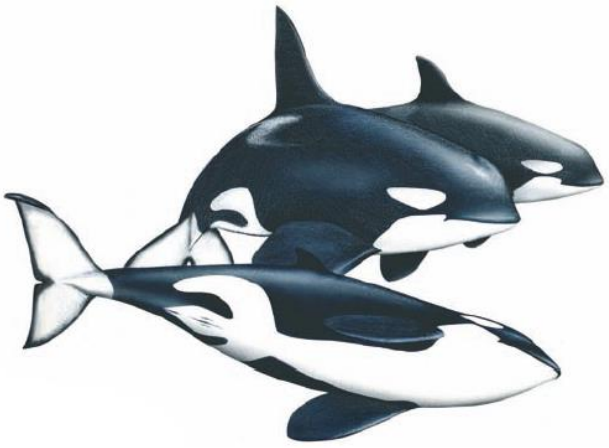
Project on mitigating the interactions between endangered marine species and fishing activities

Title of the Pilot Action:

Killer whale, *Orcinus orca* (Linnaeus, 1758)in the Strait of Gibraltar and interactions with Spanish tuna fisheries.

Date: July, 2018



Orcinus orca / *Killer whale* (© Wurtz-Artescienza

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Killer whale and fisheries interactions in the Strait of Gibraltar area (Strait-K-Whales, SKW)

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Contents

Final Report of the activities carried out by the IEO in the framework of the Pilot Action: Killer whale and fisheries interactions in the Strait of Gibraltar area.July 2018.

Executive Summary

Killer whale (*Orcinus orca*) is a cetacean species resident in the Strait of Gibraltar and adjacent Atlantic waters. Their occurrence seems to be related to the presence of one of its prey species, the large bluefin tuna. A small group of families observed along the year these orcas are part of the southernmost population of the North-East Atlantic with not more of 5 stable social groups. It is a separated management unit that has recently seen its survival threatened. Spain adopted the Order APM/427/2017, of May 4, which approves the protection measures, and the Conservation Plan for the Orcas of strait of Gibraltar and Gulf of Cadiz.

Killer whales seen as a competitor by fisheries, attacking tuna caught on fishing handlines. Studies of the distribution of killer whales in spring and summer in the area confirm bluefin tuna as the primary prey of killer whales. >In Morocco was described an artisanal handline fishery based in northern beaches targeting bluefin tuna in the strait of Gibraltar during migrations; Different authors underlined the effects of killer whale's depredation on the bluefin tuna caught by the Spanish handline and baitboat fisheries and the incidence on bluefin tuna captured by the artisanal handline fishery based on Morocco. Orcas can directly prey on tuna from handline gears, so presumably they invest less energy in this feeding approach than in the active hunting (Esteban, 2015). The bluefin tuna attacked can be completely or partially depredated, before the fishermen have been able to take on board the tuna.

In the framework of the MoU between ACCOBAMS and IEO (*Addendum to the M0U ACCOBAMS-IEO Nº 06/2016/LB 6410*) we compliled data colected by the IEO (Malaga Large Pelagic team) in the Sopanish landing ports of Algeciras and Tarifa, in relation to bluefin tuna that have interactions with killer whale in the Strat of Gibraltar area. In adition we prepare and carried out a survey with owners, skypers and fishermen in the landing port of Tarifa during February 2017 to have direct information on the interaction killer whale-artisanal fisheries targeting bluefin tuna. This report summarise the pilot project achievements.

The handline fleet in the strait fish mainly in summer, starting in may. The extension of the fishing period depends of the quota of each vessel and is based in commercial drivers. Currently the fishing period extend from February till November. The baitboat fleet also targeting bluefin tuna along the year in the same fishing grounds has reported recently the attacks of killer whale to their bluefin captures. A total of 64 bluefin tuna where landed in Tarifa and observed by IEO with whales bites during the 2000-2017 period. Despite the large number of tuna affected and landed bitted at the starting of the period, this number was decreasing till near cero from 2005 onward. According the fishermen this reduction was not the result of a less number of orcas observed in the area or a reduction of the number of interactions but a fishing and commercial strategy. The results of our analysis show that there are significant differences depending on the observed period (Chi-squared = 79.93, $P<0.0001$) before and after 2007, the year of the implementation of tuna TAC and therefore, the average of bitten tuna in relation to the total landed in Tarifa port is under evaluated in the period after the implementation of the TAC by ICCAT. The number of expected tuna landed with bites is much higher than observed, mainly during the period 2007-2010 and in 2017.

From the survey results, considering all surveys and gears pooled together 28.5 % of the answers consider that the accidental capture of orcas is frequent, while 57% consider that this capture is very rare or nonexistent. In the case of dolphins, 71% consider that this capture is very rare or nonexistent.

The fishermen underline that there is a greater presence of orcas and more pods than a few years ago related to the great abundance of tunas. The areas where the killer whales are present have also varied, now they are everywhere and the groups very close to each other. Orca whale are present more and more months a year; they were seen mainly in summer before, but now they are seen during most of the year.

1. Contextand Objectives of the Pilot Action

This report is one of the commitments included in the Addendum of the Memorandum of Understanding (MoU) between ACCOBAMS and IEO and summarizes the activities carried out by the IEO (C.O. de Malaga) since the signature of the Addendum to the MoU.

The MoU is part of the *ACCOBAMS / GFCM / RAC-SPA Project on mitigating the interactions between endangered marine species and fishing activities*, funded by the MAVA Foundation. In March 2017 ACCOBAMS and the IEO agreed to sign an Addendum to the MoU for activities related to *Killer whales and interactions with fisheries in the Straits of Gibraltar*. Information provided by the IEO onboard program, including biological and technical aspects from the Spanish fisheries in the Strait of Gibraltar targeting tuna species, is analysed.

The Strait of Gibraltar is a transition zone between the Atlantic and the Mediterranean Sea. Many species migrate between these two areas for reproduction, wintering and feeding. Killer whales (*Orcinus orca*) occur in the Strait of Gibraltar throughout the year (Esteban et al., 2016), with sightings peaking between April and September. This peak presence coincides with the migration of their main prey, the Atlantic bluefin tuna, a target species to local tuna traps and Spanish and Moroccan artisanal fisheries.

Spanish and a Moroccan artisanal handline tuna fleets started operating in the Strait of Gibraltar during summer months in 1994 (Srour 1994; de la Serna et al. 2004) targeting bluefin tuna (*Thunnus thynnus*) during the “revés” migration, a trophic phase after reproduction in the Mediterranean Sea. Killer whales’ interacting with this fishery has been reported since at least 1999, and their distribution is clearly related with the presence of the mentioned fishing fleets in the area. Interactions between killer whales and the fisheries occur in summer (de Stephanis et al. 2005; Esteban et al. 2013), whereas active hunting has been observed during spring (Guinet et al. 2007) and summer (Esteban et al. 2013).The presence of both killer whale and fishermen at the same time in the area Strait of Gibraltar with the objective of obtain some benefits from the bluefin tuna (food by orcas and revenues by fishermen) is in the origin of the current interference which is discussed in this report.

The relationship between killer whales and fishermen and the mutual benefits derived from the presence of this species and the bluefin tuna in this region of the Strait of Gibraltar is part of the history of the tuna exploitation and the human settlements related. The existence of a cave in Atlanterra (Zahara de los Atunes, Cadiz) called “the cave of the orcas” containing pictures and symbols from the Paleolithic (V-IV millennium B.C.; Ramos, et al., 1985) have been related to the presence of killer whale and bluefin tuna. This cave is in a strategic situation to observe the killer whale apparition from centuries, the signal to locals of the tuna presence. This artificial cave had the purpose to point out the winter solstice and the spring equinox, two periods in which are concentrated in these waters large number of orcas, which coincides with the two migrations of bluefin tuna, first to enter to the Mediterranean for the reproduction and second when leaving after the spawning season.
Bluefin tuna use different corridors to cross the strait according the dominant currents and the moon phases, moving or close to the coast or off. It has been argued that deep dives performed near the Strait of Gibraltar allow the fish to locate Mediterranean outflow water and thus function to guide them into the Mediterranean (Wilson & Block, 2009). When the central currents are strong (during full moon and new moon) bluefin tuna approach to the coast and the killer whale wait them for feeding, situated in front of the cave and putting press on the bluefin tuna schools that approach to the beach. Sometime the killer whales' chase launching the tuna out to the sand and locals take advantage to catch them and benefit of the killer whales hunting behavior.

Other anthropogenic activities in the region of this pilot study known to affect marine fauna include maritime traffic (Cañadas, 2006). It is estimated that approximately 30% of the world’s marine commercial traffic crosses the Strait of Gibraltar including 20% of the oil tankers navigating this sea. Other important sources of pollution and threats to marine fauna conservation and ecosystems are land-based industries that although not very important in the region, suppose potential emissions in the north (chemicals in Algeciras bay).

2. Introduction

Killer whale (*Orcinus orca*) is considered a species stationary resident in the Strait of Gibraltar and its adjacent Atlantic waters (De Stephanis, 2015). In the western Mediterranean is occasionally recorded as a visitor and as vagrant in the eastern basin. Their occurrence seems to be related to the presence of one of its prey species, the large bluefin tuna. Killer whales seen as a competitor by fisheries, attacking tuna caught on fishing hand lines. Interactions between marine mammals and fisheries are an important conservation concern to fisheries organizations and experts (Bearzi G. 2002; Clark et al., 2014; Northridge, 1985) and environmental institutions (Notarbarloto di Sciara, 2016; IUCN, 2012).

Strait of Gibraltar area is the transition between the Atlantic and the Mediterranean Sea. Cañadas and Sagarminaga, (2000); Cañadas et al., (2005); Stephanis et al., (2008); Torreblanca et al (2016) underline its importance for cetaceans as a natural corridor for species living in between both seas. The Strait of Gibraltar, is an important feeding areas to killer whales although few studies quantify the interactions in terms of number and kg of bluefin tuna taken by killer whale in the Strait of Gibraltar tuna fisheries. De la Serna et al (2010) reported *"for the period 1998-2007, 4,151 bluefin tuna were caught by handline and 152 individuals (3.6%) presented unequivocal signs of depredation by killer whales. The presence of the killer whale in the area extends from June to August, with July being the month of major incidence with an average percentage of affected bluefin tuna around 11.7%. Length distribution and sex ratio of the tuna affected by the depredation was not significantly different from the length distribution of the total bluefin tuna catch. Tuna depredation in the studied area only takes place on the specimens captured with handline, and is practically negligible for tuna caught by bait boats. For the whole period studied no killer whale was caught and no beached whale was reported on the Spanish or Moroccan coast of the Strait of Gibraltar. Depredation average weight was estimated around 67.92 kg, with a maximum of 199 kg and a minimum of 8kg, with modal value in the range (40-60 kg) for weight distribution grouped in classes of 20 kg".* By other side (BOE, BOE 117, 17 mayo 2017) it is estimated that around 7% of bluefin tuna catches in these fisheries could be depredated by killer whales.
Stable isotope analyses suggest that their main prey of killer whales is bluefin tuna (García-Tiscar, 2009).Information on the presence of killer whales in the strait of Gibraltar is published from long time ago (Horozco, 1598; Richard, 1936; Aloncle, 1964) as reported in Esteban et al., (2016) and others. Although it is not dated, it seems that the presence of orcas in the Strait of Gibraltar has also been known for some time and the place names include at least one name (Cabo Espartel) that refers to the species (esparte or espadarte is the local name of the species). Other element is a cave on the beach in Zahara de los Atunes (the Cueva de las Orcas) that put in relation more than 5000 years ago the presence of killer whales, bluefin tuna presence, sun position on the sea horizon depending of the period of the year (Morcillo, M. 2009, YouTube) in the Strait of Gibraltar area and the fishing activity. So the relationship between killer whales, bluefin tuna and fishing activity has been known in the area for centuries.

Documents containing the statistics of tuna captured in tuna traps in the Strait of Gibraltar area owned by the House of Medina Sidonia relate the project in 1774 of build a model of wood killer whales to lead the tuna schools to the coast and facilitate the captures by the tuna traps (Florido del Corral; 2006GarcíaGarcía, 2009)

Cort (2007) reported that killer whale should have an important role in stranding bluefin tuna in the Strait of Gibraltar area during the Mousterian (30.000 years ago) as registered in archeological excavations in the region (Stringer et al, 2008). García-Tiscar (2009) states that "*during the spring, orcas hunt tunas that enter the Mediterranean, and during the summer they do the same with the tunas that return to the Atlantic, once they have been reproduced. Numerous interactions have been observed between killer whales and tuna fisheries during the summer season. Likewise, the killer whales are observed around the almadrabas, both from Barbate and from Conil, Tarifa and Zahara de los Atunes in the province of Cádiz* ".

Suárez-Esteban &Miján, (2011) indicated that the diet of the orca can vary between adjacent areas and can consume a wide variety of prey, including fish, cetaceans, pinnipeds, mustelids, birds, sea turtles and cephalopods (Dahlheim, 1998). Orcas prey on bluefin tuna (*Thunnus thynnus*) according different documents (Rodríguez Roda, 1978, Cañadas and Stephanis, 2006;De la Serna et al., 2010; etc.). The estimated losses from

surveys to fishermen in the Tarifa (Spain) fishing port, was calculated of around 17% of catches (Sánchez et al., 2007).

Cañadas and Stephanis(2006) reported a subpopulation of killer whale in the Strait; De la Serna et al., (2010) underlined the effects of killer whale's depredation on the bluefin tuna caught by the Spanish handline and bait boat fisheries in the area during 1998-2007;MaloulilIdrisi et al., (2013) confirmed the incidence of killer whale on bluefin tuna captured by an artisanal fishery based on northern ports of the Moroccan coast in the Strait of Gibraltar; Esteban et al (2014) studied the distribution of killer whales in spring and summer in the area; Esteban et al., (2016) confirmed bluefin tuna as the primary prey of killer whales.

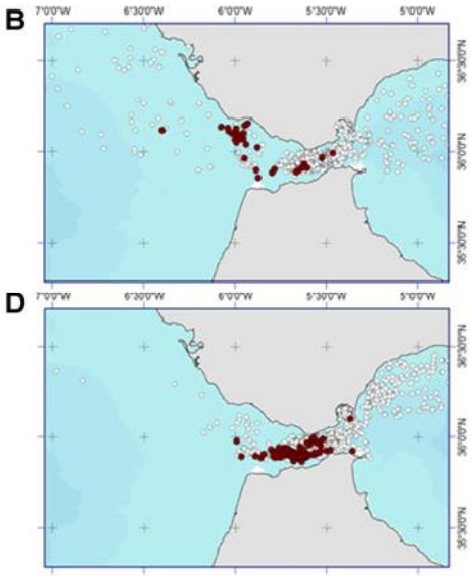

Figure 1. (From Esteban et al., 2014). Cetacean sighting distribution in the study area (B: Spring; D: Summer). In red killer whale sightings and in grey other cetacean sightings

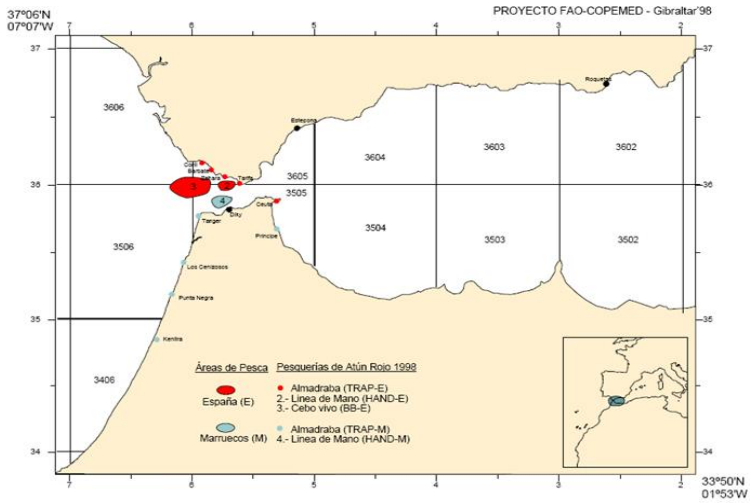

Figure 2. (From De la Serna et al. 2010). Spanish and Morocco tuna fisheries including handline fishing area

It has been estimated the presence of 5 stable social groups of killer whales (De Stephanis, 2005) in the study area. The survival and reproduction of these groups depend in large part of tuna (GarcíaTíscar, 2009) as the primary prey. All killer whales observed in this area hunt tuna by chasing individual fish until they become exhausted and can be overcome. However, a subset of pods also interacts with the handline tuna fishery

(Esteban et al, 2016)through endurance-exhaustion active hunting technique; they catch medium or small-sized tunas described in the Strait of Gibraltar population (Guinet et al., 2007).

