

FISHING AND TERRITORY. STATUS AND PERSPECTIVES OF SARDINIA FISHERIES. THE CASE OF TRADITIONAL FISHERY IN ASINARA ISLAND MPA *

Donatella Carboni¹, Giovanni Messina², Vittorio Gazale³, Ester Tarricone¹

¹University of Sassari – DUMAS, Via Roma, 151 - 07100 Sassari (Italy),

phone +39 3384285524, e-mail: carbonid@uniss.it

²University of Palermo, Palermo (Italy)

³Asinara National Park

Abstract – This contribution intends to suggest a survey on the dynamics related to fishing activity in Sardinia. Firstly, it will be proposed a quantitative synoptic analysis about the relevance of the aforementioned sector on a global, continental and national scale. This will be followed by a more careful analysis of the nautical and fishing sectors in Sardinia and, in particular, in Asinara Island. As regards the case study, through the consultation of institutional reports and cross-sector reference bibliography, there will be presented the specificities related to the state of the fishing fleet in Sardinia and to the data of the vessels carrying out fishing and aquaculture activities in Sardinian waters. In relation to the state and deployment of the fishing fleet at the major and minor port systems of the island, the main techniques and tools used by Sardinian seafarers will also be analyzed (fixed longlines, bottom trawls, purse seines, casting nets, driftnets). Next, the contribution will provide updated information about employment in fishing and about the importance of this sector for the local economy of an island with almost 1900 km of coastline and a marked vocation for seaside tourism. As a matter of fact, if fishing constitutes an economic and socially relevant activity in itself and an important historical and traditional heritage, it represents at the same time a possible trigger to read the territorial dynamics of coastal areas, to identify possible extensions and enhancements of the tourist offer (fishing tourism), to investigate the effectiveness and consistency of bottom-up governance formulas. Governability, however, is a complex concept with many dimensions and Marine Protected Areas (MPAs) are certainly a valuable tool to meet both conservation and socio-economic needs. Indeed, it has been extensively demonstrated that well-managed MPAs lead to an increase in species richness. The mapping and the identification of habitats and species fished in Asinara Island MPA made it possible to pinpoint the priority areas in need of protection and to define efficient fisheries management measures shared by all stakeholders. The study outlines small-scale fishing in the Marine Protected Area of Asinara Island and fosters knowledge and evolution of artisanal fishing activities in the study area. This work also intends to constitute the premise for future and more applicative lines of research.

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Fishery and Aquaculture: multi-scalar notes

The FAO report *The State of World Fisheries and Aquaculture 2020 Sustainability in action* [1] shows that global fish production reached approximately 179 million tons in 2018, with an estimated value of 401 billion USD. Compared to the total, 82 million tons, worth 250 billion USD, came from aquaculture production. 156 million tons of the overall total were used for human consumption, equal to an estimated annual supply of 20.5 kg per capita. The remaining approximately 23 million tons were destined for non-food uses, mainly to produce fish-meal and fish-oil.

Aquaculture accounted for 46 % of total production and 52 % of fish intended for human consumption. Most of the world's marine fish stocks are over-exploited; this leads to a decline in fish populations and drastic changes in food webs and in the functioning of the ecosystem [2; 3; 4].

As regards the European scale, we can deduce some contextual data from the report of the EUMOFA (European Market Observatory for Fisheries and Aquaculture Products) *The EU fish market* (2020) [5]. The production from fresh fish in the European Union, in 2018, amounted to 6656 million tons, with a decrease of 3 % compared to 2017. Over 5300 million tons of the total value were destined for consumption.

