completely forested. Over the past 300 years, the original forests were cleared for wood and agriculture. Today it is approximately 60 percent forested due to reforestation and forest management.

The bay's historic forest provided a buffer from climatic disturbances. Urban development and loss of forest cover has caused the watershed's hydrology to become more erratic. Storm flows in streams and
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InterCoast

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As Water Flows

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tors and levels of government are common to most approaches. These integrated efforts aim to develop management plans that deal with a set of priority issues at a basin or ecosystem scale. The Chesapeake Bay Program (see Friday, page 1) and the Gulf of Maine pilot project (see Reis, page 7) reflect the intricacies and challenges of cross-jurisdictional or transboundary resource management. The development of a comprehensive plan for Balikpapan Bay in East Kalimantan, Indonesia, (see Dutton, page 10) echoes those challenges and demonstrates the socio-cultural and economic importance of establishing an integrated process. The articles on managing essential habitat for the Pacific Salmon (see Ebbin, page 13) and watershed management on the Rhone River in France (see Henocque, page 20) further underscore the importance of managing at the river basin scale.

Of course, not all projects can be, or necessarily should be, undertaken at the basin scale. Taking local action has its own set of imperatives and challenges, and educating communities and their leaders is a universal prerequisite. The University of Connecticut's Nonpoint Education for Municipal Officials (NEMO) Project (see Nakashima, page 4) will be of special interest to readers interested in linking urban stormwater management to land-use changes at the watershed scale. Another U.S. East Coast example of involving local communities in planning comes from the University of Rhode Island's Sustainable Coastal Communities Initiative (see Kerr, page 18). Other articles on beach litter in the U.K. (see Williams, page 25) and the need for proper solid waste collection and landfill infrastructure (see Liffmann, page

22) highlight important management aspects of the ever-growing solid waste burden.

If land use activity and the treatment and disposal of urban and industrial wastes are two legs of the land-based activity stool, without doubt hydro-modification is the third leg. Here we must remember that water itself has served as the essential link between watersheds and our coasts over the millennia. Notwithstanding the importance of water quality, it is the timing and volume of freshwater inflows that are most critical to coastal health and productivity. Unfortunately, humankind has done a pretty good job at altering natural hydrologic flows.

Worldwide, there are today some 40,000 dams higher than 15 meters. And while the global population tripled to more than 6 billion in the past century, water withdrawals have increased more than six-fold. Three articles on water use examine the impacts on habitat (see Conides, page 6), on aquifer depletion (see Aguirre, page 12), and on marine impacts from desalination processes (see Alkaff, page 8). Let there be no doubt that the time has come for integrated water management worldwide, with balance between human needs and the instream flows needed to maintain estuarine productivity and the health of entire coastal ecosystems.

We are simply investing too little too late to stem the tide of destruction of coastal systems in many parts of the globe.

Worldwide, coastal urbanization is the trend, with 19 megacities (defined by the U.N. as having greater than 8 million inhabitants) now perched at the edge of the sea without adequate waste treatment and land use planning. Since 1970, the U.S. has spent more than \$500 billion on water pollution control. Yet we still let disappear some

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Global Protection of the Marine Environment from Land-based Activities (UNEP/GPA)

By Veerle Vandeweerd

Most of the oceans' problems start on land. This is where virtually all of the pollution originates. Factory and sewage wastes are discharged into rivers, fertilizer and pesticides are washed into rivers, metals and chemicals are emitted from cars and carried by runoff and winds, and clearing of forests is changing habitats.

Activities ruining coastal areas and changing habitats include explosive growth of coastal population, increased tourism, industrialization, expansion of fish farming, and development of ports. The pressures are even stronger along the coasts of many developing countries, where there is rapid population growth combined with persistent poverty, and where there is little capacity for resource management.

Global Programme of Action

The United Nations Environment Programme's Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) was adopted by 108 governments in 1995. The goal of the GPA is to prevent, reduce, control and/or eliminate marine degradation from land-based activities (see Box 1), and realize the duty of states to preserve and pro-

Box 1. The GPA Source Categories

- Sewage
- Persistent organic pollutants
- Radioactive substances
- Heavy metals
- Oils (hydrocarbons)
- Nutrients
- Sediment mobilization
- Litter
- Physical alterations and destruction

Box 2. Recommended Framework for Decisionmaking

1. Establish key principles that need to be taken into consideration when planning action
2. Provide an annotated listing of issues that need to be considered in addressing the LBA problems in an integrated manner. Issues include environmentally-sound practices and procedures for each source category and the conditions in which they are appropriate; references to comprehensive sets of technical/operational, legal/policy and economic measures, financing options and institutional arrangements; public education and awareness raising; and criteria and indicators for evaluation.
3. Provide practical guidance to stakeholders but have no legally binding character
4. Be agreed upon by stakeholders, UN agencies, and technical expert associations
5. Reflect regional characteristics, priorities and needs in regional annexes

tect the environment. The GPA is to give conceptual and practical guidance (see Box 2) to national and regional authorities and other stakeholders when devising and implementing the GPA goal.

Sustainable use depends on the maintenance of ecosystem health, public health, food security, and economic and social benefits. Many countries depend on activities that would be directly threatened by degradation of the marine environment.

Implementing the GPA is the responsibility of the national government (see Reis, page 7). However, as countries seek more socially viable forms of development, participation of all stakeholders, large and small, government and nongovernment, is

vital to achieve the GPA goals.

Specific tasks mandated for 2000-2001 include: developing and implementing the GPA Strategic Action Plan on Municipal Wastewater, and planning and

New GPA Studies

New studies will include (pending funding):

- Analyses of factors contributing to the failure/success of policy and economic responses to LBA
- Practical tools and methods that strengthen analytical capabilities at national/regional levels (e.g., transboundary diagnostic analysis, cost-benefit analysis, social impact assessment).

preparing for the first intergovernmental review of the GPA in 2001.

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Educating Municipal Officials: A Necessity for Watershed Protection

By R. Steven Nakashima, C. James Gibbons and Chester L. Arnold, Jr.

The United States' Environmental Protection Agency (EPA) has determined that stormwater runoff is the major source of polluted water in urban areas. Polluted runoff has become one of the hottest public policy issues facing state and local officials. EPA recently published federal regulations requiring local officials to prepare stormwater management plans that reduce impacts of polluted storm water. Required programs range from pollution

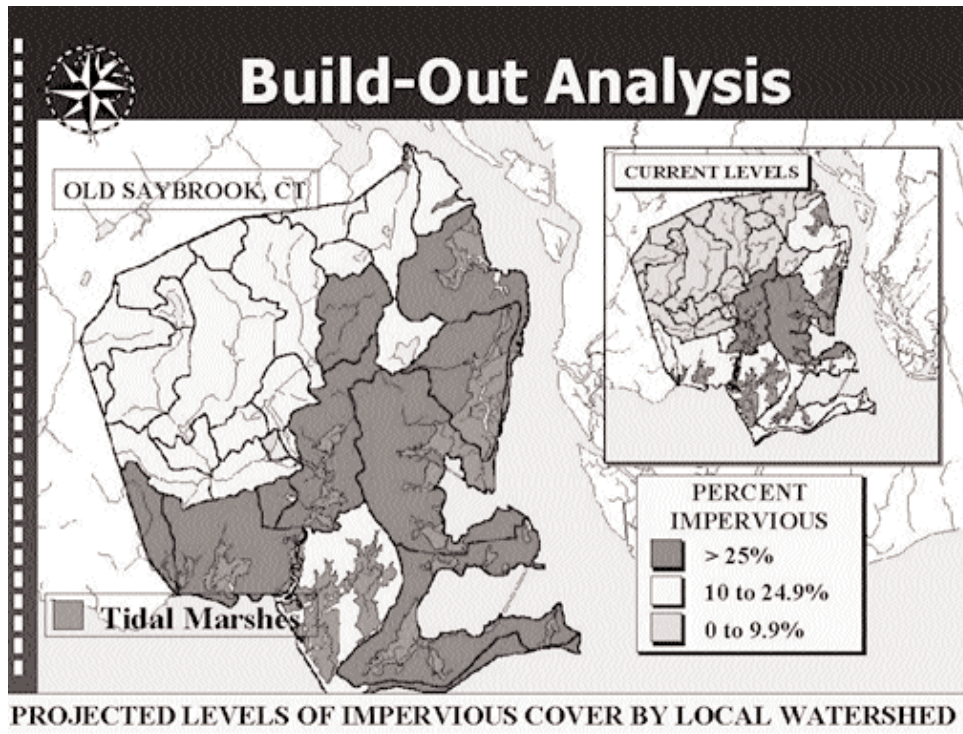
Project (NEMO) is a research-based educational program for preventing nonpoint source pollution. NEMO links water quality within a watershed to watershed land use. As land use increases, impermeable (waterproof) coverage increases generating increased polluted runoff. Therefore, to improve water quality, land use must change.

Land use in the US is largely decided locally by volunteers serving on county or municipal bodies responsible for planning, zoning and resource conservation. Many officials are elected or appointed.

for meetings with packed agendas requiring completion. Local land use regulations require compliance with state enabling legislation and an enormous amount of information needs to be reviewed by each member before rendering a decision. Members can not always discern the cumulative impacts of their often inadequately reviewed decisions. Recognizing that education is often placed at the bottom of commissions' "to do" list, NEMO has developed a program that is sensitive to the real-world of the local land use official. NEMO's materials and tools offer the opportunity to step back and look at the long-term consequences of their case-by-case decisions.

Impermeable Surfaces: An Indicator of Water Quality

While nonpoint source pollution is a complex issue involving many factors, NEMO suggests that local officials can use impermeable coverage as an indicator of both development and its impact on water resources. Use of impervious coverage is not just an off-the-cuff, overly simplified approach to water pollution. Research shows that impermeable surfaces negate the earth's ability to absorb and filter runoff. Instead of entering the land near point of contact, precipitation that hits an impervious surface flows over roofs, parking lots, roads, sidewalks or driveways increasing in volume and velocity before draining to storm drains or streams. While many land use boards have addressed soil erosion and sediment control, there are other pollutants of concern in storm water that have not been addressed. These include pathogens, toxins, debris and nutri-



prevention/good housekeeping to preventing runoff from small construction sites. Public outreach, participation and education are key components for these stormwater management plans.

The NEMO Challenge

The University of Connecticut's (Connecticut, USA) Nonpoint Education for Municipal Officials

The majority lack technical training and/or professional staff for developing land use plans, writing land use regulations or reviewing site plans. NEMO targets these local land use officials.

Educating local land use decisionmakers presents several challenges. Being a volunteer job, turnover is high. Commissions meet two or three times a month

ents as well as thermal pollution.

Research shows that when the impermeable surface within a watershed reaches 10 percent, water resources begin to be adversely impacted. At impermeable levels of 25 percent, water quality becomes degraded as the velocity and volume of the polluted runoff often overwhelms most in-place best management practices.

Many communities turn to size-of-lot zoning. They feel somewhat protected by using minimum lot sizes as a way to address the issue. National surveys indicate that one-acre zoning generates approximately 20 percent impermeable coverage due to road, driveway and sidewalk coverage. Add the asphalt surrounding commercial developments, and the true consequences are realized—land use patterns that create costly sprawl and negative impacts on natural resources.

NEMO utilizes the latest technology (e.g., remote sensing, geographic information systems (GIS) mapping, the Internet) to design educational programs that offer local officials a glimpse of their community's future. Using a build-out analysis, NEMO vividly demonstrates the amount of impermeable surface that will be generated if their community is built according to the traditional land use regulations adopted by the community. The build-out scenario is often a shocking image to local officials, allowing NEMO to gain their undivided attention, and to suggest ways communities can reassess their future destiny.

A Strategy for Reducing Polluted Runoff

NEMO suggests a three-tiered strategy that allows local officials to guide both conservation and development, with an emphasis on ways to diminish development's adverse impacts on water quality.

1. Natural resource-based land

use planning. This is at the heart of NEMO's strategy. A community needs to know what it has before it can determine what it needs. Thus, the first task is to identify the unique, fragile or endangered natural areas needing protection. The findings should be folded into an open space (OS) plan that prioritizes areas. OS plans also include areas deemed important for other reasons (e.g., town squares, tree-lined street, outdoor recreation, regulated wetlands and excessive slopes). The OS plan is then incorporated into a comprehensive town plan that identifies and prioritizes sites for development and conservation. Local zoning, planning and conservation regulations are then developed.

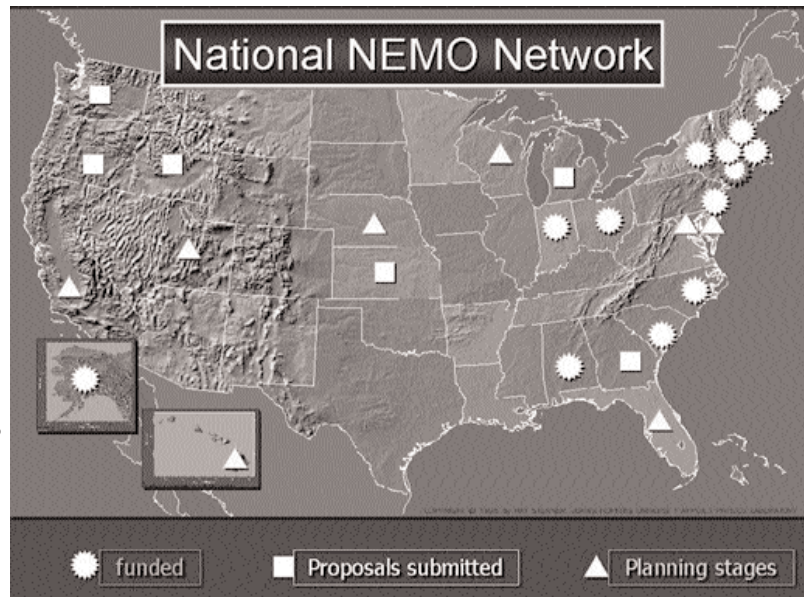
2. Site Design. Once the community reaches consensus about where to develop, it needs to establish standards on how. NEMO recommends means to ensure minimal impact on water resources, including open space subdivisions, road specifications, parking lot design and alternative types of porous pavement surfaces.

3. Land Management. Once there are site development standards, land management is assessed. While NEMO's target audience is local land use officials, it clearly recognizes the important role played by land owners, particularly forest and riparian land owners. A 'clean waters' program for homeowners discusses water friendly gardening practices, handling household hazardous materi-

als, and the care of septic sewage disposal systems.

Program Impact

NEMO's town and watershed programs have produced real local impacts, including changes to town plans, regulations and policies; adoption of watershed manage-



ment and open space plans; research and school programs; among others. In some instances, municipal boards that have never sat together as a combined unit have gathered for the first time for lively discussions during a NEMO program. At the state level, NEMO has been included in coastal and inland nonpoint source planning, and conservation and development planning.

