FIRST MEETING OF THE AD HOC WORKING GROUP ON FADs

(Madrid, Spain, 11-12 May 2015)

1. Opening of the meeting

The Meeting was held at the ICCAT Secretariat in Madrid from 11 to 12 May 2015. The Executive Secretary of ICCAT, Mr. Driss Meski, opened the meeting and welcomed all participants. Mr. Meski highlighted the importance of the tropical tuna fishery on FADs and summarized the work conducted by ICCAT in managing this fishery in order to reduce its impact in juveniles of bigeye and yellowfin. The Executive Secretary, after reminding the terms of reference elaborated by the Commission for this Working Group, encouraged the Group to face the challenge of accomplishing with its work in the limited time planned for this first meeting.

Mr. Helguilé Shep (Côte d'Ivoire) and Dr. David Die (United States), meeting co-Chairpersons, welcomed meeting participants ("the Group").

The List of Participants is included as **Appendix 2**. The List of Documents presented at the meeting is attached as **Appendix 3**.

2. Adoption of Agenda and meeting arrangements

The Agenda was reviewed and adopted with minor changes (**Appendix 1**).

3. Nomination of the rapporteur

The following participants served as rapporteurs:

Section	*Rapporteur*
Items 1-4 and 13-14	D. Die,
Item 5	M. Neves dos Santos
Item 6	S. Cass-Calay
Item 7	P. de Bruyn
Item 8	H. Murua
Item 9	L. Dagorn
Item 10	P. Bannerman
Item 11	P. Daniel
Item 12	J. Konan and D. Die

4. Terms of reference of Working Group

The Secretariat reminded the Terms of Reference for this Group as defined in the Rec. [14-03], par. 1:

a) Assess the use of FADs in tropical tuna fisheries in ICCAT, notably by estimating the past and current number of different types of buoys and FADs operating in ICCAT tropical tuna fisheries, and evaluate ways to improve the use of information related to FADs in the process of stock assessments, in particular to quantify the effort associated to this type of fishery;

b) In view of the identification of data gaps, review the information provided by CPCs pursuant to the FAD related provisions in the relevant ICCAT conservation and management measures;

c) Assess the relative contribution of FADs to the overall fishing mortality in ICCAT tropical tuna fisheries;

d) Assessing the developments in FAD-related technology, notably with regard to:

   – Technological improvement steps in relation with fishing mortality.
   – FAD and buoys marking and identification as a tool for monitoring, tracking and control of FADs.

- Reducing FADs ecological impact through improved design, such as non-entangling FADs and biodegradable material.

e) Identify management options, including the regulation of deployment limits and characteristics of FADs, and evaluate their effect on ICCAT managed species and on pelagic ecosystems, based on scientific advice and the precautionary approach. This should take into consideration all the fishing mortality components, the methods by which FAD fishing has increased a vessel's ability to catch fish, as well as socio-economic elements with the view to provide effective recommendations to the Commission for FAD management in tropical tuna fisheries.

5. Current stock status of tropical tunas and management arrangements in the ICCAT area

5.1 Current stock status

The Chairman of the SCRS, Dr. David Die, reviewed the SCRS advice related to tropical tuna fisheries provided to the Commission in 2014 by the previous SCRS Chair. He recalled that the three main species caught in the East Atlantic, i.e. skipjack (SKJ), bigeye (BET) and yellowfin (YFT), represent 9% of world catches of tropical tunas with an average yearly volume of 380,000 t over the period 2008-2012.

These fisheries are multi-gear and multi-species. Eighty three percent of catches are taken by surface gears. The use of fish aggregating devices (FADs) affects the species composition and the average size of harvest schools and has consequences for exploitation of these resources.

Recent changes took place in the purse seine fishery: the fleet which shifted towards the West and Central Atlantic in the 1990s have recently also shifted towards the area of Mauritania in the North and to an area off Angola. The percentage of catches under FADs by purse seiners has continued to increase, amounting to more than 90% of the aggregated catches of yellowfin, bigeye and skipjack tuna.

In 2013, fishing of these three species reached a volume of 392,600 t. The 2013 catches of bigeye (64,302 t) and yellowfin (87,140 t) tunas were below the annual averages for the ten-year period 2004-2013 (averages amounted to 76,238 t and 106,485 t, respectively). In contrast, skipjack catches in 2013 (231,158 t) were much higher than the average annual catches of 188,986 t from the period 2004-2013, a period when catches of this species have continued to rise.

The number of tuna purse seiners decreased steadily from the mid-1990s to 2006, then increased sharply following the shift of vessels from the Indian Ocean (impact of the piracy off the Somalian coasts). Indeed, the vessels that shifted from the Indian Ocean are the best equipped in terms of technical equipment and fish storage capacity.

The SCRS Chair drew attention to the fact that significant catches of bigeye, yellowfin and skipjack as well as other species are landed in West Africa and sold on the local market as *faux poisson*. The estimate of these catches is uncertain and the SCRS is concerned about whether *faux poisson* landings are under reported. The SCRS estimates on average that for the period 2005-2013 the *faux poisson* landed amount to 10,500 t/year.

There are also uncertainties regarding biological parameters: natural mortality, growth, stock structure and movements. The Atlantic Ocean Tropical Tuna Tagging Programme (AOTTP) will contribute to addressing these uncertainties by providing comparative biological results, indications of movements and a possible stock structure, as well as an analysis of interactions between fleets, data on the effects of FADs on the tuna resources, an assessment of the management measures (for example: impact of the closures). Tagging programmes, when successful, provide useful data for answering important questions on the status of stocks. The SCRS Chair encouraged CPCs to contribute to the AOTTP. The SCRS Chair highlighted the fact that a contract with the European Union (EU) is to be signed before the end of May 2015, with the Programme activities starting immediately after. This contract includes an EU contribution amounting to 13,5M€.

The skipjack stock was assessed in 2014. The Atlantic accounts for 7% of world skipjack production (average over the period 2008-2012). These catches are mainly taken by purse seiners and baitboats. Catches for 2012 were very high: 258,300 t. In 2013, catches reached 231,158 t, of which 212,484 t were taken in the East Atlantic and 18,574 t in the West Atlantic.

There was no specific recommendation in place for skipjack. The SCRS considers that the catches should not exceed the MSY. The Commission should be aware that the increase in removals and fishing effort for skipjack may have consequences for other species caught in association.

