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ON DEVELOPMENT, FISHERIES AND DYNAMITE: A BRIEF REVIEW OF TROPICAL FISHERIES MANAGEMENT

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ABSTRACT. Some features of underdevelopment in Third World countries are reviewed with emphasis on their impact on fisheries and fisheries management. Poverty in rural communities is highlighted as the key issue preventing rational management of tropical inshore fisheries and shown to be - along with (misguided) export-oriented development strategies - the root cause for destructive fishing techniques and environmental degradation. Some implications for modelling are outlined.

A reorientation of investments towards job creation in fisherfolk and other rural communities is advocated as the key aspect of any solution of fisheries problems in Third World countries.

1. Introduction. Worldwide, fish stocks are the only major resources that are still *hunted*. Given the enormous number of hunters (over 12 million worldwide, and the power of their weapons, the main issue is the management of the hunt, in this case the adjustment of the ratio of the number of hunters to the number of quarry.

Despite their overall diversity, the various economies of the world may be grouped into three sets:

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(i) the developed industrialized economies of Western Europe, USA/Canada, Japan and Australia/New Zealand which largely control what is also known as the "World Economy",

(ii) the industrialized socialist economies of eastern Europe and the Soviet Union,

(iii) the economies of the Third World, some of which are developing toward set (i) or (ii) but many of which are, nowadays, not developing at all.

Given prevailing economic conditions and constraints, fisheries development and management are distinct in each of these different sets of economies: these differences are emphasized by the fact that most countries in set (iii) are tropical countries and that most tropical countries are in set (iii).

Gulland [1982] describes the process of fishery management (in northern Europe and North America) as follows: "a fishery, usually on a single species, is troubled by falling catch rates (and possibly also falling total catch): biological research shows that this is due to too much fishing, and further research determines what pattern of fishing would be 'optimum' in some sense or another; and in due course controls (catch quotas, size limits, etc.) are applied that will move the fishing toward the optimum pattern."

Although idealized, this scheme is useful both for what it states, and for what it tacitly implies with reference to countries in categories (i) and (iii). Gulland did elaborate on the above-cited statement, but we will pretend here that he did not in order to be able to lead the reader to the specific points (citing the same Gulland reference) to be made here:

(a) "... biological research shows that this is due to too much fishing" (which implies that there are fishery scientists in sufficient numbers to do the job and that they have appropriate data and know how to analyze and present them),

(b) "... and further research determines what pattern of fishing would be 'optimum' in some sense or other" (the crux of the management problem here is probably: what happens if there are distinct optima valid for different segments of the fishery, supplying different markets?),

(c) "... and in due course controls (catch quotas, size limits, etc.) are applied that will move the fishery toward the optimum pattern" (this paper shows, on the other hand, why the controls are *not* applied, or why, if applied, they are *not* enforced, or why if applied and enforced, they *still do not* move the fishery toward any rationally defined optimum).

The basic reason why the above description of the management processes does not apply to many countries in category (iii) is that an increasing number of their fisheries have to serve two "masters": one fulfilling *local* demand for foodstuff, investment and job opportunities; the other meeting an increasing *export* demand of the economies in category (i) for protein products from the Third World.

Thus, the major upwelling fisheries of the world, such as those off Peru/Chile, Mauritania/Senegal and Angola/Namibia essentially produce anchoveta and sardine-based fish meal to feed Dutch chickens (e.g., Peru/Chile) or various high-value fish for human consumption in Europe (e.g., West African coast). This is notwithstanding the immense protein deficiency in the average diet of Latin Americans and Africans who live near these fisheries, and the excellent nutritive qualities of fish (Kent [1987]).

Similarly, the major demersal fisheries in the tropics are penaeid shrimp fisheries, which export the bulk of their catch to Japan, the USA or Western Europe, while the so-called by-catch (80-90% of the total, and mostly perfectly edible fish) is often discarded, such as is the case throughout most of Latin America (FAO and IDRC [1981]).

The increasing export orientation of major Third World fisheries has a number of serious implications, many of which hinder management as described above. Notably, this export orientation and the inflated foreign currency value of some catch components (tuna, shrimps) are becoming major causes of overfishing in the Third World. We recognize, but do not accept under these circumstances of overfishing, the arguments of most economists regarding "comparative advantage" and "mutual benefits from trade".

Management needs to be structured around certain definitions of "overfishing", since management is supposed to help prevent, alleviate or overcome this overfishing. In the following, we shall discuss, based in part on Pauly [1988b], the various forms of overfishing, their specific form in a typical country (the Philippines) with an economy in category (iii), and their implications for management and natural resources modelling.

