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## An approximate assessment of the production levels of the Italian fishing fleet in the Mediterranean Sea during selected years in comparison with the analogous previous estimates

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### Abstract

During the past two decades, the organization Sea Around Us (based at the Fisheries Centre in British Columbia, Canada) has been carrying out the relevant task of reconstructing national statistics on marine fisheries for almost all countries and territories to fill information gaps and correct the general trend of severe underestimation of the “true” level of catches, discards and landings.

A recent reconstruction of this kind showed that the annual catches by the Italian fleet fishing in the Mediterranean Sea had been presumably underestimated during most of the 1950-2010; in the 1970-1995 sub-period, they would have ranged from 0.7-1.1 million metric tons per year. However, comparisons with the landings for the few years for which there are “independent” estimates (i.e., not based on official statistics) show that many more bivalve molluscs and fewer “small pelagics” were caught and that the highest annual outputs reported by Sea Around Us should be presumably cut by 25%-35%.

**Keywords:** Italy; fisheries; historical landings; time series reconstruction.

### Introduction

In most countries, the official statistics on fisheries are rather unreliable and sometimes strongly underestimated because of the great spatiotemporal dispersal of the operations at sea, the insufficient effort deployed for data collection and the convenience for fishermen of hiding landings for fiscal reasons or for being tied to illegal, unauthorized, unreported fishing activities (IUU; Agnew *et al.*, 2009). Statistics issued in Italy are not an exception, as shown by the criticisms put forward by some Italian fishery scientists in the past (Levi, 1974; Bombace, 1979; Cingolani *et al.*, 1986).

To overcome the drawback of landings/catches being greatly underestimated in the official fisheries statistics of most states, the organization Sea Around Us has been comparing these data during the last 10-20 years with estimates from various sources, such as pertinent scientific and technical reports (including those written in national languages and/or unpublished) and statements by skilled fisheries scientists (Zeller & Pauly, 2015).

A revision process of this kind was recently performed by Sea Around Us on the 1950-2010 series of annual landings by the National Institute for Statistics, ISTAT (until 2004), and by IREPA (1986-2013, under different denominations in the last years), coming to the conclusion that the catches [i.e., landings plus discards, with lat-

ter mainly estimated from data by European Commission (2011)] by the Italian fleet fishing in the Mediterranean Sea were up to 2.0-2.5 times the annual landings officially recorded by the ISTAT (Piroddi *et al.*, 2014; 2015).

It has been hypothesized that with the combination of the landings for all commercial species (bivalve molluscs included), the annual catches were 1,000,000-1,100,000 metric tons during 1975-1986 and 700,000-900,000 t in 1970-1974 and 1987-1995 (Piroddi *et al.*, 2014; 2015), but large confidence limits were tied to these estimates, as the original bibliographic sources were felt to be relatively unreliable (Zeller & Pauly, 2015; Piroddi *et al.*, 2015).

The estimates by Piroddi *et al.* (2015) were questioned by Ragonese & Cannizzaro (2017) on the basis of the data by Cingolani *et al.* (1986, a paper missing in the literature reviewed by Piroddi *et al.*, 2014; 2015); this paper reported that the landings by the Italian fleet fishing in the Mediterranean Sea had been approximately 520,000 t in 1982. Although this estimate was much lower than the analogous estimate by Piroddi *et al.* (2014 and 2015) of 1,000,000-1,100,000 T, the resulting difference was not statistically relevant because Cingolani *et al.* (1986) had not reported any confidence limits and those from Piroddi and co-authors were large.

As a consequence, I scrutinized the pertinent literature looking for non-ISTAT estimates on the annual landings

by the Italian fleet (or fractions of it) fishing in the Mediterranean Sea to assess if they differed statistically from those reported by Piroddi *et al.* (2014; 2015) for the same years.

### **Gathering of official statistical data on marine fisheries in Italy after WWII**

In the decades after WWII, data on the amount and composition of the species of commercial fish and shellfish landed each year/month in Italy and its coastal subareas were collected by the National Institute for Statistics (ISTAT) and printed annually until 2004 (Fortibuoni *et al.*, 2015).

