NOTE ON POTENTIAL INDICATORS OF THE JAPANESE LONGLINE FISHERY TARGETING BLUEFIN TUNA IN THE ATLANTIC

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SUMMARY

This paper proposes a more active use of various fishery indicators showing the changes observed in the Japanese longline fishery targeting bluefin, a fishery that is of major importance in the studies of this stock. The paper first reviews various types of geographic indicators, based on ad hoc fishing maps and pie diagrams showing the main characteristics and changes in this fishery. The main indicators studied are measuring the efforts targeting bluefin using three methods, the corresponding CPUEs and the sizes of the area fished, yearly and monthly. The large anomalies observed during 2009 in this bluefin fishery should be further analyzed in 2010 based on the finalized catch and effort data set.

RÉSUMÉ

Cet article propose d'utiliser plus activement divers indicateurs qui peuvent être calculés sur la pêcherie de palangriers japonais qui cible le thon rouge de l'Atlantique Nord. Cette pêcherie est en effet d'une importance majeure dans l'étude de ce stock. L'article examine tout d'abord divers types d'indicateurs géographiques, basés sur des cartes de pêche ad hoc et sur des diagrammes camembert destinés à bien montrer les principales caractéristiques et les changements dans cette pêcherie. D'autres indicateurs sont aussi proposés pour mesurer les efforts de pêche visant le thon rouge, les CPUE correspondantes et les surfaces pêchées par la pêcherie (mensuellement et annuellement). Les fortes anomalies observées en 2009 dans la pêcherie de thon rouge devraient être analysées en 2010 en traitant les données finalisées de prises et d'effort.

RESUMEN

Este documento propone un uso más activo de diversos indicadores pesqueros que pueden calcularse a partir de los cambios observados en la pesquería de palangre japonés que se dirige al atún rojo del Atlántico norte, una pesquería de gran importancia para los estudios sobre este stock. El documento revisa primero diversos tipos de indicadores geográficos basados en los mapas de pesca y en los diagramas de tarta ad hoc *que muestran las principales características y cambios en esta pesquería. También se propusieron otros indicadores para la medición de los esfuerzos dirigidos al atún rojo, las CPUE correspondientes y los tamaños del área pescada (anual y mensualmente). En 2010 deberían seguir analizándose las importantes anomalías observadas en 2009 en esta pesquería de atún rojo, basándose en los conjuntos de datos de captura y esfuerzo finalizados.*

KEYWORDS

Catch/effort, exploitation, longlining, bluefin, fishing effort, fishing grounds, Japan

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1. Introduction

The Japanese longline fishery is of keystone importance in the stock assessment of North Atlantic bluefin because of various additive reasons such as:

- The **long duration** of its statistical series: about 50 years of fisheries targeting bluefin,
- The **importance of the fishery**: Japanese longliners have been providing since 1960 a great majority, 67%, of bluefin caught by longliners in the Atlantic.
- The **good quality** of this data base: probably one of the best statistical series available in the Atlantic,
- **Bluefin targeting**: this longline fishery that has been targeting more or less permanently large size bluefin, at least a significant fraction of the fleet, then targeting fishes from the spawning stock.
- The **very large size of the fished areas**: an average yearly surface of approximately 2.6 million km^2 with bluefin catches by the fleet (1975-2009 period) and a much wider area exploited. Such wide areas should be potentially much more informative of the adult stock biomass than a seasonal and localized fishery, such as the Mediterranean fisheries (keeping in mind that bluefin tunas have been often changing their areas of concentration).

In such context, there should be no doubt that Japanese longliners data should play a major role in all bluefin stock assessment done by ICCAT: their data set should constitute a major input in the stock assessment model, and the main results of these analysis, for instance the trend in adult biomass, should be in good agreement with the Japanese longline trends. However, it is also clear that Japanese longliners have been showing major changes in their fishing patterns and in their fishing strata targeted for bluefin. There is no doubt that these changes may easily introduce some potential bias in the CPUE/biomass relationship of bluefin. These major changes have been permanently observed since 1960, and they have been important during recent years, a period during which the level and trend of adult bluefin biomass remains widely questionable.

The Japanese document SCRS/2010/66 and the report by the June 2010 bluefin Working Group made a quick review and a discussion of this matter, but these points may need further examination and discussion. This paper will try to add some additional light upon various changes recently observed in this very important Japanese fishery that may not be highly visible in the report of the ICCAT WG.

This document will propose to establish and to use routinely several fishery indicators describing the Japanese longline fishery fishing activities on bluefin tunas, based on the basing principle that the results of the best stock assessment results should be fully consistent with the catch/effort/sizes trend of these Japanese longline indicators. Furthermore, it will make additional comments on the ICCAT June 2010 bluefin WG report based on the observed trends of these basic indicators and also on the necessary convergence between these Japanese fishery data and the best stock assessment results.

The Japanese catch and effort data of Japanese longliners used in this paper was the statistical data set submitted by Japan to the ICCAT secretariat in June 2010 for the preparation of the 2010 bluefin stock assessment. In such context there is no doubt and it should be accepted by scientists that the 2009 data set is still widely provisional, when the 2008 catch and effort data set may also be still provisional.

2. A potential check list of potentially useful fishery indicators of Japanese longliners and the bluefin fishery

2.1 Average monthly fishing maps showing bluefin catches

Fishing maps of average catches are always very interesting to make and to discuss, and they should preferably be done during a period of relatively stable fishing pattern. This conclusion is always valid, even is series of maps cannot be considered as being real indicators. The first type of basic fishing maps should for instance show the average catch by 5° areas during recent years and the proportion of bluefin in these catches by area. Another important type of maps should be the average monthly maps of bluefin catches during recent years, for instance during the period 1990-2008, a recent period of nearly 20 years, selected because of the relative homogeneity of the Japanese fishing patterns.

2.2 Pie diagrams showing time and space variability of fished zones

Figure 4 shows the monthly catches of bluefin (in numbers) taken by Japanese longliners in the Atlantic since 1960, but independently of the fishing zones. Fishing zones are necessarily used by scientists in their stock

assessment analysis, for instance the fishing zones chosen by SCRS 2001 and used in a revised form by document SCRS/2010/66, and it is always interesting to make the corresponding pie diagrams showing time and space variability of these fished zones. Such diagrams of yearly and monthly catches are always useful to consider, because they easily provide a time and space overview of past changes in the fishery. Such pie diagram should preferably cover the entire history of the fishery. These pie diagrams have been done to show Japanese total monthly catches and also catches by area, in the areas used to estimate bluefin CPUEs (with a minor adjustment done in order to isolate the historical Brazilian area). Two types of diagrams will be done to illustrate the changes in catch by time and area strata: on a yearly scale for the entire Atlantic Ocean and on a monthly scale during recent years (since 1990) for the 6 areas fished during this period.

2.3 Fishing effort targeting bluefin?

It is of great scientific interest to directly estimate the fishing efforts that have been targeting a given species or a group of species, and to compare this targeted effort to the level of global fishing efforts of he same fleet. In the case of the bluefin fisheries, this scientific target should be quite easy to reach because bluefin tuna tend to be quite a mono-specific target species, inhabiting peculiar temperate ecosystems and showing variable but clear seasonal patterns. As a consequence, when bluefin is targeted by longline fisheries, its catches in the fished strata tend to be dominant, few other species being caught in association with bluefin[2]. During the period since 1970, a large majority of the bluefin catches taken by Japanese longliners were obtained in 5°-month strata where bluefin was the major species in weight.

As a consequence, it is quite easy to estimate *a posteriori* the total fishing effort targeting bluefin based on this species composition. This method is described in **Annex 1**.

However, it should be kept in mind that such method, based *a posteriori* on the species composition of the catches, may be misleading and potentially biased, because of the declining catches of the target species: when the biomass and CPUE of the target species are heavily declining and very low, fishing efforts that have been targeting this declining biomass will be increasingly eliminated, simply because CPUEs and catches have been widely reduced, possibly reaching zero in the best bluefin fishing strata. In order to avoid this potential bias, two alternate estimates of nominal fishing efforts targeting bluefin have been estimated:

> Fishing efforts based on “fixed monthly core fishing zones” that have been chosen to be typical of bluefin in the recent longline Japanese fisheries (i.e. after 1990) (see **Annex 2**).

> A third type of specific indicator of bluefin tuna fishing effort has also been estimated, based on the historical bluefin catches by 5°-month strata: all efforts exerted in strata with a minimal catch of at least 30 bluefin individuals taken in each 5°-month strata during the period 1990-2009 have been classified as potential bluefin effort (see **Annex 3**).

These types of nominal “bluefin fishing efforts” indicators are quite interesting as they may allow to directly measure the level and trend of targeted bluefin fishing efforts exerted by longliners by Japanese vessels and to isolate them from fishing efforts that have been targeting tropical tunas or albacore. This type of indicators may be useful in various cases, for instance (1) they should be consistent with the SCRS reports and the text describing trends in the longline targeted fishing efforts and (2) such nominal targeted effort should be usefully analyzed in comparison with trend of partial fishing mortality estimated by stock assessment models, and also potentially allowing to estimate changes in stock catchability for this gear.

2.4 Bluefin nominal CPUEs

It is also possible, interesting and easy, to simply calculate indicators of yearly nominal CPUEs based on the various types of previously estimated bluefin fishing efforts. These bluefin nominal CPUEs have been estimated following the three methods described in **Annexes 1 to 3** that have been used to estimate nominal fishing efforts targeting bluefin. Such basic indicators of bluefin nominal catch rates can be quite interesting to compare between themselves, and also to compare with the trend of longline CPUEs estimated by Japanese scientists and used by SCRS.

[2]The only anomaly being observed in the historical Brazilian LL fishery when BLUEFIN catches were taken in great quantities but always mixed with yellowfin and bigeye

2.5 Yearly sizes of the bluefin fishing zones

The size of the fishing area explored by the longline fleet and the size of the fishing area successfully fished by longliners should also be an interesting indicator to consider, as changes in fishing zones may be in relation with stock status, with environmental factors, or with other causes. This conclusion is of peculiar interest and it should be an easy goal for SCRS scientists, in the peculiar case of bluefin tuna, a "very clear target species". Such a geographical indicator should preferably be based on 1° square catch and effort data (such 1° squares fished areas should easily be estimated by Japanese scientists based on their operational data), but it remains possible and useful to estimate these area sizes based on the 5° square areas that are the only ones presently available in the ICCAT data base (simply keeping in mind that the 5° squares estimates will tend to overestimate the real sizes of the areas fished).

Three types of indicators measuring these changes in the sizes of bluefin tuna fished areas are proposed:

(1) **Size of fished area:** A first indicator simply measuring the sizes of the areas where bluefin was caught during year (with a minimal level of more than 1 tuna caught).

(2) **Size of targeted areas**: A second indicator measuring the yearly sizes of the areas where bluefin was (probably) the target species (see **Annex 1**), selecting all strata where/when bluefin corresponded to more than 10% of number of tuna caught. This first indicator is calculated in two ways:

a) on a yearly scale, and b) as the average sizes of the monthly areas successfully fished for bluefin.