2. Growth overfishing. *Growth overfishing* is what happens when fish are caught before they have time to grow. This form of overfishing, which began to occur in some northern European fishing grounds as early as the end of the last century, was solved *in theory* by F.I. Baranov just after World War I. However, it is the work of R.J.H. Beverton and S.J. Holt (of the Lowestoft Laboratory, Great Britain) which, after World War II, presented methods by which growth overfishing could be diagnosed in practice and remedied by fishery management, for example, through the imposition of appropriate mesh sizes for fishing gears (Beverton and Holt [1957]).

Research work related to overfishing conducted nowadays in various research institutions throughout the world consists of estimating the ages, the growth and mortality rates of fish and assessing the (mesh) selection characteristics of fishing gears, as well as adapting Beverton and Holt's and related models to the multispecies situation typical, for example, of Southeast Asian coastal trawl fisheries.

Growth overfishing is a common problem in the marine capture fisheries of the Southeast Asian region. The multispecies nature of the resources leads to questions of how harvests could be maximized from the exploited multispecies mix given the concurrent multiplicity/variety of fishing gears utilized. The problem is best illustrated by the use of small-meshed nets (usually less than 2 cm) by the coastal trawl fisheries in the countries of the region. Several hundred species are vulnerable to the trawl gear, and about 30-50 species usually dominate the landings. These vary in size from very small (e.g., slipmouths, shrimps) to fairly large (e.g., lizard fish, rays and sharks), with correspondingly wide variation in appropriate mesh sizes to maximize yield.

Several approaches to estimate the best mesh size for the exploited faunal assemblages are available in the literature. These are all based on the Beverton and Holt [1957] model involving either (i) weighted averaging of mesh sizes corresponding to optimum lengths-at-first capture of the various species/groups (Sinoda *et al* [1979]) or (ii) aggregation of the yield isopleths of the various species/groups using catchability, selectivity and relative recruitment factors (Sainsbury [1984], Silvestre [1986]). Pauly [1988a] compiled the results of studies dealing with the estimation of best mesh size for various trawl fisheries in the Southeast Asian region, and showed that the biologically optimum range is about 3.5-5.0 cm. The widespread use of meshes 2 cm and below in the region's trawl fisheries thus leads to considerable growth overfishing.

Figure 1 illustrates, for the trawl fisheries of the Philippines, the range of eumetric lines that maximize yield from the faunal assemblage in the plane of mesh size, m, and fishing mortality, F (Silvestre *et al* [1988a]). The figure in essence delineates the optimum operational range for the fisheries given the two factors (m and F) that are frequently the object of management intervention. Note that the 2 cm. mesh size is appropriate only for very low F levels. In the case of Lingayen Gulf, a traditional trawling ground that is presently the object of intense studies (conducted under the ASEAN/US/ICLARM Coastal Resources Management Project), the prevailing mesh size ($m = 2$ cm.) and fishing pressure ($F = 2.8$ year^{-1}) on the trawlable biomass lead to considerable growth overfishing. Given the basically similar faunal assemblages and status of exploitation in Philippine trawling grounds (and for that matter other grounds in Southeast Asia, e.g., the Gulf of Thailand), the magnitude of losses could be quite large. The benefits from increasing mesh sizes, thus, could be considerable and, moreover, could be apparent within one year (Meemeskul [1988]).

The legal minimum trawl mesh size in the Philippines has been increased from 2 to 3 cm. as a result of findings similar to the ones presented here, and a 4 cm. minimum limit (from the present 2.5 cm.) is under consideration in Thailand. However, observance of the limit by trawlers is another matter and the use of small-meshed nets has persisted despite legislation for larger-meshed nets for reasons (e.g., loss of shrimps) discussed in Pauly and Neal [1985].

The problem of growth overfishing is not limited to the trawl fisheries. In the Philippines, mesh size limitations for the other net gears are common but exceptions are given in the capture of fish fry (for seeding fishponds) and "such species which by their nature are small but already mature", as the law states. This leads to growth overfishing of abundant species for which the gear was not specifically designed.