These basic data were supplied by the local port authority offices (*Capitanerie di Porto*) on the basis of the registers of the fishing vessels and the monthly declarations by the head managers of the most important Italian wholesale fish markets (44 over all of Italy during 1956-1960; ISTAT, 1959) on the amount and species composition of the sold fish and shellfish. The ISTAT data were “integrated” with estimates on the amount of landings (which in Italy nearly equalled the FAO’s “nominal catches” as the bulk of fish and shellfish are marketed full dressed, fresh or chilled; see Annexes XIII-XV of the EU Regulation No. 404/2011) sold out of the public markets. However, the precise nature of the integrations has not been explained and remains unclear (Cingolani *et al.*, 1986). Moreover, it should be stressed that ISTAT data also included the landings by the Italian flagged vessels fishing in the Atlantic and Indian oceans (on the basis of monthly declarations by the vessel captains) that were never very high (approximately 10,000-50,000 t/year during 1950-2010, with peak in late 1970s).

To overcome the problems of the Italian fisheries statistics, a project was conceived in 1978 and then carried out in 1980-1982 for a national-wide sampling survey (later known as PESTAT). Because of the delays and various difficulties, the survey started in 1981 and estimated the national annual landings only in 1982 (Bazigos *et al.*, 1984; Cingolani *et al.*, 1986; Spagnolo & Placenti, 1988). It is worth noting that an analogous survey was carried out during 1978-1980 for the fishing fleet based in Emilia-Romagna (NE Italy), but the data were not published, although they were later summarized in the National Fisheries and Aquaculture Plan in 1986-1988 (MMM, 1986).

In 1985-1993, several studies on the economic status of the Italian fisheries enterprises were carried out. According to these studies, landings from 200-350 fishing boats were monitored weekly, biweekly or occasionally monthly on a national scale, using interviews with captains and fish dealers to understand the initial sale prices (the interviews were conducted by people of the same sector to avoid false or null declarations; Spagnolo & Placenti, 1998).

Since 1997, the number of monitored fishing vessels has progressively increased (to reach 750 boats on a national scale in 2002, with an additional 750 vessels

in a “reserve pool”; IREPA, 2003), and the data were published in detailed annual reports for the years 1997-2013 [but gaps exist for 2008 and 2012 and were filled, to some extent, with the national estimates in the following reports: Mannini & Sabatella (2015)]. Then, no further reports were published, although the pertinent fisheries statistics continued to be gathered (EC or EU Regulations Nos. 199/2008 and 2017/1004).

Nevertheless, some of the mentioned annual reports did not include the national catches of wild mussels, which are mostly from the lagoons of NE Italy, supplementing the aquaculture production (Della Seta, 1989; Prioli, 2008) or those of swordfish and tuna; for those years, the corresponding data were found elsewhere.

### **Materials and Methods**

I searched papers and technical reports containing estimates on the size and structure of the Italian fleet fishing in the Mediterranean Sea as well as the corresponding annual landings of commercial fish (also the discards at sea for some segments of the fleet) in the ASFA (Aquatic Sciences and Fisheries Abstracts) electronic database, on the Internet by common search engines, in the bibliographies of all sources and in the national and EU fisheries legislation.

I derived non-ISTAT estimates of the landings of the Italian fleet fishing in the Mediterranean Sea during 1972 from several papers and speech transcripts that had been published in the proceedings of the First National Conference on fisheries (Rome, January 1974). For 1979, I obtained non-ISTAT estimates by combining data from various sources (IRVAM, 1980; MMM, 1986; Della Seta, 1989; Romanelli *et al.*, 2009) (see Table 1).

With concern to 1986, I estimated the national landings by the trawling fleet through estimates concerning the trawlers based on the Tyrrhenian and Adriatic coasts in 1985 (Spagnolo, 1989) and South Sicily in 1986 (Levi, 1991), while those in the group *Mytilus galloprovincialis* Lamarck and *Chamelea gallina* Linnaeus (i.e., mussels and Venus clams, respectively), and the ones comprising *Thunnus thynnus* Linnaeus and *Xiphias gladius* L. (bluefin tuna, swordfish and minor allied species, summed up into the group of “large pelagics”) were obtained from specific sources (Della Seta, 1989; Romanelli *et al.*, 2009; ICCAT, 2016a; 2016b). I estimated the national output of the artisanal fleet fishing inshore during 1986 by backward extrapolation of the data and time trends reported for the years 1997-2013 in one of my previous papers (Romanelli, 2018). On the landings of pilchards and anchovies, however, I had to turn to the ISTAT data for lack of any independent information (see farther).

