File: The Current State of Marine Fisheries
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[This document contains material developed in draft form for inclusion in the 3rd edition of the textbook, but not actually included in either 3rd or 4th editions.]

Chapter 17 Renewable resources
Additional Materials: The Current State of Marine Fisheries

Box 1. When is a fishery overfished?

Claims that marine resources are currently being, or have been, overfished are commonly made. But what constitutes 'overfishing'? To answer this, we need some reference point of 'optimal' fishing. Here we find some important differences of opinion.

An Economic Perspective
To an economist, optimal fishing is usually taken to mean 'efficient fishing'. That is, the level of fishing harvest (and the corresponding stock level) which maximises economic net benefits, looked at from a social point of view. This is the criterion used throughout most of this chapter, and was derived analytically for a private property fishery with enforceable property rights. An economist would define optimal fishing capacity as the cost-minimising level of effort required to attain that efficient harvest.

Biological Perspective
The economic notion of optimal fishing has had little practical impact (at least until recent years) on fishery authorities and regulators. Instead, optimal fishing has usually been defined by a particular *biological* criterion: Maximum Sustainable Yield (MSY). And, correspondingly, optimal fishing capacity has commonly been taken to be that level of fishing effort required to harvest the fishery's MSY.

As Figure 17.7 in the main text demonstrates, the economically efficient stock (or harvest) may be less than, equal to, or greater than the biologically optimal stock (or harvest). Whether the tangency point between G(S) and $\{i + (\partial C/\partial S)/P\}$ lies to the left or right of S_{MSY} evidently depends on the interest rate, market price of fish, and parameters of the fishery production function.

When is a fishery overfished?
The answer to this question will obviously depend on whether one takes a biological or economic view of 'optimal' fishing. Most discussions about overfishing by international agencies (such as the United Nations FAO) and by national and regional regulatory agencies in fact use a biological criterion.

If we were, for the sake or argument, to take MSY as a criterion of optimal fishing, then we can get some insight into whether a fishery is overfished by looking again at Figure 17.2 in the main text. We can think about this diagram in terms of various stock categories:

- When stock is at $S = S_{MAX}$, the fishery is unexploited (and in effect has been for some considerable span of recent time).
- When stock is above S_{MSY} (but below S_{MAX}) the fishery could be described as being in a developmental phase. Specifically, we might say that the fishery is ‘under exploited’ if stocks are close to S_{MAX} so that the fishery is capable of producing a great deal more under increased fishing pressure, or as ‘moderately exploited’ if S is closer to S_{MSY} so that the fishery is capable of producing some more under increased fishing pressure.
- When S is in the (close) neighbourhood of S_{MSY} the fishery is ‘fully exploited’ (and the fishery is producing close to its MSY).
- When S is less than S_{MSY} we might choose to apply one of three labels depending on how much lower is S than S_{MSY} **and** in which direction the fishery is moving:
    1. The fishery is ‘overfished’: stocks at lower level than S_{MSY}; and the catches in recent years have been showing a downward trend (so current catches less than recent historical high).
    2. The fishery is ‘depleted’ – a more extreme version of ‘overfished’ in which stocks are very far below S_{MSY}.
    3. A ‘recovering’ fishery is one in which stocks are very low relative to historical maximum levels, but in which harvest levels are trending upwards (the fishery is moving from left to right towards S_{MSY} in terms of Figure 17.2).

In fact, the notation we have just used is that currently employed by the FAO and by most policy-related discussions of fishery. The reader should note that these terms would not, in general, be appropriate from an economics perspective. However, it is not difficult to see why they are attractive to policy makers. This form of classification has low information requirements, as it does not require any knowledge of economic parameters (prices, costs, fishery production function parameters). Indeed, at a pinch all that is required are time series data on harvests. To see this, note that given a sufficiently long run of harvest data alone, the current position of any fishery could be ascribed with a reasonable degree of confidence to the appropriate one of the categories just listed.

