Tuna fishing capacity: perspective of purse seine fishing industry on factors affecting it and its management[1]

Julio Morón

Member of the WTPO Board of Directors
Organización de Productores Asociados de Grandes Atuneros Congeladores (OPAGAC)
Ayala 54, 28001 Madrid, SPAIN.
opagac@arrakis.es

INTRODUCTION

The success of an effective management scheme of tuna resources is now at steak for different and complex elements, mainly political, that do not allow countries in the different tuna Regional Fisheries Organizations (RFO) to reach agreements that could lead to effective management.

Fisheries management history tells us that no fishery under open access scheme has been able to maintain resources at a rational level of exploitation (Cunningham and Grèboval, 2001; Gréboval, 1999 and Gréboval and Munro, 1999). If applying regulated access schemes has been difficult in local fisheries, normally State controlled, one can imagine the number of difficulties that the exercise has in tuna RFOs, with so many countries involved and so many interests at the negotiation table.

Tuna fisheries, by its migratory nature are, in principle, subject to open access to all participants: countries actually fishing and coastal countries with legitimate rights to the fishery. To come from an Open Access fishery to a Regulated System has been proved to be really difficult to implement in Tuna RFOs, with only a successful scheme approved, and only for a segment of the fleet: the purse seine fleet in the Eastern Pacific Ocean by the Inter-American tropical Tuna Commission (IATTC) [2].

But first of all, a major challenging problem for a multispecies and multigear fishery as the tuna fisheries are, they are the elements to estimate the actual level of capacity in relation to stock status. Up to now, International Tuna Fisheries Management, has been concentrated in learning mainly the outputs of tuna fisheries, i.e. catch, and not so much about the inputs of this fisheries, (effort and fleet). Effort estimates in Tuna fisheries, mainly in purse seine fisheries, can not provide the appropriate proxy needed to estimate abundance indexes, that in other fisheries are possible to obtain.

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[2] IATTC Resolution C-02/03 (2002).

Currently the evaluations of the World Tuna populations are based on long series of catch and effort statistics, usually well documented for certain fleets, but still with substantial gaps in the data needed notably by the extensive practice of Illegal, Unreported and Unregulated (IUU) fisheries and the poor sampling coverage of certain industrial fleets.

The level of exploitation of the World Tuna resources, is reaching a critical point, where urgent management actions are needed in most of the RFOs. But when trying to apply efficient management actions, all the possible efforts are facing a major lack of information about the fleet that exercises the activity in every tuna fishery and its relation with effective fishing effort.

That is the reason why the World Tuna Purse-seine Organization (WTPO), since its creation in 2001 has been calling for an effective management scheme to be applied in all the RFOs, having in the limitation on fleet capacity in relation with tuna stock status, the main element for an effective management scheme.

International Plan of Action on Fishing Capacity (FAO, 1999)

Although is well known by all, it is good to recall the immediate objective of the IPOA on Fleet Capacity is "*for States and RFOs, to achieve world-wide, preferably by 2003 but not later than 2005, an efficient, equitable and transparent management of fishing capacity. Inter alia, States and regional fisheries organizations confronted with an overcapacity problem, where capacity is undermining achievement of long-term sustainability outcomes, should endeavour initially to limit at present level and progressively reduce the fishing capacity applied to affected fisheries*".

It is clear, that sometimes, good faith of Governments in approving certain documents for a voluntary application in the FAO framework, like the IPOA for the Management of Fishing Capacity, proves to be useless when the same countries do not cooperate in the proposed sense, when the discussion arrives at RFOs and might touch their political, social or economic interests. Only one RFO (IATTC) of the five tuna RFOs has work in the direction marked by the IPOA, but only partially for a segment of the fleet exploiting tunas at industrial scale.

Factors Affecting Fishing Capacity

Effective Fishing effort

The major problem affecting the estimates of tuna purse seine capacity, is to correlate any measure used in capacity (i.e. m^3, GT, tonnes,…) with fishing effort (fishing days, days at sea…) and its reflection of effective fishing effort. In this exercise there has been certain attempts to consider the increase of fishing efficiency in the purse seine fishery (Pella and Psaropulos, 1975; Gascuel et al., 1993; Fonteneau et al., 1999; Soto et al., 2000), but all the elements considered in the effort standardization exercises are difficult to be taken in consideration on a regular basis for stock assessment.

The lack of the basic information to estimate the evolution of the fishing efficiency is the major problem that scientists find when addressing this problem. Tuna scientists had paid little attention to gear and fishing techniques evolution, that is the key element to consider the increase in catchability of the purse seine fleet. Major technical advances have been identified as principal causes of fishing efficiency increase, notably the use of bird radars, sonar, echo sounders, FADs, radio buoys, satellite buoys, satellite information about Sea Surface Temperature; Altimetry; Currents; Water Fronts etc. The time of introduction and intensity of use of these elements on the tuna purse seine fleet is unknown in most of the fleets, and now is very difficult to trace back the elements needed to record the effects of certain elements on boat production increase and its correlation with fishing efficiency.