I obtained most of the data on the national landings for 1982, 1991 and 1995 from several texts (e.g., Cingolani *et al.*, 1986; MRAAF, 1994; 1997).

As in Piroddi *et al.* (2014, 2015), it has been stated that almost all discards at sea by the Italian vessels come from those fishing for commercial purposes and that discards were 8%-10% of the annual catches during 1950-2010

for all non-ISTAT estimates of landings, I have calculated the associated discards for the corresponding shares of Piroddi *et al.* (2014; 2015) after excluding the group “wild mussels and Venus clams” because *C. gallina* is known for outcompeting wild mussels, and most discarded clams are thought to survive once returned to the sea (European Commission, 2016). I have used the ISTAT estimates on the landings of bivalve molluscs in 1972 and those of pilchard and anchovies in 1986 because there was a lack of data from other sources.

All non-ISTAT estimates of landings in certain years that were retrieved from the pertinent literature and the analogous ones reported by Piroddi *et al.* (2014, 2015) were statistically compared using Mann-Whitney non-parametric tests for the same clusters of commercial fish and shellfish (Zar, 1999).

## Results

From the reviewed literature (almost all of which was in Italian), the estimates that were entirely or partially independent of those by ISTAT on the landings by the national fleet fishing in the Mediterranean Sea covered six years (1972, 1979, 1982, 1986, 1991 and 1995; see Table 1).

At the national conference on fisheries of January 1974, the economist F. Forte (1974) stated that the statistics on Italy’s external trade of fish and shellfish, the consumption of the same items by the Italian families and the national aquaculture production allowed for estimation of the annual landings by the Italian fleet fishing in the Mediterranean Sea at approximately 400,000 t in 1972 (estimate confirmed, to some extent, in the transcript of a speech held on the same occasion by a manager of the Italian federation of the owners of fishing vessels; Iandolo, 1974).

Based on IRVAM (1980), which used various sources from fishermen cooperatives and owners of fishing vessels, approximately 700,000 t of fish and shellfish were landed on a national scale in 1979. In the same report, an interview survey carried out in 1980 on 800 families showed that the annual stated consumption of fresh, refrigerated and frozen fish and shellfish was 10.8 kg per person (i.e., approximately 750,000 t for the entire Italian population of that time). This result was supposed to be indirect confirmation of the previous estimate of landings once the import and export fish and shellfish fluxes, aquaculture production and their use by national food industries had been taken into account (Marrichi, 1977, plus some data by MMM, 1986, on the Italian production of fish meal at that time).

With reference to 1982, there was the quoted estimate by Cingolani *et al.* (1986) that landings for the bulk of the commercial species caught by the Italian fleet fishing in the Mediterranean Sea amounted to 520,000 t. Once the data were added on the fished biomass of wild mussels (20,000-30,000 t/year during 1979-2010; Della Seta, 1989; IREPA, 2012) as well as those of bluefin tuna and swordfish (ICCAT, 2016a and 2016b), a total production

of 554,000 t was established.

With the summed estimate for the landings in 1985 by the local trawling fleets operating off the coasts of the Italian Peninsula in the Ligurian, Tyrrhenian and Adriatic Seas (Spagnolo, 1989) along with a second analogous estimate for the landings by Sicilian trawlers in 1986 (Levi, 1991) and an additional 8% to account for the Sardinian trawlers and those based on the Ionian coasts of Apulia and Calabria, a total of 240,000 t landed yearly, on average, was obtained by the Italian trawlers fishing on Mediterranean grounds in 1985-1986. Similarly, I estimated the national production by the artisanal and small-scale fleet (boats with LOA  $\leq$  12 m and passive fishing gears only; Romanelli, 2018) at 90,000 t landed in 1985-1986 on average (this estimate is rather close to the 80,000 t reported by Bombace & Cingolani, 1987, for 1982, from data by Cingolani *et al.*, 1986).

Again, the mean annual national landings of Venus clams and wild mussels in 1985-1986 were roughly assessed at 82,000 t/year (Della Seta, 1989; Romanelli *et al.*, 2009) and those of large pelagics at 20,000 t/year (ICCAT, 2016a and 2016b), while for those of pilchards and anchovies, I had to turn to the ISTAT data, which resulted in a value of 81,000 t. It is worth noting that in 1986, the anchovy landings were exceptionally low (Cingolani *et al.*, 1996), and this value reduces any possible discrepancy between the “true” landings in 1986 for the pool “pilchards and anchovies” and the official data for the same year (ISTAT, 1988).

