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Small-Scale Fisheries in the Tropics: Marginality, Marginalization, and Some Implications for Fisheries Management

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Abstract.—A brief analysis of tropical small-scale fisheries is presented, structured by two areas of emphasis: marginalization—actual and perceived—and Malthusian overfishing, a concept I proposed previously. It is suggested that marginality is, in part at least, a construction resulting from faulty mental maps, which leads to even more marginalization for small-scale fisher communities. Marginalization is the ultimate cause for Malthusian overfishing, whose identification and prevention, or at least mitigation, should be foremost on the agenda of fisheries scientists and policy makers. Some of the implications of these ideas for multidisciplinary research on coastal fisheries systems are outlined.

In early 1994, a number of articles in major international magazines appeared, which—for a while at least—shifted fisheries from their marginal position in the public discourse to the center of attention. There was no objective reason for this outburst of articles: the methodical grinding down of successive fisheries resources was no worse in 1993–94 than in preceding years (see Garcia and Newton 1997). Yet something of this sort had to happen at some stage, just as it happened in the 1980s for tropical rain forests: the unconstrained and massive destruction of potentially renewable resources by industrial fleets could not go on much longer before the press noticed.

The press, being what it is, could be expected to mix insights with drivel. Thus, for example, the *Economist*, in an anonymous article smartly titled "The catch about fish" (March 1994) correctly identified subsidy-driven overcapitalization as the major culprit for the state of fisheries in developed countries (Garcia and Newton 1997), but also stated that "increasingly, boats will head for third-world waters, where the decline in stocks has not yet started."

This paper is not the place to demonstrate that boats from Europe, North America, and Northeast Asia have been exploiting, for decades, the fisheries resources of developing countries, and that their stocks have long started to decline; these topics have been well covered in recent literature. Neither do I deal explicitly with the development of large industrial fisheries in third-world countries, this topic also having received much attention (see Panayotou and Jetanavanich 1987). Rather, I concentrate on tropical small-scale fisheries. In spite of the important, indeed crucial, role of small-scale fisheries in most developing countries and in many developed countries (Figure 1), they continue to be perceived as marginal to the mainstream of fisheries science as illustrated, for example, by their coverage—or lack thereof—in major texts. This perception may be strengthened by the emphasis in the next section on features of tropical small-scale fisheries not often considered by fisheries scientists, but which, I believe, explain the dynamics of many of these fisheries better than standard bioeconomic accounts. These features are as follows:

- the interactions between the factual and perceived marginality of these fisheries, and
- their tendency to drift toward what has been called Malthusian overfishing (Pauly 1988, 1990; Pauly et al. 1989; McManus et al. 1992; Pauly 1994).

Emphasis is given here to the interrelationships between these features and what they may imply for fisheries management and research in the next decades.

The Marginality of Tropical Small-Scale Fisheries

One of the characteristic features of tropical small-scale fisheries is their marginality, that is, their geographic, socioeconomic, and, ultimately, political remoteness from decision makers in major population centers. This feature is strengthened by mental maps, that is, the mental constructs through which we interrelate facts, experiences, and values (see Hampden-Turner 1982 and Peters 1983 for examples from psychology and cartography, respectively) that fail to account for management implications.

Physical remoteness, wherein "the landings may be dispersed over a great length of shoreline" (Munro 1980), is not only a matter of geographic coordinates. Rather, it is exacerbated by the lack of infrastructure (roads, markets, ice supply, communications) that characterizes most developing countries and by the nature of the gears commonly used for small-scale fishing, which are either fixed (e.g., weirs or traps) or applied from crafts with a small operating radius (Stauch 1966; Smith 1979; Horemans

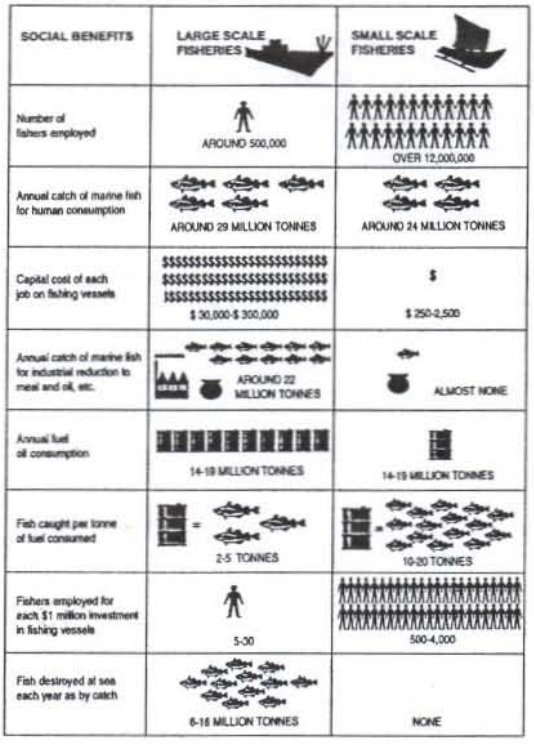

Figure 1. How large-scale (industrial) and small-scale (artisanal) fisheries compare globally in terms of catches, ecological impacts and social benefits (from Thomson and Food and Agriculture Organization of the United Nations 1988 [NAGA, the International Centre for Living Aquatic Resources Management Quarterly 11(3):17 with permission]; values are for US$). The balance of social benefits can be expected to tilt even more toward small-scale fisheries when only the tropics are considered.

1993). The latter constraint may lead to localized (or seasonal) resource depletion, leading to influxes into alternative, land-based jobs (Munro 1980), when available, or to alongshore migrations of increasing amplitude (see contributions in Haakonsen and Diaw 1991). The response of government agencies, nongovernment organizations (NGOs), and multilateral or bilateral development agencies to this aspect of marginality has generally been to improve existing infrastructure or create new infrastructure, and especially to implement motorization schemes designed to increase the operational radius of small-scale vessels (see Smith 1979, Pollnac 1981, or Neal 1982 for early critiques of this approach, which largely ignored resource access issues).

