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WORKING PAPER SERIES

FISHERIES STOCK ASSESSMENT

TITLE XII

Collaborative Research Support Program

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The University of Maryland—Center for Environmental and Estuarine Studies
The University of Rhode Island—International Center for Marine Resource Development
The University of Washington—Center for Quantitative Sciences
The University of Costa Rica—Centro de Investigación en Ciencias del Mar y Limnología
The University of the Philippines—Marine Science Institute (Diliman)—College of Fisheries (Visayas)

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A VILLAGE-LEVEL APPROACH TO COASTAL ADAPTIVE MANAGEMENT AND RESOURCE ASSESSMENT (CAMRA)

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ABSTRACT

Success with village-based marine reserves in the Philippines indicates that local coastal management may be more realistic than that based solely on national regulations. A village-based adaptive management system is proposed wherein environmental community organizers (ECO's) are assigned to villages to evaluate the fishery, environmental, sociological and economic factors, educate villagers in appropriate management options, organize for the formulation of local regulations, and network with national agencies for assistance with particular problems. The fact that many fisheries may be evaluated in a two-year period indicates that a 2 to 3 year cycle of implementation and adaptation may be usefully incorporated into local management strategies.

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INTRODUCTION

The past decade has seen a rapidly accelerating rate of degradation in coral reefs and associated ecosystems. Destructive activities affecting a coastal community include those of individuals or groups within the community, and those of individuals or corporations from outside the community. The success of a community in protecting its resources often depends upon a knowledge of the causes, consequences and management alternatives associated with specific environmental problems, and upon having the internal organization and external political support to implement a management strategy. We propose that a major emphasis of coastal management programs be directed towards providing coastal villages with the information and organizational support which would facilitate local resource management. One promising approach would involve the introduction of community organizers that have been cross-trained in fisheries and environmental assessment to assist villages in formulating adaptive management strategies specific to local situations.

MANAGEMENT APPROACHES: TOP-DOWN OR BOTTOM-UP?

The general concept of a fishery regulation is one which has been imposed by the national government and intended to be enforced at the local level. An example of an effective

application of this approach would be the current trawling ban in Indonesia. This regulation was designed to be unambiguous and therefore relatively easy to enforce. Much of its apparent success, however, is undoubtedly related to the strong support for the ban which came from coastal villagers who were convinced that the trawlers were depriving artisanal fishermen of their catch (Sardjono 1980). More typical of national fishing regulations are the bans on blast fishing in most areas of Southeast Asia. These regulations often carry strict penalties and occasionally are listed among national enforcement priorities. However, it is questionable whether these regulations have substantially deterred the proliferation of this practice in the region. The situation is similar with fish poisoning, coastal deforestation, and many other problems threatening coastal zones in Southeast Asia and many other regions. In fact, while some isolated successes may be cited, it is difficult to identify any national regulation which has had a net beneficial effect on coastal and coral reef conservation over large areas.

Village-level management, however, has been relatively successful in the few areas into which it has been introduced. Of nearly one hundred marine parks set up in Southeast Asia, the handful which appear to have been the most successful have been those set up in coastal villages in the Central Philippines. In each case, one or more field workers

assumed the roles of community organizers and assisted the villagers in developing local regulations and enforcement procedures. Notable among the success stories are the parks at Balicasag, Apo Island, and several other nearby areas (White 1984, White 1986, Castaneda and Miclat 1981, McManus 1988). The Sumilon Island Marine Sanctuary suffered from a lapse into destructive exploitation during a change in local politics (Maclean 1986), but it is reportedly returning to a protected state again. During this lapse, a dramatic drop in fish production was seen in the protected areas, as well as in adjacent areas which appear to have been receiving recruits from the protected "seed" area (Alcala pers. comm.) This information has been used to convince local fishermen of the importance of the reserve, and thereby strengthen the local conservation drive.