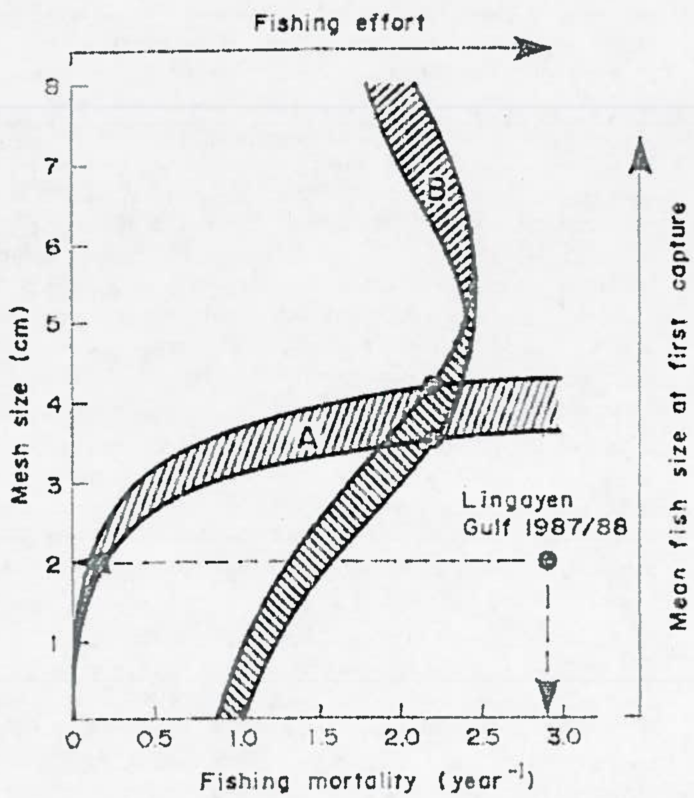
Fishing effort
Mesh size (cm)
8
7
6
5
4
3
2
1
0
0.5
1.0
1.5
2.0
2.5
3.0
A
B
Lingayen
Gulf 1987/88
Fishing mortality (year⁻¹)
Mean fish size at first capture

FIGURE 1A

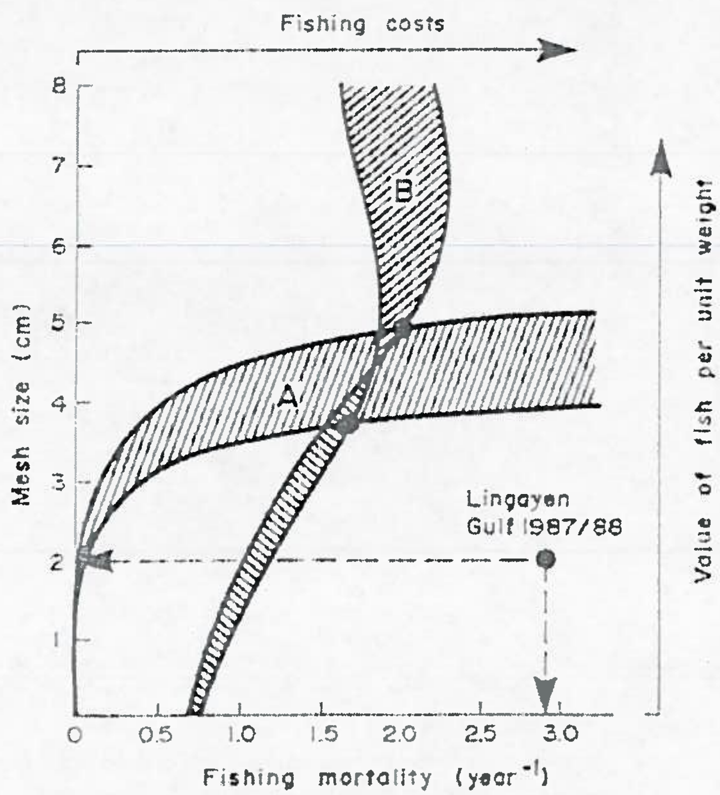

FIGURE 1B

Multispecies yield-per-recruit (Figure 1A) and value-per-recruit (Figure 1B) assessment of the demersal fisheries of the Philippines, based on vital statistics, relative recruitment rates and per kg prices of 28 representative groups of fish and invertebrates from three major fishing areas (West Sulu Sea, Lamon Bay and Visayan Sea). The method used, which relies on logistic selection ogives rather than the assumption of knife-edge selection, is detailed in Silvestre and Soriano (1988). Dots on intersections of lines A (="eumetric fishing") and B(="cacometric fishing") show range of optimum mesh size and fishing mortality combinations. Note excessively high effort and low mesh sizes in the Lingayen Gulf, leading to losses of up to 20% and 40% relative to maxima in yield and value, respectively.