A subsequent interesting indicator is RS, the percentage of the monthly fished areas, as a function of the sizes of the yearly area fished: when a fishery exploits each month and all year round the same stable fishing zones, it will show a RS close to 100%; on the opposite, when the fishery exploit a highly mobile small monthly fishing zone, typically the bluefin longline fishery, this RS indicator will show a low RS rate, indicative of the fishing zone seasonal variability.

(3) **Size of areas fished in the bluefin monthly habitat**: a third indicator measuring the yearly sizes of the areas where bluefin could have been potentially caught by longliners when their fishing efforts was exerted in "typical bluefin fishing strata", i.e. in all 5°-month strata that have been producing at least 30 individual bluefin during the 1980-2009 (i.e. an average of 1 individual per year) (see **Annex 3**).

2.6 Average weight of bluefin caught

The average weight of tuna caught is a very important parameter in all tuna stock assessment analysis: (1) as it conditions the yield per recruit obtained by the fishery, and (2) it can provide indirectly a size specific qualitative measure of abundance. The average weight of tuna caught by given fleets is most often based on the size sampling of the catches, sampling done at sea by fishermen, or size sampling done in port by field technicians. However, it appears that during recent years Japanese longliners have been widely reducing their size sampling and these results are often considered as being increasingly questionable (and not really representative of the total sizes caught), and especially when the scientific target is to simply estimate the yearly average weight caught. On the other side, Japanese longliners offer a peculiar and alternate efficient way to estimate average weights caught: simply dividing total catch in weight (Task I) by the number of bluefin declared in the Task II. As it can be assumed that Japanese Task I catches are fully valid data, and that the log book coverage is close to 100% (all individual bluefin being well recorded in these logbooks, probably the case now and with a log book coverage very close to 100%), such average weight should be a realistic indicator of the average sizes of bluefin caught by this fleet, probably much more realistic that the average weight estimated from an increasingly reduced size sampling. Such indicator should at least be usefully compared to the average weight of the catch presently estimated by ICCAT from the size sampling data.

3. Review of Japanese longliners bluefin indicators

3.1 Average fishing maps showing bluefin catches and species composition of total catches

The two maps, **Figures 1 and 2**, show the recent geographical fishing pattern developed by Japanese longiners since the early nineties. **Figure 1** shows the average yearly catches of bluefin during the 1990-2009 period, total catches being distributed between 15° and 65°N, but mainly in the central western Atlantic between 30°W off the U.S. coast and the NW area at 60°N off Iceland and the Faroe Islands. This main fishing zone is divided in

two West and East sub-components by the ICCAT bluefin frontier at 45°W. An alternate major fishing zone of the Japanese fleet was located between Azores Islands and the Med, but the quantities caught in this area remain of secondary importance compared to the northern areas. **Figure 2** shows the average species composition of tuna catches, bluefin versus other tunas in weight, taken by the Japanese fleet during the same period in the North Atlantic. Such basic maps shows the various northern areas and in the Mediterranean Sea where bluefin tuna have been caught (at a multi-annual scale) as a pure species, 100% of bluefin (then by a "bluefin fishing effort"), and the central and southern Atlantic where bluefin tend to be caught mixed with other species, at least on an average pluriannual scale. It can also be noted that bluefin has been very seldom caught south of 30°N, and it can be considered that subsequently all fishing efforts exerted south of this latitude have been exerted on other tuna and billfish species, not on bluefin.

3.2 Average monthly fishing maps showing bluefin catches

Figure 3 shows the average monthly catches of bluefin taken by Japanese longliners during recent years (average 1990-2009). This map would tend to show that there was during this period a very strong seasonal anti clockwise "migration pattern" of the longline fleet. It could easily be hypothesized that this movement of the longline fleet corresponds, at least to some extent, to a similar seasonal movement pattern of the adult bluefin biomass, between its main feeding zones in the NW Atlantic (November to February) and its main spawning zone in the Mediterranean Sea and Gulf of Mexico (June): these tuna concentrations being + or – permanently followed and targeted by a highly mobile fleet of Japanese longliners. Monthly fishing maps (available under request) have been also done and they tend to show that this average migration pattern of the fishery (and of the fishes?) tend to be observed each year. This conclusion will be indirectly shown by the pie diagrams of **Figure 7** (monthly catches by areas). On the other side, when the sizes of bluefin that are caught monthly in these various fishing zones show some heterogeneity of the sizes caught each month, but within the group of adult large fish. This heterogeneity of sizes taken may be due to various reasons, and its time and space variability should be further studied in relation with the migration hypothesis suggested by **Figure 3** (and also by various recent scientific papers such as Block et al 2004, Galuardi et al 2010).

Furthermore, it can also be noted that such sequence of average monthly fishing maps does not encourage the SCRS scientists to use the 45°W frontier between 2 western and eastern bluefin stocks, established by the ICCAT Commission in 1981 (ICCAT 1982) and since accepted and routinely used by SCSR scientists, when serious scientific questions have been permanently cast (*inter alia* by the US NRC, Magnuson et al 1994 report) on this artificial 1981 frontier established by the ICCAT Commission, not by SCRS scientists .

3.3 Pie diagrams showing time variability of bluefin monthly catches taken by Japanese longliners

This basic pie diagram of monthly catches shows well various of the changes in the bluefin Japanese fishery, in the historical time and today. It should for instance be noted that the seasonal patterns of bluefin catches have been remarkably stable during the 1995-2008 period. On the opposite, the pattern of bluefin monthly catches observed in 2009 was totally atypical: very low catches observed during the January to August period, and major catches (in numbers, small bluefin) taken in October and November.

3.4 Pie diagrams showing time and space variability of fished zones

The area used to do the pie diagrams are the areas used by SCRS since 2001 in CPUE analysis, shown by **Figure 5**. This **Figure 6** offers a simple and immediate summary of the historical changes in bluefin fishing zones by Japanese longliners. It shows well the beginning of the North central Atlantic fishery in 1993, and the relative stability of the fishing patterns by areas since that year. It also shows the major anomalies in the fished zones observed in 2009, most of the bluefin catches being taken in a the northern area 4 south of Iceland.

These pie diagrams show the stability of seasonal & geographical fishing activities developed by Japanese longliners targeting bluefin tuna in the North Atlantic since 1994. The only major anomaly again was observed in 2009, when most of the bluefin catches were taken during 2 months and in the limited fishing area 4, south of Iceland (see **Figure 8**). These maps and pie diagrams also show the marked seasonality and the between years variability of fishing patterns that have been permanently observed for this bluefin stock and the Japanese fishery. Such figures are always interesting to consider and to keep in mind in the bluefin tuna stock assessment analysis as they may help to understand and to correct strange behaviour in the residuals and/or results of some stock assessment models, for instance in 2009 a totally atypical year in the fishing pattern of the Japanese fleet (and also of size taken, paragraph 3.7).

3.5 Fishing effort targeting bluefin

(1) Bluefin tuna fishing efforts estimated in 5°-month strata with a minimum percentage of bluefin (compared to tuna catches)

These nominal fishing efforts have been estimated as described in the annex 1 of this paper. These efforts have been estimated following 3 percentages of bluefin taken (in number) in each 5°-month strata by Japanese longliners. These fishing efforts are shown **Figure 9**.

This figure would allow concluding that this method allows to reach estimates of bluefin fishing efforts that are very similar in levels and trends. The fishing efforts estimated at a highly significant proportion of bluefin, for instance 20% in number (i.e., approximately 40% in weight) could well be selected and kept as providing the best series of nominal bluefin efforts estimated by this method.

These bluefin fishing efforts would allow to conclude that the nominal fishing targeting bluefin were at quite low levels during the historical period 1975-1990, and since at much higher levels. These bluefin fishing efforts were at relatively low levels during recent years (2006-2009 period), but still remaining at much higher levels than in the previous period 1975-1990.

(2) Bluefin tuna fishing efforts estimated in core bluefin tuna monthly areas of recent Japanese longline fisheries

The analysis of bluefin yearly catches in the selected core bluefin areas (shown in the **Annex 2**) shows that a great majority of the yearly bluefin catches have been taken in these recent core areas. The yearly percentage of bluefin in these monthly "bluefin core areas" is given by the following **Figure 10**. This **Figure 10** shows that very high percentages of the bluefin catches have been taken each year in these core monthly areas: an average of 90% of the bluefin catches taken in these core areas since 1990. The corresponding nominal fishing effort targeting bluefin in these monthly core areas are shown by **Figure 11**. These estimated nominal fishing efforts targeting bluefin are quite similar in level and trend compared to the efforts estimated by the previous method.

(3) Targeted bluefin effort: bluefin tuna fishing efforts estimated *a posteriori* as the total of all fishing effort exerted in every 5°-month strata where at least 30 bluefin tuna have been caught during the last 30 years by Japanese longline fisheries. This method (described in annex 3) also allows to estimate a 3rd type of fishing effort that have been potentially targeting bluefin and these fishing efforts are shown **Figure 12. T**hese fishing efforts exerted in potential bluefin fishing strata are showing a similar trend than the 2 previous ones, but recent efforts (2007-2009) being at lower levels similar to the historical low levels of the 1975-1994 period. **Figure 13** shows the levels of total and bluefin fishing effort exerted by Japanese longliners during recent years. It allows to do the following comments:

- The levels and trends of these three fishing efforts are quite comparable. The observed differences in their levels are easy to understand, for instance the effort based on observed catches tend to be lower and underestimating the real bluefin effort as in the absence of bluefin catch this effort has not been identified as being a bluefin effort.

- Percentage of Japanese longliners effort targeting bluefin tuna has been always quite moderate , being during the period 1990-2009 in a range close to 25% of the total effort developed by the fleet (or at a lower level between close to 20% in the early period 1975-1989) in the Atlantic Ocean.

- Recent fishing effort exerted by Japanese longliners, total and bluefin fishing effort, have been declining during recent years, but these fishing efforts exerted on bluefin tuna during recent years were still higher, or at their previously observed historical levels: Japanese longliners cannot yet be considered as being a vanishing fleet, as its fishing efforts targeting bluefin are still sustained.

3.6 Bluefin nominal CPUEs

CPUEs (in number) in strata where bluefin tuna was estimated to be "the target species"

These CPUEs, (**Figures 14, 15 and 16**) based on bluefin targeted efforts (described in **Annex 1**) show very similar levels and trends, independently of the level of bluefin percentage in the total tuna catches: for instance at levels of 10, 20 and 30%. As the average weight of bluefin tuna caught are much larger than for other tunas, and

as the value per kilogram of this species is much higher than the value of other species (these 3 percentages in numbers correspond to a large or very large proportion of the value caught). These CPUEs have been always plus or minus corresponding to strata with targeted bluefin fishing efforts.

