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Annex B

# Sound ecology is good economics: Four vignettes from Philippine fisheries

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***Abstract***

Following a brief recall of the open access nature of most natural resources - and particularly of fisheries resources in the Philippines, the point is made and documented via four case studies that resources management, rather than reducing prospects for "development" in fact augment these. The cases discussed are from the Philippines and comprise (i) the national fisheries for small pelagic fishes *(tamban, dilis, galunggong, etc)*; (ii) the demersal (i.e. trawl fisheries for *maya-maya, sapsap, lapu-lapu*, etc); (iii) the small scale fishery for coral reef fishes at Apo Island, Negros and (iv) the fisheries of Bacuit Bay, Palawan. Overall, it is shown that given the present state of overfishing of these and other Philippine resources, arguments pitting "ecology" against "economics" or "conservation" against "development" lack any rational basis, because the fishery resources are presently being *wasted* in terms of *both* economics and ecology.

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## *Introduction*

Fisheries resources in the Philippines and elsewhere are largely open access resources, a feature of little importance when the resource is large in relation to the amounts extracted by humans. Thus, in the scattered villages of the early Filipinos, catching a few fish to provide a meal was as natural as obtaining clean fresh water from a nearby river, or extracting wood from a nearby grove (see, e.g. Ochotorena 1981). All of this has changed, especially in the last decade, and what appeared to be an everlasting bounty turned out to be finite, fragile resources now rapidly lost, in spite - or rather because - of the needs of an incessantly growing population (Pauly 1986, Pauly and Chua 1988).

This situation will not rectify itself by more *laissez-faire;* rather, active intervention by government and other entities is necessary to prevent further degradation, and eventually, to rehabilitate the damaged ecosystems from which the natural resources are extracted.

For such intervention to happen, though, conceptual clarity as to the *need* for such intervention must be established. Particularly, a number of red herrings must be quickly disposed of. Among these, we must get rid of the notion that dealing with ecosystem rehabilitation is a luxury that only rich countries can afford, i.e., that in the Philippines, there exists a conflict between "ecology" and "economics" or between "conservation" and "development".

The four vignettes below are presented to illustrate that in the context of overexploitation prevailing in this country, sound economics *requires* sound ecology, and that there will be no further "development" of the natural resources - especially of the marine fisheries resources - if conservation continues to be ignored.

### *Vignette 1: The case of the Philippine fisheries for small pelagic fishes*

Pelagic fishes live in schools, generally over shallow depths. They include roundscads *(galunggong)*, sardines *(tamban)*, anchovies *(dilis)*, mackerels (*hasa-hasa)*, etc. Major pelagic fishing gears in the commercial sector include purse seines *(pangulong)*, bagnets *(basnig)*, and ring nets *(pukot panalikop)*. Catches of small pelagics represent about 40% of total marine catch.

Data collected from 1948-1985 in the frame of a BFAR/ICLARM cooperative project show a declining catch per unit of effort (C/f) with increasing numbers of fishermen and boats and, since the early 1980's, a declining total catch (Fig.1).

Maximum Economic Yield (MEY) is about 500,000 tonnes and occurs at an effort level equal to about 155,000 vessel horsepower or 60% of the fishing effort generating Maximum Sustainble Yield (MSY) and only 35% of the present effort level. The economic rent of the small pelagic fisheries was

estimated at about 366,000 tonnes, worth a total of US$250 million per year. This level can be attained by reduction in effort of about 70% and would result in total catches *above* current levels (Fig.2).

A reduction of fishing effort would lessen the pressure on the fishery, thereby allowing the stock to rebuild themselves. Then, not only would total catch increase, but the fish caught would be larger on the average (because more juveniles would live longer and grow to larger sizes) and because the present trend toward smaller species (i.e. from sardine to anchovies, see Fig.3) would be reversed. From an economic point of view, this would mean that the remaining fishermen would have more and relively high-valued species to catch, and hence, higher incomes. A larger harvest of higher-value fish would mean that the fishery could address market demand without having to compromise on the ecological integrity of the resource.

Effort reduction would free resources such as labor and capital, which are presently used marginally in the fishery, and would be better used in other sectors of the economy. By reducing effort, the economic rent that is presently being dissipated could be regained. This rent could be used to pay-off the fishermen who would become unemployed as a result of effort reductions. The amount needed to repay the fishermen can be incorporated in the cost function of the fishery and subtracted from the rent. This results in a new level of MEY corresponding to a higher level of effort but would ensure, nevertheless, that the remaining fishermen earn higher (taxable) profits, while those displaced could be awarded subsidies equal to their earnings before the effort reduction (such subsidies could be used to create land-based jobs for displaced fishermen).

