On Malthusian Overfishing

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We all think we know who the Reverend Thomas Robert Malthus (1766-1834) was: an obscure, long-refuted English cleric who was nasty enough to suggest that the poor of his time couldn't (and shouldn't) be helped because the "geometric" growth of their population would always outstrip the productive capacity of the resources available to them ...

Malthus' publications (see Further Reading) had in their time the effect of helping Charles Darwin and Alfred Wallace identify resource competition and hence selection as the key creative factors of evolution. This fact alone assures Malthus forever of a suite in the Pantheon of Science.

Moreover, it turns out that Malthus' work on human populations was essentially valid. I shall here briefly restate his key points, before turning to fisheries, and presenting the concept of "Malthusian overfishing".

The basic idea behind all of Malthus' writing is that *unchecked* population growth will, in the long run, outstrip food supply. This, he argued, results from

i) populations grow in "geometric" fashion (we now call this "exponentially"), i.e., by a constant fraction every year (e.g., 2.8%); this results in a characteristic doubling time (25 years in the case of 2.8% annual increase);

ii) the supply of food and other resources for human consumption cannot grow exponentially over a long period, and in the long run, it will, *at best*, grow in "arithmetic" fashion (e.g., a field producing 2 t of rice per hectare may be made to produce 4 t/ha the next year, 6 t/ha the next, etc. (i.e., the between-year increment remains constant, although it may be quite large).

Now, it can be shown that whatever the (positive) growth rate in (i) and the constant increment in (ii), *in the long run*, population size and the demand it generates will *always* exceed production (Fig. 1).

Nobody nowadays contests that unchecked human populations grow exponentially. Indeed, we are contemporary to some of the highest growth rates - of 4% per year in some countries - ever experienced in human history (see Further Reading).

Traditionally, Malthus' opponents have, however, disputed his "arithmetic" growth of food supply more than they have his "geometric" population growth. Their main argument has been that the application of science and technology to agriculture would enable food production to keep up with about any population increase. And indeed, since Malthus' days, global food production has kept up with an exponentially growing world population.

However, the manner this was achieved - through expansion of cultivated lands into marginal areas, overgrazing, massive inputs of fuel, fertilizers, pesticides and irrigation water, the loss of staggering amounts of fertile top soil - turns out to be nonsustainable (see C. Lightfoot's article, p. 9). Indeed, their cumulative impact has now begun to reduce the productive capacity of large tracts of the Earth, and to affect our global climate (see Further Reading).

These trends, obviously, are the reason for the present emphasis on the need to reduce human population growth rates throughout most of the world.

Thus, Malthus, then also ends up being vindicated: agricultural production cannot, in the long run, keep up with unchecked population growth.

How does this all relate to capture fisheries? Basically, the point here is that they, as food production systems relying on a natural resource (a wild stock of fish or aquatic invertebrates), can generate in the long term *at best* a *steady* yield, or a yield oscillating more or less strongly around some mean value (Fig. 2), once the rush following resource "development" is over.

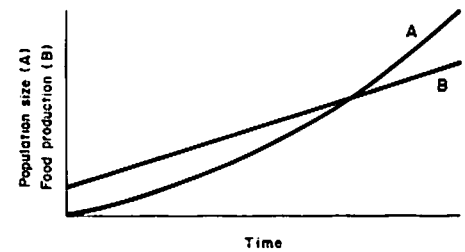

Fig. 1. Schematic representation of the basic mechanisms which, according to Malthus, would undermine per capita food supply of a human population with unchecked growth. A. The geometric growth of the population (i.e., the population increases by a constant *fraction* every year). B. The arithmetic growth of that population's food supply (i.e., agricultural production grows by a constant *amount* every year). Note that line A will *always* grow above line B, given sufficient time - whatever the initial conditions (population and growth rate in A, intercept and slope in B).

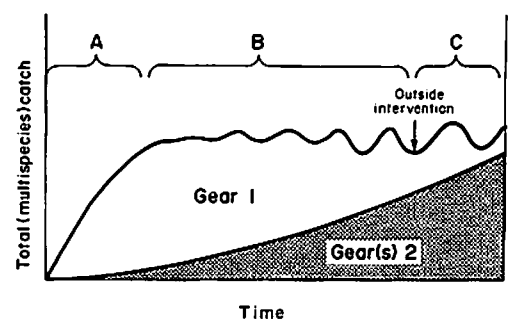

Fig. 2. Three phases in the development of single- or multispecies fisheries. A. "Development" of fishery, based on a given type of gear (1). B. Transfer of an increasing proportion of the total catch from gear 1 to gear 2, which may be more efficient, more capital intensive, subsidized, etc. Total catch is constant (massive changes in species and size composition are implicit) and indicates the reason for outside intervention (in C) when one sector of the fishery (using gear 1) turns to politicians for support. This model applies to competition between artisanal *vs.* modern, small *vs.* large, sports *vs.* commercial, *local vs.* foreign, subsidized *vs.* nonsubsidized (etc.) fisheries. More than two gears may be incorporated either in temporal succession, or simultaneously competing with each other.

