FEATURED ARTICLE

SCIENTIA MARINA 83(1)
March 2019, 7-17, Barcelona (Spain)
ISSN-L: 0214-8358
https://doi.org/10.3989/scimar.04837.18A

Reconstruction of marine small-scale fisheries captures in the Canary Islands (NE Atlantic Ocean) from 1950 to 2010

José J. Castro [1], Esther Divovich [2], Alicia Delgado de Molina Acevedo [3], Antonio Barrera-Luján [1], Rodrigo Riera [4]

[1] Instituto Universitario EcoAqua, University of Las Palmas de Gran Canaria, Edf. Ciencias Básicas, 35017 Las Palmas de Gran Canaria, Canary Islands, Spain.
(JJC) E-mail: jose.castro@ulpgc.es. ORCID-iD: https://orcid.org/0000-0001-9577-5957
(AB-L) E-mail: antonio.barrera@ulpgc.es. ORCID-iD: https://orcid.org/0000-0002-5705-7070
[2] Sea Around Us, Fisheries Centre, University of British Columbia, 2202 Main Mall, Vancouver, Canada.
(ED) E-mail: e.divovich@fisheries.ubc.ca. ORCID-iD: https://orcid.org/0000-0003-4107-0155
[3] Instituto Español de Oceanografía, C. O. de Canarias, Vía Espaldón PCL 8. 38180 S/C de Tenerife, Canary Islands, Spain.
(AD) E-mail: alicia.delgado@ieo.es. ORCID-iD: https://orcid.org/0000-0003-2924-5223
[4] Departamento de Ecología, Facultad de Ciencias, Universidad Católica de la Santísima Concepción, Casilla 297, Concepción, Chile.
(RR) (Corresponding author) E-mail: rriera@ucsc.cl. ORCID iD: https://orcid.org/0000-0003-1264-1625

Summary: Total marine fisheries catches within the exclusive economic zone of the Canary Islands, Spain, were reconstructed to include catches from the various small-scale artisanal fleets and their discards, as well as subsistence, recreational and other unreported catch. Total reconstructed catch was estimated at 38600 t in 1950, increasing to 81200 t in 1985, declining to approximately 43700 t year^{-1} in the early 2000s, and finally spiking to about 65300 t year^{-1} by the late 2000s. These catches coincide with a severe depletion of fish stocks, especially those of demersal species, due in part to fishing overcapacity in the artisanal sector, despite attempts to limit effort by the government. Spain only started to report catches to the FAO in 2006, and from 2006 to 2010 reconstructed catch was seven times the reported catch. Nearly 70% of this catch was from the recreational fishing sector, due in part to technological advancements and increased investments in the construction and improvement of secondary ports.

Keywords: Canary Islands; Atlantic Ocean; fish; tuna; catch reconstruction; small-scale fisheries.

Reconstrucción de las capturas de la pesquería artesanal en las Islas Canarias (Atlántico Nororiental) desde 1950 hasta 2010

Resumen: Las capturas totales marinas dentro de la Zona Económica Exclusiva (ZEE) de las Islas Canarias (España) fueron reconstruidas incluyendo las capturas procedentes de diferentes flotas artesanales, así como sus descartes, y además la pesca de subsistencia, recreativa y capturas no reportadas. La captura total reconstruida fue estimada en 38600 t anuales in 1950, incrementándose hasta 81200 t anuales en 1985, para posteriormente disminuir a 43700 t·anuales al comienzo de la década del 2000 y finalmente aumentar hasta 65300 t·anuales al final de esa década. Estas capturas coinciden con una disminución acusada de los stocks pesqueros, especialmente de las especies demersales. Este descenso fue debido en parte a la sobrecapacidad del sector artesanal, a pesar de los esfuerzos realizados por el Gobierno para limitarla. A partir del año 2006 se comenzó a reportar para FAO las capturas en el estado español, y las capturas reconstruidas en el período 2006-2010 fueron 7 veces superiores a las capturas reportadas. Aproximadamente el 70% de esta captura proviene del sector pesquero recreativo, debido en parte a los avances tecnológicos y al incremento de las inversiones en la construcción y mejora de recintos portuarios secundarios.

Palabras clave: Islas Canarias; océano Atlántico; pesca; atún; reconstrucción de capturas; pesca artesanal.

Citation/Como citar este artículo: Castro J.J., Divovich E., Delgado de Molina Acevedo A., Barrera-Luján A., Riera R. 2019. Reconstruction of marine small-scale fisheries captures in the Canary Islands (NE Atlantic Ocean) from 1950 to 2010. Sci. Mar. 83(1): 7-17. https://doi.org/10.3989/scimar.04837.18A

Editor: P. Sartor.

Received: July 31, 2018. **Accepted:** January 7, 2019. **Published:** February 27, 2019-

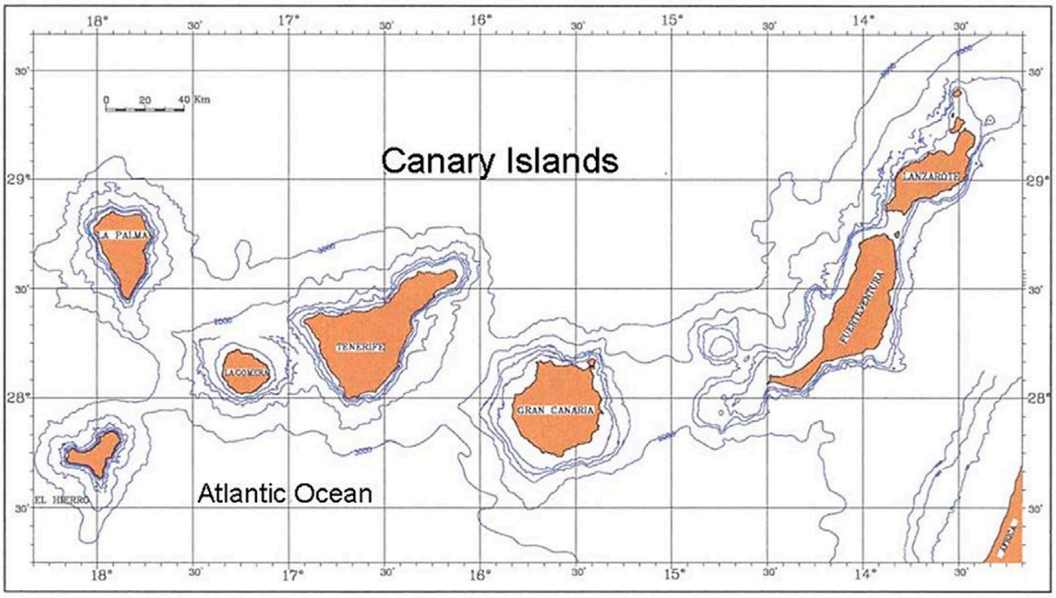

Fig. 1. – Map of the Canary Islands (central-east Atlantic).

INTRODUCTION

The Canary Islands are in a geographically unique position as a navigation base between Europe, Africa, and the Americas (Fig. 1). In contrast to the neighbouring African coast, the productivity of waters within the exclusive economic zone (EEZ) of the Canary Islands is low (Bas et al. 1995), due to the narrow insular shelf which limits demersal life. While the abundance is low, the diversity is quite high, with approximately 200 species targeted by small-scale fisheries (Pascual 2004, Santamaría et al. 2013). Currently, the small-scale fisheries of the Canary Islands share many characteristics and problems of other European, especially Mediterranean, artisanal fisheries (Guyader et al. 2013, Maynou et al. 2013). These fisheries are operated by a heterogeneous fleet composed of small boats, small crews and different gears that change their target species throughout the year. This sector also has low extraction rates and low total capital investments, and it lacks comprehensive data on catch and fishing effort (Bas et al. 1995, Hernández-García et al. 1998). Moreover, this fleet competes for the same resources with a substantial number of recreational boats (MAPyA 2006). Hence, assessing the current level of exploitation using traditional methods of fish population dynamics has not been possible (Csirke 1989, Lleonart 1994, Sparre and Venema 1998). The present reconstruction will shed more light on total catch removals from the waters around the Canary Islands, and hence assist fishers and policy makers in understanding the current state of this artisanal fishery.

