# Factors affecting recent developments in tuna longline fishing capacity and possible options for management of longline capacity

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## ABSTRACT

A study of the changes that have affected the fishing capacity of large longline vessels since the second Meeting of the Technical Advisory Committee of the FAO Project on the "Management of Fishing Capacity: Conservation and Socio-economics" in 2004 has been conducted. The numbers of large longliners, their total fishing capacity and their catches appear to be declining. This decline is due to scarcity of fish, scrapping of vessels to comply with government regulations and industry agreements and economic factors (increasing prices for fuel, decreasing prices for fish and competition with small longliners and with purse seiners). The recommendations made at the second meeting of the Technical Advisory Committee should be implemented for all the fleets. Particular concern is expressed regarding small longliners and purse seiners, for which the fishing capacities seem to have been increasing during recent years.

## 1. INTRODUCTION

At the second Meeting of the Technical Advisory Committee of the FAO Project on the "Management of Fishing Capacity: Conservation and Socio-economics" (held in Madrid on 15-18 March 2004) it was proposed that a Workshop be held to develop quantitative methods to determine the desired magnitude of or the desired change to fishing capacity on the basis of the status of stocks. This proposal was adopted, and the Workshop was held in La Jolla, California, USA, on 8-12 May 2006. The objectives of the Workshop were:

A. to develop quantitative methods to determine the desired magnitude of or desired change to fishing capacity on the basis of the status of stocks, taking into account the multi-species and multi-gear nature of tuna fisheries;
B. to determine the feasibility of (1) routinely collecting input data for Data Envelopment Analysis (DEA) and (2) performing industry surveys of tuna fishing capacity utilization;
C. to relate DEA estimates of fishing capacity utilization to traditional estimates of fishing capacity;
D. to review the factors affecting fishing capacity (numbers of vessels, their physical characteristics, *etc.*) that could be regulated by fisheries authorities;
E. to review the existing measures for managing tuna fishing capacity, and possibly, to identify additional options for such measures in the context of the outcome of addressing Objectives A to D;

F. to prepare a Statement of the participants in the Workshop;
G. to formulate recommendations of the Workshop to the FAO Project on the Management of Tuna Fishing Capacity, FAO and other organizations participating in the Workshop.

This paper is an update of a paper (Miyake, 2005a) submitted to the second FAO Technical Advisory Committee meeting on tuna fishing capacity. At that meeting it was concluded that the available longline data were not adequate for conducting DEA analyses. It was agreed, however, that the fishing capacity of the existing longliners more than 24 m in overall length (LOA) was more than adequate for catching the amounts of large tunas available at levels corresponding to their maximum sustainable yields (MSYs). Their economic breakeven point was actually higher than their average revenue, so the typical vessel was operating at a loss.

The trends in numbers of longline vessels, size compositions of the vessels, methods of operating, availability of fish and socio-economic elements that might have affected longline fishing capacity are reviewed in this paper.

## 2. DEFINITION OF LARGE LONGLINERS

At the second meeting of the Technical Advisory Committee it was recommended that "large longline" be applied to all longline vessels with the capability of freezing their catches. However, (Miyake, 2005a) had defined large longliners as vessels greater than 24 m in LOA that direct their effort at the principal market species, other than skipjack, of tunas (yellowfin, bigeye, albacore and the three species of bluefin) with freezing facilities (mostly super freezing) that sell their products for consumption as fresh fish *e.g.* sashimi or steaks. Swordfish longliners direct their effort at swordfish, usually using gear that fishes closer to the surface, and fish mostly at night.

It should be noted that most of the Regional Fisheries Management Organizations (RFMOs) have adopted "positive list" systems, which require registration of vessels more than 24 m in LOA, and some measures that adversely affect vessels that are not on the positive lists have been adopted, *e.g.* their catches cannot legally be traded internationally.

The previous report (Miyake, 2005a) concentrated on large longliners (those more than 24 m in LOA) because little information is available on small longliners. However, the numbers of small longliners and their catches have been increasing rapidly. Therefore, a section on small longline vessels is included in this report.

