

ISSF BYCATCH MITIGATION EFFORTS FOR TROPICAL TUNA PURSE SEINE FISHERIES IN THE ATLANTIC OCEAN

V. Restrepo¹, J. Murua², G. Moreno¹ and A. Justel-Rubio¹

SUMMARY

This paper summarizes ISSF activities relevant to quantifying and mitigating bycatch-related issues in tropical tuna purse seine fisheries in the Atlantic Ocean. Total target and non-target catch for 2011-2015 is presented. On average, bycatch is 7.69% of the catch in object sets, 2.12% in free-swimming school sets and 5.26% overall; which are relatively high rates mostly due to a large proportion of minor tuna species. ISSF scientists collaborate with industry both through research activities conducted at sea and by holding skipper workshops. The objectives of the workshops are to inform fishers of the latest advances in bycatch reduction practices and collect their feedback to be later tested by scientists during ISSF research cruises. Three research cruises have been conducted in the Atlantic Ocean to test bycatch mitigation measures, mostly of shark species and undesirable sizes of yellowfin and bigeye. Considering the high rate of small size major tunas, non-tuna bony fishes and minor tuna species present in Atlantic Ocean tropical purse seine bycatch, which are often targeted and marketed, a tuna retention measure would have a positive socioeconomic impact.

RÉSUMÉ

Le présent document résume les activités de l'ISSF relatives à la quantification et à l'atténuation des prises accessoires dans les pêcheries des senneurs ciblant les thonidés tropicaux dans l'océan Atlantique. Les captures totales ciblées et non ciblées de 2011-2015 sont présentées. En moyenne, les prises accessoires représentent 7,69% des prises des opérations sous objets, 2,12% des opérations sur bancs libres et 5,26% dans l'ensemble ; ce qui représente des taux relativement élevés, principalement en raison d'une grande proportion d'espèces de thonidés mineurs. Les scientifiques de l'ISSF collaborent avec l'industrie dans le cadre d'activités de recherche menées en mer et d'ateliers s'adressant aux capitaines. Les objectifs des ateliers consistent à informer les pêcheurs des derniers progrès accomplis en matière de pratiques de réduction des prises accessoires et à recueillir leurs commentaires avant de les soumettre au test par les scientifiques lors des campagnes de recherche de l'ISSF. Trois campagnes de recherche ont été menées dans l'océan Atlantique pour tester les mesures d'atténuation des prises accessoires, principalement des espèces de requins et des tailles indésirables d'albacore et de thon obèse. Compte tenu du taux élevé de thonidés majeurs de petite taille, de poissons osseux non thonidés et de thonidés mineurs dans les prises accessoires des senneurs tropicaux de l'océan Atlantique, souvent ciblés et commercialisés, une mesure de rétention du thon aurait un impact socio-économique positif.

RESUMEN

En este documento se resumen las actividades de ISSF de cuantificación y mitigación de la captura fortuita en pesquerías de cerco de túnidos tropicales del océano Atlántico. Se presenta la captura objetivo y no objetivo total para 2011-2015. Como promedio, la captura fortuita supone un 7,69% de la captura en lances sobre objetos, un 2,12% en lances sobre bancos libres y un 5,26% de la captura general; tasas relativamente elevadas, debido a la gran proporción de especies de túnidos menores. Científicos ISSF colaboran con la industria mediante actividades de investigación en el mar y talleres con los patrones. El objetivo de estos talleres es informar a los pescadores de los últimos avances en reducción de la captura fortuita y recoger su feedback para que, después, los científicos realicen pruebas durante los cruceros de investigación ISSF. Se han realizado tres cruceros de investigación en el océano Atlántico para probar medidas de mitigación de la captura fortuita, sobre todo de especies de tiburones y tallas no deseadas de rabil y patudo. Considerando la elevada tasa de túnidos principales de talla pequeña, peces óseos

¹ International Seafood Sustainability Foundation (ISSF). VRestrepo@iss-foundation.org

² AZTI-Tecnalia

que no son tónidos y especies de pequeños tónidos en la captura fortuita de la pesquería de cerco tropical del océano Atlántico, que a menudo son especie objetivo y se comercializan, una medida de retención de tónidos tendría un impacto socioeconómico positivo.