These CPUEs are showing a moderate and steady decline during the 1975-1990 period, followed by a plateau. The CPUEs observed in 2007 and 2008 where at relatively high levels, being the highest CPUEs observed during the last 13 years, when the 2009 CPUEs are at average level.

CPUEs (in number) in mobile core bluefin monthly areas

These CPUEs has been calculated following the method described in **Annex 2**. These CPUEs show a trend similar to the CPUEs in targeted 5°-month strata: a moderate and steady decline during the 1975-1990 period, followed by a plateau and 2007-2009 CPUEs being at relatively high levels (again the highest CPUEs observed during the last 25 years). The 2009 CPUEs were also at a high level.

3.7 Yearly sizes of the bluefin fishing zones

Size of bluefin fishing areas

The sizes of the three types of bluefin fishing areas described in paragraph 3-5 have been calculated and are shown by **Figure 17**. The sizes of these three yearly fishing zones show very similar sizes and also a slow but steady increase during the 25 years during the 1980-2005 period, and later show a marked decline after 2005, and especially in 2009. In 2009, the three sizes of areas fished for bluefin tuna are at their lowest levels observed during the last 20 years. It can be also noted from these indicators that when an average of 1.5 million km^2 , then a relatively small fishing zone, have been targeted for bluefin each month by the fishery during the 1975-2009 period, when a much larger zone of 8.5 million km^2 have been exploited at a average yearly scale (**Figure 19**). It can then be noticed that the average monthly surface targeted for bluefin during the 1975-2009 period (1.52 million km^2), was only 18% of the yearly targeted areas (8.54 million km^2). Furthermore, the area targeted for bluefin during the entire 1975-2009 period was much larger, 24.5 million km^2 then also showing a quite large variability of fished zones among years.

The yearly ratio of the monthly and yearly sizes of the area fished are plotted **Figure 18**, show a low variance between years of this parameter, and also show a declining trend during the period 1975-2009. This low and declining ratio probably corresponds to a major characteristic of this bluefin fishery: a highly mobile fleet that has been permanently and heavily targeting a small fraction of the bluefin habitat and stock. The decline of this indicator may well correspond: (1) either to a change in the fleet targeting, and/or (2) to a change in the biomass distribution or movement patterns and this matter should be further studied.

Size of the bluefin habitat explored

The yearly sizes of the bluefin Japanese longline fishery, based on the monthly and yearly sizes of the bluefin monthly habitat (method described in **Annex 3**), are shown by **Figure 19**. The total size of these bluefin potential areas during the 1975-2009 period has been reaching a total of 20.7 million km^2.

3.8 Average weight of bluefin caught

These average weights, based on the ratio of Task I in weigh vs. Task II in numbers (see paragraph 2-6) are shown **Figure 20**. This estimated average weight appears to be lower since 1985 (117 kg, vs. 149.kg during the historical period 1960-1984), but without clear trend, and showing a plateau since 1985. However, the average weight caught estimated for the years 2006 and 2007 (84 and 87 kg) appears to be quite low, and the 2009 average weight appears to be extremely low: only 34 kg (this weight would be the lowest average weight ever observed in the history of this fishery). There is of course a possibility that this average weight may be too low, due to the provisional status of the data base available in July 2010, but this average weight will probably remain at a very low level. It was probably linked with the very peculiar time and area strata fished by the 2009 bluefin fishery: 79% of the bluefin catches in 2009 have been taken in October and November, when in the typical fishing pattern developed by Japanese longliners during the 1995-2008 period, this catch acounted for only 35% of yearly bluefin catches.

4. Discussion on the potential role of the proposed indicators:

These indicators offer a visual overview of Japanese longliners activities when they have been targeting bluefin in the Atlantic during the last 50 years. Such basic indicators are strictly linked to the catch and effort Task II file by 5° and month, but they allow having a quick and realistic synthesis of some important parameters of this file, a result sometimes quite difficult to obtain by other methods. Such indicators may also allow modifying some of the conclusions by SCRS scientists; for instance when the report of the 2010 data Working Group made the following conclusion:

> *"The Group discussed the implication of the reduction of the number of Japanese longline vessels operating in the Atlantic Ocean. Traditionally, the CPUE of the Japanese fleet was considered important for assessment purposes due to the relatively high volume of bluefin catches by this fleet. However, given that the number of vessels (and therefore the catches) and area of operation of this fleet has been reduced, the Group agreed that the situation has clearly changed"*

The present overview of the Japanese indicators would allow quite different conclusions, for instance:

(1) on the level of bluefin fishing efforts that are still high and probably significant.
(2) on the large size of bluefin fishing zones, at least until 2008.
(3) on the great amount of information still available in the CPUE series of this fishery.

A point of major importance in any stock assessment diagnosis done by SCRS on bluefin is that this diagnosis should necessarily be consistent, at least widely, to the various basic information provided by Japanese longliners, the major fleet targeting bluefin in the entire habitat of the population and stock (and with good statistical data). As an example, it is striking to note that the rather "dramatic" trend of adult biomass that was estimated by some of the SCRS results in 2008, and later used widely by Monaco to built its CITES proposal in 2009, are totally inconsistent with Japanese data. As an example, it should be hard to conclude that the bluefin adult total biomass in the eastern Atlantic was nearly vanishing in 2008 (as it was shown by the Monaco-CITES **Figure 21**), when all the fishery indicators of the Japanese fishery (CPUEs shown by **Figure 22**, fished areas, sizes caught) were stable (areas and sizes) or CPUEs (increasing) during the period post 2003 of vanishing adult biomass.

It should of course be recognized that the stability of these Japanese indicators do not constitute an irreversible proof that the condition of the adult bluefin stock was stable, or even improving, but this major divergences between the results of the best stock assessment model and the trend observed in the "best" fishery are rather striking. They should necessarily be carefully examined and discussed in the SCRS reports. One fundamental point of this discussion should for instance cover the heterogeneity in the stock and sub population structure in the North Atlantic and in the Mediterranean Sea, and (1) how many sub populations are exploited by Japanese longliners? (2) do we have a full mixing between Mediterranean and North Atlantic fractions of adult stocks? (3) what are the mixing rates between eastern and western bluefin sub-stock?

At least consistent hypothesis should be developed by the SCRS reports to explain the major apparent inconsistencies in the stock assessment best models and in the Japanese fishery indicators.

Otherwise, the bluefin stock tends to be in a *highly questionable situation* when:

(1) All the media and the average citizens of the world consider that the bluefin stock has been extirpated from the Atlantic (or very close to being extinguished….)
(2) Japanese fishermen or ICCAT scientists analyzing the fishery indicators of Japanese longliners do not observe any severe negative trend in the CPUEs, in the fished strata and in the average weight caught.

Such major paradox would at least be fully understood and explained, when today it simply appears as being a strange residuals developed during recent years in the results of the stock assessment models.

Furthermore, these indicators are immediately raising new major questions (that are not highly visible in the Working Group report) on the very strange situation of the 2009 fishery:

- a total effort targeting bluefin that was still significant in 2009,
- but a fishing panel widely different from any previous years, most catches being concentrated at the end of the year and in smaller peculiar fishing areas,

- An extremely low average size of bluefin caught in 2009.
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Even if the 2009 catch and effort data are still provisional and not yet fully validated, they are probably significant of major changes and peculiarities in the 2009 fishery. There is no doubt that this situation should be fully analyzed and explained by the 2010 SCRS meeting, as it easily may be a consequence of interactive factors such as:

a) Poor status of the adult stock: very large bluefin tuna being absent or rare in all the traditional fishing strata.
b) Environmental anomaly and/or geographic changes in the distribution of bluefin concentrations of biomass (as they have been frequently observed in the history of the bluefin fishery).
c) Economic factors in the bluefin market and increasing interaction with farmed tunas; a global need to increase the value of a low TAC.
d) ICCAT´s increasing regulations and increased restrictions in Japanese bluefin catches by time and area strata.
e) Increased pressure against Japanese longliners activities in various fishing coastal fishing zones (stolen fishes in the Mediterranean Sea).

These major changes in the 2009 Japanese fishery should at least be well analyzed, discussed and preferably explained by scientists[3].

A major target in this analysis should be to conclude if the major anomalies observed in this 2009 bluefin fishery were due:

(1) To a major decline of the adult stock due to its overfishing, then confirming the most pessimistic results of recent stock assessment analysis done by SCRS, when surprisingly this major decline was not at all visible until 2008: stable fished zone, stable sizes caught, quite good CPUEs.

(2) Or to a combination of "external reasons" that have very little relationship with the adult stock biomass of bluefin tuna.

5. Conclusion

One conclusion of this work is that such basic indicators are easy to calculate when they could give a valuable input to the bluefin stock assessment work, especially the indicators on Japanese longliners. These indicators should for instance be used indirectly in the stock assessment analysis, allowing improving its parameterization or to understand better what results of the stock assessment analysis should be better analyzed or at least better discussed and explained to external readers of the SCRS work.

For instance these indicators strongly reinforce the pending uncertainties upon the validity of the biomass trends estimated by SCRS and used by Monaco in its CITES request. They also reinforce the great interest to widely use the Japanese data in the stock assessment analysis, even during recent years of moderate & changing fishing activities. These basic indicators also reinforce the need for SCRS to analyze in its 2010 bluefin Working Grooup, and to understand, the multiple and serious anomalies observed in the Japanese fishery in 2009. This question is of great scientific importance, and there is no doubt that these 2009 Japanese data will probably have deleterious effects of the incoming results of the stock assessment models using these most recent data.

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[3] See the post scriptum **Annex 4**, a text added a posteriori to this document and after its discussion by SCRS scientists, and discussing the major changes introduced by Japan in its November 2010 revised data set.

Kimoto, A., Itoh, T. and Miyake, M. 2011, Overview of the Japanese longline fishery for bluefin tuna in the Atlantic Ocean, up to 2009. Collect. Vol. Sci. Pap. ICCAT, 66 *(in this issue)*.