Let us illustrate this with an example observed in the purse seine Indian Ocean fishery, for the Spanish fleet. The Indian Ocean purse seine fishery for yellowfin and skipjack, could be consider a virgin fishery before the arrival of the European fleet in the mid 80's. Although the skipjack and yellowfin stock, could not be considered virgin stocks because they were also exploited by coastal fisheries, mainly targeting skipjack, and longline fisheries with a significant catch of yellowfin, before purse seine introduction.

The trends observed on the different estimates of catch rates for the Spanish fleet in the Indian Ocean, are quite similar for the catch per vessel (Figure 1) and catch per fishing days (Figure 3), but very different when we consider the catch per GT (Figure 2). None of the three could be correlated with the theoretical trend of fishing abundance, that should be higher at the beginning of the exploitation and lower when the fishery increases its effort, as predicted for most of the Biomass Dynamic Models in use (Hilborn and Walters, 1992)[3].

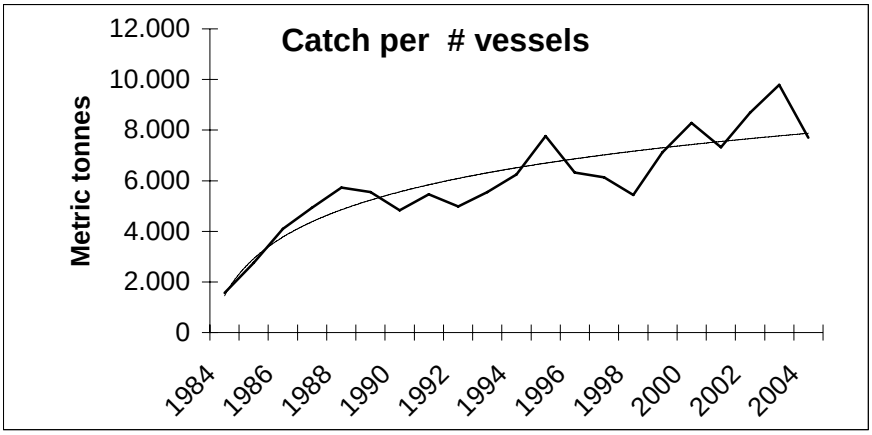

Figure 1.- Evolution of the catch per number of vessels of the Spanish purse seine fleet in the Indian Ocean from 1984 until 2004, with its logarithmic trend.

The increase of the average catch per vessel in the Indian Ocean Purse seine fishery for the Spanish fleet is 11% every year. The Indian Ocean started to be exploited by the industrial purse seine fishery in 1984. Since then, we can appreciate the logical rapid increase in the first few years of activity, to get an stable average production of around 5.500 t per vessel until 1993, to increase up to 8.000 t per vessel in the late period (1999-

[3] Chapter 3.5 (pag. 76 – 89)

2004). That increase in boat production is not a reflection of biomass increase and therefore should be directly related to fishing efficiency increase.

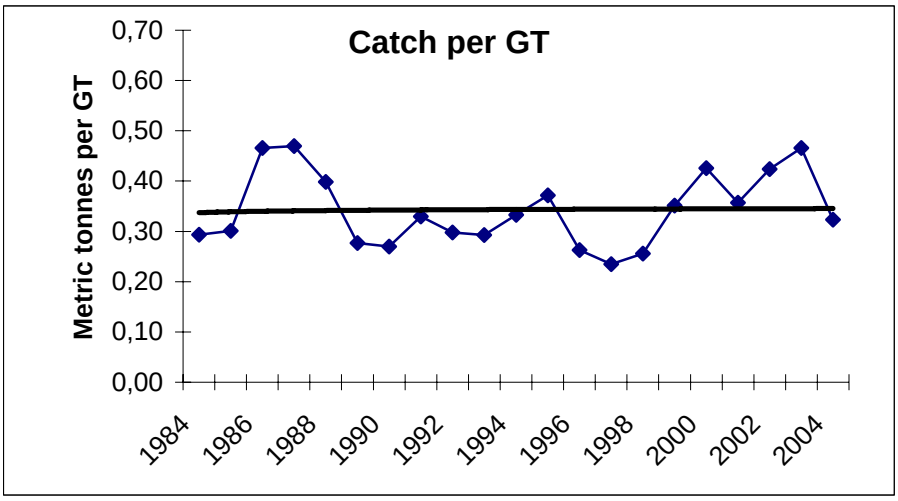

Figure 2.- Evolution of the catch per GT of the Spanish purse seine fleet in the Indian Ocean from 1984 until 2004, with its logarithmic trend.

Despite the flat trend line in the catch rate as catch per total capacity in GT, the average increase during the whole period is about 3%, mainly for the increase in the final period 1999-2004, where the size of the vessels has been increased from an average vessel size of 800 GT at the beginning of the fishery up to 1.200 GT per vessel.