National NEMO Network

Recognized throughout the US, NEMO is being copied in other states and territories. Currently, 13 states have a funded NEMO project; another 10 are seeking funding. To assist other programs during start-up, a National NEMO Network has been formed to provide a venue for those persons and organizations working on education of local officials to share ideas and

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Habitat Loss Caused by Water Withdrawal

By Alexis J. Conides, P.
Zaharaki and P. Zouganeli

Water withdrawal or activities that reduce river flow entering an estuary or lowering the water level can cause habitat alteration. These activities are done to supply freshwater or brackish water for human uses (e.g., water for cooling, for irrigation and agriculture, and for domestic use). Water withdrawal is often not directly associated with habitat loss or habitat alteration unless there is a rapid and/or significant visible change. Additionally, water withdrawal is more often associated with other forms of pollution that directly affect estuarine and riverine habitats. For example, thermal pollution often occurs when surface water is used as a coolant and returned to the waterbody. When groundwater withdrawal is intense, the aquifer can become exhausted, and groundwater salination can occur.

Most commonly affected is water salinity and temperature. Salinity of a waterbody depends on the quantity of water entering the watershed and the mixing with more saline marine water. In an estuary, when large amounts of water are withdrawn or inputs are decreased, the distribution and dynamics of the aquatic populations can be altered. In extreme cases, water withdrawals may change the ecosystem balance causing existing species to die or migrate out of the area while others migrate into the area. This loss or migration of species can upset the ecological balance causing significant changes.

Factors affecting estuarine habitat due to flow management can be summarized as follows:

- **Increased or decreased water volume/depth in an estuary or part of an estuary.** This is especially

important in estuaries with a complex geomorphology. Floodplains or near-shore areas where fish breed are lost, or the fish are prevented from reaching them. Also, changes in watershed drainage into an estuary can alter siltation patterns and water depth. A change in depth can significantly alter the distribution of aquatic vegetation.

- **Reduced water flow towards an estuary.** Dams reduce or stop the freshwater flow into an estuary either permanently or intermittently. In extreme cases, as during prolonged droughts when dilution is low, the estuarine ecosystem may be affected by increased salinity.

- **Thermal pollution.** Frequently, water is removed, used as a coolant and returned to the waterbody at a higher temperature. This may cause species' shifts or mortality and can inhibit upstream migration of fish.

- **Chemical pollution.** Changes in water chemistry can affect an ecosystem. The addition of untreated sewage, pesticides, industrial chemicals and fertilisers or other sources of nitrogen and phosphate may alter the water properties. Different effects will result depending on the waterbody's characteristics.

- **Shifts in sedimentation.** The natural transport of sediment from the watershed depends on slope, soil type, land use and rainfall. Changes in land use or climate can change these factors, changing sedimentation. In addition, dam construction and shoreline development causes sedimentation shifts.

- **Saltwater intrusion into groundwater.** Intensive groundwater withdrawal can shift the freshwater/seawater balance. In some estuaries saltwater intrudes underneath a freshwater lens causing a change in the conditions.

One or more of these events can change the ecological environment.

In general, withdrawals and flow management can change the physical habitat by reducing the water volume and depth, thus permanently or temporarily inundating or isolating parts of the estuary, most significantly affecting aquatic vegetation. Species' populations can also be affected by altering reproduction areas (floodplains and reed habitat).

The results can be economically significant if low commercial value species replace high commercial value species, or the alteration or loss of habitat affects reproduction of commercially valuable species. The volume of water withdrawals worldwide is increasing. In certain regions where freshwater is not readily available, desalination plants are being built without assessing the effects on the land or marine environments (see Alkaff, page 8). Since it is inevitable that water withdrawals will continue at an increasing rate to sustain the growing population, it is important that the effects be assessed before irreversible damage is done.

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GPA Implementation: A Pilot Project, Gulf of Maine, USA

By Kathryn Reis

The Commission for Environmental Cooperation (CEC) is a North American organization that fosters environmental cooperation on transboundary issues between the United States, Canada and Mexico. It was established in response to the United Nations Environment Program's Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA). The CEC selected the Gulf of Maine (GOM) as one of several pilot projects. The CEC established the Programme of Action Coalition for the Gulf of Maine (GPAC). This paper provides a summary of the experiences gained thus far in regional implementation of the GPA, and relates some of the lessons learned through that effort.

At the heart of the approach taken in the GOM is the reliance on a multi-stakeholder coalition,

Pollutant Priorities

- Pathogens (bacteria and viruses)
- Biocides
- Dioxins/furans
- Mercury
- Polycyclic aromatic hydrocarbons
- Petroleum hydrocarbons
- Nitrogen

consisting of approximately 34 members from state and provincial governments, federal governments, First Nations and Native Tribes, industry, nongovernmental organizations, community action groups and academia.

Experience gained in this effort has shown that the GPA is an excellent vehicle for focusing stakeholder attention on the land-based activities that degrade the

marine environment. The strategic approach that the GPA outlines is a valuable tool for establishing regional priorities and identifying strategies and actions to address these priorities.

The GPAC selected two principal areas of concern (contaminants and physical alterations to habitat) on which they would focus their attention. The GPAC commissioned scoping papers to identify the most important, specific issues in each area, their sources and related socioeconomic and environmental impacts.

The contaminants of concern included pathogens, organic and inorganic chemicals and other pollutants (see box, Habitat Alteration Priorities

At a workshop in 1998 in Portland, Maine, over 140 stakeholders from the region reviewed existing activities, identified gaps in current environmental protection and land-use programs, and developed an action package to reduce pollutants and protect and manage habitats. Fifteen top strategies were proposed. After careful review, the GPAC recommended that the CEC provide seed funding for five strategic initiatives that are currently in various stages of implementation.

These initiatives include:

1. A workshop to explore new institutional arrangements between the US and Canada
2. A conference to develop a research program and make policy recommendations for managing the harvesting of low tropic-level species
3. Expanding the capabilities of community-based organizations to

monitor water quality

4. Developing education materials on land-based sources of marine pollution

5. Establishing a regional database of salt marsh restoration opportunities and ways of evaluating their success

Although the real value of the GPA can only be assessed in the long term through the benefits gained, there have been a number of distinct short-term gains. These include establishment of a bi-national coalition on shared inter-

Habitat Alteration Priorities

- Development adjacent to and disruptive of coastal habitats
- Sewage and eutrophication in coastal waters
- Use of mobile fishing gear in coastal embayments
- Protection and restoration of salt marsh
- Tidal and freshwater hydraulic obstructions
- Impacts of aquaculture on habitats
- Harvesting of low tropic-level species and habitat
- Absence of "No-Take" reserves

ests, identification of the priority issues in the GOM, development of key strategies, and initiation of the five strategic initiatives mentioned above.

In addition, an issue of extreme importance on the community to country level and in developed and developing countries is how to institutionalize long-term GPA implementation and evaluation.

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Effects of Desalination Plants on the Marine Environment

By Huda F. Alkaff

In the last 40 to 50 years, Arabian Peninsula countries have become increasingly dependent on desalination to meet their water needs. These countries—Saudi Arabia, Kuwait, Bahrain, Qatar, United Arab Emirates, Oman and Yemen—cover an area of 3.11 million km², with a population of over 30 million. These nations do not have reliable surface water supplies and depend entirely on groundwater, desalination and wastewater recycling.

Rapid population growth, increased farm irrigation, urbanization, increased economic activities, and improved standards of living have significantly increased water demand. The annual design capacity of the desalination facilities of the seven countries is estimated at 2.02 billion cubic meters (bcm), compared to a worldwide capacity of 5.68 bcm. Actual production ranges between 70-85 percent of design capacity. The region's actual total volume of produced desalinated water in 1992 was estimated at 1.56 bcm, meeting over 50 percent of urban and industrial water

needs. Despite the benefits, building many desalination plants has its costs.

The desalination process separates water from dissolved impurities to produce freshwater. The dissolved impurities are concentrated in a waste stream known as brine that is discharged from the plant.

These desalination plants cause a variety of harmful environmental effects. Marine life is affected when water needed for the desalination process is screened to remove aquatic organisms. Marine disposal of plant effluent (brine) affects the marine environment. Often this brine is discharged at an elevated temperature (i.e., 6 to 12 degrees C higher than ambient water) increasing the harmful effects. The effluent also contains contaminants such as polycarbonic acids, anti-foam additives, anti-corrosion additives, detergents, etc., all being potentially harmful.

New production technologies are being developed that require less raw water consumption, less waste generation, and less chemical use. Requiring environmental impact assessments (EIA) has been proposed for new plants. However,

unfortunately, data on the composition of aqueous effluent from these plants in the Arabian Peninsula is presently insufficient to satisfy the requirements for a standard EIA. This emphasizes the need to investigate and monitor desalination discharges. A systematic description of all effluent, together with an assessment of its composition and temperature is imperative. In this region, little is known about the effluent's effect on the marine environment. Currently, this is an end-of-pipe problem; however, this issue should to be addressed at the design stage.

With the rapidly increasing number of desalination plants being built to satisfy the increasing water demands, and with so little information about the effects of the waste, it is impossible to estimate the cumulative effect of this pollution on the marine environment. If this problem is not addressed soon, it will be too late and far too expensive to correct the environmental damage already done.

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UNEP/GPA Mobilization at the National and Regional Levels

During 2000-2001, the GPA will emphasize national and regional level implementation and support to governments and regional organizations. The GPA will:

- Develop government-approved framework for actions and associated databases
- Promote capacity building
- Promote cooperation with GPA-related Global Environmental Facility (GEF) projects
- Support the mobilization of external resources

Sanctuary No-Take Zones Changing Fish and Lobster Populations: Florida, USA

After their first full year of protection, the Florida Keys National Marine Sanctuary's 23 no-take zones are showing signs of restoring spiny lobster (*Panulirus Argus*) and fish populations. In July of 1997, the sanctuary established a marine zoning program that includes three types of no-take zones: eighteen small sanctuary preservation areas, four special use areas and an ecological reserve. The zones comprise less than one percent of the sanctuary, but protect much of its critical coral reef habitat. The same year, the sanctuary initiated a five-year, zone-monitoring program looking at changes in ecosystem function and populations of key species. The results—how quickly animal populations responded to these no-take zones—were a surprise.

In the assessment, the Florida Department of Environmental Protection used teams of divers to compare lobster populations in fif-

teen sanctuary no-take areas with reference sites open to fishing. The divers found significantly more legal lobsters (carapace length greater than 76 millimeters) in no-take areas during both study years, 1997 and 1998. In 1997, the size of legal lobsters was the same in no-take areas and reference sites. But by 1998, the number of lobsters in the no-take areas that exceeded legal size was significantly higher than legal lobsters found in reference sites.

In addition, the average annual abundance of economically important reef fish (yellowtail snapper, hogfish, and certain species of grouper) was compared to a long-term baseline figure and between no-take zones and comparable reference sites. In all cases, the highest average abundance of species was observed in no-take zones in 1998, the first full year of no-take zone protection.

Rates of fish herbivory in the

zones compared to reference sites provide another intriguing indication that the zones may be beginning to restore the natural food chain. It was found that herbivory was higher in the no-take zones during 1997 compared to outside reference sites, but declined in the largest zone in 1998. This points to a potential trophic cascade effect, where herbivorous fish populations initially increase, but then decline as predatory fish populations rebound from overfishing.

The monitoring program also looks at other key species such as coral, queen conch (*Strombus gigas*), fish and urchins.

For further information or the first year Zone Performance Report, contact Ben Haskell, U.S. Department of Commerce NOAA, National Ocean Service Marine Sanctuaries Division, Florida Keys National Marine Sanctuary. Tel: 305-743-2437 ext. 25. E-mail: ben.haskell@noaa.gov

Tortugas 2000: Protecting Coral Reef Habitat

Situated at the western most end of the Florida Keys, in a remote area called the Dry Tortugas, is a coral reef of unparalleled beauty and diversity. Located 70 miles west of Key West and over 140 miles from mainland Florida, this reef and its surrounding hard-bottom and seagrass communities are bathed by the clearest and cleanest waters in the Florida Keys. The Florida Keys National Marine Sanctuary, a 2,800 square nautical mile area managed by the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) and the State of Florida, encompasses

the productive deep reef environment of the Tortugas. A planning effort is currently underway to protect the unique marine resources of this region by designating a no-take ecological reserve in the Tortugas by autumn 2000.

The plan, called Tortugas 2000, began in 1998 with a diverse working group composed of stakeholders and government representatives. The working group used ecological and socioeconomic information on the area, scientific data, and input from the public to identify criteria for the ecological reserve.

Boundary alternatives for the proposed reserve were then developed and approved by the Sanctuary Advisory Council. The next phase of Tortugas 2000 involves publishing a Draft Supplemental Environmental Impact Statement (DSEIS), in which the environmental and socioeconomic impacts of the reserve are analyzed. Members of the public will have an opportunity to comment on the DSEIS, revisions will be made based on public input, and the reserve will be implemented by late 2000.

Marine reserves are increasingly
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Towards Integrated Watershed and Coastal Management in Indonesia

By Ian Dutton, Steve Tilley and Ramli Malik

Despite a long history of investment in water resources development and more recent watershed management programs, integrated management of land and water is uncommon in Indonesia. Even rarer are programs that integrate the management of watersheds with the coastal areas they drain to, or programs that address land-based impacts on marine ecosystems. However, recognition of the need for improved integrated management of land and water and of the economic and administrative efficiencies to be gained from such an approach is increasing among resource users and managers. For example, on February 3, 2000, at the first seminar on integrated management of Jakarta Bay, the governor of Jakarta acknowledged that the traditional sectoral

Surprisingly, it was in the Segara-Anakan region (of south Java) that integrated watershed and coastal area management was first pioneered in Southeast Asia. However, those efforts were mostly academic. Despite recent investments in the Segara Anakan program, there remains no operational example of a truly integrated approach to watershed and coastal management in Indonesia.

What Happens Without Integration?

Ineffective integration of watersheds and coastal areas affects coastal ecosystems and communities in many ways. As was shown in Dukuj Tapak, a coastal hamlet near Semarang (north Java), the lack of an integrated approach to pollution management has had profound effects on the health of coastal communities and ecosystems. Pollution of water caused by establishment of a service factory to a

Equally significant environmental impacts have been described in Lampung Province. The establishment of some 28,000 small to medium sized industries during the past 20 years has resulted in the loss of considerable lowland biodiversity. Lowland forest cover in the province's largest river basin declined from 46 percent in 1969 to 23 percent in 1987. Mangrove forests have reduced from 17,000 ha in the 1970s to less than 3,000 ha in 1998.