Physical remoteness also causes problems in collecting catch and landing statistics (Munro 1980; Vakily 1992), severely hampering management schemes that require real time data, that is, data based transferable or non-transferable quotas. Socioeconomic remoteness from the mainstream of society is related in part to the low incomes of small-scale fishers in most developing countries—even in relative terms—and to the fact that they often belong to ethnic groups (tribes) or social classes (or castes) of low status. This is often compounded by illiteracy or limited formal education (Bailey 1982; Lunianga 1989). This form of remoteness can thus occur in small-scale fisheries immediately adjacent to major cities.

Perceptions of low status—definitely the products of mental maps—have particularly pernicious effects. They often mask—at least to managers and policy makers, usually persons with a high level of formal education—the informal biological and ecological knowledge possessed by successive generations of small-scale fishers (Ruddle and Chesterfield 1977) to catch fish, which also serves as basis for traditional, community-based fisheries management (Johannes 1981; Ruddle 1988, 1989a, 1989b; Okera 1994).

The geographic and socioeconomic marginality alluded to previously leads inexorably to lack of political power (whether the country has elected officials or not), which itself increases marginality: marginalization becomes systemic. Protest, when it occurs, may take violent form, for example, when industrial trawlers encroach into inshore, traditional fishing grounds (Sarjono 1980).

Further, fisheries, even when industrial or enormously important to food security and foreign exchange earnings, do not usually qualify for a full ministry (Peru is one of a few exceptions). They are usually administered by a department of fisheries (DoF) that is part of a ministry of agriculture, which tends to lack political clout. Indeed, investment decisions directly or indirectly affecting fisheries, such as port development or major fleet expansions funded by international development banks, are usually made through planning or finance ministries, without reference to stock assessment work that might have been done by DoF scientists and without accounting for the ecological costs of such development (see Meltzoff and LiPuma 1986 for a case study).

These various aspects of the marginalization of small-scale tropical fisheries are closely matched by the marginality of the science and scientists studying them. Within developing countries, law, medicine, and even agriculture are far more prestigious disciplines for the sons of the elite to study. The lower status of fisheries science may explain, for some countries at least, the relatively high number of female fisheries scientists (Dizon 1995). Researchers from developed countries who work on tropical small-scale fisheries are frequently resource economists, anthropologists, rural sociologists, or NGO activists, but less commonly fisheries scientists, as evi-

denced by the dearth of stock assessments in the literature on tropical small-scale fisheries (Roedel and Saila 1980; Platteau 1989a; Pollnac and Morrissey 1989; or Agüero 1992).

Common Property, Limits to Entry, and New Entrants

Recent contributions (Aguilera-Klink 1994) have succeeded in overcoming the confusion caused by the application of schemes to tropical small-scale fisheries in which the term common property was thought to necessarily imply open access, and thus resource destruction, as might be assumed after reading Hardin (1968). Indeed, barriers to open access—some subtle, some rather direct—now appear to have been the key characteristics of traditional small-scale fisheries exploiting commons (see contributions in Ruddle and Johannes 1985), as is the case for pastoralists (Behnke 1994). However, this realization may have come too late. Colonial authorities and various development projects have eroded these open access traditional systems, leaving sociologists and anthropologists only residues to describe, weakened systems that are unable to effectively limit access to commonly owned resources.

This weakening of access limitation benefits particularly the operators of industrial vessels (trawlers, purse seiners, etc.), which can and do force their way onto traditional small-scale fishing grounds. However, this problem is easy to conceive and straightforward to control once the political decision to do so has been made. It may be hard to make, however, given that decision makers, or their political allies, often own stakes in such vessels (Platteau 1989b). Here again, the Indonesian trawling ban of 1980 may serve as an example (Sarjono 1980).

More insidious are developments occurring within the small-scale sector itself, which are more difficult to notice and to conceive as problematic—especially when they occur in response to real or perceived competition from the industrial sector, as in West Africa, Sénégal (Chauveau and Samba 1989), or Ghana (Acquay 1992). Thus, to maintain their catches against pressure from trawlers operating inshore, small-scale fishers might be provided by international aid agencies with more effective gear (e.g., synthetic monofilament gillnets) or subsidized motors, or otherwise enabled to expand their radius of operation, resulting in a massive increase of effective effort, not noticed because of the simultaneous increases of industrial fleets.

What I believe is the most worrisome development within the small-scale fisheries of tropical developing countries in Asia, Africa, and South America is the entry of nontraditional fishers into these fisheries such as Peruvian highlanders, members of traditionally pastoralist groups in Sénégal, or landless rice farmers in the Philippines. In all cases, these people enter fisheries because they have been forced out of their traditional occupations, because there is excessive pressure for land, or because lack of access to grazing range has marginalized livestock production in inland areas. Fisheries have become an occupation of last resort (Neal 1982). The new entrants have been able to become fishers because coastal fisheries resources are vulnerable to simple gear or even to gleaning without gear, and because whatever access limit may have existed was not strong enough to prevent them from fishing.

Recalling Some Basic Principles of Fisheries Science

There are different ways of managing fisheries systems: the most elaborate are probably those that evolved in the Sahel in Africa to regulate access to floodplain resources (Fay 1989a, 1989b) and in the South Pacific, where tradition-based rules still mostly regulate access to nearshore resources, without explicit knowledge of their status (see Johannes 1981; Hviding 1991; Ruddle et al. 1992). In developed countries, however, a different tradition evolved, which looked first at the biological status of the fish stocks, then at the fisheries depending on these stocks (Went 1972; Smith 1994). This is well illustrated by the historical sequence of scientific concepts used to define overfishing, viz:

1. growth overfishing, the form of overfishing that was first to be identified and theoretically resolved (Baranov 1918; Hulme et al. 1947; Beverton and Holt 1957; Figure 2A);
2. recruitment overfishing, the second form of overfishing recognized by fisheries scientists, following the seminal work of Ricker (1954; Figure 2B);
3. biological overfishing, the combination of growth and recruitment overfishing leading to catch decline on the right, descending side of surplus-production models (Schaefer 1954, 1957; Fox 1970; Ricker 1975; Figure 2C) and related to ecological overfishing in multispecies fisheries (Pope 1979; Pauly 1979a, 1994);
4. economic overfishing, initially defined in terms of economic theory by Gordon (1953), then combined by various authors with the surplus-production models in (3) to yield the Gordon-Schaefer model (see, e.g., Anderson 1977; Figure 2D);