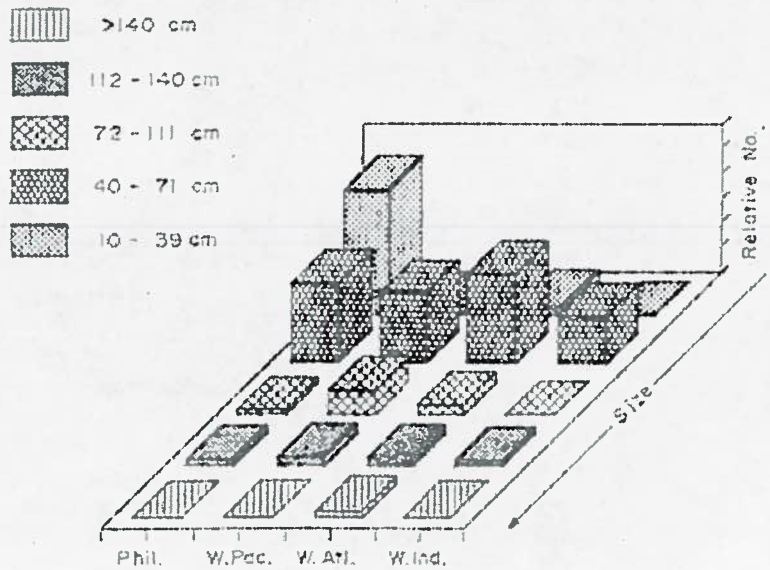

FIGURE 2. Size composition of yellowfin tuna catches in the Philippines, compared to that of other fishing areas in the Western Pacific, Western Atlantic and Western Indian Oceans (from Canaden and Stequert 1987). Note preponderance of small tuna in Philippine catches.

The problem of growth overfishing is also believed to be serious in the case of the fishery for yellowfin and skipjack (Floyd and Pauly [1984]). Aprieto [1982], White and Yesaki [1982], and Yesaki [1983] report that undersized tunas comprise a large proportion of Philippine yellowfin and skipjack landings. Canaden and Stequert [1987] estimate annual landings of yellowfin less than 40 cm. and of skipjack less than 30 cm. to be 10 million and 14 million fish, respectively, during 1980-1984. Figure 2 illustrates the disproportionately large number of undersized tunas being landed in the Philippines compared to other fishing areas. It should be noted, however, that middle-sized yellowfin (70-110 cm.) are quite scarce in Philippine waters. The growth overfishing of tunas in the Philippines, thus, is a regional management concern involving several countries exploiting the same stocks.

3. **Recruitment overfishing.** The second recognized form of overfishing is *recruitment overfishing* which refers to fishery-induced reductions of the number of young fish entering the fishing grounds. Re-

cruitment overfishing can be brought about by: (1) reduction of the spawning stock, which may become so small such as to produce a limited number of eggs and hence of recruits, and (2) coastal environmental degradation, which usually affects the size or suitability of nursery areas.

Note that preventing recruitment overfishing is not, as lay persons often think, a matter of "letting each female spawn at least once" (since, e.g., less than one in a thousand anchovy or shrimp larvae reach a mature age, even in the absence of a fishery) but rather a question of not fishing too much. Models to express what *too much* is were first developed by Ricker [1954, 1975]. Because of their requirements for data generally not available for tropical fisheries, these models found little application in low latitude situations. Rather, it is surplus-production models (Schaefer [1954, 1957], Fox [1970], Munro [1979]) that are used to manage tropical fisheries. These models do not distinguish between growth and recruitment overfishing but rather lump the two processes into a single category of general biological overfishing, defined as what occurs when fishing effort or fishing mortality increases beyond the values generating Maximum Sustainable Yield (MSY, see Figures 3A and 3B).

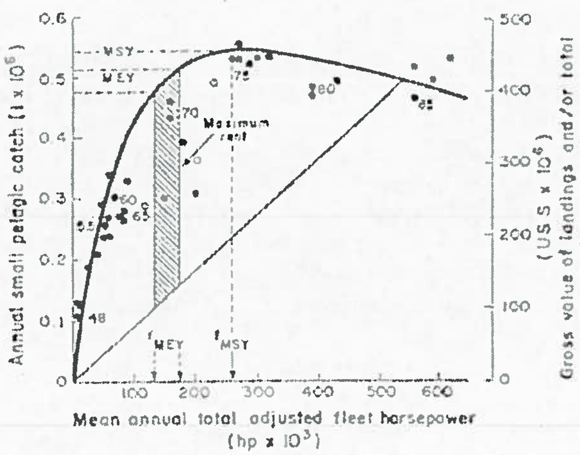

FIGURE 3A

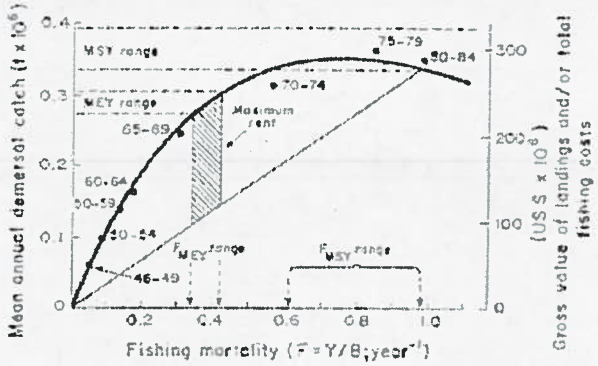

FIGURE 3B
Surplus production models of the Philippine pelagic (Figure 3A) and demersal fisheries (Figure 3B); both models provide rough estimates of total fishing costs and economic rent through the admittingly crude assumption of equilibrium in the early 1980s (modified from Dalzell *et al.* 1987 and Silvestre and Pauly 1986).