The need for local coastal environmental and fishery monitors has long been recognized. One significant experiment in this regard was the fishery monitoring program set up by the Bureau of Fisheries and Aquatic Resources of the Philippines in collaboration with ICLARM in 1984. Approximately 40 graduates of fishery colleges were assigned in pairs to monitor catch and effort along selected areas of the Central Philippine coastline. Wherever possible, the monitors were assigned to their home areas, to take advantage of their familiarity with local leaders, dialects, and

practices. Although the project was terminated after only a year and a half of operation, the data obtained is among the most instructive available in Southeast Asia, and has provided general guidelines concerning the densities of local populations and the probable state of over- or underfishing across the Philippines (Fox 1985; Fox 1986).

CONVERGING LINES OF RESEARCH

Publications in a variety of fields indicate a growing trend in favor of local coastal management. Reviews of development activities in agriculture conclude that early failures are often attributable to inadequate assessments of local perceptions, attitudes, and capabilities, and to a lack of efforts to involve affected parties in decision-making at the community level (Korten 1980). These retrospective revelations have led to policy statements from international development agencies such as the World Bank, ADB, WHO, ILO, FAO, UNESCO, and U.S. AID promoting community-level involvement in all development efforts.

In fisheries management, a variety of recent publications has indicated the need to incorporate or reinstitute traditional management practices into new regulations (Johannes 1981, Ruddle and Johannes 1985). Johannes (1978) has also demonstrated that substantial information can be

obtained from local fishermen which is invaluable in managing resources and often important to science as a whole. The need for incorporating economic and social information from the village level in fisheries management is emphasized in a growing body of literature (e.g. Smith 1979, Pollnac 1988).

A second trend in recent research involves efforts to simplify the processes of environmental fisheries monitoring. There are now a variety of handbooks available to assist a minimally trained coastal manager in assessing the status of a coral reef (Dahl 1978, Dartnall and Jones 1986). The difficult problem of determining whether or not a given stock is over- or underharvested has been considerably simplified for many cases, because of the work of Daniel Pauly and his colleagues (Pauly 1982, Munro 1983, Pauly and Morgan 1987). It is now feasible for a minimally trained coastal monitor to gather length frequency data on critical stocks over a two-year period which can be analyzed in central facilities to indicate critical directions for management. Not all stocks or fisheries can be analyzed this way, but the range of analyzable situations is growing monthly as new publications are released.

A world-wide trend toward increasing "holism" in coastal management has culminated in the recent ASEAN-U.S. Coastal Resources Management Project. Each country participating in

this project is involved in intensive multidisciplinary studies of selected coastal areas. In most cases, it appears that there is a greater range of factors of critical importance in formulating the development plans than had generally been anticipated. The results of these studies will be invaluable in developing guidelines for the training of coastal monitors and managers.

ADAPTING TO COMPLEXITY

Coral reefs can supply on the order of five hundred to one thousand species of edible fish, crustaceans, molluscs, echinoderms, and seaweeds. A management scheme must in general be concerned with at least a hundred of these species to account for 80-90% of the catch by weight. The extreme complexity and stochastic nature of coral reefs and its implications for management have been described in several recent studies (Sale 1980, Bradbury et al. 1983, Green et al. 1983, Reichelt et al. 1983). Management implications of temporally changing multispecies gears in artisanal fisheries have been proposed by Munro and Smith (1984).

Our studies of the reef fisheries at Bolinao, Pangasinan, Philippines indicate a level of gear complexity which far surpassed our expectations. There are at least twenty major gear types being used simultaneously on the reef system.

The overlap in catches by species is high in many cases, but each gear tends to favor particular life stages or size classes of each species. Thus, a given species may be subject to capture by distinct sets of gears at three or more different stages in its life history.