Such changes, combined with high natural rates of sediment export, can have a profound affect on the health of estuaries, coral reefs and other nearshore habitats. Land-based pollution has been shown to be the major threat to Indonesia's already stressed coral reefs. Coral species diversity in a range of areas has been reduced 40-60 percent due to outflows of land-sourced stressors such as sewage, sediment and industrial pollution. The net economic loss to Indonesia from such impacts is estimated as being around US\$30 billion over the next 25 years!

The Legislative Context

Linked with resolution of the Tapak case, in the early 1990s, the national government instituted a new program (Prokasih) on surface water pollution control. That program was a cornerstone of new environmental impact management programs dealing with air pollution, solid waste disposal, sea and coastal pollution control, hazardous wastes, etc. Prokasih was not linked with recent Indonesian initiatives in integrated coastal management, despite the obvious advantages in doing so. Equally



Multi-use coastline in Indonesia.

approach to management of the city and the bay was the root cause of problems such as flooding, pollution, poverty and natural resource depletion.

Such recognition is a relatively recent phenomenon globally.

larger factory upstream led to increased illnesses among villagers and then to a spiral of social conflict and legal and bureaucratic compensatory action that ultimately reached the highest levels of decisionmaking.

seriously, few local administrations have been granted authority to implement Prokasih policies or programs and those that have been initiated have, as yet, had little quantifiable impact on environmental quality.

In response to public demands for socio-political change since the end of the New Order government in 1998, there has been a renewed focus on natural resources governance, on improving government service efficiency and on decentralized and partnership-based approaches to resource management. The newly established Ministry for Marine Exploration and Fisheries will specifically address spatial planning and resource management in coastal areas—a first at the national level. A new Law (22/1999) on Regional Government provides specific authority to provinces to manage territorial seas, thus creating an incentive for better management of watershed outflows. These measures create an entirely new framework for land and water management and allow for new models of governance to be developed.

Balikpapan Bay—A Test Site for Integrated Land and Water Management

Balikpapan Bay, on the coast of

East Kalimantan (Borneo), is one of the sites where Proyek Pesisir, the USAID-BAPPENAS coastal resources management project, is developing integrated approaches to coastal management. The primary focus is on development of a bay management plan. The project is addressing land use planning within the 2,000-square kilometer watershed as a key component of the bay's plan. An initial geomorphological study found that the naturally high rate of erosion in the watershed has been accelerated due to logging, clearing, bush fires and agricultural practices. Sediment yield is especially high (> four times ambient rate) where development is leaving large areas of bare soil on steep slopes. This sediment poses a significant threat to the estuary.

In 1999, stakeholders identified the current system of land use planning in East Kalimantan as an issue needing priority attention. Stakeholders realized that, without the ability to control upland land uses and development practices, they would not be able to protect the health of the bay and offshore ecosystems. Currently, different levels of government have adopted a number of general and special-purpose land use plans.

Stakeholders are concerned about a lack of intergovernmental coordination and stakeholder involvement in developing land use plans, a lack of detail in the land use scheme and a lack of enforcement for adopted plans. Bay planners are currently analyzing the land use planning processes and their implementation systems, with special regard to Law 22/1999. Recommendations for improvement will be developed and submitted to the next stakeholder workshop in May 2000, and a draft management plan will be prepared by 2001.

The process and outputs of the Balikpapan Bay management planning process are expected to serve as good practice guides for integrated land and water management elsewhere in Indonesia. Such guides are urgently needed by all levels of government who are under the dual pressure of promoting economic recovery while protecting local environmental quality.

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Tortugas

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becoming a preferred management option for protecting biodiversity, habitats and, in some cases, fisheries. Due to its location at the juncture of several major ocean currents, the Tortugas has a high potential for exporting marine larvae downstream to the Keys and the east coast of Florida. The Tortugas Ecological Reserve will also preserve biodiversity, maintain ecosystem integrity, and act as a

reference site to help scientists discriminate between natural versus human-induced changes to the Keys' ecosystem.

The Florida Keys National Marine Sanctuary is one of 12 National Marine Sanctuaries in the United States designated to protect significant natural and cultural resources. The no-take zone network in the sanctuary is the largest in the country.

For information on the Tortugas Ecological Reserve, visit the

Tortugas 2000 website: <http://fpac.fsu.edu/tortugas/index.html>. Tel: 305 743-2437.

For further information, contact Joanne Delaney, Research Interpreter, Florida Keys National Marine Sanctuary. Tel: 305 743-2437 x32. E-mail: joanne.delaney@noaa.gov. Website: <http://www.fknms.nos.noaa.gov>

Water Withdrawal: Aquifer Depletion

By Alfonso Aguirre Muñoz

San Quintín Valley is located in the northern region of the Baja California Peninsula (see map). The main economic activity, employing nearly 40,000 laborers, is high-technology agriculture of tomatoes and strawberries. Over the last twenty years, the area cultivated and water used has greatly increased (see figure). At its peak in '98, coincident with a very rainy El Niño year, aquifer use was estimated to be approximately five times the estimated sustainable level. With the regional climatic

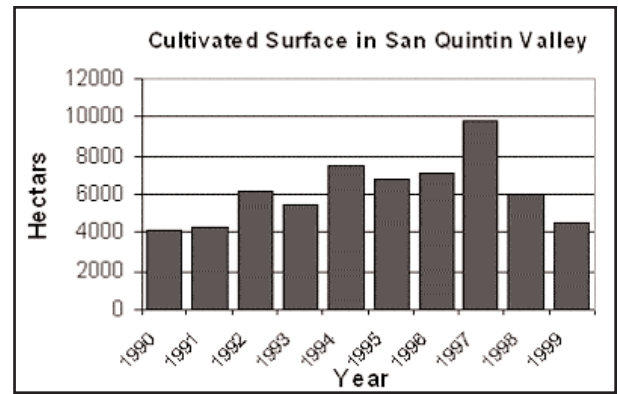
the Pacific Ocean. As the result of aquifer depletion, the volume of water entering the bay decreased, thus threatening the bay's health. The bay's eelgrass beds (*Zostera marina*) are the

last relatively pristine in the Southern California (US) and Baja California (Mexico) climate zone. These beds serve as habitat for migratory and resident birds and marine mammals, among others. Also the bay has the largest shellfish aquaculture operation in Mexico. Bay related work provides permanent and sustainable jobs for over 600 people. In the bay area, aquaculture has been integrated with conservation efforts, low-density ecotourism and fisheries.

The San Quintín Valley aquifer abuse combined with the two years of La Niña drought has seriously affected the valley's agricultural economy. As a result, there has been a 50-percent decrease in area cultivated. In addition, the market price for local produce has dropped almost in half. Other regions in Mexico and the US have not had the same water limitations, and production and prices have not dropped. The situation in San Quintín Valley has unfortunately caused a serious local depression.

Social Links and Consequences

Until recently, there has been no strong physical or ecological relationship between the bay and valley communities. However, the current situation has led to conflict between upstream interests (those decreasing aquifer volume: agriculture) and downstream interests



(those needing aquifer water: aquaculture). This is a case, as in many places, economic success inland (increasing agriculture production) has the potential to cause economic failure in the coastal region (decline in the aquaculture industry). Land-based activities have adversely affected water-based activities resulting in a clash of two communities, with the health of San Quintín Bay resting on the resolution.

In the valley, the agricultural decline caused payroll delays to laborers resulting in desperation and violence. Ranches decreased production, fired many permanent employees and did not rehire laborers for the coming year. This caused severe unemployment in the valley.

The high unemployment in the valley has led some agencies of the municipal and state governments to look for alternative occupations. Outside tourist developers see this as an opportunity and have proposed a large resort. The proposal offers 5,000 permanent jobs and 15,000 temporary and seasonal jobs. The resort would include more than 2,000 rooms, golf courses and a 350-slip marina. Estimated investment is US\$200 million. At a public hearing on the proposal, a leader of the agriculture laborers from the valley favored tourism development around the bay to provide employ-



reversal in the winters' of '98-'99 and '99-'00 (characterized as strong La Niña events—drier conditions), the cumulative effect of the aquifer depletion and climatic change resulted in an economic crisis for the area.

The aquifer depletion also affected the San Quintín Bay, located between the agricultural valley and

ment for those who lost work in the valley. Resistance to the resort comes mostly from those relying on the bay for their livelihood: aquaculture workers and local fishers. Social, conservation and other nongovernmental organizations also support the bay community. Although the project strongly contradicts the zoning plan of the state of Baja California (1994), it is being considered for authorization.

The current problem occurring in San Quintín can be addressed in real-time and in a way that considers the social and environmental consequences. In the past, the con-

sequences of inland activities were not understood. The problem could only be addressed blindly and without consideration of the consequences to other activities or the environment. Nevertheless, today's proposed remedy to the problem is poorly planned tourist development in the bay region. This does not remedy the upstream problem (collapse of the agricultural sector) or the downstream consequences (possible change to aquaculture). What is happening here is that the already desperate portion of society (the inland community) is supporting tourist development downstream to remedy their situation.

However, this is at the expense of the thriving coastal community's livelihood. The coastal community is not only trying to survive the effects of aquifer depletion, but fight increased coastal development that could also affect their livelihood.

As is happening here, without understanding the consequences of the upstream/downstream linkage, situations such as this will continue to occur.

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Upstream/Downstream: The Pacific Salmon's Story

By **Syma A. Ebbin**

Upstream/downstream relationships are those where an action made upstream, at a given point in time or place, has a significant effect downstream, at a rather inconspicuously later time or in a significantly distant place. Problems arise because the receiving (downstream) area cannot unilaterally regulate the upstream cause of the problem (e.g., pollution, depletion, etc.). This occurs because the cause is located outside its jurisdiction. Similarly, the source area of the problem (upstream) has incentives not to regulate because that area receives benefits, while the costs are externalized to downstream areas. Here, upstream pollutes and downstream suffers.

In the upstream/downstream scenario, the costs and benefits are asymmetrically distributed to the different areas. The upstream parties receive the benefits, while the costs are borne by downstream parties. Additionally, proposed

fixes-privatization and state control-may not be a viable alternative, especially in situations where the resource crosses jurisdictions. This is the case of the Pacific salmon. Salmon may cross international, regional, state, local and tribal boundaries, each area having its own decisionmaking structures, processes, agendas and priorities.

The Case of Pacific Salmon

Pacific salmon (*Onchorynchus* spp.) are migratory animals, born and reared for a period of months to years in freshwater. They then migrate to marine waters where they live several more years until spawning. These salmon cross numerous different habitats, jurisdictions and fisheries.

Historically, Native Americans captured salmon in nearshore areas and in rivers using a variety of techniques including spears, nets and traps. Modern technology has changed the industry (e.g., boat propulsion, fish finding aids, etc.).

These changes have altered the scale of upstream/downstream relationships by allowing fisheries to move farther offshore and into deeper water, increasing both the geographic and temporal distances between upstream and downstream.

Salmon are harvested primarily as adults during their return migration upstream. Here, non-native fishers have been able to out-compete native fishers. New technologies and better access to capital and licenses allows downstream fishers a greater ability to intercept the fish before they return upstream. At this stage of the salmon's life, the traditional upstream/downstream relationship is reversed. Here, factors downstream are affecting the salmon's ability to swim upstream.

Another factor is that development has occurred throughout the watershed affecting the rivers where the salmon are born, reared and spawn. Rivers have been dammed, water diverted, and forests cut for residential and commercial development. Ex-urban migration and the associated devel-

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What Do We Know About Mass Coral Bleaching After 1998?

By Heidi Schuttenberg

In apparent correlation with increased sea surface temperatures throughout the tropics in 1998, incoming reports confirm loss of pigmentation or "bleaching" in coral reefs globally on an unprecedented scale. Particularly disturbing are observations of severe bleaching and mortality in reefs within marine protected areas. With new studies, experts have been working to synthesize our understanding of coral bleaching, what it means for the future and what we can do about it.

Temperature Effect

Coral reefs are one of the richest and most unique marine environments. Their usefulness includes protein for coastal communities, income from tourism, protection from coastal erosion, genetic material for pharmaceuticals and cultural products. Without the structure and nutrient recycling provided by the coral reefs, the tropical, nutri-

stressed, corals may lose their symbiotic algae, which provides their color, and appear clear or "bleached." It is unclear whether the coral organism ejects the algae or the algae leave the coral, but whatever the mechanism, prolonged bleaching can result in irreversible damage or mortality to the coral.

At a local scale, many stressors cause coral bleaching, such as tropical storms, disease, sedimentation, cyanide fishing, salinity and temperature variations, etc. The significant features of mass bleaching events are that they are global in extent and not fully attributable to localized stressors or natural variability. Hoegh-Guldberg reports that there have been six mass bleaching events since 1979, with the 1997-98 event being the most extensive and severe. In several cases, the 1997-98 event resulted in up to 80 percent mortality in affected reefs according to a Global Coral Reef Monitoring Network (GCRMN) report.

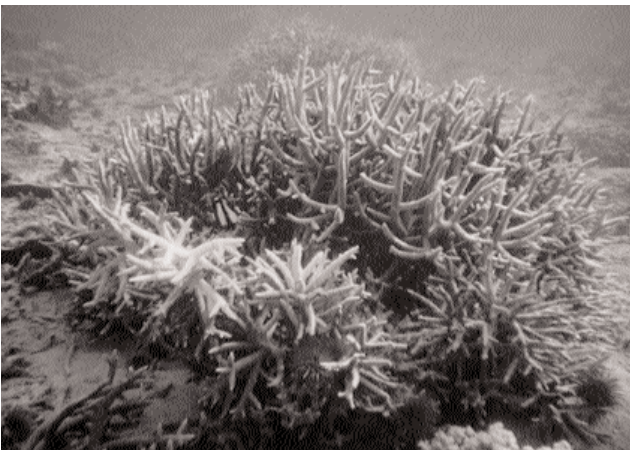
Mounting evidence suggests that the predominant cause is a global increase in sea temperatures. The US National Oceanic and Atmospheric Administration (NOAA) uses satellite imagery to map hotspot areas that equal or exceed 1 degree C above the mean monthly sea temperature. These temperature anomaly maps and Coral Reef Bleaching Indices are available at <http://psbsgi1.nesdis.noaa.gov:8080/PSB/EPS/SST/cli mo&hot.html>. During 1998, researchers and divers globally, verified bleaching of hotspot predicted areas with field observations. An analysis of the correlation between the satellite hotspot images and field reports will be published in *Geophysical Research* this year.

While work by NOAA and others suggests that sea surface temperature dictates which reefs are impacted by coral bleaching, temperature alone does not explain the variability of bleaching within a reef community. The two most recognized factors associated with intra-reef bleaching are: 1) An intensification of the coral's sensitivity to solar radiation as a result of temperature induced stress, and 2) Genetic variation in symbiotic algae, resulting in greater resilience to increased sea temperatures in some algae species. Genetic variation is high among symbiotic algae species that occur between and within taxonomic species of coral. Therefore, even within the same species of coral, some individuals are more resilient to bleaching than others due to genetic differences within their symbiotic algae.