4. **Ecosystem overfishing.** The concept of ecosystem overfishing was introduced to characterize the process which took place in the 1960s in the Gulf of Thailand (and, at different times, in other areas of Southeast Asia) where demersal trawling was so intense that it altered the balance of species on the fishing grounds, with some species increasing, but failing to replace the depleted ones (Pauly 1979a, 1979c). This process implies that an increased part of the system's ecological production now goes into side branches of the food webs, e.g., into benthic invertebrates or large zooplankton, i.e., into nonresource species.

The changes in faunal composition associated with increased fishing pressure on trawlable stocks in the Southeast Asian region (Table 1) include: (i) increased squid abundance, (ii) disappearance of rays (i.e., large, long-lived fish), (iii) increased abundance of penaeid shrimps in relation to fish biomass, (iv) disappearance of formerly abundant false trevally *Lactarius lactarius*, (v) increased abundance of triggerfishes (Fam. Balistidae), and (vi) above-average decline of large, high-valued species (e.g., snappers, Fam. Lutjanidae and the flatfish, *Psettodes* *erumei*). Similar trends have been noted elsewhere as in West Africa (for triggerfish) and the Irish Sea (for rays).

The trends for penaeid shrimps confirm their general resilience to fishing pressure. Most of the trends noted in Table 1 come primarily from the Gulf of Thailand where the statistical baseline is unparalleled elsewhere in Southeast Asia (and for that matter much of the world). In the Philippines, despite the relative scarcity of quantitative information, similar trends have been noted in San Miguel Bay (Pauly [1982a]), Manila Bay (Silvestre *et al.* [1987]) and, of late, in Lingayen Gulf. Figure 4 illustrates the decline in relative catch rates of trawlers (indicative of declining demersal biomass) in the Lingayen Gulf from the late 1940s to the late 1980s, similar to the decline noted in the Gulf of Thailand ("Learning" in Figure 4 refers to gear improvements leading to improved C/f). Note that the catch rate for the late 1940s corresponds to that for near unexploited biomass levels brought about by the lull in fishing activities in that area during World War II.

By the mid-1980s, the catch rates had declined to about 15-30% of their original levels in the late 1940s. Table 2 gives the relative abundance of the families/groups comprising the catch of trawlers for the same period. Note that, by the late 1970s, most of the trends noted above have become evident. In addition, the "trash fish", or better the "by-catch" (i.e., small fish, mostly juveniles of valuable species) increased in relative abundance in catch samples.

With this, the three resource-oriented aspects of overfishing are covered and we may turn to *Homo sapiens*.

TABLE 1. Evidence of changes in species composition of Southeast Asian demersal communities with increasing fishing pressure indicative of recruitment and/or ecosystem overfishing.

Taxa involved	Area[a)]	Observed Changes (and Possible Cause)	Sources
Cephalopods	Gulf of Thailand	massive increase (due to reduction of fish predation)	Pauly [1979a, 1985]
Cephalopods	San Miguel Bay	relative increase in relation to total biomass (probably same as above)	cf. Table 26 of Warfel and Manacop [1950] with Table 4 of Pauly [1982a]
Cephalopods	Lingayen Gulf	massive increase (probably same as above)	see Table 2
Penaeid shrimps	Gulf of Thailand	relative increase in relation to fish biomass (probably same as above)	Pauly [1982b, 1984]
Lactarius lactarius	Gulf of Thailand	disappearance from survey catches (recruitment overfishing)	Pauly [1979b]
Lactarius lactarius	Lingayen Gulf	disappearance from commercial and survey catches (probably recruitment overfishing)	see Table 2

(a) areas are Philippine fishing grounds except Gulf of Thailand.

TABLE 1 (con't)

Rays	Gulf of Thailand	virtual disappearance from survey/commercial catch (attributable to low fecundity, i.e., recruitment overfishing)	Pauly [1979a] Pope [1979]
Rays	San Miguel Bay	same as above	Pauly [1982a]
Rays	Lingayen Gulf	same as above	see Table 2
Balistidae	Lingayen Gulf	relative increase in relation to fish biomass (species replacement)	see Table 2
Canthidermis maculatus (Fam. Balistidae)	Maqueda Bay	upsurge of new resource (species replacement?)	Pauly [1986]
Lutjanidae	Lingayen Gulf	relative decrease in relation to total fish biomass (probably due to growth and recruitment overfishing)	see Table 2
Psettodes erumei	Lingayen Gulf	same as for Lutjanidae	see Table 2

5. Economic overfishing. Figure 3 also defines *economic overfishing* as fishing at a level of effort higher than the level which maximizes economic rent, i.e., the difference between gross returns and all costs. Note that this optimum level of effort is less than that which produces MSY.