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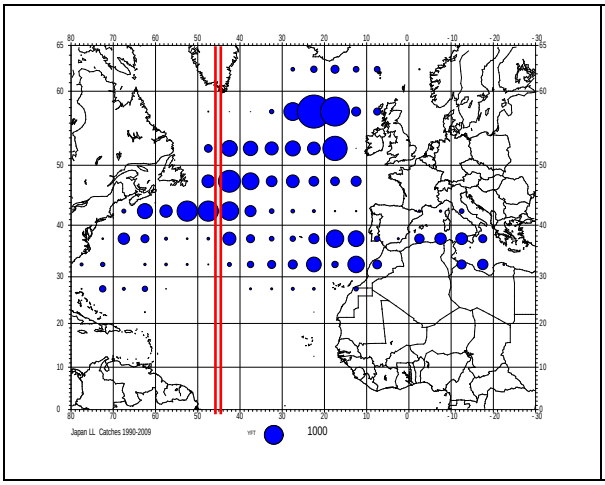

Figure 1. Average catches of bluefin taken by Japanese longliners during the 1990-2009 period

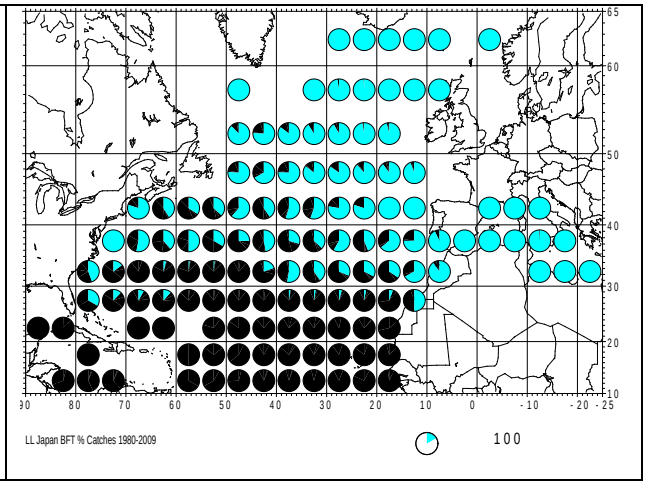

Figure 2. Average simplified species of tuna catches taken by Japanese longliners during the 1990-2009 period: in %, bluefin vs. other tuna species

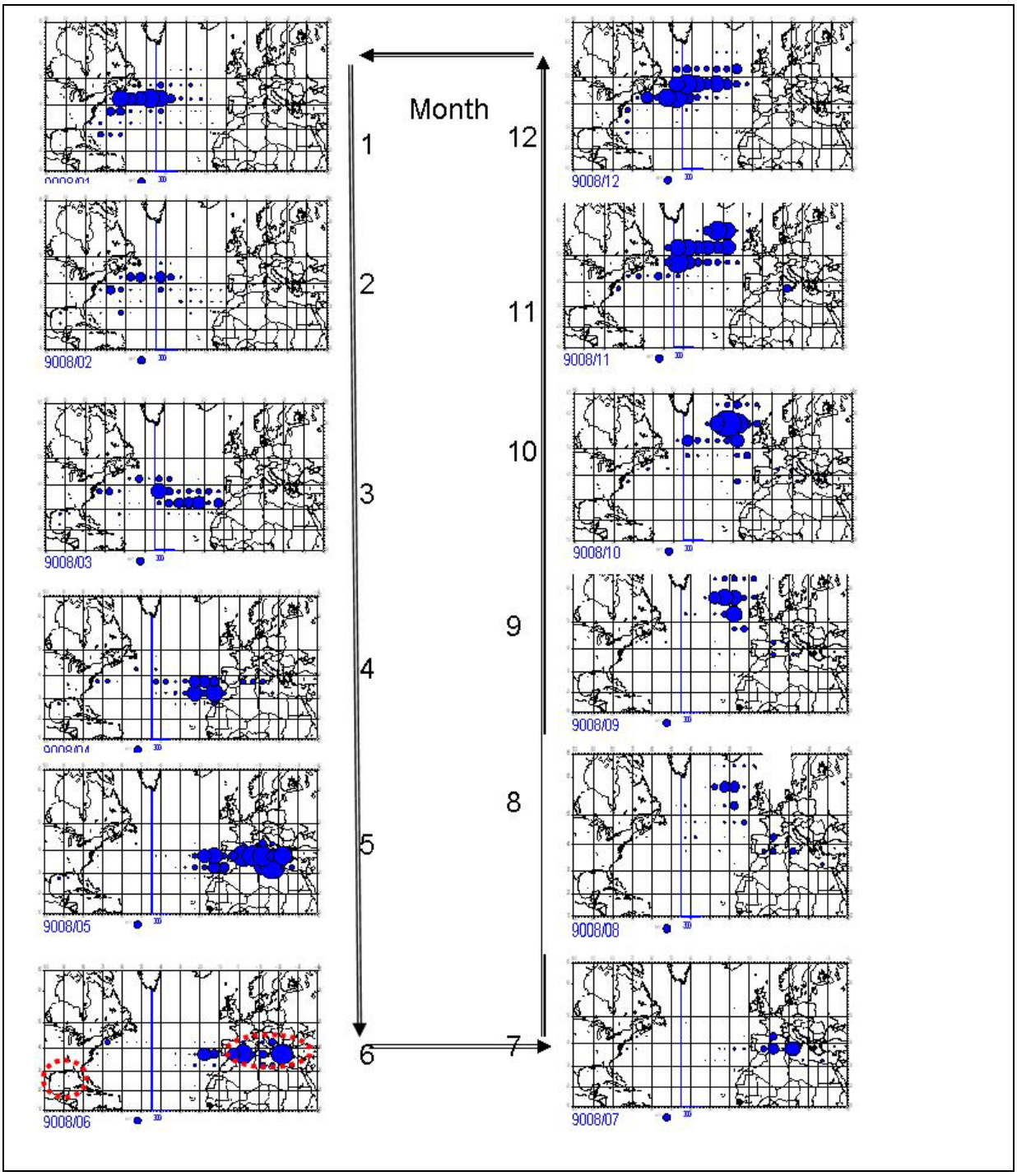

Figure 3. Average monthly catches of bluefin by Japanese longliners during the 1990-2009 period.

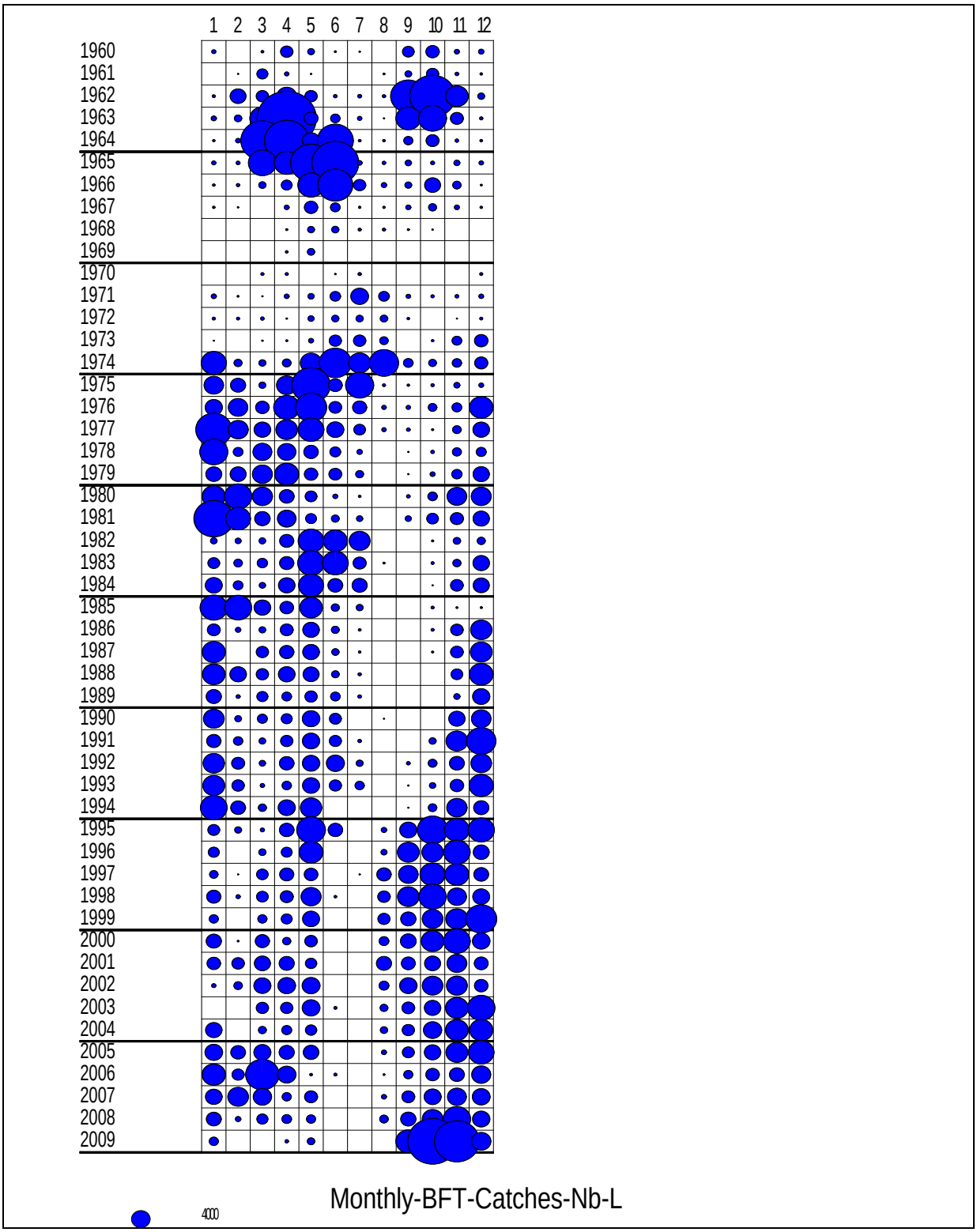

Figure 4. Monthly catches of bluefin (in numbers) taken by Japanese longliners in the Atlantic since 1960.

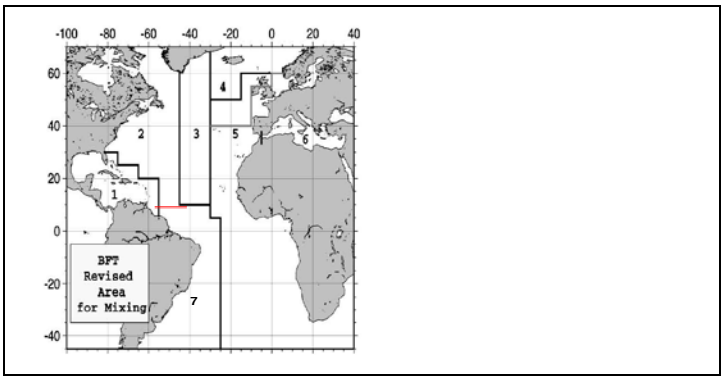

Figure 5. Area definition developed at the bluefin WG in 2001 and used for CPUE analysis.

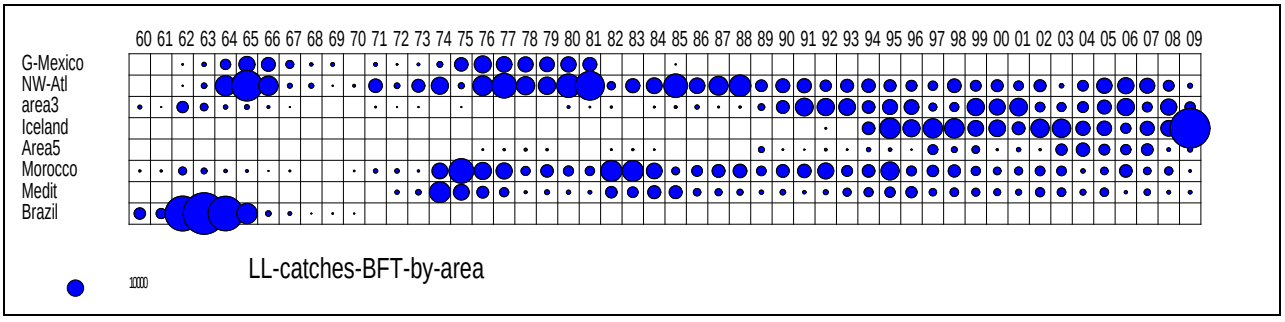

Figure 6. Yearly catches of bluefin by Japanese longliners in the CPUEs areas.