MATERIALS AND METHODS

Reported data

The system of regular fishing data collection in the Canary Islands began in 2006 (Popescu and Ortega Gras 2013, Santamaría et al. 2013). Additionally, catch data for tuna and tuna-like species have been collected separately by the Spanish Oceanography Institute (IEO) since 1970 and reported to the International Commission for the Conservation of Atlantic Tunas (ICCAT). We distinguish between artisanal and industrial tuna fishing, where the artisanal fleet is defined as bait boats between 1 and 200 gross registered tonnage (GRT), as opposed to, for example, the tropical tuna purse seine fleet, which is industrial. The present analysis of tuna catch only considered the artisanal fleet, as opposed to the industrial fleet, which is more likely to fish outside the EEZ of the Canary Islands. The artisanal fleet is also represented in ICCAT data from 1962 to 1969. Specifically, ICCAT data from 1965 showed catches of the artisanal baitboat fishery that were on average 12 times higher than FAO tuna catches for both industrial and artisanal catch. Another important distinction is that FAO catches include industrial catches, and thus it is more likely that industrial catches of tuna were reported to the FAO than the artisanal catch of the bait boats, as has occurred for other species.

Therefore, our ‘baseline’ of reported catch only includes catch reported by the Canarian Government starting in 2006, and the purpose of the present paper is to reconstruct catches for the artisanal fleet from the period 1950-2010 in which data gaps remain, as well as sectors not covered in official catch data such as subsistence catch, recreational catch (vessel-based and fishers from shore), bait catch (fish used to attract fish, particularly tuna) and discards. Since official, reported data on catches were not available prior to 2006 (except for tuna), we used a comprehensive compilation of fisheries-relevant information. These data were composed of historic and current information available in the grey literature (García-Cabrera 1970, Hernández-García et al. 1998, Melnychuk et al. 2001), as well as data obtained directly from fishermen’s associations.

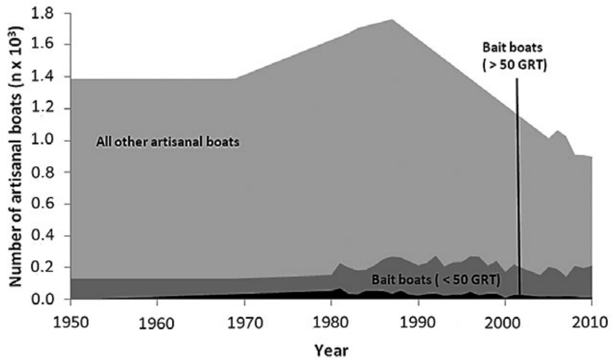

Fig. 2. – Number of artisanal boats in the Canary Islands, 1950-2010.

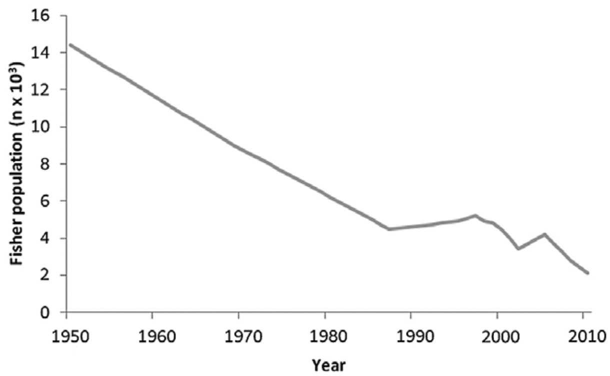

Fig. 3. – Number of artisanal fishers in the Canary Islands, 1950-2010.

Number of artisanal boats

The commercial fisheries of the Canary Islands are composed of small-scale boats which fish within the EEZ of the Canaries, as well as industrial vessels operating mostly in the fishing grounds of NW Africa, hence making it difficult to identify what part of the whole fleet [i.e. number of boats, GRT and horsepower (hp)] was dedicated to the artisanal fishery in each period.

Nonetheless, grey literature has provided some data on the artisanal fleet, and existing data gaps were resolved by interpolating catch for the missing years. This resulted in 1390 artisanal boats in 1968, increasing to 1709 boats in 1983 (Fig. 2). From 1980 to 2010, data on the number of artisanal tuna boats were available (Delgado de Molina et al. 2012), and for 1950 to 1979 we assumed that the number of bait boats followed the same trend as that of total artisanal boats (Fig. 2). We believe that this estimate is appropriate because of the existence of tuna canneries since the 1920s and 1930s, indicating that a substantial and consistent tuna catch must have been available since then to operate. Large boats (GRT>50) normally fish further from the islands and hence focus primarily on tuna all year round. Small and medium-sized boats with GRT of less than 50 catch tuna near the shore or close to the islands in the summer season, and in the remaining seasons they focus on bentho-demersal species.

Number of artisanal fishers

Data on the number of artisanal fishers in the Canary Islands were available by island for 1969, 1987, 1995, 1997-2002, 2005, 2008 and 2012. In 1950, the crew required to operate the same number of boats was 60% higher than in 1970, as motors had not yet been introduced and most of the boats at this time were rowboats. We interpolated data between years with missing data. The total amount of fishers has declined over time (Fig. 3), as has their relative representation in the resident population of the Canary Islands, from 1.74% of the resident population in 1950 to 0.10% by 2010.

Fisheries catch

Artisanal catch data were available for several key landing sites, starting with 1968, when data were available by island with varying levels of detail on the catch taxonomic composition (García-Cabrera 1970). Cumulatively, there were 3098 t of bentho-demersal species, 19900 t of pelagic species and 6850 t of species for which the taxonomic identification was unclear. After 1968, bentho-demersal catches were available for 1980, 1981, and 1982 from a compilation of various sources (Gafo-Fernández et al. 1984a, b, Barrera-Luján et al. 1983a). Given the rate of increase in catch from 1968 to the early 1980s, we estimated total catch of these species for all islands. According to a partial survey during eight months of 1982 (Barrera-Luján et al. 1983b, Delgado de Molina et al. 1983, La-Roche Brier et al. 1983), the catch of bentho-demersal species (including cephalopods, sharks and rays, and crustaceans) was only 893 t compared with the minimum estimate of 12995 t of catch. Even if we scale this to include the entire year, resulting in 1340 t of catch, this amount is still over seven times lower than the catch for only three of the seven islands (Fuerteventura, Gomera and Tenerife). Thus, we excluded this landing site, but we did use this information for other components of the present catch reconstruction.

Data for recent years were available from 1999 to 2004 (Canarian Government 2006). We depicted these data next to the reported data (Popescu and Ortega Gras 2013) from 2006-2010 (Table 1).

Table 1. – Unreported catches (t) from 1999 to 2004 (Canarian Government 2006) alongside reported catch from 2006 to 2010 (Popescu and Ortega Gras 2013); including all species.* MMF, miscellaneous marine fishes.