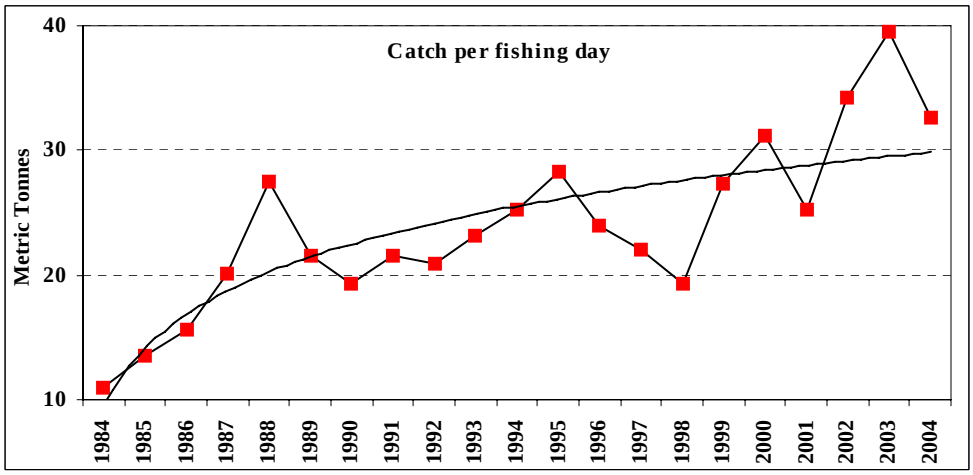

Figure 3.- Evolution of the catch per fishing days of the Spanish purse seine fleet in the Indian Ocean from 1984 until 2004, with its logarithmic trend.

The general trend of the catch per fishing day reflects a yearly increase of 4% for the whole period, but with four different periods:

- The first four years of rapid increase during the exploratory phase of the fishery (1984-1988), a logical situation in a sub-exploited fishery.
- A second period of a big drop in 1989-1990, but a steady increase un to 1995, probably by the introduction of FADs.

- A third phase of catch rate decline until 1998 for the big increase in fishing effort, reaching in those three years over the 6.000 fishing days, when the average up to then never went up to 5.000 fishing days.
- And a fourth phase of big increase since 1999 until 2004, probably related to technological changes that improve the effective fishing effort, because it is the phase where the resource has been already exploited intensively in previous years.

Different technical elements had improved the effective fishing effort of the purse seine fishery by increasing the detection capacity of the vessel, as well as gear improvement has contributed to reduce setting time or handling time, reflected in the reduction in set duration and the consequent increase in searching time. Based on Gascuel et al. (1993) and Fonteneau et al. (1999) the Scientific Committee for Research and Statistics of ICCAT (SCRS), considers a 3% yearly increase of the effective fishing effort of the purse seine fishery in the Atlantic Ocean, and so does the Scientific Committee of IOTC, which estimate was coincident with the results presented by Morón (2004). This correction only provides an approach to the basic problem of the estimate of effective fishing effort in tuna purse seine fisheries.

As we have shown, different catch rates can provide different estimates. Up to now, in purse-seine fisheries, it is very complicated to obtain any index that could provide an independent estimate of abundance. Therefore a combination of effort and capacity estimates should be taken in consideration to make any approach to calculate optimal fishing capacity.

Skipper factor

The skipper factor is an additional element that could be, in certain cases of big influence on the production of a vessel as could be seen in Figure 4, but it has been very poorly investigated in the tuna purse seine fishery.