The state of Mediterranean stocks is particularly delicate [6; 7]. Its characteristic as a semi-enclosed basin makes it extremely vulnerable to anthropogenic pressures such as habitat degradation, over-exploitation of resources and pollution, especially in the context of global warming [8]. According to the FAO, 75 % of Mediterranean stocks assessed are over-exploited [1]. Nevertheless, the exploitation of fish stocks in Mediterranean Sea is not the same among the different fishing practices: 17 % of the vessels in the fleet are dedicated to trawling, dredging and seine fishing, while 83 % are dedicated to small-scale fishing [1; 4]. Although it is the most widespread fishing practice in Mediterranean Sea, few studies have analyzed stocks fished by small-scale fisheries, resulting in an important knowledge gap between large-scale and small-scale fisheries [4; 9]. The lack of data on traditional and small-scale fishing in Mediterranean Sea (fishing effort, catch rate) and biological information (species, catch size, weight) means that most of the fish stocks affected by this type of fishery are not evaluated [10] making their insertion into national and international management policies complex [11; 12; 13].

The Italian data, referred to 2020, as regards the tons of fish, was equal to 130 085 tons, which corresponded to an economic value of 642.45 million euro [14]. Compared to the fleet operating in Italy (Figure 1), 11 926 small boats and 145 302 large fishing boats were recorded in 2020, with a constant trend in decline since 2004, for a total of 928 127 kW of delivered power [14].

Regarding instead aquaculture, again in 2019, according to the ISPRA Report [15, p.1], 152 534 tons of fish were produced: 60.7 % mollusks, 39 % fish and 0.01 % of crustaceans. In the same report we read: "Veneto is confirmed as the first region in Italy by number of plants (25 %), while Emilia-Romagna is the first region by production volumes (24 %). [...] Five regions (Veneto, Emilia-Romagna, Friuli-Venezia Giulia, Puglia, Sardinia) host 66.6 % of the aquaculture plants and contribute 66.8 % to national production. In most coastal regions, the use of brackish / salt water resources prevails, with plants located in transitional, coastal and marine environments [...]. Aquaculture production in the reference period 2013 - 2018 grew by 8.3 % overall, with an annual trend of + 1.7 %".

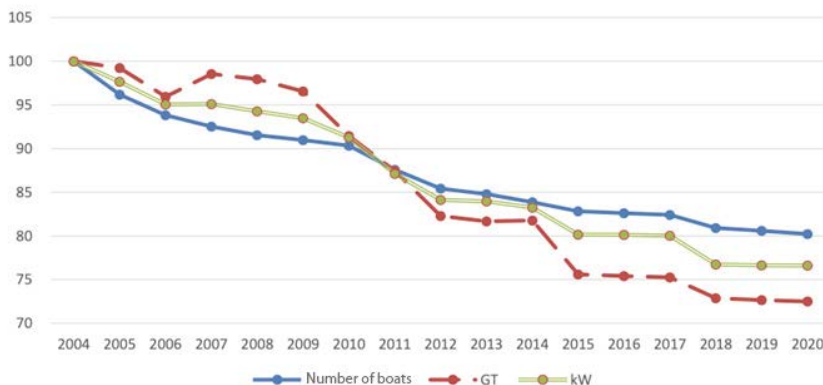


Figure 1 – Fishing fleet in Italy. Source: [14, p.6].

In 2019 in Italy, as evidenced by BMTI data [16], per capita consumption revealed that large families individually consumed less (on average 4 kg per capita in families with more than 5 members and an expenditure of 38 euro) and moved towards the purchase of less expensive products such as mussels and pangasius. Again, in the months of the pandemic, compared to the data relating to fish consumption, ISMEA 2021 data [17, p. 5] based on Nielsen calculations show that: “Fresh food, in the initial period of the lockdown, clearly suffered the effects of the limitations for the containment of infections, with an almost zero demand for quality products by the catering industry. But after a fluctuating trend, spending on fresh fish in the final phase of the year showed a clear recovery (in December it marked the best performance with a + 21 % compared to the same period of the previous year). This allowed the surpassing of the results of 2019 [...] until in the first quarter of 2021 the sales of fresh fish products rose dramatically, reaching + 33.3 % compared to the same period in the previous year”.