Each gear is subject to periodic improvements which rapidly spread across the fishery. One of the dominant gears on the reef flat is the "karukod", which combines features of trawl and encircling nets. This gear was apparently unknown a few years ago, and only became dominant within the last few months. Illegal fishing methods, such as blast fishing and poisoning, are inherently difficult to monitor. Poisoning fluctuates with the availability of sodium cyanide, but this is complicated by the widespread use of natural poisons from local roots and seeds. The cost of blast fishing has dropped drastically recently with the discovery by fishermen that nitrogen-based fertilizer or powdered urea foam used in boat-building can be mixed with small amounts of gasoline and gunpowder to produce bombs. A single, large piece of urea foam which washed into the area has reportedly been used to produce large numbers of explosives. This variability in cost and supply is exacerbated by fluctuating social and legal pressures, and by the fact that application methods for poison and blasting vary greatly between user groups and intended quarries.

Catches among lagoonal corals are believed to have been drastically reduced because of habitat destruction from blasting and poisoning, encouraging a shift to seagrass fisheries. Seagrass fishermen believe that the catches of rabbitfish (Siganidae) and other reef flat dominants have been severely reduced by the large fish corrals erected by local investment consortiums. The numbers of these corrals fluctuate seasonally, to avail of migration patterns of rabbitfish.

This combination of seasonal, technological and economically driven changes produces an extremely dynamic system of limited predictability. For purposes of monitoring, the fisheries present the advantage of being dominated by short-lived species for which life-history parameters can be determined within a two-year period. Once determined, these parameters can be used to indicate which species are under- or overfished. Unfortunately, none of the common legal gears capture a broad enough range of sizes to present a confident picture of life-histories, and the techniques for combining catches from different gears to produce complete size-spectra are still in their infancy.

The implication of this level of complexity and variability is that in order to be effective, a management strategy would have to be as dynamic as the system itself.

Not only will successful management strategies have to change to keep up with the local situation, but the process of identifying a successful strategy in the first place will generally have to involve trial and error. A strategy which is successful in one coastal area may have a low probability of success in another area, wherein different cultural backgrounds, political status, economic conditions, population levels, or exploitative histories prevail. The most promising approach, therefore, is to develop regulations tailored to each local situation with a built in provision for continuous evaluation and periodic revision.

LOADING THE CAMRA

The basic element of the Coastal Adaptive Management and Resource Assessment (CAMRA) system is the environmental community organizer (ECO) (Fig. 1). Environmental and fishery problems are of such critical importance to the future of coastal villagers that it is reasonable to distribute ECO's in key locations along with postmasters, police chiefs, and public health officers. The task of the ECO's would be concentrated in four areas: assessment, education, organization, and networking.

