

## Some Definitions of Overfishing Relevant to Coastal Zone Management in Southeast Asia

Coastal zone management (CZM), a multidisciplinary activity *par excellence*, involves branches of the natural and social sciences in which the concept of overfishing has no operational meaning. Thus, fishery biologists working alongside representatives of other disciplines are often hard-pressed to define this concept, which is of crucial importance to fishery management.

This essay is an attempt to define overfishing in terms less technical than those generally used by fishery biologists. I started from the classical definition, then quickly moved on to what I hope are concepts that may be more relevant to CZM.

Overfishing is a single process, but may be viewed as having five facets, of which three are recognized forms of overfishing. The first well-known form is *growth overfishing*, which what happens when fish are caught before they have time to grow. This form, which began to occur in some Northern European fishing grounds as early as the end of the last century has been solved in *theory* by the Russian scientist 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, 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).

Research work related to overfishing nowadays conducted in various research institutions throughout the world (including ICLARM) consists of estimating the ages, and 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 multi-species situation typical, e.g., Southeast Asian coastal trawl fisheries.

The second recognized form of overfishing is *recruitment overfishing* which

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refers to fishery-induced reductions of the number of young fish entering the fishing grounds. Recruitment 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 less than one in a thousand anchovy or shrimp larva 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 the Canadian scientist W.E. Ricker. These models found little application in the tropics, however. Rather, it is surplus-production ("Schaefer" or "Fox") models 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 (Fig. 1).

Fig. 1 also defines *economic overfishing* as a fishery at a level of effort higher than that which maximizes the economic rent, i.e., the differences between gross returns and fishing costs. Note that this optimum level is less than maximum sustainable yield (MSY) and that, therefore, maximum economic yield (MEY) is less than MSY (Fig. 1).

I have introduced in 1979 (ICLARM Newsl. 2(3): 3-4) the concept of ecosystem overfishing 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.

This process implies that a 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. Examples of ecological overfishing abound throughout the world, and research has been initiated at ICLARM on the dynamics of food webs in relation to ecosystem overfishing.

With this, the three aspects of overfishing that are focused on what

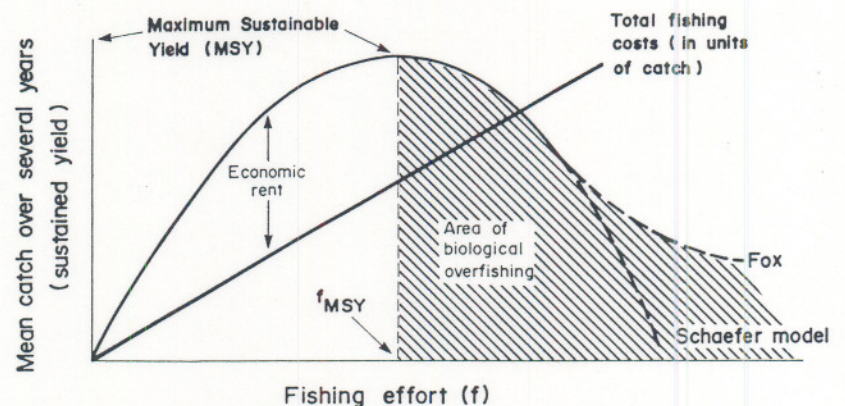
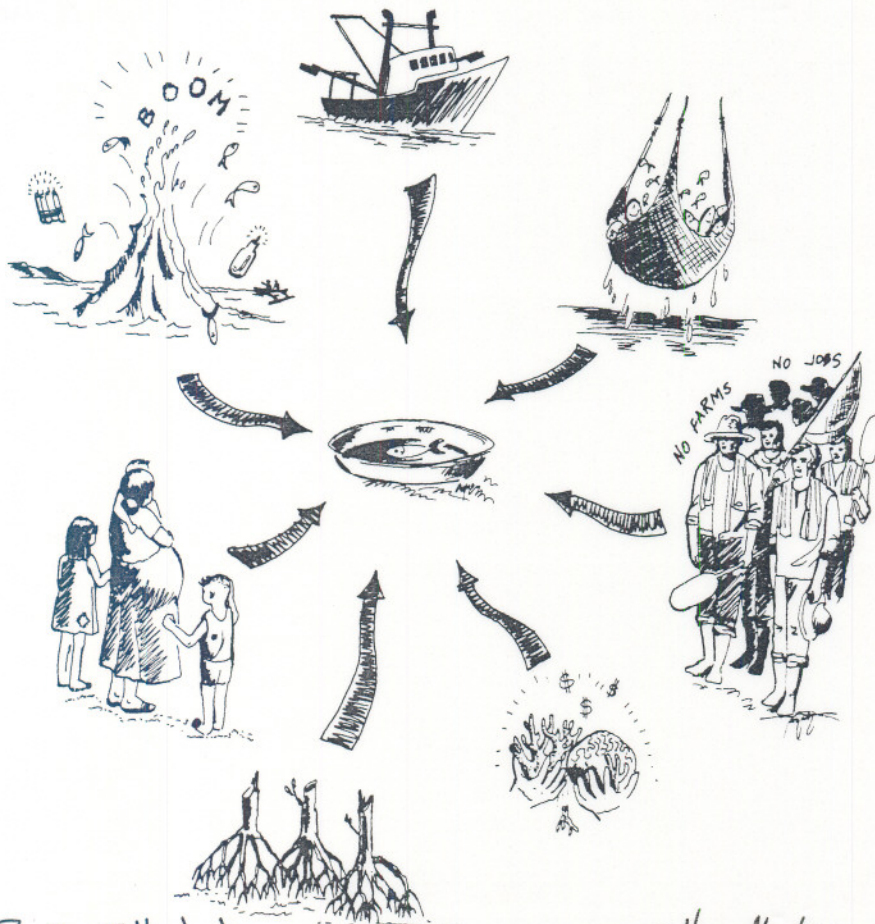


