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CATCH RECONSTRUCTION FOR THE FRENCH MEDITERRANEAN SEA, 1950-2010

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ABSTRACT

Total marine fisheries catches were estimated for France in the Mediterranean Sea for the 1950-2010 time-period using a catch reconstruction approach, which included best available data on catches of the industrial, artisanal, recreational, and subsistence sectors, as well as discards. The total reconstructed catch for the 1950-2010 time period exceeded 4 million tonnes, which is 2.1 times higher than the 1.9 million tonnes officially reported to the United Nations Food and Agriculture Organization (FAO). Just under 3.9 million tonnes were estimated to be caught in the French Mediterranean EEZ area. Major landed taxa were Clupeidae (21%), Scombridae (11%), Sparidae (6%), Engraulidae (5%), Mugilidae (5%) and Octopodidae (5%). The industrial and artisanal sectors were the most prominent, with 58% and 34% of the total catch, respectively, with unreported catches representing 52% of the total catch.

INTRODUCTION

The French Mediterranean coast hosts nearly three million inhabitants, with a density five times higher than the rest of France's mainland. Coastal settlement increased rapidly during the 1960-1975 period, and the demography has been almost stable over the last decade (Anon. 2009). The Gulf of Lions, which corresponds to the United Nations Food and Agriculture Organization's (FAO) Division 37.1.2, extends from the border with Spain in the south to the Italian border in the east (Fig. 1). The western part of the Gulf of Lions is characterized by a wide continental shelf with a mild slope, contrary to the eastern part which has a narrow to non-existent shelf area. The Division 37.1.2 roughly overlaps with the French Mediterranean Exclusive Economic Zone (EEZ),[1] which spans nearly 90,000 km^2 and has an Inshore Fishing Area[2] of around 16,000 km^2 (www.seaaroundus.org). Unlike its Atlantic counterpart – declared in 1972 – the French Mediterranean EEZ was only declared in 2012.[3]

At the national level, the *Direction des Pêches Maritimes et de l'Aquaculture* (DPMA) coordinates the policies resulting from European and international authorities/conventions (e.g., United Nations Convention on the Law of the Sea (United Nations 1994), United Nations Agreement on Straddling and Highly Migratory Fish Stock (United Nations 1995) responsible for fisheries resource management. In the French Mediterranean, some commercial fish stock management also depend on two Regional Fisheries Management Organisations (RFMO), which are the General Fisheries Council for the Mediterranean (GFCM) and the International Commission for the Conservation of Atlantic Tunas (ICCAT), both in charge of fisheries and tuna conservation. However, artisanal coastal fisheries of the French Mediterranean have been self-managed by cooperative organizations called '*Prud'homies*' for hundreds of years (Templier 1986). In 2012, there were 29 of them. These cooperatives are entrusted with ensuring

[1] Corsica, which was reconstructed in a separate report (Le Manach *et al.* 2011), does not belong to the Gulf of Lions and is not included in the present study.

[2] The Inshore Fishing Area (IFA) represents the area between the shoreline and either 200 m depth or 50 km distance from shore, whichever comes first (Chuenpagdee *et al.* 2006).

[3] Declared on October 14, 2012. See www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000026483528

the best fishing opportunities for its members, i.e., all artisanal fishers, who in turn gain access rights. They manage fishing communities by creating local fishing regulations to ensure sustainable use of a specific territory, help initiate marine protected areas along with scientists, and also self-police their waters when necessary (Decugis 2008). They have traditionally been responsible for, e.g., regulating seasonal closures, restricting gear types, controlling fleet sizes, and setting restrictions for commercial species, although they lack recognition from regional, national and European authorities (Templier 2013).

Commercial fisheries are characterised by coastal, artisanal activities (Farrugio 1991). They include a large number of boats and gear types, and spread all along the coast, which make them difficult to define (Guillou *et al.* 2002). However, fisheries types in the French Mediterranean have evolved over time and trends have emerged. In the 1960s, bottom trawl catches were reported to increase before they dropped, despite a substantial increase in fishing effort (Bonnet 1973). Before 1960, small pelagic catches (mostly Clupeidae and Engraulidae) were reported to be quite low but seem to have increased until the late 1970s, together with the use of light attraction devices called '*lamparos*' and the introduction of the pelagic trawl in 1977 (Pichot *et al.* 1978; Oliver 1983). Having been authorised in 1932, the number of purse seiners diminished considerably after 1977 (Beucher 2008). Despite an increasing fishing effort, pelagic fish catches have stabilized and then decreased, mostly due to difficulties in marketing some species (Pichot *et al.* 1978). However, based on official figures, it is thought that Clupeidae and Engraulidae (along with Tunnini) currently make up most of the catch in the French Mediterranean (Le Guilloux and Pauly 2010).

Artisanal fisheries in the French Mediterranean are known to be grossly unreported (Farrugio and Le Corre 1991; Guillou *et al.* 2002; Le Guilloux and Pauly 2010), and the national data do not include discards, recreational or subsistence catches.

Based on a concept developed by Pauly (1998) and methods developed and implemented worldwide by Zeller *et al.* (2007), Zeller and Harper (2009), Harper and Zeller (2012), and Harper *et al.* (2012), this report aims to reconstruct total marine fishery removals for the French Mediterranean Sea fleet (within and outside the French EEZ) from 1950-2010, which will improve the catch data baseline and, hopefully, inform appropriate management measures.

MATERIALS AND METHODS

French catch within the EEZ

Baseline data

Data published by the United Nations Food and Agriculture Organization (FAO) via FishStat (FAO 2012) software were used as our reported baseline. For the 1970-2010 period, we used the General Fisheries Commission for the Mediterranean (GFCM) dataset, as it contains a spatial resolution that allowed us to distinguish catches from inside and outside the French EEZ, i.e., roughly the 'Gulf of Lions' Division 37.1.2. Due to the lack of finer-scale spatial information in FishStat's 'global capture production' dataset between 1950 and 1969, we considered that the fraction of the catch in the EEZ was on average similar to that of the 1970-2010 period. The remaining data for this early period was therefore considered to be taken outside the EEZ (see 'French catch in the Mediterranean outside the EEZ' section). Note that catches of the 'Tunas' category were excluded prior to these manipulations, since we considered that the data published by ICCAT were of better quality and were therefore used for the baseline of this fishery.

Furthermore, the taxonomic allocation for the earlier years was poor and we therefore improved it. Indeed, only 20 taxonomic groups were reported on average from 1950 to 1977, whereas over 100 were reported in 2010. Thus, we decided to apply the 1978 breakdown (i.e., 57 taxa) to the 1950-1977 period, the rationale being that most taxa were actually fished but not reported prior to their first reported year.

Thus, for each year, the 'marine fishes nei' category was disaggregated following the same breakdown percentage as in the 1978 data among the missing taxa. However, the 1978 percentage was then rescaled to 97% in order to keep the 'marine fishes nei' portion maintained at 3%. Note that for 1954 and 1956, no 'marine fishes nei' catches were reported in the FAO data, so these were calculated by interpolating the 'marine fishes nei' percentages between the prior and subsequent years.

Taxonomic allocation according to gear-type

Information on the French fishing fleets in the Mediterranean Sea was available from reports published by the *Système d'Informations Halieutiques* (SIH; Fisheries Information System), which are based on data collected in 2003, and 2006-2011. The different gears reported to be used in the area (i.e., seines, trawls, divers, nets, small dragged gear, other small gear, dredges, and fyke nets [bag-shaped nets opened with rings]) were used to allocate the French Mediterranean catches to different fleets (Lespagnol *et al.* 2005; Leblond *et al.* 2008; Leblond *et al.* 2009). The type of gear likely to catch each taxon was estimated based on the evidence found in the literature (Bonnet 1973; Oliver 1983; FAO 1985; Bauchot 1987; Holthuis 1987; Northridge 1992; Guillou *et al.* 2002; FAO 2003, 2005; Lespagnol *et al.* 2005; Reid *et al.* 2005; Sacchi 2007; Leblond *et al.* 2009; Le Guilloux and Pauly 2010; Leblond *et al.* 2011; Anon. 2013). Then, the catch was allocated equally among the assigned gears for the whole time period. However, a yearly percentage of the three most commonly caught taxa (by weight, i.e., Clupeidae, Engraulidae, and Merluciidae; 58% of the total catch, respectively) to be allocated to each type of gear likely to target/catch these taxa. For the other taxa, the allocation of the catch to the different gears was considered constant throughout the time-period (Table 1).

