

Report on fishing activities and seabird bycatch risk of gears and fishing practices covering Malta, Greece, France, Portugal and Spain

LIFE PanPuffinus! project

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Report on fishing activities and seabird bycatch risk of gears and fishing practices covering Malta, Greece, France, Portugal and Spain.

Paulo Lago¹, Lucía Soliño¹, Jose Manuel Arcos¹, Martin Austad², Rita Matos², Manyá Russo², Danae Portolou³, Dimitra Christidi³, Aris Manolopoulos³, Niki Pardalou³, Ana Almeida⁴, Nuno Oliveira⁴, Flávia Carvalho⁴, Susan Waugh⁵, Louis Doremus⁵, Alexandra Caron-Strehlow⁵, Chloé Faure⁵, Jorgen Mifsud⁶, Michelle Mizzi⁶, Juan Bécares⁷

¹ Sociedad Española de Ornitología, SEO / BirdLife

² BirdLife Malta, BLM

³ Hellenic Ornithological Society, HOS / BirdLife Greece

⁴ Sociedade Portuguesa para o Estudo das Aves, SPEA

⁵ Ligue pour la Protection des Oiseaux, LPO / BirdLife France

⁶ Department of Fisheries and Aquaculture Malta, DFA

⁷ Cory's - Investigación y Conservación de la Biodiversidad

This report includes the deliverables *Report on fishing activities covering MT, GR, FR, PT, ES* (A.1.1) and *Report describing the most threatening gears and fishing practices per season and region, and preliminary information useful to develop mitigation measures* (A.1.2) of the action A.1 Reviewing the scale and characteristics of bycatch of target species. The report has been compiled by Sociedad Española de Ornitología SEO/BirdLife (SEO) with contributions from BirdLife Malta (BLM), Hellenic Ornithological Society (HOS) / BirdLife Greece, Ligue pour la Protection des Oiseaux (LPO) / BirdLife France, Sociedade Portuguesa para o Estudo das Aves (SPEA) / BirdLife Portugal, Department of Fisheries and Aquaculture Malta (DFA).

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1. Introduction

Seabirds and fishers usually share spatial and temporal activity. For centuries, they have even cooperated in their hunt for fish, since seabirds are known to be a reliable indicator of fish shoal presence and fishing vessels a predictable source of seafood for seabirds.

The over-exploitation of marine resources and resulting reduction of natural prey for seabirds, combined with an increasing offer of discards, have led to increased interaction with fisheries and greater chance of seabirds getting accidentally entangled and captured in fishing gears. The incidental capture of non-target species in fishing gears is referred to as “bycatch” incidents and is a major threat to seabirds (Dias et al. 2019). Recent studies suggest that every year, more than 200.000 seabirds are incidentally captured in fishing gears in European waters (Tarzia et al., 2017).

As top predators, seabirds are key elements of marine ecosystems, and at the same time represent one of the most threatened groups of birds. Highly oceanic species, such as shearwaters, are characterised by particularly long life-span and low productivity, which make them extremely vulnerable to anthropogenic pressures causing adult mortality. Among these pressures, fisheries bycatch is regarded as the primary source of adult mortality at sea. Since their population dynamics are mostly determined by adult survival, even slight increases in adult mortality, if sustained, can lead to significant population declines. This must be true for the Yelkouan and Balearic shearwater (*Puffinus yelkouan* and *P. mauretanicus*), both endemic species from the Mediterranean and among those species most affected by bycatch (Oppel et al. 2011, Genovart et al. 2016).

Yelkouan (YS) and Balearic shearwaters (BS) are classified as Vulnerable and Critically Endangered respectively according to the IUCN Red List of Threatened Species (BirdLife International, 2023) listed in Annex I of the Birds Directive, Annex II of the Barcelona Convention and Appendix II of the Bern Convention. BS is also listed in the OSPAR Convention, Appendix I of CMS-Bonn Convention and Agreement on the Conservation of Albatrosses and Petrels (ACAP).