KEYWORDS

By-catch, purse seining, tropical tuna, Atlantic Ocean, discard, full retention, socio-economy

1. Introduction

Since 2009, the International Seafood Sustainability Foundation (ISSF) has been conducting several activities that relate to quantifying and mitigating bycatch-related issues in tropical tuna purse seine fisheries, globally. These activities take three main forms: (1) Desktop studies such as analyses of observer data to quantify bycatch and to identify critical issues; (2) a series of at-sea research activities to test mitigation techniques (Restrepo *et al.*, 2016), and (3) a series of workshops and educational materials to disseminate best practices for bycatch mitigation among skippers and other crew (Murua *et al.*, 2014).

Paragraphs 52-54 of the 2016 *Recommendation by ICCAT on a multi-annual conservation and management programme for tropical tunas* [16-01] relate to bycatch and reductions of discards, and include a mandate for SCRS to inform the Commission on these matters. The objective of this paper is to summarize ISSF activities relevant to this item. This paper is limited to Atlantic purse seine fisheries and does not address the other fishing gears mentioned in Rec. 16-01.

2. By-catch rates

There is no universally-agreed definition of the term "bycatch", which can be used by different people to mean different things. Generally speaking, bycatch is the catch of anything that is not the main reason for which the vessel is fishing, whether retained or discarded. Here we use the term to mean any species that is not skipjack, yellowfin or bigeye tuna, regardless of whether it is discarded or retained. Note that this includes albacore tuna, which is caught in smaller quantities as well as "minor" species of tunas (the *Auxis* and the *Euthynnus* groups).

Table 1 presents, in percentages, the average total target (SKJ+YFT+BET) and non-target catch for 2011-2015, based on observer data. The non-target catch (bycatch) is subdivided into groups. Values are presented for FAD sets (more precisely, floating object sets), free swimming school sets (FS) and combined (PS). On average, bycatch is 7.69% of the catch in FAD sets, 2.12% in FS sets and 5.26% overall. These numbers are higher than in other oceans, perhaps because minor tuna species are often targeted in the Atlantic (Amandè *et al.* 2010; Justel-Rubio and Restrepo, 2017). Indeed, the catch of minor tuna species accounts for over 60% of the bycatch (**Table 1**).

In the Atlantic, bycatch of most species is more common in FAD sets than FS sets, with some exceptions: The bycatch of sharks is very similar in both set types, around 0.4% (**Table 1**). And the bycatch of rays (manta and mobulid rays) is higher in FS sets than in FAD sets (**Table 1**).

3. Best practice training

Since 2009 ISSF has sponsored over 60 bycatch mitigation participatory approach workshops for tropical tuna purse seiner skippers and crew, referred to as "Skipper Workshops", across the globe (Murua *et al.*, 2014; Murua *et al.*, 2017). The objectives of the workshops are to inform fishers of the latest advances in bycatch reduction practices (e.g. non-entangling biodegradable FADs, best protocols for bycatch release from deck) and collect their feedback on new mitigation ideas that can be later tested by scientists during ISSF research cruises.

At least 18 workshops conducted in Europe (e.g. Spain, France, Portugal) and Africa (e.g. Ghana) have targeted fishers from the Atlantic Ocean. To date 158 skippers (e.g. fishing masters and captains) and 63 crew (e.g. officers, chief engineers, deck bosses, deck crew) have attended. These fishers belonged to Spanish (and associated flag) (31 purse seiners and 7 supply vessels), French (6 purse seiners) and Ghanaian vessels (16 purse seiners and 20 pole and line vessels working with FADs) (**Table 2**). Thus, a very large proportion of the tropical tuna purse seiners in the Atlantic have collaborated in the workshops.

ISSF also organizes workshops on specific topics that need to be addressed together with fishers to find an agile solution to a given impact. This was the case of a workshop on the use of biodegradable FADs, held in November 2016, where scientist and fishers joined efforts to find solutions to reduce the environmental impacts of FADs sinking in the ocean or beaching in coastal areas. Fishers from the 3 tropical oceans were invited and specifically 2 biodegradable FAD designs were developed for the Atlantic Ocean as well as the protocol to test them at sea (Moreno *et al.* 2016).

