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FACTORS AFFECTING ON RECENT DEVELOPMENT IN TUNA LONGLINE FISHING CAPACITY AND POSSIBLE OPTIONS FOR MANAGEMENT OF LONGLINE CAPACITY

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Summary

Since the Second FAO TAC meeting, changes affecting the fishing capacity of large longliners have been studied. Due to the efforts for capacity management by respective Government and industry, economical reasons, and through the competitions with small longliners and seiners, the number of longline vessels, their catches and the fishing capacity appear declining. In addition to the capacity control, the rising fuel cost, lowering fish product prices, and heavier competitions with other fishing fleets for limited tuna resources in the world are reducing the large longliners fishing capacity. The recommendations made at the second TAC meeting should be implemented for all the fleets. Particular concern is expressed on small longliners and purse seiners, the capacity of which seems to have been increasing in recent years.

1. Introduction.

After the 2nd Meeting of the Technical Advisory Committee (2nd TAC) of the FAO Project on the "Management of Fishing Capacity: Conservation and Socio-economics" (held in Madrid (Spain) in March 15 to 18, 2004), a Workshop to develop quantitative methods to determine the desired magnitude of or desired change to fishing capacity on the basis of the status of stocks has been proposed and organized. The Workshop has 4 objectives, i.e.:

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 (i) routinely collecting input data for the Data Envelopment Analysis (DEA) and (ii) performing industry surveys of tuna fishing capacity utilization.
C. To review the factors affecting fishing capacity (number of vessels, their physical characteristics, etc.).
D. To review the existing measures for managing tuna fishing capacity and possibly, to identify additional options for such measures.

This paper is an update of the previous paper by the same author submitted at the second FAO TAC meeting on longline fishing capacity (Miyake, 2005a)[1]. At the TAC meeting, it was concluded that the set of data available was not sufficient to conduct DAE analysis for

[1] Miyake, P.M. (2005a), A review of the fishing capacity of the longline fleets of the world; In: Bayliff, W.H.; Leiva Moreno, J.I. de; Majkowski, J. (eds.) Second Meeting of the Technical Advisory Committee of the FAO Project "Management of Tuna Fishing Capacity: Conservation and Socio-economics. Madrid, Spain 15-18 March 2004 *FAO Fisheries Proceedings* No. 2. FAO Rome

longline fishery. However, it was agreed that the fishing capacity of the large longliners over 24 meters in over-all length (LOA) could easily catch all the available resources of commercial species of tunas. Their economical breakpoint (where no economical loss or profit) is actually higher than their average catch per year.

In this paper, therefore, the trend in the longline fleet size, any changes in the operational manner, stocks available and socio-economic elements which might have been affecting longline fishing capacity are reviewed.

2. Definition of large longliners

The Second TAC meeting recommended defining 'large longline' as the longline vessels with freezing capacity. However, the previous analyses (Miyake, 2005a) were based on the definition that the large longliners are: above 24 meters LOA; targeting tuna major species (i.e. bigeye, yellowfin, albacore and bluefin tunas); with freezing facilities (mostly super freezing); and sell the products in fresh fish (including sashimi and steak) market. Swordfish longliners are those targeting swordfish (mostly using shallow longliners and night-time operations).

It should be noted that most of the Regional Fisheries Management Organizations (RFMOs) have adopted so-called "positive list" system, which requires registrations of the vessels over 24 meters LOA and some managements were adopted, e.g. the international trade can be made only fish captured by the vessels on the positive list.

The previous report (Miyake, 2005) concentrated on large longliners (by the definition mentioned above), since very little information is available on small longliners. However, tuna catch and the total number of small longliners (i.e. less than 24 meters LOA) seem expanding very rapidly. Therefore, in this report, some review was made on small longline fleet (see Section 7).

3. Management effort of large longline fishing capacity by the governments and industry, and its effect on size of the world fleet

Details of effort to control the large longline fleet size by various governments and industry were described by Miyake (2005a). The longline fleet has been, in general, controlled by limited entry system by most of the longline countries for many years. In addition to such a policy, following to the FAO IPOA on fishing capacity, the joint policy (officially and at an industry level) undertaken by Japan and Taiwan Province of China (TPC) to call back flag of convenience vessels (and to scrap a part of these vessels) contributed to the general reduction

of longliners in the world. The Organizations for Promoting Responsible Tuna Fishing (OPRT) was established for this purpose.