Sardinia as focus

With almost 1900 km of coastline and 15000 hectares of wetlands, Sardinia has a highly qualified landscape for fishing and aquaculture. CREA 2021 report [18] analyzes volumes, in terms of catches and revenues, relating to this sector in Sardinia in 2019: 8160 tons of catches (4.7 % of the national figure) and 63.2 million of revenues (7.1 % of the national figure). With respect to data on catches, we report below the historical trend 2008-2016 (Figure 2).

In this context, it is possible to provide an update through January 2020 on the consistency of the fleet as reported by Fleet Register - European Commission [20]: small boats amounted to 1326 (11 % of the national figure). In general, Sardinian fleet expressed a total tonnage of 14 914 GT (gross tonnage) and a total engine power of 53 748 kW.

452 of the 1326 ships belonging to Sardinian fleet were registered in a port in Northern Sardinia. This segment of fleet expressed a total tonnage of 4768 GT (out of a Sardinian total of 14 914) and an engine power of 22 652 kW (out of a Sardinian total of 53 748). Despite a negative trend over the years, Sardinian fleet remains one of the largest in the entire national territory.

This fleet is allocated in 18 ports [20; 21] as reported in the table (Table 1).

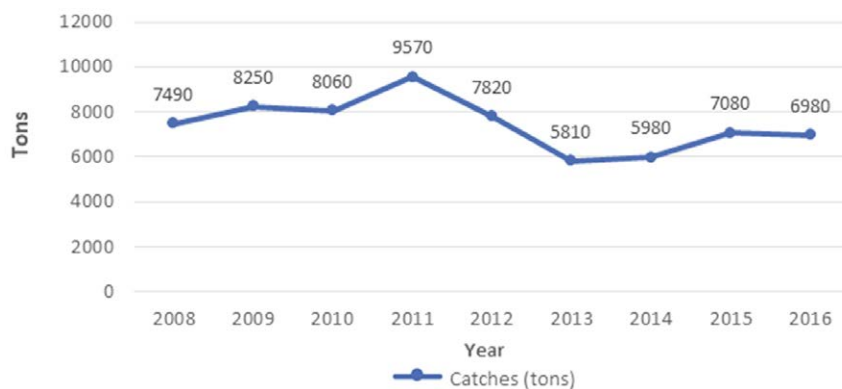


Figure 2 – Variations of catches in Sardinia seas. Source [21].

Table 1 – Fleet positioning in Sardinian ports. Source: Fleet Register - European Commission [20].

Port	Number of boats	Tonnage (GT)	Power (kW)
Alghero	91	1122	4447
Arbatax	47	661	1347
Bosa	39	127	824
Cagliari	189	4887	12270
Cala Gonone	6	311	949
Carlo Forte	38	245	1287
Castelsardo	42	173	1625
Golfo Aranci	48	176	835
La Maddalena	28	305	1605
Olbia	44	260	1017
Oristano	339	1061	4502
Porto Cervo	0	0	0
Porto Conte	1	14	397
Porto Scuso	17	150	819
Porto Torres	113	2018	9937
S. Teresa di Gallura	46	573	1965
Sant'Antioco	210	2293	8255
Siniscola	28	538	1667
Sardinia	1326	14914	53748

Concerning the reduction in terms of tonnage and engine power, the island's fleet follows a trend that has been going on for many years and involves the entire Italian fleet, and in general almost all of the fleets in Mediterranean Sea; this derives from the increase in production and fuel costs, as well as from the control policy by Europe (allocation of quotas for member countries) [19; 20; 21]. Also interesting is data on fuel consumption that represents an index of profitability of fishing activity. In the period 2008/2016 there was a decrease in fuel consumption which improved technical efficiency of production activity since, in 2016, for each kilogram of fish landed, an average value of 2.1 liters of diesel was estimated per kilogram consumed compared to the 3.1 liters per kilogram recorded in 2012.