Assessment

The ECO must be able to conduct field and market surveys

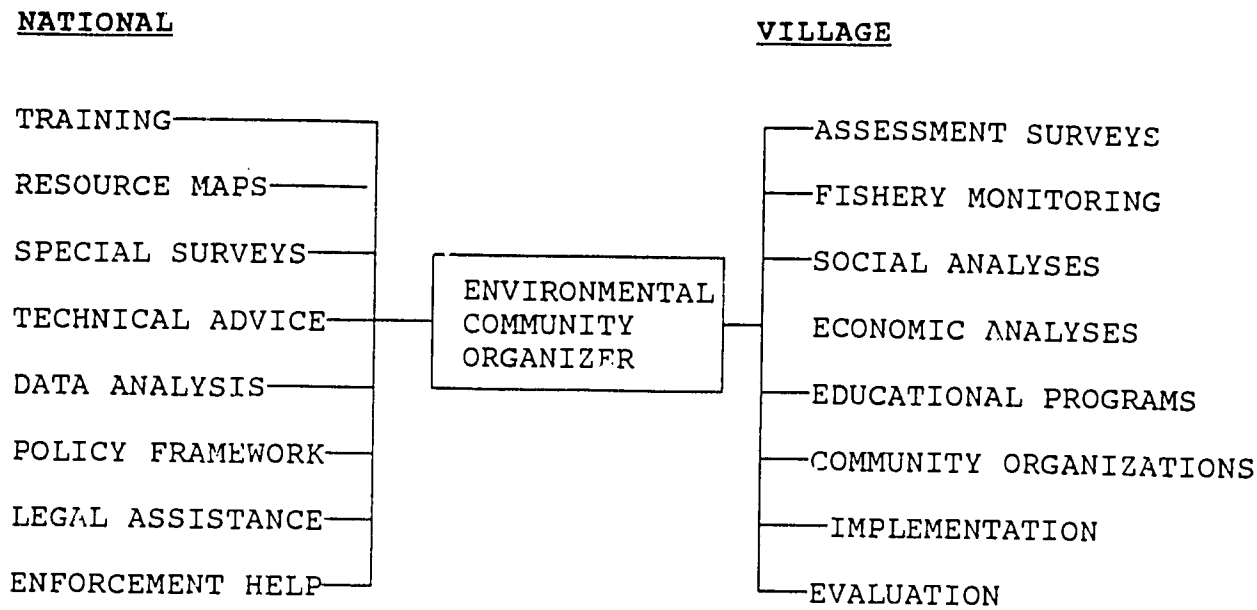

Figure 1. The role of an ECO in linking national programs with village requirements.

to determine the status of local coastal resources. Once regulations have been implemented, the system must be closely monitored to determine whether or not a beneficial effect has resulted from the imposition of the regulations. For environmental surveys, simple field observations such as those described in Dahl et al. (1978) may suffice for many purposes. Fisheries evaluations are more difficult, but in many cases two years of monthly length-frequency and catch per unit effort data on selected species can be processed at central facilities to determine which are over- or underharvested. When the ECO has some reason to suspect the existence of a problem requiring more detailed attention, he can operate in his role as a networker to request assistance from national scientists.

The evaluation of the social and economic situation is as important as the field monitoring, particularly in the assignment of priorities in areas of conflict. The approach would be based on household surveys and cultural evaluation methods. As with the field monitoring, the evaluation of the village situation is important both before and after the implementation of a set of regulations by the villagers.

Education

A fisherman is usually a valuable source of information on local fisheries and can be tapped for this purpose by the ECO. However, a fisherman is rarely in a position to objectively evaluate the causes of various problems which affect him and his family. For example, a fisherman my perceive that he is catching less now than in years past, and will often attribute this to the activities of possible competitors who are economically better situated. He has little basis to determine whether or not his troubles are due to natural stock fluctuations, habitat destruction, or increasing competition from other small-scale fishermen. While traditional superstitions are still a problem in many areas, many misunderstood or overrated scientific statements have achieved the status of superstitions. For example, it is rare to attend a forum on the problem of trawl fishing without hearing about the destruction caused by trawls to demersal

fish eggs. While evidence on both sides of this issue is inadequate, it is at least well known that as trawling has increased in the Gulf of Thailand, the numbers of bottom-laying squid have increased dramatically. Therefore, the decrease in squid predators appears to be more important to the community dynamics than the burial of eggs (Pauly 1979) - a factor which has not yet found its way into the perceptions of most coastal fishermen.

The ECO will probably be only slightly more objective than the fishermen, but will be aware of examples of environmental cause and effect which could be disseminated. The ECO could easily become an influential source of education in most villages with the help of slide shows and video tapes. Other instructional media could include posters, displays, and microscope demonstrations. These approaches have been successful in most Philippine municipal management programs, in part because of their entertainment value in remote areas. The ECO would be responsible for disseminating general principles of coastal management, in addition to specific findings of monitoring activities both before and after the implementation of local regulations.

Organization

This is undoubtedly the most difficult of the tasks. Based on evaluation of the environment, fisheries, culture, and economy, the ECO must catalyze the organization of villagers into regulatory bodies. Descriptions of general procedures for community organization are available in the literature concerning village cooperatives (Pollnac 1988). Most approaches involve the identification of local persons of influence, the formation of a core group, and gradual preparation for concerted activities and meetings. The work requires a thorough background in sociology and often months of insight into the local situation before effective action can be initiated.

The most widespread problems in most coastal developing countries will generally concern the fisheries. In many cases, a preliminary evaluation of a fishery will be possible within two years, using length-frequency data. Other assessments will generally be done in less time. Thus, a two or three year cycle of evaluations and relegislation will often be suitable to form the "adaptive" function of the adaptive management strategy (Fig. 2).