Table 1 indicates the numbers of large longline vessels registered with the OPRT every March (source: OPRT). The shaded cells indicate that the countries were not yet the members of the OPRT and the numbers are the author's own estimates. In 2005, almost all large tuna longline vessels in the world are included in this list, except a few but unknown number of Illegal, unreported and unregulated (IUU) vessels.

Table 1. Numbers of registered large longliners with OPRT for 2002-2005. Shaded cells show that the country was not the member of OPRT yet.

	2001	2002	2003	2004	2005
Japan	494	490	495	473	434
Taiwan Province of China	567	562	599	597	600
Koea	183	183	176	174	172
Philippines	6	6	17	17	18
Indonesia			14	14	14
China	98	100	105	105	113
Ecuador	0	0	0	5	5
Vanuatu+Seychelles	0	0	0	69	69
Total	1348	1,341	1,406	1,454	1,425

The total number of longliners included in the Table 1 increased from 2002 to 2004. This increase does not indicate entries of newly built boats. It rather indicates that many IUU vessels have changed the registration to one or the other members of the OPRT and managed by the flag countries. Therefore, they are no longer IUU vessels.

With exception of European and American countries, almost all countries fishing with large longliners are members of the OPRT. It should be noted that most of the large longliners of European and American countries are targeting swordfish, though some tuna species are taken as by-catch. Therefore, the current number of vessels in the OPRT list corresponds, approximately to that of the world large tuna longliners. The only exception is the IUU fleet, which has been reduced significantly, and most likely less than 30 at present. Miyake (2005a) estimated 1,615 vessels as large tuna longliners in 2003, including IUU vessels. Therefore from these figures, it can safely be concluded that the total number of large longliners have been declining in last few years.

It should be borne in mind that not all the registered and licensed boats were actually engaged in fishing. Figure 1 gives the number of Japanese longliners engaged in tuna fishing in each year, estimated from logbook records (provided by the National Research Institute of Far Seas Fisheries, Fishery Research Agency, Japan). The procedures of estimation are explained in Miyake (2005a). The total active vessels were counted independently by ocean. However, duplication of a vessel between oceans was eliminated for the world total. Therefore, the sum of the numbers of the vessels by oceans does not agree with the world total, as one boat may operate in more than one ocean. The data for 2004 are not complete, because some of the log-sheets have not yet reached the Institute.

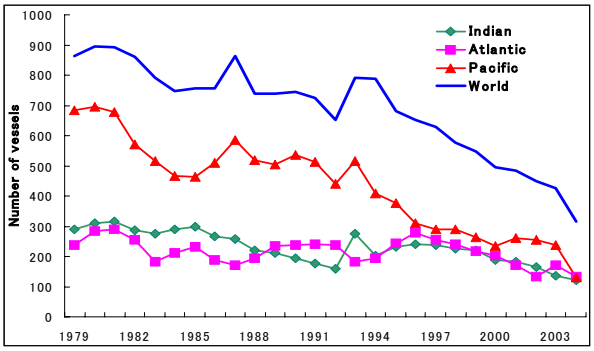

Fig. 1 Number of Japanese active large longliners by ocean. (World total eliminated double counting among oceans)

It is very clear from Fig. 1. that the number of Japanese active longliners has been constantly declining since 1994. Of course, this tendency does not necessarily reflect those of other longline fleets. Unfortunately, the information on the active number of vessels could not be obtained from any other countries. From Table 1, it can be known that TPC actually increased the number of vessels as previously described, due to the additions of called-back IUU vessels. However, the TPC declared that it would scrap 56 longliners in 2005 and 160 in total by the end of 2006. Korean longline fleet is also slightly reducing.