The problem of economic overfishing is quite evident in the case of the demersal and small pelagic fisheries of the Philippines. Silvestre and Pauly [1986, 1988] estimated that effort levels in the early 1980s on the demersal resources were already about three times that which generates maximum economic yield MEY (Figure 3). The consequent rent dissipation that this entails was estimated to be about US $100-160 million/year.

For the small pelagic fisheries, Dalzell *et al.* [1987] estimate that effort levels in the early 1980s were about four times that which will generate MEY. They estimate the consequent rent dissipation that this entails to be about US $300 million/year. A similar estimate of the degree of excess effort in a Southeast Asian fishery has also been made for pelagic fisheries in Malaysia (Nahan [1982]).

Based on these Philippine studies, the annual rent dissipation from the coastal (demersal and small pelagic) fisheries in the Philippines totals about US $400-460 million. The trend of economic overfishing of the country's coastal fisheries is reinforced by findings of more reliable, area-specific studies (Smith and Mines [1982], Smith *et al.* [1983]) and by aggregate value-per-recruit analysis for the Philippine trawl fisheries incorporating price/size relationships for the major exploited species (see Figure 1, right panel).

6. Malthusian overfishing defined. Overfishing, at least as far as the forms discussed above are concerned, is well described in textbooks, and the suggested remedies usually involve a mix of management measures (such as mesh size regulations, closed areas or seasons, limits on gear sizes or on craft designs, etc.). All of these measures imply that the fishermen concerned are actually in a social and financial position to either implement or comply with those measures or otherwise adjust to restrictions on their activity. Usually they can because the textbooks are written in and for developed countries in which most fishermen are either the employees of well financed corporations, or independent (if small) entrepreneurs who generally have the option of taking up shore-based jobs if all else fails.

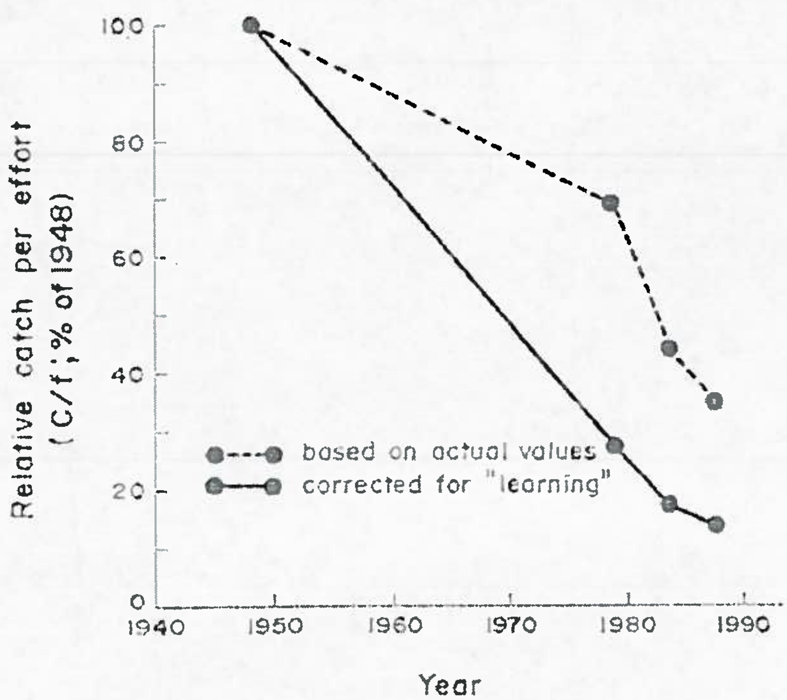

FIGURE 4. Relative catch/effort of Lingayen Gulf, Philippines (from data in Warfel and Manacop 1950, Aprieto and Villoso 1982, Mines 1986, Silvestre *et al.* 1986 and Silvestre *et al.* 1988). Note that surplus production models assume a stock to be overfished when $C/f < 40-50\%$ of its value in the unexploited stock.

But what about small-scale fishermen in Third World countries? Usually they are poor, so poor that they, and particularly their families, suffer from malnutrition. Few have alternative employment possibilities, at least without substantial retraining expenses.