Only two pods (of 5 defined in the area) were seen interacting with the hand line fishery, suggesting the transmission of this behavior may have been restricted by social structure (Esteban et al, 2016).

Target species in Spanish handline and bait boat fisheries in the Strait of Gibraltar area is bluefin tuna (*Thunnus thynnus*). The base and landing ports are Algeciras and Tarifa (Cádiz, SW Spain). Fishing grounds are located at both sides of the Strait of Gibraltar quite close to the main ports and placed in an area where different Regional Organizations/Commissions (ICES, GCFM and CECAF) have fisheries management competences (Fig. 3). The peak of killer whale presence coincides with the migration of their main prey, the bluefin tuna, throughout the area. Other important fishery in the area target red sea bream (*Pagellus bogaraveo*). Some vessels targeting bluefin tuna can use during periods of the year an authorization to target red sea bream.

Main fishing community directly concerned by the implementation and results of this pilot action corresponds to the Spanish and Moroccan vessels owners, skippers and fishermen involved in the aforementioned fisheries. The fishery regional administrations (Andalucía) and national (Spain and Morocco) are also involved in the implementation of knowledge and results from the pilot action. International Commissions related to marine mammals as ACCOBAMS or IWC are also interested in the results as ICCAT and the GFCM. Moreover, many other groups are also concerned: whale watching companies in the area, NGOs, scientist from different institutions and countries are or have been involved in activities related with the killer whale families in the Strait of Gibraltar.

The Spanish fisheries in the Strait targeting tuna are not particularly important in relation to their bycatch of protected species: some birds and small mammals could be accidentally caught and liberated (IEO observers). Fisheries considered as potentially interacting with killer whales include the traditional tuna traps.

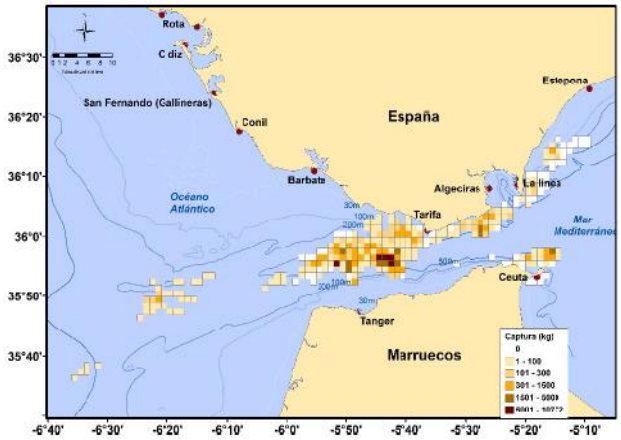

Figure3. Spanish "voracera" fishery: spatial distribution of landings in 2014 (from ICES, 2016).

3. Material and Methods

3.1. Sampling program for tuna fisheries in Algeciras and Tarifa Ports

The data set used in this report, colected by Spanish IEO (Malaga Large Pelagic team) in Algeciras and Tarifa landing ports in relation to bluefin tuna that have interactions with killer whale in the Strat of Gibraltar area, were obtained in the framework of the EC Regulation for collection, management and use of data in the fisheries sector (Spanish report 2016) and according guidelines and sampling protocols provided by ICCAT. As part of the ICCAT region, the samplig in the Strait of Gibraltarareafollows the methodology described in http://www.iccat.int/es/ICCATManual.asp and its sumarised here below.

The methodology is based on daily census of the landings of the bluefin tuna captured in the Strait of Gibraltararea with surface gears (mainly hand line and bait boat).

Baitboat targeting BFT: The baitboat is mono-speciphic fishery, and their landing take place in the same port that the handline fishery does it. During 2015 and 2016 IEO have done a census of the catches of this fleet so the assignation of trips to métier could be adequately done. This fleet is active in summer and autumn.

Handline targeting BFT: The handline is mono-speciphic fishery, and their landing take place in the same port that the baitboat fishery does it. During 2015 and 2016 IEO have done a census of the catches of these fleets so the assignation of trips to métier could be adequately done. This fleet is active in summer and autumn.

3.2. Sampling of bitted bluefin tuna at Tarifa landing port

Data set obtained by the IEO observer at the port of Tarifa on landed bluefin tuna with bites of killer whale correspond to the period 2002-2017. Data were shared to the ACCOBAMS project by the IEOLarge Pelagic team. Sampling frecuency of bites and tuna landingwas dailyby IEO observer during the sampling period.

Tuna bites have been surveyed exclusively in Tarifa where the fleet uses to landing bluefin tuna exclusively with hand lines. Since Algeciras is a port with 99% of the fleet fishing with surface bait boat gear, a gear with near zero incidence of bites, the landing of bitten tuna has not been controlled in that port.

3.3. Sitting in the dock of the bay: Surveys and sampling

Communication is a very useful tool to effectively share information between different stakeholder groups during different phases of fisheries management. Communication and open presentation of different opinions on fisheries management help the mutual understanding among different stakeholders groups involved in fisheries, research and management. A positive way to communicate between fishers and scientists is using adapted-to- fishery surveys with clear questions that clarify what we want to know and why and facilitate the explanations the fishermen needs from scientists to open each other on specific shared problems.

Surveys offer the opportunity to actively involve resource users, such as fishers, seamen, etc., into data collection for scientific purposes and make use of their local ecological knowledge, which can be a useful additional source of information to scientific research (Johannes et al., 2000; Goetz, 2014). This cooperative research facilitates transparency and communication between scientists and fishers which can be expected to translate into more effective management and therefore, creating indirect benefits(Johnson van Densen, 2007).

Fishermen involved in activities related with tuna fisheries and killer whale interactions were also queried by an *ad hoc* survey carried out at the dock in the Tarifa fishing harbor. The survey include different questions related to the fleet activity, target species, incidences with cetaceans, turtles and birds and the methods and tools used on board to reduce the interactions and problems caused by killer whales to the fleet and vice versa.

Individual interviews with fishers were developed and executed in order to get information on different aspects of fishing activities, fishing changes with time and perceptions regarding ecological changes of marine ecosystems (Coll, 2014). Interviews also help to describe the different types of interactions and the consequences of these interactions for killer whales, target species and fisheries.

Questions and answer choices should be simple, straightforward, worded unambiguously, presented to fishermen in a standardized way (Moore *et al.,* 2010). In order to ensure a good quality of recorded data, surveys with fishers were always conducted face-to-face, because, personal interviewing is thought to create more confidence between interviewer and respondents (White et al., 2005; Goetz, 2014). In addition we started explaining the purpose of the survey and to assure fishermen that interview data were confidential (Moore *et al.,* 2010).

Closed-question surveys have generally be recommended when the goal is to maximize accuracy of information especially if quantification is desired (Huntington, 2000; Gomm, 2004; White et al., 2005; Fowler, 2009; Moore et al., 2010) and reduces uncertainty in questions and answers for both interviewer and

interviewee. It may be useful to include some open-ended questions this could improve interviewees' memory recall for factual questions and yield unanticipated insights (Huntington, 2000¸ Moore et al., 2010).

Based on these principles the surveys included a series of open questions, because we were also interested in fisher´s opinions and suggestions (Goetz, 2014). We also included a fixed questions, some of them using multiple-choice and with quantitative or qualitative (yes-no) answers (Coll, 2014).

We interview fishermen in the fishing ports of Tarifa two consecutive days in February 2018. In order to maximize the number of interviews for each sampling day, timing of interviewing was adjusted to the seasonal and daily routine of the fisheries sampled (Goetz, 2014).The fishers interviewed were all professionally active skippers and crew of the fishing fleet. A total of 14 interviews were carried out, with only one interview per vessel. The questionnaire (Annex 1) was designed to take 20–30 min. Short surveys (<30 min) have been recommended to reduce non-response rates (White et al., 2005), and since many fishermen are time-limited (Moore et al., 2010).

Previously to carry out the survey at the landing port, the fishing boats with authorization to fish in that area and with those fishing gears were checked in the Official Journal (BOE). Subsequently, the vessels that landed in Algeciras and Tarifa in 2016 and 2017 were checked with the data provided by the IEO observer in both landing ports. This is how we got to recognize the Spanish fleet that could have an incidence with killer whales in the target area of Gibraltar Strait. Therefore, the information from the Official Journal and the information obtained by the IEO on the activity of the fleet were used before starting the surveys to select the active vessels. The fleet that worked with the hand line gear in 2017 and landed in Tarifa is included as Annex 2.

3.4. Capture and effort sampling by IEO

In 1989, the Spanish Institute of Oceanography (IEO) implemented a scientific observer program and a landing monitoring network in the commercial purse seiners targeting tropical tuna to obtain direct information on effort, catches and discard rates of target and bycatch species the Atlantic, Indian and Pacific oceans. Since 2003, the Spanish observer program onboard tuna fleet is under the Common Fisheries Policy (Regulation (EU) 2017/1004 of the European Parliament and of the Council).The sampling frame is the list of vessels with license to fish for each fishery. Capture and fishing effort of the Spanish fleet targeting bluefin tuna in the Strait of Gibraltar area, using hand line and/or bait boat is follow up by IEO scientist from Malaga centre and related observers at the landing ports as part of the obligations of Spain with the EU and the Secretaria de Pesca (SGP) in the framework of the National Program of Basic Data (NPBD) for fisheries purposes. The different métiers are identified to be sampled following the system established by European Commission Regulation. National data used here to know captures and fishing effort by fleet and species are those submitted by Spain (Secretaria de Pesca) to ICCAT and published on the corresponding websites.

The pilot project used the data facilitated by the IEO Malaga team and presented by the Secretaria de Pesca to ICCAT.

4. Results and Discussion

4.1. A revision of scientific literature on the status and behavior of killer whale in the Strait of Gibraltar area

Based on published data and information, Killer whale spatial distribution in the Strait of Gibraltar and Gulf of Cadiz (BOE, Nº 117, pag., 40590-91) varies according to the migratory movements of its main prey, bluefin tuna and of different physiographic, oceanographic and geographic variables. Thus, in spring, when bluefin tuna enters the Mediterranean during their genetic migration, killer whales are located in shallow waters of Barbate, in the Gulf of Cadiz. According the predictive models of species presence, the distribution at this time of year is determined by bathymetry and geographic length, so that killer whales are more likely to be present in waters of less than or equal depth at 950 m and are located within the range of 8.5 ° -4 ° W, although there will be a higher density in shallower waters. Thus, orcas wait their prey, pursue and capture them taking

advantage of the impossibility of which the tunas take refuge in depths higher to 300 m, depth by below which killer whales do not usually submerge. In summer, during the trophic migration of bluefin tuna, when it returns from its spawning areas and heads towards Atlantic waters, killer whales are observed in the shallow waters of the central part of the Strait of Gibraltar, either associated with the fishery of bluefin tuna with hand line, depredating the catches of the fishing boats, or actively pursuing these tuna in case there are no active fisheries. The distribution of orca at this time of year seems, as in the Gulf of Cadiz in the spring, to be conditioned by bathymetry and geographic length, although in this case also the surface water temperature significantly influences. Consequently, both the presence of tuna fisheries (hand line and bait boat), as well as the shallow waters of the Strait and the bottleneck representing this natural passage for the trophic migration of bluefin tuna, explain the high probability of the presence of the killer whale in the area, both in spring and summer. On the other hand, sometimes, orcas are also sighted in the waters of southern Portugal and Isla Cristina, in early summer.

Esteban et al., 2016, identified 47 different individuals from 5 pods in the Strait of Gibraltar region, genetically separated from the Canary Island pods.

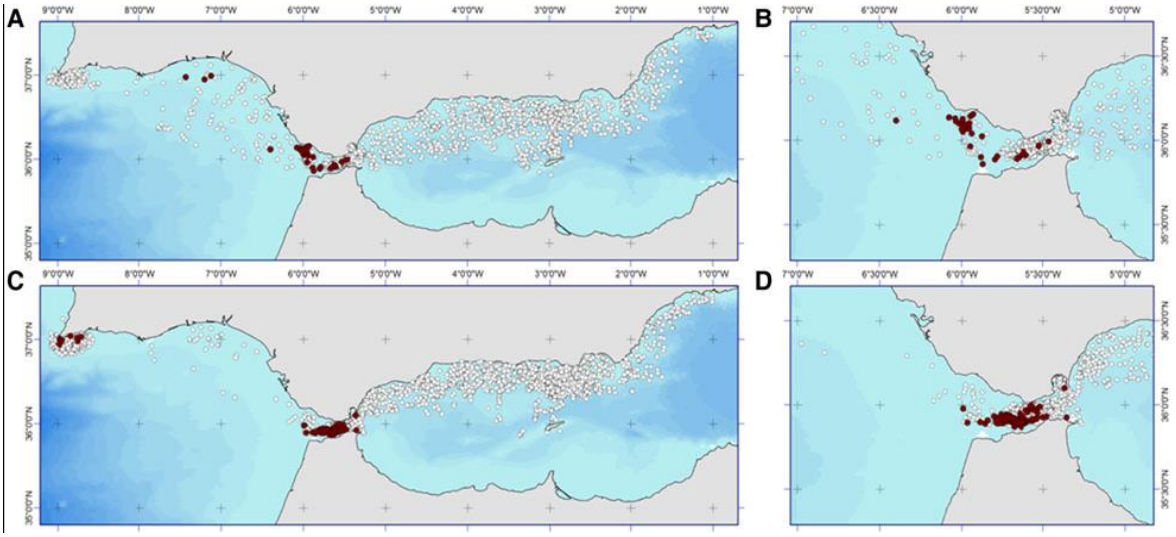

Figure 4. Cetacean sighting distribution in the study area. In brown, killer whales sightings and in grey other cetacean sightings: (A) sightings in spring in the southern Iberian Peninsula; (B) sightings in spring in the Strait of Gibraltar; (C) sightings in summer in the southern Iberian Peninsula; (D) sightings in summer in the Strait of Gibraltar (Esteban et al., 2013).