These forms of overfishing are well-described in textbooks, and the suggested remedies traditionally involve a mix of management measures aimed at reducing effective fishing effort (such as mesh size regulations, closed

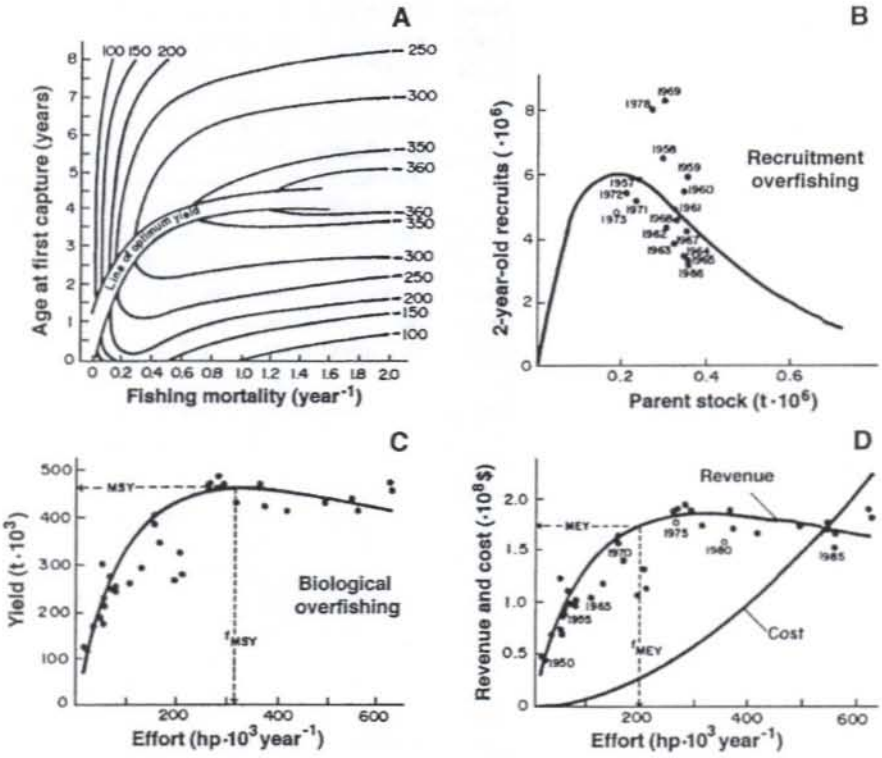

Figure 2. The four "classical" forms of overfishing, illustrated by the models used to define them: (A) An example of a yield per recruit (in g year^{-1}) isopleth diagram for red snapper in the South China Sea, defining growth overfishing (from Pauly 1979b). This model is used for mesh size and related regulation. (B) Example of a stock-recruitment curve for southern bluefin tuna (*Thunnus maccoyi*), defining recruitment overfishing (from Murphy 1982). This model is now used to identify replacement spawning stock levels (Goodyear 1989; Mathews 1991; Mace and Sissenwine 1993). (C) Surplus production model, defining biological overfishing and related parameters (MSY, f_{MSY}) of the small pelagic resources of the Philippines (from Trinidad et al. 1993). This model is used for effort regulation. (D) Simple bioeconomic model of a fishery in model C, defining economic overfishing and associated parameters (MEY, f_{MEY}) (from Trinidad et al. 1993). Each model implies a certain research program, including field sampling of raw data, collation of secondary data, as well as certain "levers" to implement suggested action.

seasons or limits on gear sizes or on craft designs, with individual transferable quotas recently added to the panoply; see Anderson 1997, Hannesson 1997). These measures assume that the fishers concerned are actually in a social and financial position to either implement or comply with those measures. In developed countries, they can, because the textbooks are written in and for such countries, in which fishing is done by corporations (often subsidized by government), or by independent (if small) entrepreneurs who can generate enough political pressure to also obtain governmental subsidies or to take shore-based jobs if all else fails. The situations of various aboriginal groups within developed countries and of small-scale fishers in the Atlantic Provinces of Canada (Ommer 1991, ~~in press~~ 1995) provide exceptions to this, and resemble more the developing country situation presented in the following text.

Malthusian Overfishing Defined

Small-scale fishers in tropical developing countries are usually poor and lack alternative employment opportunities; that is, once they start fishing, they are forced to continue, even if the resource declines precipitously. The numbers of small-scale fishers tends to increase, both because of internal recruitment and through destitute new entrants. Malthusian overfishing is here defined as what happens when these new fishers, who lack the land-based livelihood of traditional fishers (e.g., a small plot of land or seasonal work on nearby farms or plantations), are faced with declining catches and induce wholesale resource destruction in order to meet their immediate needs.

Overfishing may involve, in order of seriousness and generally in temporal sequence, (1) use of fishing techniques, gears or mesh sizes not sanctioned by govern-

ment; (2) use of gears not sanctioned within the fisher communities or catching of fish "reserved" for a certain segment of the community; (3) use of gears that destroy the resource base; and (4) use of destructive techniques such as dynamite and fish poisons that endanger the fishers themselves. (Note that this parallels slash-and-burn agriculture in upland areas, which also leads to environmental degradation and which is also exacerbated by immigration from the lowlands). This sequence, generally misunderstood by administrators and fisheries scientists as based on the ignorance or shortsightedness of fishers, reflects attempts to maintain incomes in the face of declining catches.

The reason I chose the adjective "Malthusian" to characterize this process is not because I wanted to join the chorus lamenting the impacts of rural population growth on natural production systems—these impacts are now obvious (Southgate and Basterrechea 1992; Homer-Dixon et al. 1993). Neither was it because I believe that one should put "population control front and center among the possible ways to confront the problem of overfishing," as suggested by Sunderlin (1994) in an otherwise thoughtful discussion of what he calls "the structural antecedents of poverty and high fertility." Rather, I wanted to emphasize, through this choice of words, what I believe is the key to Malthus' writings—his contention that production (of food) cannot *in the long run* keep up with an ever increasing demand (Malthus 1798).