For bigeye tuna (Anon., 2011) (last assessment was carried out in 2010 and currently SCRS is undergoing a new assessment), 18% of the world production is from the Atlantic. A historical peak of 133,000 t was reached in 1994, then the catches declined following the reduction in size of the fishing fleet (longliners) and the decrease in fishing effort (longliners and baitboats), the number of purse seiners and the establishments of TACs. The catches, carried out by purse seiners, baitboats and longliners, amounted to 63,556 t in 2013, which are below the TAC (85,000 t).

There is considerable uncertainty concerning stock status and the forecasts for bigeye tuna. Fifty-two percent (52%) of the results from modelling indicate that the stock status of bigeye tuna is consistent with the Convention objectives.

It should be noted that if the main countries caught the catch limits established in Rec. 11-01 and the other countries maintained recent catch levels, the total catch could exceed 100,000 t, which is significantly higher than the current TAC of 85,000 t. In addition, the future changes in selectivity may give rise to an increase in relative mortality of small fish which will modify these forecasts and add to their uncertainties.

Concern about the catches of small bigeye tuna has resulted in the establishment of area closures in the Gulf of Guinea. The SCRS does not have sufficient information at this time to determine the efficacy of the current closure in reducing the mortality of juvenile bigeye tuna.

The SCRS recommended maintaining the TAC level for 2015 at 85,000 t or less in order to keep the stock in line with Convention objectives.

Regarding yellowfin, a stock assessment was performed in 2011. The Kobe matrix showed considerable uncertainty in the assessment of the status of the yellowfin tuna stock and its productivity. Twenty six percent of results were consistent with the objectives of the Convention.

The reported catches of yellowfin in the Atlantic, which account for 9% of world production, amounted to 97,140 t in 2013 and are below the TAC of 110,000 t. The selectivity of juveniles has a significant impact on stock productivity and recovery. The assessment showed that the yellowfin tuna stock was overfished in 2010. The area/time closure fixed by Recommendation 11-01 should also benefit yellowfin stocks.

The SCRS recommended maintaining the TAC at 110,000 t which would enable attainment of a biomass above B_{MSY} towards 2016 with a probability of 60%. The SCRS also recommended reducing fishing under objects (FADs) for this species (high juvenile mortality).

Finally the SCRS Chair provided some additional information on the work developed by the Group of Tropical Tunas during the recent Bigeye Tuna Data Preparatory meeting.

During the following discussions a number of participants raised concerns on the impact of changes on gear selectivity on the results of recent stock assessments of tropical tuna species. The SCRS Chair clarified that the models used in the past (e.g. production models) do not take into account the effects of changes on selectivity (do not incorporate size data) on the assessment of the status of the stocks of bigeye tuna, or skipjack but it did so for yellowfin tuna. Moreover, he highlighted the fact that such changes in selectivity may have significant impact on the estimations of MSY, which is the major reference point for the provision of the advice.

5.2 Current management

The Group pointed out that in the context of managing fisheries, all sources of fishing mortality need to be monitored and managed. The use of FADs contributes to fishing mortality, but is not the only source (e.g., for Atlantic bigeye, floating object sets represent less than one-third of the total catch in weight).

Document SCRS/2015/081 (rev. 1) discusses FAD management in the context of overall management of tropical tuna purse seine fisheries. The paper also presents recommendations for arriving at science-based management solutions and for enabling more complete monitoring of purse seine fisheries. In addition, Appendix 2 in the document provides a list of references related to by-catch in purse seine fisheries.

The Group noted that one of the short-comings of Rec. 14-01 and other recommendations on data collection, is that the fishery operational data is made available only to National scientists. However, it is essential that operational data is merged for regional analysis covering all components of the same fishery, aiming the provision by the SCRS of sound science-based advice. This could be carried out under ICCAT confidentiality rules (http://iccat.int/Data/REP_EN_10-11_I_1_Annex_6_Confidentiality.pdf).

Document SCRS/2015/100 presented the information reported by CPCs in accomplishing with the recommendations adopted by the Commission in order to obtain more detailed information on FADs in the Atlantic Ocean. The submission of both FAD management plans as well as information regarding the type and number of FADs deployed have become mandatory as prescribed in Rec [14-01].

It was noted that the information required under Rec [11-01] and Rec [13-01] may not be sufficient to fully assess the impact of FADs on tropical tuna populations. The information requested appears to lack certain important details, such as the association of number of objects to the number of vessels deploying them. It was thus suggested that the SCRS review what additional data is required to adequately assess the impact of FADs on tuna populations and provide an updated list of data requirements to the Commission. In addition, it was discussed, that ideally, data provided on FADs should be harmonized across tuna RFMOs to decrease the burden on fishers to complete and submit information in different formats for the different RFMOs as well as to allow joint analysis across tRFMOs.

Regarding the FAD management plans, it was suggested that these should also be standardized within tRFMOs as currently it is difficult to compare the different plans. It was also noted that most CPCs are already collecting more information than is outlined in the plans that could be used for scientific analysis. These data could be provided in SCRS documents, as has occurred in recent years.

6. Historical experiences of FAD management in the ICCAT area: FAD seasonal and temporal closures

The Chair directed the Group to the archive containing ICCAT Recommendations as well as SCRS reports and numerous documents SCRS scientists have prepared to examine the effects of the various spatial closures to surface fishing gears in the Gulf of Guinea established in the ICCAT Recs. 98-01, 99-01, 04-01, 08-01, 11-01. The Group was encouraged to look to the original documents for details of the analyses and conclusions considered by the SCRS, and used to develop advice for the Commission.

Three spatial closures have been implemented by ICCAT (**Figure 1**). The first and largest closure began with a voluntary moratorium on FAD fishing in 1998, negotiated by EU-Spain and EU-France purse-seine fisheries organizations to protect juvenile bigeye tuna in the Gulf of Guinea, before the first ICCAT Recommendation on this issue [Rec. 98-01] was adopted. The SCRS used a variety of methods to examine the effect of this closure, including catch trend, yield-per-recruit and spawner-per-recruit analyses and concluded that while some beneficial effects could be demonstrated, the benefits would have been larger had the closure been fully implemented by all fleets. A meeting participant also noted that closure did have one major effect, which was to reduce the catches of skipjack by up to 30% for some purse seine fleets.