From the analysis of the killer whale distribution in the area, Esteban et al (2013) concluded that killer whales are highly associated with a probable distribution of bluefin tuna during their migration throughout the study area, constraining their distribution to the Gulf of Cadiz in spring and the Strait of Gibraltar in spring and summer. A most recent analysis of the distribution of killer whale in the Strait of Gibraltar area (Fig. 5) is presented by Esteban, 2015 (Adapted from de Stephanis et al. 2008)

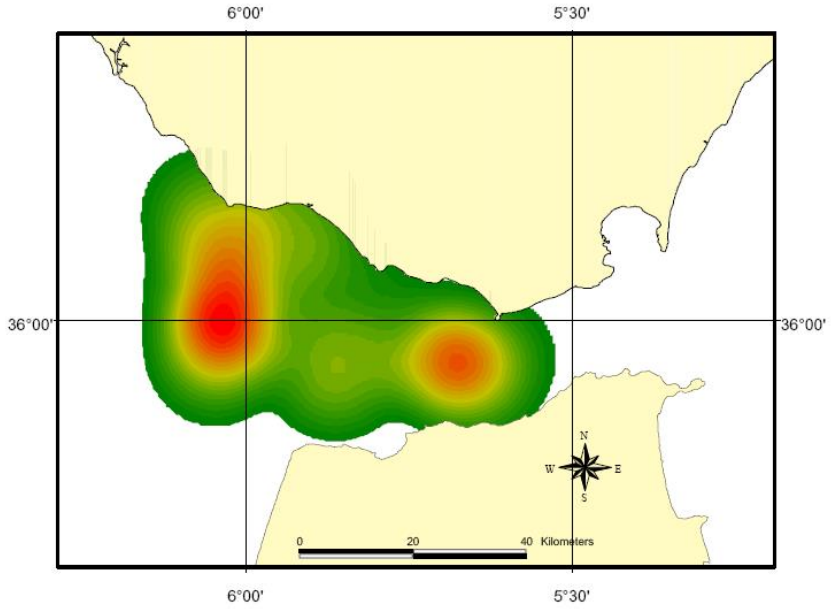

Figure 5.Model of distribution of killer whale in the Strait of Gibraltar (from Esteban et al., 2015)

Esteban et al (2015) suggest that the social structure and behavior (Fig. 6) "*of the different groups of killer whale was shaped by maternal kinship, which appears to be a species-specific trait, but also by foraging behavior, which is less common at the intra-population level. At the start of the study, only one cohesive pod interacted with the fishery, which during the course of the study underwent fission into two socially differentiated pods. Social structure within these two fishery interacting pods was more compact and homogenous with stronger associations between individuals than in the rest of the population. Three other pods were never seen interacting with the fishery, despite one of these pods being regularly sighted in the area of the fishery during the summer*". Later on these authors also said "*our results suggest plasticity in both sociality and foraging behavior. First, all individuals were observed actively chasing tuna, but only two pods were seen interacting with the dropline fishery, suggesting the transmission of this behavior may have been restricted by social structure*".

Orcas can directly prey on tuna from handlines, so presumably they invest less energy in this feeding approach than in active hunting (Esteban, 2015). The bluefin tuna can be completely or partially depredated, before the fishermen have been able to take on board the tuna.

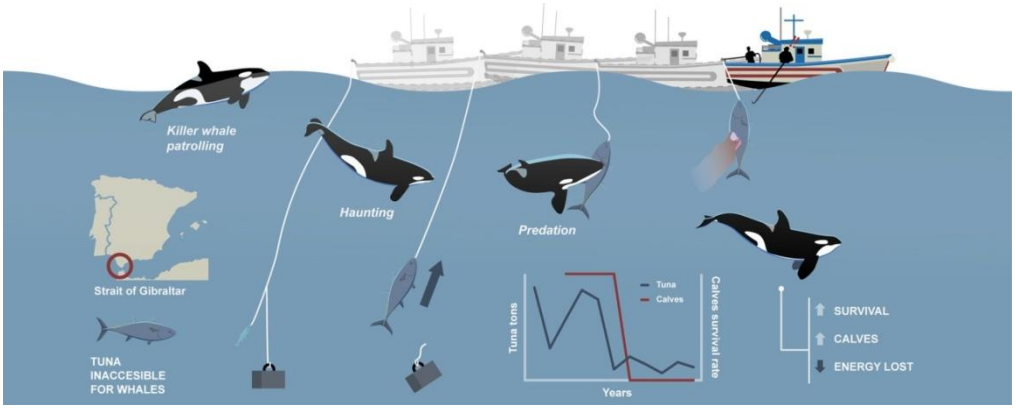

Figure 6. Killer whale depredation on a captured bluefin tuna in the Strait of Gibraltar area (Esteban, 2015)

So, the close dependence of a part of the killer whales population in the Strait of Gibraltar on depredated bluefin tuna catches by Spanish and Moroccan handline fisheries, mean that a reduction of the fishery activity during spring and summer period could reduce the availability of food for killer whale and calves, and a possible increasing of their natural mortality. Nevertheless a hypothetical situation as described here could suppose a modification of the foraging behavior of killer whale pods, changing from depredating bluefin tuna (interacting with fisheries) to actively chasing in group hunting bluefin tuna.

Behavior of killer whale in the Strait of Gibraltar in relation to handline fishery was studied on board Spanish vessels by Rosero (2011). This author found that the family of orcas that enters the Mediterranean Sea goes to this area exclusively for food, since 45% of these are "swirling" around the fishing boats waiting to bite a tuna directly from the hook; while 23% of them feed by directly capturing the tuna (Fig. 6). This author also explains the killer whale–fishermen relationship and the attacks as follow "*there was a very direct association between killer whales and fishermen in the fishing zone, so that fishermen use the killer whales to guide themselves towards the areas where the tunas are found in deep waters. Once the fishermen cut their lines, the orcas begin to swim among the fishing boats, circling them while waiting for the tuna to take the bait. So, patiently, they wait for the fishermen to raise the tuna to the surface, and it is at that moment that the cetaceans bite the capture by surprise. Usually the attack is directed towards the ventral area and the tongue of the fish leaving sometimes only the head or part of the back. In some cases, fishermen can save part of the tuna caught and sell it at a lower price*".

Figure 7. Behavior of killer whale in the Strait of Gibraltar (from Rosero 2011)

Also Rosero (2011) based on surveys and onboard observations at sea accounted for a total of 22 tunas captured by orcas, of which 10 were directly observed in situ. Of the latter, 6 were direct attacks to the tuna and 4 to the fishing lines, where the orcas only left the head of the tuna hooking to the hook.

Figure 8. Bluefin tuna landed in Tarifa port after killer whales attacks (Photo Rosero, 2011)

Different regulations and resolutions related to marine mammals, adopted by ACCOBAMS (The Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area), IWC (International Whaling Commission), ASCOBAMS (Agreement on the Conservation of Small Cetaceans in the

Baltic, North East Atlantic, Irish and North Seas), ICCAT (the international Commission for the Conservation of Atlantic Tuna) and the GFCM (General Fisheries Commission for the Mediterranean) are currently implemented by the Spanish legislation.

At international level, killer whales are included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Appendix II of the Bonn Convention on the Conservation of Migratory Species of Wild Animals (CMS) and in Appendix II of the Berne Convention on the Conservation of Wildlife and Natural Environment in Europe. In addition, it is also listed in Appendix II to the Protocol on Specially Protected Areas and Biodiversity of the Barcelona Convention for the Protection of the Marine Environment and the Mediterranean Coastal Region.

In European Union waters all cetaceans are strictly protected under Article 12of the EU Habitats Directive (HD). Additional obligations of Member States include the conservation of cetacean populations and the monitoring and mitigation of anthropogenic impacts under the Marine Strategy Framework Directive (MSFD) and Council Regulation (EC) No. 812/2004, as well as through regional agreements such as ASCOBANS and ACCOBAMS. Marine mammals are species of concern in the whole Mediterranean and the Alboran Sea (PNUE PAM-CAR ASP, 2016); MED PAN prepared an Action Plan for these species in the Mediterranean (UNEP MAP-RAC SPA, 1991). Under the EU Habitats Directive it is punished to deliberately capture, kill or disturb cetaceans; or to cause deterioration or destruction to their breeding or resting places (Articles12 and 16). Article 12 requires that Member States establish a system to monitor the incidental capture and killing of cetaceans, and to take measures to ensure that incidental capture and killing do not have a significant negative impact on the species concerned, whilst Article 11 requires Member States to implement surveillance of the conservation status of habitats and species of Community Interest (Dolman et al., 2016).

In addition to the laws and regulations established by the Government of Spain and the Autonomous communities for the protection of the natural environment and biodiversity (Law 42/2007 of 13 December, on Natural Heritage and Biodiversity, the Spanish Inventory of Marine Habitats and Species (IEHEM) is the legal instrument lying down the rules for the collection of data on the distribution, abundance, conservation status and use of natural heritage, with special attention to those elements that require specific conservation measures or have been declared of community interest. The Spanish Inventory of Habitats and Marine Species is regulated by Royal Decree 556/2011 of 20 April, for the development of the Spanish Inventory of Natural Heritage and Biodiversity.

In accordance with the provisions of article 59 of Law 42/2007 of 13 December, a conservation plan should be adopted, including the most appropriate measures to eliminate the threat factors affecting this population and to carry out the actions necessary for its preservation.

Recently (BOE 117, 17 mayo 2017) a Real Order refers to 5 social groups of killer whales in the Strait of Gibraltar and Gulf of Cadiz as a part of the southernmost population of the North-East Atlantic, considered an independent management unit. This Order approved the **Conservation Plan for the Killer whale (*Orcinus orca*) population of the Strait and Gulf of Cadiz** whose purpose is to actively manage this population through the impulse and implementation of measures that favor its survival and guarantee its good conservation status. These actions are aimed at the protection, conservation and recovery of both the killer population and its habitat, based on the best available scientific information and taking into account the socio-economic characteristics of the environment. The implementation, monitoring and coordination of the Conservation Plan correspond to the General Direction of Sustainability of the Coast and the Sea (MAPAMA).

4.2. Feeding strategies in killer whales and Spanish fleets and fishing gears involved

There are two different strategies used by killer whales to obtain food (Esteban et al, 2016). The first is a cooperative group of killer whales chasing the bluefin tuna prey by an endurance-exhaustion active hunting technique. The second method is direct depredation on cached tuna: a single killer whale (or a small 2-3 individuals group) depredates on the capture taking a part (bite) from a bluefin tuna captured by fishermen' before they can bring the tuna onboard. Only the second strategy has effects on the fishing activity. This

second foraging method appears to be non-cooperative and done on an individual basis (Esteban, personal observation)".

An artisanal fishing activity since 1994 (Srour 1995) started in the middle of the Straits of Gibraltar (de la Serna et al 2004), consisting in hand line and live bait targeting bluefin tuna. The fishing period has been extended from August to March. The Spanish handline fleet is composed by artisanal vessels with mean characteristics 10 TRB, 200 HP and 12 m LOA. The Spanish bait boat fleet (11 vessels) based in Tarifa (10 TRB, 200 HP and 12 m LOA) and Algeciras (20 TRB, 120 HP and 15 m LOA).

The IEO-Malaga Large Pelagic team follows the activity of the two fleets from 2000. Vessels less than 15 m in length are not required to take part in the on-board observer scheme mandated under Council Regulation (EC) No. 812/2004 (Reg. 812), with monitoring generally conducted through scientific studies and pilot projects instead. Spain has not provided a report on its implementation of R 812/2004 since 2009.

Table 1. Spanish fleets targeting tuna species in the Strait of Gibraltar area and "métiers" used by in 2016.

Year	Active Fleet : quota + incidental quota	Fleet with quota (BOE: 2016)	Effort (in days (PNDB, IEO)	Fish captures (kg) (As reported to ICCAT)
2016	22+33= 55	22	Bait boat 105 **Hand line 84** Total 189	Bait boat 189.274 Hand line 34.865 Total 224.139

In 2016 the number of vessel with a quota authorized to catch bluefin tuna was 22. Other more 33 vessels were authorized to catch bluefin tuna as incidental catch (Table 1). The two fleets using bait boat and hand line in the area obtained a total captures of 224 tons in 2016. This situation is different as at the beginning of the fisheries when bait boat fleet captures was similar that the handline (De la Serna et al., 2010). Fishing area of handline during the period 1988-2007 was the center of the Gibraltar Strait, same that actually.

Concerning direct employment, we estimate that the bait boat vessels have onboard 6-7 fishermen and the hand line a mean of 5-6 fishermen. A gross estimation of the number of Spanish fishermen directly involved in the two flees account for over 215 persons.

4.3. Main characteristics of the two artisanal gears used to catch bluefin tuna

Gear 1: Handline (with stone) main characteristics

The fishing area is located in the center of the Strait, on depths of 200 - 240 fathoms, even more. Consists of a line of plastic and nylon braid of 3.5 mm and about 400 - 500 meters long, to which is attached a monofilament line of nylon of 2 mm to with a large hook (12 cm of cane per 5 cm of breast). Of bait, horse mackerel (*Trachurus trachurus*) of 25 - 30 cm of total length is used (De la Serna et al., 2004).

The fishing is done by pulling the line (usually 3 per boat) to 200 - 240 fathoms deep. The gear is tied by a "falseta" to a 20 kg stone. When the stone reaches the bottom, the line is pulled breaking the "falseta" and leaving the baited hook free. The catches are mainly produced in the center of the day (12 - 13 hours) and are specimens between 170 and 300 cm in length LH.

Other characteristics are:

- Used from May to December
- Fleet mean characteristics is 10 TRB, 200 HP and 12 m LOA
- Gear used is one to several hand-lines, baited with dead bait.
- Fishermen throw into the water complementary bait to attract the bluefin tuna
- Each hand-line is weighted (20 kg) end using nº 0/1 or 1 hook of Japanese type (curved hook).
- Baits are *Trachurus* ssp., *Scomber scombrus* or *Sardinela aurita* attached to a line of about 50-100 m length which, in turn, is attached to a main line of about 500 m in length with a buoy.

- Once hooked and in water surface, the bluefin tuna is brought onboard by means of a hand harpoon and a pulley.

Figure 9. A Spanish vessel targeting bluefin tuna with bait boat in the Strait of Gibraltar area (Photo by Rosero, 2011)

Gear 2: Pole and Line (Bait Boat) main characteristics

With the sonar and the probe the presence of the tuna is detected, estimating the quantity and depth of the schools. Then they start to throw the live bait, usually jack mackerel, sardine and / or sardine among others, while proceeding to water the surface of the sea. The cord, of the same structure as the hand line, although provided with a lower curved hook, size (4.5 x 3.5cm) is carried out with live bait, with the help of a lead. Normally 3 or 4 ropes are used per boat. When the tunas are young they rise to the surface and are caught with baited canes (De la Serna et al., 2004)

Other characteristics are:

- It is used all year round
- The Spanish bait boat fleet (11 vessels) is based in Tarifa (10 TRB, 200 HP and 12 m LOA) and Algeciras (20 TRB, 120 HP and 15 m LOA).
- The gear is composed of a rigid pole and a strong short line. The line is a single filament line that attaches a hook with live bait. The pole is held by a fisherman standing. Each fisherman operating a pole has access to a small fishpond.
- Bait is captured using small purse seine (and maintained alive in fishponds)
- Live bait: *Trachurus* spp, *Scomber* spp; *Sardina* spp and *Sardinella* spp.
- Fishermen throwing water and alive baits to attract tuna.

MAPAMA, 2018

Figure 10.A Spanish vessel targeting bluefin tuna with pole and line gear in the Strait area (Photo: MAPAMA)

Moreover a fleet (Table 2) based on three landing sites in Morocco uses also the hand line gear targeting bluefin tuna in the same area (Malouli et al., 2013). This artisanal fleet targets the same species (bluefin tuna)

in the same area, and have the same problems derived from the interactions with killer whales. In order to have a reference to the Spanish fleet we present here some summarized data from the equivalent Moroccan fishery.