Table 1. Anchor points used to allocate catch (%) to gear-type (missing years were linearly interpolated)

Taxa	Years	Nets	Seines	Trawls	Others
Clupeidae	1950-1960[a]	60	40	-	-
	1961-1965[a]	40	60	-	-
	1966-1970[a]	20	80	-	-
	1971-1976[a]	10	90	-	-
	1980	5	55[b]	40[a]	-
	2007-2010	5	18[c]	78[c]	-
Engraulidae	1950-1960[a]	60	40	-	-
	1961-1965[a]	40	60	-	-
	1966-1970[a]	20	80	-	-
	1971-1976[a]	10	90	-	-
	1980	5	55[b]	40[a]	-
	2007-2010	5	5	90[c]	-
Merlucciidae	1950-1962[b,d]	-	-	80	20
	1975[d]	20	-	70	10
	2008-2010[e]	4	-	88	8

[a]Pichot et al. (1978), [b]Beucher (2008), [c]Le Guilloux and Pauly (2010), [d]Bonnet (1967), [e]Macher et al. (2010)

Sectorial allocation

Once allocated to the different gears, catches were further allocated to either artisanal or industrial sectors by assigning gear types to sector. This second allocation was based on the likelihood that a given gear was used by either one (or a combination) of these two sectors, i.e., by small-scale and/or large-scale fishers (Table 2). A fishing gear was considered to be used by the industrial sector (i.e., large-scale) if it involved an active type of fishing, i.e., was towed from a boat such as a trawler or a seiner (Martín 2012). Thus, a fishing gear was considered to be used by the artisanal sector (i.e., small-scale) if only passive fishing methods were used, e.g., fyke nets and other small gears. For fishing nets, which greatly vary in terms of size and use, we assumed an equal allocation to both sectors.

Table 2: Sectorial allocation (%) based on gear-type

Gear[a]	Artisanal	Industrial
Divers	100	
Fyke nets with rings	100	-
Nets	50	50
Other small gear	100	-
Seines	-	100
Small dragged gear	-	100
Tellin dredges	100	-
Trawls	-	100

[a] Based on Leblond et al. (2008), in which seines = 'senneurs', trawls = 'chalutiers', nets = 'fileyeurs', small dragged gear = 'petits arts traînants', other small gear = 'autres petits métiers', tellin dredges = 'telliniers', divers = 'plongeurs' and fyke nets with rings = 'capéchades'.

Unreported catches

Once the reported baseline was established and catches were allocated to gears and sectors, unreported catches were estimated. It is clear from the scientific literature, that only a negligible portion of artisanal catches are sold via official fish auctions, and therefore that most artisanal catches are unreported (Farrugio and Le Corre 1991; Guillou *et al.* 2002; Le Guilloux and Pauly 2010). Furthermore, a recent report underlines that there are financial incentives that may result in under-reporting, as subsidies are given to fishers who do not sell their catch via official auction rooms (Anon. 2010). Therefore, we considered that the reported data accounted for a third of the actual catches for all gears, except for trawlers and seiners, whose catches were likely accurate (Farrugio and Le Corre 1991).

Discards

Discard rates of the various gear-type were collected from two major studies on discards (Kelleher 2005; Vassilopoulou 2012). The trawling discard rate for the French Mediterranean was calculated by averaging the published discard rates for Spanish and Italian bottom trawlers in the Mediterranean Sea, since no information was available specifically for French trawlers. For nets and small dragged gear, the discard rates we used were the same as the Spanish and Italian rates, i.e., 4.13% and 50% respectively. For taxa caught by purse-seiners, the weighted global average discard rate from Kelleher (2005), i.e., 1.6%, was used. When a given gear did not have a specific discard rate (e.g., other types of artisanal gears), the global discard rate suggested in Vassilopoulou (2012), i.e., 4.9%, was used. Finally, divers, dredges, and fyke nets were assumed not to generate any discards, since they are selective fishing activities or allow any potential by-catch to be released in good condition. The scientific literature was then reviewed to allocate the discarded catch of each gear to specific taxonomic groups. A total of 14 taxa were identified (Bauchot 1987; Sacchi 2007; Saïdi and Bradai 2008; Rochet 2011; Anon. 2013), although it is acknowledged that not all discarded taxa have been accounted for. The various taxa were equally distributed for each gear generating discards (Table 3).

Table 3. Taxa allocation (%) for discards depending on gear-type

Gear	Seines	Trawls	Nets	Small dragged gear	Other small gear
Alopiidae	25	7.7	14.3	-	12.5
Argentinidae	-	7.7	-	14.3	-
Carangidae	-	7.7	-	14.3	-
Carcharhinidae	25	7.7	14.3	-	12.5
Cepolidae	-	7.7	-	14.3	-
Clupeidae	25	7.7	-	-	12.5
Elasmobranchii	25	7.7	14.3	14.3	12.5
Marine fishes	-	7.7	14.3	14.3	12.5
Mugilidae	-	7.7	-	14.3	-
Rajidae	-	7.7	-	14.3	12.5
Scombridae	-	7.7	-	-	-
Scyliorhinidae	-	7.7	14.3	-	-
Squalidae	-	-	14.3	-	12.5
Triakidae	-	7.7	14.3	-	12.5

Recreational catches

Recreational fishing in France is defined as non-commercial fishing for self- or family-consumption purposes (Pawson *et al.* 2008). It is further defined as a motivated by fun, pleasure or sport, and not by a dependence on fish for food (Gaudin and De Young 2007).

Qualitative information regarding recreational fisheries in the French Mediterranean is scarce. However, this activity is known to be expanding in the Mediterranean area and now plays an important social and economic role, especially with the development of tourism and the enhancement of charter fishing (Gaudin and De Young 2007).

Our reconstruction is mainly based on one set of studies, carried out between 2006 and 2008 (Levrel *et al.* 2009; Levrel 2011; Herfaut *et al.* 2013). These studies are based on a combination of telephone and on-site surveys, in collaboration between a statistical institute and the French Research Institute for the Exploitation of the Sea (IFREMER). A total of 15,000 households were surveyed and their results were scaled up to be representative of the entire territory. Results show that 5.1% of the French population beyond 15 years of age is fishing recreationally, i.e., 2.45 million recreational fishers. An overwhelming majority of these recreational fishers are males between 25 and 64 years of age, who actively fish 13 weeks per year on average. It also appears that most fisher live in the coastal area (Levrel *et al.* 2009).

These studies also illustrate that most fishers feel that the marine resources have been declining over the past years, and that the French recreational fishery has been rapidly expanding for the last 30 years, and is currently catching around 24,000 t·year^{-1} of fish, as well as 5,200 t·year^{-1} of shellfish, Crustacea and Cephalopoda (Herfaut *et al.* 2013). Out of these totals, one third are estimated to be caught in the French Mediterranean Sea (Levrel 2011). The most targeted species are seabass (*Dicentrarchus labrax*), Atlantic mackerel (*Scomber scombrus*), and various species of Sparidae and Gadidae (e.g., *Sparus* spp., *Pagrus* spp., *Diplodus* spp., *Pollachius* spp.) (Levrel *et al.* 2009; Levrel 2011; Herfaut *et al.* 2013) although Mediterranean rainbow wrasse (*Coris julus*) and comber (*Serranus cabrilla*) make up most of the recreational catches in terms of sheer abundance in Mediterranean marine protected areas (Font *et al.* 2012). Mugilidae, Blenniidae, Mullidae and Polyprionidae are also reported to be commonly targeted by recreational fishers (Gaudin and De Young 2007).

Based on this information, we considered that the recreational sector truly started to expand in 1976 (i.e., 30 years before the 2006 study), and that the prevalence of recreational fishers in 1976 was 1/4th of that in 2006, i.e., 0.01. We also considered that this ratio had only doubled between 1950 and 1975 (i.e. although

growing, the sector truly started to expand afterwards). Furthermore, we considered that the catch per unit of effort in 1976 was twice that of 2006 (and following years), and stable prior to that, as fishers have been noticing a decline in fish per unit of effort.

For the taxonomic breakdown, we allocated 75% of the total catch to the most targeted families (Moronidae, Scombridae, Sparidae, Serranidae and Gadidae), and equally distributed the remaining percentage among the other families listed in Font *et al.* (2012) and Gaudin and De Young (2007) (i.e., Labridae, Carangidae, Scorpaenidae, Mugilidae, Mullidae, Blenniidae, Polyprionidae), as well as a 'marine fishes' category.