## 3. EFFORTS TO MANAGE THE TOTAL FISHING CAPACITY OF LARGE LONGLINE VESSELS BY GOVERNMENTS AND INDUSTRY, AND THEIR EFFECT ON THE FISHING CAPACITY OF THE WORLD FLEET

Information on efforts by various governments and by industry to control the numbers of large longline vessels is given by Miyake (2005a). The numbers of large longliners have been controlled by the limited-entry systems of most of the countries with major longline fleets for many years. In addition, following to the FAO International Plan of Action on fishing capacity, Japan and the Taiwan Province of China (TPC) have called back flag-of-convenience vessels (vessels owned by citizens of those countries, but registered in other countries) and scrapped many of them. The Organization for Promoting Responsible Tuna Fishing (OPRT) was established for this purpose.

The members of the OPRT register their large longline vessels with that organization every March; the numbers registered each year with the OPRT are shown in Table 1. The numbers in the shaded cells are estimates by the author of this report for the countries were not yet members of the OPRT. In 2005, almost all large tuna longline vessels were included in this list, the exceptions being a few (probably less than 30) vessels engaged in "illegal, unreported and unregulated" (IUU) fishing.

TABLE 1
**Numbers of large longliners registered on positive lists of RFMOs**

| | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|
| Japan | 494 | 490 | 495 | 473 | 434 |
| Taiwan Province of China | 567 | 562 | 599 | 597 | 600 |
| Republic of Korea | 183 | 183 | 176 | 174 | 172 |
| Philippines | 6 | 6 | 17 | 17 | 18 |
| Indonesia | - | - | 14 | 14 | 14 |
| China | 98 | 100 | 105 | 105 | 113 |
| Ecuador | - | - | - | 5 | 5 |
| Vanuatu-Seychelles | - | - | - | 69 | 69 |
| Total | 1 348 | 1 341 | 1 406 | 1 454 | 1 425 |

The shaded cells indicate years in which the countries were not members of the OPRT (source: OPRT).

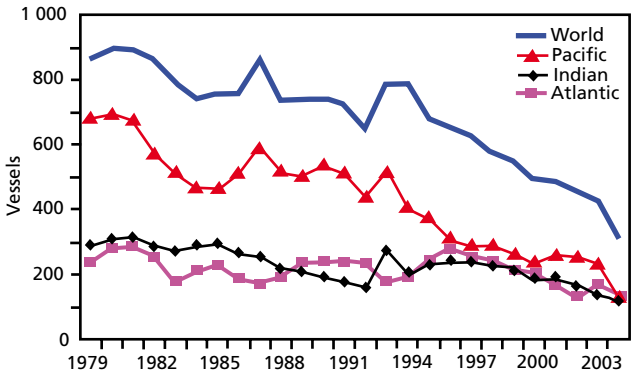
The total number of longliners included in the Table 1 increased from 2002 to 2004, but this does not mean that newly-built vessels entered the fishery. Rather, it indicates that many IUU vessels changed their registration to countries that were members of the OPRT, and therefore, were no longer IUU vessels.

With the exception of vessels registered in European and Western Hemisphere countries, almost all countries in which large longliners are registered are members of the OPRT. It should be noted that most of the large longliners of European and Western Hemisphere countries direct their effort towards swordfish, though some tunas are taken as bycatches by these vessels. Therefore, the current number of vessels in the OPRT list corresponds approximately to number of large tuna longliners in existence. The only exception is the IUU fleet, which has been reduced significantly, probably to less than 30 vessels at present. Miyake (2005a) estimated that there were 1,615 large tuna longliners in 2003, including IUU vessels, so it can be safely concluded that the total number of large longliners has been declining during the last few years.

It should be borne in mind that not all the registered and licensed vessels are actually engaged in fishing. The numbers of Japanese longliners engaged in tuna fishing in each year, estimated from logbook records provided by the National Research Institute of Far Seas Fisheries (NRIFSF), Fisheries Research Agency of Japan are shown in Figure 1.The procedures of estimation are described by Miyake (2005a). The numbers of vessels that fished in each ocean were counted independently. However, some vessels fished in more than one ocean during the same year, so duplications were eliminated to obtain the world totals. The data for 2004 are not complete, because information for some of the vessels has not yet reached the NRIFSF.