*Vignette 2: The case of the Philippine demersal fisheries*

Demersal resources are those fish and invertebrates which live on or near the sea bottom (whether soft/trawlable or coral/hard grounds). The major demersal fishing gears are the trawlers *(galadgad)* which are used over soft bottoms. Examples of trawl-caught species are the slipmouths *(sapsap)* and the sea breams *(bisugo)*. BFAR (1987) statistics show that 500,000 tonnes of demersal fish were landed in 1987, of which 75% was accounted by the municipal fishery, while the catch of demersals contributed approximately 40% to the total catch.

G. Silvestre, formerly of the UP College of fisheries and Daniel Pauly of ICLARM and associates have reviewed the status of the Philippine demersal fisheries (Silvestre et al. 1986, 1987; Silvestre and Pauly 1989) and their findings are summarized in Fig.4. These shows, as in the case of the pelagic fisheries, a steadily increasing effort (measured here as horsepower deployed per year) which grew from 21,000 hp in 1948 to 976,000 in 1984), a decreasing catch per effort (1.23 tonnes/hp in 1948 to 0.42 tonnes/hp in 1984), and a declining total catch ($1.3 \times 10^6$ tonnes in the late 1940's to $0.4 \times 10^6$ tonnes in the early 1980's).

A related study which analyzed the profitability of medium sized trawlers of Lingayen Gulf (Cruz and Silvestre 1990) reflected the same trend. Average catch rates collected from separate trawl surveys in 1984 and 1988 showed a decline of 20%. Even in a regime of constant operating costs, persistently low catch rates depressed profits for the trawl owners, and led to a negative internal rate of return for an investment life of 10 years.

Again, catch per effort (which determines fisherfolk incomes) and total catch would increase if aggregate fishing effort were reduced. Indeed, a MEY of 240-260 million US$ per year would be obtained if effort were reduced to 40% of its present, excessive level (Fig.2B).

Effort reductions in the demersal fishery are particularly appealing because of the negative externalities of trawling i.e. (i) adverse effect on the sea bottom (especially when trawling for shrimps in shallow areas) and (ii) incessant conflicts with small-scale fishermen, whose fishing grounds are usually encroached upon. Aside from the potential economic rent to be earned by reducing trawler effort, serious equity issues would likewise be addressed in a positive manner because of the greater number of small-scale fishermen who would benefit from reductions in the number of trawlers.

*Vignette 3: The case of Apo Island Marine reserve, Negros*

Apo Island is one of three community-managed marine reserves in Southern Philippines, maintained by the people who live in the community. This scheme was implemented via a marine conservation and education program of Silliman University (White 1989). The basic management concept advocated in Apo Island was to obtain, from the people who exploit the resource, a commitment to perpetuate its sustainability. This included the avoidance of destructive fishing techniques and the establishment of a sanctuary, where no fishing or collecting is permitted.

The implementation of the marine reserve resulted in improved fish catch (from 17t/km$^2$ in 1981 to 32 t/km$^2$ in 1987) and hence, increased incomes; increased fish diversity and abundance within sanctuary areas (50 species/1,000 m$^2$ in 1985 to 70 species/1,000 m$^2$ in 1986, Fig. 5); and improved coral substrate cover, and an increase in revenue from tourism (i.e. SCUBA diving). Similar positive results have been reported from other studies.

*Vignette 4: An apparent conflict between the fisheries and logging sectors of Bacuit Bay, Palawan.*

An important resource use conflict between logging and fishing/ tourism is presently experienced in Bacuit Bay, Palawan. The logging activities in Bacuit Bay watershed impact on the marine environment via sedimentation of washed out soil, which kills corals. This results in decreased coral cover and a reduction of coral reef fishes, all leading to decreasing fish catch. Also, sedimentation reduces underwater visibility, and hence directly reduces the attraction of parts of Bacuit Bay for SCUBA diving tourists.