In terms of value, small-scale fishing produced approximately 44 % of the total turnover of the regional fishing sector compared to 39 % produced by trawling. Therefore, considering data relating to gross salable production, it is evident the economic importance assumed by systems that use small boats and which as such do not involve particularly onerous investment decisions for operators. The better valorization of small-scale fishing production compared to trawling is also due to the better quality of the landed product and to the mix of species more concentrated on products with a higher unit value. Data analysis on the volume and on the regional production by species indicates that the most fished products on the island were: the common octopus or rock octopus (772.24 tons), sardines (455.67 tons), blotched picarels (499.12 tons), baby octopus (398.59 tons) and swordfish (344.31 tons). These species accounted for 35 % of regional catches in 2016 and 24.4 % of their value [19; 20].

The constant reduction in terms of tonnage, engine power and length of Sardinian fleet, together with the general age of the boats that constitute it, clearly affect the type of fishing that is carried out, which cannot be large. This is confirmed by the analysis of the main fishing gears used by Sardinian boats (Table 2). As can be seen from the table, in Sardinia there is a clear majority of boats that use fixed longlines as their main fishing gear. Almost 68 % of the boats use this type of gear, while in Northern Sardinia it reaches almost 70 % of the total fleet [20; 21].

A note should certainly be addressed precisely to the fishing techniques (Tab. 2) used and often linked to ancient traditions and pertaining to an intangible heritage of the highest value [20].

Table 2 – Fishing techniques in Sardinia. Source: Fleet Register - European Commission [20].

Lenght (m)	LLS Longlines set	OTB Trawls nets Large tables	PS Purse seine	GNS Gillnets dropped	GND Drift nets	Total
Alghero	68	9	8	6	0	91
Arbatax	32	7	5	3	0	47
Bosa	27	4	3	2	3	39
Cagliari	90	54	8	37	0	189
Cala Gonone	2	3	1	0	0	6
Carlo Forte	24	4	5	5	0	38
Castelsardo	31	0	11	0	0	42
Golfo Aranci	33	6	7	2	0	48
La Maddalena	15	5	6	2	0	28
Olbia	23	3	8	10	0	44
Oristano	289	28	17	3	2	339
Porto Cervo	0	0	0	0	0	0
Porto Conte	1	0	0	0	0	1
Porto Scuso	10	2	2	3	0	17
Porto Torres	78	16	19	0	0	113
S. Teresa di Gallura	40	2	4	0	0	46
Sant'Antioco	119	41	24	19	7	210
Siniscola	17	10	1	0	0	28
Sardinia	899	194	129	92	12	1326

Data available on types of gear used by Northern Sardinia fleet, connected with those on the length of the boats, generally depict a fishing sector made up of generally small boats (in Northern Sardinia more than 80 % does not exceed 12 m) which carry out a type of fishing that is mainly artisanal and therefore sustainable, with a modest quantity of fish, carried out in fishing areas not very far from the coast and the reference port. The choice to practice small-scale fishing seems to be dictated by several reasons, such as the limitation of means of work, the increasingly worse economic conditions of fishing sector in Italy, the European and national policies linked to the protection of environment and marine ecosystem services, but also an increasingly widespread awareness of fishermen on the need to preserve marine environment in order to conserve fish resources and, therefore, save their jobs [21].

As regards intensive and semi-intensive aquaculture only, Sardinian companies are currently represented by plants for the breeding of valuable fish species of both salt water and fresh water and shellfish. Sardinia is in fact one of the leading Italian regions in marine fish production, with the greatest potential for both quantitative and qualitative development.

As far as the system of enterprises linked to fishing and its consistency in 2019 in Sardinia, there were 702 fishing enterprises, with 3087 total employees. The most represented sub-category was “0311 - Fishing in marine and lagoon waters and related services” (575 companies with 2370 employees), followed by “0321 - Aquaculture in sea, brackish or lagoon water and related services” (58 companies with 407 employees). These two sub-categories together represented 90 % of the island's fishing enterprises [21; 22].