It is clear from Figure 1 that the number of active Japanese longliners has been declining steadily since 1994. This tendency is not necessarily indicative of what has taken place in other longline fleets. Unfortunately, information on the numbers of active vessels could not be obtained for the fleets of any other countries. It can be seen that numbers of vessels registered in the TPC actually increased, which is due, as pointed out previously, to registration of called-back IUU vessels in the TPC. However, the TPC declared that it would scrap 56 longliners in 2005 and 104 more in 2006. The Korean longline fleet has also been slightly reduced.

FIGURE 1
**Numbers of active Japanese longliners, by ocean**




Double-counting was eliminated in calculating the world totals.

## 4. TUNA RESOURCES AVAILABLE FOR LARGE LONGLINERS

### 4.1 Large longliners vs. small longliners

Most tuna stocks are exploited by more than one fishing gear (*e.g.* longlines and purse seines), which compete with one another for fish, so it unrealistic to attempt to estimate the sustainable quantities of the various species that are available to the longline fishery.

Miyake (2005a) estimated that the 2001 catch of tunas by large longliners was roughly 390 thousand tonnes. A more detailed analysis was conducted for the present report. The longline catches of albacore, bigeye, yellowfin and the three species of bluefin in the three oceans were tabulated by species, oceans and countries in which they were registered. Using his knowledge of the fisheries, the author divided the data in each species-ocean-flag stratum into the catches of large longliners, small longliners and longliners that direct their effort towards swordfish. Those separated catches, summed for longline types for each ocean, form the basis for Figures 2, 3, 4 and 5. The data for 2005 are very incomplete.

FIGURE 2
**Catches by large, small and swordfish longliners in the Pacific Ocean**

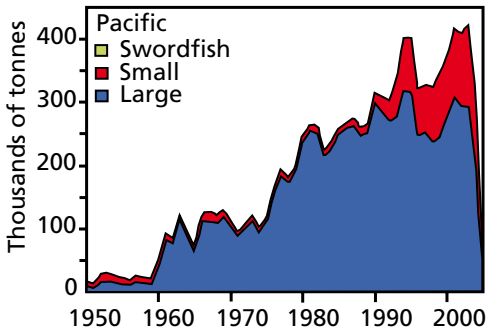



FIGURE 3
**Catches by large, small and swordfish longliners in the Indian Ocean**

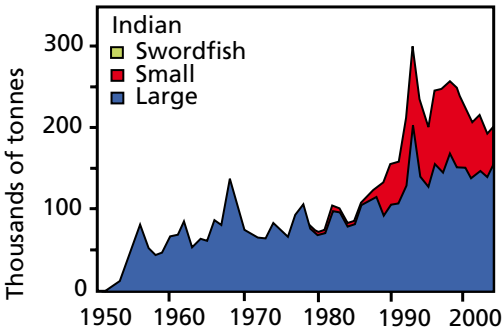
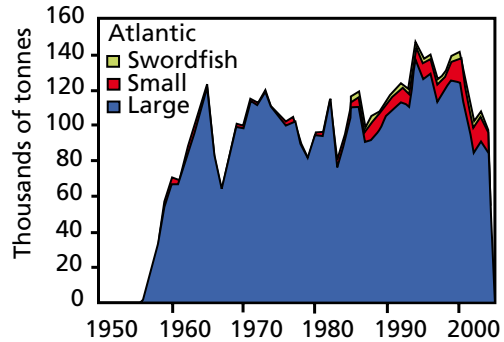



FIGURE 4
**Catches by large, small and swordfish longliners in the Atlantic Ocean**




It can be seen in Figure 5 that the longline catch increased sharply from about 100 thousand tonnes in 1959 to about 300 thousand tonnes in 1960, and thereafter gradually increased to about 500 thousand tonnes by the late 1980s. Another rapid increase, to about 800 thousand tonnes, took place during the early 1990s, but then the catches stabilized again. The catch by large longliners has been stable at about 500 thousand tonnes since 1990, and the increase during the 1990s is all attributable to increased catches by small longliners. This is particularly evident for the Indian and Pacific Oceans; the catches by small longliners in the Atlantic Ocean are still relatively small.