After a number of years, ICCAT reviewed the moratorium area and the Commission recommended [Rec. 04-01 and 08-01] to prohibit surface fisheries in a smaller area for a shorter time. Using the results from a number of analyses, the SCRS concluded that while the small closure may have had a modest beneficial effect, a larger/longer closure would have been more beneficial.

The effect of the most recent closure [Rec. 11-01] was analyzed in 2014 with inconclusive results. The SCRS Chair clarified that the effect of this closure could not be fully assessed until additional data becomes available. The SCRS will continue this work in 2015.

The Group discussed the frequency of changes to the spatial closures and the scientific basis for these decisions. The SCRS Chair pointed out that fisheries for tropical tunas have evolved throughout the period of spatial closures. For example, it is now clear that FAD fishing for skipjack has recently expanded off of Mauritania. Similarly, the Group noted that there are spatial areas that are appropriate to protect certain species, but that a given closure might not benefit all three tropical species simultaneously. Therefore, to help ensure effective conservation and management, it would be important to explore the efficacy of spatial closures as fisheries develop and change, or particular species requiring additional controls in fishing mortality.

The Group also considered whether the analyses available to date could be improved to better inform the placement and timing of spatial closures. It was noted that in the past, the definition of such closures was not based on scientific advice from the SCRS, nor did the SCRS recommended this particular type of regulation, although the SCRS has expressed concern about the impact of growth overfishing in the Gulf of Guinea FAD fishery on tropical tuna stocks for a number of years. It was pointed out that EU scientists did provide information to the EU purse seine fleet to help them design the first closure. Some members expressed concern that ICCAT manages FAD measures and closures in an arbitrary manner, and that scientists have not demonstrated the efficacy or need for these measures conclusively. These participants also noted that these regulations are costly for the industry and deserve a proper evaluation before additional fishery mortality controls (*i.e.* closures) are recommended. To improve the expected efficacy of future regulations, the Group recommended that the Commission consider both scientific advice, and compliance related attributes.

7. Review of FAD management in other tuna RFMOs

Document SCRS/2015/014 provided a summary of FAD management across all the tuna RFMOs (not including CCSBT to whom this is not applicable). It was noted that only the IATTC does not require FAD management plans, although the marking of the FADs is less prominent amongst the RFMOs. Regarding conservation measures, no RFMOs prescribe biodegradable FADs. Although ICCAT implements time-areas closures and non-entangling FADs, it has no requirements regarding (i) capacity limits and or number of FADs per vessel, (ii) regulations on the number of FAD sets or (iii) bans on discards. It was noted that no tuna RFMO implements all the previously mentioned conservation measures. In general, data collection/reporting/control regarding FADs is fairly comprehensive amongst the tuna RFMOs although increased VMS polling rate during time and area closures was generally not conducted except in the Western Central Pacific. The paper concluded that there is scope to improve and strengthen FAD management measures in ICCAT and to develop a comprehensive approach to FAD management based on science. To this end, operators should provide information to scientists on FAD design and technological developments. There is also scope to develop and apply best practices across tuna RFMOs and to establish a joint meeting of FAD working groups of tuna RFMOs in 2016.

The Group discussed the need to view these issues on a global scale and thus information should be shared between tuna RFMOs. Some participants suggested that the focus should not only be on FADs but on all fleet sectors that impact the resource and to address additional issues such as fleet capacity. In addition it was mentioned that it is important to investigate compliance with existing measures. Additional management options are directly reliant on the levels of compliance across all fleets that access the tropical tuna stocks. It was clarified that although it is extremely important in the context of the fishery to not focus only on individual issues such as FAD management, and that no management measure is particularly useful in isolation, the objective of the Working Group is to address issues related to FAD fishing and it is still necessary to know the impact of FADs on fish mortality.

The Group also discussed issues related to the marking of FADs. It was generally agreed that a common standard of marking the objects is required. ICCAT requires that such objects be marked, but does not specify how, and it was suggested that this Working Group could provide advice as to a standard method for doing so. What was less clear is whether both FADs and beacons should be marked and if so, how this should be done. It was suggested that the marking of the object is of greater importance, as the most important issue regarding the FADs is the history of the ecological impact of the FAD. The beacons attached to each object may change (e.g., due to changes in ownership) but the history of the object remains relevant. However, marking the objects in conjunction with other information collected through FADs Management Plans, observers and logbooks, could potentially allow tracking the objects. For estimating the fishing effort related to FAD fisheries, marking the beacon followed by purse-seine would be necessary. Potentially marking both beacons and objects using a common format may be the best way to ensure all dynamics are captured. This common format could be agreed between tuna RFMOs.

8. Description of FAD operations and FAD technology

8.1 Drifting FADs

Document SCRS/2015/087 investigated tuna species discrimination of echosounders of Fish Aggregating Devices (FADs) used by purse seine targeting tropical tuna. Many of FAD buoys are now equipped with echo-sounders in order to provide remote information on the aggregated biomass. Nowadays these biomass estimates

are not accurate enough to provide information on species composition. Species discrimination at FADs to provide in situ and remote species composition, by using 3 echo-sounders operating simultaneously at three different frequencies (38 kHz, 120 kHz and 200 kHz), was investigated. Target strength for bigeye and skipjack tunas were obtained for the different frequencies used and a frequency response mask created to discriminate between species. This work confirmed the potential of using multiple frequencies to discriminate between fish with swim-bladder (yellowfin and bigeye tunas) from fish without swim-bladder (skipjack).

The Group noted the importance of the study because the knowledge of species specific acoustic signals could contribute to a more selective fishery. Moreover, the Group noted that information of biomass estimation of the school from the acoustic sounder of the drifting FAD (dFAD) buoy could help to develop a biomass index semi-independent of the fishery. However, it was mentioned that a better knowledge of the species composition based on the acoustic signals of the buoy can also result in an increase of fishing efficiency as well as changes in fishing strategy. Although the results of the study can allow an increase in efficiency and hence in catchability; the Group noted that these results, in combination with complementary management measures, could make a more selective fishery. For example, in cases where bigeye is a concern, the identification by acoustic signals of bigeye schools under the dFAD could allow to mitigate the unintentional capture of bigeye.