Nonetheless, territorial distribution of companies was not homogeneous. In fact, Provinces with the largest number of companies were that of Cagliari (282 companies with 1398 employees) and that of Sassari (286 companies with 548 employees), which together housed about 80 % of the fishing companies in Sardinia. The only sub-category in which the provinces of Oristano and Nuoro were more represented than the other two provinces was that of “0312 - Freshwater fishing and related services”. The municipal detail tells us that Northern Sardinia owned 293 companies in the fishing sector with 558 employees, thus accounting for 41 % of the total Sardinian fishing companies.

Compared to the legal form, the most evident data is that the highest number of enterprises were individual (356 enterprises with 239 total employees), confirming that Sardinian fishing was characterized by a type of artisanal and small-scale activity. This is followed by Cooperatives (190), which obviously have more employees (1934 total). Finally, of the 702 fisheries enterprises in Sardinia, 48 were female enterprises, 45 were youth enterprises and 7 were foreign enterprises. These categories of companies substantially had little impact on the overall Sardinian entrepreneurial total. In particular, female businesses accounted for 7 %, youth businesses 6.5 % and foreign companies less than 1 % [21; 22].

Traditional fishing on Asinara Island

Marine Protected Areas (MPAs) are certainly a useful tool for preserving biodiversity and promoting the sustainable use of resources. Fisheries management is important everywhere, but it is even more important in Marine Protected Areas (MPA) where, according to the objectives set by the Italian Framework Law on Protected Areas (Law No. 394/1991), the protection and conservation of environment and its resources must be guaranteed, in accordance with existing traditional activities. All this is even more important especially in areas where

fishermen have a strong socio-cultural weight as it is a traditional activity. A cultural legacy of fishing on Asinara Island is certainly represented by fishing techniques practiced in Sardinia and beyond, which have had to adapt, as everywhere, to history, to the particular geographical, natural and atmospheric conditions present in the area. This heritage of teachings, result of infinite practice and repeated experiences, which have influenced human culture through work, were and are handed down to younger fishermen generations only rarely through oral stories, but mainly through example, practice, memorization [23]. Despite technology of modern boats can help, long practice of experiential teachings, which are learned at an early age, remains a fundamental characteristic of the fisherman's culture because "it is only by fishing that men acquire the knowledge that will allow them to have a right of use on what it will become a fishing territory for a community, a group, a family, a crew" [24, p. 95].

Marine Protected Area (MPA) of Asinara Island has an extension of approximately 108 km². The marine area is divided into zones with a different degree of environmental protection: zone A, an integral reserve; zone B, general reserve; zone C, partial reserve. Zones A, where access is completely forbidden, are located in three areas: in the stretch of sea between Punta dello Scorno and Punta del Porco, in the stretch of sea between Punta l'Arroccu and Punta Galetta and the stretch of sea between Punta Pedra Bianca and Punta Agnada. Zones A cover about 5 % of the entire protected area, while Zones B and C cover, respectively, 65 % and 30 % of Marine Protected Area.

Since 2002, the founding decree of MPA (13 August 2002) establishes a ban on fishing on Asinara Island by all seafarers, with the exception of small-scale fishing in Porto Torres and Stintino seafarers which are granted the relative authorization at a distance from the coast greater than 150 m and with respect for fully protected areas.

The decree of the Ministry of the Environment of 28 November 1997 also provides for the absolute ban on trawling "within three nautical miles along the west coast of the island (from Punta dello Scorno to Punta Salippi) and, within the bathymetric depth of fifty meters along the eastern and southern coast from Punta dello Scorno to Punta Salippi" (art. 5); for which this activity does not fall within those permitted within MPA [25].

From the processing of the data contained in the Community Fleet Register in January 2020, the fleet belonging to Porto Torres and Stintino navy was equal to 113 units, while there were 48 boats that could potentially carry out fishing activities in MPA but of these only 14 units operated quite frequently in the MPA [20; 25].