The ISSF Skipper Workshops directly align with objectives from the 1st Joint T-RFMO FAD WG meeting (Madrid, April 2017), which highlighted as a key area for future action the "Collaboration between industry and scientists for the improvement of the collection of data, scientific research and to develop effective mitigation techniques". Other parallel science-fisher joint efforts exist in the Atlantic, such as the Code of Good Practices by the Spanish fleet implementing the use of non-entangling FADs and best bycatch release practices (Goñi *et al.*, 2015; Lopez *et al.*, 2017).

4. Research

ISSF conducts research to define and promote best practices that can positively impact the issues of concern in the global tuna fishery. The research effort is mainly based on at-sea research to investigate potential mitigation measures, and is closely linked to the previous activity, leading workshops with tropical tuna purse seine vessel fishers to discuss mitigation techniques, to develop scientific hypotheses, prioritize research, and improve management measures. Meaningful research results are also linked to advocating to global tuna RFMOs for the adoption of essential bycatch data collection and mitigation measures.

As for any research, it is key to prioritize activities to make the most of the available funds. Research priorities are guided by the ISSF Bycatch Mitigation Steering Committee, a group of world-renowned experts in relevant fields such as tuna fisheries, bycatch, gear technology, animal behavior, physiology, and ecology. The Committee's deliberations also take into consideration suggestions from purse seine skippers, which are obtained through the ISSF Skipper Workshops. Much of the emphasis of the research is focused on the current two main issues of concern in tropical tuna purse seine fisheries: the bycatch of sharks (primarily silky sharks) and the catches of small undesirable sizes of bigeye and yellowfin tunas.

Three research cruises have been recently conducted in the Atlantic Ocean (Restrepo *et al.* 2016):

- (i) The first cruise, on the *Cap Lopez* purse seine vessel in 2015, departing from Tema, Ghana on the 20th of July and returning on the 5th of August.
- (ii) The second cruise took place also in 2015, on the *Sea Dragon*, a sailing vessel operated by Pangaea Exploration. The cruise departed from Dakar, Senegal on the 4th of October and returned on the 22nd of October.
- (iii) The third cruise took place in 2016, on the *Mar de Sergio* purse seine vessel, starting in Abidjan (Côte d'Ivoire) on March 14th and ending in Dakar (Senegal) on April 11th.

Activities conducted on the purse seine vessels (cruises 1 and 3) were mainly devoted to mitigating bycatch by releasing and measuring the post-release survival of species, specific objectives were (see for more information: Sancristobal *et al.* 2016 and Itano *et al.* 2016a):

- Improving pre-set estimation of species composition, sizes, and quantities of tunas associated with FADs using acoustics: (i) Attaching echo-sounder buoys from four different brands to the FADs to compare signals. (ii) Using three scientific acoustic echo-sounders with frequencies of 38, 120 and 200 kHz and a EK80 wideband echo-sounder, followed by intensive spill sampling to compare acoustic data and species composition.
- Behavior of tunas and other fishes within purse-seine nets: Study of fish behavior inside the net to find solutions to release them.
- Releasing sharks from the net: Test the efficacy and potential of a release panel that could be used to selectively release sharks from purse seine sets.
- Releasing sharks from the net: Fish and release sharks from inside the net
- Modifications in FAD designs to reduce impacts: Observation of shark and bycatch entanglement rates in drifting FADs with description of FAD types observed.

Main objectives of the second cruise onboard the chartered vessel studied the behavior of tunas and sharks around FADs (see Itano *et al.* 2016b for more information):

- Behavior of tunas and other fishes around FADs: Investigate the associative behavior of target and non-target species using acoustic telemetry and the horizontal movements of oceanic sharks using PAT tags.
- Behavior of tunas and other fishes around FADs: Active tracking of sharks, tuna and other non-target species at FADs
- Modifications in FAD designs to reduce impacts: Observation of shark and other bycatch entanglement rates in drifting FADs with description of FAD types observed.