There are still many people who believe that, globally, terrestrial food production will continue to increase as it has done since 1798 when Malthus published his major essay, despite well-documented, widespread destruction of agricultural production systems as the result of such problems as erosion and salinization (Lightfoot 1990; Southgate and Basterrechea 1992; Mathews 1994; Harris 1996).

Even optimists will have to agree, however, that the biological production of aquatic ecosystems must have an upper limit, and that fish catches will, over time, remain at best constant once a fishery is "developed" (see Pauly 1990). In such situations, catches tend to fluctuate and then gradually decline because of excessive fishing effort (Figure 3), because of the reduction of biodiversity induced by fishing itself, and because of impacts from adjacent sectors, such as logging-induced siltation of highly productive coral reefs (Hodgson and Dixon 1992). Thus, for capture fisheries at least, Malthus' contention applies: once the "boom" is over, fisheries production will stagnate at best, and certainly not accommodate an ever-growing demand. Further, this ever-growing demand need not be due to local population growth: globally increasing incomes, leading to increased fish consumption and prices, may, through remote markets, affect otherwise isolated fisher communities.

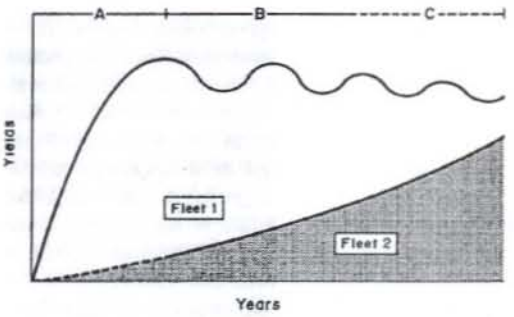

Figure 3. Schematic representation of the evolution of a typical fishery, emphasizing that catches cease to (A) increase after a short development phase, (B) increasingly fluctuate, then (C) head toward a collapse fueled by the competition between groups of fishers, and/or of gears. Phase C is when fisheries scientists are requested to help while the private fishing costs of Fleet 1 and/or 2 are reduced through subsidies from public funds.

Causal Pattern and Diagnosis of Malthusian Overfishing

Given the prior description and the elements of Figure 4, the following causal pattern is hypothesized to occur in a fishery suffering from Malthusian overfishing:

- Stagnating overall catches and an increasing number of fishers lead to
- decreasing catch per fisher (this may be masked, at the income level, at least for a while by increased value of the catch), which with the first element, jointly lead to
- evidence of (at least localized) biological and ecological overfishing and gradually to
- classical economic overfishing (when the value of the catch does not increase as fast as the costs of fishing), which may coincide with an increased tendency for fishers to undertake seasonal alongshore migrations, a gradual breakdown of traditional management schemes, and non-enforcement of "modern" management regulations.

Important additional symptoms are as follows:

- New fishers are recruited from ethnic groups (e.g., of traditional pastoralists) or regions (e.g., highlands) without a tradition of fishing. The new fisheries will require cheap and easy fishing gears, hence there will be
- increasing use of destructive gears (explosives, poisons). An important, but often neglected corollary of poverty is an
- increasing contribution of women in fisher communities to overall family incomes (i.e., women subsidizing the fisher*men*).

This causal pattern may appear hard to diagnose. However, some fisheries in South and Southeast Asia contain most of the elements of this pattern (see McManus et al. 1992 or Saeger 1993). The last element in this list, which I deduced from observations in several fishing villages (emphasized in Figure 4), still needs empirical verification. However, gender-disaggregated data suitable for verification are rarely collected or analyzed under the prevailing mental map, which tends to relate women to fisheries only when they act as middle*men* .

Malthusian overfishing, which is widespread in Asia, notably South and Southeast Asia, can be expected to spread in the next decades to and within Africa and South America, often in the wake of dynamite fishing. Anecdotal evidence suggests that dynamite fishing is spreading into areas where it was previously unknown, such as the Caribbean or West Africa (see Vakily 1993 for one of the few well-documented cases outside of Southeast Asia). Modern technology will not help in such cases since, as might be seen from Figure 2D, any decrease in fishing costs (such as those induced by economically more efficient gears) tends to further deplete the resource base of the fisheries.

Overcoming Marginalization

Marginalization and Malthusian overfishing, its derived phenomenon, need not occur. A number of remedial actions that would help to alleviate or at least mitigate some of the effects of marginalization are possible. An obvious short-term measure, for which Figure 1 may be seen as providing much of the required justifications, is for central governments to ban commercial fishing on the inshore fishing grounds of small-scale fishers or to enforce existing legislation forbidding such incursions. Such bans have been implemented for the explicit purpose of reallocating coastal resources, and evidence indicates that the intended purposes were achieved, at least in part (Sarjono 1980; Saeger 1981; Martosubroto and Badrudin 1984; Martosubroto and Chong 1987). However, such short-term measures tend to produce only short-term benefits, as are the benefits accruing from enforcing prohibitions on destructive gears such as dynamite or poisons.

In the longer term, dealing with Malthusian overfishing will involve providing the women in fishing communities—obviously in the context of nationwide programs—reasons and the means to limit child-bearing, an option they are largely denied at present by their husbands and such powerful men as conservative politicians and religious leaders, and by economic conditions that make it seem rational to invest in large families (Stevens 1994; Anonymous 1994).