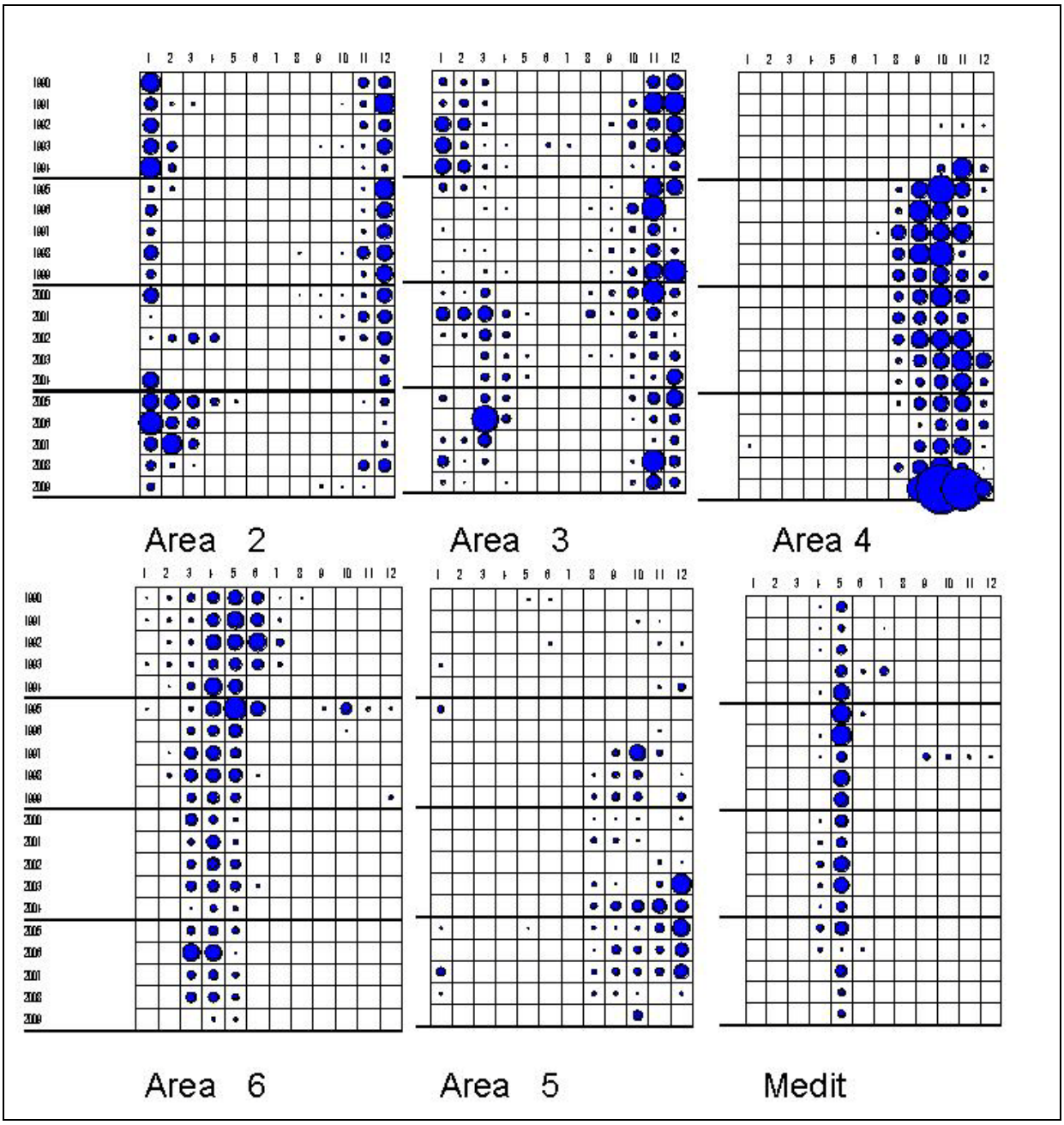

Figure 7. Monthly catch of bluefin in the areas shown figure 5, taken by Japanese longliners during the period 1990-2009.

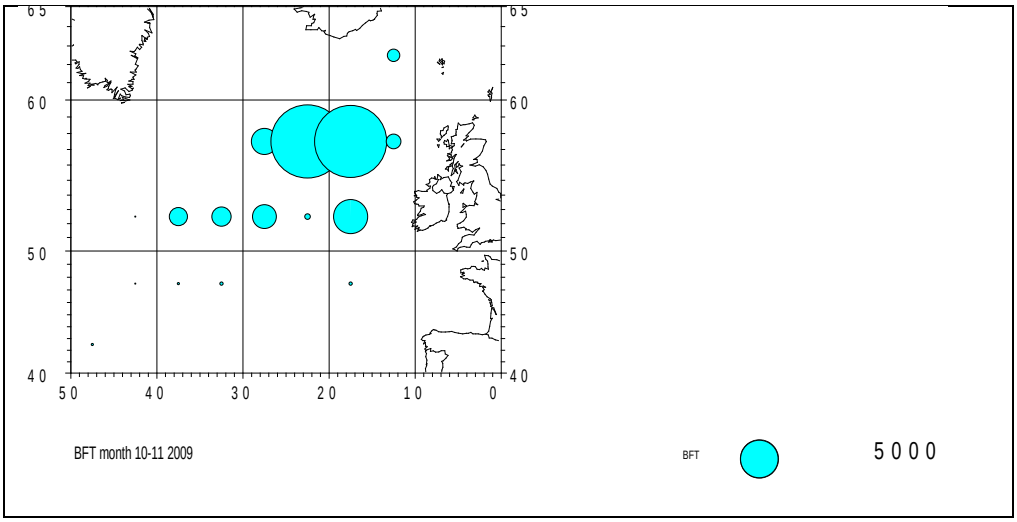

Figure 8. Bluefin catches taken by Japanese longliners in October and November 2009 (number).

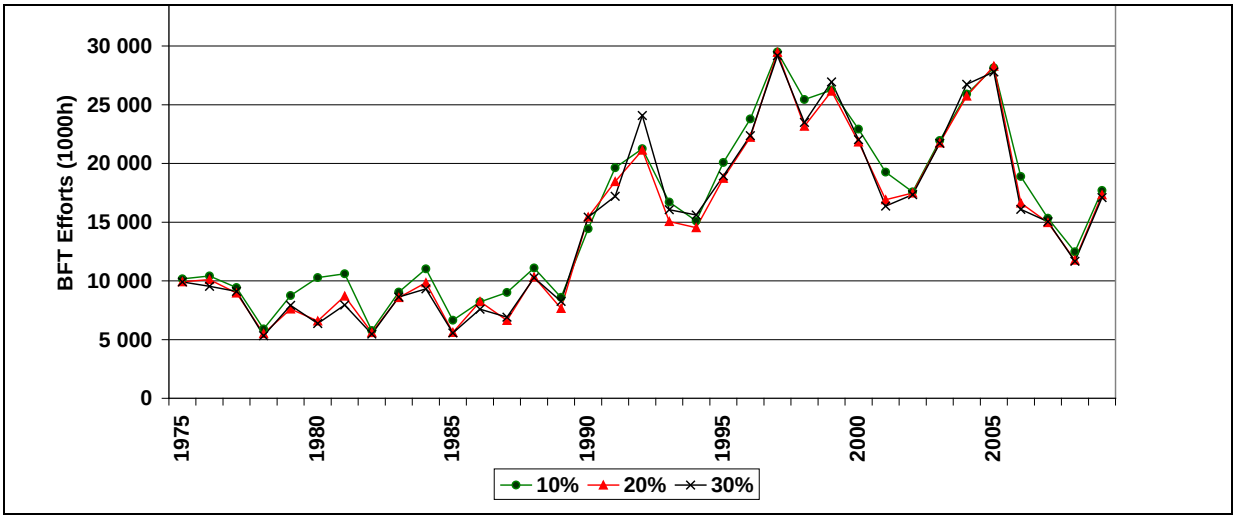

Figure 9. Yearly fishing efforts targeting bluefin tuna exerted by Japanese longliners: total of all fishing efforts in 5° & month strata with a given catch of bluefin tuna (in % of the total tuna catches in number).

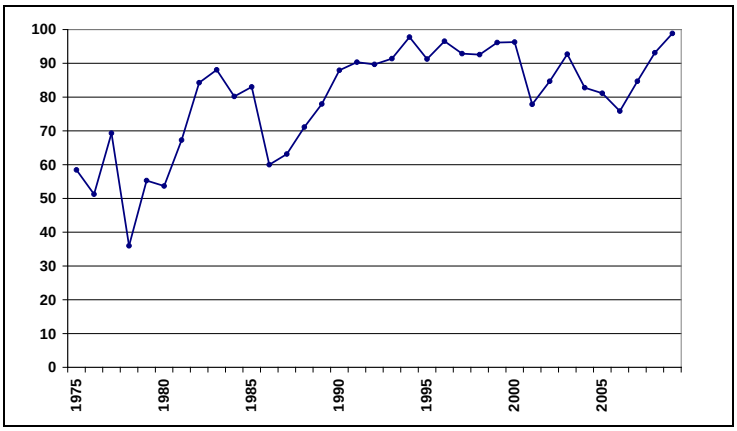

Figure 10. Yearly percentage of bluefin taken by Japanese longliners in the selected core areas (Annex 2, Figure 1).

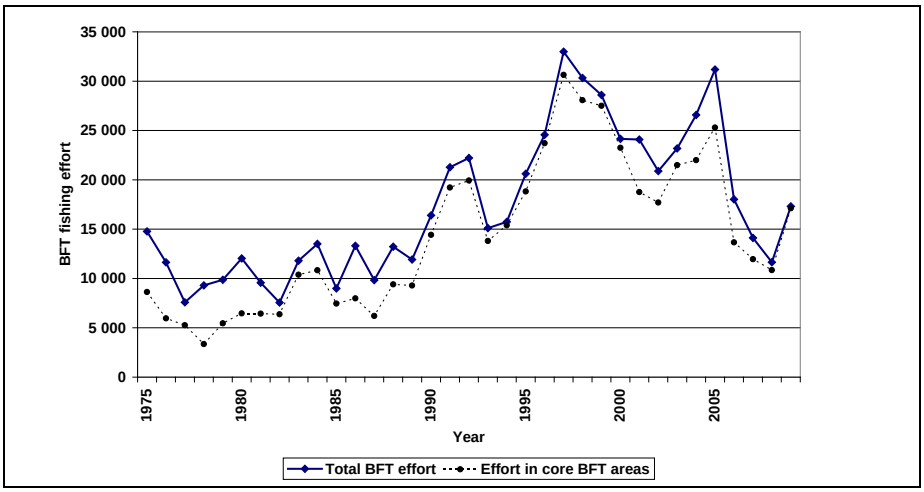

Figure 11. Yearly fishing efforts targeting bluefin tuna exerted by Japanese longliners based on the total fishing efforts exerted in typical monthly core bluefin areas (Figure 1 of Annex 2).