Due to this differential resistance between species and individuals, an increase in the frequency of mass bleaching events may have significant impacts on reef structure and biodiversity. To predict the impacts of mass coral bleaching on the future coral reefs, the effects of all these factors must be considered.

Future of Coral Reefs

Recent research on coral bleaching has focused on extrapolating insight gained from the 1997-98 mass bleaching event into predictions for the future condition of coral reefs. A widely publicized study by Hoegh-Guldberg concludes, "The current understanding of coral bleaching suggests that corals are not keeping up with the rate of warming that has occurred and that they may be the single largest causality of 'business-as-usual' greenhouse policies." His work compares the current understanding of temperature-induced mass bleaching with climate change predictions from four global models. He predicts an increase in frequency and intensity of mass coral



Bleached Acroporacoral. Photo by Michaël Rard

ent-poor waters in which they occur would likely be a biological desert.

The existence of coral reefs hinges on nutrient exchange between the coral organism and symbiotic algae, called zooxanthellae, living in its tissues. When

bleaching events until they occur annually by 2030-2070 with the end result that, "combined with the increasing stress on reefs from human-related activity ... coral reefs may be dysfunctional within the near future." Hoegh-Guldberg's paper, published in the November 1999 issue of *Marine and Freshwater Research*, has been criticized for the high rates of temperature increase predicted by the climate models used.

The rate of sea temperature increase will likely be a defining factor in determining coral reefs' resiliency to bleaching. A U.S. State Department report (available at http://www.state.gov/www/global/global_issues/coral_reefs/990305_coralreef_rpt.html) notes that a subset of corals have survived naturally varying climate conditions for the past 75,000 years. However, the paper explains, "due to the potential rate at which significant climatic changes could now proceed, the ability of most corals to acclimatize and/or migrate is uncertain."

Hoegh-Guldberg's paper, the State Department report and a report produced during an Expert Meeting on coral bleaching convened by The Convention on Biological Diversity (CBD) Secretariat (October 1999) all observe that the future of coral reefs will be shaped by coral bleaching in combination with local reef conditions. Locally, reefs may be additionally stressed by anthropogenic threats or protected by management schemes, such as marine protected areas (MPAs).

The CBD Expert Meeting report (Website: <http://www.biodiv.org/JM/pdf/Expert-2-2.pdf>) specifically discusses the impact of the 1997-98 event on corals within a MPA citing the Mafia, Tanzania, as an example. According to GCRMN "80-100 percent of the corals ... died in Mafia Marine Park, which

probably had the best coral reef in the country with almost 100 percent coral community cover over vast areas." Although many questions remain about the implications of this observation, the extent of bleaching observed preliminarily suggests that MPAs alone may be limited in their ability to address mass bleaching. The CBD Expert Meeting did not speculate whether the starting condition of coral reefs provided additional resilience against bleaching, instead highlighting that this question is very important, but currently unknown.

The predicted degradation of coral reefs globally will result in a concurrent loss of services that coral reefs provide to humans. The extensive value of such losses necessitates an urgent need to better understand both the impacts from and potential responses to coral bleaching.

The Coral Bleaching Challenge

Several characteristics challenge management efforts to address coral bleaching. First, the causative factor, global temperature rise, is difficult to address. Temperature rise appears irreversible in the short term and results from CO₂ emissions often originating far from the coral reef. Second, the impacts of bleaching may overwhelm local coral reef management efforts. It is crucial to determine if MPAs and other efforts to optimize reef quality can be effective in preventing temperature-induced coral bleaching. Third, options for prevention and response are currently limited.

The CBD Expert Meeting report includes recommendations for prevention and post-bleaching response and additional research. Prevention measures in the short term focus on building the resilience of coral reefs to bleaching by optimizing their health through protection from localized

anthropogenic threats. Longer-term prevention focuses on building a constituency to support eventual reductions in CO₂. Response measures focus on aid, planning and education to protect local human populations from threats likely to accompany reef degradation. Such measures might include emergency financial assistance for



After bleaching.
Photo by Craig Quirolo

tourism operators and fishers adversely affected by bleaching, coastal flooding emergency management planning to address reductions in coastal protection as reefs degrade, and public education regarding the increased risk of ciguatera potentially associated with bleaching and reef degradation. Coral reef restoration is also a potential response. While these recommendations represent valuable steps toward addressing the bleaching issue, there remains no obvious solution for definitively preventing bleaching or reversing predicted trends of increased bleaching frequency. Until such solutions are found and implemented, future coral reef integrity remains in limbo.

Optimistically, mass coral bleaching is receiving a significant level of political attention. After review of the CBD Expert Meeting report, the CBD's Subsidiary Body on Scientific, Technical and Technological Advice adopted coral bleaching recommendations on 5 February, 2000. These recommendations (available on the web at

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“Must Do” for Development of Indicators and Monitoring Plans

By Wendy Garpow

Sustainability indicators are becoming common elements of coastal zone management. There are ample models for monitoring and evaluating the impacts of coastal management efforts (see *InterCoast* #29, Fall 1997), many of which offer lists of standardized indicators. However, many standardized indicators do not apply to, nor represent specific communities. This article presents a summary of an indicator-monitoring project and offers some lessons learned in the continual quest for developing ideal site-specific sustainability indicators.

Case Study: Akumal, Mexico

Akumal is the oldest tourism community on the Caribbean coast of Mexico's Yucatan Peninsula. The town occupies 3.4 km of coast in

increasing tourism development as Cancun's tourism industry expands.

There appears to be an inverse correlation between the number of tourists and the quality of Akumal's coastal environment. Tourism impacts Akumal's marine environment through inadequate sewage treatment, increased impervious surface, illegal landfilling, overfishing and the conversion of wetlands and mangroves into land for condominiums and parking.

This research was undertaken to identify sustainability indicators and develop a monitoring plan to explain the linkages between Akumal's tourism development and the condition of the marine environment—particularly the coral reef.

Twenty-two sustainability indicators were identified following the Organization for Economic

Cooperation and Development (OECD) Pressure-State-Response framework (1993). For these indicators, monitoring protocols were developed and baseline data was collected for Akumal.

Throughout the process, the list of indicators and the monitoring plan were continually refined to ensure the variables were feasible, efficient and effective.

Described are eight very basic, yet often ignored or misunderstood, approaches learned learning the process of defining and refining indicators.

Eight Lessons Learned

1. Do not underestimate your time horizon

Identifying useful indicators is a

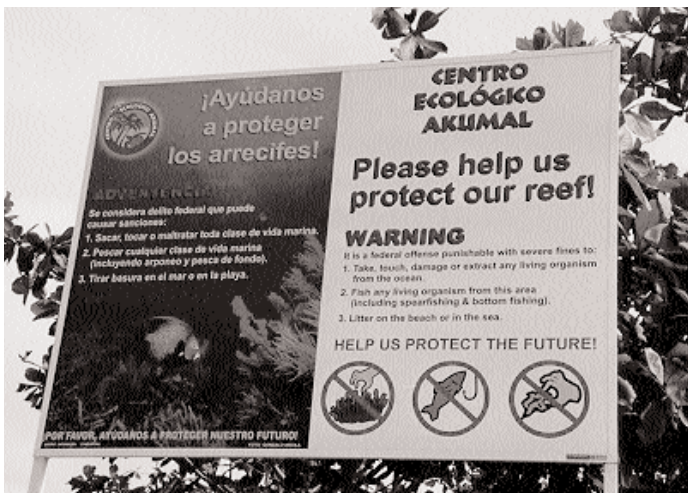
time consuming and difficult process requiring personal experience within the community. There is a positive correlation between the amount of time spent on site and the quality/relevance of indicators and data. Quite simply, it takes time to cultivate working relationships and trust with key informants and stakeholders. If the host culture is different than the researchers, the time horizon will be extended since differences in language, social mores and codes of conduct are roadblocks needing to be overcome. Furthermore, while electronic correspondence (E-mail) is less expensive and more convenient for the researcher, it does not necessarily yield as high-quality results as on-site reconnaissance work.

2. Even expert opinions are not perfect

Local stakeholders truly are the experts regarding the economic, environmental and social sustainability of their community, but no one ever has perfect knowledge or information. While stakeholders may be the researcher's best source of information, they definitely should not be the only source. Researchers should confirm and re-check what has been presented as fact via multiple key informants, personal observation and literature review. Even then, it is not assured that the information is 100 percent correct, or that it will not be challenged in the future.

3. Continuously communicate, but do not inundate

Indicator development is a continually evolving process that requires continuous stakeholder involvement. In most cases, it is better to spend too much rather than too little time on personal communications. However, communicating with stakeholders is tedious and impersonal by E-mail, yet costly and logistically challeng-



Sign at entrance of Centro Ecologico Akumal.

the center of the region known as the Riviera Maya, a 140-km corridor from Cancun to Tulum. In between are white beaches and dense jungles that are speckled with small independent towns, tourism resorts, traditional Maya villages and ancient ruins. Like all communities along the Riviera Maya, Akumal is being faced with

ing in person. Furthermore, E-mail is not as integrated into Mexican society as it is elsewhere. In this study many stakeholders chose not to participate after the initial meeting. This was a surprise since all 25 participants agreed to continue participating in the project via E-mail, however, only two responded to the follow-up questionnaire. A later visit revealed that many did not respond because the questionnaire was "too voluminous," however they were more than happy to meet individually.

4. Anticipate and overcome communication barriers

It is extremely important yet difficult to communicate with all stakeholders. There were several extremely important individuals in the Akumal community who were active stakeholders but were unable to participate because the workshop conflicted with work schedules (locals who were not business or property owners, but rather the typical residents of Akumal). Nevertheless, many became key informants during the data collection process, and thus contributed greatly to the research.

Language barriers caused difficulties. Effective research can only be accomplished if the researcher is able to communicate in all languages of the study region. Many Akumalians only speak Yucatec Maya, a difficult, infrequently studied language. Because communication in Yucatec Maya was not possible, that segment was neglected. This inability to communicate rendered the research findings incomplete, thus misrepresentative of this community. The lack of advanced Spanish and Yucatec Maya also prevented dissemination of the research findings to those people who would benefit most from the findings.

5. Beware of bias

Sustainability indicators are nei-

ther politically, economically nor socially neutral. It is impossible for people to remove themselves from their own biases. During this research, this seemed especially true for small business owners who perhaps perceived that their livelihoods were under scrutiny. Therefore, unless fellow stakeholders are comfortable in confronting and correcting each other's biases, it is unlikely that indicator research can remain completely neutral. This exemplifies one of the reasons why it is so important to have a wide range of stakeholders to represent many facets of the community.

6. Do not assume anything

Quality indicator data is difficult to obtain, especially in developing countries. Creativity, patience and persistence are the keys to success. Often, collection of data considered to be common to the researcher (such as census data) is simply not available. Furthermore, businesses in developing countries do not necessarily keep detailed daily records as researchers might expect. This does not mean the information cannot be found, it only means that researchers need to look a little harder and in non-conventional ways.

7. Flexibility is a necessity

Indicator development requires researchers be flexible and willing to forego "ownership" of the indicators. In other words, the researcher must remain neutral, just as the stakeholders. During dialog with some stakeholders, it became apparent the stakeholders had a personal interest in which indicators were included and which were omitted. Researchers often feel a moral obligation to accommodate every suggestion and concern. Being flexible and willing to continually modify the research process proved to be quite time consuming and sometimes frustrat-

ing, but in the end generated a more suitable (and acceptable) list of indicators.

8. Compromise is the essence of creating site-specific indicators

The common thread of all seven lessons is the necessity to compromise. When creating site-specific indicators and a monitoring plan, the quality of indicator data is always a trade-off between desired accuracy and practicality. The highest quality data may only be attainable at great expense of time and resources. As in any research or coastal management program, cost effectiveness is an extremely important consideration. However, compromising time or quality when refining the indicators and monitoring plan is inappropriate. Identifying initial sustainability indicators and collecting baseline data is merely the beginning of evaluating the effectiveness of coastal management programs.

While all lessons offer valid advice, the final two are of utmost importance when creating a site-



Akumal children participating in environmental education program.

specific indicator/monitoring plan. If one chooses to explore beyond standardized sustainability indicators, one must be flexible and willing to compromise through all steps of the process. While this may be more challenging and resource intensive, the end product is a set of indicators that best describe the

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Sustainable Coastal Communities Initiative

By Meg Kerr

Throughout the world, communities are struggling with the question of sustainability, "Can the current generation develop and maintain a satisfactory quality of life without compromising the needs of future generations?" To move towards sustainability, communities must strike a balance between the social, natural and economic environment. Economies must develop and grow without depleting the natural resources needed for future growth. More sustainable communities nurture a high quality of life that is defined not only by its material goods and wealth, but by a social structure that supports a positive sense of community and an appreciation for preservation of environmental quality.

The Coastal Resources Center (CRC), University of Rhode Island, USA, works worldwide to promote integrated management as a way to move communities towards a sustainable future. CRC's Sustainable Coastal Communities Initiative develops tools for balancing the conflicting economic, social and environmental needs of communities. CRC tests these tools and techniques for sustainable development in the US-based projects, then applies them in CRC's international coastal projects.

CRC develops management tools in the US with access to extensive technical data and resources largely unavailable in other countries. Tools and techniques can then be tested in the context of the US legal system that supports national, state and local regulatory controls over economic and natural resource allocation.

Sustainable Coastal Communities Initiative

The Sustainable Coastal Communities Initiative focuses on two areas of Rhode Island: Aquidneck Island and Washington County. In Rhode Island, as in coastal communities throughout the US, suburban housing and commercial development is consuming coastal farm and forest land at an alarming rate. In the last decade, although the state's population has remained stable, more than 26,000 acres of land has been lost to development. This development has decreased coastal access, eliminated open space for wildlife habitat, jeopardized drinking water and limited certain types of recreation.

In Rhode Island, town governments have primary responsibility for regulating residential and commercial development. With few controls on development from the state's planning agency, and local government ill-equipped to deal with issues of sustainability, the current pace is too fast for most towns to handle.

In Washington County and on Aquidneck Island, CRC is working with town governments, private businesses, local organizations and state and federal agencies to develop techniques to link economic development with resource management. CRC's goal is to have a broad coalition of community interests work together to create a sustainable future for their region. CRC is facilitating a process where the groups first create a vision for the future of their community and then work as a group to implement actions that move the community toward a more sustainable future.

As a result of this project, con-

flicts between diverse interests will be reduced, and people living and working in the project areas will work together on economic development initiatives, natural resource conservation and open-space preservation. Towns in the pilot areas will begin to guide new development so it enhances traditional villages and creates communities able to provide adequate infrastructure and services for sustainable growth.