Better educated women are now recognized by development agencies as crucial agents of change in rural settings. Hence, overcoming the marginalization of fisher communities cannot be achieved without empowering women (see contributions in Oestergaard 1992). This may involve the partial devolution of government functions to local fisher communities, leading to arrangements wherein the communities would have the right and the means to establish and enforce exclusive fishing areas,

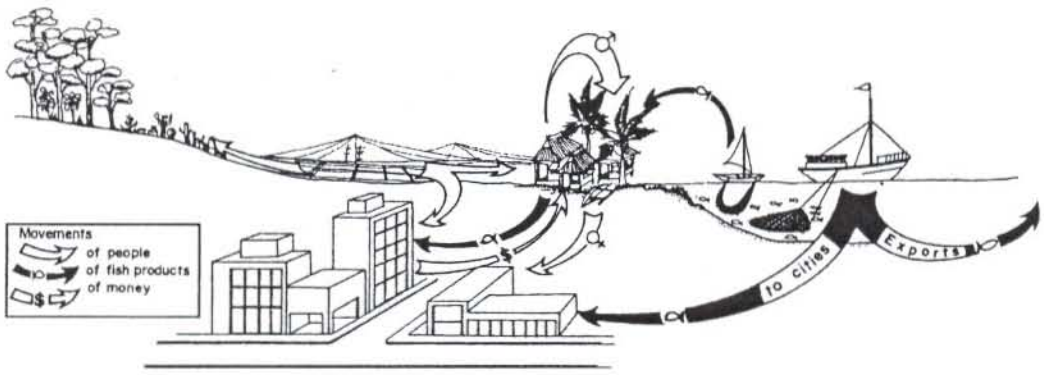

Figure 4. Schematic representation of the processes leading to Malthusian overfishing. A comparatively large agricultural sector releases excess labor, landless farmers who migrate either to urban, upland, or coastal areas. Under this influx, traditional arrangements preventing open access to the fisheries gradually collapse, leading to excessive fishing pressure. This is exacerbated by inshore commercial fishing, by new entrants to fishing as the male children of fishers pick up their fathers' trade, and by the contribution of many young women who leave the communities to work in urban areas, providing a subsidy for men to continue to fish even when resources are depleted. The migrants to upland areas accelerate and complete the deforestation initiated by logging companies, which leads to siltation of rivers and streams, and eventually to smothering of coral reefs and other coastal habitats, thus further reducing coastal fish yields. This model implies a research program and levers to affect events, just as the traditional fisheries models in Figure 2 do.

sanctuaries, and gear restriction schemes (Alcala and Russ 1990; Russ and Alcala 1994). Several of the individual transferable quotas (ITQ) schemes discussed elsewhere in this volume may be useful here as well.

Devolution—to the extent that it does not permit local elites to replace a more distant and perhaps more benign central government and leads to more decentralized modes of governance (described in Putnam 1992)—would represent a lessening of the marginalization presently besetting small-scale fishing communities, which would become the partners, rather than the "target" of government agencies (see contributions in Kooiman 1993). This is particularly important as governments the world over have shown themselves largely unable to manage natural resources without the cooperation of key stakeholders, however large the bureaucracy that is deployed. Also, it is only in the context of devolution that communities can use traditional ("local") knowledge for fisheries management, for example, to establish seasonal or area closures based on empirical knowledge of species life history or to formulate *and enforce* equitable resource access rules.

For local management to result in increased incomes for fisher families, alternative employment will have to be found for those leaving the fisheries. However, few detailed and realistic plans for phased *reduction* of fishing effort through alternative livelihood projects exist. The work of McManus et al. (1992) is one of the few exceptions. This work, and related publications on coastal area management, make abundantly clear that eventually reducing the number of small-scale fishers—by providing alternative livelihood opportunities such as mariculture and others—must involve *intersectoral* arrangements. Hence fisheries managers must interact with representatives of sectors operating in coastal areas such as agriculture, tourism, and manufacturing.

Coastal transects, adapted from the transects used in farming systems research, can be used to formalize intersectoral relationships in coastal areas (Pauly and Lightfoot 1992), and thus facilitate the previously mentioned intersectoral conceptualizations and perhaps even consultations. Interestingly, while small-scale fisheries are usually marginal in conventional mental maps, on land's end, they emerge at the core of coastal areas when they are plotted on graphs (Figure 5). Such transects show that biomass exchanges in coastal systems cannot be accurately quantified without accounting for the fish caught by small-scale fishers or gleaned by women and children (Chapman 1987; Talaue-McManus 1989; Wynter 1990). That part of marine production, important in tropical waters, that is derived mainly from terrigenous input, and generated close inshore is recycled back inland. The cycle applies to incomes generated by small-scale fish processing, a major contributor to the coastal economy of communities and one in which women often play the major role (Nauen 1989; Arnal et al. 1992).

For these and related reasons, coastal area management, an important area of systems research, must focus on small-scale fisheries, and thus render them less marginal. Similarly, studies of the world's biodiversity, a new integrative framework for several biological disciplines, cannot but encompass tropical coastal fisheries—coastal systems such as coral reefs being, after tropical forests, the main global sources of biodiversity (see Reid and Miller 1989). For coral reefs, as is the case with the Amazonian rain forest, local knowledge—suitably re-

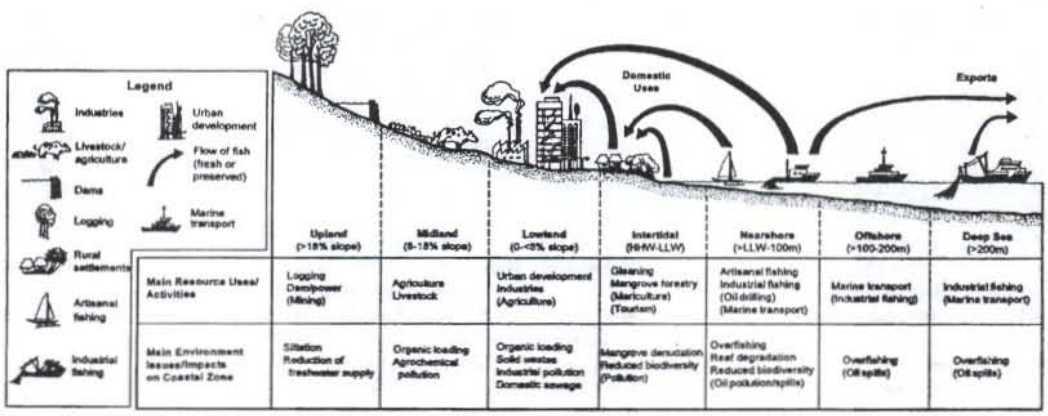

Figure 5. A coastal cross-section, or transect, illustrating the central and structuring role of small-scale fisheries in coastal areas and showing main resources uses and activities along a transect, along with their impact on the coastal zone proper (items in parentheses have no icons). Such graphs, derived from farming systems research (Pauly and Lightfoot 1992) can be used to reconceptualize small-scale fisheries away from their present marginal location on our mental maps toward a central role at the heart of coastal systems.

corded and validated—will be crucial in complementing scientific knowledge of endangered species or of unique events or processes, such as spawning aggregations, an area of fisheries biology largely driven by local knowledge (Johannes 1981).