It should be borne in mind that the apparent increases in the catches by small longliners might be partly the result of improvements in the collection of statistics. The Indian Ocean Tuna Commission and the governments of some countries, *e.g.* Australia and Japan, have been aiding in the collection of data from coastal fisheries, particularly those involving small longliners. These improvements are mostly for the Indian Ocean and the western and central Pacific Ocean. However, it is not known how much of the increase is due to increased catches and how much to improved catch statistics.

In conclusion, from the mid 1980s to 2004, the catch of tunas by large longliners was stable at about 500 thousand tonnes. The catch by the small longliners increased from the mid-1980s to the mid-1990s. The catch of small

longliners has been stable at about 200 thousand tonnes during recent years. These are probably close to the upper limits for the tunas (not including swordfish) available for longliners for the fresh fish or sashimi markets, under current conditions.

## 4.2 Competition among fishing gears other than longlines

### *4.2.1 Reduced catch rates*

In general, the catch rates of the major species of tunas by longline vessels have been declining in many parts of the world due to excessive fishing effort, which has led to lesser abundance of the fish. The situation for bigeye tuna in the Atlantic Ocean, for which the catch rates declined from the late 1960s to the early 2000s (Figure 6) is typical. In this case, it was recognized that the stock has been fished down to a level close to or slightly less than that corresponding to the MSY.

### *4.2.2 Longline and purse-seine catches*

In multi-gear fisheries, such as those for tunas, the reduction of a stock is often associated with activities of other gear, such as purse-seine gear, that can take large amounts of juvenile fish. The catches of tunas by purse seiners have increased rapidly since the early 1980s (Figure 7), and a large part of this increase has been due to increased used of fish-aggregating devices (FADs), which catch fish that are smaller, for the most part, than fish in free-swimming schools and fish that are associated with marine mammals. Purse seiners that fish on schools of fish associated with FADs catch mainly skipjack tuna, which are seldom caught on longline gear, but they also catch bigeye, the mainstay of the longline fishery, and yellowfin. When large amounts of juvenile fish of a species are caught, the overall yield per recruit and MSY of that species are reduced. The catches by longliners are reduced much more than those of purse seiners; in fact, those of purse seiners may not be reduced at all.

FIGURE 5
**Catches by large, small and swordfish longliners in the world oceans**

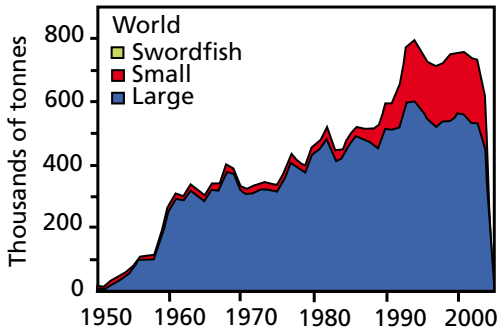



FIGURE 6
**Standardized longline catch per unit of effort of bigeye tuna in the Atlantic Ocean (after SCRS, 2004; BET-Figures 4)**

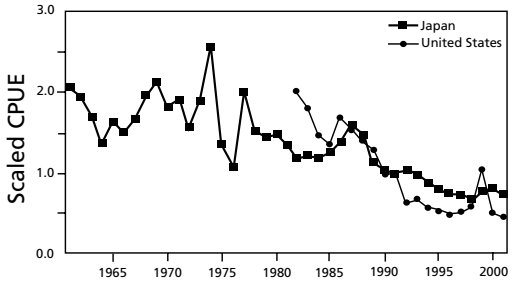
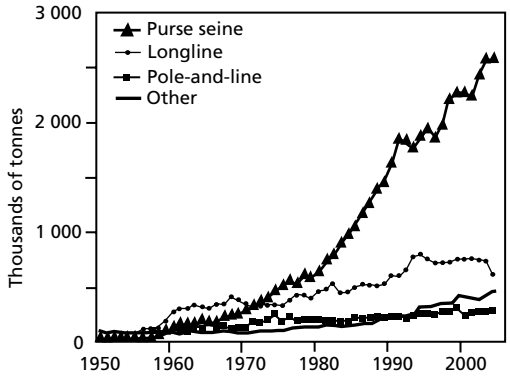