Fig. 1. Schematic representation of a surplus-production model defining biological overfishing (due to growth and recruitment overfishing) as any fishing at a level of  $f$  beyond  $f_{MSY}$ . (Schaefer and Fox type model differ only in shape of rightmost area.)





(1) use of gears and of 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 endanger the fisherfolks themselves.

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).

To put things bluntly: if I were a fisherman, with no alternative employment opportunities, and I had to feed my two children by blowing up a fishing ground, I certainly would do so.

Thus, what I'm saying here is that "Malthusian overfishing" being quite simply due to too many fishermen chasing too few fish can only be tackled by altering the fishermen/fish ratio. No clever mesh size regulations or motorization scheme, no strict enforcement or laments about dynamite fishing can replace such change.

On the short run, some palliatives may be found for this problem, however. Trawl bans, such as the one imposed in 1980 in Indonesia, illustrate one of these palliatives, i.e., increasing the number of fish available to small fishermen by eliminating their competitors.

This is not a long-term solution, however, because, as mentioned above, fisherfolk populations in Southeast Asia are likely to double in less than 20 years--especially in countries such as the Philippines and Indonesia--and the problem of declining income to reappear within far fewer years than this.

The solution is clearly alternative employment opportunities, in villages and towns and cities, for young and not so young, for literates and illiterates, and stabilization of populations. Without these? Forget about coral reefs and mangroves, and forget about having options for coastal resources management. □

Fig 2 Illustrating some of the causes and the effects of poverty among small scale fishers in the tropics. Area Management 2(3): 1-4.

happens to the resource species are covered. I may now turn to *Homo sapiens*.

Overfishing, at least as far as its first two forms are considered, is well-described in textbooks, and the suggested remedies usually involve a mix of management measures (e.g., 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. Usually they can, because the textbooks are written in and for developed countries in which most fishermen are 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.

How about small-scale fishermen in Southeast Asia? Usually they are poor, so poor that they, and particularly their families suffer from malnutrition (see Lingayen Gulf Profile, Tropical Coastal

By all scientific standards, there are too many small-scale fishermen in Southeast Asia. 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 of last resort.

I shall call the form of overfishing these fishermen produce "Malthusian overfishing," after the Reverend I.R. Malthus (1766-1834), the prophet of doom that would be so easy to refute if the real problems of humanity were tackled, rather than their ideological shadows.

**Malthusian overfishing** is thus what 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:

Fig 2 and