A change of mental maps is required for all the factors involved in reducing the marginalization of fishers—changing gender roles, the devolution of political power toward fisher communities, the new governance that devolution implies, and the perception of coastal fisheries as only one sector in coastal areas, albeit an important one. Some of the graphs presented in this paper (Figures 1, 4, and 5) are proposed as elements of new mental maps for fisheries scientists, particularly those working on tropical small-scale fisheries. Small-scale fishers would be at the center of these new maps, not at the edge. Such new maps, I believe, would guide us better than the old maps that I suspect most of us still use to orient ourselves.

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References

Acquay, H. K. 1992. Implications of structural adjustment for Ghana's marine fisheries policy. Fisheries Research 14:59-70.

Agüero, M., editor. 1992. Contribuciones para el estudio de la pesca artesanal en America Latina. ICLARM (International Centre for Living Aquatic Resources Management) Conference Proceedings 35, Manila.

Aguilera-Klink, F. 1994. Some notes on the misuse of classic writings in economics on the subject of common property. Ecological Economics 9:221-228.

Alcala, A., and G. Russ. 1990. A direct test of the effect of protective management on abundance and yield of tropical marine resources. Journal du Conseil International pour l'Exploration de la Mer 46:40-47.

Anderson, L. G. 1977. The economics of fisheries management. The Johns Hopkins University Press, Baltimore.

Anderson, L. 1997. Efficiency and distribution issues during the transition to an ITQ program. Pages 000-000 in E. K. Pikitch, D. D. Huppert, M. P. Sissenwine, editors. Global trends: fisheries management. American Fisheries Society Symposium 20, Bethesda, Maryland.

Anonymous. 1994. Population misconceptions. The Economist, 28 May 1994:81-82.

Arnal, S., A. L. Kodjo-Nyaku, and K. Amegavie. 1992. Les systemes de crédit utilisés par les femmes transformatrices et commerçantes de poisson–Togo, Ghana, République de Guinée, Mali. Programme Régional Afrique de l'Ouest: valorisation des captures de la pêche artisanale. Dossiers Technico-Economique Bonga, Ser. 4, Abidjan.

Bailey, C. 1982. Small-scale fisheries of San Miguel Bay, Philippines: occupational and geographic mobility. ICLARM (International Centre for Living Aquatic Resources Management) Technical Report 10, Manila.

Baranov, F. I. 1918. On the question of the biological basis of fisheries. Issled. Ikhtiologicheskii Inst. Isv. 1:81-128 (in Russian). Reprinted *in* Baranov, F. I. 1976. Selected works on fishing gear. Vol. 1. Israel Program for Scientific Translation, Jerusalem.

Behnke, R. 1994. Natural resource management in pastoral Africa. Development Policy Review 12(1):5-27.

Beverton, R. J., and S. J. Holt. 1957. On the dynamics of exploited fish populations. United Kingdom Ministry of Agriculture Fisheries, Investigations Series II:19.

Chapman, M. D. 1987. Women's fishing in Oceania. Human Ecology 15(3):267-288.

Chauveau, J. P., and A. Samba. 1989. Market development, government intervention and the dynamics of the small scale fishing sector: an historical perspective of the Senegalese case. Pages 599-620 *in* J. P. Platteau, editor. Third world fisheries: the dynamics of incorporation and transformation. Development and Change 20(4).

Dizon, L. B. 1995. The impact of publication productivity of scientists in fisheries institutions in the Philippines on the development of fisheries science. Doctoral dissertation. College of Mass Communication, University of the Philippines, Quezon.

Fay, C. 1989a. Sacrifice, prix du sang, "eau du maître": fondations des territoires de pêche dans le delta central du Niger (Mali). Cahiers des Sciences Humaines 25(1/2):159-176.

Fay, C. 1989b. Systèmes halieutiques et espaces de pouvoirs: transformation des droits et des pratiques de pêche dans le delta central du Niger (Mali), 1920–1980. Cahiers des Sciences Humaines 25(1/2):213-236.

Fox, W. W. 1970. An exponential yield model for optimizing exploited fish populations. Transactions of the American Fisheries Society 99:80-88.

Garcia, S. M., and C. Newton. 1997. Current situation, trends and prospects in world capture fisheries. Pages 000-000 in E. K. Pikitch, D. D. Huppert, and M. W. Sissenwine, editors. Global trends: fisheries management. American Fisheries Society Symposium 20, Bethesda, Maryland.

Goodyear, C. P. 1989. Spawning stock biomass per recruit: the biological basis for a fisheries management tool. International Commission for the Conservation of Atlantic Tuna, Working Documents SCRS/89/82, Miami.

Gordon, H. S. 1953. An economic approach to the optimum utilization of fisheries resources. Journal of the Fisheries Research Board of Canada 10(7):442-457.

Haakonsen, J. M., and M. C. Diaw, editors. 1991. Fishermen's migration in West Africa. Programme for Integrated Development of Artisanal Fisheries, IDAF/WP/36, Cotonou, Benin.

Hampden-Turner, C. 1982. Maps of the mind: charts and concepts of the minds and its labyrinths. Macmilllan Publishing, New York.

Hannesson, R. 1997. The political economy of ITQs. Pages 000-000 *in* E. K. Pikitch, D. D. Huppert, M. P. Sissenwine,

editors. Global trends: fisheries management. American Fisheries Society Symposium 20, Bethesda, Maryland.

Hardin, G. 1968. The tragedy of the commons. Science 162(3859):1243-1248.

Harris, J. 1996. World agricultural futures: regional sustainability and ecological limits. Ecological Economics 17:95-115.

Hodgson, G., and J. A. Dixon. 1992. Sedimentation damage to marine resources: environmental and economic analysis. Pages 421-445 *in* J. B. Marsh, editor. Resources and environment in Asia's marine sector. Taylor & Francis, New York.

Homer-Dixon, T. F., J. H. Bontwell, and G. W. Kathjens. 1993. Environmental change and violent conflict. Scientific American (February) 268(2):38-45.