For the non-fish catch, we allocated 5% to Echinodermata, i.e., sea urchins (Nadaud 1955) and the proportions given by Levrel (2011) to the remaining 95%, i.e., Bivalvia and Gastropoda (36%), marine Crustacea (30%), and Cephalopoda (29%).

Subsistence catches

Subsistence fisheries consist in sharing and consuming caught fish (or other marine resources) directly with the family and kin of the fishers (www.fao.org/fishery/topic/12306/en). Pawson *et al.* (2008) explained that the term subsistence fishing in France is based more on the "cultural" element of traditional fishing activities, and one example of this is the tradition of hand-picking shellfish from beaches, such as the Mediterranean mussel (*Mytilus galloprovincicalis*), which has been traditionally harvested from the French Mediterranean coast for millennia. While farms have grown immensely in recent decades, there is still a small public fishery for wild mussels (Prou and Goulletquer 2002).

No data were found regarding subsistence-type or traditional fisheries but we did not want to ignore catches from this sector, as is often the case. Therefore to estimate subsistence catches, it was simply assumed that subsistence catches were of the same amount as our estimated recreational catch amounts from 1950-1959 (i.e., which average of 1,650 t· year^{-1} for the decade), and then the 1959 value was linearly decreased to one percent of the 1959 value by 1980, as Bivalvia culturing grew in prominence by then. This assumption is justifiable by the fact that France is a rich country and thus it can be assumed that subsistence fishing is marginal. Also, due to the lack of pronounced tides in the Mediterranean, the gleaning of shellfish along its beaches is far more limited than on the French Atlantic coast and it is considered to be very low in the 2000s. Therefore, there is no double accounting with regards to the recreational catch estimated by Herfaut *et al.* (2013).

To allocate these subsistence catches to taxa, we used the same invertebrate breakdown proportions as the recreational sector but added a "marine fishes" group representing 20% and kept Echinodermata at 5%; shellfish (Bivalvia and Gastropoda) at 29%; marine Crustacea at 24%; and Cephalopoda at 22%.

Tunas

The baseline for 'Tunas' (containing mostly Scombridae but also Istiophoridae and Xiphiidae) came from the data published by ICCAT, as their taxonomic resolution was better than the more generic FishStat data. They included catches of Albacore (*Thunnus alalunga*), bigeye tuna (*Thunnus obesus*), Atlantic bluefin tuna (*Thunnus thynnus*), bullet tuna (*Auxis rochei*), Atlantic bonito (*Sarda sarda*), plain bonito (*Orcynopsis unicolor*), little tunny (*Euthynnus alletteratus*), skipjack tuna (*Katsuwonus pelamis*), longbill spearfish (*Tetrapturus pfluegeri*), swordfish (*Xiphias gladius*), wahoo (*Acanthocybium solandri*), yellowfin tuna (*Thunnus albacares*) and tunas nei. ICCAT data - which included some species common with FAO and GFCM data (i.e., Albacore, Atlantic bluefin tuna, Atlantic bonito, little tunny, skipjack tuna, and swordfish) matched the GFCM data except during the 2000s, for which the GFCM tunas catches were higher.

Farrugio and Le Corre (1991) explained that tuna catches were reported for the most part. However, Fonteneau and Fromentin (2009) later reported that since 1996, bluefin catches were under-reported by 30%. Hence, beginning in 1996, we added 30% to the reported bluefin catches to account for this unreported component (ICCAT 2009). The evolution of tuna catches attributed to different gears was also available in the ICCAT data. Since, on average, 99% of the tunas catch was bluefin tuna, their yearly gear allocation was applied to all tuna catches. The gear-related discards were then estimated as previously described in the 'discards' section. However, note that ICCAT data also include sport catches, which were removed from these calculations and reallocated to the 'Other marine fish' previously estimated for the recreational sector.

The sectorial allocation was performed slightly differently than for the artisanal sector: gillnets (nets) and unclassified gear (other small gear) were considered as artisanal, whereas purse seines and trawls were considered as industrial. We further considered that catches of nets and other small gears were exclusively taken in the EEZ (J-M Fromentin, pers. comm., IFREMER), whereas catches of seines and trawls were considered to come exclusively from the EEZ only from 1950 to 1980, and then progressively from outside the EEZ as well before reaching respectively 100% and 50% of catch coming from outside the EEZ by 2000. Between 1981 and 1999 these ratios were linearly interpolated and from 2001 to 2010 the same geographical allocation was kept.

French catch outside the EEZ

As described in the 'Baseline data' section, GFCM data allowed the segregation of catch between 'within' and 'outside' the Division 37.1.2, which we considered to represent the French Mediterranean EEZ. GFCM catches other than in Division 37.1.2 were used for the 1970-2010 period, similarly to the first part of the exercise, we considered that the proportion of the catch taken outside the French EEZ for the 1950-1969 was similar to that of 1970-2010, in the absence of a spatial breakdown in the FishStat database for this period. Unlike for the catch inside the EEZ, we did not perform a taxonomic breakdown for the earlier years. The gear allocation was also performed differently than for the Gulf of Lions catches. Indeed, we divided the catch among only three gears (i.e., seines, trawls, and nets), as they were the only gears likely to be active that far away from the French coasts. Their respective percentages were estimated by using results from Le Guilloux and Pauly (2010), who classified gear by boat power, allowing them to go further offshore. As only seines and nets were represented in classes where High Seas boats were dominant, and as trawls were represented in a class where coastal and high sea activities were mixed, we took into account their respective importance in each class and used the following percentages: seines (70%), trawls (10%) and nets (20%). Furthermore, all catches were considered to be industrial (i.e., artisanal fishing is restricted to near-shore areas). Finally, we added the ICCAT tuna estimated to have been caught outside the Gulf of Lions to this baseline.

RESULTS

Inside the EEZ

Industrial catches

Industrial reported catches

Industrial reported catches for the 1950-2010 period amounted to almost 1.3 million tonnes. The industrial and artisanal catches were similar in the 1950s, when they averaged just over 5,200 t·year^{-1}. (Fig. 2a; Appendix 1). Industrial reported catches gradually increased throughout our study period and peaked in the early 1980s, whereby they averaged almost 32,700 t·year^{-1}. They subsequently dropped to nearly 15, 000 t·year^{-1} in 1996, before reaching again 30,000 t·year^{-1} by 2000 and finally declined to an average of less than 13,000 t·year^{-1} during 2008-2010.

The major reported taxonomic groups for the industrial sector were Clupeidae (635,000 t), Engraulidae (183,000 t), Scombridae (119,000 t), Merlucciidae (86,400 t), Sparidae (38,400 t) and Gadidae (25,000 t) with 58 other taxonomic groupings accounting for the remaining 15.8% of catches.

Industrial unreported landings

Industrial unreported catches for the 1950-2010 period amounted to 471,000 t, peaked in 1972 with just over 17,300 t, and averaged 7,700 $t \cdot year^{-1}$ for the whole period.

The major industrial unreported taxonomic groups for this sector were Clupeidae (80,200 t), Octopodidae (46,300 t), Sparidae (46,000 t), Ostreidae (27,000 t), Elasmobranchii (23,600 t) and Mytilidae (19,900 t), while 52 other taxa accounted for the remaining 48.4% of the catch.

Discards

Discards from the industrial sector were estimated at almost 372,000 t for the entire 1950-2010 period. Discards averaged just over 2,300 $t \cdot year^{-1}$ throughout the 1950s, gradually increased to a peak of over 12,000 t in 1986, 1992 and 2003, and then gradually declined to average just over 5,100 $t \cdot year^{-1}$ for 2008-2010.

The main species discarded by the industrial sector throughout the 1950-2010 period were Elasmobranchii (40,800 t), and Mugilidae, Carangidae, Rajidae, Cepolidae, and Argentidae (each at 36,200 t). Eight other taxa accounted for the remaining 40.3% of catch.

Artisanal catches

Artisanal reported catches

Artisanal reported catches for the 1950-2010 period amounted to around 460,000 t. These catches peaked in 1972 (15,900 t) then globally decreased since 1992, and averaged 7,500 $t \cdot year^{-1}$ for the whole period (Appendix 1; Fig. 2a).