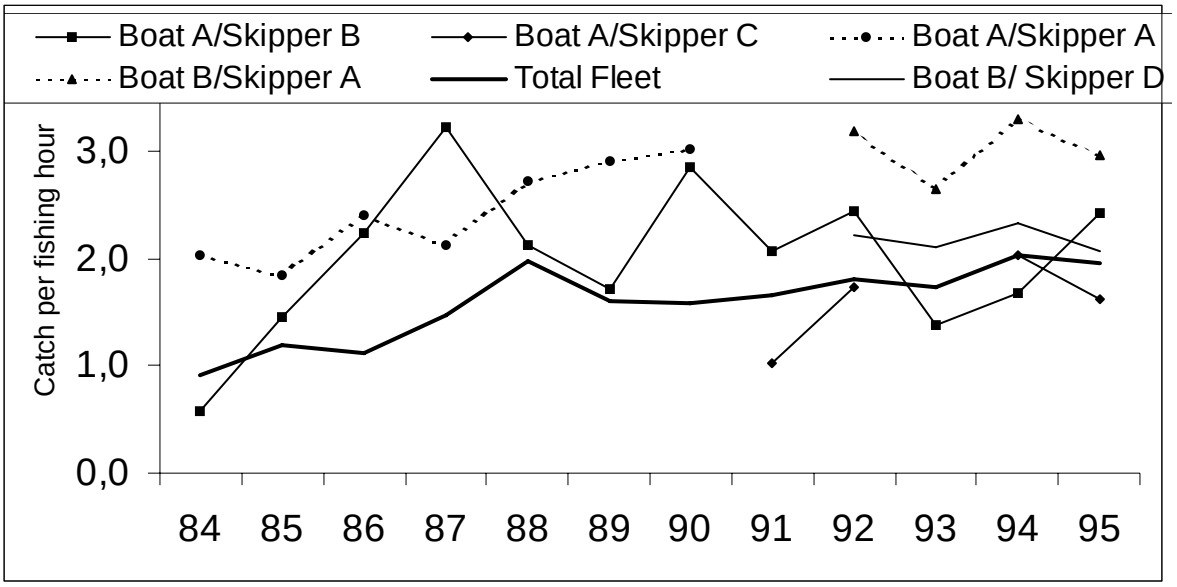

Figure 4.- Skipper Catch rate (t/fishing hour) of four skippers on board two different vessels compared with the average catch rate of the average skipper catch rate of the Spanish fleet operating in the Indian Ocean from 1984 until 1995 redrawn from Morón, 2004.

The influence of the skipper factor on the effective fishing effort could be, in certain cases, quite significant as we can appreciate in Figure 4. Skipper A has a significantly higher ability to catch tunas compared with other skippers in the same vessels and compared with the average of the fleet (70% higher catch rate than the average). Even when he changed from boat A to boat B, his catch rate is higher than the other skippers catch rate. Other skippers on board the same vessel have a lower catch rate than skipper A, although some have also a higher catch rate than the average (Skipper B 29% and Skipper C 16%), whereas Skipper D, replacing Skipper A in boat A, has a lower catch rate than the average.

This is just an example of how skipper performance could affect effective fishing effort estimates in tuna purse seine fisheries, but as it happens with the technological changes and gear modifications, the information needed to include skipper factor in purse seine effort standardization is very difficult to collect and trace back in history.

Multispecies nature of tuna purse seine fisheries

The whole exercise of managing tuna purse seine fishing capacity, becomes more complicated because of the multispecific composition of the catch. There are two major species that dominate the purse seine catch: skipjack (*Katsuwonus pelamis*) and yellowfin (*Thunnus albacares*). The third species caught in the purse seine fishery is bigeye (*Thunnus obesus*), with a significantly lower proportion of the purse seine catch.

Table 1 shows the average species proportion by fishing ground of the purse seine catch. It is well known that the Western Central Pacific purse seine fishery is dominated by skipjack catch (68%) and the Eastern Pacific by yellowfin catch (64%). The Atlantic purse seine fishery has a bigger proportion of yellowfin (53%) and the Indian Ocean of skipjack (50%). Bigeye average proportion of the total purse seine catch ranges from 3 to 7%.

Table 1.- Average species proportion of the purse seine fishery by major fishing ground (Data source IOTC, ICCAT and SPC Yearbook 2004).

Average Species Proportion	SK	YF	BE
Indian (1984-2004)	50%	44%	7%
Atlantic (1966-2004)	39%	53%	6%
Western Pacific (1951-2004)	68%	29%	3%
Eastern Pacific (1950-2004)	33%	64%	4%

When we consider the adaptation of the fleet capacity to the status of the stock, we have to consider the multispecific nature of the purse seine fishery and its evolution.

The status of the three major species caught by purse seiners is quite different.

It is widely accepted that skipjack populations are in a moderate state of exploitation in all the four major fishing grounds (IATTC 2005, ICCAT 2005, IOTC 2005 and SCTB, 2005), although in certain areas could be detected a local depletion of the Atlantic skipjack stock (ICCAT, 2005).

All four yellowfin stocks considered in the World, are fully exploited, at its maximum sustainable yield (MSY) in the Atlantic and Eastern Pacific (ICCAT, 2005,

IATTC 2005) or above de MSY in the Indian and Western Pacific Oceans (IOTC, 2005 and SCTB, 2005).

All bigeye tuna stocks in the world are considered to be overexploited (ICCAT 2005, IOTC 2005, IATTC 2005 and SCTB 2005).

When looking at the evolution of the species composition by major fishing ground we can observe different trends in the species proportion.

Figure 5 shows the significant changes in the species proportion of the Western Central Pacific purse seine fishery. During the 60's, the skipjack catch accounted with the highest proportion of the purse seine catch (60 to 80%) to decline in the early 70's. Since the mid 70's, the skipjack proportion has been increasing constantly to reach the current level of more than 80% (1.2 million tonnes). The reason for this increase could not be entirely related to the use of FADs, because its inception in the fishery was around the early 90's, and the increasing trend starts in the mid 70's. Accordingly the yellowfin catch proportion has been reduced since then.