Horemans, B. 1993. The situation of artisanal fisheries in West Africa in 1992. Programme for Integrated Development of Artisanal Fisheries in West Africa, IDAF/WP/47, Cotonou, Benin.

Hulme, H. R., R. J. H. Beverton, and S. J. Holt. 1947. Population studies in fisheries biology. Nature 159:714-715.

Hviding, E. 1991. Traditional institutions and their role in contemporary coastal resource management in the Pacific Islands. NAGA, the ICLARM (International Centre for Living Aquatic Resources Management) Quarterly 14(3):3-6.

Kooiman, J., editor. 1993. Modern governance–society interactions. Sage Publications, London.

Johannes, R. E. 1981. Words of the lagoon: fishing and marine lore in the Palau district of Micronesia. University of California Press, Berkeley, California.

Lightfoot, C. 1990. Integration of aquaculture and agriculture: a route to sustainable farming systems. NAGA, the ICLARM (International Centre for Living Aquatic Resources Management) Quarterly 13(1):9-12.

Lunianga, D. A. 1989. Le village de pêche artisanale de Kayar, Sénégal. Canadian International Development Agency, Ottawa.

Mace, P., and M. Sissenwine. 1993. How much spawning is enough? Pages 101-118 *in* S. Smith, J. J. Hunt, and D. Rivard, editors. Risk evaluation and biological reference points for fisheries management. Canadian Special Publication Fish Aquatic Sciences 120.

Mathews, J. 1994. A small price to pay for proving Malthus wrong. International Herald Tribune (June 9):5.

McManus, J. W., C. L. Nañola, Jr., R. B. Reyes, Jr., and K. N. Kesner. 1992. Resource ecology of the Bolinao coral reef system. ICLARM (International Centre for Living Aquatic Resources Management) Studies and Reviews 22, Manila.

Malthus, T. R. 1798. An essay on the principle of population. Reprinted 1970 by Penguin Books, Harmondsworth, Middlesex, England.

Martosubroto, P., and M. Badrudin. 1984. Notes on the status of the demersal resource off the north coast of Java. Pages 33-36 *in* Report of the fourth session of the Standing Committee on Resources Research and Development of the Indo-Pacific Fisheries Commission, Jakarta, Indonesia, 23-29 August 1984. Food and Agriculture Organization of the United Nations, Fisheries Reports (318), Rome.

Martosubroto, P., and K.-C. Chong. 1987. An economic analysis of the 1980 Indonesian trawl ban. Indonesian Agriculture and Resources Development Journal 9(1/2):1-12.

Mathews, C. P. 1991. Spawning stock biomass per recruit: a timely substitute for stock recruitment analysis. Fishbyte 9(1):7-11.

Meltzoff, S. K., and E. LiPuma. 1986. The social and political economy of coastal zone management: shrimp mariculture in Ecuador. Coastal Zone Management Journal 14(4):349-380.

Munro, J. L. 1980. Stock assessment models: applicability and utility in tropical small-scale fisheries. Pages 35-47 *in* P. M. Roedel and S. B. Saila, editors. Stock assessment for tropical small-scale fisheries. International Center for Marine Resources Development, University of Rhode Island, Kingston.

Murphy, G. I. 1982. Recruitment of tropical fishes. Pages 141-148 *in* D. Pauly and G. I. Murphy, editors. Theory and management of tropical fisheries. ICLARM (International Centre for Living Aquatic Resources Management) Conference Proceedings 9, Manila.

Nauen, C. 1989. Women in African artisanal fisheries. NAGA, the ICLARM (International Centre for Living Aquatic Resources Management) Quarterly 12(2):14-15.

Neal, R. A. 1982. Dilemma of the small-scale fisherman. ICLARM (International Centre for Living Aquatic Resources Management) Newsletter 5(3):7-9.

Oestergaard, L., editor. 1992. Gender in development. Routledge, London and New York.

Okera, W. 1994. Will traditional African coastal fishermen survive? Ambio 23(2):168-169.

Ommer, R. E. 1991. From outpost to outport: a structural analysis of the Jersey-Gaspé cod fishery, 1767–1886. McGill University Press, Montreal.

Ommer, R. E. 1995. Deep water fisheries, policy and management issues, and the sustainability of fishing communities. Pages 307-322 *in* A. G. Hopper, editor. Deep water fisheries of the North Atlantic oceanic slope. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Panayotou, T., and S. Jetanavanich. 1987. The economics and management of Thai marine fisheries. ICLARM (International Centre for Living Aquatic Resources Management) Studies and Reviews 14, Manila.

Pauly, D. 1979a. Biological overfishing of tropical stocks. ICLARM (International Centre for Living Aquatic Resources Management) Newsletter 2(3):3-4.

Pauly, D. 1979b. Theory and management of tropical multispecies stocks: a review with emphasis on the Southeast Asian demersal fisheries. ICLARM (International Centre for Living Aquatic Resources Management) Studies and Reviews 1, Manila.

Pauly, D. 1988. Some definitions of overfishing relevant to coastal zone management in Southeast Asia. Tropical Coastal Area Management 3(1):14-15.

Pauly, D. 1990. On Malthusian overfishing. NAGA, the ICLARM (International Centre for Living Aquatic Resources Management) Quarterly 13(1):3-4.

Pauly, D. 1994. On the sex of fish and the gender of scientists: a collection of essays in fisheries science. Chapman and Hall, London.

Pauly, D., and C. Lightfoot. 1992. A new approach for analyzing and comparing coastal resource systems. NAGA, the ICLARM (International Centre for Living Aquatic Resources Management) Quarterly 15(2):7-10.

Pauly, D., G. Silvestre, and I. R. Smith. 1989. On development, fisheries and dynamite: a brief review of tropical fisheries management. Natural Resource Modeling 3(3):307-329.

Peters, A. 1983 The new cartography. Friendship Press, New York.

Platteau, J. P., editor. 1989a. Third world fisheries: the dynamics of incorporation and transformation. Development and Change 20(4).

Platteau, J. P. 1989b. The dynamics of fisheries development in developing countries. Pages 565-597 *in* J. P. Platteau, editor. Third world fisheries: the dynamics of incorporation and transformation. Development and Change 20(4).