The main taxa caught by the industrial sector were Mugilidae (42,800 t), Clupeidae (40,100 t), Scombridae (39,600 t), Octopodidae (38,600 t), Sparidae (38,400 t), and Gadidae (25,000 t), with 59 other taxa accounting for the remaining 51.2% of catch.

Artisanal unreported catches

Artisanal reported catches for the 1950-2010 period amounted to over 893,000 t. These catches had a trend similar to that of the reported artisanal catches, and averaged just over 14,600 $t \cdot year^{-1}$ for the 1950-2010 period.

The major caught taxa reported by the artisanal sector were Mugilidae (85,600 t), Clupeidae (80,200 t), Octopodidae (77,200 t), Sparidae (76,800 t) and Scombridae (53,200 t) with 58 other taxonomic groupings accounting for the remaining 58.2% of catch.

Discards

Discards from the artisanal sector were estimated at just over 40,600 t for the 1950-2010 period, peaking in 1972 at over 1,300 $t \cdot year^{-1}$ and averaging just under 670 $t \cdot year^{-1}$ throughout the 1950-2010 period (Appendix 1) (Fig. 2a).

The major groups discarded by the artisanal sector were Triakidae, Squalidae, Carcharhinidae, Alopiidae and Elasmobranchii (5,400 t each), Clupeidae and Rajidae (2,900 t each) and Scyliorhinidae (2,500 t).

Recreational catches
Our estimate of the unreported recreational catches for the 1950-2010 period is 286,000 t. They averaged 1,570 t·year^{-1} from 1950-1954, and reached an average of 8,980 t·year^{-1} by 2006. The only reported recreational catch consisted in the ICCAT tuna catch, which only amounted to 730 t.

The recreational catches were distributed by family as follows: Gadidae, Moronidae, Scombridae, Sparidae and Serranidae almost reached 40,600 t, while Blenniidae, Carangidae, Labridae, Mugilidae, Mullidae, Polyprionidae and Scorpaenidae reached over 8,450 t each for the whole period. Seven other taxa accounted for the remaining 8.6%.

Subsistence catches
The estimate of subsistence catches for the Gulf of Lions for the 1950-2010 period reached just over 39,100 t (Fig. 2a) (Appendix 1). Of this amount, marine Crustacea accounted to 9,400 t, Cephalopoda amounted to around 8,600 t, Bivalvia and Gastropoda to nearly 5,700 t, and Echinodermata to almost 2,000 t.

Total reconstructed catch for EEZ
The total reconstructed catch for the French Mediterranean for the 1950-2010 period was 3.85 million tonnes, which is 2.2 times higher than the 1.75 million reported to FAO, i.e., an add-on of roughly 2.1 million tonnes of unreported catches (Appendix 1).

Specifically, the unreported catches mostly consisted of artisanal catches (893,000 t), followed by industrial catches (471,000 t), industrial discards (372,000 t), recreational catches (286,000 t), artisanal discards (40,700 t), and subsistence catch (39,200 t).

Overall, the main species caught in the Gulf of Lions from 1950 to 2010 were Clupeidae (856,000 t), Scombridae (287,000 t), Sparidae (240,000 t), Engraulidae (218,000 t), Mugilidae (199,000 t) and Octopodidae (185,000 t; Fig. 2b; Appendix 3). The remaining 48.5% of total reconstructed catches consisted of 67 other taxa.

Outside the EEZ
GFCM catch reported outside the EEZ were extremely variable throughout the years in terms of total catch and taxonomic composition. They were the most important from the 1970s until the 1990s, with also two peaks in 2002 and 2009 (Appendix 2). However, together with the ICCAT tuna catch allocated outside the EEZ, the total catch outside the EEZ strongly increased from nearly 500 t in 1950 to 11,000 t in 2005, before dropping rapidly to 2,500 t in 2010.

Discards followed the same trend and reached 200 t in 2007 before dropping to around 50 t by 2010 (Appendix 2). Unreported catches consisted of Scombridae and amounted to approximately 2,100 t in 1996 before increasing to 2,900 t in 2007 and decreasing to 470 t by 2010.

Overall, Scombridae and Clupeidae made up 76.5% and 4.5% of the catch, respectively, while 53 other taxa accounted for 21.3% of the total catch outside the French Mediterranean EEZ (Appendix 4).

DISCUSSION

This report is a first attempt to re-estimate the total marine fishery removals for the French Mediterranean Sea, in order to confront national data reported to the FAO from 1950 to 2010 to a more comprehensive baseline derived from independent estimates. The reconstructed catch is more than twice the official data, which highlights the discrepancy between the reported catch and the amount of marine likely actually caught. Of the total reconstructed catch, the unreported artisanal catches, unreported

industrial catches, recreational catches, and subsistence catches represented 44% (2% discards, 42% unreported), 41% (18% discards, 23% unreported), 13%, and 2%, respectively.

This huge disparity between the quality and comprehensiveness of data on artisanal versus industrial fisheries is common throughout the world, as many countries have not even begun to comprehensively account for their artisanal fishing sector. France does monitor this sector, but only partially (Farrugio and Le Corre 1991; Guillou *et al.* 2002; Le Guilloux and Pauly 2010), and it has been demonstrated here that the artisanal sector catch is substantial, representing about half that of the industrial sector in terms of tonnage.

While the *prud'homies* have been successful at managing their resources for centuries, they are no longer able to restrict the access of coastal inshore fishing areas to other sectors such as the recreational and industrial sectors, which is causing increasing tension between sectors and negatively impacting any notion of sustainable management. Overall, the French Mediterranean fisheries show a worrisome trend, with catches declining at a very rapid rate in the last decade. Indeed, the total reconstructed industrial catches declined by a factor of 2.4 between 2000 and 2010, while the total reconstructed artisanal catches declined by a factor of 1.4 during the same period. This trend parallels that of fish stock biomass, which has been shown to have declined by 80% since the industrialization of fisheries (Cardinale et al. 2012).

On the other hand, recreational catches by locals did not show the same declining trend, probably because this sector is becoming more popular (i.e., effort increases), which may have masked the average declining catch per unit of effort noticed by many surveyed fishers (Levrel *et al.* 2009). Noteworthy, Herfaut *et al.* (2013) noted that the recreational sector may represent a major part of the total catch for some species, e.g., 100% of the commercial landing of European sea bass, and 19% and 44% for Atlantic mackerel and sea bream, respectively. Compared to Le Goff *et al.* (2012), who reported recreational catch for the whole French mainland in 2011, our estimate of Bivalvia and Crustacea catches seem quite low. However, the most favorable areas for collecting these taxa are mostly located on the Atlantic and English Channel coasts, hence it seems realistic that smaller amounts are collected in the Mediterranean area. It is also important to acknowledge that we did not estimate bycatch and bait catches related to recreational fisheries. However, these could constitute significant amounts and should be monitored (Gaudin and De Young 2007).

Due to the lack of data, it is also important to note that our recreational catch estimates should be improved upon as we did not include any catches taken by tourists. Indeed, since the Mediterranean is a major tourist destination (Garau-Taberner and Manera 2006), it can be excepted that the high number of tourists can drive the fishing pressure, directly (i.e., fishing by themselves) or indirectly (i.e., willing to eat fresh fish), and therefore have a consequent impact on the resources, especially during summer months (Trumbic 2005). This is a topic to explore, especially as tourism in the region is expected to double by 2025 (Barceló et al. 2011).

Concerning the GFCM catch reported outside of the EEZ, it seems highly unlikely that they dropped from 1000 t in the 1990s to around 20 t in the 2000s with only two punctual high catches in 2002 and 2009. We think that catch data coming from this area are of quite poor quality for this time period but we lacked information to reliably estimate the magnitude of unreported catches.

We believe that our reconstructed catch estimates for the French Mediterranean marine fisheries provide a more comprehensive baseline of total fishery removals for the 1950-2010 period, notably by identifying major discrepancies between the reported catch and independent estimates and anecdotal evidences about all fisheries sectors. We hope that these preliminary estimates will be improved by focusing on the aforementioned weaknesses, and that they will serve as a basis of future management decisions accounting for all sectors, and therefore reducing the impact we have on the marine resources.

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REFERENCES

Anon. (2009) La population littorale a fortement augmenté depuis trente ans. Démographie et économie du littoral, INSEE. 4 p.

Anon. (2010) Rapport sur les aides de l'État à la Pêche, Exercices 2000 à 2009. 2010-14-0, Cour des comptes, Septième chambre, Troisième section.

