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MANAGEMENT AND REHABILITATION OF COASTAL RESOURCES IN THE THIRD WORLD: JAMAICAN MODEL FOR SEAGRASS RESTORATION

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ABSTRACT

The Global Conservation Strategy launched by the United Nations Environmental Program emphasized the importance of wise resource use and management of coastal resources. The Caribbean Action Plan signed in 1982 pointed out the importance of coastal resources to environmental health of the Caribbean. Some developing nations such as Jamaica already had realized the importance of their coastal resources. Jamaica has approximately 200 miles of coastline which is fringed by mangrove forests and beaches, has large seagrass meadows and offshore corals.

In the process of development of urban centers, infrastructure, and industries, tens of thousands of acres of seagrasses have been decimated. An important step in making seagrass resources and their fisheries nursery function sustainable was to transfer the technology of seagrass rehabilitation to Jamaica. It had never before been attempted in the tropics or the Third World.

A set of 20 test locations for seagrass rehabilitation was jointly decided upon, including various portions of the coastline, various major types of pollution impacts and different environments (open ocean, coastline and estuary). At each site, the major types of seagrasses found in the area were planted. The results of this project show that the technology of seagrass rehabilitation can be transferred to the tropics. Test plots grew well on a variety of impacts. In some cases, seagrass beds coalesced in four months.

1. INTRODUCTION

The "World Conservation Strategy" (IUCN, UNEP and WWF, 1980) launched and signed in March, 1980 by Jamaica, as well as many other developing nations, emphasized under priority requirements for life support systems, the following natural resources management policy:

> "Ensure that the principle management goal for estuaries, mangrove swamps and other coastal wetlands and shallows critical for fisheries is the maintenance of processes on which the fisheries depend."

Following the "World Conservation Strategy", the Regional Seas Program for the Caribbean Action Plan carefully drafted for the Montego Bay, Jamaica meeting in March, 1981 and signed in Cartegena, Colombia in March, 1983, emphasized that

the Caribbean Islands were essentially coastal areas. It also emphasized the need for research on mitigation of coastal resources in the face of development impacts (UNEP/CEPAL, APCEP 13/5.4., 1980).

Jamaica has taken these guidelines seriously and is the first developing nation in the world to attempt to rehabilitate "shallows critical for fisheries", that is seagrasses, in Jamaica's attempts to preserve for future generations the natural resource of fisheries nurseries in the face of national development.

Jamaica, the second largest island nation in the Caribbean Sea, has approximately 330 miles of coastline which is fringed by mangrove forests and beaches, has large seagrass meadows and offshore corals, as well as extensive coastal plains backed by a major mountain range. Large estuaries and bays have long made this an extremely attractive island.

Development has occurred almost since Christopher Columbus discovered the island in 1494, and has been steady since Britain seized the island from Spain in 1655. Estuaries were made into ports around which cities developed. Large plantations were created from coastal plains and upland forests. Bauxite and limestone (for cement) have been mined intensively with loading ports built along the coastline. Infrastructure such as causeways, roads, bridges, airports, ports, power and sewage treatment plants also have been built on the edge of the coastline causing shoreline and subtidal damage. Effluents of sewage, chemicals and urban run-off have historically been discharged into the estuaries around which the major urban centers were developed. Tourism is a major industry that uses the natural resources, beaches, reefs and seagrass meadows, but this is confined mainly to the north and west coastlines. Fisheries historically have been an important protein source for the island's inhabitants.

The Natural Resource Conservation Department of the Ministry of Science, Technology and Environment has the responsibility for creating policy, regulating, planning and doing scientific research on environmental resources in Jamaica. The investigation reported here was a portion of their plan to bring the important resources of estuarine and offshore seagrass meadows into a sustainable balance for the future. The "World Conservation Strategy" estimated that the cost of damage to U.S. marine fisheries caused by degradation of coastal wetlands has been almost $86 million a year (IUCN et al., 1980). Seagrasses play an important role in coastal processes by serving as a fisheries nursery, controlling erosion and by providing a matrix for habitat for coastal ecology.

In the process of development of urban centers, infrastructure and industries, thousands of acres of seagrasses have been decimated in Jamaica. An important step in making seagrass resources and their fisheries nursery function sustainable was to transfer the technology of seagrass rehabilitation from the United States, where it is required on a regular basis for development, to Jamaica as a model for the Caribbean. The techniques have never before been attempted in the tropics or the Third World.