Pollnac, R. B. 1981. Sociocultural aspects of developing small-scale fisheries: delivering services to the poor. World Bank Staff Working Paper 490, Washington, D.C.

Pollnac, R. B., and M. T. Morrissey, editors. 1989. Aspects of small-scale fisheries development. International Center for Marine Resources Development, University of Rhode Island, Kingston.

Pope, J. G. 1979. Stock assessment in multispecies fisheries, with special reference to the trawl fishery in the Gulf of Thailand. South China Sea Fisheries Development and Coordinating Programme, SCS/DEV/79/19, Manila.

Putnam, R. D. 1992. Democracy, development and the civic community: evidence from an Italian experiment. Pages 33-73 *in* I. Serageldin and J. Taboroff, editors. Culture and development in Africa. Environmentally sustainable development proceedings series 1, The World Bank, Washington, D.C.

Reid, W. V., and K. R. Miller. 1989. Keeping options alive: the scientific basis for conserving biodiversity. World Resources Institute, Washington, D.C.

Ricker, W. E. 1954. Stock and recruitment. Journal of the Fisheries Research Board of Canada 11:559-623.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bulletin for the Fisheries Research Board of Canada 191.

Roedel, P., and S. Saila, editors. 1980. Stock assessment for small-scale fisheries. Proceedings of a workshop, University of Rhode Island, 19–21 September 1979. International Center for Marine Resources Development, University of Rhode Island, Kingston.

Ruddle, K. 1988. Social principles underlying traditional inshore fishery management systems in the Pacific Basin. Marine Resource Economics 5:351-363.

Ruddle, K. 1989a. Traditional sole property rights and modern inshore fisheries management in the Pacific Basin. Pages 68-76 *in* H. Campbell, K. Menz, and G. Waugh, editors. Economics of fishery management in the Pacific Islands region. Proceedings of an International Conference, Hobart, Tasmania, Australia, 20-22 March 1989. The Australian Centre for International Agricultural Research, Canberra.

Ruddle, K. 1989b. The organization of traditional inshore fishery management systems in the Pacific. Pages 73-85 *in* P. A. Neher, editor. Rights based fishing. Kluwer Academic Publishers, Hingham, Massachusetts.

Ruddle, K., and R. Chesterfield. 1977. Education for traditional food procurement in the Orinoco Delta. University of California Publications, Ibero-Americana 53:1-172.

Ruddle, K., and R. E. Johannes, editors. 1985. The traditional knowledge and management of coastal systems in Asia and the Pacific. UNESCO-ROSTSEA, Jakarta.

Ruddle, K., E. Hviding, and R. E. Johannes. 1992. Marine resources management in the context of customary tenure. Marine Resource Economics 7:249-273.

Russ, G., and A. Alcala. 1994. Sumilon Island Reserve: 20 years of hopes and frustrations. NAGA, the ICLARM (International Centre for Living Aquatic Resources Management) Quarterly 17(3):8-12.

Saeger, J. 1981. Do trawling bans work in tropical waters? ICLARM (International Centre for Living Aquatic Resources Management) Newsletter 4(1):3-4.

Saeger, J. 1993. The Samar Sea: a decade of devastation. NAGA, the ICLARM (International Centre for Living Aquatic Resources Management) Quarterly 16(4):4-6.

Sarjono, I. 1980. Trawlers banned in Indonesia. ICLARM (International Centre for Living Aquatic Resources Management) Newsletter 3(4):3.

Schaefer, W. E. 1954. Some aspects of the dynamics of populations important to the management of the commercial marine fisheries. Inter-American Tropical Tuna Commission Bulletin 1:27-56.

Schaefer, W. E. 1957. A study of the dynamics of the fishery for yellowfin tuna in the eastern tropical Pacific Ocean. Inter-American Tropical Tuna Commission Bulletin 2:247-268.

Smith, I. R. 1979. A research framework for traditional fisheries. ICLARM (International Centre for Living Aquatic Resources Management) Studies and Reviews 2, Manila.

Smith, T. D. 1994. Scaling fisheries: the science of measuring the effects of fishing, 1855–1955. Cambridge University Press, Cambridge, England.

Southgate, D., and M. Basterrechea. 1992. Population growth, public policy and resource degradation. Ambio 21(7):460-464.

Stauch, A. 1966. Le bassin camerounais et sa pêche. Editions ORSTOM, Paris.

Stevens, W. K. 1994. Poor lands' success in cutting birth rate upsets old theories. The New York Times (January 2):1, 8.

Sunderlin, W. 1994. Beyond Malthusian overfishing: the importance of structural and non-demographic factors. Traditional Marine Resource Management and Knowledge Information Bulletin, South Pacific Commission, Noumea (4):2-5.

Talaue-McManus, L. 1989. The gleaners of Northwestern Lingayen Gulf, Philippines. NAGA, the ICLARM (International Centre for Living Aquatic Resources Management) Quarterly 12(2):13.

Thomson, D. and Food and Agriculture Organization of the United Nations. 1988. The world's two marine fishing industries—how they compare. NAGA, the ICLARM (International Centre for Living Aquatic Resources Management) Quarterly 11(3):17.

Trinidad-Cruz, A. C., R. S. Pomeroy, P. V. Corpuz, and M. Agüero. 1993. Bioeconomics of the Philippine small pelagics fishery. ICLARM (International Centre for Living Aquatic Resources Management) Technical Report 38, Manila.

Vakily, J. M. 1992. Assessing and managing the marine fish resources of Sierra Leone, West Africa. NAGA, the ICLARM (International Centre for Living Aquatic Resources Management) Quarterly 15(1):31-35

Vakily, M. 1993. Dynamite fishing in Sierra Leone. NAGA, the ICLARM (International Centre for Living Aquatic Resources Management) Quarterly 16(4):7-9.

Went, A. E. J. 1972. Seventy years agrowing: a history of the International Council for the Exploration of the Sea. Rapports et Procès-Verbaux du Conseil International pour l'Exploration de la Mer 165.

Wynter, P. 1990. Property, women fishers and struggle for women's right in Mozambique. Sage 7(1):33-37.