CRC has identified five steps crucial to the success of this and many programs addressing related issues.

Step One: Build trust and learn about community issues

CRC began working on Aquidneck Island in 1995, hosting a series of workshops on planning issues for municipal board and commission members. CRC had two objectives for these workshops. First, CRC staff developed personal relationships with local decisionmakers and heard their issues. Second, the workshops encouraged more communication among town officials, increasing the likelihood of collaboration among the towns. The three towns (Newport, Middletown and Portsmouth) have a long history of working independently. The workshops brought people from the communities together in a safe, structured environment where they discovered numerous common issues.

In the months following the workshops, CRC facilitated the formation of the Aquidneck Island Partnership, an organization with both public and private representation and dedicated to fostering discussion of island-wide issues. CRC also worked closely with the Aquidneck Island Planning Commission, a regional planning board with representatives from the three towns.

Over the last twenty years, CRC has worked on numerous projects in Washington County and has established a good relationship with many organizations in the region. The Washington County sustainable communities project began in 1998 under the direction of the Washington County Regional Planning Council. The council, comprised of town government representatives, promotes collaboration between the nine towns in Washington County. Their current focus is on developing regional approaches to manage the area's rapid growth. Initiatives developed at the regional scale will be implemented through local governments and will be incorporated into state planning efforts.

Several partnerships in Washington County are developing priorities for managing watershed ecosystems. When integrated with the regional council's growth management agenda, these coordinated ecosystem management efforts will improve the local decisionmaking process for both economic and environmental issues.

Step Two: Help the community define a broad-based vision of their future

CRC's projects explore ways to increase public involvement in the decisionmaking process. CRC listens to community residents and leaders and then works with them to identify and articulate the priority issues. CRC facilitates the development of solutions that often require involvement of local leaders, businesses, and all levels of government. Partnerships are formed to engage key stakeholders and then become the forum for improved decisionmaking.

On Aquidneck Island and in Washington County, extensive interviews with municipal government officials, volunteer boards and commissions, community and

business leaders, environmental interests and faith-based organizations helped CRC understand multiple points of view on local economic development, land use and resource protection. On Aquidneck Island, these interviews culminated in the production of a clearly articulated vision document, Aquidneck Island, Our Shared Vision. The report uses four theme areas: livable landscapes, social well being, strong economy and multiple modes of transportation, to describe a desirable future for the island.

The vision document for Washington County is not yet complete, but its emerging themes include improving transportation; protecting open space; developing the economy; providing affordable housing; and effectively using groundwater supplies, the only source of drinking water for the region.

Step Three: Develop plans consistent with the vision

Plans to address selected issues are developed with input from key decisionmakers. Policies, regulations, partnerships and memorandum of understanding necessary to support the plans are then developed.

On Aquidneck Island, several initiatives are underway to implement the island's vision:

- Land conservation strategy: During the summer of 1999, CRC convened a series of workshops with local stakeholders in partnership with state and local decisionmakers to develop strategies for conserving land on the island. The final strategies included recommendations for water supply protection, habitat conservation, sustainable farms, linking open-space areas, and promoting alternative modes of transportation.

- West side plan: On the western side of Aquidneck Island, the US

Navy-owned lands are mixed with privately owned lands. The Navy asked the Aquidneck Island Planning Commission to develop a comprehensive plan to combine Navy reuse with appropriate uses of adjacent lands. The outcome will provide planners and developers with a road map for development that considers economic growth in balance with protection of the area's environmental and social qualities.

- Comprehensive planning: CRC is working with the three towns to update their town comprehensive land use plans. For the first time in Rhode Island, these land use plans will direct future growth for not just one town, but for a region including several towns.

In Washington County, CRC is focusing on comprehensive plans as one mechanism for implementing a regional vision. Regional issue papers and planning overlays will be developed for housing, transportation, economic development and natural resources. Through regional planning, strategies to market desired economic growth are formed (e.g., legislative initiatives, inter-town memoranda of understanding, and regional partnerships).

Step Four: Implement the plan

These projects are still young and implementation is limited. On Aquidneck Island, CRC is working closely with the Aquidneck Island Land Trust to develop a nature trail that links existing open space throughout the island. The first two-mile section will open in June 2000. When complete, this trail will create an series of linked open space areas connecting one end of the island to the other and will achieve a key component of the islander's vision.

With assistance from the Aquidneck Island Partnership, the three island municipalities submit-

(continued page 32)

Integrated Watershed Management: Rhône River, France

By Yves Henocque

In order to provide a balanced water resources management plan within France's watersheds, the Water Act (adopted in 1992) established the Water Development and Management Master Plan (Schema Directeur d'Amenagement et de Gestion des Eaux (SDAGE). A SDAGE is prepared for each watershed under the initiative of the local state representative. The plan is adopted by the basin committee and approved by the basin coordinator.

The Rhône-Mediterranean-Corsica Watershed

The Rhône River flows over 850 km from Mt. Saint-Gothard in Switzerland to the Mediterranean Sea near Marseilles. The Rhône-Mediterranean-Corsica watershed (RMC) has a population of 13 million in 8,000 municipalities. The RMC fully or partly covers five different administrative regions including Corsica, Provence-Alpes-Cote d'Azur, Languedoc-Roussillon, Rhône-Alpes and Franche-Comte.

The RMC watershed's SDAGE was adopted in 1996. Focus areas include pollution, water quality, groundwater and outstanding aquatic systems. Directives include building respect for natural processes; promoting better management before investing (incorporate risk management); promoting community participation and including water management in all land-use development. Each directive was to be addressed for each of the 29 territories within the RMC's watershed, the 29th territory being the coastal area.

The RMC's SDAGE is based on an environmental assessment of the

drainage basin (includes the entire coastal strip from the Spanish to Italian borders, and Corsica).

Consultations with all stakeholders, big and small, are done throughout the process.

Management of the Receiving Waters: The Mediterranean Sea

The French Mediterranean coastal areas are densely populated (highest density 2,000 inhabitants per square kilometer). The coastal area is the final destination for the runoff and inputs from the RMC's drainage basin. Being an integral part of the RMC's hydrographic basin, the policies managing the Mediterranean must be similar to those managing the inland waters.

The RMC's SDAGE was assessed after three years (1997-1999) to get an overview of what had been achieved and to establish a set of indicators for the RMC. Three types of indicators were applied: those describing the 'State' of natural aquatic systems; the 'Pressure' they receive from human activities; and the 'Response' given through actions corresponding to the SDAGE objectives. For each of the categories (see box) there can be up to three of these indicators.

Resource Protection

Within the SDAGE's objectives, a number of local initiatives devoted to environmental assessments and restoration of natural sites are being developed through inter-municipal coordination. One of the major institutional structures is the National Coast and Lakeshore Conservation Agency (CELRL). The CELRL was established in 1975 to facilitate land acquisition

aimed at protecting the coast and natural sites, while maintaining ecological diversity. By 1998, the agency had acquired 291 km of coastline on the French Mediterranean. In general, these areas are managed by local authorities through contracted agreements.

Monitoring

Five monitoring networks address the health of the entire Mediterranean Sea:

- The Marine Bathing Water Monitoring Network monitors microbiological parameters
- The National Marine Environment Monitoring Network (RON) monitors chemical pollutants and general water quality
- The Microbiological Monitoring Network (REMI) monitors levels and trends of fecal con-

Categories Addressed by SDAGE

- Combatting general pollution
- Eutrophication
- Toxic pollution
- Accidental pollution
- Physical state
- Quality of rivers and channels
- Quantitative management of rivers
- Flooding risks
- Groundwater
- Drinkable water
- Wetlands
- Species protection
- Coastal areas

tamination by measuring fecal coliform in mollusks

- The Phytoplankton Monitoring Network (REPHY) monitors phytoplankton populations, particularly species toxic to humans or marine organisms
- The Posidonia Monitoring Network monitors the extension or regression of seagrass beds from the nearshore to their lower limit

of development (40 meters)

Yet, despite these networks, it is still difficult to assess coastal and marine water quality along the French Mediterranean. Even more difficult is to relate the contamination observed with the inputs from inland sources.

In an effort to coordinate the entire network, a new network was formed, the Réseau Littoral Méditerranéen (RLM—Coastal Mediterranean Network). The RLM carried out two pilot studies to assess coastal and marine water quality (1996 to 1998). Significant information was compiled for each of the 50 geographic and management units. Results showed concentration areas for various pollutants (e.g., metal concentrations are higher in coastal lagoons; lead concentrations are significant only in areas directly affected by urban, industrial or port activities; organo-chlorine concentrations are still noticeable in many areas).

These monitoring networks have been spatially integrated allowing the definition of the coastal space as follows:

- The coastal space consists of a double strip: landward corresponding to the downstream part of the drainage basin, and seaward corresponding to the area affected by the chemical inputs coming from the

entire watershed (landward strip).

- The coastal space is divided into 50 geographic units, from the Spanish to Italian borders.

Each geographic unit corresponds to a management unit with its own characteristics and objectives. Each unit is considered to be at its optimal scale for integrated coastal management.

The SDAGE is the most integrative tool for coastal area and river basin management. In the RMC river basin, this is due to the strong commitment of the RMC Water Agency that manages not only the RMC, but the entire French Mediterranean watershed.

The RMC has been particularly active in promoting a whole-basin approach. In collaboration with agencies such as IFREMER (French Research Institute for the Exploitation of the Sea), systematic spatial analyses integrating information on the physical state (e.g., geomorphology, ecology) and the pressures on (e.g., human activities, inputs fluxes) each geographic unit give a comprehensive review of coastal contamination. However, despite these monitoring networks, there is still inadequate information on pollution and the relationship to land-based sources. This need for additional information on land-based sources led to an increased

collaboration and data exchange with the National Water Data Network (RNDE), a network of inland-source communities addressing water quality. This collaboration greatly improved the information base.

The undertakings of the SDAGEs are enormous. A master plan of this scale needs to cover the headwaters to the receiving waters as one unit. Each segment along the path must develop and implement a management plan best suited for that segment. If the segments are assessed and refined under the direction of the master plan, the direction and progress of upstream segments can significantly influence the focus and indicators chosen by downstream segments.

This planning technique can be applied far more easily in smaller geographic areas that have more direct contact and information exchange between upstream and downstream segments. Despite this, the coordination seen at the RMC's scale is impressive.

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Indicators

(continued from page 17) community's unique issues, and a monitoring plan that is more likely to be successfully implemented into the future.

The source paper for this article, "Identifying Sustainability Indicators Regarding Coral Reefs and Coastal Tourism Development: A Case Study of Akumal in the Mexican Caribbean" by Wendy Garpow, is available through inter-library loan from the University of New Hampshire, USA, or can be ordered from Wendy Garpow for

printing and postage costs. The paper also includes a historiography of previous research regarding Akumal's reef and an extensive literature review of anthropogenic impacts on coral reefs, Caribbean tourism development and sustainability indicators.

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Land-based Infrastructure Hampers Reducing Marine Debris

By Michael Liffmann and Marilyn Barrett-O'Leary

Globally, the management of solid wastes presents a growing problem that is likely to become even more acute with industrialization and population growth. What makes up solid wastes vary throughout the world because social customs and living standards determine both quantity and constituents. The specifics of the problem vary from country to country and from cities and towns to rural communities. The types of waste to be disposed of, financial constraints, the institutional machinery and the available infrastructure, all affect how to manage this problem.

In general, the gross rate of land-based pollution entering the sea depends more on national prosperity and industrialization levels than on population. The more developed nations produce far more potential pollutants in proportion to their population than do the developing nations. Presumably, as the developing nations increase levels of industrialization and well being, there will be an accompanying increase in total waste generated, and thus a greater potential contribution of land-based pollution to the sea. Plastics, for instance, represent between 20 and 25 percent of a developed country's waste stream, while for a developing nation plastic is less than 10 percent.

Over the past decade, analyses have repeatedly identified land-based sources as the cause of marine debris. These sources were traced to runoff and natural drainage. The goals of the study described here were to determine sources, likely impacts, and possible solutions to the marine debris

problem. Although definite categorization of sources of the debris was not achieved, researchers concluded that the major source of coastal marine debris was the nearby land, as compared to farther inland sources. Even in the Antarctic, marine debris is derived from land-based sources (nearby research stations). The United Nations Joint Group of Experts on the Scientific Aspects of Marine Pollution concluded that globally, 80 percent of marine pollution stems from land sources. In addition, waste materials reach the oceans by direct discharges, runoff, and to a lesser extent, the atmosphere.

It must be recognized that developed nations have far more effective collection and disposal infrastructure systems than developing nations. However, even in developed countries where rural areas are usually served as efficiently as most towns and cities, the collection and transportation of domestic solid waste is the most difficult and expensive aspect of waste management. On average, 70 percent of the entire solid waste-handling budget is consumed in collecting and transporting, leaving little money for treatment and adequate disposal. In developing nations, this problem is intensified because collection and transport are difficult. Here, composting and recycling occurs, but much of the waste stream is used to reclaim and level less usable land areas such as old quarries and wetlands.

Data from six Organization Eastern Caribbean States (OECS) member nations indicate that 40-50 percent of solid wastes generated by their cities does not reach official landfills or dump sites. By most accounts, the solid waste collection and disposal needs of most

rural areas in the member nations are rarely met, largely because of access problems and limited funding. This results in open dumping and uncontrolled landfilling, allowing much of the waste to be carried in runoff to the sea.

Even in the rare instances when the systems and budgets are adequate for collection, safe disposal of collected wastes often remains a problem. Sanitary landfills have become the norm in only a handful of areas. Controlled sanitary landfills and other waste disposal methods are desperately needed in developed and developing nations both to improve living conditions and to reduce pollutants such as plastics and other floatables from entering the ocean.

Infrastructures' shortcomings are only one of the constraints that hamper reduction of marine debris from land-based sources. Others are inadequate resources for management and enforcement, inefficient legal processes and low fines. Even if the regulatory systems were not limited, they would be unable to control solid waste dumping and littering because the infrastructure needed to receive and dispose of these materials is grossly inadequate or not in place. In addition, public authorities frequently need persuading that investment in landfills, garbage plants, equipment and manpower are really priorities.

Waste management in developed and developing nations is a massive problem that is only going to increase over time. It must be realized that until a major investment in infrastructure is made, there will only be an increase in land-based debris entering the sea.

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The Effects of El Niño on Shrimp Fisheries in Indonesia

By **C.P. Mathews, F. Cholik, M. Badruddin and N.G. Willoughby**

The culture of fish and shrimp in coastal Indonesia, and the coastal capture fishery for shrimp and its relationship to shoreline mangrove forests has been extensively studied. However, there is little work relating variations in shrimp capture fisheries to anything other than fishing effort.