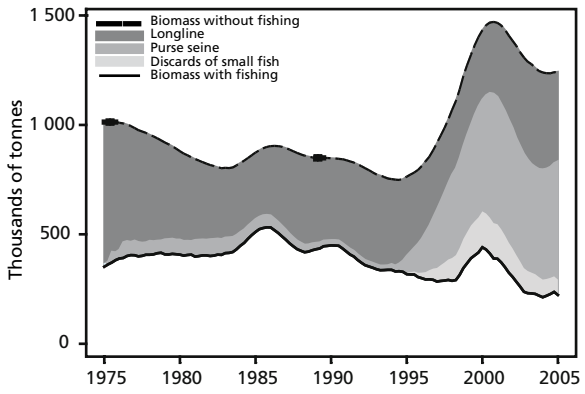

FIGURE 7
**World catches of the principal market species of tunas, by gear**




### *4.2.3 Effects of purse seine catches on the availability of fish to longline gear*

The estimated effects (Maunder and Hoyle, 2006: Figure 4.12) of the purse-seine and longline fisheries on bigeye tuna in the EPO are shown in Figure 8. The small fish discarded at sea were all caught by purse seiners. It is clear that the increased catches of bigeye by purse seiners beginning during the early to mid-1990s were coincident with the decreased biomass of bigeye and the decreased catches of that species by longliners. Maunder and Hoyle (2006) attributed the decreases in biomass and longline catches to

FIGURE 8
**Effects of catches of various gears on the biomass of bigeye tuna in the eastern Pacific Ocean (after Maunder and Hoyle, 2006: Figure 4.12)**




the increased catches of bigeye, nearly all juveniles, by purse seiners.

#### *4.2.4 Conclusion*

In conclusion, the amounts of some species of tuna available for longliners have been reduced, and are possibly still decreasing, due to the increased catches of small individuals by purse seiners. It is obvious, therefore, that reduction in longline fishing capacity alone will not increase the abundance of large tunas. There must also be a reduction in the fishing capacities of other gears, particularly of purse seiners, that catch smaller tunas. Reduction of the purse-seine fishing capacity would increase the amounts of bigeye and yellowfin available to the longline fishery, and probably increase the yields per recruit for those species as well.

## 5. FACTORS OTHER THAN CAPACITY MANAGEMENT MEASURES BY GOVERNMENTS AND INDUSTRY AFFECTING LONGLINE FISHING CAPACITY

### 5.1 Technological improvements

The major technological improvements in longline fishing up to 2004 are discussed by Miyake (2005b). Since that report was written, there have been some changes in the gear used aboard large longliners and in the methods of fishing. Until very recently, the mainline was set and retrieved once each day, but now a few vessels operating in the Indian Ocean and the western Pacific Ocean are using a shorter mainline, but setting and retrieving it twice a day. The effect of the new type of operation on efficiency is not well investigated or documented, but if it proves to be more effective than setting and retrieving a longer mainline once a day it is likely that it will be adopted by many more vessels. If that is the case, the fishing capacity would increase while the fleet size remained the same.

Technological changes may be introduced to protect non-target species, rather that to increase the catches of target species. Specifically, there is evidence that the use of circle hooks, rather than J hooks, reduces the bycatches of sea turtles and the severity of the injuries inflicted on the sea turtles that are caught (Watson *et al.* 2005). Many experiments are being conducted to determine the relative efficiencies of J hooks and circle hooks to determine their relative efficiencies for fish of various species and sizes in various conditions, but it is too early to evaluate the effects of changing from J hooks to circle hooks on fishing capacity.