I have derived the bulk of the annual landings by the Italian fleet in 1990-1991 from IREPA surveys, and the results of which were not published and were later summarized in the Fourth Triennial National Plan for marine fisheries and aquaculture, which were 458,500 T in 1991 (see Tables 15-18 in MRAAF, 1994). Taking into consideration the landings of wild mussels and “large pelagics”, another 43,000 t must be added (Della Seta, 1989; IREPA, 2012; ICCAT, 2016a and 2016b), and I consequently calculated 501,500 t of total biomass from the Mediterranean for that year (Table 1).

Out of the estimates of annual landings in Table 1, those of the pool “Venus clams and wild mussels” result lower for 5 out of 6 years than those reported by Piroddi *et al.* (2014) for bivalve molluscs. The central values of the two of five data sets significantly differ after the Mann-Whitney test on the “ranks” (two-way test Mann-Whitney  $U_{5,5} = 25$ ;  $p < 0.01$ ), but if I consider the year 1972, then the central values of the distinct sets of six data sets do not differ each other (two-way test Mann-Whitney  $U_{6,6} = 30.5$ ;  $0.05 < p < 0.10$ ). Additionally, the central values of the distinct sets of six data sets on the annual landings of “pilchards and anchovies” differ significantly (two-way Mann-Whitney test, with  $U_{6,6} = 31.5$ ;  $p < 0.05$ ).

## Discussion and Conclusion

My investigation into the pertinent scientific and technical literature showed that non-ISTAT estimates for the annual landings by the Italian fishing fleet operating in



Table 1. Estimates of the total and partial landings by the Italian fleet over several years as reported by various bibliographic references and Piroddi et al. (2014).

YEAR	*WILD MUS-SELS + VENUS CLAMS (t)	PILCHARDS + ANCHOVIES (t)	**ALL OTHER SPECIES (t)	***TOTAL (t)	§DISCARDS LANDINGS (t)	***\$TOTAL CATCHES (t)	References
1972	<sup>a</sup> 20,000	<sup>b</sup> 122,000	258,000	400,000	[34,200]	[434,200]	(Forte, 1974; ISTAT, 1974; Levi, 1974);
1972	21,600	288,200	437,100	746,900	58,100	805,000	(Piroddi et al., 2014);
1979	110,000	<sup>c</sup> 290,000	<sup>d</sup> 300,000	700,000	[53,100]	[753,100]	(IRVAM, 1980; MMM, 1986; Della Seta, 1989; Romanelli et al, 2009);
1979	38,100	422,000	567,300	1,027,400	86,600	1,114,000	(Piroddi et al., 2014);
1982	120,000	153,600	280,400	554,000	[39,100]	[593,100]	(Cingolani et al. 1986; Della Seta, 1989; Romanelli et al, 2009; ICCAT, 2016a; 2016b);
1982	47,800	382,500	595,700	1.026.000	91,000	1,117,000	(Piroddi et al., 2014);
1986	82,000	<sup>e</sup> 81,000	<sup>f</sup> 350,000	513,000	[38,800]	[551,800]	(Della Seta, 1989; ISTAT, 1988; Spagnolo, 1989; Levi, 1991; Romanelli et al., 2009; ICCAT, 2016a; 2016b; Romanelli, 2018);
1986	34,900	287,500	375,200	697,600	70,000	767,600	(Piroddi et al., 2014);
1991	72,500	74,000	355,000	501,500	[38,600]	[540,100]	(MRAAF, 1994; ICCAT, 2016a; 2016b);
1991	25,400	137,300	316,000	478,700	44,300	523,000	(Piroddi et al., 2014);
1995	59,000	109,000	335,000	503,000	[40,000]	[543,000]	(MRAAF, 1997; Romanelli et al., 2009; ICCAT, 2016a; 2016b);
1995	28,150	152,600	327,550	508,300	47,700	556,000	Piroddi et al., 2014);

\*: landings to be compared with that of bivalve molluscs in Piroddi et al. (2014);

\*\*\$: estimates often obtained by the difference between the total landings and the sum of the pools “wild mussels and Venus clams” and “pilchards and anchovies”;