	Unreported catches						Reported data				
Species group	1999	2000	2001	2002	2003	2004	2006	2007	2008	2009	2010
Demersal	2166	1243	1372	1263	1166	1028	355	543	953	1052	621
Pelagic	6454	8821	7660	4769	7117	9152	6734	4138	7642	6544	6268
MMF*							621	922	1440	1657	1453
TOTAL	8620	10064	9032	6032	8283	10180	7710	5603	10035	9253	8342

Catch per unit effort (CPUE) of bentho-demersal species

The fishing data available before 2006 were obtained from data recorded by two fishers of Gran Canaria (from 1971 to 2009) and La Palma (from 1975 to 2012), and commercial fish transactions between all the small-scale fleet of Mogán and a wholesale fishmonger (from 1989 onward). We also reviewed documents and grey literature, from which it was possible to obtain survey-based information regarding the fleet and gears used (González et al. 1988, 1991, García-Santamaría et al. 2001, among others), as well as data on the trends in the abundance of fishing resources from changes in the CPUE.

Since about 30 different gears exist, to create a comparable CPUE time series that would be ideal for comparison, we chose to model the development of the trap gear, as traps are used extensively all year, around all islands (except in El Hierro after 1994, Fuerteventura between 2000 and 2010, and La Gomera after 2015). The use of other gears, i.e. longline and gillnets, is only permitted during certain periods and in specific areas of the islands. Therefore, trap CPUE is a more homogenous index of changes in fish abundance.

From fishing research surveys (Barrera-Luján et al. 1982, 1983b, Pérez-Artiles et al. 1987, Caldentey-Morales et al. 1988, among others), the CPUE for fish traps targeting demersal species can be grouped into four well-defined periods: (i) a period of high abundance in the 1950s and early 1960s; (ii) a period of relatively lower CPUE in the late 1960s, according to García-Cabrera (1970), who indicated that fishing grounds shallower than 100 m depth were already overfished; (iii) a period of intermediate-low abundance during the 1980s; and (iv) a period of low abundance from the late 1990s to the present day. Such data enabled us to partially rebuild the temporal changes in CPUE over the time period from 1950 to 2010 (Fig. 4). Prior to 1969, we assumed that CPUE increased at half the rate after the late 1970s. A progressive 93.3% decrease in CPUE values has been observed over 60 years (1950-2010).

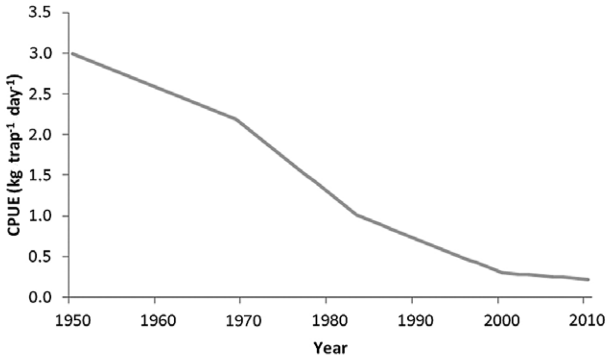

Fig. 4. – Catch per unit effort (CPUE) in kg trap^{-1} day^{-1} of the demersal artisanal trap fishery in the Canary Islands, 1950-2010.

Estimation of artisanal catch

Using the above-mentioned data, we estimated catch based on their broad taxonomic classifications, i.e. bentho-demersal species, tuna and tuna-like species, and other pelagic species.

Bentho-demersal species

Of the 30 different gears used to target bentho-demersal species, the most common gear is the pot, or trap gear, which is used by 94% of the vessels (Popescu and Ortega Gras 2013) and corresponds to *ca*. 50% of bentho-demersal catches. As described previously, we derived the evolution of CPUE data on the trap gear, which provides the most homogenous index of catch over time. There are insufficient data on the other gears to estimate catch, so we first reconstructed catch for the trap gear and then scaled it for other catch. We also compared our final estimate to the landing sites cited for bentho-demersal species.

Therefore, we used the data on the number of boats (Fig. 2) and the CPUE of the trap fishery (Fig. 4) in Gran Canaria to build a temporal representation of catch. We assumed that the CPUE of Gran Canaria was representative of all seven islands of the archipelago and that the average number of fishing days per boat was 250 days in a year, which is conservative given the year-round nature of fishing operations (Melnychuk et al. 2001) due to favourable sea conditions almost all year round in the leeward areas.

Also, effort was adjusted to reflect the number of traps set per day and other factors that influenced effort. CPUE declined by about 54% between 1969 and 1983, coinciding with an increase in the fishing capacity of the fleet. During this period, the fishing capacity of an "average" boat was multiplied by almost ten. Between 1981 and 1983, this increase in fishing capacity was associated with a large increase in catches, particularly in the leeward zones of the largest islands. Given this information, we adjusted the effort to represent the number of traps set per day per boat, assuming that from 1950 until 1969 fishers set six traps per day, interpolated to 45 traps in 1983, after which this value remained constant.

Finally, we multiplied each fleet sector (regular artisanal boats or smaller bait boats) by the number of traps set per day, CPUE and the number of days fished. This resulted in an estimate of total trap catch, as shown in

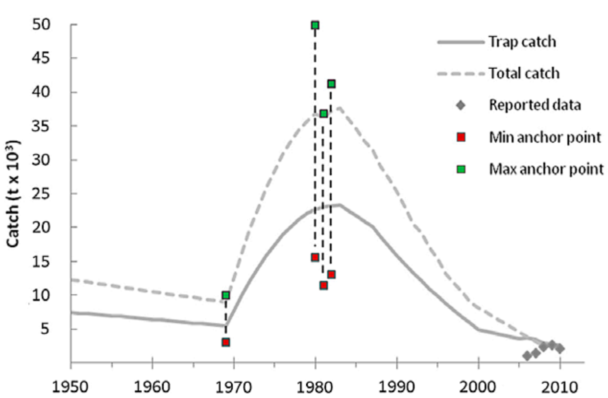

Fig. 5. – Estimated catch of demersal species form the trap fishery plotted against various landing sites, 1950-2010.

Figure 5. Then we extended this estimate of trap catch of bentho-demersal species to catch from all gears based on survey data from 1982, whereby trap catch accounted for 47.7% of total catch. The 1982 survey carried out along the archipelago was done separately for the eastern islands, i.e. Lanzarote, Fuerteventura, and Gran Canaria (Barrera-Luján et al. 1983b), and the western islands, i.e. Tenerife, Gomera, Hierro, and La Palma (La-Roche Brier et al. 1983). La-Roche Brier et al. (1983) stated that trap catch represents 17% of the demersal catches, but this assumption would result in catches as high as 100000 t year^{-1} of bentho-demersal species from 1982-1985, which is not realistic given that the western islands are less productive than the eastern ones. Hence, we used data from the eastern islands, where trap catch accounted for 47.7% of overall catch.

We assumed that the trend line was representative until the early 1990s, as we do not have enough data points for the later time period on the number of traps set per day, and it is possible that this trend changed by the 2000s. Hence, we interpolated our estimates in the 1990s to 2008, which is considered to be more reliable than the reported 2006 and 2007 catches (Popescu and Ortega Gras 2013, Santamaría et al. 2013). Thereafter, the estimated catch of bentho-demersal species by the artisanal fleet was equivalent to reported 2009 and 2010 catches.

After scaling, total catches were plotted against the landing site of catch. Our estimate fell within the minimum and maximum range of landing sites for 1968 and 1980 to 1982. In 1968, our estimate suggests that 88% of the catch not taxonomically classified was considered bentho-demersal catch. The remaining 12% of catch was classified as catch of various pelagic species.