Economic analysis, based on discounting techniques over a project period of 10 years, and involving two development options (a logging ban vs. continued logging) revealed that the logging ban generated larger economic benefits (Hodgson and Dixon 1988). Although the second option (continued logging) results in higher profits for the first five years, income from logging becomes insignificant in the last five years, due to total extirpation of the forest and the losses experienced by the fishery and tourism sectors (Fig.6).

The problem of wealth distribution, perennially a prickly issue in the discussion of economic benefits, can be resolved in this particular case. The benefits of continued logging would accrue to a single entity (the concessionaire) while the losses (sedimentation, flooding, loss of forest wildlife, fishery catches) due to logging would be divided amongst many (fishermen, farmers, lowland dwellers). If logging were banned, the converse would happen. The distribution of wealth and of losses would therefore be more equitable if logging were discontinued.

## *Discussion*

Each of four vignettes above illustrates in its own way one or several of the following points:

o Interventions by government and other entities aimed at restoring the economic health of a fishery will automatically, if indirectly, also contribute to restoring and/or maintaining the ecologic health of the ecosystem which sustains that fishery.

o Continued non-intervention (i.e., *laissez-faire*) will lead to further resources degradation and reduced catches. Note that the market which traditionally provides a clearing ground for resolving conflicts via the pricing mechanism, fails to do so in the case of fisheries because of the absence of property rights. Thus, the implicit price for the use of a fishery happens to be very low because supply agents are unable to enforce the real cost on users. Since many exchanges involving natural resources fall outside the market (Harris 1985), intervention is needed.

o subsidy schemes, such as the earlier Biyayang Dagat, KKK loans, etc. only aggravate the prevailing trends, because they reduce the cost on fishing, and hence lead to more capital and labor entering the fishery sector, eventually leading to decreased catches and net economic losses for the economy as a whole.

As elaborated elsewhere (Pauly et al. 1989), the ultimate solution to the various forms of overfishing affecting the Philippine fisheries, and the environmental degradation this entails is for a massive exodus of labor *from* the fishery sector - something that presently appears inconceivable given the pressure on land-based resources emanating from the growing Filipino population, and its growing needs. However, as briefly sketched above

(Vignette 1), the fisheries themselves, if properly managed and *taxed* could provide the resources to fund this reallocation of labor resources. The International Center for Living Aquatic Resources Management (ICLARM) is interested in following up on this issue through its research, and in its dialogue with Philippine institutions and personalities.

## *Reference*

Bureau of Fisheries and Aquatic Resources. 1987. Fisheries Statistics of the Philippines. Bureau of Fisheries and Aquatic Resources, Manila, Philippines.

Cruz, A.V. and G.T. Silvestre. 1990. Economic analysis of medium trawlers in the Lingayen Gulf. Fish. Res. J. Phil.3(1/2):1-14.

Dalzell, P. and D. Pauly. 1989. Assessment of the fish resources of Southeast Asia, with emphasis on the Banda and Arafura seas. Neth. J. Sea Res.24(4):641-650.

Dalzell, P. and R. Ganaden. 1987. A review of the fisheries for small pelagic fishes in Philppine waters. Bureau of Fisheries and Aquatic Resources, Tech. Pap. Ser. Vol.X, No. 1:58 p.

Dalzell, P. and R. Ganaden. 1987. The overfishing of small pelagic fish stocks in the Philippines, pp. 249-256. Proceedings of the 22nd Session of the Indo-Pacific Fisheries Commission, Darwin, Australia, 6-26 February 1987. RAPA Report 1987/10, Bangkok.

Dalzell, P., P. Corpuz, R. Ganaden and D. Pauly. 1987. Estimation of maximum sustainable yield and maximum economic rent from the Philippine small pelagic fisheries. BFAR Technical Paper Series. Vol. X, No. 3.23 p. Bureau of Fisheries and Aquatic Resources, Quezon City, Philippines and International Center for Living Aquatic Resources Management, Manila, Philippines.

Harris, S. 1985. The economics of ecology and the ecology of economics. Search 16(9-12):284-290.

Hodgson, G. and J.A. Dixon. 1988. Logging versus fisheries and tourism in Palawan. East-West Environment and Policy Institute Occasional Paper No. 95 p.

Hodgson, G. and J.A. Dixon. 1988. Measuring economic losses due to sediment pollution: logging versus tourism and fisheries. Tropical Coastal Area Management 3(1):5-8.

Ochotorena, M. 1981. Ag tobig nog keboklagan: a Subanon folk epic kinaadman. J. South. Philipp. 3:348-543.