Table 2.Artisanal fleet targeting bluefin tuna in the Strait of Gibraltar area based in Morocco (Malouli et al., 2013)

Sites de pêche	Nombre de barques	Barques ciblant le thon rouge	%
Ksar Sghir	69	45	65
Dikky	47	32	68
Ferdioua	23	18	78
Total	**139**	**95**	**68**

The main and most frequented fishing areas by the Moroccan artisanal fleet are approximately one to two hours away from the landing sites. These areas are located at depths of 150 and 500 m.

The total catch of bluefin tuna by Moroccan vessels in the Strait of Gibraltar region is estimated at 34 tons and 62.8 tons respectively in 2009 and 2010. Fifty percent (50%) of this catch is made during the month of August. More than half of this production (56%) is achieved at the Ksar Sghir site.

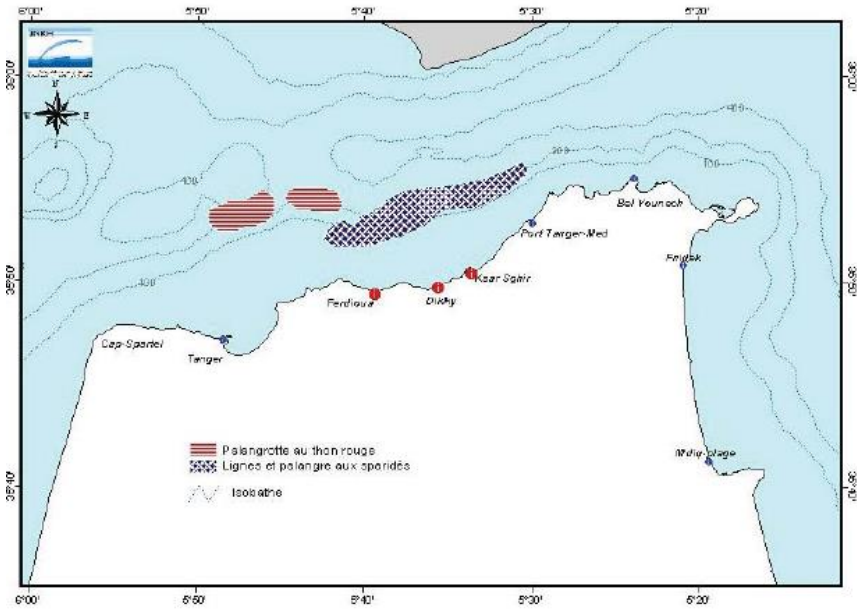

Figure 11. The fishing areas (in red fishing zone with hand line targeting bluefin tuna, in grey fishing zone for Blackspot seabream) and the situation of the three landing site in Morocco (from Malouli et al., 2013).

Concerning killer whales attacks, of 588 fishing operations monitored in 2009 (Malouli et al., 2013), 24 were reported with attacks, representing 4.1%. The frequency of attack by boat recorded at the Ksar Sghir site is 7.1%, compared to 2.7% at the Dikky site. Maximum attack frequency takes place in July, with 9.5% of the operations, against 4.6% in August. No attacks were reported during September and October (Table 13). It should be noted that no killer whales attacks had taken place during the 2010 fishing season as reported by the fishermen. Total annual losses of bluefin tuna catch were estimated at around 6 tons in 2009, and a total of 37 bluefin tuna. These losses represent on average 17% of the total catch of bluefin tuna made by this Moroccan artisanal fleet.

4.4. Tuna landings

The monitoring of Spanish baitboats and handline captures landed in the ports of the Strait of Gibraltar has been carried out by the IEO observers from 2000. Biological samples of the tunas landed by this fleets were obtained and surveys were carried out daily during the fishing season. Surveys were conducted on killer whale attacks on the hand-line and baitboat fleet.

As mentioned the main capture of bluefin tuna in the Strait of Gibraltar and surrounding area correspond to the tuna traps. As the interactions with killer whale is an effect related to artisanal handline and baitboat fisheries we comment here only this fleets' captures. As observed in Fig. 8 the hand line fleet fish mainly during summer months, although starting in May. The extension of the fishing period depends of the quota of each vessel and is mainly based in commercial drivers.

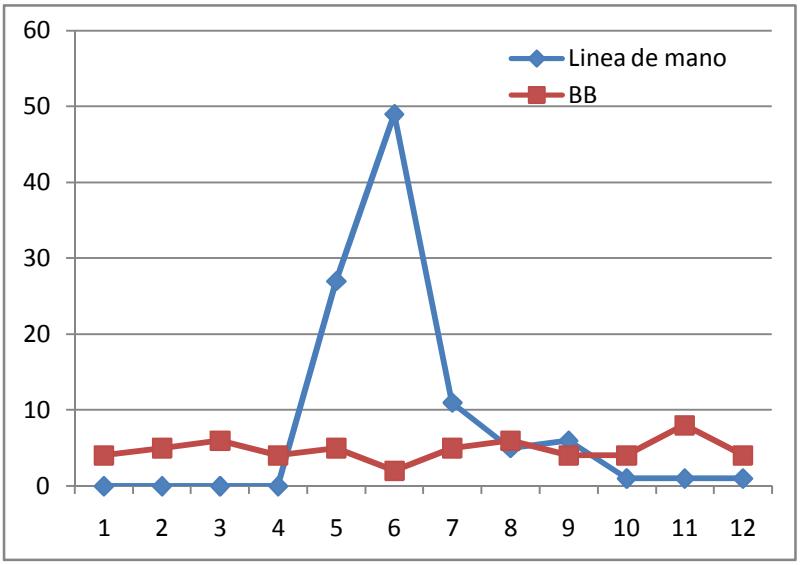

Figure 12. Total captures (tons) **by** month and gear (handline and bait boat) of bluefin tuna in the Strait of Gibraltar landed and observed by IEO from 2002-2017.

The number of bluefin tuna affected by the killer whale during 2002-2017 based on the IEO observations at the Tarifa landing ports is present in Table 3.

Table 3. Total annual and monthly number of bluefin tuna landed with bites of killer whale in Tarifa port

Year	June	July	August	Total
2002	1	33	0	34
2003	0	5	0	5
2004	0	4	2	6
2005	0	0	0	0
2006	0	3	0	3
2007	0	0	2	2
2008	0	0	2	2
2009	0	0	0	0
2010	0	0	0	0
2011	0	4	3	7
2012	3	0	0	3
2013	0	0	0	0
2014	0	0	0	0
2015	0	1	0	1
2016	0	0	0	0
2017	0	1	0	1
	4	51	9	64

4.5. Sampling results of bitten tuna in Spanish fleet

Interferences between killer whale and Spanish fisheries in the area has important economic consequences to the fishing sector, mainly by the loss of captures of bluefin tuna due to two elements: i) the reduction of total bluefin tuna weight obtained by vessels affected by bites (Kgs lost) and ii) the reduction of the first sale price when a tuna piece has signals of killer whales' interactions.

The proportion of bluefin tuna detracted by killer whales in the Strait of Gibraltar to the Spanish handline fleet rise till 3,66% of its capture (De la Serna et al., 2010). In Morocco (Maluli Idrisi et al., 2013) 100 artisanal vessels from three sites in the Strait captured bluefin tuna with handline having attacks in 4,1% of the total fishing operations observed, estimating a grand total bluefin tuna eaten by killer whales in the area as equivalent to the total bluefin tuna captured by Spain and Morocco.

Figure 13.A bluefin tuna bitted being boarded and a specimen at the landing market (lonja) ready for selling

Figure 10 represent the number of bluefin tuna with bites observed by the IEO during landing operations of bluefin tuna in the port of Tarifa from 2000-2017. Despite the large number of tuna affected and landed bitted at the starting of the observation period, this number was decreasing till near cero landing from 2005 onward. According the fishermen comments this reduction was not the result of a less number of orcas observed in the area or a reduction of the number of bites (interactions) observed but a fishing and commercial strategy to satisfy a more exigent market with the quality of this product.

Assuming that the killer whale population has not been reduced during the period under consideration and that the number of tunas bitten during handline fishing has remained constant throughout the period and affects the entire fleet that discharges tunas at the fish market of Tarifa, we have analyzed the existence of significant differences in the number of affected tuna before and after the implementation by the Spanish fleets of the TAC of bluefin tuna in 2007, in accordance with the resolution of ICCAT 08-05 BFT / ICCAT, and weighted to the total tunas sold in the fish market of Tarifa represented by the official landings data facilitated by the Junta de Andalucía (source IDAPES).

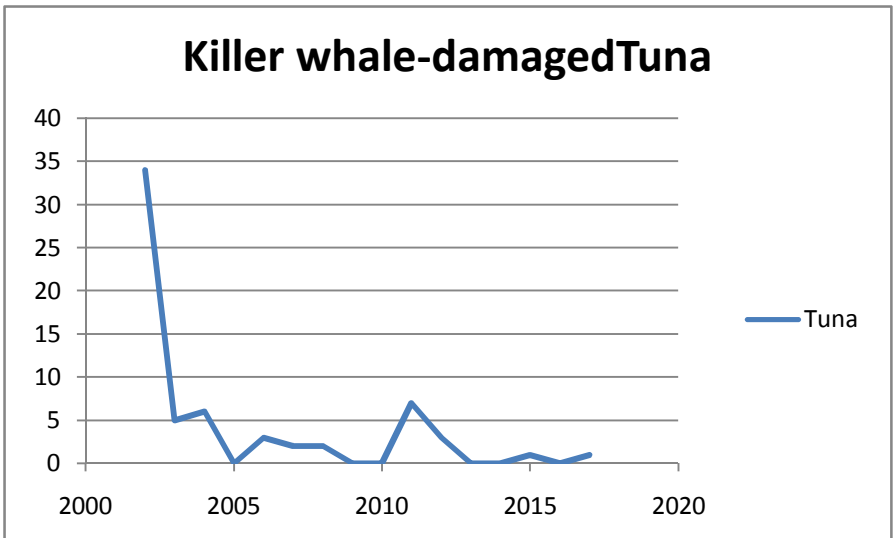

Figure 14. Number of bluefin tuna landed in Tarifa affected by killer whale bites (2000-2017)

Figure 15. Abluefin tuna bitted by killer whale (in Esteban, 2008, master thesis)

The results of the analysis (Fig. 12) show that there are significant differences depending on the observed period (Chi-squared = 79.93, P<0.0001) before and after 2007, the year of the implementation of tuna TAC and therefore, the average of bitten tuna in relation to the total landed in Tarifa port is under evaluated in the period after the implementation of the TAC by ICCAT. The number of expected tuna landed with bites is much higher than observed, mainly during the period 2007-2010 and in 2017.

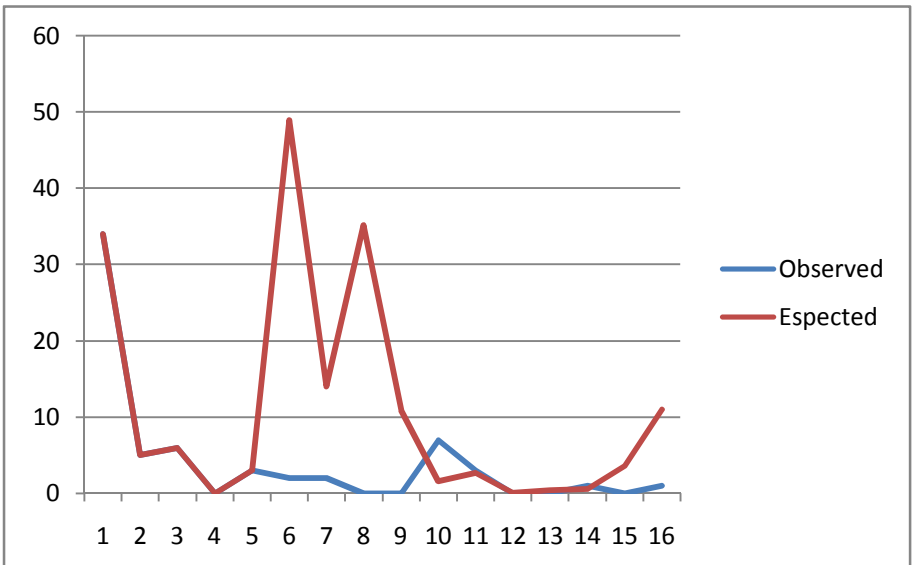

Figure 16. Number of observed and expected bluefin tuna landed in Tarifa port with bites of killer whales.

Although landing data from IEO observers are those presented in Table 3,according the information provided by fishermen the incidence of tuna bitted can be ten times greater or more. Fishermen underline that some days Tarifa's hand-line fleet is forced to give up fishing because bitten tuna can reach 100% of captures. The IEO observer knows these data because the day that no tuna has been landed the fishermen' answer is that the depredation was on all the tuna caught. In such situation fishermen prefer to use the quota they own in landing complete bluefin tuna because take higher prices at the landing market.

4.6. Results of the survey at the landing port' docks

Approximately 30% of the total Spanish active fleet (22 vessels) fishing with handline in the Strait of Gibraltar area was interviewed. Results from the survey are:

- Although the data of the characteristics of the boats have been asked, we compare with the official census of the fleet athttp://www.mapama.gob.es/es/pesca/temas/flota-pesquera-espanola/censo.as.
- The main fishing gears targeting bluefin tuna in the Strait of Gibraltar are the bait boats and handline. Smaller vessels do not use bait boats because they do not have the capacity for on board tank to maintain the bait alive they need to this technique (available information on the permit used to each vessel, as well as the bluefin quota https://www.boe.es/boe/dias/2017/02/22/pdfs/BOE-A-2017-1815.pdf). Generally the hand line gear is used from the end of May until the end of August, depending on the quota of each boat. Many boats end the quota in few (2) months because they have very small quota and yet others with higher quotas extend the fishing period longer. Handline gear characteristics has not changed over time, unless the fishing line is now thinner than when started the fishery (1995) and the hook is sunk to a depth separated from the bottom to prevent entanglements.
- Another used (new) gear is the green stick, there is only one boat that uses it, since a year ago, and it seems to have no interactions with killer whales, or accidental catches of cetaceans, birds and turtles. They fish this way all year until finish the quota.
- Many Spanish vessels do not recover the stone they use to sink the line, which may be causing a significant alteration of the seabed.
- The species of cetaceans sometime hooked in handline are the dolphin and killer whale. The dolphin is usually hooked in baitboats gear (rare). Orcas hooked, however, occur in the hand line. Fishermen do not consider it a catch, since in most cases the orcas break the hook or are liberated by cutting the handline.

- The main problem stands out by fishermen in relation to killer whales is the theft of tuna; in addition they underline the risk to the safety of the crew if there are entanglements with the line or hooks hooked in killer whales.
- The fishermen consider that there is a greater presence of orcas related to the great abundance of tunas. They think that there are more pods than a few years ago, now they see up to 5. The areas where the killer whales are present have also varied, now they are everywhere and the groups are very close to each other.
- Orcas are present more and more months a year; they were seen mainly in summer before, but now they are seen during most of the year. In 2018 have been seen in February and in 2017, there are ship owners who have seen them until October and even until December. Although more months are present in the area, however there are days that do not see any (even in summer).Ship owners perceive that the behavior of killer whales is changing.
- In relation to solutions for killer whale bites on cached tuna, some fishermen proposed acoustic deterrent methods, however they also remembered that a few years ago the IEO tried the use of pinger to deter cetaceans but the cetaceans played with the pingers. It did not have any effect on their behavior; it seems that it was not effective.
- Regarding the cost of bitten tuna, they do not consider it now as a loss because when occurs they try to catch another tuna. They do not usually bring to the landing market pieces of tuna bitten because their price is lower, and avoid lose their quota.
- Years ago, when there were less bluefin tuna and lower quotas, they did landed pieces bitten by killer whales, despite their lower price.
- When we ask what measures they propose to mitigate the interactions with orcas, they have not answered anything.
- To the question how they release cetaceans, what tools they use on board, the common answer is “We do not have specific material”; all have on board tools (eg pliers) allowing to release non-target species.
- In 2017, for the first time interactions with killer whales occurred with the baitboats gear, feeding on captured tunas.
- Variation in the orcas' behavior, according to the time of day: at the beginning of the day are very voracious, then they leave the head of the tuna; later they eat the belly and finally they do not eat just play.
- Adults teach the young how to feed on the tunas caught by the fleet; they give the pieces of tuna (often the tummy) to the young.
- The orcas retreat if there are pilot whales in the area, and fishermen do not know why. The pilot whales do not attack the orcas, they appear and the killer whales leave. It does not happen often.
- There are more groups (up to 5)of killer whale present in the strait of Gibraltar during more months a year; however the problematic period is the summer.
- In 2017 many killer whales have been seen and the groups are closer to each other.