Anon. (2013) Pêches profondes dans les eaux européennes : expertise et travaux menés par l'Ifremer. Dossier d'actualité, IFREMER. 3 p.

Barceló D, Petrovic M and Alemany J (2011) Problems and needs of sustainable water management in the Mediterranean area: conclusions and recommandations. pp. 295-305 *In* Barceló D and Petrovic M (eds.), Waste water treatment and reuse in the Mediterranean region14. Springer, Berlin (Germany).

Bauchot M-L (1987) Poissons osseux. pp. 891-1421 *In* Fischer W, Bauchot M-L and Schneider M (eds.), Méditerranée et mer Noire - Zone de pêche 37 - Révision 1. Guide FAO d'Identification des Espèces pour les Besoins de la Pêche 2: Vertébrés. Food and Agriculture Organization of the United Nations (FAO), Rome.

Beucher P (2008) Histoire des engins et techniques de pêche. IFREMER.

Bonnet M (1967) La pêche du merlu au filet maillant - Son évolution technique sur les côtes provençales. Science et Pêche 163: 16.

Bonnet M (1973) Les pêches maritimes sur les côtes françaises de Méditerranée. Actualités, perspectives. Science et Pêche 222: 18.

Cardinale M, Rätz H-J and Charef A, editors (2012) Report of the Scientific, Technical and Economic Committee for Fisheries on assessment of Mediterranean sea stocks (STECF 12-03). JRC Scientific and Technical Reports. Joint Research Centre of the European Commission, Institute for the Protection and Security of the Citizen, Ispra (Italy). 404 p.

Chuenpagdee R, Liguori L, Palomares MD and Pauly D (2006) Bottom-up, global estimates of small-scale marine fisheries catches. Fisheries Centre Research Reports 14, University of British Columbia, Vancouver (Canada). 112 p.

Decugis C (2008) Gestion collective de pêche en Méditerranée, les prud'homies. Prud'homie de pêche de Saint-Raphaël, Marseille (France).

FAO (1985) Atlas of the fisheries of the western and central Mediterranean. Food and Agriculture Organization of the United Nations (FAO), Rome (Italy).

FAO (2003) Triakidae. p. 21 *In* Sharks. Food and Agriculture Organization of the United Nations (FAO), Rome (Italy).

FAO (2005) L'état des ressources halieutiques marines mondiales. FAO Document technique sur les pêches 457. 254 p.

FAO (2012) FishStatJ, a tool for fishery statistics analysis. United Nations Food and Agriculture Organization, Rome.

Farrugio H (1991) Artisanat et pêche en Méditerranée : évolution et état de la recherche. pp. 143-156 *In* Durand J-R, Lemoalle J and Weber J (eds.), La recherche scientifique face à la pêche artisanale = Research and small-scale fisheries. ORSTOM, Paris (France).

Farrugio H and Le Corre G (1991) Recherche halieutique et pêches artisanales interactives en Méditerranée française : caractéristiques et perspectives d'aménagement. pp. 349-355 *In* Durand J-R and Lemoalle J (eds.), La recherche scientifique face à la pêche artisanale = Research and small-scale fisheries. ORSTOM, Paris (France).

Font T, Lloret J and Piante C (2012) Recreational fishing within Marine Protected Areas in the Mediterranean. MedPan North project, WWF-France. 168 p.

Fonteneau A and Fromentin J-M (2009) Menaces sur le thon rouge. Pour la Science, edition of Juillet 2009.

Garau-Taberner J and Manera C (2006) The recent evolution and impact of tourism in the Mediterranean: the case of island regions, 1990-2002. Social Science Research Network Electronic Paper Collection, Departamento de Economía Aplicada, Universitat de les Illes Balears, Balearic Islands (Spain). Available at: http://www.feem.it/Feem/Pub/Publications/WPapers/default.htm [Accessed: 22/01/2014].

Gaudin C and De Young C (2007) Recreational fisheries in the Mediterranean countries: a review of existing legal frameworks. Studies and Reviews 81, Food and Agriculture Organization of the United Nations (FAO), General Fisheries Commission for the Mediterranean, Rome (Italy). 85 p.

Guillou A, Lespagnol P and Ruchon F (2002) La pêche aux petits métiers en Languedoc-Roussillon en 2000-2001. Convention de participation au programme PESCA (PIC) DIRAM - IFREMER n° 00/3210040/YF, Convention de recherche Région Languedoc-Roussillon - IFREMER n° 00/1210041/YF, IFREMER, Sète (France).

Harper S and Zeller D, editors (2012) Fisheries catch reconstructions: islands, part II. Fisheries Centre Research Reports 19 (4). Fisheries Centre, University of British Columbia, Vancouver. 143 p.

Harper S, Zylich K, Boonzaier L, Le Manach F, Pauly D and Zeller D, editors (2012) Fisheries catch reconstructions: islands, part III. Fisheries Centre Research Reports 20 (5). Fisheries Centre, University of British Columbia, Vancouver. 134 p.

Herfaut J, Levrel H, Thébaud O and Véron G (2013) The nationwide assessment of marine recreational fishing: A French example. Ocean & Coastal Management 78: 121-131.

Holthuis LB (1987) Crevettes. pp. 189-292 *In* Fischer W, Schneider M and Bauchot M-L (eds.), Méditerranée et Mer Noire - Zone de pêche 37 - Révision 1. Guide FAO d'Identification des Espèces pour les Besoins de la Pêche 1: Végétaux et Invertébrés. Food and Agriculture Organization of the United Nations (FAO), Rome (Italy).

ICCAT (2009) Rapport de la période biennale 2008-09 - 1ere partie (2008).2Madrid (Spain). 283 p.

Kelleher K (2005) Discards in the world's marine fisheries - An update. Fisheries Technical Paper 470, Food and Agriculture Organization of the United Nations (FAO), Rome (Italy). 19 p.

Le Goff R, Morizur Y, Levrel H, Biseau A, Véron G, Drogou M, Laurans M, Merrien C, Morandeau G and Caill-Milly N (2012) Note relative à la pêche maritime de loisir et à sa gestion. IFREMER. 10 p.

Le Guilloux E and Pauly D (2010) Description synthétique des pêcheries françaises en 2007. Prepared for the French Ministry of Fisheries. Bloom Association and Sea Around Us, with the support of IFREMER, IRD and MNHN, Paris (France). 32 p.

Le Manach F, Dura D, Pere A, Riutort J-J, Lejeune P, Santoni M-C, Culioli J-M and Pauly D (2011) Preliminary estimate of total marine fisheries in Corsica, France (1950-2008). pp. 3-14 *In* Harper S and Zeller D (eds.), Fisheries Catch Reconstructions: Islands Part II19. Fisheries Centre, University of British Columbia, Vancouver.

Leblond E, Demaneche S, Le Blond S, Merrien C, Berthou P, Daurès F, Macher C and Lespagnol P (2011) Activité 2009 des navires de pêche de la façade Méditerranée (Hors Corse). Système d'Informations Halieutiques, IFREMER. 9 p.

Leblond E, Demaneche S, Pitel-Roudaut M, Merrien C, Berthou P, Daurès F, Le Blond S and Lespagnol P (2009) Activité 2007 des navires de pêche de la façade Méditerranée (Hors Corse). Système d'Informations Halieutiques, IFREMER. 10 p.

Leblond E, Merrien C, Berthou P, Bermell S and Demaneche S (2008) Activité 2006 des navires de pêche de la façade Méditerranée (Hors Corse). Système d'Informations Halieutiques, IFREMER. 10 p.

Lespagnol P, Leblond E, Merrien C, Berthou P and Demaneche S (2005) L'activité des navires de pêche du Quartier Maritime de Sète en 2003. Système d'Informations Halieutiques, IFREMER. 8 p.

Levrel H (2011) Pêche récréative / SRM MO. Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER), Plouzané. 10 p.

Levrel H, Herfaut J, Berthou P, Thébaud O and Morizur Y (2009) Enquête relative à la pêche de loisir (récréative et sportive) en mer en Métropole et dans les DOM. Synthèse des résultats finaux, Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER), Direction des pêches maritimes et de l'aquaculture, Paris (France). 13 p.

Macher C, Merzéréaud M, Le Grand C, Jadaud A, Le Corre A, Guyader O and Frangoudes K (2010) Réunion du groupe de travail partenarial sur la pêcherie de Merlu du golfe du Lion: pêcherie et enjeux. IFREMER, Sète (France).