This article compares a shrimp capture fishery and a shrimp culture fishery. Also, it looks at the probable influence of both the culture system and environmental variables on the yields from the capture fishery.

Introduction

Data from 17 provinces was assessed for the relative importance of culture and capture landings of shrimp. It was found that:

- Where shrimp capture landings were dominant, they exceeded culture landings from all species (not just shrimp) by a factor of between 2 to 10
- Where shrimp culture landings were dominant, they exceeded capture landings by a factor of 2 to 20
- Shrimp capture landings peaked in most provinces in the mid-'80s to early '90s, suggesting country-wide overfishing
- Shrimp culture landings appeared to peak in only four provinces, suggesting that in most areas culture at current levels was sustainable

These results suggested a working hypothesis that the presence of a major shrimp culture system using brackish water ponds may occur at the expense of a coastal shrimp capture fishery.

Data for two provinces, East Kalimantan and South Sulawesi,

were analyzed. Basic analysis showed that the East Kalimantan shrimp fishery displayed classic relationships between catch, effort and catch per unit effort (CPUE), while on the other side of the Makassar Strait in South Sulawesi, catch, effort and CPUE fell simultaneously. This suggested that external factors, not related to the effort expended on the fishery, were responsible for the reduced landings in South Sulawesi. This study set out to determine what the alternative factors might be.

South Sulawesi and East Kalimantan provinces face each other across the Strait of Makassar. In 1993, South Sulawesi had a large culture system producing 71,000 tons (t) of all species (fish and shrimp) and a relatively small shrimp capture landings of 4,400 t. East Kalimantan had a small culture system (3,000 t of all species) and a large shrimp capture system (6,500 t).

South Sulawesi: Shrimp Culture More Important than Shrimp Capture

Landings of the multi-species shrimp capture fishery in South Sulawesi peaked at 8,000 t/year in '85-'87, then fell sharply to less than half this by '93. The effort applied fluctuated, peaking in '85 then halving by '93. The CPUE rose sharply in '88-'89 then fell sharply in '92. The combination of falling effort and falling landings from '88 onwards suggested that external factors, either natural or anthropogenic, impacted the shrimp landings. Excessive effort, such as overfishing, could not have caused the reduced landings.

Meanwhile, the total area under culture in the province increased significantly between '77 and '93,

with shrimp culture yields largely replacing capture landings in terms of total biomass. Furthermore, culture productivity increased significantly from '87-'93, just as the shrimp capture landings started to fall. Could the large, productive fish and shrimp culture industry of South Sulawesi have been impacting the shrimp capture fisheries? This was tested by two forms of mathematical modeling: a multiple regression model and a surplus production model, CLIMPROD.

The multiple regression model, which related capture landings to total areas under culture and total culture yields, showed that both relationships were highly significant. The model also suggested the presence of an important factor over-riding general conditions for capture (but not culture) from '85 onwards. The particular cause or factor could not be identified at this stage.

The environmentally sensitive, surplus production model, CLIMPROD, was used to fit shrimp capture fishery effort for the main species caught (*Penaeus merguensis*) to the El Niño Southern Oscillation Index (ENSOI). This showed that the CPUE of *P. merguensis* was significantly related to the ENSOI, and that in non-El Niño years maximum shrimp yields increased significantly. Thus, the ENSOI was shown to be an independent environmental variable affecting the shrimp capture system.

East Kalimantan: Shrimp Culture Less Important than Shrimp Capture

Fish and shrimp capture landings are smaller in East Kalimantan than in South Sulawesi, and culture is also smaller. The shrimp capture fishery also shows a markedly different history. High fishing effort coincides with low CPUE; while periods of low effort coincide with

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Community Volunteer Monitoring: Brazil

By Marcus Polette

Camboriú watershed, located in southern Brazil, can be considered one of Brazil's most important tourist area. The fixed population is about 120,000; yet during the summer the population reaches over 1,500,000. The municipalities of Balneário Camboriú and Camboriú occupy the 200-square kilometer area. Balneário Camboriú, located in the estuarine area, is predominantly urban with a tourism-based economy. An increasing number of migrant workers live outside the area, while depending on Balneário Camboriú for employment. Camboriú is predominately agricultural with an economy based primarily on growing rice.

In the last 60 years, there has been significant development, and the population has increased as more Brazilians choose to live there. However, there has been no land use planning accompanying the development. Developers, having a strong influence on local governance, were not required to give consideration to the area's natural resources and its carrying capacity.

The watershed can be divided into four distinct landscapes: natural (Atlantic rainforest), agricultural, semi-urban and urban. Practices such as timbering, illegal hunting and rock extraction are a major problem in all areas. The agricultural area is being effected by agrochemicals. Problems facing the semi-urban area include lack of infrastructure and services (e.g., sanitation, security and urban housing). This is particularly important because this area is absorbing the rapid growth of Camboriú and Balneário Camboriú. Problems facing the urban area include vehicle traffic, sanitation, beach vulnerability and the lack of a master plan to address the watershed growth.

A community was formed to address these problems. However, there is little local political support for conservation efforts because of the possible changes associated with these efforts. This lack of support led teachers from the public schools in the two municipalities to form the Landscape Volunteers Monitoring Program for the Camboriú watershed. The purpose of the program was to educate

teachers and their students about the coastal landscape, and to collect information on the changing landscape. This information is to be used for conservation, environmental protection and development strategies to be undertaken by the municipalities.

Initially, 20 local teachers identified four phases of training:

1. How do I teach about the Camboriú watershed? (understanding the environmental education process)
2. How do I see the watershed? (defining the current condition of the watershed)
3. What do I think the watershed can survive? (defining the watershed's sustainability)
4. How do I see the watershed in the future? (developing a vision for the watershed's future)

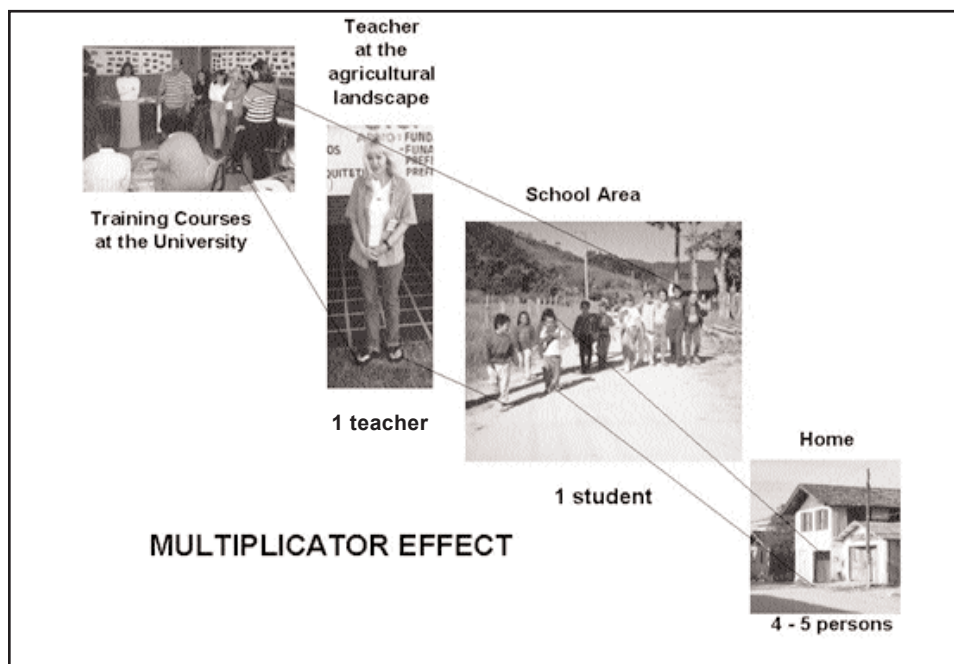
The 12 teachers were supplied cameras to monitor the changes in the four landscapes: natural, agricultural, semi-urban and urban. Each month teachers took six photos at the same location. Comparing these photos showed the annual physical changes at these locations. Teachers also randomly took six additional photos of points of interest (preferably close to their schools).

Results

Over the year, changes in the natural landscape (Atlantic rainforest) were barely noticeable. The agricultural landscape (rice fields) went through the cultivation stages: seeding, growing and harvesting. The semi-urban and urban landscapes changed most dramatically. Assessing these changes is a step towards understand the effects of the increase in summer population and migrant workers.

Conclusion

The local teachers evaluated the monitoring results. In addition to



defining the current environmental situation, these teachers and their students gained an understanding of the watershed as a geographic unit. Both teachers and students learned the importance of environmental monitoring and the techniques involved. They also learned that alone they were ineffective, and that forming a watershed committee is necessary to start a coastal management initiative.

The teachers and their students also produced an educational multiplier effect. The best example is Mara, a rural-area teacher. Mara's teachings influenced 12 children

who took their knowledge home, influenced their families who influence other families. Mara's work reached 48 individuals who are now better educated and concerned about land planning and management.

The monitoring exercise required cooperation between the 12 teachers, not only at the academic level, but also at the community level. They now understand that coastal landscapes have a structure and function, and they change over time. This exercise was valuable not only as a monitoring instrument for land management, but the

results are being used to develop an environmental education program that will inform the community of the problems it is facing. This is the beginning of a developmental process that will help the local community understand that it is their responsibility to direct change and development to better their community for the future.

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Beach Litter from Land-based Activities

By A. T. Williams, R. Morgan and D. Tudor

Each litter originates from three major sources: land, vessels and beachgoers. Material from riverine sources has a vastly different composition than true marine litter, e.g., containers are predominant in true marine-originated material, but are not prominent in river material (apart from small drink containers).

Finding the source of the litter is the key to successful management. Many published papers give lists of materials found in litter, but make little attempt to attribute items to source via any kind of rigorous statistical assessment. Controversy exists regarding the amounts of litter attributable to marine as opposed to land-based sources. For example, one study attributed 70 percent of United Kingdom's (UK) beach litter to shipping sources; whereas, a global survey estimated approximately 80 percent of beach litter is land derived.

Land-based sources of such litter have been comparatively neglected

in research. A 1997 study examined beach litter on the Glamorgan Heritage Coast (GHC), Wales, UK, and suggested that the many plastic containers found were the result of riverine litter reaching the marine environment. Containers and other large plastic items were commonplace at local riverine fly-tipping sites. During conditions of high flow, similar containers were often observed being carried downstream towards the sea. Moreover, many of the plastic containers examined on the GHC were related to home decorating/construction activities and were considered unlikely to have originated from either shipping or beach users.

The high population of the GHC hinterland (over 1 million) and high rainfall also put great pressure on the sewage disposal system. Combined sewer overflows (CSOs) divert excess flow from inland sewage treatment plants. The result is large quantities of sewage-related debris (SRD) and other solid waste entering the river. This also reaches the sea and makes a major contribution to SRD on local beaches.

Litter Tracking Experiments

In 1999, a pilot-scale study of riverine litter movement was carried out on one major river in the GHC area, the Ogmore. Spray-painted items of various materials and shapes were placed in the river approximately 3 km from its mouth and followed downstream. Results showed that plastic items were more likely to be washed out to sea, even in low-flow conditions. Plastic sheeting and paper products were found to be more likely to become stranded along river banks, though it is possible that these could also be washed down to the sea at times of flood. The fact that many objects reached the sea that were placed in the river where visible debris already existed, strongly suggested a link between riverine and beach litter.

Larger-scale tracking experiments were also conducted on the same river in February/March 1999. In the first experiment, 250 empty spray-painted plastic bottles were released some 300 m

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Indonesian Villages' Management Plans Approved

In November 1999, the villages of Blongko, Talise and Bentenan-Tumbak, in Minahasa, North Sulawesi, Indonesia, approved their Village Development and Management of Coastal Resources Plans. These were approved by village governments, institutions and the communities.

The communities were active contributors to the plan's development. The plans went through several formal and informal discussions and reviews in each of the villages and were reviewed by the Regency Task Force (KTF) members and Proyek Pesisir (Indonesian Coastal Resources Management Project). In the Minahasa Kabupaten at a KTF meeting, the vice Bupati (regency head) supported management plan approval

and asked the KTF members and the communities to fully support the plan's implementation. These plans are an excellent example of bottom-up, participatory and decentralized resources management. If successful, this method can be applied more broadly to other government initiatives.

The acceptance and encouragement to take an adaptive management approach acknowledges that some changes in implementation arrangements and procedures may be needed. There is much enthusiasm and hard work being directed towards making these plans successful.

The management plan has goals and activities. These include development of: an ordinance on approval and implementation;

strategies and goals; community vision; expected issues, objectives, actions and results; institutional arrangements; and monitoring and evaluation.

With the successful implementation of these plans, the next step is to effectively apply these methods to other communities in North Sulawesi.

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The Coastal Guide Website

(<http://www.coastalguide.org>)

The European Union for Coastal Conservation and Bureau D&K have introduced a new information service for professionals in coastal conservation, management, planning and research, especially in Europe and the Mediterranean in an effort to assist professionals in finding the best available information.

The Coastal Guide is a continuously growing website that is updated with the most current information regarding the management of coastal waters. The site is not intended to offer detailed research or monitoring data but rather designed as an interactive tool to allow a direct connection between experts via phone, fax, mail and internet.

The Coastal Guide includes a searchable library with 25,000 titles offline and more than 1,500 coastal publications and book reviews online. Over 300 excellent website links are organized into two categories: coastal and marine; and environment, biodiversity and geology. A free E-mail newsletter is also available. With 25 issues per year, the Coastal Guide newsletter is an extra source for conference announcements and upcoming events; coastal publications, articles and websites; and news on current research, policy and management initiatives.

For further information on The Coastal Guide, contact E-mail: info@coastalguide.org

The Coastal Guide Helpdesk

(<http://www.coastalguide.org/helpdesk/index.html>)

The Coastal Guide Helpdesk can be used to obtain information and expertise on European and Mediterranean coasts. Helpdesk staff can assist with general or tailor-made services including references to literature, CD-ROMs, Internet sites, databases, experts and institutes, slides archive on European coasts and up-to-date advice on international funding opportunities.

For further information on the HelpDesk, contact Coastal Guide Helpdesk, EUCC, PO Box 11232, NL-2301 CK Leiden, Netherlands. Fax: +31 71 5124069. Tel: +31 71 5122900. E-mail: helpdesk@coastalguide.org

Indonesian Community's Land Ownership Acknowledged

Proyek Pesisir (Indonesian Coastal Resources Management Project) has a field site on the island of Talise, North Sulawesi. Proyek Pesisir, during assessment of the Talise coastal management plan, identified land ownership as the high-priority management issue. The community felt that until this issue was resolved, no progress could be made on other management issues. The community hesitated to participate in management projects without being recognized as the owners of the land; without ownership, there is no guarantee the land wouldn't be taken over after its successful management. Data collected by Proyek Pesisir showed that among the 275 households in Talise Village, only 47 households had land tenure/ownership.