Pauly, D. 1986. A brief historical review of living marine resources research in the Philippines, pp. 3-18. In: D. Pauly, J. Saeger and G. Silvestre (eds.) Resources, Management and Socio-Economics of Philippine Marine Fisheries. UP College of Fisheries, Dept. Mar. Fish. Tech. Rep. 10, 217 p.

Pauly, D. and C. Thia-Eng. 1988. The overfishing of marine resources: socioeconomic background in Southeast Asia. Ambio 17(3):200-206.

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

Silvestre, G., R. Federizon, J. Munoz and D. Pauly. 1987. Overexploitation of the demersal resources of Manila Bay and adjacent areas, pp. 269-287. Proceedings of the 22nd Session of the Indo-Pacific Fisheries Commission, Darwin, Australia, 6-26 February 1987. RAPA Report 1987/10, Bangkok.

Silvestre, G.T. and D. Pauly. 1989. Estimates of yield and economic rent from Philippine demersal stocks (1946-1984) using vessel horsepower as an index of fishing effort. Univ. Phils. Visayas Fish. J. 1(2)/2(1/2)/3(1/2) [publ. 1989]: 11-24.

Silvestre, G., R. Regalado and D. Pauly. 1986. Status of Philippine demersal stocks-inferences from underutilized data. p. 47-96. In D. Pauly, J. Saeger and G. Silvestre (eds.) Marine Resources Management and Socio-Economics of Philippine Marine Fisheries. UP College of Fisheries, Dept. Mar. Tech. Rep. 10,217 p.

White, A.T. 1989. Two community-based marine reserves: lessons for coastal management, p. 85-96. *In* T.-E. Chua and D. Pauly (eds.) Coastal area management in Southeast Asia: policies, management strategies and case studies. ICLARM Conference Proceedings 19,254 p. Ministry of Science, Technology and the Environment, Kuala Lumpur; Johor State Economic Planning Unit, Johore Bahru, Malaysia; and International Center for Living Aquatic Resources Management, Manila, Philippines.