Martín JI (2012) The small-scale coastal fleet in the reform of the Common Fisheries Policy. Note IP/B/PECH/NT/2012_08, European Parliament, Directorate General for Internal Policies, Policy Department B: Structural and Cohesion Policies - Fisheries, Brussels (Belgium). 38 p.

Nadaud J (1955) La pêche, Larousse editionParis. 575 p.

Northridge S (1992) La pêche aux filets dérivants et son impact sur les espèces non visées: étude mondiale. FAO Fisheries Technical Paper 320, United Nations Food and Agriculture Organization (FAO), Rome (Italy). 124 p.

Oliver P (1983) Les ressources halieutiques de la Méditerranee: première partie: Méditerranée occidentale. Studies and Reviews 59, Food and Agriculture Organization of the United Nations (FAO), General Fisheries Commission for the Mediterranean, Rome (Italy). I-VI, 135 p.

Pauly D (1998) Rationale for reconstructing catch time series. EC Fisheries Cooperation Bulletin 11(2): 4-7.
Pawson MG, Glenn H and Padda G (2008) The definition of marine recreational fishing in Europe. Marine Policy 32(3): 339-350.
Pichot P, Aldebert Y, Carries C and Pichot Y (1978) La pêche de la sardine en Méditerrannée Française. Science et Pêche 277: 1-16.
Prou J and Goulletquer P (2002) The French mussel industry: present status and perspectives. Bulletin of Aquaculture Association of Canada 120: 17-23.
Reid A, Jereb P and Roper C (2005) Cuttlefishes. p. 7 *In* Jereb P and Roper C (eds.), Cephalopods of the world: an annotated and illustrated catalogue of cephalopods species known to date. FAO Species Catalogue for Fishery Purposes 1 Rome (Italy).
Rochet M-J (2011) Rejets de pêche / SRM MO - Evaluation initiale, Projet SEXTANT. PI_Rejets de pêche_V2_MO. 3 p.
Sacchi J (2007) Impact des techniques de pêche en Méditerranée : solutions d'amélioration. Food and Agriculture Organization of the United Nations (FAO), General Fisheries Commission for the Mediterranean, Rome (Italy). 53 p.
Saïdi B and Bradai MN (2008) Captures accidentelles des élasmobranches en Méditerranée: Synthèse bibliographique - Draft Document. 21 p.
Templier E (1986) Les prud'homies de pêcheurs en Méditerranée : la force des traditions. Hier, L'avenir: 43-46.
Templier E (2013) Les prud'homies de pêche de Méditerranée. L'Encre de Mer.
Trumbic I (2005) Tourism carrying capacity assessment in the Mediterranean coastal tourist destinations. Proceedings of the 14th Biennial Coastal Zone Conference, July 17 to 21, 2005, New Orleans, Louisiana. 5 p.
United Nations (1994) United Nations Convention on the Law Of the Sea (UNCLOS), Montego Bay (Jamaica), 10 December 1982. Treaty Series 1833New York, NY (USA). 3-581 p.
United Nations (1995) United Nations Fish Stocks Agreement (UNSFA), New York (USA), 4 August 1995. Treaty Series A/CONF New York NY (USA). 40 p.
Vassilopoulou V (2012) Review of existing knowledge on fisheries by-catch in the GFCM area. Food and Agriculture Organization of the United Nations (FAO), General Fisheries Commission for the Mediterranean, Sofia (Bulgaria). 22 p.
Zeller D, Booth S, Davis G and Pauly D (2007) Re-estimation of small-scale fishery catches for U.S. flag-associated island areas in the western Pacific: the last 50 years. Fishery Bulletin 105(2): 266-277.
Zeller D and Harper S, editors (2009) Fisheries catch reconstructions: islands, Part I. Fisheries Centre Research Reports 17 (5). Fisheries Centre, University of British Columbia, Vancouver. 108 p.

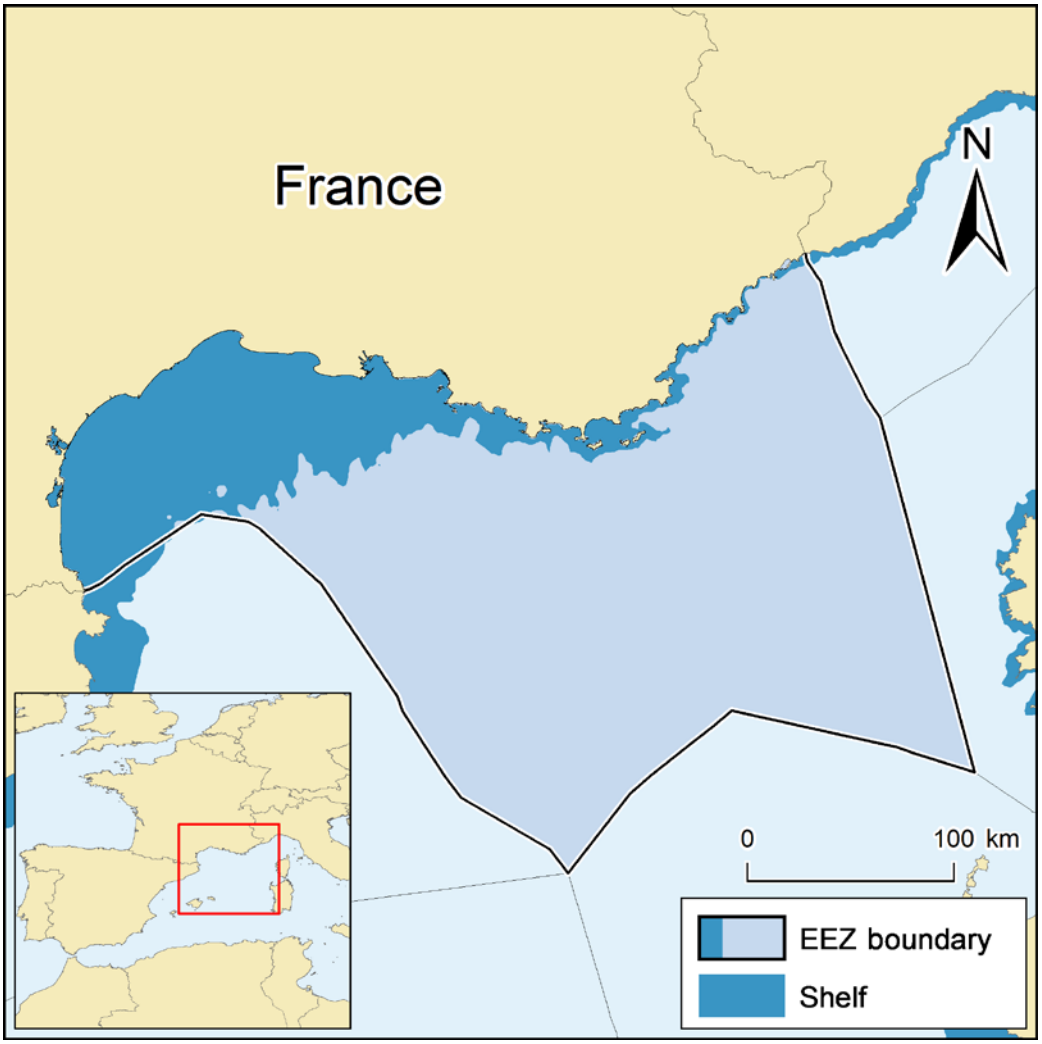

Figure 1. Map of France Mediterranean with its Exclusive Economic Zone (EEZ).

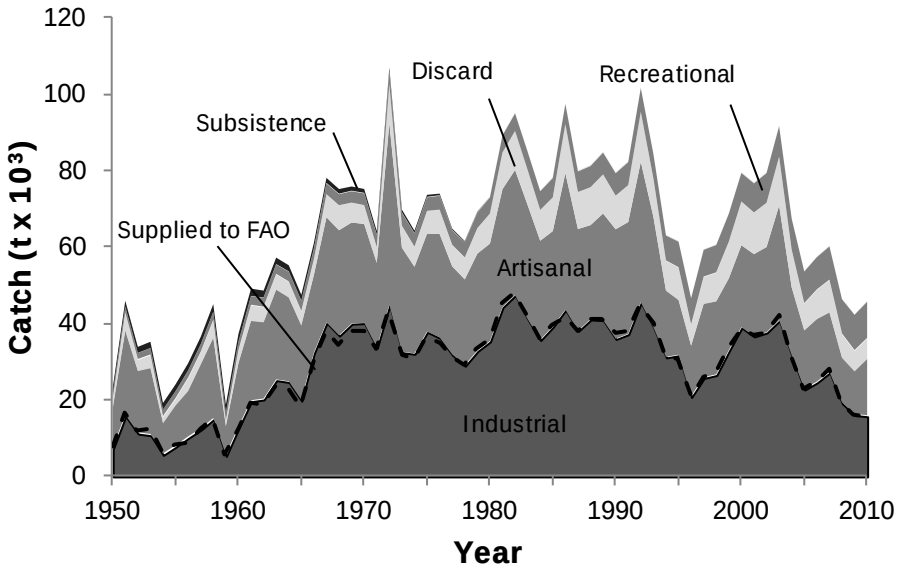

Figure 2a. Total reconstructed catch of the French Mediterranean Sea (Gulf of Lions i.e., EEZ only), 1950-2010.