While research is still ongoing, so far, several bycatch mitigation measures tested at-sea have resulted in positive outcomes in the Atlantic Ocean. The use of non-entangling FADs drastically reduces the number of sharks and turtles captured as bycatch. Likewise, using best practices when releasing live sharks and turtles from deck resulted in survival rates of ~100% for turtles and ~ 15 % for sharks. First results on releasing sharks from the net by fishing them with handlines, showed that 20% of sharks found in the net could be released with 100% of survival. This technique, that has been tested twice, shows potential for improvement, specially on the time needed to release sharks as well as on the safety of the crew. Current development of acoustic technology will help skippers identify the proportion of bigeye and yellowfin tunas compared to skipjack tuna at FADs in order to help them make more sustainable decisions. Finally, the research conducted and knowledge acquired in other oceans, could be used in the Atlantic Ocean too, as the use of biodegradable materials at FADs to prevent marine debris and ghost fishing.

At-sea conditions cannot be controlled easily, like in a laboratory setting. Working with wild fish often comes with surprises, especially when scientists are testing new ideas for the first time. Also, progress can sometimes be slow, especially when working opportunistically with commercial fishing vessels that have fishing efficiency as their main priority. Still, ISSF believes that this type of research offers opportunities that cannot be found in a lab or in a library. That is why ISSF has invested the past several years focusing on these initiatives and will continue to do so.

5. Conclusions

Some of ISSF's objectives are to better understand bycatch in tropical tuna purse seine fisheries, to research bycatch mitigation and management best practices and to share these best practices with fleet members, while also learning from the fleets' at-sea experiences. ISSF Skipper Workshops have proved to be a valuable tool to facilitate this type of collaboration between scientists and industry, reaching a very large proportion of the Atlantic tropical tuna purse seine fishery.

Outputs from the Skipper Workshops have been directly applied to research at-sea, where bycatch mitigation best practices have been tested and improved over the past years. Several measures have been tested on board research cruises in the Atlantic Ocean, focusing on the bycatch mitigation of sharks and juvenile target tropical tunas accidentally captured in purse seine fishing activities.

As regards to bycatch utilization, studies on the trade and utilization of retained bycatch in Atlantic Ocean tuna fisheries highlight how the retained bycatch of the small sized individuals of major tuna species (in particular, *Katsuwonus pelamis*), "minor" tuna species and other bony fishes — all of which represent a large percentage of total bycatch in the Atlantic Ocean region (**Table 1**) - highly contributes to food security and can have a big social and economic importance for local population, as it is frequently kept and sold in local markets in western Africa as fish called "faux poisson" (Amandè *et al.*, 2016a; 2016b).

WCPFC, IOTC and IATTC have adopted mandatory measures for the full retention of yellowfin, skipjack and bigeye unless the fish are unfit for human consumption. Since in the Atlantic Ocean, catches of very small tunas as well as non-tuna species play an important role in food security in this region; a tuna retention measure for purse seine fisheries in the Atlantic Ocean would directly help critical issues such as food security, local employability and would result in improved data on total removals of these species (Amandè *et al.*, 2016a; 2016b).

Acknowledgements

ISSF is grateful to the owners, managers and crew of the vessels that have participated in the research program in the Atlantic: CAP LOPEZ, MAR DE SERGIO and SEA DRAGON; ISSF would like to thank all the fishers that attended our workshops and shared their knowledge with us.