4. Tuna resources available for large longliners.

4a. Large-sized longliners vs. small-sized longliners

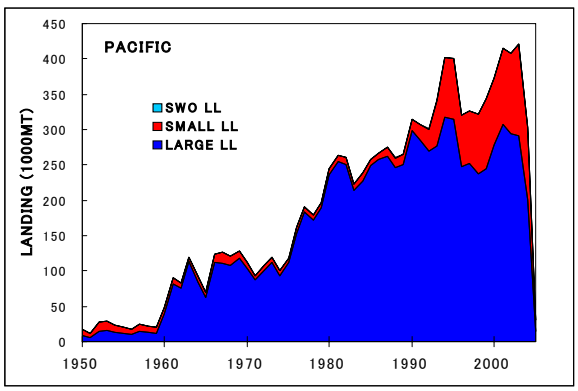

Fig. 2. Cumulative catches of large, small and swordfish longliners in the Pacific Ocean.

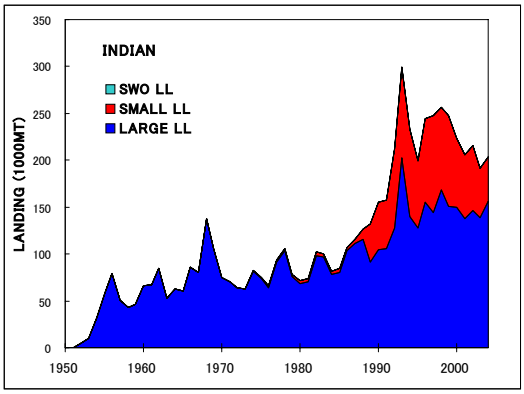

Fig. 3. Cumulative catches of large, small and swordfish longliners in the Indian Ocean.

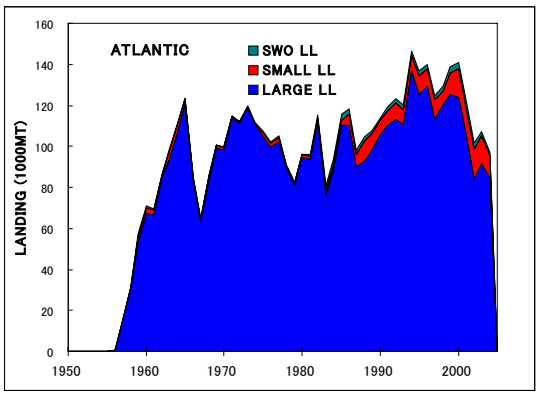

Fig. 4. Cumulative catches of large, small and swordfish longliners in the Atlantic Ocean.

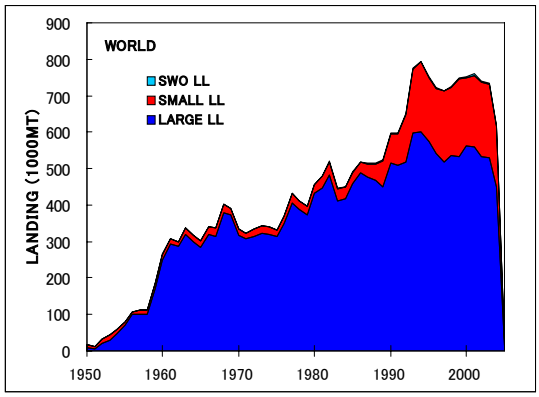

Fig. 5. Cumulative catches of large, small and swordfish longliners in the world..

Most tuna stocks are exploited by more than one fishing gear (e.g. longline and seines) and they are competitive in fishing. Therefore, to single out sustainable quantity of tunas that is available for the longline fleet is not practical.

Miyake (2005a) estimated roughly, the 2001 tuna catch by large longliners to be about 390,000 metric tons. This time, a more detailed analysis was conducted. All the longline catches in three oceans for albacore, bigeye, yellowfin, and bluefin (Pacific, Atlantic and southern) tunas are classified by flag countries. Using the best knowledge of the author, each area-flag-species catch was divided into the catches of large longliners, small longliners and swordfish-target longliners. Those separated catches were summed up by longline types for each ocean and shown in Figs. 2, 3, and 4. The quantity of swordfish catch is not included in this figure, even though albacore, bigeye, yellowfin and bluefin by-catches by swordfish target longliners were. Fig. 5 gives the world total by three types of longliners. Data for 2005 are very incomplete.