Pelagic species

Landing sites for pelagic species were available for 1968, 1982 and from 2000 to 2010. Given that we assumed that 12% of taxonomically unclassified catch in 1968 was of pelagic species, total pelagic catch in 1968 was approximately 25100 t. Data specifically for tuna and tuna-like species were available from 1962-2010.

Tuna and tuna-like species

Data on tuna catch were collected by the Spanish Oceanography Institute (IEO) and reported to the ICCAT between 1970 and 2010 (Fig. 6). Prior to this, data on tuna catches were not reported, yet given the longstanding history of tuna fishing and indications from other sources (e.g. García-Cabrera 1970), it can be concluded that a substantial tuna fishery existed. Therefore, we reconstructed catch for the period 1950 to 1969 from various sources.

Catches reported by ICCAT for the bait boat tuna fishery from 1962 to 1969 were quite low, and since data by García-Cabrera (1970) indicate catches in 1968 at least three times as high (and at most nine times as high), we believe they are underestimated significantly. Additionally, while there was an upward trend in catches from 98 t in 1962 to 3298 t in 1969, we did not believe this trend was representative, as this simply represented an increase in reporting capacity rather than any significant changes in tuna fishery. Nonetheless, we utilized the ICCAT data to generally understand the relative change of catch from year to year while using the magnitude suggested by the 1968 data point as well as IEO data from the early 1970s.

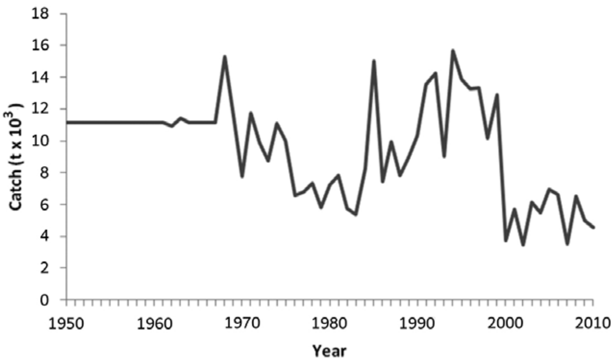

Fig. 6. – Tuna catch by the artisanal bait boat fleet in the Canary Islands, 1950-2010.

For 1968, high tuna catches were reported. In La Gomera most of the 11000 t of catch was tuna, so we assumed 90%, resulting in 9900 t. In Tenerife, 10000 t of catch were reported to be large- and medium-sized pelagic fish. Without a clear indication we simplistically assumed 50% was large pelagic species (tunas) and the rest were other pelagic species. Catches from La Palma, Gran Canaria and Lanzarote totalled 6850 t, with no indication as to what species were caught. While most of them was assumed to be bentho-demersal species, the remaining 822 t of catch were pelagic species and we again assumed a 50% split between tuna-like and other pelagic species. This resulted in an estimate of 15311 t of tuna catch in 1968.

Prior to 1968 we assumed that catch was approximately the same as the average catch from 1968 and 1970-1972, as effort in terms of the number of boats was constant for this time period. Hence, from 1950-1961 we assumed catches averaged the catch of 1968, 1970, 1971 and 1972. Starting in 1961, there are data on catch at 98 t, increasing to 491 t in 1963 and declining to 144 t in 1964. Finally, we maintained catch at the average used for the 1950-1961 and the 1965-1967 periods. For 1969 an average was taken between the 1968 and 1970 data.

Bait for pelagic catch

Pole and line fishing requires a substantial amount of bait to lure tuna and tuna-like species. The most common species used for bait are the Atlantic chub mackerel (*Scomber colias*), followed by the European pilchard (*Sardina pilchardus*). Other common species used as bait were bogue (*Boops boops*), longspine spinefish (*Macroramphosus scolopax*), European anchovy (*Engraulis encrasicolus*), sand smelt (*Atherina presbyter*), jack and horse mackerels (*Trachurus* spp.) and sardinellas (*Sardinella* spp.) (Canarian Government 2006, Herrera-Perdomo 2017).

Logbook data from the IEO suggest that a medium- to large-sized bait boat uses about 2300 to 2500 kg of live bait per month, or on average 28.8 t per year. Since bait boats range from 1 to 200 GRT, we assumed that medium to large bait boats were boats of more than 50 GRT and that small bait boats were those of less than 50 GRT. Herrera-Perdomo (2017) estimated that 626.4 t of live bait was used by the tuna fleet during the period 2014 to 2016. We made the conservative assumption that bait boats of less than 50 GRT used half the amount of bait used by medium to large boats, averaging 14.4 t of bait annually.

Pelagic species, excluding tunas

Landing sites of catch of pelagic species were available for 1968, 1982 and from 2000 to 2010. We excluded using the landing site for 1982, which reported an overall catch of 4644.6 t of pelagic species (less tuna) in 8 months, due to the severe underestimation of bentho-demersal species compared with other data. Likewise, we excluded the data from 1999-2004 (Canarian Government 2006), which also included captures in the African fishing grounds. Thus, we interpolated the catch between the 1968 landing site of 5411 t and the 2008 landing site of 1222 t, thereafter following the trend of official reported data (Fig. 7).

Unregulated catch

As the number of artisanal boats began to decline, due in part to the national regulations, this gave way to a rise in unregulated fishing activities by those who officially leave the fishing industry. For example, in Valle Gran Rey (La Gomera) in the 1990s, the number of legally licensed fishing boats dropped by more than 50%, which "led to a rise in part-time and non-legal fishing activities by some fishers who left the activity professionally, but continue to fish and sell their catches through different channels" (Pascual 2004). This trend was and remains true for all the islands (Castro and Santana-Ortega 2008). Retired fishers occasionally fish "recreationally", and then sell their catches to restaurants and local fishmongers as a way to supplement their low retirement pension (Castro and Santana-Ortega 2008). Nonetheless, considering all ports and islands, this proportion is significantly low (*ca.* <10%). This trend has increased over time (Pascual-Fernandez and de la Cruz Modino 2011), which is logical as the number of artisanal boats and fishers has steadily declined.

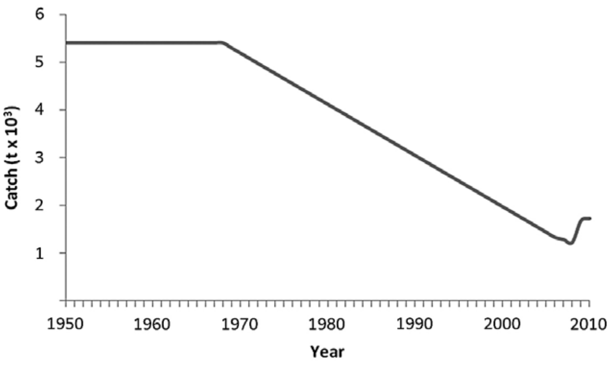

Fig. 7. – Pelagic catch (except tuna and tuna-like species) of the artisanal fleet in the Canary Islands, 1950-2010.

Hence, after the number of boats began to decline in 1989, we assumed that a certain proportion continued to stay active in fishing, averaging approximately 10% of retired artisanal boats. Of the 10% of boats still in operation, we assumed that retired artisanal fishers only used them for fishing a sixth of the level of artisanal fishers. We assumed that they have the same catch composition as other artisanal fishers, excluding those targeting other pelagic fish.

Population

Data on resident and non-resident populations were useful in estimating non-commercial fishery catch for the subsistence and recreational sectors. Data on resident population were obtained from the Canarian Government (2004) for 1940, 1960 and 1981. For all other years the population figures were interpolated between the nearest landing sites. Data on the tourist population were available from 1990 to 2010 (http://www.gobiernodecanarias.org/istac/). The expansion of tourism dates back to the 1960s and steadily increased up until the 1990s (Pascual 2004).