END OF BOX 17.1

1.1 The current state of marine fisheries

Information about marine fisheries globally has been collected by the FAO since 1970, and published regularly since then in the publication *The State of World Fishery Resources, Marine Fisheries*. Much of this data is now publicly available; sources are provided in the *Further Reading* at the end of chapter 17.

Working at the highest level of aggregation, we might begin by asking what is the uppermost limit to the global fish catch, and where we are now relative to that. A commonly quoted answer to the first part of this question is that provided by Gullard (1971) who estimated the global sustainable yield upper limit to be 100 million tonnes per annum. Figures for the global fisheries catch per annum over a long time span until the present are shown in Figure 17.1 (in the file *Statepictures.ppt*). Global annual production of marine fisheries is estimated to have increased from 19 million tonnes in 1950 to about 80 million tonnes in the mid-1980s. If these figures are trustworthy, there does not appear to be much scope left for sustained fisheries expansion globally.

Insert Figure 17.1 near here. (See the pictures file "Statepictures.ppt").
Caption: Trends in global marine fisheries production.
Source: Garcia and de Leiva Moreno (2001), page 5.

Figure 17.2 shows an estimate by Garcia and de Leiva Moreno (2001) of the proportions of total fisheries in each of the states classed in Box 17.5. Trends in these proportions are shown – in summary form - in Figure 17.3. Since 1974 the proportion of fully or moderately exploited stocks has decreased steadily from 95% to just over 70%; the proportion of overexploited, depleted or recovering stocks has increased from about 10% in the mid-1970s to nearly to 30% in the late 1990s.

Insert near here Figure 17.2 (See the pictures file "Statepictures.ppt").
Caption: State of world stocks in 1999.
Source: Garcia and de Leiva Moreno (2001), page 4.

Insert near here Figure 17.3 (See the pictures file "Statepictures.ppt").
Caption: Global Trends in the state of world stocks since 1974.
Source: Garcia and de Leiva Moreno (2001), page 5.

17.13.1 Are global fisheries in a good or bad state?

If we continue to work with a largely biological criterion of the state of a fishery, then it would be reasonable to conclude from Figure 17.2 that 25% of fisheries are in a good state (the top two categories) and 28% are in a poor state (the bottom three categories). This begs the question of how we should treat the 47% classed as Fully Fished. This is a moot point, and one which has profound implications for the conclusion one reaches about the state of marine fisheries, and for public policy towards fisheries.

A conventional view of fisheries management is that the stock which corresponds to MSY is a appropriate *policy target*. This view is reflected, for example, in the United Nations Conference on the Law of the Seas, which espouses the objective of managing stocks at or above the MSY level of abundance. Using this criterion, Figure 2 suggests that 72% of the stocks are in a good state.

More recently, these statistics have been interpreted rather differently. This has coincided with the interest in the use of Sustainability Indicators, and the Precautionary Principle and Safe Minimum Standard of Conservation concepts. In this case, S_{MSY} is regarded as an appropriate *limit or threshold*. Stocks which are currently exploited near to S_{MSY} are potentially endangered by future harvesting behaviour. This changes the way in which the 'fully fished' category is treated, and implies that 75% of fishery stocks are in a poor state.

Such assessments are of course crude, and need much qualification. We have already mentioned in this chapter that an economic appraisal would very often yield entirely different estimates of appropriate targets (or limits) to that of S_{MSY}. Ideally, an assessment would also include qualitative information (rather than data of catch or stock quantities alone). This would include such considerations as spawning stock biomass, magnitude of by-catch and discards, and the species composition and age structures of catches and marine stocks. Most current assessments of the state of marine fisheries worsen when these factors are taken into account.