As there is also a need to mitigate the capture of non-target species by-catch, the Group requested if this could also be applied to by-catch species. The authors of the work explained that although the results of by-catch were not presented, the acoustic signal of the by-catch can also be identified and, hence, be used to mitigate their capture.

Document SCRS/2015/086 combines the information provided by some French fishing companies on GPS buoy track, the number of buoy purchase and French and Spanish observer programs to understand the strategies of fishers regarding dFAD deployment, dFAD fishing strategies, and effects on the ecosystem. The work identifies four different seasons of GPS buoy deployment. The total number of dFADs and GPS buoys used by all purse seine fleets was estimated over 2007-2013 on a daily basis, showing a strong increase in the number of dFADs from 2007 to 2013. The impacts of dFAD use on the level of tuna habitat modification and catches of juveniles were examined, showing that the Atlantic Ocean was a relative dFAD zone over 2007-2013 and possible mitigation of catches of juveniles of bigeye and yellowfin were studied.

The Group welcomed the collaborative work between industry, providing very detailed data, and scientist to improve the knowledge around dFADs activity such as deployment periods, density, etc. The Group also noted the importance of the data analyzed such as VMS, buoys trajectories and observers to increase the knowledge about dFAD activities and their effect in the increase in fishing effort and effect on the ecosystem. However, the Group noted partial use and low coverage of the sampling which could affect the results and conclusions of the work. In this sense, although the Group acknowledged the increase of the number of dFADs in recent years, some participants questioned the level of increase described in the work which can be considered very large compared with previous estimates. This discrepancy could result of the partial and low coverage of the sampling used in the study and the Group noted that it would be worth to expand this type of work to a more representative sampling covering all PS fleets using dFADs; which will allow a better understanding of dFADs fishing activities. Thus, the Group recommends to attempt historical data mining from fishing companies on dFADs activities as well as to expand this type of work to other fisheries which can allow collaborative work to analyse detailed information from different fleets under agreed ICCAT confidentiality rules (Annex 6 of the Report for biennial period, 2010-2011 Part I (2010). The authors also noted the difficulty to compare the results of the work with previous studies as there is a lack of standardized terminology used when describing the trends on the use of dFADs. For example, it is not clear whether some authors are dealing with number of daily active FADs, total number per year and/or other metrics. Thus, the Group recommends that a standardized terminology of dFAD activities, is developed and agreed.

Presentation SCRS/P/2015/015 related to a recently published paper (López *et al.,* 2014) investigated the practical use, fishing strategy and state of echo-sounder buoy technology applications using personal interviews over three consecutive years (2010–2012) with approximately half of the Spanish tropical tuna purse seine fishing masters and licensed captains operating in the Atlantic, Pacific and Indian Oceans. The results suggested that echo-sounder buoys have significantly impacted dFAD fishing strategies since their introduction into the fishery in the last decade, favouring the expansion of dFAD fishing grounds. In addition, fishers' echo-sounder buoy seeding and visiting strategy is not random anymore, which increases the fleet efficiency. Additionally, the number of echo-sounder buoys used by each vessel has increased, which demonstrates its utility for fishermen. Various aspects of these devices' use, consequences for fishing strategy, search time, nominal effort and potential future applications were discussed.

The Group requested if it would be possible, based on the information presented, to assess quantitatively the time (effort) associated to different activities of the PS (fishing, searching, transit, etc.) in order to improve the unit of effort of the PS and, hence, assess the increase in fishing efficiency of the fleet. The authors responded that the objective of the work was not focused on the estimation of the effort but to assess the use of different buoys by fishermen for acoustic selectivity discrimination studies. They also noted that the work investigated qualitatively the changes in fishing technology but not quantitatively, for which other metrics as fishing set per day and fishing information should be used. The Group noted that this type of studies would be valuable to investigate the increase in fishing efficiency of the purse seiner to be used in stock assessment models of tuna RFMOs.

A short reminder from Fonteneau *et al.*, 2015 estimated an increase of number of dFADs used by the EU PS fleet in recent years and described the associated increase on bigeye catches on dFADs. The author also reminds that the paper review different possibilities and management tools for a sustainable use of dFADs in purse seiner fishery. The Group noted that the increase of number of dFADs in recent years could be due to the increase of price of skipjack, but noted that the price of skipjack has decreased in the last two years. The Group also noted that more accurate number of dFADs can be obtained from the current reported FAD Management Plans agreed in ICCAT and reported since 2012; however, the historic information is not always available. Thus, the Group recommends a data mining exercise to recover the use and number of dFADs for the historic period. The Group also noted that there are some inconsistencies in the presentation as the bigeye catch on dFADs is stable since 1995 which would not be expected with a large increase of the number of dFADs in recent years, provided that dFADs are major component of bigeye catch of PS. It was noted that this could be due to the decrease of total number of PS since 1995. This underlines the importance to consider all components of the PS fishery affecting the fishing mortality, as well as other fleets, as the number of dFADs should be considered in conjunction with the overall fishing capacity (No. of vessels). This is a global issue for all tuna RFMOs and the Group considers that overall fishing capacity for a sustainable management of resources should be addressed as soon as possible in tuna RFMOs.

8.2 Baitboat/Purse-seine associations

No papers were presented under this item. However, the Group was informed that the association of baitboats and purse seiners has started in the mid-1990s and the catches have increased around 40% since then. The Group noted the importance of considering this new type of fishery from two angles: (i) how this information is incorporated into the stock assessment (*i.e.* fishery characteristics) and (ii) how this capture enters the market as can be marketed as baitboat FAD free catch despite being a FAD associated catch. The Group was informed that the bigeye data preparatory meeting agreed to consider this association of BB-PS as fishing with PS with regard to species and size composition for the assessment. The Group was also informed on the use of pole and line (bait) during the first 5-6 days of the trip followed by an association with PS thereafter. The Group also noted information about BB at sea without pole and lines, which indicates that the association occurs for the whole trip. The Group also noted the effort to separate the fish caught using pole and line (BB) from the catch by BB-PS association in order to market this catch as pole and line catch. However, the Group noted that this should be addressed as matter of priority in order to assure the traceability of the fish caught by BB. In that sense, it would be worth to define a BB FAD free capture for this fleet as well as the development of criteria to define a BB/PS association. The Group also noted that the association fishery between BB/PS will increase the level of non-target species by-catch in comparison to a traditional BB fishery which makes the monitoring of this new component necessary.