By all scientific standards, there are too many small-scale fishermen in Southeast Asia and specifically in the Philippines. Moreover, their numbers are rapidly growing (with a doubling time of less than 20 years), both because of their own children and because of increasing landlessness among farmers, to whom fishing becomes the occupation

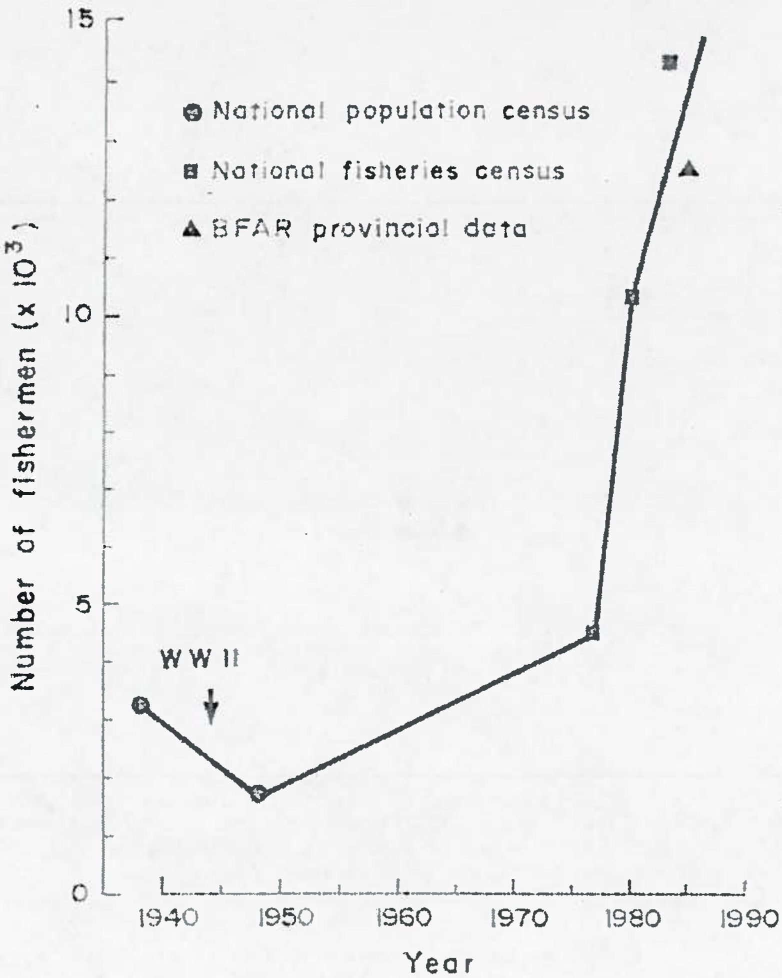

FIGURE 5. Changes of the number of small-scale fishermen in the Lingayen Gulf area from the 1930s to the early 1980s. Note dip due to WWII and tremendous increase in the 1980s. (The last point does not reflect a decrease, but the result of a different sampling methodology.)

of last resort (Librero *et al.* [1982], Pauly and Chua [1988], and see Figure 5).

We shall call the form of overfishing these fishermen produce "*Malthu-*

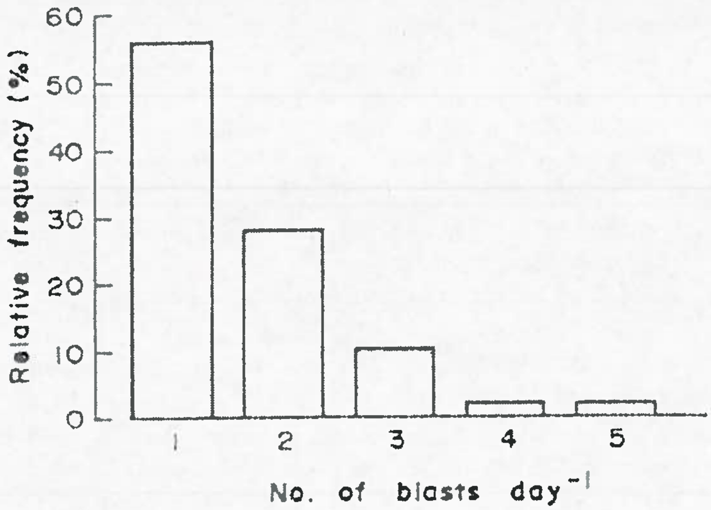

FIGURE 6. Relative frequency in Lingayen Gulf, Philippines, of the number of blasts per 10-16 hp boat involved in dynamite fishing (from Calud *et al.* 1988).

sian overfishing," after the Reverend I.R. Malthus (1766-1834), the prophet of doom who would be so easy to refute if the real problems of humanity were tackled, rather than their ideological shadows.

Malthusian overfishing occurs when poor fishermen, faced with declining catches and lacking any other alternative, initiate wholesale resource destruction in their effort to maintain their incomes. This may involve in order of seriousness, and generally in temporal sequence: (1) use of gears and mesh sizes not sanctioned by government; (2) use of gears not sanctioned within the fisherfolk communities and/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 "gears" such as dynamite or sodium cyanide that do all of the above and even endanger the fisherfolks themselves (Figure 6).

This sequence, generally misunderstood by administrators and fishery scientists alike as reflective of ignorance, or of putting the short-term gain ahead of future benefit (or even as evidence of a moral decline), is in fact reflective of nothing but the logical result of declining catch per effort (and hence incomes). It can be tackled only by increasing rural incomes in the non-fishery sector and to attract fisherfolk out of fishing, and of course by enforcing the fisheries law for those that remain.