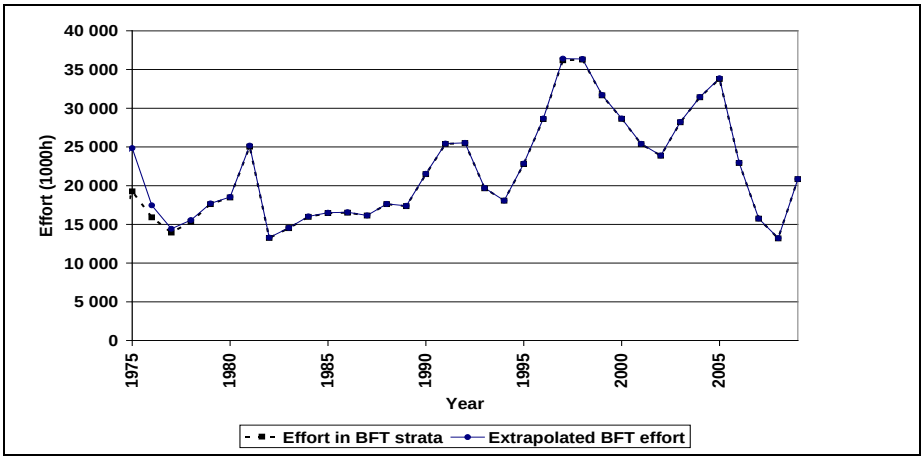

Figure 12. Yearly fishing efforts targeting bluefin tuna exerted by Japanese longliners: total of all fishing efforts exerted in 5° & month strata with an average of at least 1 bluefin taken each year during the 1980-2009 period.

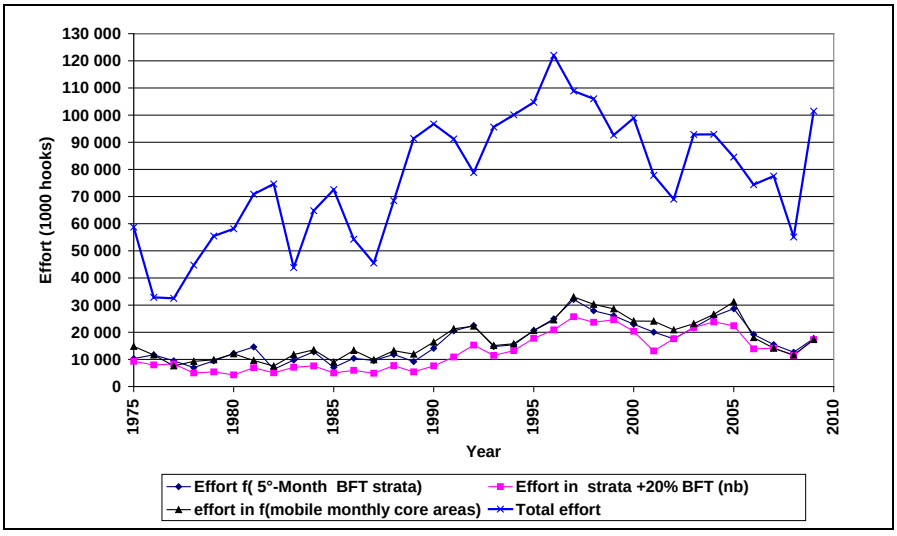

Figure 13. Total yearly fishing effort exerted in the Atlantic by Japanese longliners and the 3 types of nominal fishing efforts targeting bluefin.

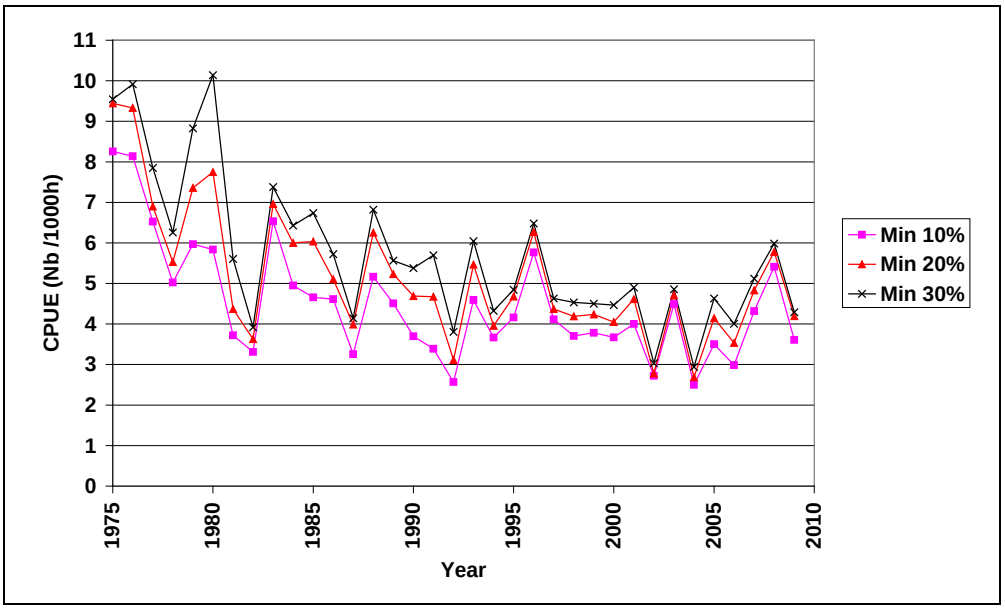

Figure 14. Yearly CPUEs of bluefin for Japanese longliners in 5°-month strata as a function of the proportion of bluefin tuna (in %) in the total tuna catches (in number) (each point is the average of all 5°-month CPUEs each year in strata with a minimal % of bluefin).

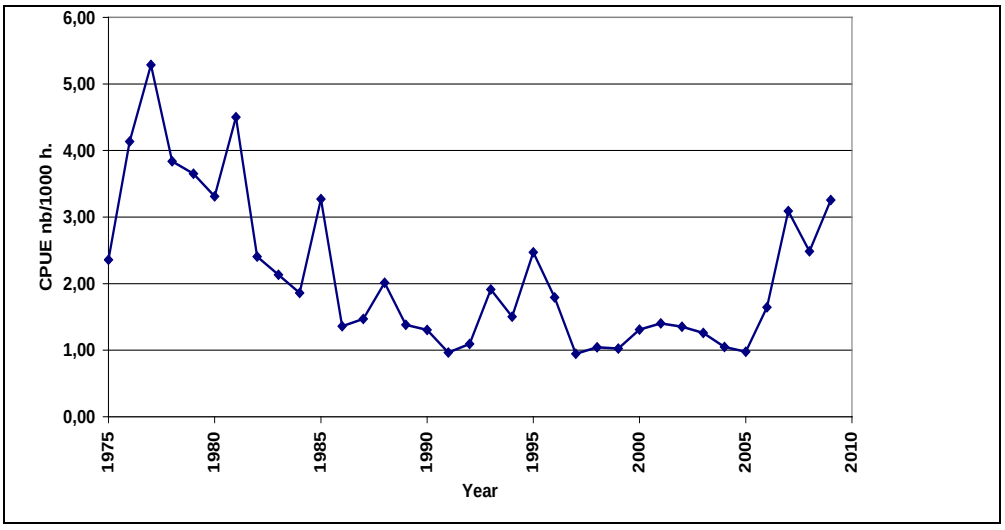

Figure 15. Yearly nominal bluefin CPUEs estimated in the mobile bluefin monthly core fishing zones typical of recent years, shown by Figure 1 of Annex 2.

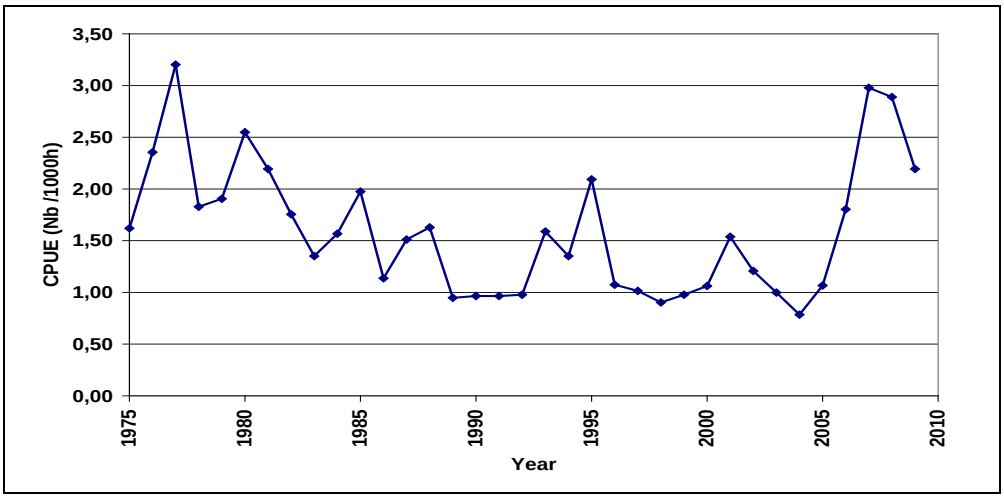

Figure 16. Yearly bluefin CPUEs of Japanese longliners based on all fishing efforts exerted in 5°-month strata showing an average of at least 30 bluefin taken during the 1980-2009 period.

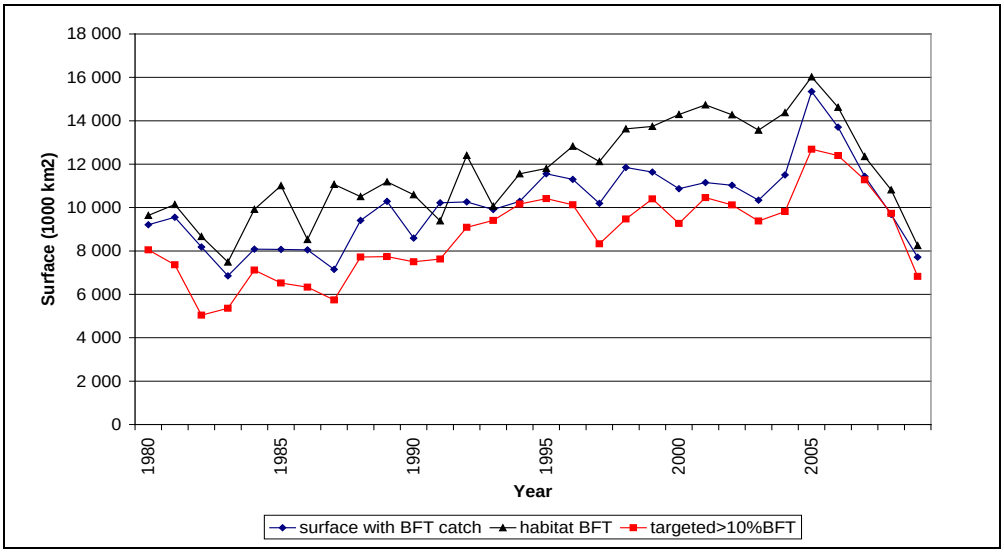

Figure 17. 3 types of indicators showing the yearly surface of the bluefin tuna fishing zones (in million of km2): (1) areas where bluefin was targeted by longliners (more than 10% of bluefin), (2) areas with a bluefin catch (at least more than 1 individual) and (3) area corresponding to the potential habitat of the species (based on its 1980-2009 fishing zones).