As seen in Fig. 5, the longline catch suddenly increased in 1960 from 100 to 300 thousand tons, and thereafter gradually increased until late 1980s to about 500 thousand tons. In early 1990s, another rapid increase was observed from about 500 to near 800 thousands, but stabilized again. The interesting observation is that the catch by large longline has been stabilized since 1990 at the level of 500 thousand. Therefore, the increase in 1990s is all attributable to the increase by small longliners. This is particularly evident for the Indian and Pacific Oceans.

It should be borne in mind that a part of the increase of the catch by small longliners might be the results of improvement in statistics. The IOTC and some countries (e.g. Australia and Japan) have been aiding in collecting data from coastal fisheries, particularly by small longliners. These improvements occurred mostly in the Indian Ocean and West Central

Pacific. However, the magnitude of improvement affecting the increased reported catch is unknown. The small longliners' catch in the Atlantic is still relatively small. (See Figs. 2, 3 and 4.)

In conclusion, from mid 1980s to 2004, the catch by the large longliners was stabilized at 500 thousand tons. The catch by the small longliners increased during this period until mid-1990s. In recent years, the small longliners' catch has been also stabilized at about 200 thousands. These are the possible limits for the tunas (not including swordfish) available for longliners for the fresh fish or sashimi markets, under the current fishing patterns (i.e. age-specific mortality pattern).

4b Competitions between fishing gears other than longline.

Lowering catch rate. In general, the catch rates of longline are declining in many parts of the world for various major species. In most cases, such declining trends reflect the reduction of the stock of large fish, but also are resulted from the saturation of fishing efforts, i.e. heavy competition for fishing the same stock among longliners themselves (due to the over-capacity). A typical example is given in Fig. 6, which shows catch rates by various longline fleets for the Atlantic bigeye. In this case, it was recognized that the stock has been fished at a level close to or slightly lower than the MSY.

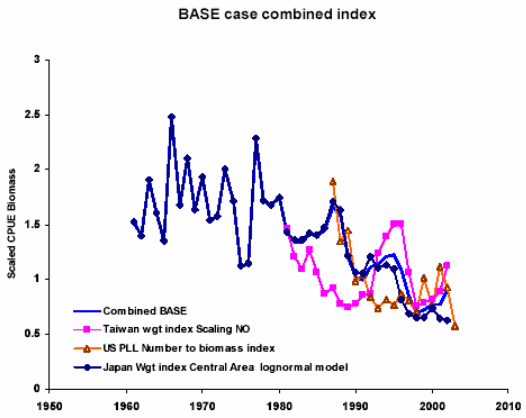

Fig. 6. Standardized longline CPUE for Atlantic bigeye. (Sourc: Detailed Report of ICCAT SCRS, 2004)

Longline and purse seine catches. In the multi-gear fisheries such as tuna, the reduction of stock is often associated with activities of other fishing gears (particularly with higher efficiency such as purse seiners). The rapidly increasing catch of purse seine (see Fig. 7), particularly on FADs, affected on longline catch and catch-rates, as seiners capture smaller sized fish (i.e. at the earlier stage of tuna life cycle). Increasing seine catch certainly changed the catch curve and hence reduced the share of longline fleet in

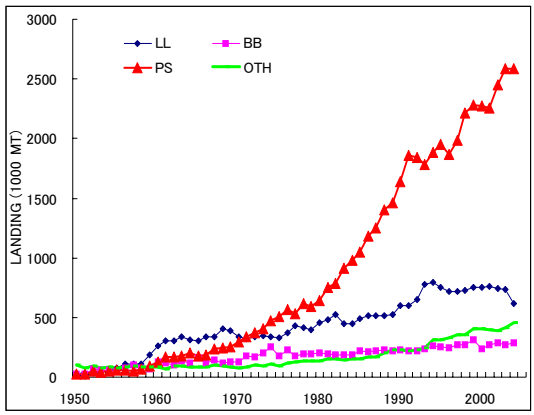

Fig. 7. World catch of major tuna species by fishing gears.

the catches, while lowering catch rates. Besides, the Y/R was reduced by capturing great number of fish smaller than the optimal size. MSY level was also brought down by the purse seine catches.