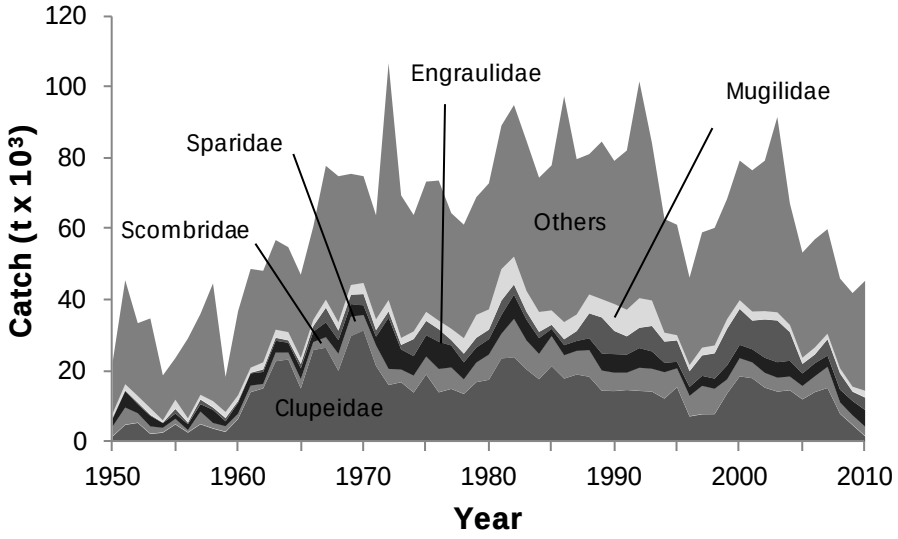

Figure 2b. Total reconstructed catch by major taxa, 1950-2010, others grouping includes 62 other taxonomic groupings.

Appendix Table A1. French Mediterranean catch within the EEZ as reported to FAO, compared to total reconstructed catches by sector, discards being shown separately, 1950-2010.

Year	FAO landings	Total reconstructed catch	Artisanal	Industrial	Recreational	Subsistence	Discards
1950	7,776	22,696	10,555	7,143	1,433	1,433	2,133
1951	16,596	45,620	22,311	15,744	1,501	1,501	4,564
1952	12,032	33,520	16,340	11,165	1,567	1,567	2,882
1953	12,165	34,862	17,511	10,731	1,635	1,635	3,350
1954	6,199	18,797	8,215	5,613	1,702	1,702	1,565
1955	8,181	23,687	10,734	7,752	1,773	1,773	1,655
1956	8,779	29,222	12,191	10,081	1,847	1,847	3,256
1957	12,399	36,140	16,960	12,216	1,924	1,924	3,116
1958	14,848	44,729	21,236	14,924	2,005	2,005	4,561
1959	5,621	18,359	7,684	5,317	2,084	2,084	1,189
1960	12,598	36,899	16,811	12,680	2,165	1,986	3,256
1961	18,914	48,791	20,990	19,604	2,247	1,888	4,061
1962	18,833	48,273	20,202	20,049	2,334	1,790	3,898
1963	23,796	56,929	23,675	25,095	2,455	1,691	4,013
1964	22,842	54,933	22,155	24,591	2,543	1,593	4,051
1965	18,153	47,168	19,687	19,717	2,634	1,495	3,634
1966	30,472	60,759	20,447	32,170	2,720	1,397	4,026
1967	37,810	77,838	27,674	40,068	2,809	1,298	5,988
1968	34,475	74,910	27,657	36,685	2,895	1,200	6,472
1969	37,927	75,588	26,566	39,790	2,983	1,102	5,148
1970	37,766	74,927	26,015	39,960	3,075	1,004	4,874
1971	33,420	63,887	22,236	33,537	3,172	905	4,036
1972	43,239	106,725	47,726	44,676	3,270	807	10,248
1973	31,484	69,521	27,385	32,381	3,366	709	5,680
1974	30,733	63,989	22,815	31,936	3,461	610	5,167
1975	36,226	73,394	25,759	37,668	3,549	512	5,906
1976	34,877	73,704	27,243	36,112	3,632	414	6,302
1977	31,071	64,522	23,198	31,664	3,793	316	5,552
1978	28,947	61,270	22,626	28,820	3,954	217	5,653
1979	33,469	69,010	25,504	32,691	4,114	119	6,582
1980	35,691	72,915	25,632	35,191	4,275	21	7,797
1981	45,084	89,177	31,027	44,101	4,435	21	9,594
1982	48,085	94,966	32,905	47,265	4,596	21	10,180
1983	41,774	84,868	29,999	40,943	4,756	21	9,148
1984	36,076	74,508	26,055	35,516	4,917	21	7,999
1985	39,245	77,973	25,081	39,022	5,077	21	8,772
1986	41,393	97,426	35,882	43,443	5,238	21	12,842
1987	37,846	79,713	26,728	37,919	5,398	21	9,647
1988	40,967	81,136	24,773	40,898	5,559	21	9,885
1989	40,871	84,670	28,020	40,709	5,719	21	10,200
1990	37,258	79,244	28,786	35,804	5,880	21	8,752
1991	38,130	82,166	29,400	37,074	6,040	21	9,630
1992	44,680	101,622	36,917	45,381	6,201	21	13,101
1993	40,066	84,311	29,069	38,802	6,361	21	10,057
1994	30,913	62,864	17,503	31,001	6,522	21	7,817
1995	30,748	61,245	14,469	31,591	6,683	21	8,482
1996	20,800	46,348	13,391	20,683	6,843	21	5,411
1997	26,086	59,095	19,368	25,671	7,004	21	7,031
1998	26,713	60,365	19,271	26,426	7,164	21	7,482
1999	33,175	68,591	18,932	32,788	7,325	21	9,525
2000	38,649	79,314	21,589	38,802	7,485	21	11,417
2001	36,746	76,581	21,601	36,463	7,646	21	10,850
2002	37,624	79,280	22,431	37,499	7,806	21	11,523
2003	42,055	91,586	30,175	40,638	7,967	21	12,785
2004	31,265	67,267	17,864	31,474	8,127	21	9,780
2005	22,814	53,395	15,466	22,625	8,288	21	6,995
2006	24,804	57,165	16,540	24,517	8,448	21	7,639
2007	27,784	60,002	15,696	27,107	8,715	21	8,462
2008	19,298	46,097	11,941	19,026	8,976	21	6,132
2009	15,951	42,004	11,405	16,013	9,240	21	5,326
2010	15,456	45,457	14,962	15,672	9,500	21	5,303

Appendix Table A2. French Mediterranean catch outside the EEZ reported to FAO, compared to total reconstructed industrial catch and discards, 1950-2010.