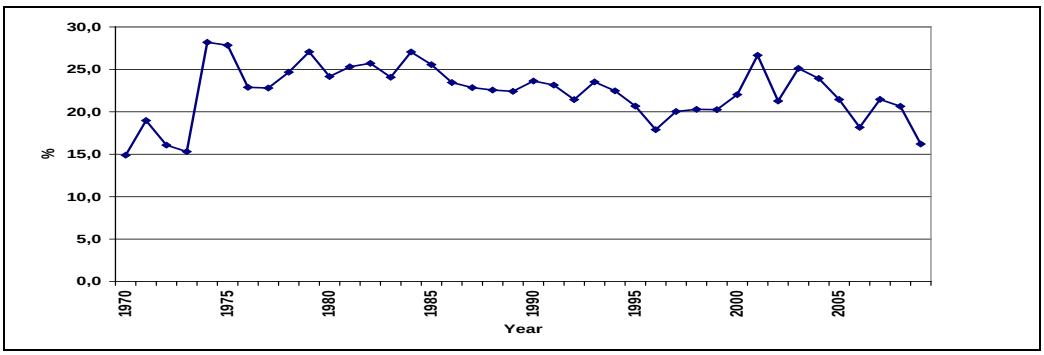

Figure 18. Indicator showing the ratio (expressed in percentage) of the size of the monthly bluefin areas fished and size of the yearly area fished with a bluefin catch.

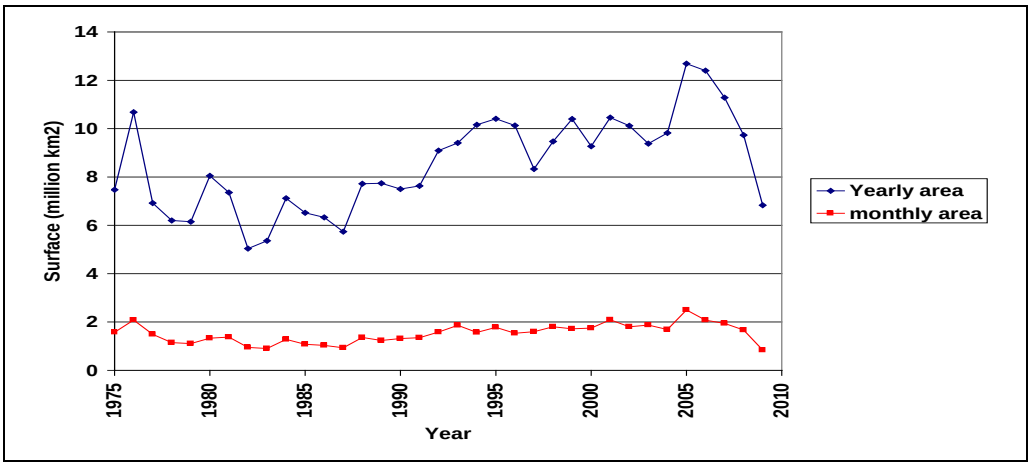

Figure 19. Yearly and monthly surface of the fishing zones targeted for bluefin (at least 10% of bluefin caught in numbers in each 5°-month strata, surface in million of km^2, cf Annex 1).

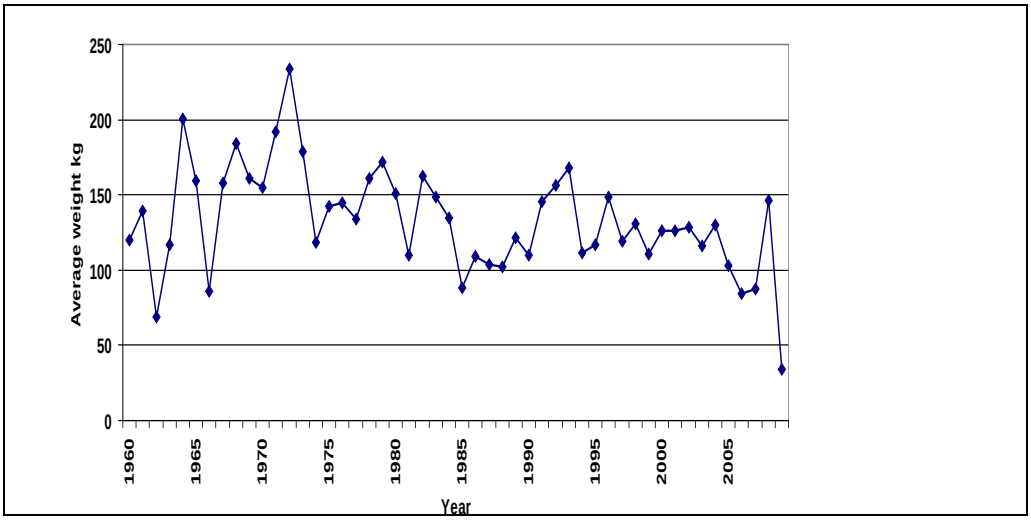

Figure 20. Average weight taken by Japanese longliners estimated by the yearly ratio of TASK1 (total catch in weight) and Task II in number of bluefin declared to ICCAT by Japanese longliners.

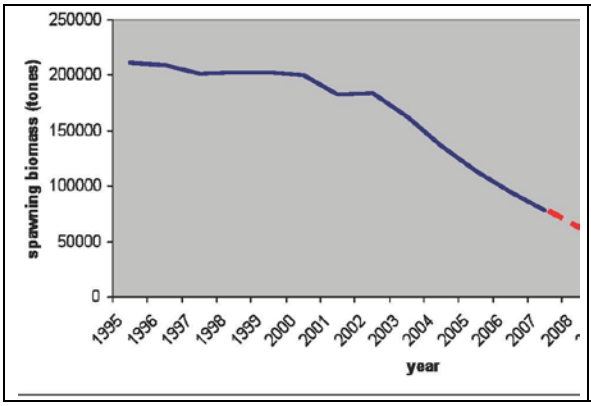

Figure 21. Adult biomass of the eastern Atlantic stock estimated by SCRS 2008 and used by Monaco in its CITES 2009 proposal.

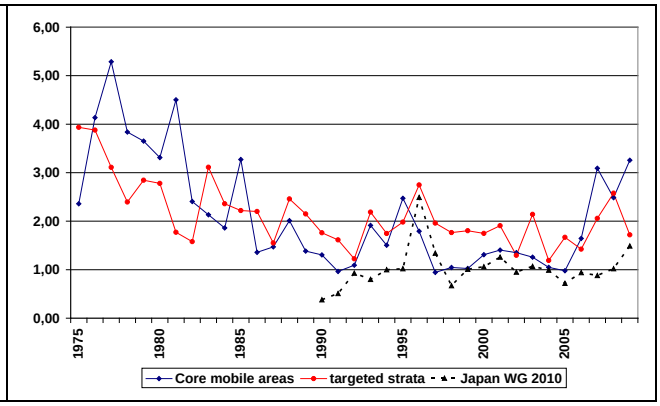

Figure 22. Yearly nominal CPUEs (in number) of adult bluefin during the 1975-2009 period estimated by the 2 methods described in annex 1 and 2 (compared to CPUEs proposed by Japan at the 2010 bluefin data WG)

Annex 1

Nominal fishing effort targeting a given species based on the species composition in each 5°-month strata

1- Basis of the method

The analysis of catch and effort data shows that a target species taken by longline fisheries can be easy to identify as it is dominant in value and often dominant in weight at the scale of the 5°-month strata. In such context all the effort corresponding to this dominant species can be classified as being a targeted effort. The method used simply choose a percentage of the number of tunas caught in each 5°-month strata, for instance in the case of bluefin, a tuna of very large average weight (over 100 kg) and of great commercial values, these selected percentages corresponding to a target species can be in a range between 10, 20 or 30%.

2- Calculation done

The catch in number and effort data of Japanese longliners by 5° and month strata provides the basic data of this indicator. A given target species and a percentage of catch corresponding to this status of targeted species are first selected. In each strata the number of the selected tuna species caught is compared to the total of tuna catches in the same strata (in numbers of tunas). If the catch of the selected species in the strata is larger than the percentage assumed for target species, then the fishing effort is cumulated in the monthly and yearly fishing efforts targeting the selected species. The total yearly catches of the selected species in these selected strata are also cumulated.

In a second stage, an estimate of the total fishing effort of Japanese longliners that have been targeting the selected species is obtained, multiplying the efforts observed in these strata by the ratio of total yearly catches of the species and of the yearly total catches of the selected species in all 5°-month strata showing the dominant species. All these calculations area based on numbers of fish.

Annex 2

Fishing efforts based on "fixed monthly core fishing zones" chosen as being typical of a given species

Basis of the method

The method is based on the monthly fishing effort exerted in "monthly core fishing zones" of the targeted species. The first step is to select by eye these core areas on monthly fishing maps of catches done for a selected period of years. In the case of bluefin, a consistent period may well be the 20 years period 1990-2009, see the following maps.