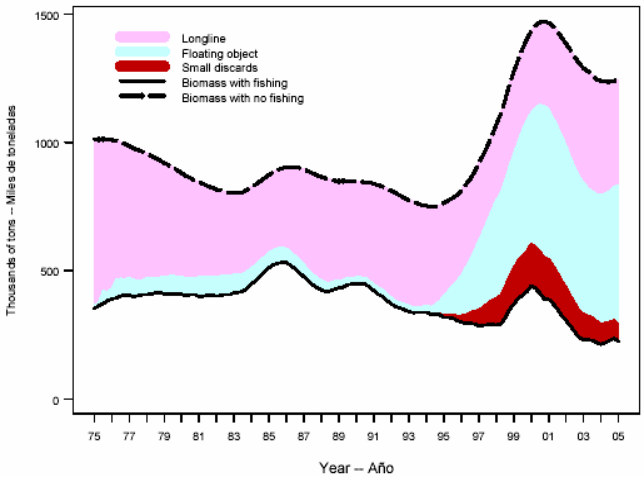

Fig. 8. Effects of various fishing on bigeye stock size in the East Pacific.

Effect of purse seine catch on longline resources. In Figure 8, the effects of various fishing gears on the east Pacific bigeye stock is estimated (from the IATTC Report on stock conditions in the east Pacific, 2005). In this Figure, the estimated quantities of the stock affected by longline, purse seine on floating object, and small fish discarded into the sea by purse seiners are given (from the top to the bottom). It shows very clearly, that the purse seine catch, particularly with floating objects are most significantly influencing on the entire stock, and hence the portion of the stock that is available for longline has been significantly cut down since early 90s.

Conclusion of gear competitions. In conclusion, the tuna resources available for longline has been reduced and possibly still decreasing by the increase of catch of small specimens by mostly purse seiners. Therefore, it is obvious that the implementation of a reduction in large longline fishing capacity must be accompanied with the implementation of a similar reduction in other fishing gears that catch younger tunas than longline, particularly of purse seiners, as their catches are still rapidly increasing. Otherwise the effort to reduce the longline fishing capacity would be only benefit the other fisheries.

5. Factors affecting the longline fishing capacity other than the capacity management efforts by the government and industry.

Possibly the most significant factor which affected the large longline fishing capacity was the governmental and industrial effort to control the fleet size, following the FAO IPOA for Fishing Capacity and the recommendations of 2nd FAO/TAC Working Group, as discussed in Section 3.

Also the fishing capacity has to be considered relative to the fish resources available for the fishery. The resources available for longline fleet are discussed in Section 4. However, some other factors are also significantly affecting the capacity.

In last few years, the world longline fleets, particularly those of the developed countries, are suffering economical difficulties. These other factors affecting fishing capacity include: technological development, economical elements, and eco-system related elements. Items below discuss those possible effects. However, in the case of longliners, it is interesting to note that most of these elements affected negatively the fishing capacity, except some of the technological improvements.

5a Technological improvements

The major technological improvements in the history are discussed by Miyake (2005b)[2]. Since that report was written, there have been some changes in equipments and/or operational pattern of large longliners. The most significant change possibly is that some longliners recently started two consecutive sets (of lines) per day in the Indian and western Pacific. This is to reduce the length of main line per set but set them twice a day, instead of once a day (conventional operating pattern). The effect of the new type of operation on the efficiency is not well investigated or documented. A minor portion of the longline sets is made in this manner at present, but there is a tendency of increasing in proportion, which possibly means more effectiveness in fishing. If that is the case, this would increase the fishing capacity, while maintaining the same fleet size.

The technological factor that may affect reversely on the fishing efficiency is the use of many mitigation devices and/or procedures, such as use of circle hooks instead of J-hooks. Circle hooks have been introduced recently for minimizing incidental by-catches. Many experiments are currently ongoing and it is too early to evaluate its effects on the fishing capacity.

5b Economical factor.