\*\*\*: estimates of the total commercial fish and shellfish landed by Italian-flagged vessels fishing in the Mediterranean Sea;

§: the estimates in brackets relate to or include discards at sea derived from those reported by Piroddi et al. (2014), assuming that they make up the same share of the annual catches after excluding the bivalve molluscs;

a: obtained estimate from the ISTAT data on all “other molluscs” (i.e., other than Cephalopods) landed on the Italian coast of the northern and central Adriatic Sea;

b: estimate obtained adds up to 90% of that proposed by Levi (1974) for the Italian Adriatic coast and the values reported by ISTAT for the other Italian seas.

c: Landings of the pooled “pilchard and anchovy” data derived from those of “small pelagics” in 1980 as reported by MMM, 1986;

d: estimate obtained by inserting the 1980 data in the column of the “pilchards and anchovies” pool;

e: value taken from ISTAT (1988) because there were no other estimates;

f: The estimate includes data on the landings during 1985 by Italian trawlers based on the Ligurian, Tyrrhenian and Adriatic Seas (Spagnolo, 1989).

the Mediterranean Sea existed only for the years 1972, 1979, 1982, 1986, 1991 and 1995, and these estimates are much larger than the official ones (herein not detailed; Cingolani *et al.*, 1986; Spagnolo & Placenti, 1998).

Nevertheless, the data I gathered on the annual landings of 1972, 1979, 1982, 1986, 1991 and 1995 by the Italian fishing fleet significantly differ from the analogous data estimated by a team of experts on behalf of Sea Around Us. Specifically, the estimates reported by Piroddi *et al.* (2014; 2015) on the bivalve molluscs were too low, as they never surpassed the level of 50,000 t/year over the entire 1950-2010 period, while the data in Table 1 shows that landings for the pool “wild mussels and Venus clams” were 80,000-120,000 t in three out of six of the years in question.

In contrast, the estimated landings in the pool “pilchards and anchovies” that I retrieved for the same six years were significantly lower than those reported by Piroddi and colleagues (2014; 2015), as shown in Table 1, where the level of 300,000 t would only have been reached in 1980, according to the reviewed literature (see footnote on Table 1), while it was reached in 1972, 1979, 1982 and 1985, according to the team of experts affiliated with Sea Around Us.

It is interesting to note that Levi & Andreoli (1989) stated that the official data by ISTAT during the period 1959-1983 on the total size (in tonnage or horsepower, averaged over the last three years) of the Italian fleet trawling and the corresponding annual landings (as estimated from data on bottom fish and shellfish species living at some distance from the coast, i.e., in areas where trawling can be legally performed) showed that once the relatively stable yearly days spent at sea were assumed, the best yields per boat on the Tyrrhenian coasts (also including Sardinia, after the FAO-GFCM delimitation of the Mediterranean sub-areas at that time) had presumably been recorded in the first years of the series; thus, they believed it to be necessary to institute a 50% reduction in the trawling fleet that had operated locally during the most recent years to return to the previous annual yields. The same analysis gave less clear results for the trawlers operating in the northern and central Adriatic, as the total yields of the exploited species seemed to have been larger in 1972-1983 than in the past, but the data for the most recent years showed that the fishing fleet had to be either been stable or were slightly reduced. Similarly, the data on the Italian trawlers operating in the Strait of Sicily and adjacent zones (west Ionian and south Adriatic Seas) showed that the best annual yields would be obtained by a 13% reduction in the effort recorded during the last years of the time series.

On the annual landings of pilchards and anchovies, it is worth noting that the very low catches of the latter species in Adriatic during 1986 (Cingolani *et al.*, 1996) forced the Italian maritime authorities to forbid the conversion of any kind of catch from the Italian seas to fish meal (MMM, 1987; prohibition still in force).

Finally, it is known that the development of the Italian *C. gallina* fishery using hydraulic dredges started in the early 1970s (which explains the use of the low ISTAT

datum on the production of bivalve molluscs in 1972 in Table 1, which was used due to the lack of any other estimate) and that after the first decade, its landings progressively decreased from 100,000 down to 15,000-20,000 t/year (Romanelli *et al.*, 2009).

On the basis of all retrieved data and information, I reached the conclusion that the very high estimates of 1,000,000-1,100,000 t of fish and shellfish caught annually in 1975-1985 by the Italian fishing fleet operating in the Mediterranean Sea should be cut by 25%-35%.

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