### 5.2 Economic factors

#### *5.2.1 Operating costs*

The cost of fuel is an important part of the costs of operating a longline vessel. The average prices paid for fuel by Japanese longline vessels whose owners are members of the Japan Tuna Federation are shown in Figure 9. Fuel is sold at higher or lower prices on the world market, but it is obvious that the price of fuel has about doubled since 1999.

The cost of labour is also an important part of the costs of operating a longline vessel. Vessels of some countries, such as Japan and the TPC, have hired crew members from coastal developing countries, which reduces labour costs, but may also reduce efficiency.

## 5.2.2 Market conditions

### *5.2.2.1 Market prices*

The prices of most industrial products are determined by the cost of producing them. The prices of fish, however, are determined mostly by the balance of supply and demand. In particular, it is difficult for domestic fishery products in a developed country to compete with imported fishery products from developing countries, where the production costs are less. Furthermore, as longliners are less efficient than purse seiners, the former cannot compete with the latter unless they can produce a superior product for which they can get higher prices.

FIGURE 9
**Prices for fuel for Japanese tuna longliners**

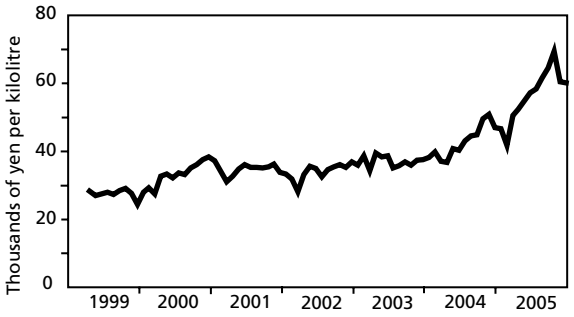
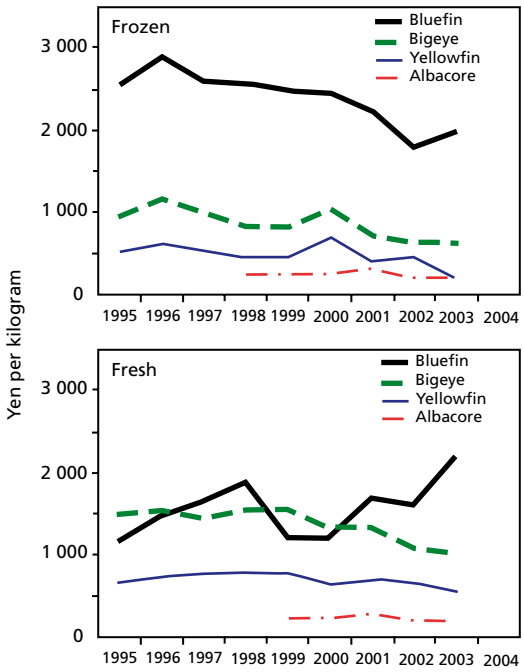



FIGURE 10
**Average prices for domestic frozen and fresh tuna products in the Japonese market**




The average prices of the major species of tuna produced by the Japanese tuna longline industry and consumed in the Japanese market are shown in Figure 10. (Data for the three species of bluefin are combined.) Data for imported products are not included in those used to produce this figure, but there is little difference in the prices of domestic and imported products of the same species, provided the quality is the same. The prices, with the exception of those for fresh bluefin, and possibly albacore, have been declining since 1996. The declines are possibly the result of a combination of over-supply of fish, competition from countries with lower producing costs, the condition of the Japanese economy and increased quantities of farm-raised tuna. The declines are more obvious for frozen tuna, which are products of large longliners. Comprehensive data were not available for years subsequent to 2003, but data for prices in the Tsukiji fish market show that the prices there were lower in 2004 and 2005 than in 2003, so it is almost certain that the downward trends continued after 2003.