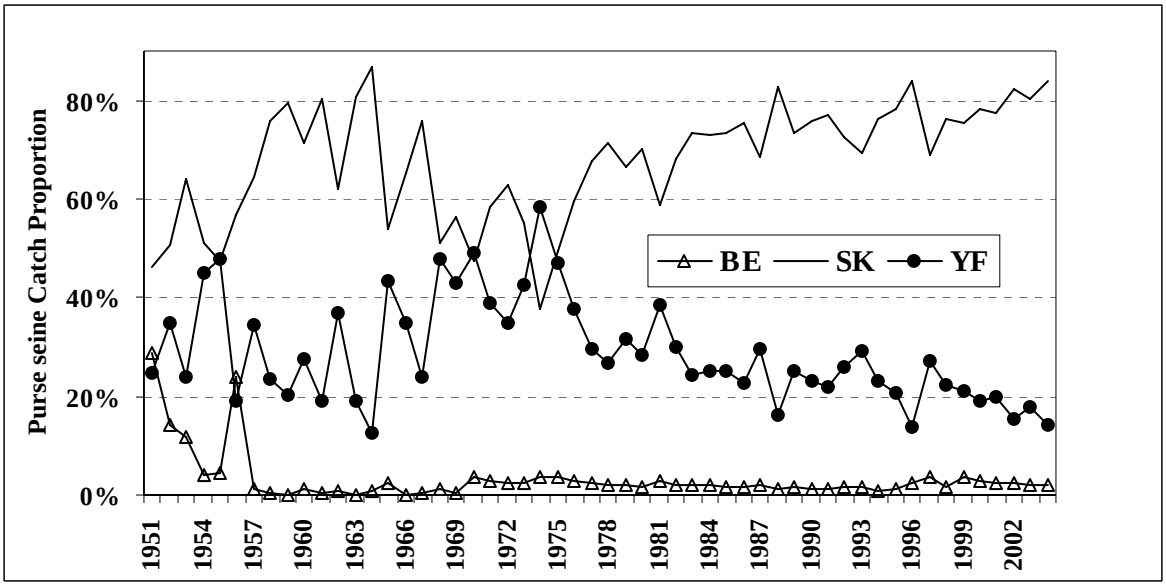

Figure 5.- Evolution of the proportion of the purse seine catch by species in the Western Central Pacific Ocean purse seine fishery from 1951 until 2004 (SPC Yearbook 2004).

The Eastern Pacific purse seine fishery has been dominated by the yellowfin catch since the beginning(Figure 6), with a period where skipjack and yellowfin proportions were similar in the 60's. Since then yellowfin proportion is over 50%, with periods (mid 80's mid 90's) over 70%. It is to note the increase in bigeye proportion since the mid 90's, being the highest bigeye catch proportion in the purse seine catch of any fishery in the World (average 12% in the last ten years). That increase in the bigeye catch estimates could be related with the introduction of FAD fishing and the sampling estimates made by IATTC. That increase in the bigeye proportion affects the yellowfin proportion.

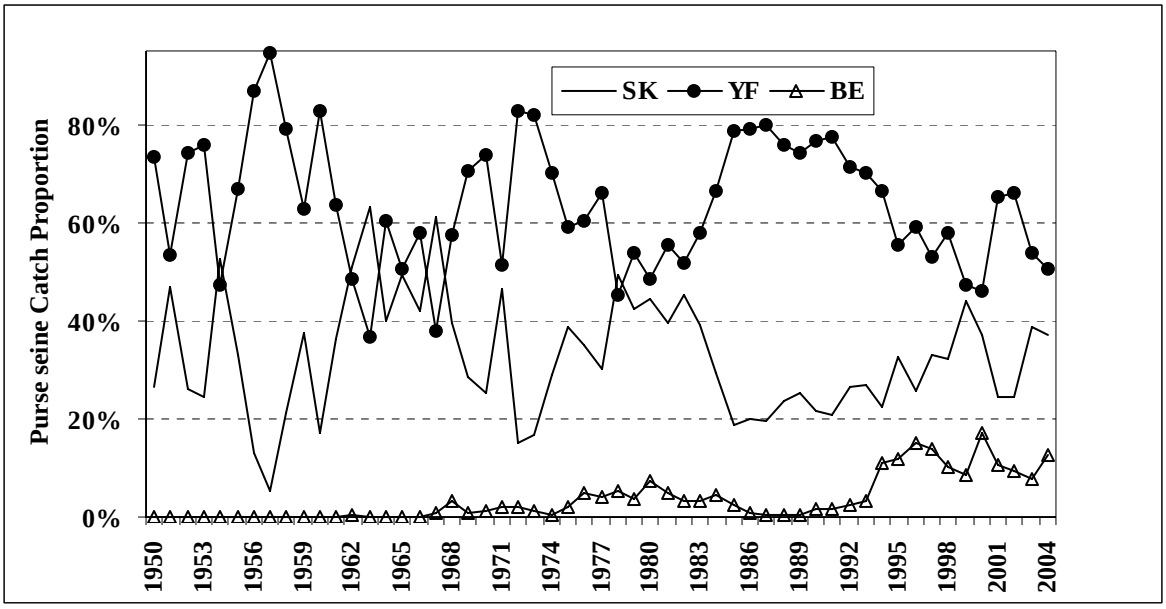

Figure 6.- Evolution of the proportion of the purse seine catch by species in the Eastern Pacific Ocean purse seine fishery from 1950 until 2004.