8.3 Anchored FADs

No papers were presented under this item. However, the Group noted that there are several reports of marlin and small tuna catches in anchored FADs in Antilles and Caribbean Sea as well as of bluefin tuna in Malta, although it was pointed out that the impact of these catches are difficult to evaluated because, in some cases, these catches are not consistently reported. The Group noted that this should also be addressed and studied in this Working Group and that that CPCs with these type of fisheries should report their data to ICCAT. Currently there is a lack of information available on the use of anchored FADs.

9. Ecological communities around FADs

9.1 Drifting FADs

Document SCRS/2015/104 presented the European Research project “Catch, effort, and ecosystem impacts of

FAD-fishing" (CECOFAD) (www.cecofad.eu), regarding ecosystem impacts of FAD fishing. The project was developed due to the continuous implementation of dFADs by tropical tuna fishermen in the early 1990s, which has impacted the species and size composition of the tuna catch, as well as some components of the epipelagic ecosystem (e.g., sharks, turtles, etc.). In addition, the development of this fishing mode introduced a new uncertainty in stock assessment models, as abundance indices derived from FAD-fishing cannot be calculated easily since the conventional unit of fishing effort (*i.e.*, the searching time) traditionally used for free school fishing cannot be applied. The objective of the project is to improve the understanding of the use of fish-aggregating devices (FAD) in tropical purse seine tuna fisheries and to provide reliable estimates of abundance indices and accurate indicators on the impact of FAD-fishing on juveniles of bigeye and yellowfin tunas and on by-catch species.

The project addresses different questions:

- Apply the Gerodette *et al.* (2012) approach to quantify the total biomass of all removals, characterise these removals by diversity indices, trophic levels and replacement rates, in order to compare FAD and free-swimming school fishing.
- Assess the effects of soaking time and trajectory on fauna associated with FADs.
- Estimate the consequences of the reallocation of the fishing effort due to a moratorium on the associated megafauna.
- Estimate the potential stranding of lost FADs on coral reef areas.

The project also investigates the transition from traditional to non-entangling FADs (NE FADs). It was reported that since 2012, EU purse-seiners have progressively replaced traditional FADs by NE FADs, and that ICCAT Recommendation 14-01 indicates that CPCs shall replace by 2016 existing FADs with NE FADs.

ISSF informed the Group that a new version of the guide for NE FADs produced in 2012, will be released in 2015. The new version proposes a ranking of FADs according to the risk of entanglement associated with each design.

It was recommended that estimates of the mortality due to entanglements in FADs in the Atlantic Ocean be developed. In general, statistics of all sources of mortality for all species from all fishing gears should be collected and analyzed, in order to compare the ecosystem impacts of different fishing gears.

The EU-Spain fleet has set a project with third parties (IEO, AZTI) to evaluate the implementation of good practices onboard their vessels, including the use of NE FADs (see section 11).

It was mentioned that a study (SCRS/2014/124)[1] on the survival of triggerfish released by purse-seiners was presented to last year to the SCRS, and that a model on the ecosystem impacts of FAD fishing in a restricted area of the equatorial Atlantic will be presented at the next SCRS meeting.

9.2 Anchored FADs

No information on anchored FADs was submitted to the Group.

10. Comparison of bycatch in FAD/Free schools

SCRS/P/2015/016 presented a comparative analysis of by-catch caught off FAD fishing by Ghana. The effect of different types of FAD designs on the catchability of fish species were noted and typically the transitional "sausage" type of netting from trials appears to reduce by-catch incidences (e.g. sharks and turtles) due to less likely entanglement than the normal type of FAD, with larger meshes used over the past decades entangles more by-catch species including sharks and turtles.

It was also presented during the meeting that, as part of the CECOFAD (catch, effort and ecosystem impacts of FAD fishing) project being carried out by the IRD/IEO/AZTI in collaboration with the industry, potential impacts of FAD fishing on other marine organisms including sharks are in progress.

[1] Document not published.

Earlier discussions noted that a lot of information collated from the purse seine fleet and observer reports have been presented by SCRS scientists on the mortality of by-catch species caught off FADS and free swimming schools under the Sub-Committee on Ecosystems.

11. Stakeholder initiatives to manage FADs

Five contributions were submitted to the Working Group: document SCRS/2015/089 explained the progresses made through collaborative approaches held between scientists and vessel masters; presentation SCRS/P/2015/017 and document SCRS/2015/099 described initiatives taken by tuna Producer Organizations to tackle possible issues relating to the use of dFADs in tropical tuna fisheries; while the documents SCRS/2015/061 and SCRS/2015/088 introduced the role played by scientific institutes, either to audit some actions or to support experiments already carried out by vessel owners, skippers and crews.

Participants involved in the activities related to the abovementioned documents provided the Group with information on the historical development of the use of ancillaries in tropical tuna fisheries. The use of dFADs in tropical tuna fisheries has been an increasingly important component of the effort since the mid-1990s, with different technological leaps observed till this date. Some initial concerns on the possible impact of such ancillaries on the environment were firstly raised by end of the 1990s. However, estimations on the number of dFADs deployed seem to indicate that their use increased substantially at the turn of 2010, which explain the current concern on the topic.

Participants sought then to identify possible positive and negative impacts of the use of dFADs. They indicated that for several years now (since 2010 for the first attempts) fishermen have taken initiatives to address and to tackle possible negative impacts, like environmental damages and in particular those related to incidental by-catch of sensitive species. They also pointed out that EU vessel owners were proactive since the beginning of the 2010s by adopting specific measures on a voluntary basis to better monitor the use of dFADs and by improving dFADs' design. Measures such as dFAD logbooks and dFAD management plans, have been adopted in order to better monitor dFADs fisheries and at reducing and mitigating possible negative impacts, particularly allowing fishermen to tackle questions directly related to incidental catches.

Producer Organizations representatives presented a number of experiments that have been developed by fishermen to improve dFADs design, in order to reduce entanglements observed on rafts or in the immerge structures. They pointed the need for a deep involvement of vessel masters and crew members when carrying out these experiments to favour an efficient approach and a better diffusion of possible design improvements. They also noted that any of these improvements, to be well accepted and properly implemented by fishermen, should also avoid any dramatic change neither on catch yield, nor on dFADs building costs.