Recreational catch

Recreational catch was calculated by creating a time series of the number of active anglers and multiplying it by an appropriate variable catch rate per fisher.

Number of active anglers

A total of 16247 fishing licences, i.e. private individuals and charter boat captains, were issued in 2005, each one valid for three years (MAPyA 2006). This means that in 2005 the number of active anglers was approximately three time the number of professional fishing licences issued, *ca.* 49000 active anglers. In 2007, the number of valid fishing licences grew to approximately 60000, then to 100000 in 2009 (Pascual-Fernandez and de la Cruz Modino 2011), and peaked at 110000 in 2011 (MAGRAMA 2013). Recently, around 90000 licences have been active yearly (http://www.gobcan.es).

Additionally, Jiménez-Alvarado (2016) reported that approximately 10% of individual anglers fish without licences, which is equivalent to unreported fishing licences at 11.1% of reported ones. Ultimately, we created separate time series for recreational anglers and charter vessels, which would have different catch rates because charter vessels take many passengers at a time and fish all year round.

Of the recreational fishing boats registered in the Canary Islands in 2005, MAPyA (2006) indicated that 827 were under the "sixth list", or recreational vessels which are for-profit, and 22619 vessels were for personal recreational fishing ("seventh list"). Hence, we assumed that of the 48741 active anglers in 2005, 827 were charter licences for taking tourists, and the rest were generally for residents.

We extended this division over time by creating a proxy variable: the number of charter licences divided by the tourist population, which in 2005 was 0.009%. We assumed that this ratio would be 0% from 1950 to 1959 when tourism had not yet expanded, interpolated to 0.009% in 2005 and then continued the linear trend to 2010. This time series of the proxy ratio was multiplied by the tourist population from 1950 to 2010 to obtain an estimated time series of the number of charter boats in operation.

Since we have data on the total number of active licences from 2005 to 2010, we subtracted the number of charter licences to obtain the number of recreational licences. For the years prior to 2005, we utilized a similar strategy as that for charter licences, obtaining a ratio of resident licences in 2005 to resident population in 2005 at 2.7%. Since 1950 to 1959 was a time of food shortage (Palmero 2001), indicating that subsistence fishing was more likely than recreational fishing among residents, we interpolated between 0% from 1950-1959 to the 2005 value. Also, the development of the touristic industry in the 1960s facilitated a better economic position for the local population and, thus, investment in recreational fishing equipment. This ratio from 1950 to 2004 was multiplied by the resident population to generate a complete time series of reported licences. Finally, we adjusted this time series to account for the 10% of recreational anglers fish without a fishing licences by multiplying the reported resident licences (not charter) by 11.1%.

From comparing boat capacity on recreational charters, it appears that on average, each charter takes between 3 and 4 people at a time. We assumed a very conservative number of trips at two per year per charter, resulting in each charter licence accommodating the equivalent of seven private licence holders. It is likely that fishing is far more common among charters, who fish the whole year, but we assume this conservative estimate.

Catch rate per angler

From interviews with anglers, MAPyA (2006) reported a catch rate of 0.085 t fisher^{-1} trip^{-1} when fishing from a boat and 0.0085 t fisher^{-1} trip^{-1} when fishing from the shore. We weighted these rates by the number of fishers in each category to obtain one representative rate of 0.0099 t fisher^{-1} trip^{-1}. Furthermore, the average number of trips taken was 43 trips annually (MAPyA 2006), so we adjusted this rate to obtain a total catch rate of 0.425 t fisher^{-1} trip^{-1} in 2005.

While this catch rate is appropriate for 2005, we varied catch rates over time using some simple assumptions about changes in the CPUE and technological improvements. These changes came first for artisanal fishers and then recreational fishers, and we assumed a five-year lag. Throughout the 1970s, most of the artisanal fleet became equipped with onboard engines and hydraulic fishing winches, and in the 1980s and 1990s

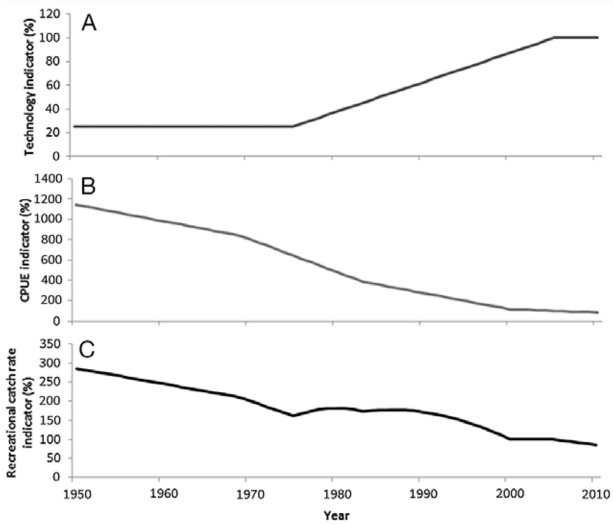

Fig. 8. – Data from recreational fisheries in the Canary Islands, showing the technological creep (A); the CPUE indicator (B); and the cumulative indicator for 1950-2010 (C). The base year is 2005 with 100%.

other technological improvements such as radio, GPS, synthetic nets and echo sounders were also incorporated. We assumed a constant level of technology until 1975, thereafter increasing to 100% in 2005, and then remaining constant (Fig. 8A). CPUE was modelled in Figure 8B, where the 2005 value was also normalized to 100%. The merging of the two trends created a variable trend line of the catch rate before and after the 2005 catch rate (Fig. 8C).

The time series of catch rate was adjusted accordingly, and this time series was multiplied by the total amount of recreational anglers, counting seven anglers per charter licence to obtain the entire time series of recreational catches. For the species composition, we used the percentage of fishers who target certain species as a representative sample of catch (MAPyA 2006).

Discards

Few studies of discards at sea have been undertaken. This issue is complicated by the fact that the artisanal fishers use about 30 different gears targeting over 200 species (Santamaría et al. 2013). One of the few discard studies undertaken dealt with the artisanal shrimp trap fishery (Arrasate-López et al. 2012), which has been a traditional fishery of the Canary Islands since the late 1980s (FAO CECAF-SC 2011), though catches are scarce. Many other trap fisheries, especially for finfish and coastal morays (FAO CECAF-SC 2011, Santamaría et al. 2013), can be used as a representative study on discards for bentho-demersal species (Popescu and Ortega Gras 2013). According to Kelleher (2005), among other sources, the bait boat fishery targeting tuna is highly selective, so we assumed discards were zero. For other pelagic species, no studies were undertaken, but in the 1990s Castro (pers. obs.) observed a discard rate of more than 50% of bogue (*B. boops*). We conservatively assumed an average discard rate of 25% for the entire time period for all species.

Table 2. – Species discarded in the artisanal fisheries targeting demersal species (1950-2010).

Species name	Common name	Percentage of discards (%) 1950-1979	1980-2010
Tetraodontidae	Puffers	9	10
Canthigaster rostrata	Caribbean sharpnose-puffer	9	10
Canthigaster capistrata	Macaronesian sharpnose-puffer	9	10
Sphoeroides marmoratus	Guinean puffer	9	10
Synodus	Lizardfishes	9	10
Pomacentridae	Damselfishes	9	10
Chromis limbata	Azores chromis	9	10
Abudefduf luridus	Canary damsel	9	10
Echinoidea	Sea urchins	3	3
Holothuroidea	Sea cucumbers	3	3
Miscellaneous aquatic invertebrates	Aquatic invertebrates	3	3
Dasyatis spp.	Stingrays	2	3
Myliobatis aquila	Common eagle ray	2	3
Taeniura grabata	Round stingray	2	3
Squatina squatina	Angelshark	2	3
Stephanolepis hispidus	Planehead filefish	9	0

For the bentho-demersal fishery, we used the species composition from Saavedra (2011), assigning certain percentages based on the qualitative description used (Table 2). For the purse seine fisheries, we estimated that the bogue (*B. boops*) accounted for 90% of the species discarded and the Madeiran sardinella (*Sardinella maderensis*) for 10%.