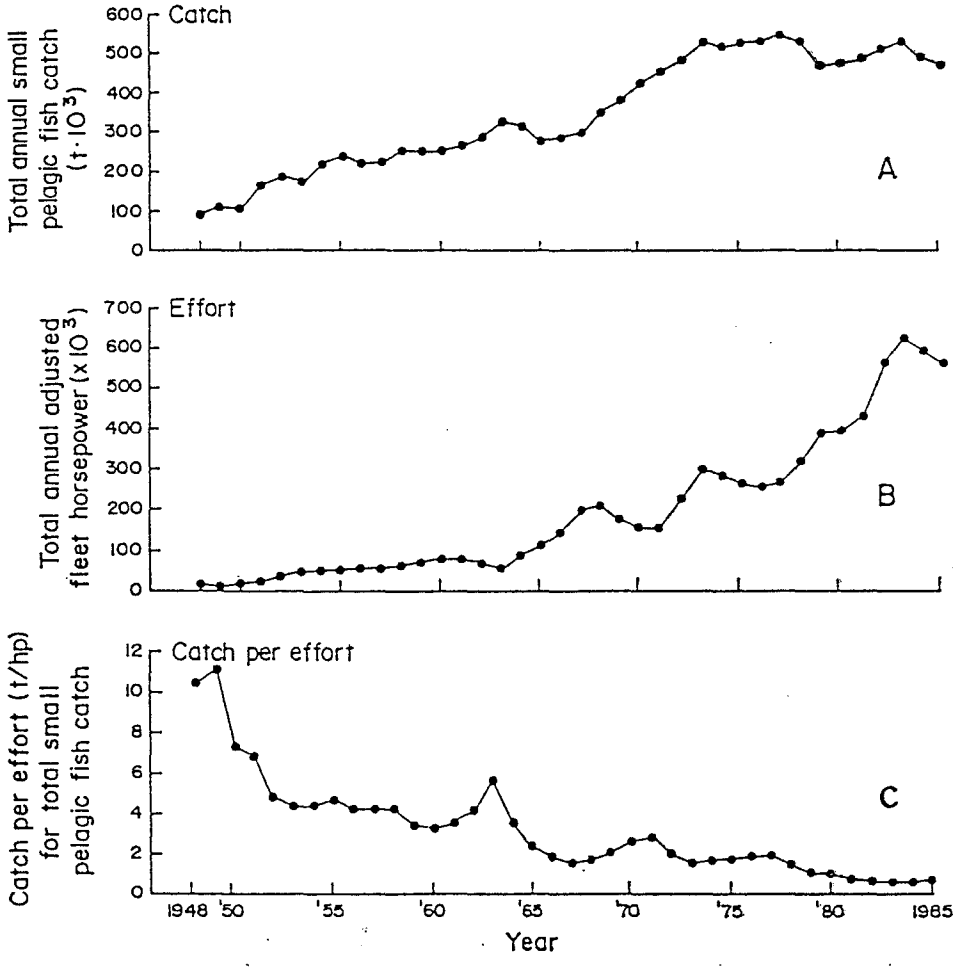


Fig. 1. Time series of (A) total small pelagic catch, (B) fishing effort and (C) catch per effort, 1948-1985 from the entire Philippines (from Dalzell et al 1987)

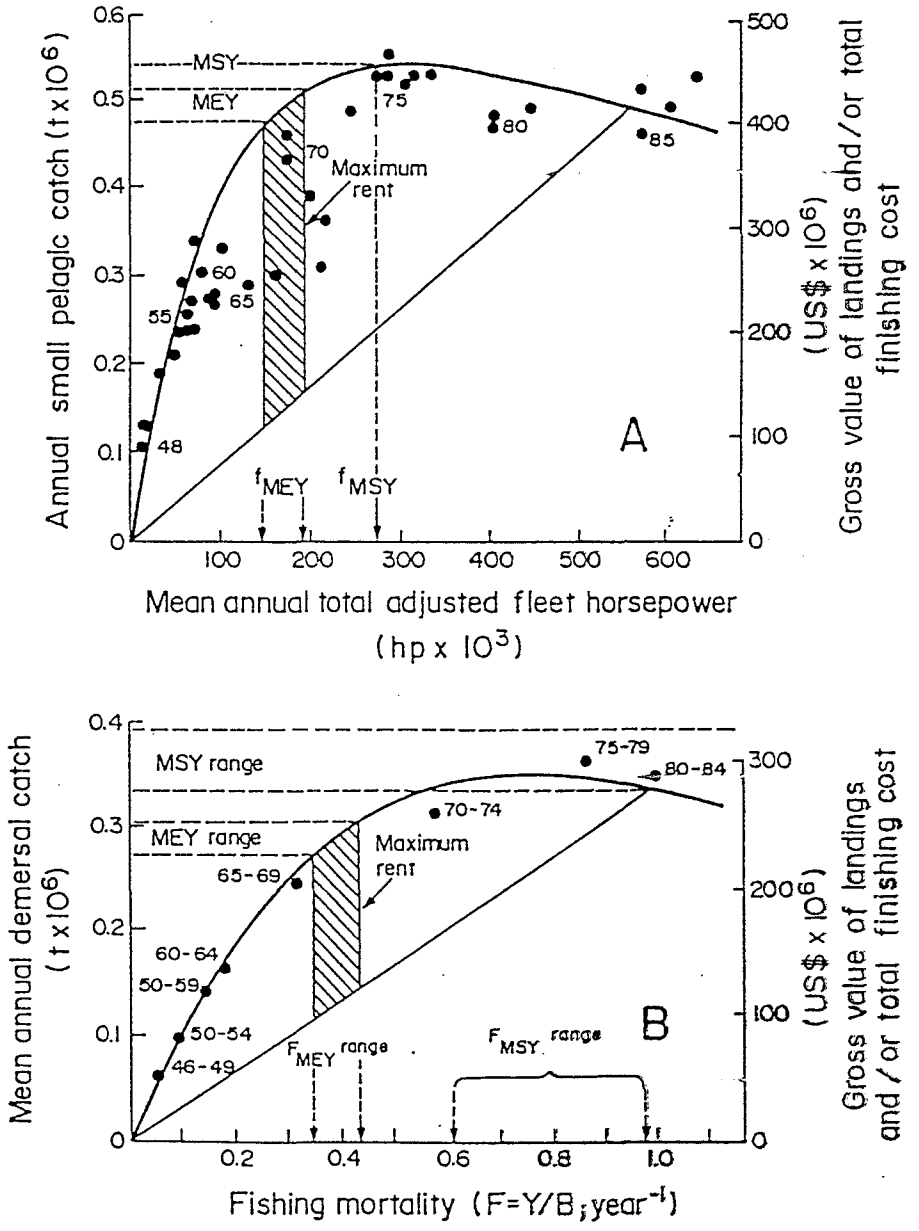


Fig. 2. Production models of the Philippine (A) pelagic and (B) demersal fisheries; both models provide rough estimates of total fishing costs and economic rent if the assumption is made that economic equilibrium occurred in the early 1980s (modified from Dalzell et. al. 1987 and Silvestre and Pauly 1986).