In addition to design improvements, ISSF and EU tuna Producer Organization representatives also mentioned the adoption, publication and diffusion of sets of guidelines describing how to properly handle and to correctly manipulate vulnerable species incidentally entangled on dFADs or caught during a set. Where properly implemented, advice and good practices, detailed in these guidelines, aim at contributing both to ensure crew safety while releasing these individuals and to reduce catch and post-release mortality of such specimens.

Document SCRS/2015/089 mentioned the organization of a series of workshops all around the world, with representatives of all main fleets using floating objects in tuna fisheries. The authors indicated that it had contributed to a cross fertilization in terms of exchange of information between skippers operating in different Oceans. Workshops in the Atlantic Ocean involved scientists and skippers from EU-France and EU-Spain and Ghanaian purse seine fleets in order to improve FAD management and reduce by-catch. Some participants clearly pointed the added-value of supporting a common, collaborative and iterative approach between scientists and fishermen. This cooperative way of working would favor the provision of relevant data and information to scientists, particularly on technological changes and leaps, allowing them to better assess the impact of the use of dFADs on fishing mortality rates and on the ecosystem. They also highlighted the importance of implementing independent frameworks auditing how measures adopted by fishermen are really implemented. Such audit frameworks have already been adopted and implemented by the EU tuna Producer Organizations present. In that view, document SCRS/2015/061 presented a method to verify the implementation of the abovementioned good practices by the Spanish fleet in the three Oceans under tuna RFMOs based on information collected through a 100% coverage observer program for the EU-Spain fleet. Training workshops were organized aiming to enhance good practices. A hand book of instructions for observers has also been implemented. Forms are currently being filled by the observers, which includes information on animal releases (including the disposition of the released animal) and on the material of the dFAD.

EU tuna Producer Organization representatives reminded the willingness of the EU vessel owners to progress towards full non-entangling and biodegradable dFADs. However, the next steps appear to be far more complex than those already made. Participants indicated that at sea trials had already been carried out, testing different types of material (e.g. coco fibre or ropes made of other natural materials), rigging and designs of the different parts of dFADs. First results seem, however, rather inconclusive and further developments will be necessary. Document SCRS/2015/088 introduced to the Working Group information on such additional experiments implemented in collaboration with some ship-owners and material suppliers. A project on bio-degradable material which will be tested in a controlled experiment by placing them in depths from 0 to 50 m and monitoring their state with regard to different depths and time of immersion. In this study eight different types of material will be tested and four different configurations used.

EU tuna Producer Organization representatives reminded that programmes and measures implemented by fishermen to improve dFADs' design and to reduce their environmental footprint have been adopted on a voluntary basis, anticipating policy frameworks adopted by t-RFMOs. They also pointed that some negative aspects highlighted and denounced by other stakeholders as a result of the increased use of dFADs in tuna fisheries were either insufficiently documented or even supported by no clear evidences. In particular, OPAGAC mentioned that unwanted and incidental catches of vulnerable species – such as sea turtles, sea mammals or oceanic sharks – appear as being far below levels reported for other tuna fisheries. In the same vein, the presentation indicated that the proportion of juveniles: adults for bigeye and skipjack in the purse-seine FAD fishery are similar to those observed in the overall catch (all gears combined) in the Atlantic Ocean. It was also pointed out that possible changes in fishing patterns, in relation with management measures to be likely adopted in dFAD fisheries, in the light of new developments and assumptions on the concept of harvest balance, should be taken into account better.

EU tuna Producer Organization representatives reminded the Working Group that they would continue to be proactive on these issues by implementing more ambitious measures than those already adopted by ICCAT. In particular, they mentioned the implementation of observer programmes and investments in Close Circuit Tele Vision (CCTV) allowing for a full coverage of fishing activities on board purse seine vessels operating in Atlantic tropical tuna fisheries. Therefore, they underlined that EU vessel owners were supporting additional operational costs directly linked to these additional and voluntary measures. They also pointed that, when adopting possible constraining measures aiming at reducing the environmental impact of dFADs and at managing the contribution of dFAD fisheries to the fishing mortality of tropical tunas and associated species, ICCAT should carry out cost/benefit analysis and assess in particular the possible efficiency of such measures, their likelihood of compliance and the additional operational costs.

In addition unexpected and unwanted impacts of possible measures were pointed out, such as those related to an inappropriate definition of FAD free fisheries (supported by some environmental NGOs and promoted on some markets) and FAD associated fisheries, which might lead to misreporting and induce some substantial loss of reliability on the reported catch and effort data.

During presentation SCRS/P/2015/017 the need for a typology of dFADs was mentioned, based on type of material used, partially non-biodegradable or fully biodegradable materials, the type of positioning and the associated communication equipment – VHS, GPS, echo-sounder, etc. Such a typology should be considered in relation with management objectives and management measures and should be deeply discussed and assessed, prior to possible adoption by ICCAT. In particular, the authors clearly pointed that measures aiming either at managing the contribution of dFADs to fishing mortality rates or at mitigating environmental impacts of the use of dFADs might be different in nature. For instance, on the one hand, measures aiming at managing the contribution of dFADs to fishing mortality rates should be based on a limitation of the number of activated beacons per vessel at any time, as part of a set of complementary measures limiting the whole fishing capacity deployed in tropical tuna fisheries. On the other hand, measures aiming at mitigating environmental impacts of dFADs might lead to a limit of the total number of dFADs deployed per year. As an example and highlighting that these decisions were made on a voluntary basis by EU-France vessel owners, it was suggested that no more than 200 beacons should be bought per year and per vessel and only 150 should be activated by the vessel master at any time.