References

- Amandè, M.J., J. Ariz, E. Chassot, A. Delgado de Molina, D. Gaertner, H. Murua, R. Pianet, J. Ruiz and P. Chavance. 2010. Bycatch of the European purse seine tuna fishery in the Atlantic Ocean for the 2003–2007 period. *Aquat. Living Resour.* 23: 353–362.
- Amandè, M.J., N’Cho, A.J., Kouakou, N.D., N’Cho, C.M., Koffi, K.F., Kouadio, A.N.C., Dewals, P. and Restrepo, V. 2016a. Utilization and trade of faux-poisson landed in Abidjan. SCRS/2016/158
- Amandè, M.J., P. Dewals, A.J. N’Cho, P. Pascual, P. Cauquil, B.Y. Irie, L. Floch and P. Bach. 2016b. Retaining bycatch to avoid wastage of fishery resources: How important is bycatch landed by purse-seiners in Abidjan? SCRS/2016/017
- Goñi, N., Ruiz, J., Murua, H., Santiago, J., Krug, I., Sotillo de Olano, B., Gonzalez de Zarate, A., Moreno, G., Murua, J., 2015. System of verification of the code of good practices on board ANABAC and OPAGAC tuna purse seiners and preliminary results for the Atlantic Ocean. IOTC–2015–WPEB11–INF09
- Itano, D., J.D. Filmlalter, and F. Forget. 2016a. ISSF bycatch reduction research cruise on the F/V CAP LOPEZ, Gulf of Guinea 2015. ICCAT SCRS/2016/127.
- Itano, D., J.D. Filmlalter, and Melanie Hutchinson. 2016b. ISSF bycatch reduction research cruise on the SEA DRAGON, eastern Atlantic Ocean 2015. ICCAT SCRS/2016/155.
- Lopez, J., Goñi, N., Arregi, I., Ruiz, J., Krug, I., Murua, H., Murua, J., Santiago, J., 2017. Main results of the Spanish Best Practices program: evolution of the use of Non-entangling FADs, interaction with entangled animals, and fauna release operations. IOTC–2017–WGFAD01–11.
- Justel-Rubio, A. and V. Restrepo. 2017. Computing a global bycatch Rate of non-target species in tropical tuna purse seine fisheries. ISSF Technical Report 2017-01. International Seafood Sustainability Foundation, Washington, D.C., USA.
- Moreno, G., Restrepo, V., Dagorn, L., Hall, M., Murua, J., Sancristobal, I., Grande, M., Le Couls, S. and Santiago, J. (2016). Workshop on the use of biodegradable Fish Aggregating Devices (FADs). ISSF Technical Report 2016-18A. International Seafood Sustainability Foundation, Washington, D.C., USA.
- Murua, J., G. Moreno, M. Hall, D. Itano, L. Dagorn, and V. Restrepo. 2014. ISSF Skipper Workshops: Collaboration between scientists and fishing industry to mitigate bycatch in tuna FAD fisheries. ISSF Technical Report 2014-06. International Seafood Sustainability Foundation, Washington, D.C., USA.
- Murua, J., G. Moreno, D. Itano, M. Hall, L. Dagorn, and V. Restrepo. 2017. ISSF Skippers’ Workshops Round 6. ISSF Technical Report 2017-03. International Seafood Sustainability Foundation, Washington, D.C., USA.
- Restrepo, V., L. Dagorn, G. Moreno, F. Forget, K. Schaefer, I. Sancristobal, J. Muir and D. Itano. 2016. Compendium of ISSF At-Sea Bycatch Mitigation Research Activities as of 12/2016. ISSF Technical Report 2016-13A. International Seafood Sustainability Foundation, Washington, D.C., USA.
- Sancristobal, I., U. Martinez, G. Boyra, J. Muir, G. Moreno and V. Restrepo. 2016. ISSF bycatch reduction research cruise on the F/V MAR DE SERGIO in 2016. ICCAT SCRS/2016/156.

Table 1. Percent composition of purse seine catches in the Atlantic by species groups and set type for 2011-2015. The first two rows show the catch percentage for target tropical tunas, and for all other species combined ("bycatch"). The next five rows show the percentages of the Other category broken down by species group. Data are from observer programs from EU-France and EU-Spain (kindly provided by L. Dagorn of IRD and H. Murua of AZTI).

	<i>FS</i>	<i>FAD</i>	<i>PS</i>
YFT+SKJ+BET	97.88	92.31	94.74
OTHER	2.12	7.69	5.26
OTHER TUNAS	1.47	4.87	3.35
BONY FISH	0.10	2.19	1.31
BILLFISH	0.06	0.16	0.17
SHARKS	0.40	0.42	0.42
RAYS	0.08	0.05	0.06

Table 2. Atlantic Ocean tuna purse seine, supply and pole and line vessels whose skippers and crew have collaborated in at least one ISSF Skipper Workshop. *Including Spanish-owned boats under other flags.

<i>FLEET</i>	<i>VESSEL TYPE</i>		
	<i>PURSE SEINE</i>	<i>SUPPLY VESSEL</i>	<i>POLE & LINE</i>
France	6	-	-
Ghana	16	-	20
Spain*	31	7	-
	53	7	20