The 48 vessels authorized to fish in the MPA were divided into four tonnage categories. 48 % of the boats (n = 23) had a GT equal to 1, 23 % of the boats (n = 11) had a GT between 2 and 5, 23 % of the M / p (n = 11) had a GT between 5 and 10 and only 6 % (n = 3) had a GT greater than 10. This data shows that the current fleet authorized to fish within the MPA was mainly represented by small boats. Furthermore, the few boats with larger dimensions (LFT > 12 m) were tolerated as they were considered a "historical" part of the current fleet [25].

Fishermen who can operate in Asinara Island MPA use tools like longline, pots and trammel net. In general, it is a rather selective fishing, although much depends on the practices adopted, the size of nets and hooks and the fishing area, on the basis of the target species and of the different seasons. From 2013 to 2017, Asinara Marine Animal Recovery Center "Centro di Recupero Animali Marini dell'Asinara" (CRAMA), in agreement with the Park, carried out a geo-referencing census of fishing signals in the seas of MPA; this amount of data made it possible to have a picture of the areas most affected by exploitation with different capture tools and provided a precise indication of the usage and of the possible overlap in the use of the

seabed. The maps shown below (Figures 3 and 4) highlight the different sectors and the types of fishing practiced. These maps show that the sectors most affected by fish harvesting are the eastern ones [21; 23]. In particular, the areas to the east of the island were most affected by fishing with pots, while those to the west by the use of longline. However, the use of longlines is prevalent to the west of the island, where the dominance of the rocky bottoms is greater.

Generally, trammel net fishing is carried out constantly throughout the year, with different target species depending on the season; on the other hand, fishing with pots and longlines is mainly seasonal. The pots are mainly used in summer season, while longline in summer-autumn season (June-October) and in winter season (December-January). This type of strategic use of tools seems to be linked to the availability of resources according to seasonality, sea and weather conditions that allow greater usability of one tool compared to another. However, it is important to underline that MPA has become a strength for small-scale fishing activities, allowing precisely this strip of sea to act as an effective recruitment area for juvenile fish. All this was made possible thanks to the limitations imposed on human activities by Park Regulations and in particular by means of the prohibition of fishing within the first 150 meters from the coastline [21; 23].

Conclusion

If fishing is in itself an economically and socially relevant activity and an important historical and traditional heritage, it also represents a possible trigger to read the territorial dynamics of coastal areas, to identify possible expansions and enhancements of tourism (fishing tourism), to investigate effectiveness and consistency of bottom-up governance formulas. And it is precisely for this reason that it is necessary to emphasize the importance of participatory approaches since the long-term sustainability of Asinara MPA depends precisely on the adequate involvement of all the human elements involved in the management strategies, including the fishermen of the area. Compared to Sardinia (and in particular to Asinara), the qualitative-quantitative framework proposed in this work can become an important resource for future reflections on the management of complex systems such as that of an MPA. This contribution, which has drawn a multiscale and quantitative framework, is to be considered the premise for a research of land aimed at identifying and designing efficient and effective management solutions in Asinara MPA. Specifically, to manage complexity in order to create consensus and reduce conflicts in the use of fishing resources, Stakeholder Analysis (SA) will be adopted precisely as a support to study and design efficient and effective management solutions for this resource; it will make it possible to highlight the strengths and weaknesses in the current management system of traditional fisheries in Asinara Island and it will recognize fishermen for their fundamental role in the bottom-up governance process as primary stakeholders.

In this regard, in fact, UNESCO defines fishermen as holders of “local and indigenous knowledge” to refer to “the understandings and skills developed by societies with a long history of interaction with their natural environment”, as in the case of communities of fishermen [26; 27]. Their knowledge includes seasonal species abundance, tracking systems or fishing gear practices, etc. Furthermore, it has been shown in numerous literatures that fishermen's observations can provide information on the presence of endangered species and ecosystems when traditional scientific data are scarce or absent [27; 28].