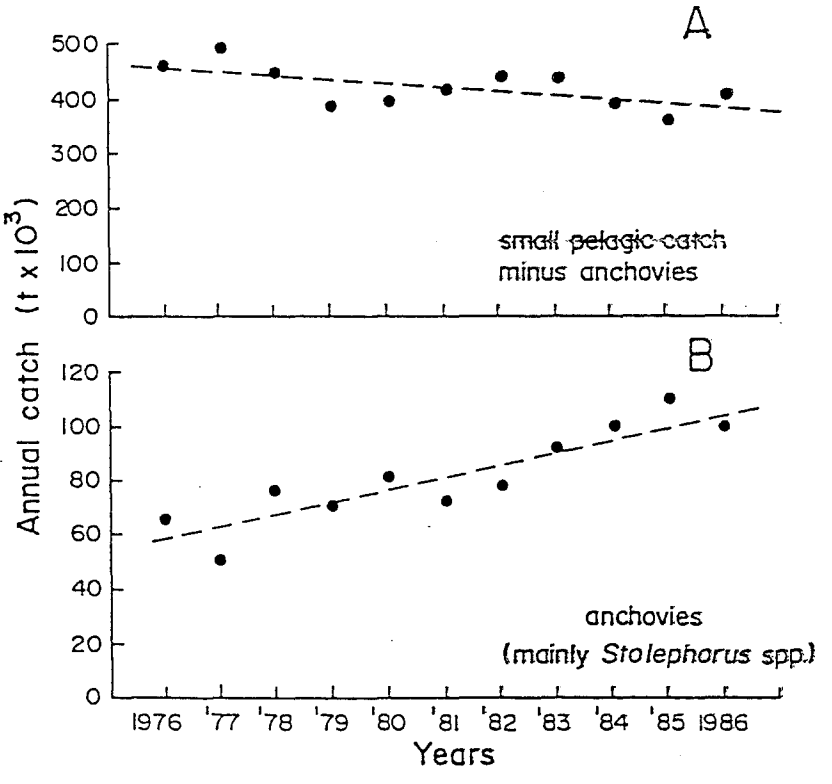


Fig. 3. Time series of Philippine small pelagics catches, showing partial replacement of sardines, carangids and mackerels (A) by anchovies (mainly *Stolephorus* spp.; B) (from Dalzell and Ganaden 1987)