The Indian Ocean purse seine catch has been shared almost equally between the yellowfin and skipjack catch, with a bigger yellowfin proportion at the beginning and the end of the series (Figure 7). The bigeye proportion was somehow bigger in the late 90's (10%) but has been reduced in recent years (5%).

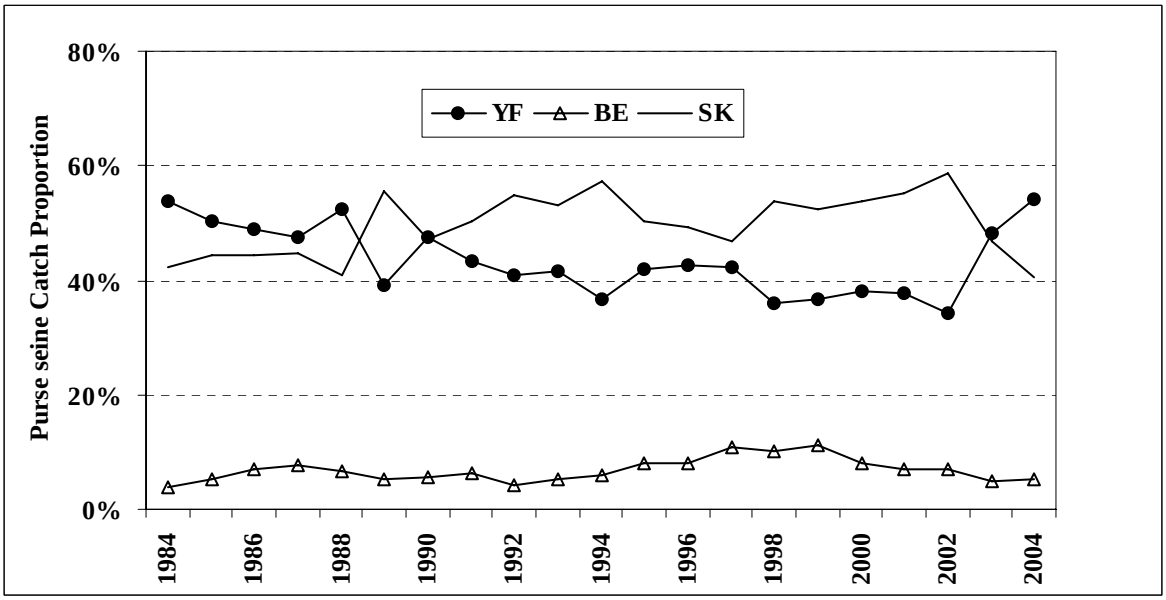

Figure 7.- Evolution of the proportion of the purse seine catch by species in the Indian Ocean purse seine fishery from 1984 until 2004.

The Atlantic purse seine fishery has been clearly dominated by the yellowfin catch (except from 1971 until 1974 and 1984) until the early 90's, when the catch is equally shared among the two main species (Figure 8). The bigeye proportion has increase in the

early 90's, probably related to the use of FADs in the Atlantic purse seine fishery (almost 10% from 1992 until 2004).

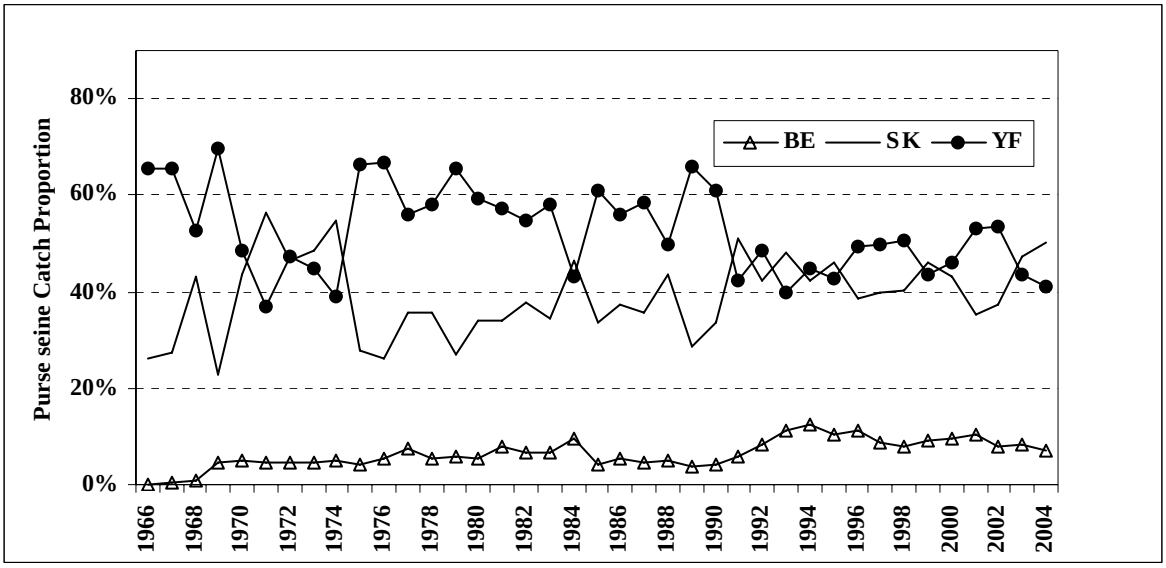

Figure 8.- Evolution of the proportion of the purse seine catch by species in the Atlantic Ocean purse seine fishery from 1966 until 2004.