Fresh tunas are obtained mostly from longliners that fish near the coasts of Japan. The prices for fresh bluefin are highly variable from year to year because the size composition of the fish is highly variable from year to year. Large bluefin are rarely caught near the coasts of Japan, and when even a few are caught the average price increases significantly. In contrast, the price of the frozen bluefin tuna, which competes with imported products (particularly with farm-raised bluefin tuna), has declined almost continuously.

### 5.2.2.2 Market structure

The structure of the market for tuna (for the world and within Japan) affects the fishing capacity, although it is difficult to quantify the magnitude of the effect. Air

transportation of fresh fish to Japan used occur only sporadically, but now it is a well-established practice. The increased production of farm-raised bluefin in Australia, some Mediterranean countries and, most recently, Mexico provided an impetus for this, but tunas caught by small coastal longliners in southeastern Asia are also shipped by air to Japan. Fresh fish are transported to specific locations, and daily cargo flights carry them to their destinations. This establishment of routines has resulted in lower shipping costs.

Another notable development is the establishments of plants at ports of landing in coastal states where the fish are butchered. A few years ago the fish were sent to the Japanese central market as round or gilled-and-gutted fish. Wholesalers would buy entire fish at auctions at the central market, cut them into "blocks" and sell the blocks to retailers. The retailers would then prepare sashimi (from the blocks) at their own shops in accordance with customers' requests. Recently, however, some tuna have been cut into sashimi-size pieces and shipped to Japan and other countries where they are consumed. This practice significantly reduces the costs of preparing the fish and transporting them to their destinations.

### 5.3 Regulations

Regulations are either in effect or under consideration for most of the important tuna stocks of the world. There are several reasons for regulation, including regulations to protect stocks of tunas that are considered to be fully exploited or over-exploited, regulations to protect bycatch species, and regulations to prevent vessels not registered in a country from fishing within its EEZ. Among the types of regulations are catch limits, effort limits, area-time closures, gear restrictions, and measures restricting the ports at which fish can be landed. All of these can affect fishing capacity.

## 6. BYCATCHES

Virtually every fishery takes non-target species, including some that are in need of protection, such as some species of sharks, sea birds and sea-turtles. It has already been mentioned that if J-hooks are replaced with circle hooks the mortalities of sea turtles are likely to be reduced, but that such a change might affect the efficiency of the vessels. Closures in certain area-time strata can protect non-target species, but such closures are likely to reduce the efficiency of the longline vessels, as otherwise they wouldn't fish in those strata, and there would be no need for the closures. In addition, area-time closures can increase the costs of fishing, as the vessels would sometimes have to travel further to reach suitable fishing grounds.

## 7. SMALL LONGLINE VESSELS

There are apparently two different types of small longliners, multi-purpose longliners and longliners that target tunas. It is impossible to evaluate the fishing capacity of these small longliners, as not even information on the numbers of vessels is available. However, as discussed in Section 4, their catches have increased rapidly in recent years (Figures 2-5). A part of the increase could be a reflection of improved statistics, but most of it is the result of increased fishing capacity. Swordfish catches by the longliners targeting swordfish are not included in Figures 2-5. In addition, the numbers of swordfish longliners are increasing rapidly, except in the Atlantic Ocean, where a severe quota system has been adopted. However, the bycatches of tunas by swordfish longliners are minor.

### 7.1 Multi-purpose longliners

Multi-purpose longliners, *i.e.* boats that fish sometimes with longline gear and sometimes even other types of gear, such as harpoon, handline, trolling and/or gillnet gear, and target the species that will produce the greatest income at the time, are

employed in many developed and developing coastal states. The potential fishing capacity is huge, but is related to the resources of tunas and other species available, their relative abundances and their relative prices. The management of multipurpose fleets would be very difficult.

### 7.2 Longliners that target tunas

In recent years there has been a marked increase in the numbers of small longliners that target tunas, and in the catches of tunas by these vessels. The most important reason for this increase appears to be the introduction of various fishing regulations, some of which apply only to the longliners more than 24 m in LOA.