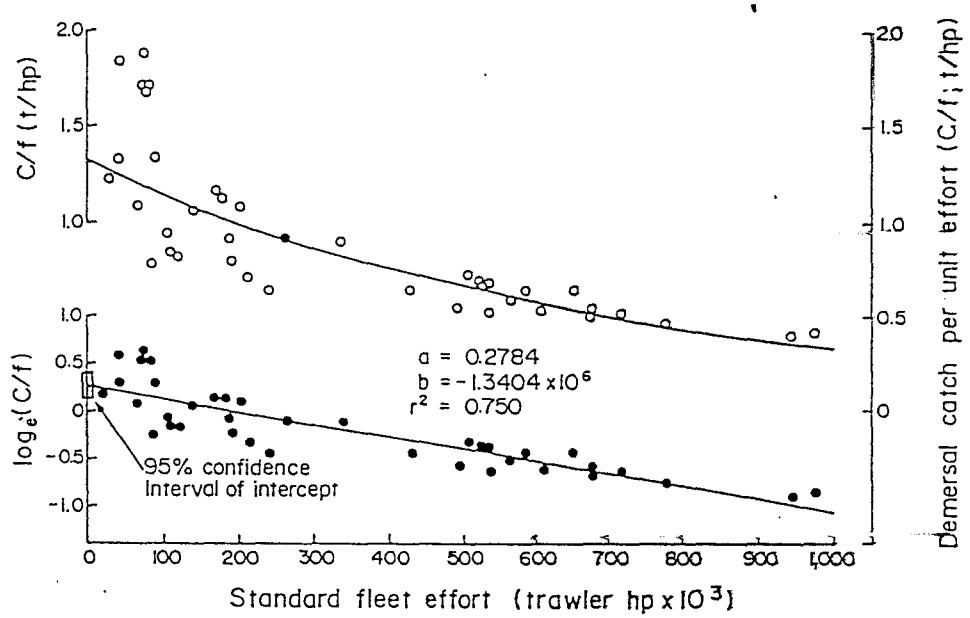


Fig. 4. Demersal catch per unit effort (C/f) and its natural logarithm plotted against standard fleet effort (f) on Philippine demersal resources for the period 1946-1984. Note the good fit of the $\log_e$ C/f vs. f relationship derived explaining 75% of the variance, and the greater scatter of points about the derived relationship for earlier years (i.e. lower f values).

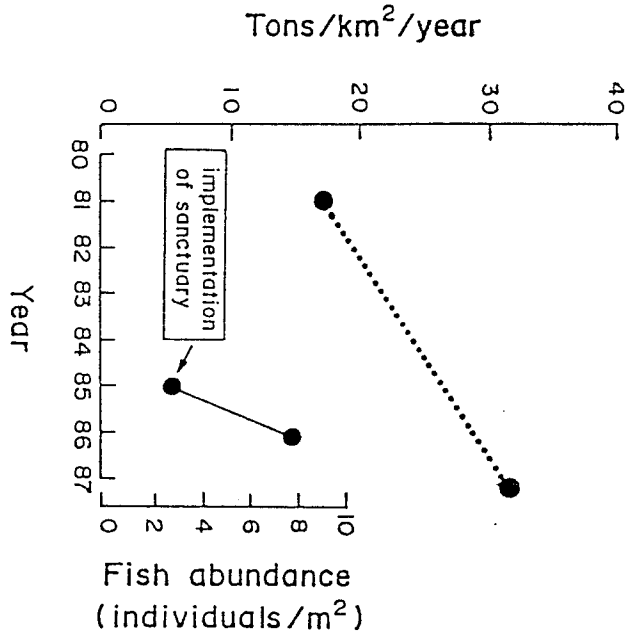


Fig. 5. Relative changes in fish yield and abundance in Apo Island, Negros, reflecting the effect of management (from White 1989)

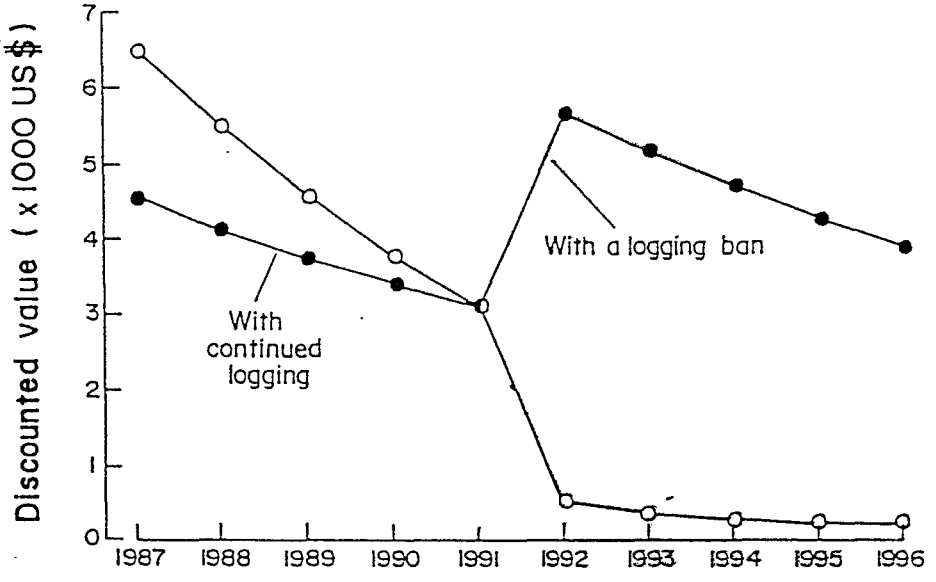


Fig. 6. Comparison of present value of economic benefits, discounted at 10% for 10 years, of two resource uses: logging *vs.* fishery/tourism in Bacuit Bay, Palawan (adapted from Hodgson and Dixon 1988)