This was a completely cooperative program among the U.S. Agency for International Development, Jamaica's Natural Resources Conservation Department (NRCD) and Florida International University (FIU). All were highly cooperative parties in planning the original design of the program, contributing many ideas to solve problem areas of development to be investigated and facilitating the operation of the project. It is indeed a model of cooperation and a two-way flow, and creation of new knowledge between a developed and a developing nation. The high level of ecological knowledge and training of NRCD technical staff and directors was as important a factor as the seagrass restoration knowledge of FIU personnel. The joint knowledge of future development problems of NRCD and U.S.

AID Kingston Mission was important to formulating sites of future usage of this information.

2. METHODS

2.1. Site Selection

A joint team from NRCD, FIU and UWI selected sites where developmental impact had occurred. Criteria were: 1) aerial photos, literature or interviews showed that seagrasses had existed prior to impact; 2) sites be scattered around various parts of the Island; 3) major types of present and future development be represented. After a long list of sites were compiled and examined, a feasible subset of sites were finalized. Within each site location appropriate areas for test plots were selected by the restoration biologists.

2.2. Test Plot Setup

The test sites usually measured 27 x 9 m; the long dimension was divided to make six subplots 4.5 x 9 m. Each of the three species of seagrass was planted in two adjacent subplots. A different planting technique was attempted in each subplot. The four technique variables were plant seeds, roots, plugs and anchors; with plants installed in a 0.9 x 0.9 m matrix. Each subplot contained 50 planted units exept where noted. Plots of similar size were designated as controls at each site.

2.3. Planting

Both fall and spring planting were carried out to test feasibility. Three species were planted at each site, each by two methods. A joint U.S.-Jamaican team of biologists and fishermen were utilized in the planting efforts.

2.4. Monitoring

Sampling at each consisted of counting all the surviving planted units and measuring 25 percent of the planted units (every fourth plant) for length of blades, rate of rhizome laterial growth, number of blades per shoot, rate of blade growth and coalescence of plantings into homogeneous cover. Measurements were made along line transects set over the planted rows. Physical, chemical and biological parameters that had been noted in the preplanting survey (location, depth, sediment depth and type, indigenous seagrasses, dominant algae, visibility, wave energy regime and current) were noted during the monitoring. In addition, oxygen, light penetration, salinity and temperature were measured. Sediment cores were taken from selected sites for hydrocarbon residue and trace metal content analyses. Monitoring periods were approximately 60 days.

3. RESULTS

3.1. Dredge and Fill

This was the most successful impact type in terms of success of seagrass rehabilitation. All three species survived and grew successfully in former

dredge sites on both north and south coasts.

3.2. Bauxite Sites

Although bauxite was evidently continually being emitted at periodic intervals from ship loading facilities, Thalassia in particular did well in survival and growth at these sites on bith the north and south coasts.

3.3. Thermal Pollution

One species only, Halodule wrightii, survived and grew in the thermal plume where effluents were being emitted.

3.4. Artifically Constructed Industrial Lagoons

While the salinity range was below 60 o/oo, Halodule wrightii survived. Found in the lagoon was a fourth seagrass, Ruppia. It should be noted that the period of study took place during a 55 year drought on the central south coast of Jamaica where the lagoon was found. Therefore, lagoons must be tested for upper dry season salinity. Basically, survival could be expected under more normal rain conditions.

3.5 Riprap and Jetties

Behind artifivally jettied areas restoration of seagrasses worked differently. One area exhibited high survival for Thalassia and Halodule, whereas another, with river discharge as an additional factor, failed completely.

3.6. Erosion

Repeated work was done on the north and south coast erosion sites using a wide variety of anchors. At certain medium erosion sites the Thalassia (seeds with heavy anchors and well-anchored sprigs) survived moderately well. At the highest energy site low survival of Thalassia occurred.

3.7. Cement Trailings

The site was a land fill of cement tailings into Kingston Harbor. Continuous wind-blown fine particles were entering the site when the planting took place. The submerged slope from this fill was very steep and composed of these fine particles. This site failed for all species.

4. DISCUSSION

For the first time in any developing nation, and for the first time in the tropics, seagrasses, essential to tropical fisheries nurseries, have successfully been rehabilitated from a variety of impacted sites. Dr. Mustafa Tolba, Director of the United Nations Environmental Program recognized this program and its success as a contribution by Jamaica to the world environment in his "World Environment Day" address, delivered from Jamaica in June, 1983.