Rising operating cost. Most obvious factors resulting in an increase in operating cost are the rising labor and fuel cost. In Figure 9, the trends in monthly mean price of fuel for the Japanese tuna longliners are shown (Source: Federation of Japan Tuna). The price is given in Yen per kiloliter of the fuel,

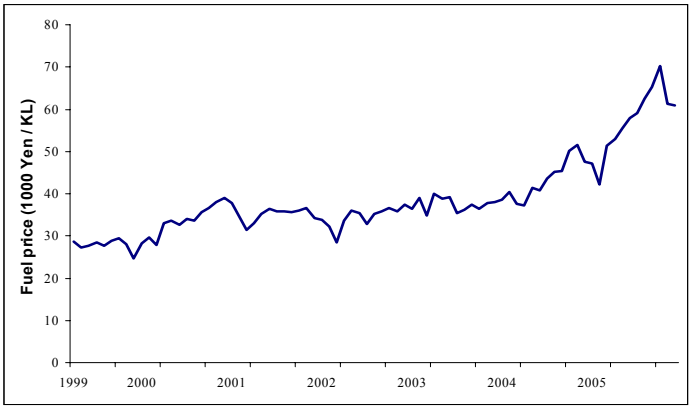

Fig. 9. Trends in the fuel price (Yen per Kiloliters)) for tuna longliners.

[2] Miyake, P.M. (2005b), A brief history of the tuna fisheries of the world. In: Bayliff, W.H.; Leiva Moreno, J.I. de; Majkowski, J. (eds.) Second Meeting of the Technical Advisory Committee of the FAO Project "Management of Tuna Fishing Capacity: Conservation and Socio-economics. Madrid, Spain 15-18 March 2004 *FAO Fisheries Proceedings* No. 2. FAO Rome

which the Japan Tuna Federation provided to their member boats. There is fuel sold at a higher or lower price in the world market. However, Fig. 6 gives at least a good indication of the trends of the fuel cost. In the last 5 years, the price has been doubled, which is actually too much to be absorbed by the fisher's effort. For the labor cost, many longline countries such as Japan and TPC are using crew from coastal developing countries. This would cut down the cost of labor but the fishing efficiency might have come down.

Market conditions. Market conditions are very important factor influencing the fishing capacity. For most of the industrialized products, the price is determined by the production cost. However, the fish price is determined mostly by the balance of production and demand (consumption), and not related to the production cost. Therefore, the rising operating cost can not be reflected in fish price. In particular, when the domestic fishery products in a developed country are competing with imported products from developing coastal countries, where the production cost is less, this is very clear. Besides, as longline is less efficient fishing method, compared with surface fishing such as purse seine fishery, it is more difficult to compete with these surface fisheries.

Figure 10 gives annual average prices of four major species of tuna produced by the Japanese tuna longline industry and consumed in the Japanese market. The price is shown in Yen per kilogram. The upper panel is for frozen products and the lower panel is for fresh products. The imported products are not included in these statistics. However, it is considered that there is little difference in price, for the same species between domestic and imported products, if the quality is the same. In general, it is obvious that the price has been in downward trends since 1996. The reason for such a declining trend is possibly a combination of over-supply, competition from countries with lower producing cost, Japanese economy condition, and increased quantity of farmed tuna (also see Section 5c). These trends are more obvious for frozen tuna, which are products of large longliners. The data source is the Federation of Japan Tuna, and available