Moreover this summary elaborated with the grouping of the answers of the fishermen we analyzed the frequency of interactions with the different gears used, handline and baitboats, the results of the analysis are presented in the next section.

4.4. Results of the analysis of the interactions of killer whales and fishing gears

For the analysis we have only taken into account the gears used during summer, which was in turn the month with the highest incidence of cetaceans (unanimous).

The results of the survey to fishermen show that eleven of the respondents fished with hand lines, while three fished with live bait (and one with green stick).

Baitboat gear has a rare incidence in the capture of dolphins and killer whales. On the contrary, the Handlines involve more incidental hooked animals.

Significant differences were observed according to the period (before and after the ICCAT bluefin tuna Recovery Plan in 2007 (Chi-squared = 79.93, P <0.0001).

All respondents (15 vessels) answer that orcas cause problems, due to the bites on tuna. Of the respondents,93% say that the interactions increased in recent years.

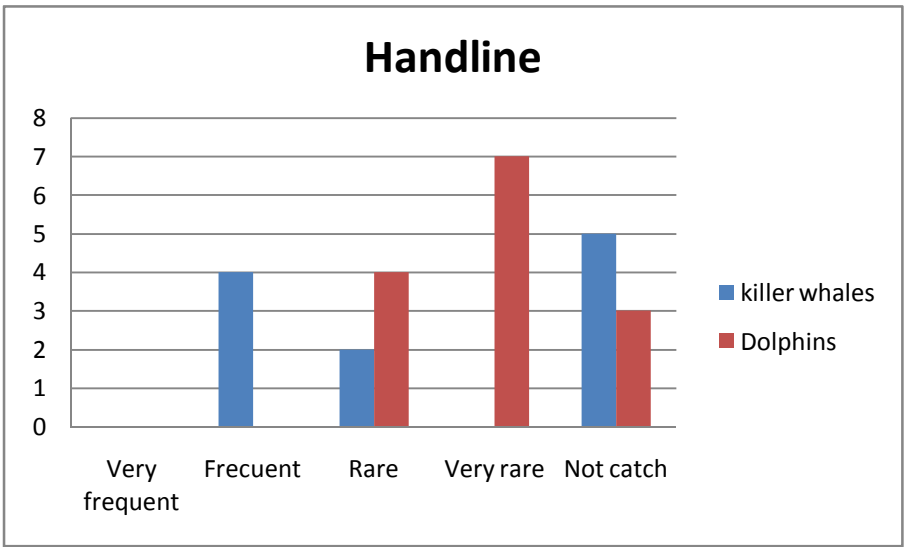

Figure 17. Frequency of interactions of the handline fleet with killer whale (based on surveys) in the Gibraltar Strait.

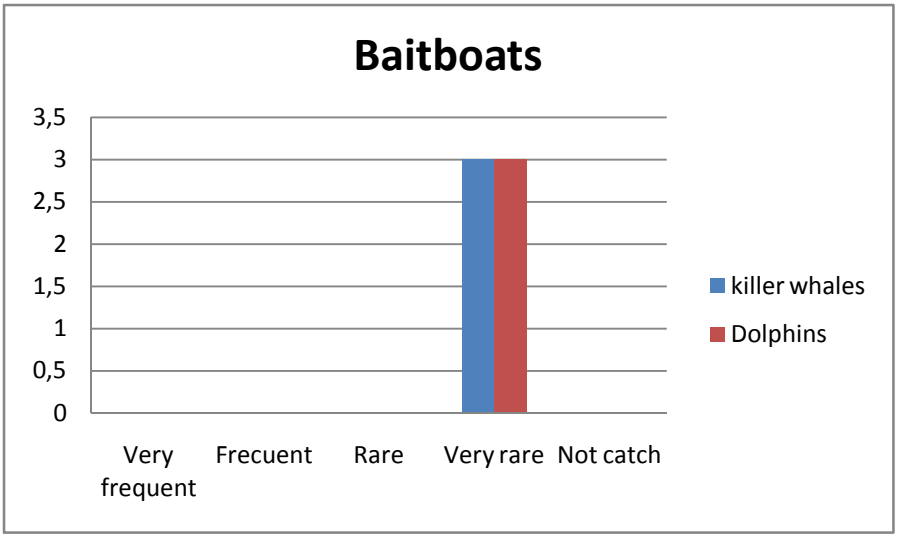

Figure 18. Frequency of interactions of the Baitboats fleet with killer whale (based on surveys) in the Gibraltar Strait.

Considering all surveys and gears pooled together (Fig. 15), 28.5 % of the answers consider that the accidental capture of orcas is frequent, while 57% consider that this capture is very rare or nonexistent.

In the case of dolphins, 71% consider that this capture is very rare or nonexistent.

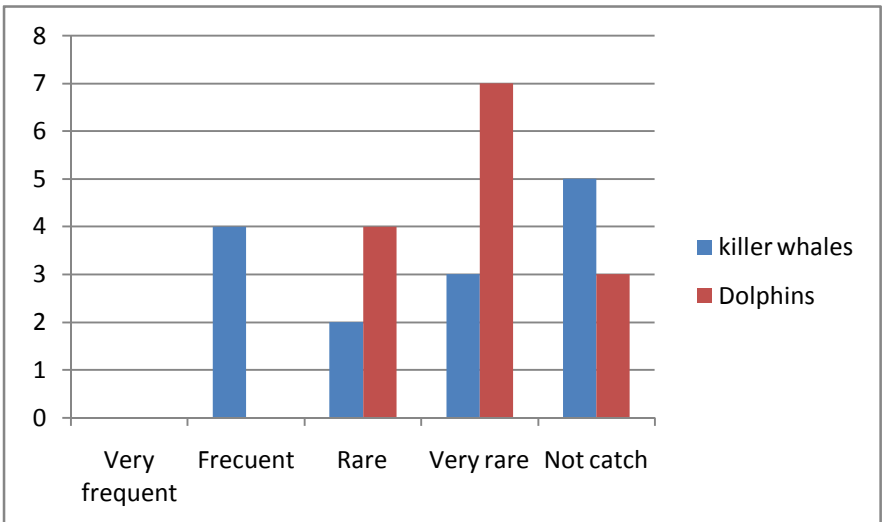

Figure 19.Frequency of interactions (nº, pooled both fisheries) of the two Spanish fleets (handline and baitboat) with killer whale and dolphins (based on surveys) in the Strait of Gibraltar area.

4.7. Discusión

Families of killer whales (*Orcinus orca*) presents in the Strait of Gibraltar area (47-50 different individuals from 5 social groups),are genetically separated from the Canary Island pods (Esteban et al., 2016) and represent a specific genetic biodiversity pool among the orca whale. According authors previously working in the area with this specie, killer whales occur in the Strait of Gibraltar throughout the year(Esteban et al., 2016), with sightings peaking between April and September.

The two main fisheries targeting bluefin tuna (*Thunnus thynnus*) in the area affected and interacting with killer whale are the artisanal baitboat and handline. Both fisheries use small boats and compete for tuna not only between them and with killer whale depredations but also with other fisheries targeting bluefin tuna. One even most important fishery in the area (in terms of total capture) is the tuna trap, a traditional gear situated as a barrier labyrinth extended several kilometer off from the coastal line to catch the bluefin tuna during i) the reproductive migration (from the Atlantic to the Mediterranean Sea called “de derecho” period) and also ii) during the trophic migration (“de revés” period) just after the spawning period when the species go out from the Mediterranean and migrate to the north Atlantic.

But the relationship of the tuna traps fishermen with the killer whale not only has not been negative to fishermen or orcas but the contrary, a collaboration that give benefits to both, because the capture of bluefin tuna in the area has been related from centuries (Ramos, et al., 1985) to the presence of killer whale when follow the tuna schools to feed and this prosecution can facilitate the entry of tuna schools into the tuna trap during his escape from the killer whales, or even, that bluefin tunas appears on the beaches and the fishermen appropriate those tuna when stranded (Cort, 2007).

Other fisheries in the same area, interacting with killer whale and targeting also bluefin tuna, are the Moroccan artisanal handline and Moroccan traps. In general the fishing effort targeting bluefin tuna in the area of the Strait of Gibraltar by Morocco and Spain is very important in terms of number of vessel, type of gears and the extension of the fishing periods, which currently extend along the whole year. This extension is market-dependent (local and international) and also dependent of the annual quota of bluefin tuna that has every single fishing vessel (from Morocco and Spain).

The aforementioned fisheries targeting bluefin tuna are regulated by national legislation (Spain and Morocco), managed in the framework of the European Union Fisheries Policy in the case of Spain and regulated by international Recommendations, Regulations and other decision adopted in the framework of the

International Fisheries Organization ICCAT. The specie is fished under an annual TAC (Total Allowable Capture) distributed in quotas among the members. Artisanal fisheries from Spain targeting bluefin tuna in the Strait of Gibraltar are subjected to individual quotas under control at landing port.

The studies of killer whale in the Strait of Gibraltar area refers to summer months as the maximum presence, a peak that coincides with the migration of their main prey, the bluefin tuna, a target species to local tuna traps and Spanish and Moroccan artisanal fisheries (De la Serna et al.2004; Srour, 1994). At the same time a recent Real Order of the Spanish administration (Orden APM/427/2017, de 4 de mayo) adopted a series of protection measures and established a Conservation Plan for the killer whale of the Strait of Gibraltar.

The Spanish administration manages the interactions with fisheries of the orcas in this area and the protection of this species through the application of two different and complementary tools: one that protects the main prey, the bluefin tuna, establishing fishing annual quotas to vessel authorized to fish in the strait of Gibraltar with artisanal gears and, a second management tools establishing the aforementioned Conservation Plan. The purpose of the Conservation Plan is "*to actively manage this orca population through the promotion and implementation of specific measures that favor their survival and guarantee their good conservation status. These actions are aimed at the protection, conservation and recovery of both the killer whale population and its habitat, based on the best available scientific information and taking into account the socioeconomic characteristics of the environment. Thus, to the extent that there are substantial variations in the conservation status of the species or its habitat, or in the factors that put its survival at risk, the Conservation Plan may be subject to a total revision or partial Likewise, critical areas are designated through this ministerial order and general protection measures are established for this population*".

Based on the first of the management measures, the fishing activity control and surveillance, the ICCAT, UE and Spanish administrations (central and autonomous from Andalucia) controls the fisheries targeting the eastern Atlantic and Mediterranean bluefin tuna stock. The IEO Large Pelagic team within its competences established a pool of scientific measures and a system to monitor the status of the stock of bluefin tuna exploited in the area with artisanal gears, handline and baitboat, as complement to the monitoring of the captures and of the biological parameter of bluefin tuna captured in the tuna traps. Other information obtained refers to the interactions of these fleets with the orcas by following up the number of landed bitten bluefin tuna in the port of Tarifa, and the monitoring of biological parameters of the specimens of bluefin tuna landed in such port such as size, weight, age, reproduction status, genetic, parasitism, etc., to subsequent laboratory analysis and study.

Since 1995 two new fisheries have been developed in the Strait of Gibraltar by Spain and Morocco targeting bluefin tuna with hand line (Srour, 1994, de la Serna et al, 2004). Just with these fisheries begin systematically observations of killer whale groups that prey on the bluefin tuna caught by the fleet of artisanal vessels. So, attacks of killer whale occur from the beginning of the two artisanal fisheries, but there is not information of other attacks to bluefin tuna in other regions. Although killer whale preys on different species as mentioned, here the main prey is bluefin tuna, abundant and available during trophic and reproductive migrations.

The killer whales in the strait of Gibraltar and contiguous waters follow the bluefin tuna preys until extenuation and capture them even during periods in which there is not handline fishing in the area. This behavior is a killer whale's feeding approach historically known by local and fishermen; moreover the presence of orcas traditionally was used by almadrabas' owners to know the presence of bluefin tuna. Alternatively to the mentioned feeding and recently orcas take a piece of bluefin tuna when fishermen take onboard the tuna cached with handline. As the Spanish and Moroccan fisheries using handline are relatively recent in the area (from 1998 onward) this feeding strategy is newer than the one mentioned based on the weakness of the tuna prey. So the availability of resources that are important to killer whale would therefore decrease with an increased exploitation of bluefin tuna stock for human consumption but, considering the extraordinary amount of measures and control of the bluefin tuna fisheries, including landings control and quotas established by ICCAT and the members to improve the status of the stocks, that currently is in a progressive recovery as show the last assessment of the stock (ICCAT, a decline of the killer whale population of the Strait

of Gibraltar it couldn't be attributed to the existence or not of the artisanal fisheries using handline in the area of distribution of killer whales.

During the ACCOBAMS-GFCM/IEO pilot project the IEO compiled the existing information on i) landed bites bluefin tuna and ii) carried out a survey with a part of the fleet owners and skippers working in the Strait of Gibraltar with both handline and baitboat at the landing port of Tarifa.

Monitoring of bluefin tuna landed in Tarifa from 2000 shows that captures with baitboat are obtained along the year, with few months in winter without captures. Handline fleet operates from May to October with annual variations dependent of the quota that own each fishing vessel. Percentages of bites tuna vary from 3, 66% of the capture in the Spanish fleet (De la Serna et al., 2010) to 4,1% in the Moroccan handline fleet. Controlled landings in Tarifa show that maximum landing of the bites bluefin tuna correspond to July, with maximum at the beginning of the data series (2000-2007) decreasing the number till near cero from 2005 onward. Assuming a non reduction in the killer whale population and an increase in the number of bluefin tuna at sea (based on the assessment of the stock in recent year resulting in a recovery and the increase of the quotas) the analysis of the landing show significant differences in the number of expected tuna landed with bites than the observed. This result is concordant with the comments of the fishermen that are contrary to landing bluefin tuna attacked because reduced quota and prices at landing, that is translate in a lesser or cero tuna bites landing in recent years. According fishermen the attacks exist, so the killer whales continue obtaining his part of the tuna to feeding the families.

Complementary to IEO data collection at landing, individual interviews with fishers were prepared and done at the docks in order to get information on different aspects of fishing activities, fishing changes with time and interactions with orcas. The survey contains a series of open and fixed queries focus on the perception that the professionals have on different aspects related to the interactions with orcas, including the knowledge they have on the legislations and measures to protect the orcas or managed animals when hooked or entangled.

The totals of interviews (30% of the handline fleet) were carried out following the approach of only one interview by boat. Although the number of interviews is not significant to obtain conclusions on the fisheries interactions it is a first step to have direct information of the feeling of fishermen with the problem, the frequency of the interactions, the methods used to liberate the killer whale when entangled or hooked, and to obtain a numerical value on the number of bites bluefin tuna landed in Tarifa along a series of years (2000-2017) as a proxy of the real importance of the interactions and the losses of the fishery due to these interactions.