In December 1999, as a result of hard work by the community and local government to resolve a major management issue, Sarwono Kusumaatmadja, the Minister of Marine Exploration and Fisheries, delivered 220 land certificates to the community. The Minister recognized the community's hesitation to actively manage land without any legal ownership of land or resources. He recognized that stewardship must be given for the land area for the community to feel responsibility for the resources (e.g., ocean, mangrove, coastline and forest).

The Minister's purpose for visiting Talise was not only to learn from this community, but also to show continued support for active programs that have shown progress and success, Proyek Pesisir being an excellent example. It is hoped that this visit will bring attention to the success of this program and ultimately lead to implementation

of similar programs in other villages.

Of significance is the recognition by the Minister that it is the community that has the greatest responsibility and works hardest in the management of the resources. Thus, his department should take the lead in supporting communities by giving technical input and guidance and by developing an appropriate policy framework for



Shrimp pond.

resources management. The community, with land ownership and sufficient capacity, and with government support, guidance and just policy, will achieve Proyek Pesisir's goal of improved coastal condition and community livelihood.

Mariculture and Ocean Utilization

Two other issues, mariculture development and ocean utilization based on traditional law, were discussed. There is potential for mariculture development in North Sulawesi, including seaweed, giant clam, reef fish and others. A study is needed to determine what mariculture is the best suited for Talise Village. This study will be done by Proyek Pesisir in the coming year.

Currently, traditional law is not written, and it is difficult to establish legal rights over an area if, for example, a large company were to lay claim to an area for resource utilization. To ensure this does not happen, it would be best to translate traditional law into written law, thus giving the community legal rights to these resources. This will be done through the Talise Island Management Plan (see previous article) recently approved by the local government.

The Minister stated that a priori-

ty would be to ensure that community programs of this sort would continue. Guidelines will be developed to assist communities to better manage their resources and to prevent further degradation.

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Building Human Capacity for Better Management of Marine Protected Areas in the Western Pacific Ocean

By Julius Francis

The Coastal Zone Management Centre (CZMC), the Netherlands, in cooperation with the Institute of Marine Sciences, Dar es Salaam University, Tanzania, initiated a project for capacity building in marine protected areas (MPA) in the Western Indian Ocean (WIO). The project aims to develop a MPA training manual and a short-term regional training program. Also proposed is to strengthen links among existing regional programs, conventions and information networks. This one-year project is funded through The World Bank /Dutch Partnership Programme.

The key factor that constrains effective establishment and management of MPAs is the lack of trained personnel. There are several examples clearly illustrating that the availability of financial and other resources without trained personnel does not ensure effective and long-term management.

There is new optimism in the region: the possibly to turn "paper" MPAs into working MPAs. At both the regional and global levels, MPAs are widely recognized as an important component of any management strategy for the sustainable development of coastal and marine environments. This has led to several regional and global con-

ventions, as well as other initiatives that make specific reference to the need for improved MPA management. These include the UN Law of the Sea, Chapter 17 of Agenda 21 and the Strategic Action Programme for the Marine and Coastal Environment of the Western Indian Ocean. The latter, initiated through the Nairobi Convention, recommended consolidating existing MPAs and establishing new MPAs, including transboundary MPAs in the border areas of Kenya/Tanzania, Tanzania/Mozambique and Mozambique/South Africa. These efforts will inevitably lead to the revival of a number of "paper" MPAs, as well as the establishment of new MPAs in the region. This will lead to an increased demand for trained MPA personnel throughout the region, clearly showing that a mechanism for training MPA personnel is urgently needed.

One of the initial activities undertaken by the MPA capacity-building program was a planning workshop held in Zanzibar in June 1999. This was the first opportunity for regional MPA experts, trainers and organizations to meet and exchange information and experiences and define the training needs within the region. Also developed was a detailed outline for the MPA training manual to be produced in

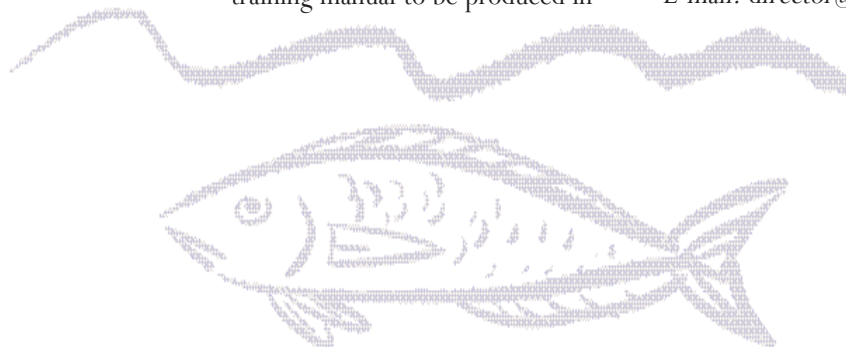
the coming months and a proposed pilot training program scheduled for early 2000.

The outcome of the planning workshop was very promising. It provided a clear insight to the needs and priorities in the region, as well as strong and active support for this initiative from all participants.

The regional training will be as practical as possible and will include lectures, field exercises, simulations, case studies, and group discussions. More specifically, the training aims to provide mid-level MPA managers the skills, techniques and tools for management of human use and/or impacts on an MPA.

The successful implementation of the project activities will go a long way towards laying a firm foundation for future initiatives in capacity building in MPA management. The demand for training in the region cannot be adequately addressed through planned training courses alone. For this reason, regional and global organizations must jointly support long-term capacity building in MPA management in the Western Indian Ocean region.

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More Refugees Flee from Environment than from Warfare

There has been a rapidly increasing migration of people escaping from environmentally degraded areas and from areas where conflict has arisen over too few natural resources for too many people. The enormity of the problem prompted the Canada's Department of Foreign Affairs and International Trade (DFAIT) and the U.S. Central Intelligence Agency (CIA) to establish units to monitor environmental and resource conflicts and the eco-refugee migration they create.

This investigation determined

that environmental refugees fleeing from drought, floods, deforestation and degraded land totaled 25 million in 1998. This outnumbered those displaced by war for the first time, according to the International Red Cross, Geneva. Natural disasters in 1998 were the worst on record, creating 58 percent of the world's refugees. With the combination of environmental problems of global warming and deforestation, and social problems of increasing poverty and growing shanty towns, the scale of the problem is enormous. The International

Red Cross predicts the devastation caused by the combination of human-driven climate change and rapidly changing social and economic conditions will be so enormous, it in-it-self will be a super-disasters.

The report is available through the International Federation of Red Cross and Red Crescent Societies.

Website: <http://www.ifrc.org/>
Excerpted from The Gallon Environment Letter, Vol. 3, No. 21, July 4, 1999, Canadian Institute for Business and the Environment, Quebec Canada. Tel: 514-369-0230. Fax: 514-369-3282. E-mail: cibe@web.net. Website: <http://www.gallo.n.elogik.com>

Tsunami Test Buoy Reacts to California Earthquake

A tsunami alert test buoy floating in the Pacific Ocean off of the coast of Monterey, Calif., USA, reacted to an Oct. 16, 1999, Southern California earthquake. Deployed early 1999, soon after the 1998 tsunami that devastated northern Papua New Guinea, killing 2,000 (see InterCoast #35), the buoy is one in a series deployed by the National Oceanic and Atmospheric Administration to provide early warning of tsunamis.

Although there was no tsunami produced by the 7.0 earthquake, it triggered the buoy and was an unexpected test of the system; thus indicating that the buoy system performed as designed. The buoy's seafloor sensor was lifted by seismic waves from the earthquake, creating an amplified pressure change that triggered the buoy.

The buoys are part of the Deep

Ocean Assessment and Reporting of Tsunamis program (DART), designed to provide as much warning as possible. The two warning centers, one in Hawaii and one in Alaska, did not receive the data from the test buoy as they are in the process of installing the necessary software, so no warning action was taken.

DART provides information to the Tsunami Warning System, composed of 26 participating international member states. The Pacific Tsunami Warning Center, located in Honolulu, Hawaii, is the operational center of the Pacific Tsunami Warning System and provides tsunami warning information to national authorities in the Pacific Basin. NOAA operates a warning center in Alaska that provides warnings to Alaska, California, Oregon and Washington.

NOAA is one of the participating agencies in the U.S. National Tsunami Hazard Mitigation Program, a federal/state partnership that also includes the Federal Emergency Management Agency, the U.S. Geological Survey, and the states of Alaska, Washington, Oregon, California and Hawaii.

For information on the National Tsunami program, see Website: <http://www.pmel.noaa.gov/tsunami-hazard/> Excerpted from National Oceanic and Atmospheric Administration press releases (<http://www.noaa.gov/public-affairs>)

Students and Community Address Pollution

The School for Field Studies (SFS) is a nonprofit, educational institution that sponsors undergraduate programs in six resource-dependent regions around the world. SFS employs a unique teaching model that combines undergraduate education, environmental problem solving and local community partnerships.

SFS offered the small town of Puerto San Carlos, Mexico, a way to solve a significant environmental problem while teaching students the interdisciplinary techniques associated with environmental research.

Puerto San Carlos is on the west coast of Baja California Sur on the shores of Bahía Magdalena. SFS's project is to identify sources of contamination in waters surrounding the town, while educating and providing the local stakeholders with environmentally conscious and sustainable remediation options.

Bahía Magdalena is a vast saltwater embayment, well protected by a series of barrier islands shielding the highly productive shallow waters from the Pacific Ocean. Encompassing over 1000 km², Bahía Magdalena is the largest wetland system on the west coast of the Americas. Despite being surrounded by the barren desert of western Mexico, the bay has a variety of diverse and productive marine habitats. Its waters host numerous fish as well as the annual migration of the gray whales.

The high productivity of Bahía Magdalena supports large stocks of shrimp, blue crab and a variety of fish species. The bay supports the town of Puerto San Carlos, a fishing village of 5,000 people. During the shrimp season, transient fishers nearly double the population of Puerto San Carlos. Between fishing

and the seasonal influx of tourists, the population and economy of Puerto San Carlos are supported almost solely by the bay. In addition, the bay provides the only deep-water port on the west coast for 300 miles.

Unfortunately, this increasing population has become an environmental threat as waste disposal becomes more difficult. Household trash is simply dumped into deserted areas outside the town. More than just an eyesore, this material contains organics and other potentially toxic materials that enter the bay and threaten its habitats.

There are also specific industries and activities that threaten the ecosystems. These include shipping and pumping of toxic materials such as fuel oil; a local thermoelectric power plant that dumps heated water into the bay; and a local cannery that processes seafood for export and dumps its organic wastes into the bay.

The cannery, La Conservera San Carlos, processes tuna and sardines taken by local fishers. As part of the canning process, highly acidic organic wastes are generated and discharged directly into the bay. Preliminary work performed by SFS and outside researchers shows that the sediments are contaminated, and nutrient levels and hydrogen sulfide levels are hundreds of times higher in sediments near the cannery than expected naturally. Sampling of the bottom habitat near the cannery confirms that the existing biological community is a classic indicator community of severe disturbance and environmental degradation. In the water column above, oxygen levels are quite low near the cannery, and water turbidity is quite high.

The cannery represents an important economic resource for the community. It is the single largest employer in the area,

employing from 150 to 450 people depending on the season. Since the local community is highly dependent upon the cannery, a solution to the water quality problems needs to be found to allow the cannery to continue to support the community.

Currently, SFS is examining the sources and extent of various water quality issues. At the same time, SFS has developed partnerships with the local community, including business representatives, local government, regional research institutions (i.e., Centro de Investigación Científica y de Educación Superior de Ensenada and El Centro de Investigaciones Biológicas del Noroeste, S.C.) and researchers from the University of San Diego, California. These partnerships will aid SFS in the next phase, developing remediation steps to help reduce or eliminate pollution sources.

Instead of the traditional adversarial relationship between scientists, government and industry, SFS has designed and is implementing an international grassroots project in which all parties work together to address an environmental problem. Local individuals with concerns have been kept informed, and a committee with representatives from the local government, cannery management and ecotourism concerns has been formed. A partnership involving a nonprofit educational institution bringing together local government, industry and researchers represents a relatively unique way to address local environmental problems.

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Guidelines for the Environmental Assessment of Coastal Aquaculture Development

Guidelines for the Environmental Assessment of Coastal Tourism

Secretariat for Eastern African Coastal Area Management
(SEACAM)



Coastal tourism and coastal aquaculture drive the economic development of many tropical regions, including much of coastal Eastern Africa. These two hands-on SEACAM environmental assessment guidelines are designed to address the environmental impacts of tourism and aquaculture in Eastern Africa. Major topics include developing and implementing Eastern African systems, public participation,

screening and scoping, assessing, mitigation and monitoring, case studies, standards, and examples from developing countries.

The guidelines are based on an analysis of experiences in Eastern Africa, and existing guidelines, best practices and lessons learned from many developing countries. These are examined to help develop methods to alleviate negative impacts. While targeted to an Eastern African audience, the guidelines are a useful resource for stakeholders in other countries.

The guidelines will be published in French and Portuguese. Summary booklets of the guidelines will be available in mid-2000.

For further information or to obtain a copy, please contact SEACAM. Tel: 258 1 300641. Fax: 258 1 300638. E-mail: seacam@virconn.com. Website: www.seacam.mz

Pacific Salmon

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Development are altering more and more of the salmon's upland habitat. The result is degraded habitats, diminished flows, poor water quality and unfavorable temperature regimes. Here, the traditional upstream/downstream relationship returns as upstream activities are adversely affect downstream activities.

After years of litigation, a court decision established a framework for the co-management of Pacific salmon between the native tribes and the state. It also gave tribal governments the authority to manage their on- and off-reservation fisheries.

After years of arguing over slices of a diminishing "pie," tribal and state managers have begun to look for ways to increase the overall size of the pie. This includes focusing on the ecosystem and realizing that

the salmon's health is interconnected with the ecosystems' health. Correspondingly, for a management plan to be successful, it must account for this interconnectedness and establish means of control over the resource within its entire migratory range, both upstream and downstream.

This change in management concepts has been accompanied by a proliferation of new organizations and fora developed under the umbrella of state/tribal co-management. The co-management techniques development in Puget Sound, Washington, USA, have provided an institutional means to link upstream and downstream users and impacts, thus requiring management techniques to consider direct and indirect impacts.

Despite these changes, efforts to protect the downstream salmon and restore its upstream habitat have been inadequate. Co-man-

agers lack adequate jurisdictional control and decisionmaking authority over upstream/downstream impacts. Additionally, the rate of degradation and depletion of upstream habitat may be outstripping the managers' ability to protect and restore resources, even in cases where there are no jurisdictional management problems. Institutional and jurisdictional changes are needed to allow integrated management—management that considers all uses and impacts in a unified process. Means are needed to expose indirect impacts and foster joint action between upstream and downstream users.