And, if the pressure on the (unmanaged) resource becomes too strong, the oscillations will increase and the stock will collapse, or production will gradually decline - first in terms of valuable species, then in terms of the species that replaced the original stock. Thus, the peculiar aspect of fisheries - and its basic difference with agriculture - is that science and technology affect only the harvest/postharvest sectors, but do not influence the factors which determine the level of (natural) fish production. In terms of items (i) and (ii) above, this means:

iii) if per caput fish consumption is to be maintained, and human population grows exponentially, then fish harvests should increase exponentially; however

iv) production by natural stocks of fish tend in the long term to remain constant *at best*, and to decline in the majority of cases (usually because of overfishing, but also because of genetic deterioration brought about by removal of the most productive part of the stock - see R.S.V. Pullin's article, p. 5).

Because of the conflict between (iii) and (iv), fisheries should thus provide evidence of the effects of strong population growth predicted by Malthus, notably that of increasing human misery.

Some countries in which such evidence has been forthcoming are, e.g., the Philippines and India. Fig. 3 illustrates the reported trends in the number of fishermen in the Lingayen Gulf area of the Philippines, where the natural growth of fisherfolk communities has recently been exacerbated by the influx of landless poor. The effects of this massive increase are documented in several publications on Lingayen Gulf and others in the list of Further Reading. In very abbreviated form, they are: massive biological overfishing of the resource (growth, recruitment and ecosystem overfishing), economic overfishing and minimalization of incomes (now about US$30 per month for an average household of 6.1 persons), and regular use of destructive fishing methods such as explosives and chemical poisons.

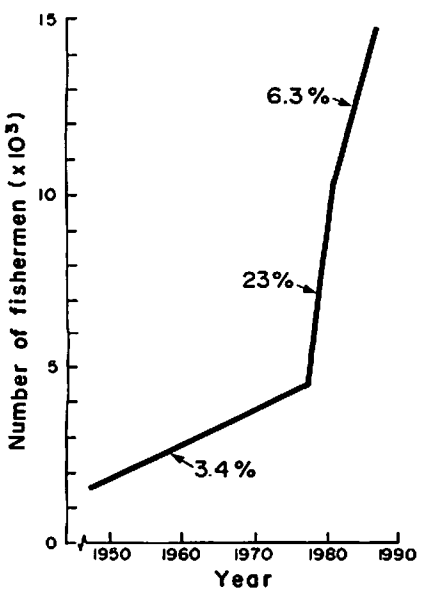

Fig. 3. Changes of the number of small-scale fishermen in the Lingayen Gulf area, Philippines, from 1950 to the early 1980s. (The computed % growth rates are annual.)

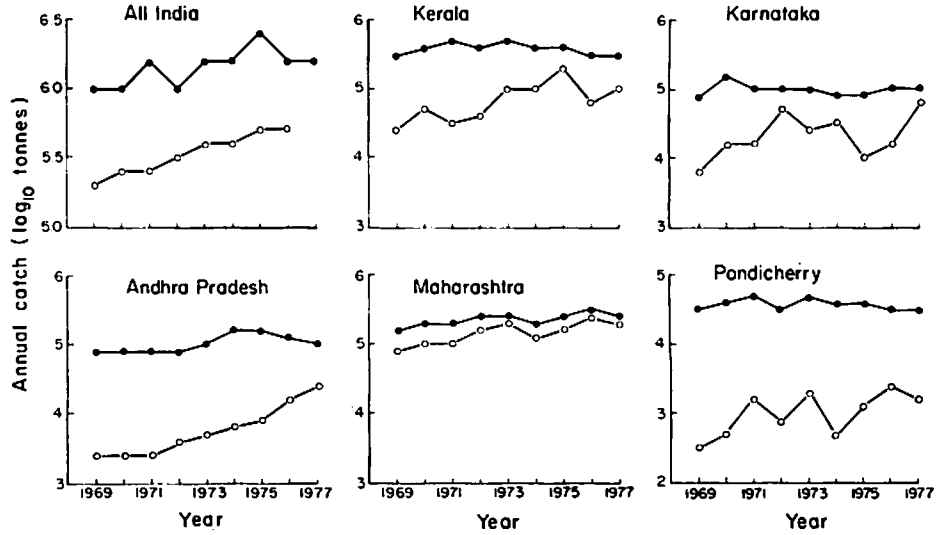

Fig. 4. Marine fisheries catch trends for the whole of India and five of its States, 1969-1977, showing overall stagnating catches (full dots), and the transfer of an increasingly larger fraction of the catch from artisanal fisherfolks to the "mechanized" sector (i.e., the large-scale, industrial sector; open dots). Adapted from data in Alagaraja, K. et al. 1982. Centr. Mar. Fish. Inst. Sp. Pub. 10, Cochin, India.

Fig. 4 illustrates trends of marine catches in India and five of its States. These trends show stagnating catches. This should result in a reduction of per capita catches of the growing number of artisanal fisherfolks even if the situation was not aggravated by the inroads of trawlers and other "mechanized" vessels (which, in case of "developed" resources, will not increase production, but only redistribute income).

Fig. 4 thus illustrates one of the factors which cause Malthusian overfishing (the overall ceiling on catches), as well as a factor that aggravates it (the entry into a small-scale fishery of powerful harvesting machines).

Malthusian overfishing is here to stay and make people's lives miserable until fishery resources systems cease to be perceived and used as dumps for "excess labor". The list of Further Reading indicates numerous reasonable ways this can be achieved. They all imply that Rev. Malthus was essentially right.

Further Reading

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