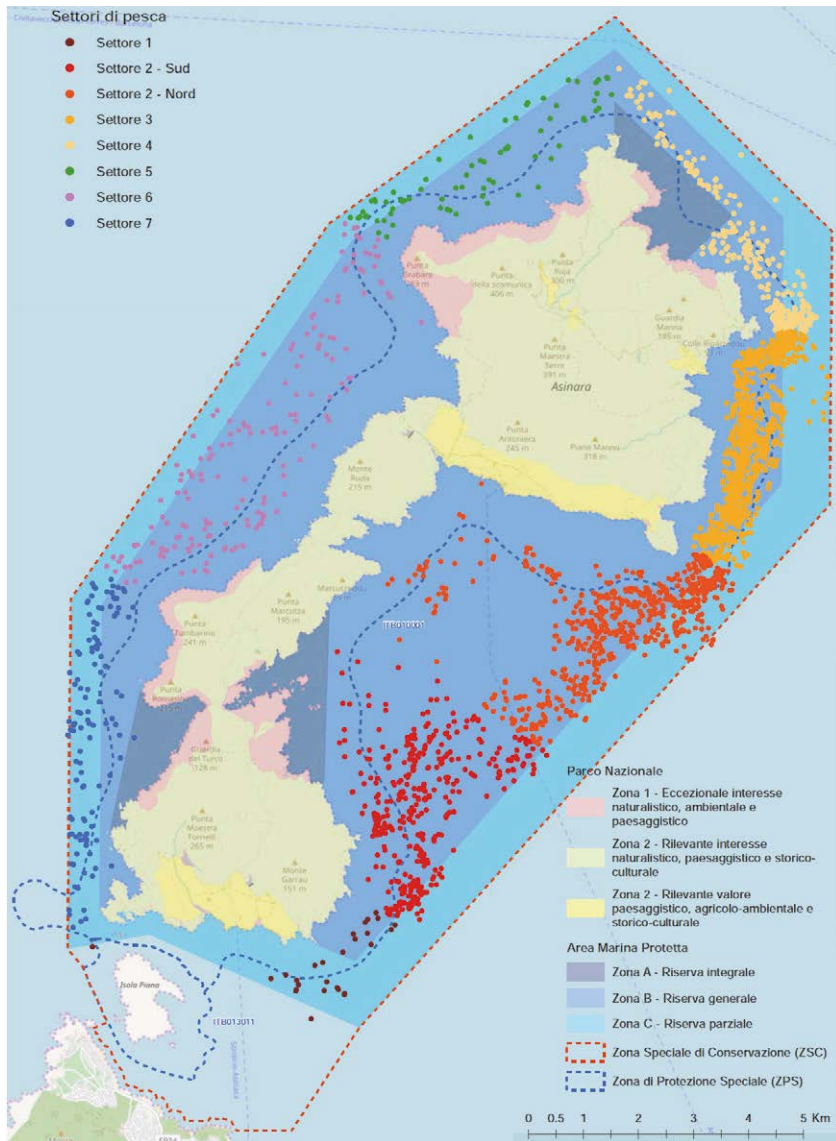


Figure 3 – Fishing sectors monitored in the years 2013-2017 in Asinara Island MPA. Source: [23] †.