The situation of the different tuna stocks, make us consider the need to apply different management options. But in some cases the stock condition of a species, like bigeye that is not the main species for the purse seine fishery, triggers the application of management measures on a fleet that has a limited impact on the stock condition of the species in question.

The reasons for the decline of the stock conditions of bigeye is a combination of the high long line fishing effort and juvenile catch by purse seiners and environmental conditions. Any management action should focus the whole fleet exploiting the species under consideration, because if the purse seine could be accused of taking a big number of juvenile fish under FADs, longliners could be also responsible of the overexploitation of the adult biomass. The bigeye stock condition lead to several discussions about interaction issues between the purse seine and long line gears with some intensive work during the early 90's (Shomura et al., 1991) without a clear conclusion on the effects between gear types.

When we talk about Limiting Fishing Capacity, an specific management action, it is a principle that should be immediately applied to all the industrial fleets (mainly long line and purse seine) exploiting the two major tropical tuna stocks: bigeye and yellowfin. With its application, we just stop the reason that could worsen the situation, and once limited the fleet, other management measures could be implemented to regulate the exploitation to its rational level, whatever the reference point considered.

EXISTING MEASURES FOR MANAGING TUNA FISHING CAPACITY

As we mentioned before, the first actual management measure taken in order to control purse seine capacity at RFO level was the Resolution C-02-03 on "*Capacity of the tuna fleet operating in the EPO*". Before that, the Palau Arrangement (FFA, 1992), was the first management instrument implemented at subregional level to control purse seine fisheries, setting a limited number of vessel to be licensed by the signatory countries of the Palau Arrangement.

Both cases are the only effective examples of fleet management in tropical tuna fisheries. Both are only concentrated in the purse seine fishery. The conditions of the purse seine fleet, its size, the importance of its catch and the way they operate (every trip unloading or transhipping at a lading place that facilitate control and monitoring), make this fleet the first target for management, being the IUU problem of residual importance in purse seine fisheries with only some recognised cases in the IATTC for non compliance (Colombian case) and in IOTC (Ex-Russian vessels, now legalised under Thailand flag).

IATTC

The raising concerns about the level of exploitation of the tuna resources and the threat of the increase of the existing purse seine capacity in the Eastern Pacific Region, were the driving forces to set up a limited number of purse seine vessels in 1998[4]. After four years of intense negotiations and six Special Working Groups on Fishing Capacity, the 69th Session of the IATTC in Manzanillo (Mexico) adopted Resolution C-02-03.

Resolution C-02-03 of IATTC provides a certain fleet capacity for every country member with a not well defined possibility of capacity transfer among "participants" (particular term used to include non-members of the Commission in the management scheme). One of the major problems in the application of this Resolution, has been in fact the transfer management. Until a later Commission meeting (73rd Session of the IATTC, Lanzarote, Spain), i.e. four Sessions later, the way that capacity transfer should be managed, was not defined. In confrontation there are two opinions: State right against Private right on capacity.

At the time of the negotiation of the resolution after four years of intense work, every country was allocated with a certain fleet capacity that was first measured in tons of carrying capacity, to be later transformed in cubic metres of fishing wells in trying to get an objective unit of fishing capacity. As a result of negotiation every country had what they could and some were given a certain time frame to develop the capacity given. The principle rule for the negotiation was to freeze fleet capacity at the level of 1998, although some changes were introduced during the negotiation until the final adoption of the

[4] Resolutions to limit the capacity of the tuna purse-seine fleet in the EPO approved by the IATTC at its 62nd Meeting in October 1998 and by correspondence on 19 August 2000

resolution in 2002. In general the allocation issue was overcome by certain imposition of the fishing countries, at the same time coastal countries, over the non yet participants in the fishery.

After that, the evolution of the fleet, has been of a certain increase improving the margins given for the non participants in the fishery. But the most significant event, after the adoption of the resolution has been the transfer of fleets between countries. Whereas there are countries that allow free entry and exit of vessels, recognizing a certain right to the ship owners in moving from one country to another, there are others that are very closed in that perception and consider the fleet capacity and in-transferable right that belong to the country. In the later case, if a ship owner wants to, or it is forced to move from a register to another, they should find idle capacity to be able to include their vessels in the registry and continue fishing under the scheme. That has a major risk: the arbitrary use of the capacity right, generated by a private entrepreneur, by certain countries with limited or volatile legal security.

It is now the time that after four years of implementation of that resolution, the different situations presented by certain governments participating in the scheme, are and soon will be source of hot political discussions on the IATTC meetings in relation with maintaining the basic principle of that Resolution, that is the non increase of the purse seine fleet in the Eastern Pacific.