Box 17.2 Overcapacity in fishing fleets and fishery profitability

FAO data suggests that the tonnage of the world fleet has almost doubled between 1970 and 1999 (from 13.5 to 25 million tons) increasing nominal fishing capacity at about 3% per year. However, a more appropriate measure would be effective fishing capacity, taking account of technological progress. Garcia and de Leiva Moreno (2001) construct such an index and suggest that with a correcting factor being applied the increase in fishing capacity appears to be from 9 to 40 million tons, at about 12% per year.

This average rate of increase of effective fishing capacity is at the very least worrying, not only because it outstrips the growth of catches but also as it suggests that fishing effort may be highly cost-inefficient. [1] Previous editions of this textbook reported evidence (for example, Huppert, 1990; FAO, 1992, and WR, 1994) which suggested that, taken as a whole, the costs of the global fishing fleet exceeded its revenues by a substantial amount. This appraisal was supported by estimates made by the Food and Agriculture Organisation (FAO) of the United Nations during the early 1990's (see FAO, 2002).

However, this assessment did not fit well with the observed evidence that most individual fisheries were commercially viable, a fact confirmed by detailed regional studies undertaken by the FAO during the period 1995-97, and by the EC (for individual European countries). The only cases of loss-making fisheries appeared to be at extreme ends of the size scale: small scale gill netting, and large industrial deep-sea trawling. Losses in the former case appear to be due to an inability to compete with technologically superior capture techniques (such as purse seiners and coastal trawlers). In the latter case, losses are attributable to excess fishing capacity and the associated high operational and capital costs per unit of harvested fish. Also of importance here is that a substantial part of deep sea trawling occurs outside national territorial limits, and so is less heavily regulated. It is these kinds of fisheries that most closely resemble the pure open access fishery model examined in this chapter.

It is interesting to note that many of the commercially most profitable fisheries are found in developing rather than industrialised countries. This is explained, at least to some degree by three sets of conditions that relatively favour developing countries: lower operational and labour costs; lower capital costs (because of the use of older vessels, many of which are sold at very low costs to developing countries from the surplus fleets of the industrialised nations); and less overfished marine resources.

Two factors go some way to account for the apparent paradox that the global fleet as a whole is loss-making while individual fisheries are typically commercial. First, global estimates include both active and non-active vessels in cost calculations, whereas individual fishery studies include only active vessels. This is thought to account for much of the difference. Second, the global estimates do not include subsidies and other transfers to fisheries, while the individual fishery studies do. Data on subsidy payments suggests that these transfers are often extremely large, with the result that true economic loss making firms are able to achieve financial viability.

Thus, our conclusion in previous editions – that there is chronic overcapitalisation in the fishing industry, with far more fishing capacity available than is necessary to catch at current levels, as a result of which the industry is massively inefficient – might still be valid. Latest evidence does confirm this for several fisheries, including deep sea trawling fisheries (as noted above) and long-line fleets exploiting tuna in temperate waters, in which excess capacity is estimated to be in the order of 20 to 30% (FAO, 10/05/2002).

We also noted in previous editions a linkage between overcapacity and subsidy payments that remains valid. Overcapacity is partly a result of responses to fluctuations in fish populations. As fish stocks rise, perhaps as a result of unusually beneficial environmental conditions, the industry installs new capital, often with government support. Subsequently, as stocks fall, either because of natural changes in environments or because of excessive harvesting, the industry is left heavily overcapitalised. Normal market mechanisms, driving firms out of loss-making industries, commonly work slowly or not at all, as government protective subsidies are introduced to maintain employment in areas where fishing activity is heavily concentrated. This linkage is likely to be weakened to the extent that international pressures against the use of subsidies for protection of 'national-favourites' intensifies.

End of Box 17.2

Endnotes:

[1] It should be noted, however, that the global fleet capacity appears to have been relatively constant during the last decade, suggesting that the trend has been broken. Note also that technology improvements do have important, positive effects too. Not only can fish be caught at lower real effort but technology change has also improved catch preservation and quality. It also improves the potential effectiveness of Monitoring, Control and Surveillance (MCS) measures.