Te interviews show that the species affected by hooks of the handline include some dolphin species and killer whale. The dolphins are rarely hooked and only using the baitboat gear; the whales are hooked with the handline. As in many of those cases the orcas break the hooks or the lines fishermen don't consider this action as captures. A consequence of breaking the hooks or the line is the danger to the crews that suppose if the hook/line reaches their bodies/faces and hurt them.

All fishermen interviewed related the losses due to bites on tuna by orcas the main problem. At the same time some answer underline differences in the frequency of attacks depending of the vessel. According some surveys when a fishing vessel is attack has more possibilities of a new attack. Fishermen talk on learning and acknowledge by killer whales of certain vessels with previous attacks, meaning a bigger possibility of attack in certain vessels.

Fishermen confirm an increase of the number of orcas' pods (and attacks, according 93% of the answers) year after year and their distribution/observation in a larger area. Esteban et al (2016) confirm that during the period 1999 to 2011, a small community of 39 killer whales was observed in the Strait in spring and summer. All individuals displayed active hunting and 18 (46, 15%) of them depredated on the fishery, that could be consider a high number of attacks. But if we consider other answer from fishermen, once the whale obtain the appreciated piece of tuna they don't repeat the attack and the fishermen can try other tuna again in a new fishing set.

Also fishermen confirm the presence of orcas in the fishing area practically during the whole year. These observations by fishermen confirmed by recent publications(Esteban et al., 2016c) at the same time suppose a major concern by fishermen on the attacks because can be extended during more moths of the year.

Results from other authors working with handline and killer whale in the area and the own IEO data on competitive interactions between cetaceans and fisheries validate that the attacks of orcas to obtain bluefin tuna bites for food is always by surprise; attacks are usually focus towards the ventral area but not on the head and the tail of the tuna.

The results from the survey allow understanding that interactions with handline are part of the feeding behavior of the killer whale taking advantage of the fishing activity, but confirm that this feeding approach is not the only one to the species. The Conservation Plan include in the item distribution and habitat that "*orcas wait for their prey in the Barbate area where, after detecting their arrival, they chase and capture them taking advantage of the impossibility that exists in these shallow waters for the tunas to take refuge at a depth greater than 300 m, depth below which killer whales do not usually submerge*". The same Plan continue as follow "*In the summer, during the trophic migration of bluefin tuna, when they return from their spawning areas and head towards Atlantic waters, orcas are observed in the shallow waters of the central part of the Strait of Gibraltar, either associated with the bluefin tuna handline fishery, preying on catches of fishing vessels, or actively pursuing these tunas if there are no fisheries in the area*".

Mammals are social vertebrate that maintain the pods together the mothers during a long period (until approximately 2 years old). Fishermen observed that adults teach the young on how to feed on the tuna after the catch by the fishing vessels. Mothers start by giving the pieces of tuna to young after bitten, as part of the teaching behavior of tuna attacks, according fishermen.

We already mentioned the difference in killer whale behavior with handline and baitboat vessels catching bluefin tuna. From the analysis of the landed tuna in the port of Tarifa we obtained significant differences in the landing of bitten tuna before and after the ICCAT bluefin tuna recovery plan established in 2007.

The analysis of the survey also result that the accidental capture (hooks or line entanglement) of orcas is "frequent" (28, 5% of answers pooling together answers of the handline and baitboat fleets) while 57% of the answers consider that this interaction is "very rare" or "null". In the case of the dolphins species captures by a handline, 71 % of the interviews answers that the capture is "rare" or "inexistent".

5. Conclusions and Recommendations

- The area of the strait of Gibraltar and contiguous Atlantic waters concentrate annually the migration of bluefin tuna during two periods: the reproductive migration from the Atlantic to the Mediterranean Sea during the Spring period, concentrating in the area reproducers bluefin tuna from the whole eastern Atlantic bluefin tuna stocks and, a trophic migration from the Mediterranean to the Atlantic after the reproduction, that occurs mainly during summer months in the same area. These two migrations facilitate the development of tuna traps in both Moroccan and Spanish coast from centuries ago.
- Tuna traps situated in both north and south coasts of the Gulf of Cadiz and Strait of Gibraltar captured the bluefin tuna from centuries ago with commercial objectives. An artisanal fishery using a handline gear targeting adult bluefin tuna was first developed and described in 1994 in the Moroccan coast of the strait of Gibraltar acting the whole year with maximum activity in summer months. This fishery was first based only in three landing sited (beaches) situated northwest of Morocco. A similar Spanish fleet based in Tarifa and Algeciras was developed using as in Morocco, baited handline as main gear. Subsequently a fleet using baitboat based in the same Spanish ports started to fish in the area targeting also bluefin tuna during the two migrations' phases; more recently (2016-17) a new gear "green sticks" started to be used to catch the bluefin, complementing the other gears. Even more the traditional tuna traps in the area and the new artisanal gear mentioned here, 5-6 different fleets using four gears from two countries fish for tuna in the strait of Gibraltar area.

- Killer whale is a social marine mammals protected by international and national lows. A separated small population is observed in the Strait of Gibraltar and adjacent Atlantic waters along the year. These killer whales are part of the southernmost population of the North-East Atlantic and are considered an independent management unit within it with not more of 5 stable social groups. It is a management unit that has recently seen its survival threatened due to negative effects of various kinds and whose small size, which is thought to probably not exceed 50 individuals, contributes to its greater vulnerability. Spain adopted the Order APM/427/2017, of May 4, which approves the protection measures, and the Conservation Plan for the Orcas of strait of Gibraltar and Gulf of Cadiz.
- The presence of killer whale interacting with Spanish fisheries in the Strait of Gibraltar area is an historical fact. Killer whale feeding on bluefin tuna near the coast in the area of the Strait of Gibraltar and Atlantic contiguous waters where traditional tuna traps are located interacted for centuries positively with tuna traps in a relationship recognized as collaborative.
- History scientists and Archeologists working in the area gathered in their research work the relationship between fishermen and killer whales. Fishermen used the observation of killer whale in the strait area to known the apparition of bluefin tuna and better positioning the tuna traps and increase the captures. At the same time killer whale use the tuna concentration by the traps to feed their groups and the pods.
- The interaction of killer whale with Spanish fleets targeting bluefin tuna in the Strait with handline gear is a fact and a real problem known by fishermen and IEO at least from 2000. The depredation on captured bluefin tuna during the fishermen onboard action it's a new feeding approach of the killer whale in the area that appear in parallel with the new handline artisanal fisheries, both Moroccan and Spanish vessels targeting bluefin tuna in the same periods and fishing grounds in the Strait of Gibraltar and Gulf of Cadiz.
- Artisanal fisheries in the Strait of Gibraltar compete for tuna with families of resident killer whales. This competition is based on the interferences between a feeding behavior of the orcas and the legal activity developed by fishermen to capture valuable bluefin tuna mainly during the reproductive and trophic migration of this species through the Strait.
- As a consequence of the fisheries in the area, some dolphins and eventually killer whales are hooked or entangled in the handline during the fishing operations. Fishermen considered this interaction rare and sometime some mammals can death by these fisheries. Both killer whale and dolphin are able to break the hooks or cut the line and leave the fishing gear. The dolphins are rarely hooked and only using the baitboat gear. Eventually if an orca is hooked or entangled its liberated by cutting the line.
- Bluefin tuna landings are regulated by TAC and quotas. Fishermen extend the fishing period to the whole year to increase the revenues and for commercial reasons. Based on the IEO/ACCOBAMS surveys to fishermen working in the area and results from scientific publications related to this fishery and the killer whale population in the area we confirm the presence of killer whale practically the whole year (surveyed fishermen answers the presence in 2017 from February until November) and the interactions with handline fishery mainly during summer months (July-September).
- Landing of bluefin tuna bitten by killer whale in Tarifa were register by IEO from 2000 onward. The number of total killer whale interactions or the total number of bitten bluefin tuna in handline vessels was not assessing. Nevertheless the number of landed bluefin tuna bites by orcas decrease to near cero from the introduction of the ICCAT recovery plan in 2007. The analysis of the landing show significant differences in the number of expected tuna landed with bites than the observed.
- The appraisal of fishermen refers to an increase in the number of orcas in the area in recent years and in the number of attacks to tuna's vessels. All the interviewed assume an increase in the number of killer whales in 2017.The increase of the tuna stock and the quota by vessel introduce more incertitude in the estimation of the number of attacks.
- Losses in total income in the Spanish handline fishery were not calculated during this project because a reduced number of answers refer to this issue. Summarizing main results from the IEO surveys, the main

losses correspond to bitten bluefin tuna not landed, more time at sea for new capture when attacks occurs, consume of carburant, gear repairs, etc. Some fishermen estimated 30% of the capture lost, an amount varying between 10 and 40.000€/year.

- In the case of Spain, the fishery administration has the responsibility in managing the fisheries in the area of distribution of the orcas by implementing different laws and normative. At the same time the Spanish administration is protecting the main prey, the bluefin tuna, establishing fishing annual quotas to vessels/fleets authorized to fish in the strait of Gibraltar with artisanal gears. To complement the protection of the killer whale a new management tools has been establish, the killer whale of the strait of Gibraltar and Gulf of Cadiz Conservation Plan.

As final statement, we recommend a continued effort by national administrations including research institutions and international conservation organizations on data and information collection, including biological parameters and others related to the populations structure of both bluefin tuna and killer whale, to better understand the situation (status and trends) of the two populations and the interactions between killer whale and fishermen in the strait of Gibraltar and the gulf of Cadiz. We are talking of a special place where a small group of families of killer whale managed under a Spanish Conservation Plan, and a group of families of fishermen targeting bluefin tuna in the framework of the ICCAT bluefin tuna Recovery Plan, are competing for the same resource, the bluefin tuna. The management of bluefin tuna artisanal fisheries in the area should consider the interactions with killer whales and options to adapt the quota of these fleets considering the annual losses by attacks of killer whales.

As bluefin tuna has a very high commercial interest and illegal captures are reported in the area as consequence of an increasing in product demand, a possible management measure is reinforcing the control and surveillance of the fisheries and landing in the area. Complementary biological and fisheries data collection is also a very valuable tool for management purposes, but information on the killer whale population and biological conditions, including reproduction and success rates, is also of paramount interest to maintain this small group of families in the best possible conditions and to accomplish the objective of the Conservation Plan “actively manage this population of killer whales through the promotion and implementation of specific measures that favor their survival and guarantee their good conservation status”.

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10. Financial statement of the expenditures incurred with the funds available for the Pilot Action

Mr. Eduardo Balguerías Guerra, Director of the Spanish Institute of Oceanography

This is to Certifythat, accordingto the register in our Institute, the activities carried out by the IEO in the framework of the *Project on mitigating the interactions between endangered marine species and fishing activities, Addendum to the M0U ACCOBAMS-IEO Nº 06/2016/LB 6410,* from March 2017 to the end of June 2018 has incurred in following expenses of the available funds provided by ACCOBAMS.

Activity	Expenditures

Madrid (Spain), 31 of July 2018

Dr. Eduardo Balguerías Guerra

Annex 1

Acción Piloto SKW

Interacciones de Orcas y Pesquerías españolas en el Estrecho de Gibraltar

(Killer whale and fisheries interactions in the Strait of Gibraltar area (SKW)

Coordinador: Juan A. Camiñas

Centro Oceanográfico de Málaga (IEO)

ENCUESTA REALIZADA EN EL MARCO DE LA ACCIÓN PILOTO SKW

Survey carried out in the framework of the SKW Pilot Action

InquiryNumber/ Encuesta Número: _____

Inquiryauthor/ Autor de la encuesta: _____

Date/ Fecha: _____

Place/PortLugar/Puerto: _____

Gear1/PeriodArte/ periodo de uso: _____

Gear2/PeriodArte/ periodo de uso: _____

Otherinfo/ Otra información de interés: _____

_____

INFORMACIÓN DE LA ENCUESTA REALIZADA EN LA ACCIÓN PILOTO SurPeLine. IEO. España

El Objetivo de esta encuesta (dirigida fundamentalmente a patrones de pesca) es obtener información y datos sobre la percepción de la flota de superficie dirigida a atún rojo en el área del estrecho de Gibraltar sobre las interacciones orcas-pesca, coste estimado de la captura perdida por mordeduras de orcas, medidas de mitigación en uso y posibles medidas de mitigación a aplicar.

Se realizará una encuesta por barco, preferentemente a los patrones. Una vez que se haya hecho una encuesta por barco no se repetirá otra encuesta para ese barco.

1. ¿QUÉ ARTES HA UTILIZADO/UTILIZA Y EN QUÉ PERIODOS?

(INCLUIR DESCRIPCIÓN DEL ARTE, ESFUERZO, HORARIOS DE PESCA Y SI HA HABIDO VARIACIONES EN EL TIEMPO)

1.:_____DESDE_____HASTA_____, PERIODO_____

2.: _____ DESDE_____HASTA_____, PERIODO_____

3.: _____ DESDE_____HASTA_____, PERIODO_____

1.:

2.

3.:

2. ¿CONSIDERA QUÉ TIENE INFORMACIÓN SOBRE LAS SIGUIENTES ESPECIES? (ESPECIES, NORMATIVA, ETC). INDICAR SI LES GUSTARIA RECIBIR ALGÚN TIPO DE INFORMACIÓN

AVES: ☐ **NADA** ☐ **POCO** ☐ **SUFICIENTE** ☐ **MUCHO**

MAMÍFEROS: ☐ **NADA** ☐ **POCO** ☐ **SUFICIENTE** ☐ **MUCHO**

TORTUGAS MARINAS: ☐ **NADA** ☐ **POCO** ☐ **SUFICIENTE** ☐ **MUCHO**

3. ¿QUÉ ASPECTOS POSITIVOS O NEGATIVOS DESTACARÍA DE LAS PROHIBICIONES Y/O REGULACIONES QUE CONOCE?

4. ¿QUÉ ESPECIES DE MAMÍFEROS MARINOS HA CAPTURADO ALGUNA VEZ?

1. _____ ☐ **MUY RARO** ☐ **RARO** ☐ **FRECUENTEMENTE** ☐ **MUY FRECUENTE**

2. _____ ☐ **MUY RARO** ☐ **RARO** ☐ **FRECUENTEMENTE** ☐ **MUY FRECUENTE**

3._____ ☐ **MUY RARO** ☐ **RARO** ☐ **FRECUENTEMENTE** ☐ **MUY FRECUENTE**

¿EN QUÉ ESTACIÓN CREE QUE HAY MÁS CAPTURAS ACCIDENTALES?

PRIMAVERA ☐ **VERANO** ☐ **OTOÑO** ☐ **INVIERNO** ☐

5. ¿GENERALMENTE LOS CETÁCEOS CAPTURADOS ESTÁN VIVOS O MUERTOS?

☐ ☐ ☐

VIVOS **MUERTOS** **NO SABE**

6. Cuantifique LOS CETÁCEOSQUE LE CAUSAN PROBLEMAS

1. _____ FRECUENCIA: _____ _____ MES/AÑO

2. _____ FRECUENCIA: _____ _____ MES/AÑO

3. _____ FRECUENCIA: _____ _____ MES/AÑO

7. DE LOS CETACEOS ANTERIORES, INDIQUE QUE PROBLEMAS SUPONEN PARA EL DESARROLLO DE LA PESCA

1._____ PROBLEMA:_____

2._____ PROBLEMA:_____

3._____ PROBLEMA:_____

8. DESDE QUE EMPEZÓ A PESCAR COMO PATRON (AÑO:), ¿HA AUMENTADO LA PRESENCIA DE ORCAS/ESPARTES?

ORCAS: **AUMENTADO** ☐ **DISMINUIDO** ☐ **STANTE NO SABE** ☐ ☐

EN CASO AFIRMATIVO, CAUSAS DEL AUMENTO:

_____

¿EN QUÉ MES DEL AÑO CREE QUE HAY UNA MAYOR PRESENCIA E INCIDENCIA PARA LA PESCA?