RESULTS

Reconstructed total catch

Reconstructed total catch increased from approximately 38600 t in 1950 to 81200 t in 1985, before declining to about 43700 t year^{-1} in the early-2000s and then rebounding to 65300 t year^{-1} by the late-2000s (Fig. 9A). For 2006-2010, reconstructed catch was seven times higher than the reported catch. For the entire time period, artisanal catch comprised 66% of total catch, recreational catch 26%, discards 6%, and subsistence catch 2%. This composition is not representative for the 2000s, however, when artisanal catch declined to 26% of catch, discards to 4% and subsistence catch to 0.4%, and recreational catch increased to 40% to 70% of catch depending on the island.

Approximately 21% of the catch was composed of various sparid species (Fig. 9B), mainly the Moroccan white seabream (*Diplodus sargus cadenati*), red porgy (*Pagrus pagrus*), gold line, (*Sarpa salpa*), black seabream (*Spondyliosoma cantharus*) and ten other species that contributed a smaller portion of the total catch. The two most dominant species, which each contributed 10% to total catch, were the parrotfish (*Sparisoma cretense*) and the Atlantic chub mackerel (*S. colias*; Fig. 9B). Among tuna species, bigeye tuna (*Thunnus obesus*) (8% of total catch) and skipjack tuna (*Katsuwonus pelamis*) (6%) were the most common. Besides the 18 abovementioned species, 37% of the remaining catch was a mixture of 94 species (Fig. 9B).

DISCUSSION

Fishing in the Canary Islands is performed by a large, polyvalent, multi-gear small-scale fleet, alternating the exploitation of different fish resources in a similar way to other European small-scale fisheries (Maynou et al. 2011, 2013, Guyader et al. 2013). Most of the approximately 54000 t year^{-1} of reconstructed catch until the start of the 21st century was taken by this artisanal fishery, including its bait catch and discards, while the remaining 28% was from informal sectors such as recreational and subsistence fishing. Recreational fishing has generally been a larger proportion of catch than subsistence fishing, which has a small catch but is nonetheless culturally significant.

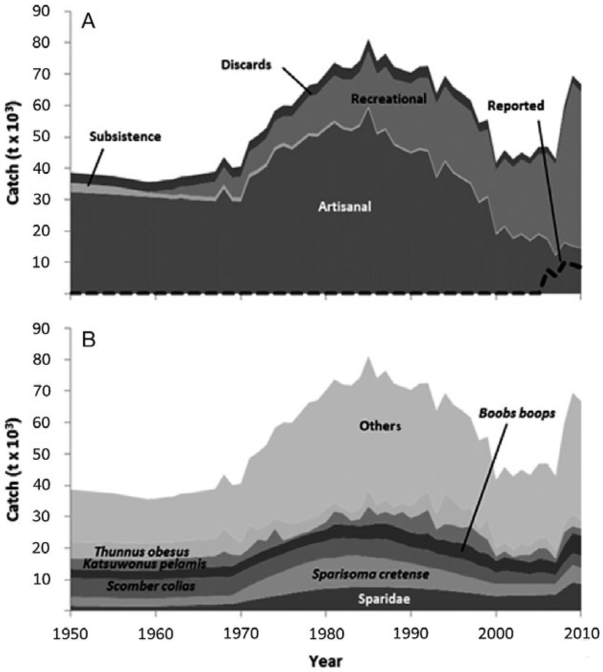

Fig. 9. – Reconstructed total catch for the Canary Islands (1950-2010), by sector (A), with official reported data overlaid as line graph; and major taxa (B), with "Others" consisting of over 90 additional taxa (see Appendix 1).

In the 1970s, the Canarian fishing fleet started to reorient to tuna exploitation (García-Cabrera 1970), particularly in the Canary-Saharan Bank fishing grounds (Balguerías 1995), as part of the future development strategy for fishing from the islands, and to design a fishing industry based on the manufacturing and processing of these species. However, this expansionist policy was incorrectly applied to the islands. This fact, in addition to the subsequent loss of the Western Sahara fishing grounds (Pérez-Labajos et al. 1996, Guénette et al. 2001) and the disappearance of the processing industry (Bas et al. 1995) contributed to the exhaustion of bentho-demersal fishery resources of the archipelago, while the small-scale fleet, the recreational fleet and onshore infrastructures expanded, resulting in fishing overcapacity. This can be clearly seen in the present catch reconstruction, in which the catch of this artisanal fleet increased in the 1970s, reaching over 59000 t in 1985 before declining four-fold by 2010.

Target species have largely shown signs of overfishing (García-Cabrera 1970, González 2008), and this fact has still not motivated a significant change in management strategies. The management policy of this fishery has been based primarily on regulations of fishing effort and technical measures for both professional and recreational fishers. However, this policy failed to reduce overcapacity (ECOA 2011) and overfishing. On the contrary, it has led to the reduction of the available biomass of demersal stocks by approximately 93% over the entire 60-year period (1950-2010).

Paradoxically, onshore infrastructures were developed to assist the artisanal and recreational fishing fleets along the entire archipelago, as secondary ports, producing a significant increase in the fishing capacity and effort. Thus, the progressive investment in the construction and improvement of secondary ports, incorporating frozen systems, storing, cranes, naval repair, supplies, etc., has allowed artisanal boats to have easier access to fishing grounds and operate with fewer crew members, a fact that also increased fishing effort, and after its decline has facilitated the growth of the recreational fleet by providing assistance.

While in the second half of the 20th century most catch was taken by the artisanal fleet, by the late 2000s this dynamic shifted from a large increase in recreational fishing, which comprised nearly 70% of total catch and averaged about 40000 t year^{-1}. This large amount also explains why, from 2006 to 2010, when data were assumedly reported, total reconstructed catch was nearly seven times the reported FAO catch. This is problematic for the fishery since there is still no management plan to control recreational catch. Likewise, the number of recreational anglers grew by 230% from 2005 to 2010, while the number of professional fishers decreased by 49% in the same period. Additionally, there is an increasing trend in recent years of recreational fishers poaching and selling their catches illegally (Pascual-Fernandez and de la Cruz Modino 2011).

Finally, there is no management plan for the bait boat fishery of the Canary Islands, as in many other countries with such fisheries (Gillett 2012). This is compounded by the fact that baitfish demand and catches have declined substantially in recent decades, so there is even less reason to manage the fishery than before (Gillett 2012). This is the first report that estimated the catch of baitfish (ca. 5000 t year^{-1}), while the food fishery has averaged only 4,000 t year^{-1}, with catches drastically declining by the 2000s. Additionally, bait catches of sand smelt (*Atherina presbyter*) are permitted but not for catch in the commercial fishery for food, which leaves some discrepancies (Gillett 2012).

From 1950 to 2010, many changes in fishery have taken place on the islands. With the introduction of new technologies, such as GPS and eco sound, "small-scale fishers no longer have the same capacities to control their territories", as recreational fishing boats can simply pass by artisanal fishing boats while they fish, and "store" their GPS coordinates (Pascual-Fernandez and de la Cruz Modino 2011). Additionally, young people are no longer attracted to the fishing industry, and the prestige associated with being a good fisher has diminished. As the artisanal fleet declines, several economic alternatives have sprouted for fishing households, namely investment in fresh fish restaurants or renting their houses and apartments for complementary incomes (Pascual-Fernandez and de la Cruz Modino 2011). Such viable alternative livelihood options complement artisanal fishing and are particularly important for tourism, especially domestic tourism. The artisanal fishers are adapting, but with the rapid increase in recreational fishing the question is whether management policy will adapt as well, or continue to overlook the fishery problems.