However, the problem is not yet solved. Development is proceeding rapidly in Jamaica. Yearly impacts by oil spills, infrastructure and other urban development and coastal industries are still damaging seagrasses. Plans are underway in Jamaica to begin to solve this particular coastal management problem. Coastal mapping of seagrass resources is being planned. Consideration of policy, regulations and implementation to protect and mitigate seagrasses is now underway at NRCD. A large scale restoration project to rehabilitate an impacted fisheries nursery, using the trained NRCD staff and fishermen, is being planned between U.S. AID and NRCD. The NRCD staff is being trained in large scale mitigation logistics in the world's largest seagrass rehabilitation program in Dade County, Florida, for the Port of Miami (251 acres of seagrasses).

In summary, the technology for seagrass rehabilitation has been tested and transferred to Jamaica. Since other Greater Caribbean nations have the same species of seagrasses with equivalent fisheries nurseries associated with them, similar environmental conditions and similar developmental impacts,this can be considered an extrapolatable model for the Greater Caribbean basin. Plans are now underway to utilize this technology in coastal management by NRCD.

5. A REVIEW OF APPLICABLE POLICIES FOR FISHERIES NURSERY PROTECTION AND COASTAL WETLAND MITIGATION

5.1. International Policy

"World Conservation Strategy".
5.7 "Ensure that the principal management goal for estuaries, mangrove swamps and other coastal wetlands and shallows critical for fisheries is the maintenance of the processes on which the fisheries depend."
7.7 "Maintain habitats of resource species."
"Caribbean Action Plan".
"To determine the impact of coastal development activities and land use on the ecological integrity of coastal swamps and lagoons in order to develop quidelines for conservation, management and recovery of these resources."

5.2. Federal U.S. Policies

National Marine Fisheries Services (NMFS). Habitat Conservation Policy (1983)
"The goal of NMFS activities will be to maintain or enhance the capability of the environment to ..., maintain fish and shellfish populations which are used ... (see appendix for complete policy)". "At a minimum, Fishery Management Plans should include identification and descriptions of habitat requirements and habitats of the stock(s) comprising the management unit; assessment of the conditions of these habitats, to the extent possible,as they relate to the continued abundance and distribution of the species; identification, where possible, of causes of pollution and habitat degradation; description of programs to protect, restore, preserve and enhance the habitat of stock(s) from destruction or degradation; and, where appropriate, proposal of measures intended to preserve, protect, and restore habitat determined to be necessary for the life functions of the stock(s)."
National Environmental Policy Act.
"Every federal agency shall consider ecological factors when dealing with activities which may have an impact on man's environment."
Federal Legal Background. The legal background for mitigation is found in statutory programs dealing with conservation of fisheries and wildlife resources

includes the Clean Water Act § S 402, 404, 102 (b, 303), Coastal Zone Management Act, program authorities of the Federal land managing agencies, Water Resources Planning Act of 1965, Federal Power Act, program authorities of NMFS, NOAA and EPA, River and Harbor Act of 1973, NEPA, Endangered Species Act of 1973, several authorities of the Corps of Engineers, FWCA, Etc.

Mitigation. In the 1958 amendements to FWCA, Congress provided authority to the federal water project agencies to modify or add fish and wildlife mitigation and enhancement measures to the structure and operation of such projects.

5.3. Proposed Florida State Policy

403.--Mitigation

"(1) It is the policy of this state to preserve wetland functions. The object of mitigation shall be to alleviate unavoidable loss of wetlands and estuarine systems, but not to justify the destruction of wetlands.

(2) For the purposes of this section, mitigation shall mean:

(a) avoiding the impact altogether by not taking a certain action or parts of an action;

(b) minimizing impacts by limiting the degree or magnitude of the action and its implementation;

(c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

(d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; or

(e) compensating for the impact by replacing or providing substitute resources or environments.

Mitigation shall not include payment of fees in lieu of other measures, dedication of land to natural uses, transfer of land or easements into public ownership, or the creation or restoration of wetlands not similar in nature to those being damaged.

(3) When deciding whether to issue a permit to dredge or fill pursuant to this chapter or chapter 253, the department may consider mitigation proposed by the applicant. Mitigation may be considered only after a dredge or fill activity has been proposed in a manner that minimizes loss of wetland functions to the greatest extent practical.

(4) The department shall not issue a permit to dredge or fill if the permitted activity, as mitigated, will result in a flat loss of wetland functions."

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