Year	Reported data	Total reconstructed catch	Industrial	Discard
1950	431	456	431	25
1951	920	973	920	53
1952	634	671	634	37
1953	634	671	634	37
1954	299	316	299	17
1955	402	425	402	23
1956	450	476	450	26
1957	616	652	616	36
1958	747	790	747	43
1959	263	279	263	15
1960	602	636	602	35
1961	885	936	885	51
1962	881	932	881	51
1963	1,072	1,134	1,072	62
1964	993	1,051	993	58
1965	788	834	788	46
1966	1,279	1,353	1,279	74
1967	1,540	1,630	1,540	89
1968	1,325	1,402	1,325	77
1969	1,474	1,560	1,474	85
1970	955	1,010	955	55
1971	827	875	827	48
1972	1,317	1,393	1,317	76
1973	1,078	1,140	1,078	62
1974	1,782	1,885	1,782	103
1975	2,167	2,293	2,167	126
1976	1,720	1,820	1,720	100
1977	625	661	625	36
1978	846	895	846	49
1979	667	706	668	39
1980	1,090	1,153	1,090	63
1981	1,100	1,159	1,100	59
1982	1,653	1,728	1,653	76
1983	1,752	1,831	1,752	79
1984	1,917	1,997	1,917	80
1985	2,668	2,763	2,668	95
1986	2,132	2,211	2,132	80
1987	2,476	2,555	2,476	79
1988	3,409	3,509	3,409	100
1989	2,599	2,666	2,599	67
1990	2,965	3,037	2,965	71
1991	3,184	3,259	3,184	75
1992	4,921	5,021	4,921	100
1993	4,792	4,878	4,792	86
1994	8,414	8,554	8,414	140
1995	7,222	7,341	7,222	120
1996	6,933	9,142	8,994	148
1997	6,634	8,747	8,606	141
1998	6,197	8,171	8,039	132
1999	5,669	7,473	7,353	120
2000	6,805	8,986	8,843	143
2001	6,156	8,135	8,006	129
2002	6,950	8,883	8,700	184
2003	5,570	7,354	7,237	117
2004	6,381	8,416	8,283	133
2005	8,343	11,016	10,842	174
2006	7,467	9,855	9,699	156
2007	9,594	12,657	12,457	200
2008	2,595	3,410	3,356	54
2009	3,783	4,768	4,659	109
2010	1,930	2,451	2,400	51

Appendix Table A3. Total reconstructed catch within the EEZ by major taxa 1950-2010.

Year	Clupeidae	Scombridae	Sparidae	Engraulidae	Mugilidae	Others[a]
1950	1,539	2,836	2,189	208	1,370	14,555
1951	4,752	4,913	4,590	208	1,878	29,279
1952	5,311	2,761	2,531	416	2,001	20,500
1953	2,215	2,153	2,973	208	2,062	25,252
1954	2,575	1,396	1,313	90	806	12,618
1955	4,862	1,633	1,481	1,252	2,745	11,715
1956	2,595	732	1,674	360	1,384	22,477
1957	4,918	3,603	2,104	1,254	1,474	22,786
1958	3,710	1,613	3,706	628	1,928	33,144
1959	2,768	1,653	1,389	838	1,871	9,840
1960	6,408	1,538	3,090	419	1,781	23,663
1961	13,884	1,948	3,432	172	1,560	27,796
1962	14,925	1,383	3,370	687	2,116	25,791
1963	22,520	2,621	3,308	860	2,382	25,238
1964	23,021	2,132	2,742	689	2,430	23,920
1965	14,917	2,717	3,061	1,206	1,847	23,418
1966	25,671	2,417	2,943	1,610	1,841	26,278
1967	26,293	3,155	4,178	4,163	2,341	37,708
1968	19,853	4,938	3,850	2,689	2,436	41,144
1969	29,560	5,666	3,542	2,691	2,813	31,316
1970	31,123	4,568	2,738	3,220	3,197	30,082
1971	21,219	5,915	2,475	1,856	3,134	29,287
1972	15,887	4,640	14,423	1,800	3,274	66,702
1973	16,655	3,711	5,642	1,291	2,075	40,147
1974	13,786	4,870	5,489	4,796	2,254	32,795
1975	18,841	5,153	6,016	4,067	2,635	36,682
1976	13,835	6,671	7,660	3,566	2,510	39,461
1977	14,801	6,135	6,200	1,520	3,311	32,554
1978	13,396	4,185	4,803	2,440	4,483	31,964
1979	16,676	5,649	4,230	2,770	6,529	33,157
1980	17,340	7,225	4,344	2,685	5,821	35,500
1981	23,312	7,101	5,307	4,106	8,930	40,420
1982	23,633	10,961	6,843	2,910	7,902	42,717
1983	20,232	8,279	5,870	2,274	5,945	42,268
1984	17,494	7,255	4,440	1,781	5,714	37,825
1985	21,157	8,588	2,057	1,174	4,142	40,856
1986	17,672	6,702	2,847	1,674	4,933	63,597
1987	18,809	6,794	2,802	2,792	4,775	43,742
1988	18,193	7,624	3,321	7,068	5,408	39,522
1989	14,277	5,796	4,805	10,178	5,224	44,389
1990	14,187	5,278	5,223	6,549	7,681	40,325
1991	14,480	4,993	5,087	5,156	7,598	44,852
1992	14,230	6,615	5,547	5,735	8,446	61,048
1993	14,046	6,525	4,886	7,186	7,274	44,393
1994	12,087	7,509	2,645	5,988	2,621	32,014
1995	15,268	5,426	1,840	6,038	1,561	31,110
1996	7,102	5,848	2,528	4,392	1,850	24,628
1997	7,714	8,043	2,821	5,751	2,295	32,471
1998	7,743	7,208	2,857	7,109	2,337	33,110
1999	13,528	4,070	3,972	10,313	2,805	33,905
2000	18,296	5,244	3,758	10,171	2,527	39,319
2001	17,782	4,578	3,702	8,096	2,655	39,768
2002	15,146	4,282	4,237	10,817	2,435	42,363
2003	14,041	4,033	4,346	11,769	2,399	54,999
2004	14,407	3,973	4,436	8,081	2,133	34,237
2005	11,867	3,865	3,529	2,676	1,868	29,590
2006	13,904	4,579	3,673	2,451	2,095	30,463
2007	15,057	6,055	3,165	4,602	1,680	29,442
2008	7,841	3,281	3,579	4,552	1,570	25,275
2009	4,710	2,760	4,043	2,594	1,533	26,364
2010	1,572	2,728	4,665	3,481	2,051	30,960

[a] This group includes 68 taxa.

Appendix Table A4. Total reconstructed catch outside the EEZ by major taxa, 1950-2010.

Year	Scombridae	Clupeidae	Sparidae	Palinuridae	Mullidae	Others[a]
1950	18	15	6	36	-	381
1951	39	32	13	76	-	812
1952	27	22	9	52	-	560
1953	27	22	9	52	-	560
1954	13	10	4	25	-	264
1955	17	14	6	33	-	355
1956	19	16	7	37	-	398
1957	26	22	9	51	-	544
1958	32	26	11	62	-	659
1959	11	9	4	22	-	233
1960	26	21	9	50	-	531
1961	38	31	13	73	-	781
1962	38	31	13	73	-	778
1963	46	38	16	89	-	946
1964	42	35	15	82	-	877
1965	34	28	12	65	-	696
1966	55	45	19	106	-	1,129
1967	66	54	23	127	-	1,360
1968	57	46	19	110	-	1,170
1969	63	52	22	122	-	1,301
1970	41	33	14	79	-	843
1971	43	20	41	63	-	708
1972	18	608	30	15	100	623
1973	17	384	88	74	36	541
1974	34	507	250	62	81	951
1975	23	795	272	95	111	996
1976	18	478	234	74	109	907
1977	33	104	89	40	67	329
1978	15	8	149	43	76	605
1979	8	8	162	54	78	396
1980	5	28	215	66	96	742
1981	122	10	201	69	101	656
1982	486	9	233	76	146	778
1983	551	9	188	83	124	875
1984	750	18	218	88	112	812
1985	1,417	22	233	94	107	890
1986	1,048	29	202	76	102	754
1987	1,530	31	190	57	98	650
1988	2,321	34	6	38	115	996
1989	1,999	21	74	31	100	441
1990	2,395	22	58	30	95	437
1991	2,603	24	65	30	47	490
1992	4,422	31	74	26	35	433
1993	4,574	30	60	25	21	168
1994	8,280	43	25	23	14	170
1995	7,125	40	2	7	14	153
1996	8,900	41	13	8	11	168
1997	8,523	40	13	8	10	153
1998	7,967	37	8	8	10	140
1999	7,297	35	7	3	5	126
2000	8,818	35	3	-	-	130
2001	7,969	32	3	-	-	131
2002	7,613	37	2	-	-	1,232
2003	7,217	29	2	-	-	106
2004	8,241	33	2	-	-	140
2005	10,827	43	2	-	-	144
2006	9,670	66	-	-	-	119
2007	12,432	50	-	-	-	175
2008	3,331	13	-	-	-	66
2009	3,842	49	59	20	95	704
2010	2,049	20	35	29	14	304

[a] This group includes 50 taxa.