PALAU ARRANGEMENT

The concerns about the level of exploitation of tuna resources in the Western Central Pacific Region (Muller and Wright, 1990), was the driving force to prepare the ground for the signatory of the Palau Arrangement (PNA). This arrangement first set a maximum number of purse seine vessels to be licensed by the members of the PNA in 1990, giving access to 164 purse seine vessels in the EEZ of the PNA country members, including adjacent high seas in the WCP where purse seine vessel operate. This concept is out of the UNCLOS legal framework, and is the main reason why this scheme had not big support from fishing countries. That limit it was later raised up to 205 purse seine vessels in 1993 (Dunn et al., 2006).

This limit is still effective until the entry into force of the new Vessel Day Scheme (VDS) by the beginning of 2007. The reason for a change in the management scheme in the PNA countries aims to *"enhance sustainability of the Western and Central Pacific purse seine fishery by controlling the level of fishing effort"* from the biological perspective. And from the economic perspective "*it aims to increase economic benefits to resource-owning states by creating a real limit on fishing days that will create a demand from vessel operators for these days*" (Dunn et al. 2006).

The first concern of the private operators is the way that the number of days may be set. There is a general intention to limit fishing effort to the 2004 levels, but there might be other elements taken in account when finalising the total allowable effort with particular focus on fishery development. There are other exemptions that will be considered in the

new scheme to the Multilateral Treaty on Fisheries with the United States (UST) (FFA, 1987) and the FSM Arrangement for Regional Fisheries Access (FSMA) (FFA, 1994), that will reduce the number of days available for the rest of the operators.

The different fees to be paid by vessel size and the possibility of carry over fishing days for future years, burrow from future years and transfer among PNS members, could be in a way limited by the three year limit of the scheme. This might produce difficult situations in certain years when no fishing days might have been sold by certain parties, and an excess of fishing days will be offered the following years, producing certain levels of excessive fishing effort in particular years.

CONCLUSION

Hilborn and Walters (1992) mentioned a first principle on fisheries management: "*You cannot determine the potential yield from a fish stock without overexploiting it*". We believe that this time it might have not arrived for the particular case of skipjack, but the other two species caught by the purse seine gear, yellowfin and bigeye, are ready to be considered overexploited. Unfortunately, the situation has evolved in the way, where the fishing effort is above the MSY levels, and most of the Scientific Committees of the RFOs, recommend an effort limitation or reduction for both species and for all the gears that exploit them.

The same authors propose a second principle that is of key importance for the purpose of the Management of Tuna Fishing Capacity: "*The hardest thing to do in fisheries management is reduce fishing pressure*" (Hilborn and Walters, 1992). In applying a limitation of current fishing capacity in all the four major tuna fishing grounds, we will not address the problem of effort reduction. With a capacity limitation we only be able to make that the problem will not be worst in the near future, because the effective fishing effort will continue to increase due to technological advances and other factors, and therefore the stocks will still be subject to increasing fishing pressure.

A feasible fleet management scheme for the tropical tuna fleets should have in consideration the following principles:

- Recognizing the difficulties in assessing the proportional fleet capacity to the stock status, and applying the Precautionary Approach, the application of an immediate fleet capacity limitation to the current number of vessels operating in the four major tuna RFOs (IATTC, ICCAT, IOTC and WCPFC) should be the first priority.
- Any fleet capacity scheme should be applied equally to all the industrial fleets exploiting the two major tropical tuna species: yellowfin and bigeye.
- Until a feasible quantitative tool could be developed and feed with adequate data to estimate fleet capacity in relation with stock status, current number of vessels, translated into capacity measure (preferably cubic metres), should be used as limiting factor for capacity.
- Under a RFO state based capacity scheme, privately generated rights should be considered by Governments to allow free transfer of fleets among country members of the RFO in order to avoid later increases of

capacity. That should provide legal security for private operators operating in different countries.

- Only ships flying the flag of the members or cooperating parties (CPC) of the RFOs which are actually fishing in the RFO competency area and adequately registered in the corresponding RFO register should be allowed to exercise its rights to fish.
- Tuna fishing, unloading, transhipment, warehousing, marketing, exportation, and importation will be allowed only to the boats registered in the respective RFO. Ships that are not registered in an RFO shall be strictly and efficiently forbidden to carry out any activity mentioned above.
- In order to link Responsible Fisheries with Responsible Markets, apply a marketing certificate, exclusive for every boat included in the RFO Registry with a good standing, compulsory for the commercialisation of tuna products

Burrows (2006) mentions that "*Perceptions of stakeholders must be addressed equally as well as facts in the allocation process if decisions are to be supported*". This is a final remark that we want to address, because the lack of communication among stakeholders (mainly coastal countries and private operators) is some times mislead by the intervention of certain third parties (government agencies, consultants, NGOs,…) with different interests or agendas. Any management scheme proposed should count with the direct involvement and support of the major actors affected by the application of such scheme to optimise the level of compliance.

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