During the following discussions, participants highlighted that:

- Spanish and French purse seine vessel owners, and more particularly the EU tuna Producer Organizations, are conscious of questions related with impacts of the use of dFADs

  - both on catch structure or composition and on fishing mortality rates applied to tropical tunas and associated species, and
  - on offshore and inshore marine ecosystems;
- A collaborative, iterative and inclusive approach, where scientists have a key role to play, is considered the best way to progress towards better dFADs designs and towards a better management framework of dFADs tuna fisheries;
- Science needs sufficient and reliable information of both qualitative and quantitative nature, more particularly on the history of dFAD fisheries development, on technological leaps, on fishing strategies with regards dFAD positions or trajectories and data reported by the activated beacons;
- A segment of the fishing fleet already took initiative on a voluntary basis and anticipating possible modification of the policy framework;
- Any measures to be implemented on dFAD fisheries should be
  - considered as part of a set of measures aiming at managing all components of the fishing capacity within a broader framework better, addressing all sources of fishing mortality and environmental impacts;
  - assessed, through possible cost/benefit analysis based on criteria such as efficiency, acceptability, feasibility and controllability;
- Next steps towards full non-entangling dFADs and biodegradable dFADs might be more complex and would need more support from fishing technology science.

12. Consideration of future work

12.1 Future work for the ad hoc Working Group on FADs

This first meeting of the *ad hoc* Working Group has been very productive. It has been a test of the importance of having diverse views from all stakeholders as regards to issues related to FADs. The Working Group, however, has not reached all its objectives yet and therefore should:

- Continue supporting and encouraging collaboration between scientists and the industry in the collection of data on FAD operations;
- Participate in the work of the tropical tuna Working Group, in particular the upcoming assessments of bigeye and yellowfin, to support analysis that can evaluate the contribution of the FAD fishery to total fishing mortality and changes in selectivity patterns for these stocks that can be attributed to the FAD fishery;
- Participate in the meetings of the Sub-committee on Ecosystems to help in the evaluation of impacts of FADs on ecosystem;
- Hold a meeting as a Working Group in 2016 after the yellowfin assessment to prepare the final response to the Commission under recommendation [14-03];
- To collaborate with other tuna RFMO FAD Working Groups to harmonize progress in addressing FAD issues that are common to all tuna RFMOs;
- Provide a response to the Commission at the 24th Regular meeting in November 2016.

12.2 Recommendations

To the Commission or to the Commission and the SCRS:

- Review FAD management plan requirements with the aim of harmonizing these requirements with those of other tuna RFMOs;
- Promote the harmonization of FAD nomenclature, and data reporting as to facilitate data sharing across Oceans;
- Recommends that the Commission evaluate the capacity of all CPCs to have to comply with current measures related to FAD management, and if necessary provide mechanisms and resources to enhance such compliance;
- Recommend the Commission that the design of measures related to FAD management should be supported by scientific studies conducted by the SCRS and by studies of the likelihood of compliance, made by the Permanent Working Group;
- Recommend that the SCRS and the Commission review its measures of fishing capacity for purse seiners in light of all increases in fishing power related to technology improvements, number of vessels, etc.;

- Recommend the Commission to clearly define what "association" means in baitboat/purse seine association fisheries;
- The Group noted that some purse seine fleets are already achieving 100% observer coverage and recommends that the Commission should require that all purse seine fleet aim at achieving such coverage;
- Recommend that all fleets provide detailed information on FAD operations so as to be able to estimate the overall impact of FADs.

To the SCRS:

- Request the SCRS to review the current template including the detailed information to be collected. The review should use the CECOFAD project template as a starting point to select the most important variables to be collected;
- Quantify the contribution that all gears have the overall by-catch of vulnerable species in the Atlantic in order to truly evaluate the relative importance of by-catch from purse seiners;
- Recommend research on the evaluation of balanced harvest strategy;
- Recommend considering development of a framework in order to develop fishery independent indices of abundance from data from acoustic sensors found in FADs;
- Recommend SCRS scientists assess, through management strategy evaluation, the potential use of limits on FAD fishing effort, for example:
  - the number of active beacons
  - the number of FADs seeded
- Recommend the SCRS to clearly define what "FAD set" and "FAD fishing" are;
- Note that the evolution for the biodegradables may be much harder than the evolution to non-entangling FADs, thus recommend further studies on appropriate materials and designs.

12.3 Other future scientific work

Document SCRS/2015/090 presented a methodology to use the biomass information provided by the acoustic records derived from echo-sounder buoys as a complementary relative abundance index in the stock assessment of tropical tuna stocks. Around the mid-2000s the tropical tuna purse seine fleet started to regularly use satellite linked echo-sounder buoys in their drifting FADs. This technological development is causing rapid changes in the fishing strategy and fleet behavior due to the possibility of informing remotely and in near real-time about the accurate geo-location of the FAD and the presence and size of tuna aggregations underneath them. Apart from its unquestionable utility as a fishery tool, echo-sounder buoys have also the potential of being a privileged observation platform to evaluate relative abundances of FAD-associated fish using catch-independent data. Some of the features of the information available from satellite tracking echo-sounder buoys used and provided by the Spanish TT PS and associated fleet to work on the development of a "fishery semi-independent" abundance index were reviewed.

The Group noted the importance of the study because an abundance relative index independent of the fishery would be very valuable to increase the precision of the stock assessment of tropical tunas. The Group acknowledged the presentation of this collaborative initiative between industry and scientists and recommended the authors to continue working on this line in order to get a more representative echo-sounder acoustic record sample which will allow building the index. Moreover, the Group noted that previous work on acoustic selectivity will contribute to discriminate the acoustic signal by species to estimate species specific abundance indices. However, the Group also noted some difficulties in the interpretation of the acoustic signal as some characteristics can affect the assumption that the acoustic records are proportional to tropical tuna abundance (e.g. timing of the signal, position of the buoy in relation to the tuna school, etc.). Although there are many questions to be considered both in data exclusion criteria as well as in the development of the model, the Group agreed on the huge potential of these buoys to actively sample vast extensions in a cost-effective manner and on the usefulness of these buoys to be used in estimation of abundance index.

13. Other matters

No other matters were discussed.

14. Adoption of Report and adjournment

Due to the limited time, only item 12 was reviewed and adopted by the Group during the meeting. The rest of the report was adopted by correspondence.

The co-Chairs thanked the participants and the Secretariat for their work as well as the interpreters for their patient and excellent work.

The co-Chairs adjourned the meeting.