To illustrate what can happen when this does not occur at a sufficiently high rate, we compiled below some quantitative information on the fishermen of the Lingayen Gulf area, as reported in Silvestre *et al* [1988b] and Yazon and McManus [1987]:

(i) number of fishermen 12500; they operate 7050 boats ("bancas"), generally with 10-16 hp engines; of these bancas, 3-4% are involved in dynamite fishing (Figure 6);

(ii) size of fishery area: 160 km of coastline and about 1000 km^2 of "municipal" waters (i.e., waters legally reserved (but rarely observed) for small-scale fishermen, from the coastline to 7 km offshore or up to a depth of 7 fathoms);

(iii) average family size: 6.1 persons. With a "food threshold" estimated at US $58 per month and a "poverty threshold" estimated as US $96 month, small-scale fishermen live well below the "food threshold";

(iv) 58% of the children in coastal communities suffer from second or third degree malnutrition.

We believe this to sufficiently describe what is meant here by Malthusian overfishing.

6. Conclusion. There are obviously numerous factors that keep a given group of individuals poor. Fisherfolk and their families have long been identified as amongst the "poorest of the poor", and this is certainly as true in the Philippines as it is in most tropical Third World countries with significant fisheries or large groups of fishing-dependent families.

The conditions described in the main body of this paper have elicited varying responses from national governments. At the beginning of this decade, for example, Indonesia, specifically citing its desire to assist the majority of fishermen, banned trawlers from within its territorial waters (Sardjono [1980]). No other government in Asia has yet followed suit in quite such a dramatic fashion, though the Philippines and others have attempted partial bans, usually based on restricting trawlers to waters beyond certain depths or beyond certain distances from the shoreline. Due to the extremely weak enforcement power of the fisheries or other authorities concerned, however, such partial bans have generally elicited little by compliance.

Elsewhere in Southeast Asia, Thailand is the only country that appears to have given serious consideration to regulation of minimum mesh sizes as a means of regulating fishing effort. Most countries in the Third World find themselves with such serious problems generating employment for their populations at large that they are in no position to single out fisherfolk for favored treatment, no matter how important their contribution to animal protein requirements of the national population.

Given this situation where economic and social perspectives have much bearing, but where fisheries cannot be considered in isolation, fishery management as described in the main body of this paper is not something that can be tackled by fishery biologists alone. Nor are the solutions to overfishing (no matter how defined) and to the resulting poverty and human misery likely to be found within the fisheries sector. Rather, any improvement over the present situation must occur through the diversion, or preferably through the attraction, of substantial numbers of fisherfolk to non-fishing activities. These activities could include mariculture or new fishing activities in association with the growing number of artificial reefs which are being placed in tropical waters.

Beyond these fishery-related activities, it is very clear that long-term solutions to poverty within fishing communities must be found altogether outside fishing. Given the pressure also on other tropical natural resources, such as agricultural land and forests, these solutions are most likely to be in trade and manufacturing that initially take a labor-intensive form.

What about the remaining fishermen? If economic growth in other sectors is great enough, those that are initially attracted out, or legislated out of the fishery, will be able to remain out. The ones that remain fishing, however, also need encouragement to establish the rights of tenure and exploitation that will increase their incomes (Smith [1981]). Much has been made of the Japanese success with coastal fishing rights systems established at the township level. Such decentralization of management is most certainly correct, but would this system have been successful without the growth of the Japanese economy as a whole which served to reduce numbers of fisherfolk to less than one-third their previous levels? We think not. Therefore, solutions to the overfishing and poverty elsewhere in Asia described earlier require not a single solution but rather an entire range of remedies and actions.

Bioeconomic models include a focus on the concept of "opportunity cost"; that is, the returns to the factors of production (i.e., capital, labor) in fishing when they are used in the "next best" activity. We have always been most concerned about this concept; not because we disagreed with the theory *per se*, but rather because of its implications. The value of the environment generally does not enter these economic calculations with the result that one could argue that fisherfolk should continue fishing, regardless of the levels of catch and income so derived, as long as they had no income-generating alternative. Now that overfishing and the attendant losses to society are being convincingly demonstrated in case after case in tropical waters, such an argument can no longer be tolerated. Particularly in countries with growing populations, fishing at levels of effort beyond that needed to produce the maximum sustainable yield or something near that, implies now not only a waste of resources from the producers' point of view, but also an eventual tremendous loss to consumers as well. When, at the extreme as cited earlier in this paper, one begins to measure fishing effort in terms of dynamite blasts per day, it is clear that fisheries management still has a long, long way to go. But it is clearly time to begin.

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