ACKNOWLEDGEMENTS

We acknowledge the support of the *Sea Around Us*, supported by The Pew Charitable Trusts and the Paul G. Allen Family Foundation. We also acknowledge all the research by the ULPGC staff, supported by Canary Islands CIE: Tricontinental Atlantic Campus. Finally, we would like to thank Sebastian Villasante for his input in the present work, and Stuart Jones for revising the English language. Two anonymous referees and Dr. Paolo Sartor are acknowledged for their insightful comments on an earlier version of the manuscript.

REFERENCES

Arrasate-López M., Tuset V.M., Santana J., et al. 2012. Fishing methods for sustainable shrimp fisheries in the Canary Islands (North-West Africa). Afr. J. Mar. Sci. 34: 331-339. https://doi.org/10.2989/1814232X.2012.725281

Balguerías E. 1995. Fish of the Canary Islands on the Saharan Bank: Historical precedents and accounts. The black seabream, *Spondyliosoma cantharus* (Linnaeus, 1758), and methods of stock assessment by the Canarian artisanal fleet. Publ. Inst. Esp. Oceanogr. 6: 1-357.

Barrera-Luján A., Carrillo-Molina J., Castillo-Enguía R., et al. 1982. Estudio preliminar de la pesquería artesanal canaria. Cabildo Insular de Gran Canaria. 151 pp.

Barrera-Luján A., Bordes-Caballero F., Castillo-Enguía R., et al. 1983a. Evaluacion de recursos pesqueros en la Provincia de las Palmas. Doc. Técn. III, Gobierno de Canarias, Fuerteventura.

Barrera-Luján A., Carrillo-Molina J., Castillo-Enguía R., et al. 1983b. Evaluación de los recursos pesqueros de la provincia de Las Palmas. Doc. Técn. I, II, IV, Gobierno de Canarias. 534 pp.

Bas C., Castro J., Hernandez-García V., et al. 1995. La Pesca en Canarias y áreas de influencia. Ediciones del Cabildo Insular de Gran Canaria, Las Palmas de Gran Canaria. 331 pp.

Caldentey-Morales M.A., Lozano-Soldevilla I.J., Jiménez-Navarro S., et al. 1988. Resultados de la campaña de prospección pesquera MOGAN 8802. Informes Técnicos del Departamento de Biología Animal (Ciencias Marinas) de la Universidad de La Laguna, 103 pp.

Canarian Government. 2004. Anuario Estadístico de Canarias, Instituto Canario de Estadística, Annual Report, 440 pp.
Canarian Government. 2006. Documentación para la elaboración del Plan Estratégico Nacional. Viceconsejeria de Pesca (Deputy Ministry of Fisheries).
Castro J.J., Santana-Ortega A.T. 2008. Memoria relativa a la evaluación de la actividad pesquera desarrollada en el Estrecho de la Bocaina, entre las islas de Lanzarote y Fuerteventura. In: Haroun-Tabraue R (ed.) Estudio de viabilidad de una reserva marina de interés pesquero en el entorno de la Isla de Lobos (Noreste de Fuerteventura). Consejería de Agricultura, Pesca y Alimentación. Gobierno de Canarias.
Csirke B. 1989. Introducción a la dinámica de poblaciones de peces. FAO, Rome.
Delgado de Molina A., García-Santamaría M., Rodríguez-Rodríguez E., et al. 1983. Plan regional de evaluación de recursos. Pelágicos Costeros II, Junta de Gobierno de Canarias (Consejería de Agricultura y Pesca) e Instituto Español de Oceanografía (Centro Costero de Canarias), Provincia de Santa Cruz de Tenerife.
Delgado de Molina A., Delgado de Molina R., Santana J., et al. 2012. Datos estadísticos de la pesquería de túnidos de las Islas Canarias durante el periodo 1975 a 2010. Collect. Vol. Sci. Pap. ICCAT 63: 10.
European Court of Auditors (ECOA). 2011. Have EU measures contributed to adapting the capacity of the fishing fleets to available fishing opportunities? European Court of Auditors (ECOA), Luxembourg.
FAO CECAF-SC. 2011. Spain artisanal trap finfish fishery - Canary Islands waters, 2011. CECAF Fisheries Reports 2011, FAO CECAF Scientific Committee (FAO CECAF- SC), Rome. 26 June 2014.
Gafo-Fernández J., Smith-Agreda C., Lagarejos-García M., et al. 1984a. Situación y necesidades de infraestructura pesquera en el Archipiélago Canario. Tomo II. Departamento de Planificación de CEPSA. Consejería de Agricultura y Pesca. Gobierno de Canarias: 293-597.
Gafo-Fernández J., Smith-Agreda C., Lagarejos-García M., et al. 1984b. Situación y necesidades de infraestructura pesquera en el Archipiélago Canario. Tomo I. Departamento de Planificación de CEPSA. Consejería de Agricultura y Pesca. Gobierno de Canarias, 292 pp.
García-Cabrera C. 1970. La pesca en Canarias y Banco Sahariano. Consejo Económico Interprovincial de Canarias, 232 pp.
García-Santamaría M.T., Balguerías E., González J.F., et al. 2001. A pilot study for estimation of data from local fisheries in Tenerife (Canary Islands). Study Contract 00/022, European Commision.
Gillett R. 2012. The management of tuna baitfisheries: the results of a global study. 2012 ISSF Workshop.
González J.A. 2008. Memoria científico-técnica final sobre el Estado de los Recursos Pesqueros de Canarias (REPESCAN). Instituto Canario de Ciencias Marinas, Agencia Canaria de Investigación, Innovación y Sociedad de la Información, Gobierno de Canarias, Telde (Las Palmas), 210 pp.
González J.A., Caldentey J.A., Lozano I.J., et al. 1988. Resultados de la campaña de prospección pesquera MOGAN 8710. Informes Técnicos del Departamento de Biología Animal (Ciencias Marinas) de la Universidad de La Laguna, 100 pp.
González J., Santana J., Carrillo J. 1991. La pesca en el puerto de Mogán (Islas Canarias): flota, artes y análisis de las capturas entre 1980 y 1990. Informe Técnico del Centro de Tecnología Pesquera (Pesquerías), Telde, Las Palmas.
Guénette S., Balguerías E., Santamaría M.T.G. 2001. Spanish fishing activities along the Saharan and Moroccan coasts. In: Zeller D., Watson R., Pauly D. (eds), Fisheries Impacts on North Atlantic Ecosystems: Catch, Effort, and National/Regional Data Sets. Part III: South-eastern North Atlantic. Fisheries Centre Research Reports0, pp. 206-213.
Guyader O., Berthou P., Koutsikopoulos C., et al. 2013. Small scale fisheries in Europe: A comparative analysis based on a selection of case studies. Fish. Res. 140: 1-13. https://doi.org/10.1016/j.fishres.2012.11.008
Hernández-García V., Hernández-López J., Castro J. 1998. The octopus (*Octopus vulgaris*) in the small-scale trap fishery off the Canary Islands (Central-East Atlantic). Fish. Res. 35: 183-189. https://doi.org/10.1016/S0165-7836(98)00080-0
Herrera-Perdomo J. 2017. Caracterización del cebo vivo utilizado e impacto sobre el mismo en la pesquería de túnidos en Canarias. MS-Thesis, Universidad de Las Palmas de Gran Canaria, 77 pp.
Jiménez-Alvarado D. 2016. Pesca recreativa en Canarias: aspectos principales y evolución. PhD Thesis, Universidad de Las Palmas de Gran Canaria.
Kelleher K. 2005. Discards in the world's marine fisheries, an update. FAO, Rome.
La-Roche Brier M., Franquet Santaella F., Quintero Pérez M.E. 1983. Demersales. Plan regional de evaluación de recursos pesqueros. Provincia de Santa Cruz de Tenerife. 3, Junta de Canarias: Instituto Español de Oceanografia, Centro de Costero de Canarias, Santa Cruz de Tenerife, 114 pp.
Lleonart J. 1994. Methods to analyse the dynamics of exploited marine populations: use and development of model. Sci. Mar. 57: 261-267.
Maynou F., Recasens L., Lombarte A. 2011. Fishing tactics dynamics of a Mediterranean small-scale coastal fishery. Aquat. Liv. Res. 24: 149-159. https://doi.org/10.1051/alr/2011131
Maynou F., Morales-Nin B., Cabanellas-Reboredo M., et al. 2013. Small-scale fishery in the Balearic Islands (W Mediterranean): A socio-economic approach. Fish. Res. 139: 11-17. https://doi.org/10.1016/j.fishres.2012.11.006
Melnychuk M., Guénette S., Martín-Sosa P., et al. 2001. Fisheries in the Canary Islands, Spain. In: Zeller D, Watson R., Pauly D. (eds), Fisheries Impacts on North Atlantic Ecosystems: Catch, Effort, and National/Regional Data Sets. Fish. Cent. Res. Rep. 9: 221-224.
Ministerio de Agricultura, Alimentación y Medio Ambiente (MAGRAMA). 2013. Estadísticas pesqueras: Flota pesquera de pesca marítima. Ministerio de Agricultura, Alimentación y Medio Ambiente (MAGRAMA). Accessed: August 2014. Available at: https://www.mapa.gob.es/images/es/Estadisticas_Pesqueras_2013-11_tcm30-128531.PDF
Ministerio de Agricultura, Pesca y Alimentación (MAPyA). 2006. Análisis y ordenación de la pesca de recreo en el ámbito de las Islas Canarias. Ministerio de Agricultura, Pesca y Alimentación (MAPyA), Secretaría General de Pesca Marítima. 124 pp. Accessed: July 2014. Available at: https://www.mapa.gob.es/es/pesca/temas/pesca-deportiva-recreo/Analisis_tcm30-77485.pdf
Palmero R.A.G. 2001. El mercado negro en Canarias durante el periodo del Mando Económico: una primera aproximación. Rev. Hist. Can. 183: 175-189.
Pascual J.J. 2004. Littoral fishermen, aquaculture and tourism in the Canary Islands: Attitudes and economic strategies. In: Boissevain J., Selwyn T. (eds), Contesting the foreshore: Tourism, society and politics on the coast. Amsterdam University Press, Amsterdam, pp. 61-82.
Pascual-Fernandez J.J., de la Cruz Modino R. 2011. Conflicting gears, contested territories: MPAs as a solution? In: Chuenpagdee R. (ed.) World small-scale fisheries contemporary visions. Eburon Academic Publishers, Delft. pp. 205-220.
Pérez-Artiles F., Barrera-Lujan A., Gómez-Bethencourt J.A., et al. 1987. Recogida de datos de estadística pesquera de la flota artesanal. Cabildo Insular de Gran Canaria.
Pérez-Labajos C.A., Blanco-Rojo B., Mazas-Arranz R. 1996. The Canary Islands fishing policy. Mar. Pol. 20: 463-474. https://doi.org/10.1016/S0308-597X(96)00037-1
Popescu I., Ortega Gras J.J. 2013. Fisheries in the Canary Islands. Fisheries, European Parliament.
Saavedra J.M. 2011. Analysis of the state of fishery resources from Gran Canaria study of the historical catch series. Master in Sustainable Management of Fisheries Resources thesis, University of Las Palmas de Gran Canaria, 39 pp.
Santamaría M., Jiménez S., Gonzáles J. 2013. Artisanal Fisheries in the Canary Islands:Tenerife. GEPETO.
Sparre P., Venema S.C. 1998. Introduction to tropical fish stock assessment - Part 1: Manual. Food and Agriculture Organization of the United Nations (FAO), Rome.