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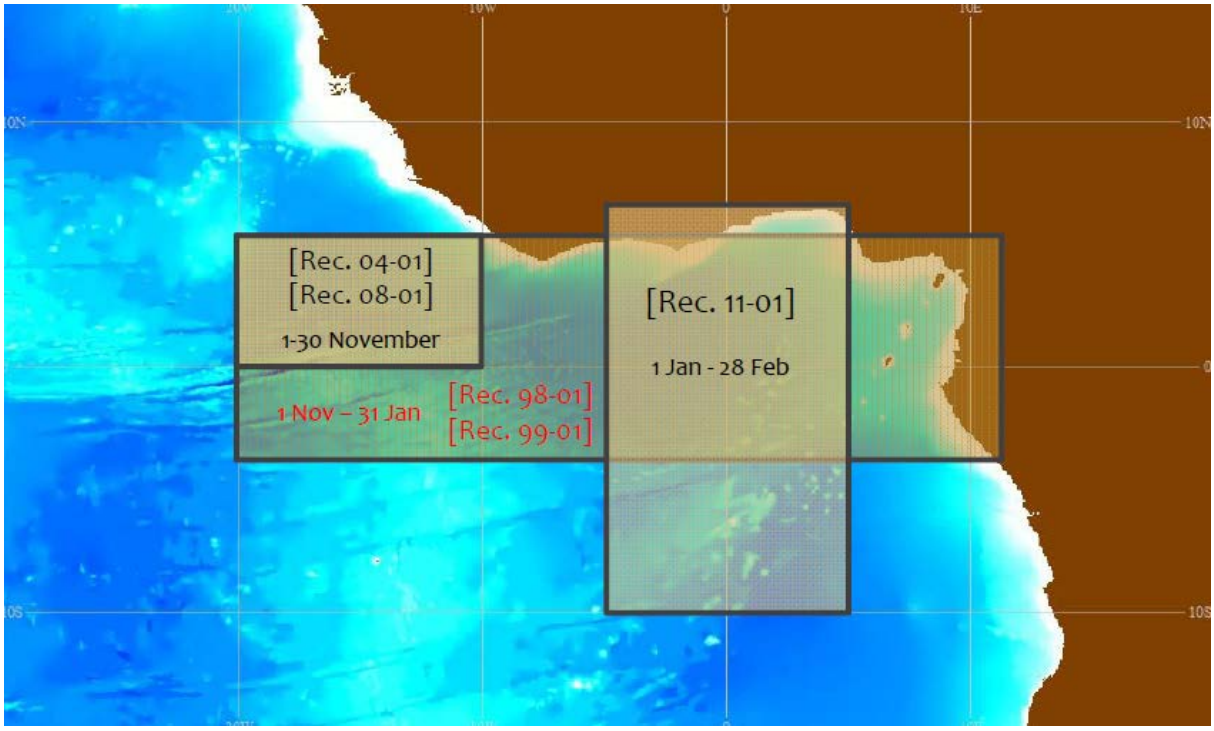

Figure 1. Spatial closures implemented by ICCAT in the Gulf of Guinea since 1998.

Appendix 1

AGENDA

1. Opening of the meeting
2. Adoption of Agenda and meeting arrangements
3. Nomination of Rapporteur
4. Terms of reference of Working Group
5. Current stock status of tropical tunas and management arrangements in the ICCAT area
   - 5.1 Current stock status
   - 5.2 Current management
6. Historical experiences of FAD management in the ICCAT area: FAD seasonal and temporal closures
7. Review of FAD management in other tuna RFMOs
8. Description of FAD operations and FAD technology
   - 8.1. Drifting FADs
   - 8.2. Baitboat-Purse seine associations
   - 8.3. Anchored FADs
9. Ecological communities around FADs
   - 9.1. Drifting FADs
   - 9.2. Anchored FADs
10. Comparison of bycatch in FAD/Free schools
11. Stakeholder initiatives to manage FADs
12. Consideration of future work
    - 12.1. Future work for the Ad hoc WG on FADs
    - 12.2. Recommendations
    - 12.3. Other future scientific work
13. Other matters
14. Adoption of the report and closure

Appendix 2

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Appendix 3

LIST OF DOCUMENTS

SCRS/2015/061 System of verification of the code of good practices on board ANABAC and OPAGAC tuna purse seiners and preliminary results for the Atlantic Ocean. Goñi N., Ruiz J., Murua H., Santiago J., Krug I., Sotillo de Olano B., Gonzalez de Zarate A., Moreno G., Murua J.

SCRS/2015/081 Options for managing FAD impacts. Restrepo V., Scott G. and Koehler H.

SCRS/2015/086 Drifting Fish Aggregating Devices (dFADs) of the Atlantic Ocean: how many? Maufroy A., Kaplan D.M., Bez N., Delgado de MolinaA., Murua H., Floch L. and Chassot E.

SCRS/2015/087 Towards acoustic discrimination of tuna species at FADs. Moreno G., Boyra G., Rico I., Sancristobal I., Filmater J.D., Fabien F., Murua J., Goñi N., Murua H., Ruiz J. and Santiago J.

SCRS/2015/088 Evaluating potential biodegradable twines for use in FADs. Moreno G., Ferarios J.M., Sancristobal I., Murua J., Goñi N., Murua H., Ruiz J., Santiago J.

SCRS/2015/089 ISSF skippers workshops: understanding FADs from a fisher's perspective. Murua J., Moreno G. and Restrepo V.

SCRS/2015/090 Towards a Tropical Tuna Buoy-derived Abundance Index (TT-BAI). Santiago J., H. Murua, G. Moreno, M. Soto and I. Quincoces

SCRS/2015/099 Industry initiatives for FAD management. Morón J. and Herrera M.

SCRS/2015/100 Summary of Information available on FADs submitted to the ICCAT secretariat. de Bruyn P.

SCRS/2015/104 Objectives and first results of the CECOFAD project. Gaertner, D., Ariz, J., Bez, N., Clermidy, S., Moreno, G., Murua, H. and Soto, M.

LIST OF PRESENTATIONS

SCRS/P/2015/014 FADs: State of Play in tuna RFMOs. Cervantes A.

SCRS/P/2015/015 Evolution and current state of the technology of echo-sounder buoys used by Spanish tropical tuna purse seiners in the Atlantic, Indian and Pacific Oceans. J. Lopez, G. Moreno, I. Sancristobal and J. Murua

SCRS/P/2015/016 Comparison between Korean Standard and Transition FAD Designs. Iriarte F.

SCRS/P/2015/017 The use and regulation of FADs - the French FAD management plan. Goujom M.