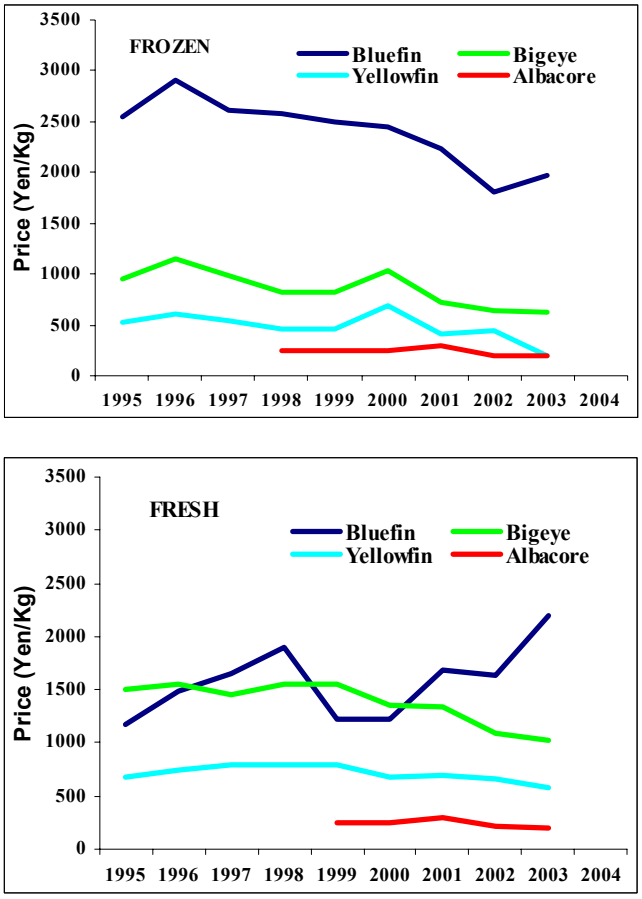

Fig. 10. Average price for domestic frozen (upper) and fresh tuna product in Japanese market.

only up to 2003. The average price in Tsukiji fish market shows the prices were lower in 2004 and 2005 than in 2003. Therefore, it is almost sure that this downwards trend has been continuing until 2005.

Fresh fish are mostly from the domestic coastal or near coast longliners. For fresh bluefin, the size composition is very variable between years and the quantity of large fish captured is minor. As a large bluefin tuna caught near coast is a rare item, the price reflects the annual landing quantity of such fish and not the general trends. In fact, the price of the frozen bluefin tuna, which is competing with its imported products (and particularly with farmed bluefin tuna), has been continuously down.

5c. Change in market structure

Market structure (of the world and within Japan) affects the fishing capacity, although it is difficult to quantify the magnitude. Air transportation of fresh fish used to be a sporadic event, but is now well-established routine. This is the results of rapidly increased quantity of farmed bluefin tuna exported to the Japanese market from Australia, the Mediterranean ports and now from Mexico. Also increased exports of fresh fish caught by coastal small longliners in southeastern Asia contributed to this system. Fresh fish are gathered at a specific location and daily cargo flights carry them to the destinations. This establishment of the routine resulted in lower shipping cost.

Another notable development is the recent establishments of fish dissecting factory at coastal states. The fish used to be sent to the Japanese central market, as round or gilled and gutted conditions. After the auction at the market, wholesalers butch them down into blocks, and fish retailers prepare (from the blocks) sashimi at their own shops according to the customers' request. Japanese marketing system and the consumers are accustomed to such procedures. However, recently, some of tuna are cut down into sashimi-ready size and pre-packed before shipping out to the consuming countries. This would significantly reduce labor cost of preparation of fish, and transport cost as well. These pre-packed sashimi-ready pieces are directly sold to super markets by the importers. Such system is widely spreading in the Japanese market as well as in the U.S. and European markets.

These changes in the market structure make an access to the Japanese and world markets by the coastal fisheries easier, and greatly affect the fish retail price.

5d Increasing international regulations. For most of the important tuna stocks all over the world, either regulatory measures have been introduced or are being placed under consideration. Naturally, in most cases, these regulations are related to the tuna stock conditions, as they are now being fully utilized or over-utilized. More importantly these measures include catch quota and effort limitations but also other measures such as time-area

closure, gear restrictions (type of hooks, etc.).Even measures taken to restrict landing ports would affect fishing capacity.

6. Echo-system related items (Incidental catch).

Any fishery takes non-target species. Often those non-target species include stocks to be protected, such as some species of shark, sea birds and sea-turtles and hence the measures to reduce such by-catches are required. Measures may include use of a certain type of a gear, time-area closure (protection area), and the use of a special device for mitigation. These measures would increase the cost of operation as well as affect in selection of good fishing grounds. Because more attention is required on such by-catches, the tuna fishing operations are more restricted (see also Section 5a).

7. Small sized longline fleet\

There are apparently two different types of small longliners; multi-purpose longliners and tuna target longliners. It is difficult to evaluate the fishing capacity of these small longliners, as even fleet statistics are not available at present. However, as discussed in Section 4, their catches increased very rapidly in recent years (See Figs. 2, 3, 4 and 5). A part of the increase could be a reflection of improved statistics but mostly the results of increased fishing capacity. In the figures in Section 4, swordfish catch by the longliners targeting swordfish is not included. However, the swordfish longliners are also increasing rapidly, except in the Atlantic Ocean, where a severe quota system has been adopted. However, the tuna by-catches by such longliners are minor.