9. DESDE QUE EMPEZÓ A PESCAR COMO PATRON, ¿HAN AUMENTADO LOS ROBOS DE ATUNES POR ORCAS/ESPARTES?

SI ☐ **NO** ☐ **NO SABE** ☐

RAZON:

¿EN QUÉ MESES DEL AÑO HAY MÁS ROBOS DE ATUNES? ¿ES TODOS LOS AÑOS EN LOS MISMOS MESES?

10. QUÉ ALTERNATIVAS PROPONE PARA REDUCIR LOS ROBOS DE ATUNES. INDICAR SI LE GUSTARÍA PROBAR ALGUNA EN SU BARCO:

1._____ **SI** ☐ **NO** ☐

2.: _____ **SI** ☐ **NO** ☐

3.: _____ **SIN** ☐ ☐

11. ¿QUÉ COSTE MENSUAL/ANUAL SUPONE PARA EL BARCO LA INTERACCIÓN/PERDIDA DE ATUNES MORDIDOS/ROBADOS?

ARTE 1: _____ €/MES **_____€/TEMPORADA-AÑO**

ARTE 2: _____ €/MES **_____€/TEMPORADA-AÑO**

ARTE 3: _____ €/MES **_____€/TEMPORADA-AÑO**

12. TIPOS DE MEDIDAS DE MITIGACIÓN QUE PROPONE PARA LAS INTERACCIONES EXISTENTES

INTERACCIONES EXISTENTES	MEDIDAS DE MITIGACIÓN PROPUESTAS	COSTE APROXIMADO DE LA MEDIDA
CON MAMIFEROS:		
1.	**1.**	**1.**
2.	**2.**	**2.**
3.	**3.**	**3.**
CON TORTUGAS:		
1.	1.	1.
2.	2.	2.
3.	3.	3.
CON AVES:		
1.	1.	1.
2.	2.	2.
3.	3.	3.

¿UTILIZA ALGUNA MEDIDA DE MITIGACIÓN EN SU BARCO?

13. ¿CUÁNDO LIBERA LAS ESPECIES PROTEGIDAS CAPTURADAS (CETÁCEOS, TORTUGAS Y AVES)?

☐ **AL LLEGAR A BORDO** **LAS MANTIENE A BORDO (INDICAR TIEMPO) _____**

☐ **OTRA OPCION: _____**

¿CÓMO LAS LIBERA? INDICAR SI TIENE EQUIPOS DE MANEJO A BORDO (PERTIGAS, ALICATES, DESANZUELADORES) PARA LIBERAR LAS ESPECIES CAPTURADAS INCIDENTALMENTE

16. EN SU OPINIÓN, ¿CUÁLES SON LOS FACTORES MÁS IMPORTANTES QUE INFLUYEN EN LA CANTIDAD DE INTERACCIONES (DAÑO A LA CAPTURA / APAREJO Y CAPTURA INCIDENTAL) CONCETÁCEOS?

☐ NO SABE

☐ NO HAY FACTORES

☐ HORA DE PESCA, DURACIÓN, DÍA Y NOCHE

☐ ESPECIE OBJETIVO

☐ ÁREA DE PESCA

☐ COMPORTAMIENTO DE LA ESPECIE

☐ PROFUNDIDAD

☐ ESTACIÓN

☐ ARTE DE PESCA

☐ CLIMATOLOGÍA

☐ OTROS (INDICAR CUALES):----------

17. DATOS DEL ENCUESTADO Y DEL BARCO (VOLUNTARIOS)

NOMBRE DEL BARCO: _____

ESLORA _____ MANGA _____

ARTE PRINCIPAL DE PESCA _____

PUERTO BASE: _____ INICIO DE ACTIVIDAD (AÑO) _____

ZONAS DE PESCA HABITUALES POR ÉPOCA:

PRIMAVERA _____ VERANO _____

OTOÑO _____ __ INVIERNO _____

NOMBRE DEL PATRÓN:

NOMBRE DEL ENCUESTADO:

NOTAS Y OTRAS CONSIDERACIONES DEL PESCADOR/PATRON:

_____

_____

_____

_____

_____

_____

Annex2.Fleet of handline landing in Tarifa in 2017 by month

HAND 2017	Month											
Names	1	2	3	4	5	6	7	8	9	10	11	12
ALFONSITO CHICO						X	X		X	X		
AMALIA						X						
ANA ISABEL SEGUNDO					X	X						
ANA SEGUNDA					X	X						
ANTONIO Y CARMEN					X	X						
ANTONIO Y LUISA					X	X						
AVE SIN PUERTO					X	X	X					
EL MARBELLA					X	X						
EL MELENAS					X							
ELISA MARIA					X	X						
FELIPE Y MARUJA						X						
FRANCISCO JOSE					X							
FRANCISCO Y JOSE						X						
GOMEZ RIERA						X						
GRANT DEL MAR						X	X					
HACHOMAR					X	X						
HERMANOS SANCHEZ					X	X						
INESITA					X	X						
JOSE MANUEL						X						
JOSE Y ANA					X	X						
JOSE Y SORALLA						X	X	X	X			
JULIAN LACERA					X	X						
LEONOR						X						
MANOLITO E ISABEL					X	X						
MANUEL Y PATRICIA						X						
MARIA DEL CARMEN						X						
MARIA TERESA					X							
MARIA TERESA SEGUNDA					X	X						
MARILUZ						X	X	X				
MI JOAQUINITO					X	X						
MI JOSELITO						X	X		X			
MI MADRE DOS						X						
MIGUEL ANGEL						X						
MIRIAN Y LORENA						X						
MUÑI					X	X						
NUEVA ENCARNACION PRIMERA					X	X						
NUEVO BAMBI						X	X					
NUEVO FONTANILLA									X		X	
NUEVO GABANCHO					X	X						
NUEVO JULIO CHICO						X	X					
NUEVO MARI CARUCHI						X	X	X	X			
NUEVO MIGUEL ANGEL						X						
NUEVO TOTOÑO						X						
PEDRO GETARES					X	X						
PEDRO Y ANA					X	X						
ROMAN Y MARTOS						X	X	X				
RUA MAR						X						
SALADILLO					X	X						
SAN MANUEL					X	X						
SEGUNDO ANA						X						
SEGUNDO JUAN					X	X						
TENORIO MEDINA					X	X						
VILLA DE NOJA						X	X	X	X			X

Annex3

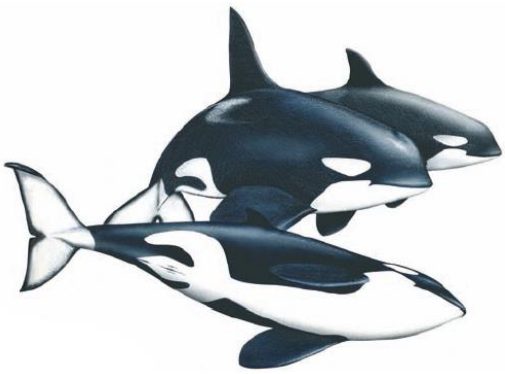
Proyecto ACCOBAMS-CGPM en colaboración con el IEO para la mitigación de las interacciones entre las especies marinas en peligro y la pesca (2015-2018)

Interacciones de Orcas y Pesquerías españolas en el Estrecho de Gibraltar

Acción Piloto de colaboración del IEO con ACCOBAMS y la CGPM

(Acuerdo IEO-ACCOBAMS Nº 06/2016/LB 6410)

LAS ORCAS Y LAS INTERACCIONES CON LA PESCA DE ATUN ROJO EN EL ESTRECHO DE GIBRALTAR



Orcinus orca / *Killer whale* (© Wurtz-Artescienza)

Contacto: Juan A. Camiñas y David Macías. Equipo de Grandes Pelágicos Oceánicos.

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La Orca (*Orcinus orca*)

Las orcas son carnívoros oportunistas situados en un alto nivel en la red trófica, con dietas que difieren estacional y regionalmente. Su distribución se asocia a la migración del atún rojo por el Estrecho de Gibraltar. Es uno de los odontocetos más fácilmente reconocibles. Llegan a alcanzar 9,0 m los machos y 7,7 m las hembras. Su masa corporal oscila entre 3.500 Kg. y 6.000 Kg. Los machos se diferencian de las hembras por poseer aletas de mayor envergadura, tanto las pectorales como la caudal y la dorsal, la cual, erguida, puede llegar a alcanzar los 1,8 m de longitud y es, el rasgo más determinante para diferenciar los sexos en la especie.

Los neonatos suelen medir de 2-2,5 m y pesar alrededor de 200 Kg. Poseen una coloración parcheada. En general la parte dorsal es negro azabache. Sobre los ojos presentan un parche ovalado de color blanco. Detrás de la aleta dorsal, aparece un dibujo en forma de silla de montar de color gris blanquecino. El mentón y la garganta son de color blanco. A partir de ellos surge una amplia franja blanca que se extiende por el vientre y se ramifica en forma de tridente en la parte posterior. Las aletas pectorales son completamente negras y la caudal es también negra en el dorso y blanca en el reverso. En la parte inferior emerge un entrante blanco resultado de la expansión del tridente ventral. En las crías, las áreas normalmente blancas se muestran anaranjadas.

Hábitat y biología de la especie

Es una especie cosmopolita, presente en todos los océanos y mares del mundo. Pese a que se ha constatado su presencia en zonas tropicales y oceánicas, son más abundantes en hábitats costeros y en altas latitudes. Parecen mostrar preferencia por aguas frías y productivas, por lo que alcanzan mayores densidades en las zonas polares de ambos hemisferios. La única limitación a su distribución parece ser la formación de hielo durante los inviernos polares. En algunas zonas su presencia puede ser estacional, generalmente asociada a los movimientos migratorios de sus presas. En mares con poca productividad como el Mediterráneo es menos abundante.

La dieta de la orca puede variar entre áreas colindantes e incluso dentro de una misma zona. Está bien documentado que estos depredadores pueden consumir una gran variedad de presas, incluyendo peces, cetáceos, pinnípedos, mustélidos, aves, tortugas marinas y cefalópodos. Las orcas utilizan gran variedad de técnicas de caza, incluyendo la cooperación entre individuos de un grupo para atacar bancos de peces o grandes cetáceos. Las orcas basan su estrategia de caza en la emisión de ondas de sonar (ecolocación), lo que les capacita para localizar a sus presas y para comunicarse con otros individuos del grupo y tender emboscadas a sus presas, táctica especialmente importante en la caza de grandes mamíferos marinos.

La orca es un cetáceo polígamo. Las épocas de apareamiento y alumbramiento pueden durar varios meses. Además, parece no existir sincronía alguna en los ciclos reproductores, variando en distintas partes del mundo. El periodo de gestación oscila entre 15-18 meses. Las crías no desarrollan la dentición completa hasta las 13 semanas de vida, momento en el que comienzan a consumir alimento sólido. Los cuidados maternos finalizan unos 18 meses después del alumbramiento. Habitualmente las hembras jóvenes colaboran en el cuidado de las crías.

La esperanza de vida de las hembras es aproximadamente de unos 50-60 años. Dejan de ser fértiles entorno a los 40 años. Aportan entre 5 y 6 individuos a la población durante toda su vida. Los machos tienen una esperanza de vida más corta (30 años), aunque se han registrado longevidades máximas similares a las de las hembras.

Distribución de *Orca* (Reeves, R *et al.* 2017; © IUCN R. List)

En el Estrecho de Gibraltar, donde se han identificado 5 manadas, las orcas se alimentan principalmente de atún rojo (*Thunnus thynnus*). Permanecen toda su vida dentro del grupo social o manada donde nacieron, y se asocian con individuos de otras manadas solo para la reproducción. En el Estrecho de Gibraltar su distribución también ha sido asociada a la migración del atún rojo. En primavera las orcas se aprovechan con frecuencia de la presencia de las almadrabas de la zona como barreras para cerrar la huida de los atunes durante su persecución y captura. En verano las orcas

se observan en las aguas centrales del Estrecho asociadas a la pesquería de atún a la línea de mano o cebo vivo. Estudios genéticos han revelado que hay en la zona del estrecho de Gibraltar y aguas atlánticas contiguas dos grupos de orcas con líneas maternas diferentes. Se estima que pertenecen a la misma población, con diferencias significativas con otras dos poblaciones situadas en las aguas del mar del Norte, alrededor de Gran Bretaña, Islandia y Noruega.

Estado de la especie y medidas de conservación

Es una especie protegida que se encuentra incluida en el Apéndice II de la Convención sobre el Comercio Internacional de Especies Amenazadas de Fauna y Flora silvestres (CITES), en el Apéndice II del Convenio de Bonn sobre la conservación de especies migratorias de animales silvestres (CMS), y en el Apéndice II del Convenio de Berna relativo a la Conservación de Vida Silvestre y del Medio Natural en Europa. Además, también está incluida en el Apéndice II del Protocolo sobre zonas especialmente protegidas y la diversidad biológica del Convenio de Barcelona para la protección del medio marino y de la región costera del Mediterráneo.

La Directiva 92/43/CEE del Consejo, relativa a la conservación de los hábitats naturales y de la fauna y la flora silvestre (Directiva Hábitats) incluye a la orca en su anexo IV, por lo que requiere adoptar medidas de protección estricta. La Ley 42/2007, del Patrimonio Natural y de la Biodiversidad, que transpone esta norma comunitaria al ordenamiento jurídico español, cataloga a la orca en su anexo V sobre Especies de interés comunitario que requieren una protección estricta.

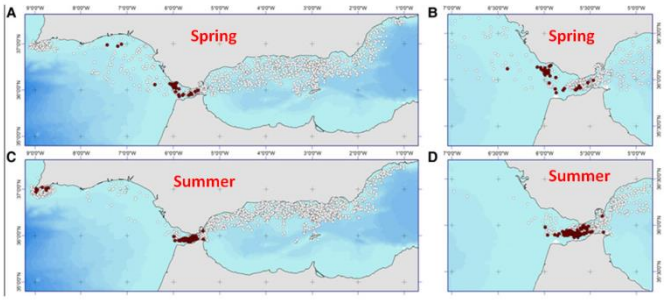
La población de orcas del Mediterráneo y del Atlántico adyacente está considerada como amenazada y de alta prioridad según la Unión Internacional de Conservación de la Naturaleza (UICN) y el Acuerdo para la Conservación de los Cetáceos del Mediterráneo, Mar Negro y Atlántico Contiguo (ACCOBAMS).

La población de la orca del estrecho de Gibraltar y golfo de Cádiz se halla incluida en la categoría vulnerable del Catálogo Español de Especies Amenazadas (CEEA), creado por la Ley 42/2007, y regulado por el Real Decreto 139/2011, para el desarrollo del Listado de Especies Silvestres en Régimen de Protección Especial y del Catálogo Español de Especies Amenazadas. Debe adoptarse un plan de conservación que incluya las medidas más adecuadas que permitan eliminar los factores de amenaza que afectan a esta población y llevar a término las actuaciones necesarias para su preservación. Asimismo se prevé también la designación de áreas críticas para las poblaciones incluidas en el CEEA en las que se podrán fijar medidas de conservación integradas en planes de gestión.

De acuerdo con esto, se ha aprobado mediante orden ministerial (APM/427/2017*)* el **Plan de Conservación de la orca *(Orcinus orca)* del Estrecho y golfo de Cádiz**, que permite gestionar de forma activa dicha población de orcas mediante el impulso y la puesta en marcha de medidas específicas que favorezcan su supervivencia y garanticen su buen estado de conservación.