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Coral Bleaching

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<http://www.biodiv.org/sbstta5/pdf/English/SBSTTA-5-07e.pdf>) will be considered by the CBD's full Conference of Parties, May 2000. They call for increased identification, funding and implementation of responses to coral bleaching and enhanced cooperation between governments and related global conventions and initiatives.

The U.S. Draft Coral Reef Action Plan addresses coral bleaching as a Key Conservation Objective and recommends

"strengthening international research, monitoring and assessment efforts."

Several sessions at the 9th International Coral Reef Symposium (9ICRS) in Bali in October 2000 will focus on bleaching. A session on the ecological and socioeconomic impacts of mass coral bleaching is sponsored by a US Agency for International Development University of Rhode Island initiative, funded by the US State Department, called the Coral Bleaching Program. In addition to organizing the 9ICRS session, the

Coral Bleaching Program is coordinating ecological and socioeconomic studies of coral bleaching impacts within the East Asia-Pacific region. The Coral Bleaching Program has also compiled a library of peer-reviewed and gray literature on this subject.

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Sustainable Communities

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ted coordinated transportation improvement proposals to the state government. These proposals included a request for an island-wide traffic model. It was the first time that the three towns worked cooperatively on a transportation proposal.

Step Five: Evaluation

CRC strives to find useful indicators of project impact as well as project progress. Once defined, these can be applied throughout the life of a project. This project is fortunate to have good information on current land use and the condi-

tion and use of other natural resources. This information will be used to track the initiative's long-term impacts. CRC is also monitoring changes in the relationship between groups. CRC hopes that future partnerships and joint projects will be based on trust, respect and a joint vision for the future.

Conclusion

CRC's integrated and holistic approach demands a long-term view and an extended commitment to people and places. The idea of creating sustainable communities in harmony with local and regional economic forces is daunting.

Throughout the process, monitoring and evaluation is paramount for continued success. In time, these continual evaluations will allow adjustments in the methods to better address the issues and assure sustainable development. This cannot succeed without a long-term commitment of time and resources by all those concerned.

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Land Use

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rivers increase faster and have higher peaks. This in turn increases soil erosion and stream channel scouring while decreasing rates of groundwater recharge. Less groundwater discharge between storms causes lower base flows of streams and rivers which are more likely to dry up during a drought. When storm flows from the non-forested and developed watershed

reach the estuary, they are laden with sediment and nutrients. The higher peaks of fresh water flow alter the salinity balance between fresh water from the watershed and salt water mixing from the ocean. Altered salinity and sediment from storm flows affect aquatic organisms throughout the bay.

In the late 1970s, the bay's declining fisheries productivity and waterfowl populations led to an

intensive research and restoration initiative. It was determined that high levels of nutrients, nitrogen and phosphorus were a primary cause of the declining productivity. Resource management of the Chesapeake Bay was needed.

Management Initiatives

Management of the Chesapeake Bay is complicated by a very fragmented decisionmaking process and government structure. The bay is bordered by two states, while its

watershed extends into four additional states. Several agencies and many local governments in each state regulate land use practices. The land is owned by millions of people who make millions of small, uncoordinated management decisions. Thus, it is a daunting task to implement good land use management, even in one small town.

Since the early 1970s, the state of Maryland has seriously attempted to improve land use management and reduce nutrient and sediment pollution into the bay. This state's initiatives illustrate the complexity and long-term commitment necessary for integrated coastal management.

Maryland's first initiatives to improve management were single issue focused, such as managing sediment and stormwater from developments, and reducing the amount nutrients being discharged by wastewater treatment plants. Wastewater was tackled through two parallel efforts: large federal and state funding programs to help cities and towns upgrade sewage treatment plants (ongoing), and a 1985 ban on the sale of laundry detergents containing phosphates. These early initiatives were easy and successful and produced significant results.

Rapid shoreline development and high growth pressures along the bay's shoreline and tributaries led to the first land use initiatives to manage development to protect shoreline habitats and water quality. Tidal wetlands (coastal wetlands flooded by each tidal cycle) are important water pollution buffers as well as wildlife and fisheries habitats. Historically, these wetland areas were routinely filled to create developable land or dredged to create navigation channels. An estimated 70 percent of tidal wetlands has been lost during the past 100 years. Records indicated that an average of 400 hectares per year of

wetlands was destroyed in the early 1970s. These trends led to Maryland's first statewide environmental protection land use initiative, or in other words, adoption of regulations that protected tidal wetlands from filling and dredging.

In 1984, Maryland moved beyond wetland protection and adopted regulations (Chesapeake Bay Critical Area Program) that placed a management zone along all tidal shorelines (bay and rivers) and wetlands. Criteria are integrated and are designed to protect water quality and coastal habitats during land use activities. The program restricts new development in rural areas to agricultural uses and low-density residential development. More intense development is only permitted in existing urban areas and narrowly defined growth areas. Buffers of forest and other natural vegetation along the shorelines are protected from development, and important habitats are protected. In addition, there are strict sediment control and stormwater management standards for new development.

Forestry and agricultural activities are also managed. A governor appointed commission oversees implementation of the Critical Areas Program by state and local authorities. The critical area covers about 10 percent of the state's land. Several efforts to adopt this program upstream, making it a statewide growth and natural resource management program, have failed.

Despite experts' opinion that existing growth will slowly overtake improvements, legislation addressing this was defeated. However, in 1991 the Forest Conservation Act was adopted. This act responded to the rapid rate of forest loss in Maryland. The act requires local governments to incorporate criteria in their zoning and subdivision regulations that

protect forests, water quality, and important environmental features during the development process. Developers must map areas with pre-development forest cover along with the location of streams, wetlands, steep slopes and important habitats. Based on these maps, development plans must retain and protect at least 20 percent of pre-development forest cover, in addition to protecting the most environmentally important features. Priority is given to protecting large blocks of forest and forest corridors along streams and rivers.

In 1992, Maryland adopted the 1992 Economic Growth, Resource Protection, and Planning Act. This act established a state commission to develop planning techniques, educate residents about growth and planning, develop inter-jurisdictional coordination, and develop initiatives that balance environmental protection with economic development. Plans are also required to include an environmental protection component regarding streams and their buffers, wetlands, habitat for endangered species, and steep slopes.

In 1997, state records indicated that development patterns and trends still had not improved. These facts along with the fiscal and environmental consequences of new development led the state to adopt another growth management program called the Smart Growth & Neighborhood Conservation Act. This growth management initiative directs state fiscal resources toward two goals: revitalizing older urban communities so people want to live there, and protecting the state's most productive agricultural and natural resource lands. State funding for infrastructure such as schools, sewer, water and transportation will only be used in existing communities and designated growth areas. The state will also pay landowners in the most pro-

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Beach Litter

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upstream from the river mouth, three hours after high tide under normal river flow conditions. Within 24 hours, 140 (56 percent) of these bottles were washed up on the adjacent shoreline within 1 km of the river mouth. Most of these (127) were found on the beach at Merthyr Mawr, which is a frequent and heavy litter collector.

An identical experiment was carried out, but using 300 bottles filled with river water. In this case, extensive searches of local beaches located 85 bottles (28 percent) within 24 hours, the furthest being 5 km from the release point. Forty-eight hours following release, only three additional bottles were located (all within 2 km of the release point). Careful examination of local beaches over the following two weeks failed to locate any of the more than 200 unaccounted for bottles from this experiment or from the previous release. It is postulated that the strong tidal currents in the Bristol Channel carry away and widely disperse most riverine debris that is not washed up on nearby beaches within 2-3

tidal cycles. The ultimate destination of this material is unknown. Whether most plastic containers reach the sea filled with water, partly filled or empty is essentially unknown, but might be expected to depend on many factors such as river turbulence, whether the cap was in place, damage to the container before or during transport, etc. Most other plastic objects might be expected to float low in the water, similar to a water-filled bottle and perhaps behave similarly.

Conclusions

The pilot-scale studies described barely scratch the surface of the work required to properly investigate the movement of riverine litter from land into the marine environment. Further studies need to be carried out with a greater variety of items (e.g., SRD items, gross litter) and in times of flood flow when large quantities of riverine debris can be swept downstream from fly-tipping sites, CSOs, etc. Mathematical modeling of marine litter movement (as carried out for sewage discharge plumes) is problematic because of the great variation in composition, size, density, etc., both within any body of mate-

rial and as a result of spatial/temporal changes in content. Additional work to study the pathways and sinks of riverine debris in the marine environment under varying regimes of wind and tides may well have to be conducted on a locally specific, ad hoc basis. Without use of sophisticated tracking techniques, this type of study has potential to be uncertain and very time consuming.

An initiative that must be taken is to tighten legislation on riverine and marine pollution. In addition, other techniques need to be developed to investigate and control the problem of dumping debris. Such efforts would need to be greatly improved to bring about any change of the current situation.

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NEMO

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educational models.

Communication through NEMO's National Page of the NEMO website (<http://www.nemo.uconn.edu>) provides an active connection between the projects.

To help guide this network and explore mechanisms for collaboration and support, the National NEMO Network Interagency Work Group has been formed (members include: U.S. Department of Agriculture, EPA, National Aeronautics and Space Administration, and National

Oceanic and Atmospheric Administration).

The interconnected issues of water resource health, sustainable growth and community character are virtual concerns everywhere. People are finding that attention given to reducing impermeable surfaces and combating sprawl will pay off, not just in improved water quality but also for quality of life issues, such as air pollution, traffic safety, community character, urban renewal and neighborhood livability. The key to assisting communities is education, but it has to be on their terms. NEMO successfully

blends education and technology in a program that links natural resources, land use planning and long-term community health.

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El Niño

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high CPUE. This is a simple, classic relationship between effort, catch and CPUE, suggesting that the East Kalimantan stock is heavily fished.

The multiple regression analyses used on the South Sulawesi data were also applied to those of East Kalimantan. These showed that regressions of shrimp capture landings on either total culture yields or the area cultured were not significant. Therefore, the two geographical situations cannot be considered in the same theoretical way.

The application of the CLIMPROD model to the East Kalimantan data showed that, contrary to the situation in South Sulawesi, the ENSOI had no effect on the capture shrimp landings, and the capture yields were in no way affected by the development of the culture system.

Explanations

Why should the South Sulawesi, and not the East Kalimantan, coastal shrimp fishery be affected by the ENSOI? At least two factors play a part. First, the South Sulawesi coastline and the shrimp fishing grounds receive relatively

little freshwater and land-based nutrients. The limited inputs are coming from approximately 10 small, seasonally flowing rivers with small catchment areas. In El Niño years with low rainfall, this freshwater and nutrient supply will be very limited. Furthermore, shrimp farmers would prefer to use the limited freshwater for controlling salinity in their brackish water culture ponds, thus reducing immediate freshwater input to the open coastal system. It is possible that this could lead to reduced recruitment and lower landings of shrimp from the capture fishery.

Second, the culture systems are usually constructed in areas that were previously mangrove covered. Mangrove areas are well known for juvenile shrimp development, so increased mangrove degradation (and reduced primary mangrove habitat) could be expected to lead to reduced recruitment of shrimp to the capture fishery.

East Kalimantan's coastal shrimp grounds receive freshwater and nutrients in abundance from one main river, the Mahakam (1,000 km). The river has extensive internal flood plains, and hence considerable buffering capacity to miti-

gate poor rainfall effects seen during ENSOI years. This buffering of ENSOI climatological effects will have allowed a capture fishery yielding consistent catches to develop. Since the brackish water culturing system in East Kalimantan is small relative to the shrimp capture fishery, it would be unlikely to impact the adjacent coastline and its shrimp capture fishery significantly.

The implications of this study are far reaching and may be important to not only the shrimp fisheries, but to other activities. Nevertheless, further study would require revisiting the 17 provinces for data collection. Similar collection, collation and analysis techniques would need to be used. Unfortunately, at this time a study of this scale is not possible.

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Conflict Management and Consensus Building for Integrated Coastal Management in Latin America and the Caribbean

The Inter-American Development Bank Sustainable Development Department
Frank Rijsberman, editor

Dealing with conflicts is especially challenging for coastal managers because most coastal systems have a multi-use setting with a mosaic of "rights" and ownership. Coastal management often calls for reconciling divergent objectives among the competing sectors. The report looks at the application of consensus building and dispute resolution processes that must be utilized to achieve sustainable development. It provides a summary of conflict management issues and options in the cultural, ecological, economic and social context of coastal management in Latin America and the Caribbean. It does so with three case studies in Central America where the effects of Hurricane Mitch in 1998 have had a major impact on coastal communities. The report identifies lessons learned and provides suggestions for further action that should be of great use to practitioners in the field. This strategy will serve as a tool to help develop a process for communities dependent on coastal resources to improve their quality-of-life and attain sustainable development with the least effort spent on conflict management.

The book is available on the Internet: <http://www.iadb.org/sds/utility.cfm/205/ENGLISH/pub/1532>. Hard copies can be obtained from Publications ENV, Mail Stop W-500, Inter-American Development Bank, 1300 New York Ave NW, Washington, DC 20577 USA. E-mail: mariak@iadb.org

InterCoastWebsite

<http://crc.uri.edu/comm/htmlpubs/ic/index.html>

Back issues available.



Coastal Resources Center's homepage (<http://crc.uri.edu>) has links to all CRC's activities worldwide.

COASTAL RESOURCES CENTER
University of Rhode Island

Land Use

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ductive rural areas to forgo their future rights to initiate any urban development.

The Smart Growth Act is the latest in a sequence of management techniques Maryland has adopted over the past 30 years to reduce negative impacts that intense human development have on coastal waters of the Chesapeake Bay. Early initiatives focused on single issues such as pollution (easiest). Later initiatives have been integrated,

addressing multiple issues (more difficult). Recent initiatives regulate land use by property owners, making these initiatives politically, thus appreciably (very) difficult to adopt.

This review of management initiatives in Maryland is revealing. Although residents and resource managers understand the impacts of human activity on coastal systems, and sound management techniques exist to prevent the degradation of coastal systems, these techniques are not

As Water Flows

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50,000 ha of wetlands each year that protect water quality, prevent flooding, and provide habitat and recreational opportunities. To reverse these trends, we must find ways to eliminate perverse economic incentives that work at cross-purposes to other national goals. We must also instill a spirit of stewardship in the individuals and communities whose livelihoods and quality-of-life depend on a healthy coast. Along the way, we must come to understand and respect the many ways that oceans are integrally and irrevocably connected to the land.

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implemented until after coastal resources are significantly degraded. In Maryland, serious and widespread degradation occurred and was documented before the necessary political support could be generated for implementing sound management practices. Today, the challenge facing resources managers is to get communities to adopt sound resource management practices before irreparable degradation occurs and costly mitigation and restoration initiatives are necessary.

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