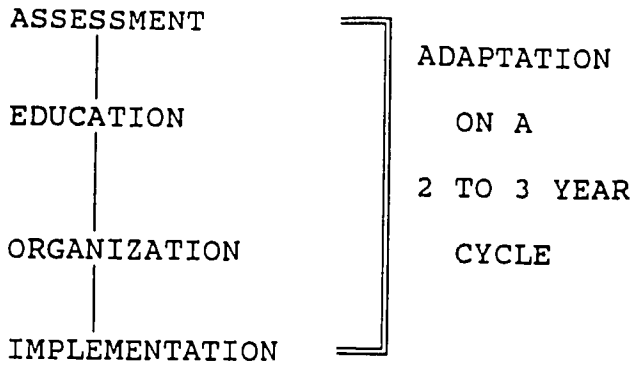

Figure 2. Cyclical adaptation of village level management policies limited by the minimum time of one to two years required to assess fishery exploitation levels plus time to implement new policies as appropriate.

Networking

A major role of the ECO would be to serve as a conduit through which national scientific resources are made available to the villages. The ECO may need satellite maps of the reef areas along a village coastline in order to plan his field surveys. The village may decide that it needs rubber tires for a fish shelter. Adverse effects of mine tailing dumpings may require toxicity studies from a national institute. The ECO should be suppored by a mandate and organization which facilitates his/her access to these resources.

ECO TRAINING

An ECO will generally be affordable if limited to person with a B.A. degree or possibly a two-year technical degree. In places such as Indonesia and the Philippines, such a person would earn less than U.S. $150.00 per month (this type of program would be difficult to justify on the grounds

of economic returns in a country with a higher pay scale). The training would be considerably simplified if the candidates had a strong background in sociology. However, a general applicant with an applied science degree could probably by trained in approximately a year. This would include a major portion on community development including field experience. Other topics would include fisheries and environmental science. The courses should be very specific and applied, because of the specific nature of the work to be undertaken, the expectations of the people the ECO's will be working with, and the broad range of factors to be considered in the training and subsequent work.

SETTING THE STAGE FOR A CAMRA

A variety of research projects are underway which will greatly facilitate the implementation of a CAMRA. The University of the Philippines College of Social Work and Community Development has fielded research assistants in seven locations in the Lingayen Gulf and Bolinao Reef Complex as part of the ASEAN-U.S. Coastal Resources Management Program (CRMP). These researchers have worked in the villages for more than a year in some cases, and have assumed many of the roles defined for an ECO. The researchers have as their

primary task, the evaluation of the social and economic factors relevant to future coastal management plans. Several of the researchers have received instruction in fundamental environmental and fisheries management, which they use as both evaluators and educators. A slide show on coastal conservation has been assembled for them to present in key areas. In Santiago Island, a researcher has been helpful in keeping villagers informed of the purposes of various research endeavors in their area, such as mangrove planting, experimental mariculture, and surveys by ultralight aircraft. Some villagers from other regions initially feared that the ultralight was a UFO or supernatural phenomenon and reacted by changing their fishing areas; the same areas we were trying to estimate fishing pressure on.

Other aspects of the CRMP include work by the Marine Science Institute of the University of the Philippines on determining the utilization of coral reef areas by local villagers. These studies include investigations of the role of gleaning in providing nutrition to the families of fishermen whose catch is generally sold whenever possible (McManus, L.T. et al. 1988).

A major focus of the U.S. Philippines Fish Stock Assessment Collaborative Research Program is the development of techniques to facilitate evaluations of coastal fisheries

including coral reefs. To this end, we are developing methods for satellite mapping of important fish habitats, techniques for aerial surveys of fishing effort by ultralights and remote-controlled aircraft, and are determining production, catch composition, and sources of variability for specific gears on the Bolinao Reef Complex. All of these efforts will eventually assist national support groups in providing services needed by the villagers as local management schemes are under development and implementation (Campos et al. 1988, McManus et al. 1988, Roa 1988a,b).

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