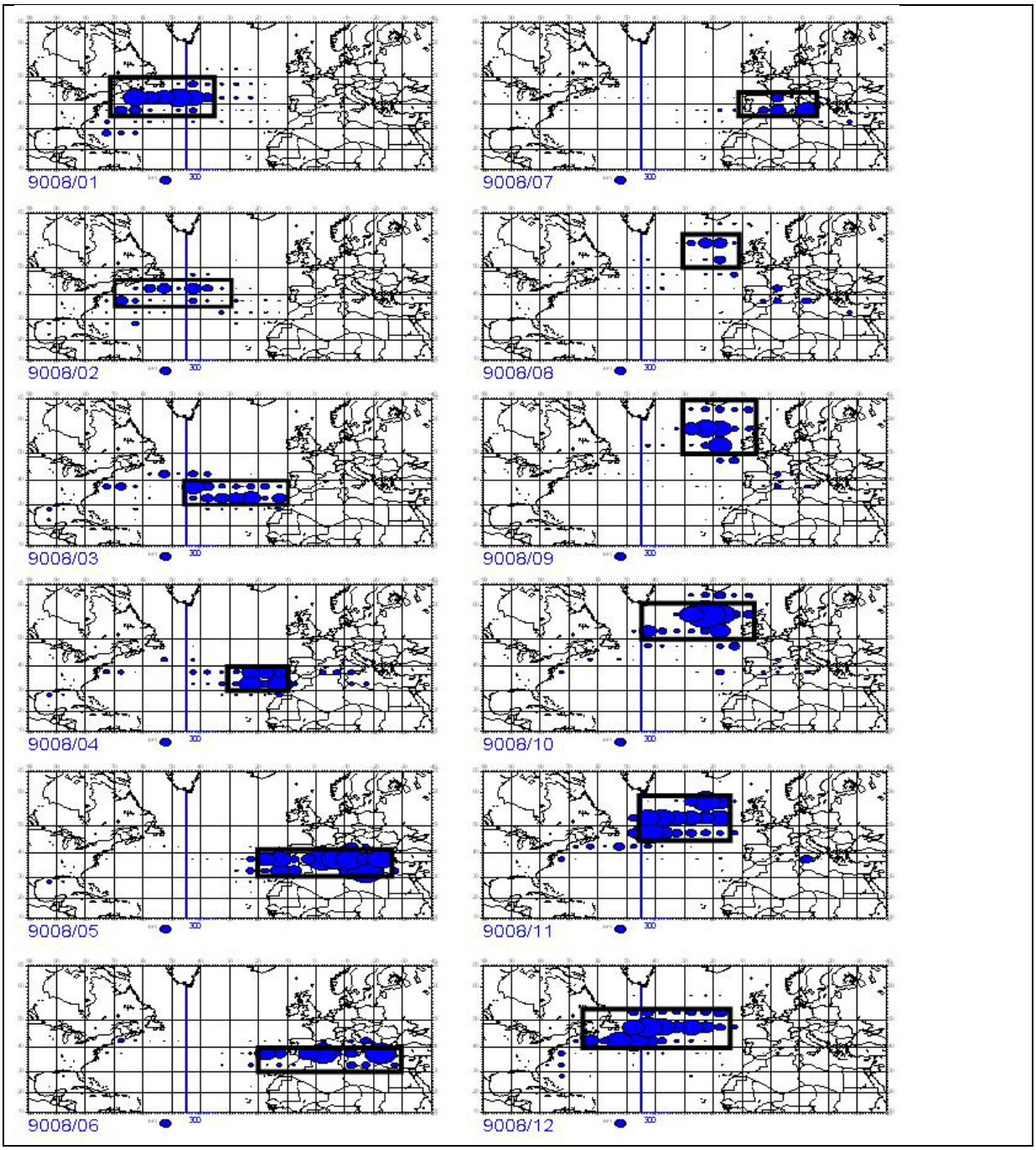

Figure 1. Average monthly catches of bluefin by Japanese longliners during the 1990-2008 period and potential core areas built for the species and fisheries and where the adult biomass have been seasonally & heavily targeted by Japanese longliners.

Calculation done

The first step of the calculation is to identify and to cumulate at a yearly scale all the monthly efforts in these core areas of the species and the monthly catches of the concerned species (bluefin in this case).

In a second stage, an estimate of the total fishing effort of Japanese longliners targeting the selected species is estimated: multiplying the yearly efforts observed in these monthly core areas strata, by the yearly ratio of the total yearly catches of the species and of the yearly total catches of the selected species in these selected core areas (all these calculations being done in numbers of fish).

Annex 3

Fishing effort estimated from the historical time and area distribution (by 5°-month strata) of the targeted species.

Basis of the method

The method is based on the hypothesis that all fishing efforts exerted in 5°-month strata in which bluefin tuna had been significantly caught during recent years, are fishing efforts that are potentially targeting bluefin. The first step of this method will be to identify all 5°-month strata where/when significant catches have been observed during the last 30 years: an average yearly rate of 1 bluefin tuna (or a total of 30 individual taken during the period) has been selected as being indicative of such potential bluefin strata, and shown **Figure 1**.

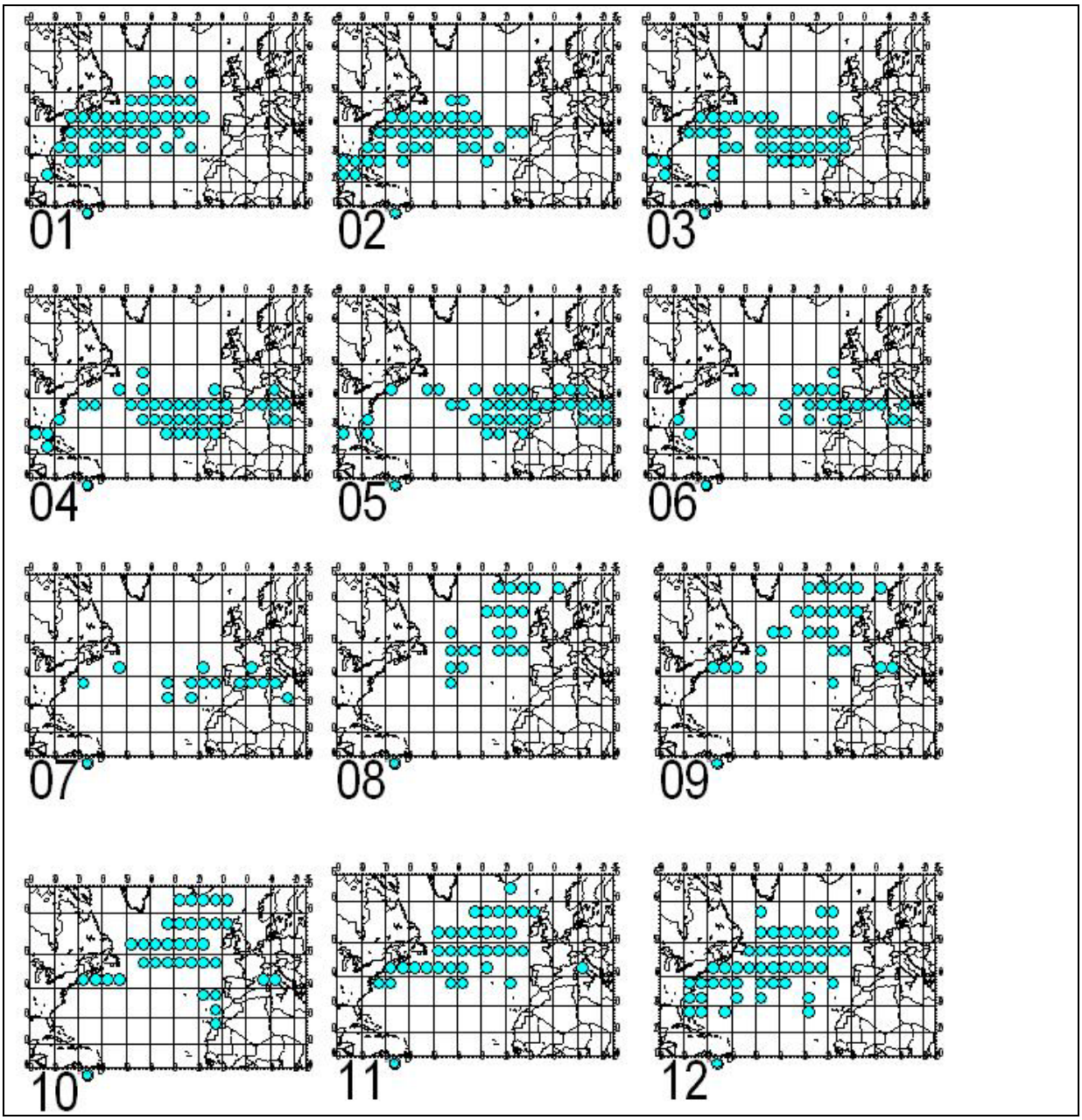

Figure 1. Monthly 5° strata selected as strata of potential bluefin effort (more than 30 bluefin individuals taken the 1980-2009 period).

Calculation done

The catch (in number) and effort file of Japanese longliners by 5° and month during the 1975-2009 period is the basis of the present calculation. Each fishing effort and Bluefin catch is kept when the monthly effort was exerted in a monthly Bluefin strata, or otherwise it is left outside the calculation. At the end of the calculation, a sub file of bluefin catches and bluefin effort is kept, allowing to estimate bluefin catches, bluefin efforts, bluefin CPUEs and sizes of the bluefin areas fished, on a monthly and on a yearly basis.

In a second stage, an estimate of the total fishing effort of Japanese longliners targeting bluefin is obtained, multiplying the yearly efforts observed in these bluefin 5°-month potential strata by the yearly ratio of the total yearly catches of the species and of the yearly bluefin catches of the bluefin strata (all these calculations being done in numbers of fish).

Annex 4

Post scriptum text added to this document after its original submission and discussing the main changes between the Japanese catch and effort statistics between the June and November 2010 Japanese data sets

When this document has been using the catch and effort data set submitted by Japan to the ICCAT secretariat in June 2010, it appears that a revised and corrected data set has been submitted to the ICCAT 5 months later in November 2010. The goal of this post scriptum added to the original document in November 2010 is to examine briefly the main changes in the catch and effort data between these 2 data sets.

The comparison of these 2 data sets shows the main following factors:

1) Period concerned: in the revised data set, major changes can be observed during the years 2008 and 2009 between the original and corrected data.
2) Fishing efforts: in the November revised data set, the fishing effort of Japanese longliners, total effort and effort targeting bluefin, are now estimated to be much larger in 2008 (+ 53 %), but much lower in 2009 (- 35 %).
3) Number of bluefin caught: in 2008 they are 20% larger in the revised data set, and 70% lower in the 2009 data set.
4) As the Task I of Japan was stable in 2009, the average weight of bluefin caught are now subsequently much larger in the November data set (and now typical of the bluefin longline fishery: 118 kg)
5) Bluefin CPUEs tend to be lower in the revised data set during the corrected years 2008 and 2009.
6) Seasonal fishing zones are nearly identical and unchanged (at least qualitatively) between the original and revised data sets, but the levels of catch, fishing efforts and CPUEs tend to be widely modified during most months of 2008 and 2009.

These statistical changes observed between the provisional and the corrected data Japanese data sets should be considered as being major ones for the most recent year 2009, but also -more surprisingly- during 2008, i.e. more than 1 year after the finalization of this year. These changes are often difficult to understand: for a fishing fleet like Japanese longliners and its 100% of log book, a fleet well followed nearly in real time by scientists, these major changes in the total efforts and in the total catches are very surprising.

Our plan is to prepare for the next meeting of the ICCAT Sub. Com. Stat. a technical document comparing in detail the content of the 2010 June and November catch and effort Japanese file. The goal of this working paper will be to promote an interaction with Japanese scientists, helping the ICCAT secretariat and the scientists to understand better why such wide statistical differences can be observed 15 month later between a provisional and a finalized catch and effort data set of Japanese longliners.