7a Multi-purpose longliners. Many coastal states, both developed and developing, have multi-purpose longliners, i.e. coastal boats fishing occasionally with longline gears and sometimes even other types of gears such as harpoon, handline, trolling and/or gillnets, and target most economical species at the time. The potential fishing capacity is huge but is related with tuna resources available, tuna price, and abundance and price of other competing species than tuna. The management of such a fleet would be very difficult.

7b Tuna-target small longliners. They are small longliners targeting mostly tuna and tuna-like species. Their fishing grounds are generally, but not necessarily, the waters within the EEZ of the base countries. Most of them carry catches in ice but some have freezing facilities, including super freezer. A recent increase in number of this type of longliners is markedly noted. The most important reason appears to be the introduction of various fishing regulations, some of which apply only to the longliners over 24 meters LOA, but not to these small longliners. Their catches also seem to be increasing seriously and fishing ground is not limited to the EEZ of the flag countries. Their mobility is comparable to large longliners.

Since the length of a trip is up to a few weeks, naturally they seek landing ports near the fishing grounds. As a result, they often change the flags to the countries, which they want to base from or make joint-venture agreements. Such procedures make it more difficult to collect information on fleet.

The most advanced type of such longliners are slightly below 24 meters LOA; equipped with a limited capacity of super freezer (as much as 20MT); and the rest of the catches are kept fresh in ice. The catches are mostly landed fresh and sold in the "sashimi" or steak fish market.

The author has no information on the number of such longliners and it will be very important to investigate the scale at a worldwide level.

7c. Future prospect If the current socio-economic conditions continue, it is unlikely that the large longline fleet would increase the fishing capacity but instead would rapidly decrease the capacity. In which direction the fleet capacity would move depends on various factors. As the tuna resources of the world are being fully exploited while the demand for fresh sashimi or steak quality tuna continues increasing in the world, the fish price is likely to start recovering or even increasing beyond the past high level. If this happens, it will be a driving force for the increase of the fishing capacity. Particularly as discussed earlier, the small-sized longliners would be more economical and efficient than large-sized longliners in catching large tuna specimens for fresh fish market. Therefore, the increase in the fishing capacity of small-sized longliners would continue into the near future, unless a proper management is introduced.

However, management of the small longliners would be difficult as these vessels are mostly flying flags of coastal developing states and often enjoying the privilege of exemption from current fishery management measures. In addition, the flag country might not have enough structure in getting statistics and administrations of these vessels, particularly if the nationality of the owners are different from the flag country and the boats change the flag occasionally moving from one fishing area to the other. The problems we used to face in handling the large IUU longliners are now shifted to some extent to these small longliners. Since the numbers of the boats are even much greater and many more countries are involved, the scope of the problem is even greater than in the case of large IUU longliners. Therefore, their management could be a future major problem.

8. Possible management scheme for longline fishing capacity and conclusions

The recommendations made by the 2nd FAO TAC meeting are still valid. In general, fishing capacity of large longliners is declining by the proper management and for other reasons.

However, the tuna fishing capacity as a whole seems to be still increasing, while the tuna resources available are not. Therefore, without any enforced management measures on the fishing capacity, the over-capacity will become more serious in the future. The above TAC recommendations must be considered as the minimum requirements, and should be applied to all the tuna fishing types, particularly for small longliners and purse seiners, as their catches are still increasing rapidly. Otherwise, the effort made to control large longline fishing capacity in past several years would only benefit the increasing fishing capacity of other fishing gears such as purse seine.

In the case of the longliners, the problem lies with the small-sized longliners. The first step to be taken would be to compile their fleet statistics. This is not so easy. Lowering the limit of positive list by RFMOs could be one of the solutions but assistance for the developing coastal states would be essential.

Statistical document system is currently adopted only for the Atlantic bluefin, Pacific bluefin, southern bluefin, and frozen bigeye tuna (except for canning use) in the world[3]. Besides, not all the countries are implementing the system. If this system is applied for fresh bigeye as well as for yellowfin tuna, and is fully implemented, that will help in the investigation of actual situations of fishing by small longliners. However, we have to expect a big cost and strong will by all the importing countries for such products.

[3] Besides these tuna species, it is also adopted for swordfish.