APPENDIX

Appendix 1. – Total reported and reconstructed catch (t) for the Canary Islands by sector, 1950-2010.

Year	Reported catch	Total reconstructed catch	Artisanal	Subsistence	Recreational	Discards
1950		38630.0	32531	2835		3263
1951		38403.5	32354	2789		3260
1952		38175.1	32178	2741		3257
1953		37944.9	32001	2691		3253
1954		37713.1	31825	2639		3250
1955		37479.6	31648	2585		3246
1956		37026.6	31472	2312		3243
1957		36569.2	31296	2,034		3240
1958		36107.8	31120	1752		3236
1959		35642.6	30944	1466		3233
1960		35769.6	30768	1176	596	3229
1961		36206.6	30592	1189	1200	3226
1962		36405.4	30172	1201	1810	3223
1963		37342.2	30485	1212	2425	3219
1964		37549.5	30066	1223	3045	3216
1965		38003.2	29890	1234	3666	3212
1966		38457.6	29715	1244	4289	3209
1967		38911.4	29540	1254	4912	3206
1968		43511.6	33513	1264	5533	3202
1969		40122.1	29533	1273	6150	3166
1970		40573.8	29493	1225	6631	3224
1971		48584.4	37052	1178	7076	3278
1972		50479.5	38537	1132	7483	3327
1973		52840.9	40534	1086	7849	3372
1974		58318.0	45694	1042	8172	3411
1975		60022.7	47133	997	8448	3445
1976		59909.8	45941	954	9542	3473
1977		63158.6	48133	911	10619	3495
1978		66374.3	50334	869	11660	3,511
1979		67073.0	50080	828	12645	3520
1980		70275.7	52413	787	13552	3523
1981		73664.8	54400	748	14358	4159
1982		72112.7	52498	708	15019	3887
1983		71830.6	51931	670	15531	3699
1984		74300.7	53389	632	16597	3683
1985		81205.7	59124	595	17622	3865
1986		74105.8	50795	559	18596	4156
1987		76499.4	52240	523	19504	4232
1988		72386.5	47435	522	20336	4094
1989		71391.3	45995	522	21076	3799
1990		70447.9	44713	521	21712	3502
1991		72394.4	45915	520	22394	3566
1992		72579.6	45296	519	22872	3893
1993		63795.7	36835	517	23220	3223
1994		69422.2	41981	516	23553	3372
1995		65712.6	38367	514	23506	3326
1996		63870.5	36625	523	23142	3581
1997		61638.1	34951	531	22672	3484
1998		54415.0	28913	494	22088	2919
1999		55437.5	30733	477	21118	3110
2000		41747.4	18836	441	20037	2434
2001		45803.9	21301	386	21298	2818
2002		42849.0	17574	324	22407	2544
2003		45002.4	18863	344	23492	2303
2004		43311.5	16795	363	24100	2053
2005		46835.6	18863	382	25112	2478
2006	7710	46982.7	17300	335	27056	2292
2007	5603	42954.5	12090	288	28740	1837
2008	10035	59723.6	16261	243	40789	2431
2009	9253	69485.8	15070	210	51761	2445
2010	8342	66738.8	14561	179	49391	2609