Although these vessels are capable of traveling great distances, most of them cannot remain at sea for more than a few weeks, so they fish mostly in waters within the Exclusive Economic Zones (EEZs) of the countries in which they are based. However, they frequently change their flags to those of countries in whose waters they wish to fish or enter into joint-venture agreements with those countries. This behaviour makes it more difficult to collect information on these vessels.

Most of these vessels preserve their catches with ice, but some have freezing facilities, including super freezers. The most advanced small longliners are only slightly less than 24 m in LOA, and are equipped with super freezers capably of freezing as much as 20 tonnes of fish; the remainder of their catches are preserved with ice. The catches are sold mostly for marketing as sashimi- or steak-grade fish.

No comprehensive information on the numbers and the catches of small longliners is available, but because of their increasing importance, it is essential that such information be obtained.

### 7.3 Future prospects

If the current socio-economic conditions continue, it is likely that the number of large longline vessels will continue to decrease. However, the total longline fishing capacity is another matter because, as mentioned above, the number of small longline vessels has been increasing. If the demand for sashimi- and steak-grade tuna continues to increase the prices of fish are likely to increase, perhaps even to the levels of a few years ago. If so, unless restrictions on the entry of new vessels into the fishery are implemented, the overall fishing capacity is likely to increase. Because, as discussed earlier, small longliners are more efficient than large ones, the increase in fishing capacity would most likely be the result of entry of new small longliners into the fishery.

Unfortunately, management of the activities of small longliners would be difficult, as most of these vessels are registered in coastal developing states, and are exempt from current fishery management measures. In addition, the countries in which these vessels are registered may not be able to collect catch and effort statistics and control their activities, particularly since the owners of the vessels may not be citizens or residents of the countries in which the vessels are registered. Also, vessels may change their registrations from one country to another and/or shift their operations from one area to another. The problems that were encountered in handling large longliners engaged in IUU fishing have now shifted, to some extent, to small longliners. Since the numbers of vessels are even greater, and many more countries are involved, the scope of the problem is even greater than it was a few years ago. Therefore, management of longline fishing could be a major problem in the future.

## 8. A POSSIBLE SCHEME FOR MANAGING LONGLINE FISHING CAPACITY AND CONCLUSIONS

The recommendations made by the second meeting of the FAO Technical Advisory Committee are still valid.

In general, for various reasons, the fishing capacity of large longliners is declining. However, tuna fishing capacity as a whole is still increasing, while the tuna resources available to the longline fishery are not. In fact, due to increased catches of bigeye and yellowfin by the purse-seine fishery, the amounts of those species available to the longline fishery are less than they were during the years previous to the 1990s. It is clear, therefore, that if fishing capacity is not controlled the problems associated with overcapacity will become more serious in the future. The recommendations of the Technical Advisory Committee must be considered as the minimum requirements, and should be applied to all major gear types, and especially to purse seiners and small longliners, as the catches of those two types of gear are still increasing rapidly. Otherwise, the effort made to control the numbers of large longline vessels during the past several years would not achieve the intended result of reducing the overall effort to levels commensurate with the levels of abundance of the various species of tunas.

In the case of longliners, the problem lies with the small vessels. The first step to be taken would be to compile a list of small longliners, with information on registration, length, equipment for preserving the catches, *etc*., which would not be easy. One way to accomplish this would be to lower the length limits for inclusion in the positive lists of the RFMOs. The cooperation of the developing coastal states in which these vessels are registered or in whose vessels these vessel operate would be essential to the success of any such measures.

A Statistical Document System (a system that requires that fish that are imported be accompanied by this document, validated by the government of the producing country, which includes information on the catch and the type and weight of the product) is currently in effect only for the Atlantic bluefin, Pacific bluefin, southern bluefin and frozen bigeye tuna (except that destined for canning), and for swordfish. Besides that, not all of the countries are implementing the system. If this system were applied to fresh bigeye, and also to yellowfin and albacore tuna, and if it were fully implemented, this would be helpful in assessments of the stocks of tunas affected by fishing by small longliners. However, that would require substantial expenditures and cooperation from all the countries that import tunas caught by small longliners.

## 9. REFERENCES

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