† MONITORING OVER THE YEARS 2013-2017 - Fishing Sectors: Sector 1; Sector 2 - South; Sector 2 - North; Sector 3; Sector 4; Sector 5; Sector 6; Sector 7. National Park: Zone 1 - Exceptional naturalistic, environmental and landscape interest; Zone 2 - Significant naturalistic, environmental, and historical and cultural interest; Zone 2 - Significant landscape, agri-environmental and historical and cultural value. Protected sea area: Zone A – Integral reserve; Zone B – General reserve; Zone C – Partial reserve; Special area of conservation; Special Protection area

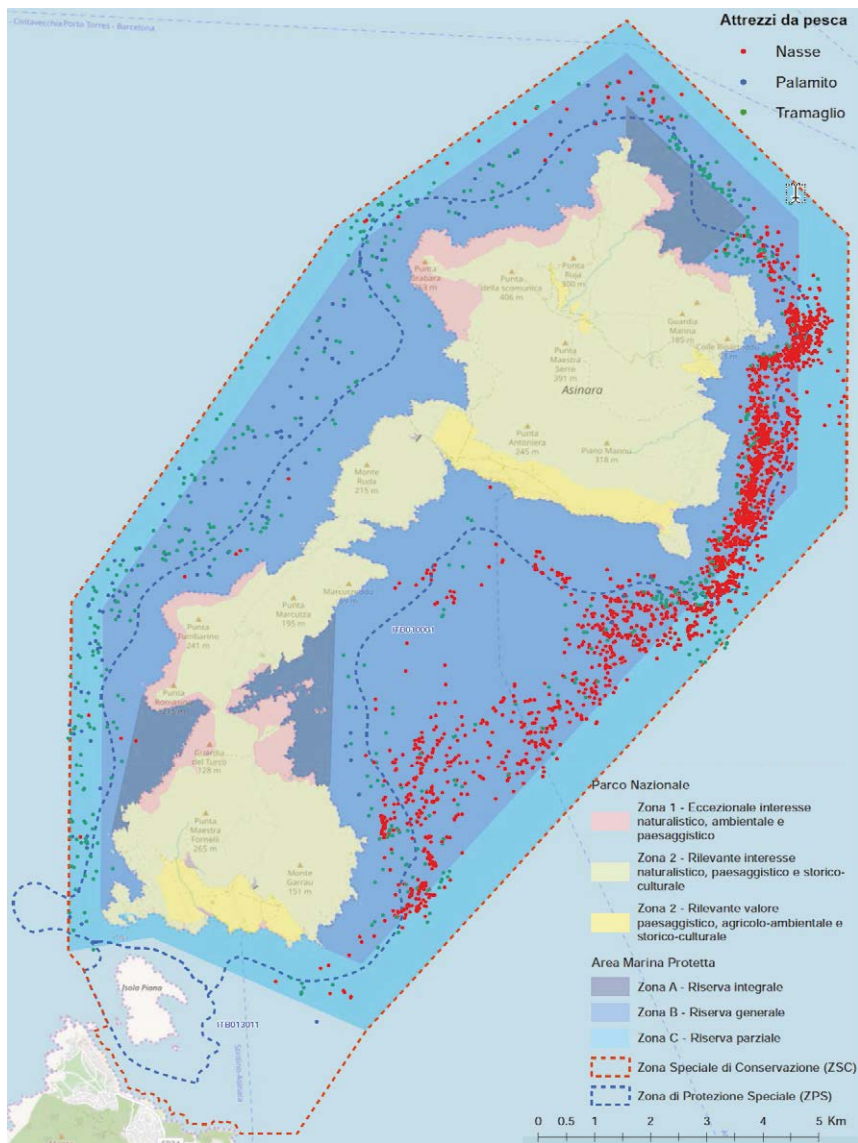


Figure 4 – Distribution of fishing effort in the years 2013-2017 by fishing area in Asinara Island MPA. Source: [23[‡]].

[‡] MONITORING OVER THE YEARS 2013-2017 AND PROTECTED AREAS.

Fishing gears: Pots; Longline; Trammel. National Park: Zone 1 - Exceptional naturalistic environmental and landscape interest; Zone 2 - Significant naturalistic, environmental and historical and cultural interest; Zone 2 – Significant landscape, agri-environmental and historical and cultural value. Protected sea area: Zone A – Integral reserve; Zone B – General reserve; Zone C – Partial reserve; Special area of conservation; Special protection area.

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