La población de orcas del estrecho de Gibraltar

El área atlántica adyacente al Estrecho de Gibraltar ha sido escenario tradicional de observación de la presencia de orcas tanto en los meses de abril a junio, época denominada “de derecho” para el atún rojo, que se encuentra en migración reproductiva desde el Atlántico al Mediterráneo. También se observan atunes durante el período de junio a agosto, en la época de migración post reproductiva del atún rojo y a ellos se asocian los grupos de orcas.



Avistamientos de orcas (puntos oscuros) y otros cetáceos (en gris): (A) avistamientos en primavera en el sur de la Península Ibérica; (B) avistamientos en primavera en el estrecho de Gibraltar; (C) avistamientos en verano en el sur de la Península Ibérica; (D) avistamientos en verano en el Estrecho de Gibraltar (Esteban, 2013).

Presencia en el Estrecho de Gibraltar: Épocas y número de individuos

Según publican Esteban et al., (2016), se identifican 47 individuos pertenecientes a 5 grupos diferentes en la región del Estrecho de Gibraltar, separados genéticamente de los grupos presentes en las Islas Canarias y Atlántico norte.

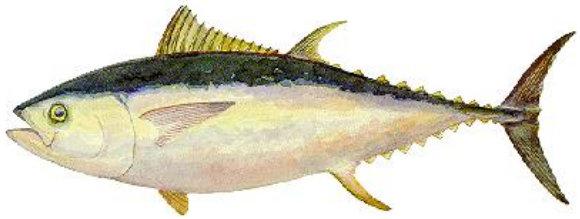
La supervivencia y reproducción de estos grupos depende en gran parte del atún (García Tíscar, 2009) como principal presa. Todas las orcas observadas en esta área cazan atunes persiguiendo peces individuales hasta que se agotan y pueden ser vencidos. Sin embargo, un subconjunto de vainas también interactúa con la línea de mano de la pesquería de atún (Esteban et al, 2016) a través de la técnica de caza activa de agotamiento de la resistencia, capturan atunes medianos o pequeños descritos en la población del Estrecho de Gibraltar (Guinet et al., 2007).

Solo se observaron dos grupos (de los 5 definidos en el área) que interactúan con la línea de mano de la pesquería, lo que sugiere que la transmisión de este comportamiento puede haber estado restringida por la estructura social (Esteban et al, 2016).

El atún Rojo (*Thunnus thynnus*), objetivo de las pesquerías artesanales españolas del estrecho de Gibraltar

El atún rojo (*Thunnus thynnus thynnus*) es una especie de gran valor comercial para el sector pesquero. Se distribuye en aguas templadas y los adultos también en aguas frías, realizando amplias migraciones transatlánticas. Se reproduce en el Mediterráneo en áreas en torno a las Islas Baleares y en el Mediterráneo oriental. Se adentra en el Mediterráneo entre abril y junio, buscando aguas cálidas para el desove, regresando al Atlántico tras la puesta. La población del Atlántico este y Mediterráneo se considera aislada de la del Atlántico occidental.

Es un gran nadador en aguas sub-superficiales que se sumergen hasta profundidades de 500-1000 m. Habita el sistema pelágico, donde puede soportar bajas y altas temperaturas (3-30^{o}C).



***Thunnus thynnus thynnus* (de IATTC)**

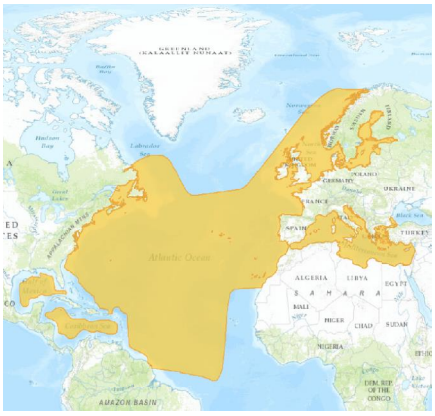
La talla máxima es de 330 cm y 725 kg de peso, aunque las tallas grandes en la captura suelen llegar a 220 cm. Tiene hábitos gregarios, sobre todo hasta los 3-4 años, y suele constituir cardúmenes formados por individuos de tamaño semejante. Los cardúmenes de reproductores migran en grupos de diferente tamaño y edad. Los ejemplares mayores consumen peces pelágicos y los más pequeños crustáceos y moluscos.

Estado del stock

Aunque sigue habiendo incertidumbres, el estado del stock ha mejorado en los últimos años y la tendencia de la biomasa reproductora es creciente, pero la magnitud y velocidad del aumento de la biomasa reproductora continúan siendo muy inciertas. Según ICCAT (evaluación de 2017) se encuentra plenamente explotado.

Ha habido mejoras considerables en la calidad y cantidad de los datos en los últimos años, sin embargo, aún existen lagunas importantes en la cobertura temporal y espacial. Se ha producido una disminución sustancial de la captura en el Atlántico este y el mar Mediterráneo tras la aplicación del plan de recuperación y los controles de vigilancia.

Las evaluaciones de ICCAT (2017) evidencian que se ha producido un aumento de abundancia del stock. El Comité aconseja que se incrementen las capturas, pero de manera gradual y siendo revisado anualmente su estado.



Distribution atún rojo (*Collette *et al. 2011; © IUCN Red List)

Dado el aumento de la abundancia del stock, el Comité Científico aconsejó que la Comisión considere la posibilidad de pasar del plan de recuperación actual a un plan de gestión.

Artes de pesca

La pesca del atún rojo ha venido realizándose en el Mediterráneo desde el séptimo milenio A.C., por los fenicios, y más tarde por los romanos.

La flota que faena en el Estrecho de Gibraltar procede de los puertos de Tarifa y de Algeciras. Los artes de pesca utilizados para capturar atún rojo se describen a continuación.

Cebo vivo: En primer lugar, la pesca se realiza con una red de cerco, con la que se captura el pescado que posteriormente será utilizado de cebo. Éste se mantiene vivo a bordo, en estanques de peces, equipados con luz artificial y bombas para la oxigenación del agua. Algunas de las especies que suelen utilizarse son: *Trachurus* spp, *Sardina* spp y *Sardinella* spp.

Se arroja carnada para atraer atún y al mismo tiempo chorros de agua desde la cubierta para imitar la

presencia de un enorme banco de presas potenciales y para distorsionar la capa de la superficie del mar.

El arte se compone de una caña o palo y una única línea corta y resistente, al final de la cual se coloca el anzuelo con cebo vivo. El palo es sujetado por un pescador, que se encuentra de pie. Es utilizado durante todo el año.

Línea de mano: Se compone de una a varias líneas de mano, cebadas con cebo muerto. En el extremo se coloca un peso (20 kg). Los anzuelos suelen ser n ° 0/1 o 1 de tipo japonés (gancho curvo). Las especies utilizadas como cebo suelen ser jurel, caballa o alacha. Se unen a una línea de aproximadamente 10-20 brazas de longitud que, a su vez, está unida a una línea principal de unos 500 m de longitud. Una vez enganchado, el atún se lleva a bordo por medio de un arpón de mano y una polea. Es utilizado de mayo a diciembre, aunque principalmente se utiliza en los meses de verano.

Palo verde: El nombre de "palo verde" viene asociado al color de la materia original utilizada para su fabricación. Consiste en un mástil o palo, de grandes dimensiones (más de 15 m), para elevar el hilo y los señuelos a gran altura y poder pescar a distancias de 200-250 de la popa. Es robusto y dúctil, de manera que puede doblarse intensamente. Del mástil parte una línea principal, de la que parten líneas secundarias, en cuyo extremo se encuentran el cebo con su correspondiente anzuelo. Como cebo se utilizan calamares sintéticos con grandes flecos y colores variados. Pescan en la superficie donde el cebo va entrando y saliendo del agua. No se producen interacciones con cetáceos.

Medidas de Gestión pesquera del stock de atún rojo en el Atlántico oriental y en el Mediterráneo

-Real Decreto 71/1998, de 23 de enero, por el que se regula la pesca de túnidos y especies afines en el Mediterráneo.

-Reglamento (UE) 2017/127 del Consejo, de 20 de enero de 2017, por el que se establecen, para 2017, las posibilidades de pesca para determinadas poblaciones y grupos de poblaciones de peces.

-Reglamento (UE) 2016/1627 del Parlamento Europeo y del Consejo, de 14 de septiembre de 2016, relativo a un plan de recuperación plurianual para el atún rojo del Atlántico oriental y el Mediterráneo.

-Orden APM/264/2017, de 23 de marzo por la que se regula la pesquería de atún rojo en el Atlántico Oriental y Mediterráneo.

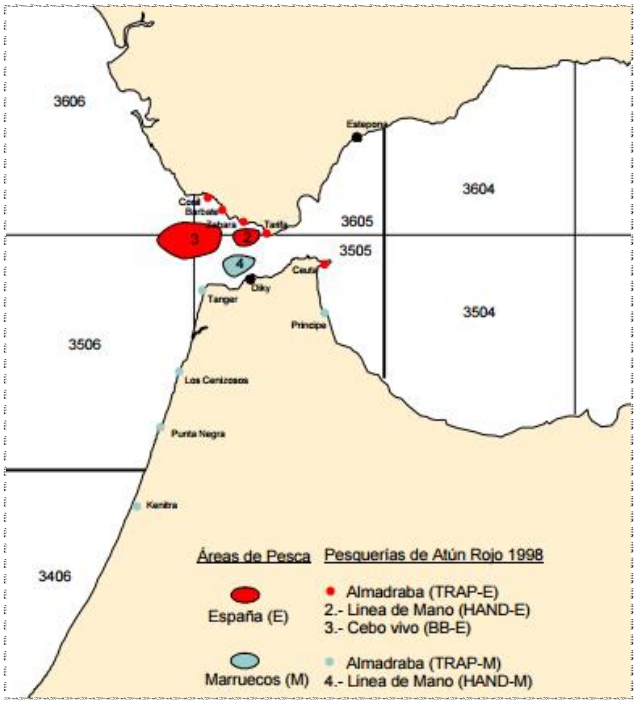
-Resolución del 6 de marzo de 2017, de la Secretaría General de Pesca, de aplicación del Plan de recuperación del atún rojo en el Atlántico oriental y en el Mediterráneo para 2017.

-Resolución del 15 de febrero de 2017, de la Secretaría General de Pesca: asignación de cuotas de atún rojo y del censo específico de la flota autorizada.

-La legislación aplicable es la Orden APM/1057/2017, por la que se regula la pesca con arte de palangre de superficie para la captura de especies altamente migratorias

Presencia del atún en el Estrecho de Gibraltar

El Estrecho de Gibraltar es un lugar de paso del atún rojo. La migración ocurre estacionalmente dos veces al año: en primavera, la reproductiva (también conocida como "de derecho" o "de paso") tiene lugar desde el Atlántico hacia zonas de desove en el Mar. Por otro lado, la migración de alimentación (también conocida como "de revés" o "de retorno") del Mar Mediterráneo al Atlántico tiene lugar durante el mes de julio (De la Serna, 1999).



Áreas de pesca de atún rojo por arte. (CopeMed I 1998)

Pesquerías españolas de atún rojo que sufren su actividad depredadora

A partir de 1995, se desarrollan nuevas pesquerías, dirigidas al atún rojo, en el Estrecho de Gibraltar, tanto en España como en Marruecos. El arte utilizado es la línea de mano. Comienzan entonces, a ser avistadas sistemáticamente grupos de orcas, que depredan sobre los atunes capturados por la flota artesanal, principalmente en los meses de verano. Desde el comienzo de la pesquería de línea de mano hasta la actualidad siempre ha habido ese comportamiento de

las orcas que muerden los atunes capturados por los pescadores.

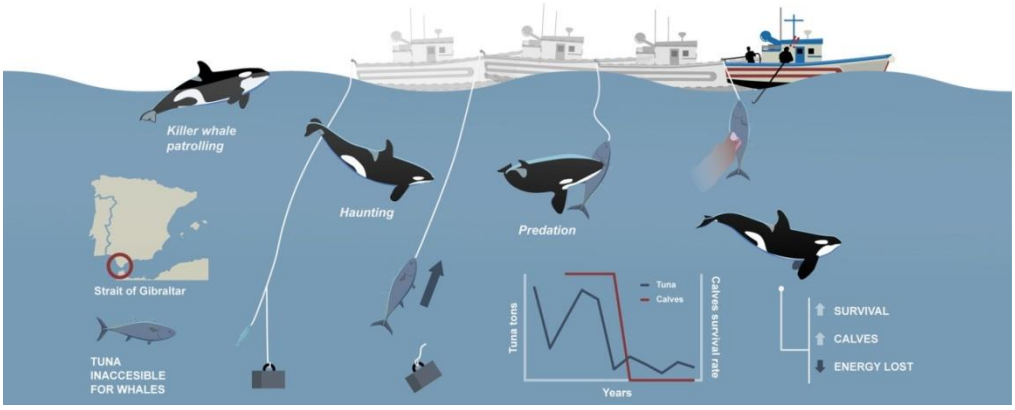
Interacciones Orcas-pesquería de línea de mano

Las orcas pueden depredar de manera directa el atún ya capturado con línea de mano, por lo que presumiblemente invierten menos energía que la necesaria en la caza activa (Esteban, 2016). La pieza puede ser depredada completa o parcialmente, antes de que los pescadores hayan podido subir el atún a bordo.

La depredación del atún tiene lugar en los especímenes capturados con línea de mano y es muy baja para el atún capturado por los barcos de cebo. Se estima que alrededor del 7% de las capturas de atún rojo en estas pesquerías, tanto de la flota española como marroquí, podrían ser depredadas por las orcas.

Interacciones Orcas- pesquería de cebo vivo

Esta pesquería no sufría ataques de orcas, pero en 2017 se produjo la primera interacción con las mismas, según informan los pescadores de esa modalidad.



Depredación directa en barco de línea de mano (Esteban, 2016)

Medidas propuestas por el sector (a partir de encuestas realizadas)

La mayoría de los encuestados no propone ninguna alternativa, puesto que consideran que el "robo de atunes" no puede evitarse al ser un fenómeno natural. Algunas propuestas realizadas son emitir sonidos que puedan espantar a las orcas (ej. Imitar calderones), o ampliar los permisos y las cuotas para poder pescar con artes que tengan una menor interacción con esta especie, como el cebo vivo.

Para saber más sobre el atún rojo

https://www.iccat.int/Documents/SCRS/Manual/CH2/2_1_5_BFT_SPA.pd

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NOTAS:

Atunes, Pescadores y Orcas

Conviviendo en el Estrecho de Gibraltar

1. El atún rojo es una especie cuya pesca aporta importantes beneficios sociales y económicos en el área del estrecho de Gibraltar, tanto en España como en Marruecos. La alimentación de orcas sobre atunes capturados es un problema para la pesca de ambos países.

2. Las orcas forman familias estables en el estrecho de Gibraltar que se nutren en ocasiones de los atunes capturados por los pescadores. Su presencia es indicador del buen estado ambiental y de la riqueza de esas aguas, además de producir beneficios sociales.

Las presencia en el estrecho de Gibraltar de atún rojo y familias de orcas supone beneficios para los pescadores españoles y marroquíes y para otras entidades, por lo que el respeto a las leyes , acuerdos internacionales y a las especies es fundamental para mantener las especies y las pesquerías.

SurPeLine, Proyecto del Centro Oceanográfico de Málaga (IEO) para reducir las interacciones entre las especies marinas en peligro y las actividades de pesca (2015-2018)

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