The global breeding population of the BS, estimated in about 3000 breeding pairs, is restricted to the Balearic Islands, largely foraging off the East coast of Iberia, and less in the French, Algerian and Moroccan Mediterranean coast during breeding season (Arcos 2011). At the current level of decline, the expected extinction time for the species is less than 60 years (Genovart et al. 2016) and its EU population status is considered Declining (Art. 12 Birds Directive) and considered Critically Endangered by the IUCN (BirdLife International 2023), attributed to low adult survival rate, related to fisheries bycatch (Genovart et al. 2016).

As for YS, 32-36% of the global breeding population of this species breeds in Greece, 7-10% in Malta and 2.3% in France (Gaudard 2018). The global population is estimated to decrease by more than 30% in the next 54 years (Derhé 2012). Recent colony data (Garcia Robles et al. 2016, Gaudard 2018) show that the species is in Decline, with a decreasing short-term trend. For instance, the YS population in Port-Cros National Park (France) has been estimated to decline steadily in the next 40 years for unknown reasons (CEFE-CNRS unpublished). This is why the species is considered Vulnerable by the IUCN (BirdLife International 2023) and its EU population status as Threatened (2008-13; Art. 12 Birds Directive).

In the Mediterranean shearwaters are particularly affected, with YS (42.5%) and BS (50.2%) being the two most frequently captured species (Tarzia et al. 2017). According to past data from Spain, small scale demersal longlines (included in set longlines gear type in this report) represent the most impacting gear (SEO/BirdLife 2014). Also, results from LIFE09 NAT/PT/000038 suggest that Portuguese fisheries are responsible for the mortality of 8.2% of the BS population, which forages in the Portuguese waters following the breeding season. In Greece, results from LIFE07NAT/GR/000285 (Fric et al. 2012) showed that YS is among the most vulnerable species to bycatch in bottom longlines (included in set longlines gear type in this report), during spring migration and the breeding season. In Malta, questionnaire surveys (2007) revealed that high seabird bycatch occurred in bottom longlines (included in set longlines gear type in this report), with an unknown number of YS (Dimech et al. 2008). Demersal and bottom longlines are included in the gear type set longlines along this report.

However, seabird bycatch in fisheries seems to happen sporadically and irregularly and therefore solid baseline information is needed to come up with effective mitigation measures (Laneri et al. 2010). Moreover, seabird bycatch data is scarce for most areas and gears in the Mediterranean, including small-scale and semi-industrial fleets. Thus, to tackle bycatch in the Mediterranean it is firstly necessary to compile information on the spatio-temporal characteristics of fisheries and bycatch occurrence in the different study areas.

2. Objective

The objective of action A1 of the LIFE PanPuffinus! project presented in this report is to collect baseline information about the scale and frequency of seabird bycatch in various fisheries of the project sites and other marine areas known to be important for YS and BS, filling knowledge gaps in Greece, France, and Malta, (where data are missing at the national level) and completing the available information in Spain and Portugal. This approach is a first step in collecting coarse-scale seabird bycatch data and in covering a large area and wide range of fishing gears.

3. Methodology

The action focused on the more important areas for YS and BS, namely the Mediterranean region and north continental coast of Portugal in the Atlantic.

To achieve the objective, temporal and spatial data on the fishing fleet by gear, target species, and fishing grounds available were collected through Fisheries Institutions (fisheries departments, research institutes, universities, etc.). This data was enhanced with questionnaire surveys conducted with fishers, especially relevant to collect unavailable information for small scale fisheries (SSF). The questionnaire surveys aimed to provide an initial overview of the occurrence of shearwater bycatch throughout the region.

3.1. Overview of the project area

The project covers 28 sites in five countries in the breeding and distribution areas of the BS and YS across the Mediterranean Sea and the Atlantic coast of Portugal (Fig. 1). The sites where the project focused are important areas for the species and most are located within protected areas, generally part of the Natura 2000 network. Most of these areas were selected in base of their importance for the species (Table 1), potential or actual threats (i.e. bycatch, predation), and need for data collection. Most of these areas include important fishing grounds where semi-industrial and SSF operate, with potential risk of shearwater bycatch occurrences.

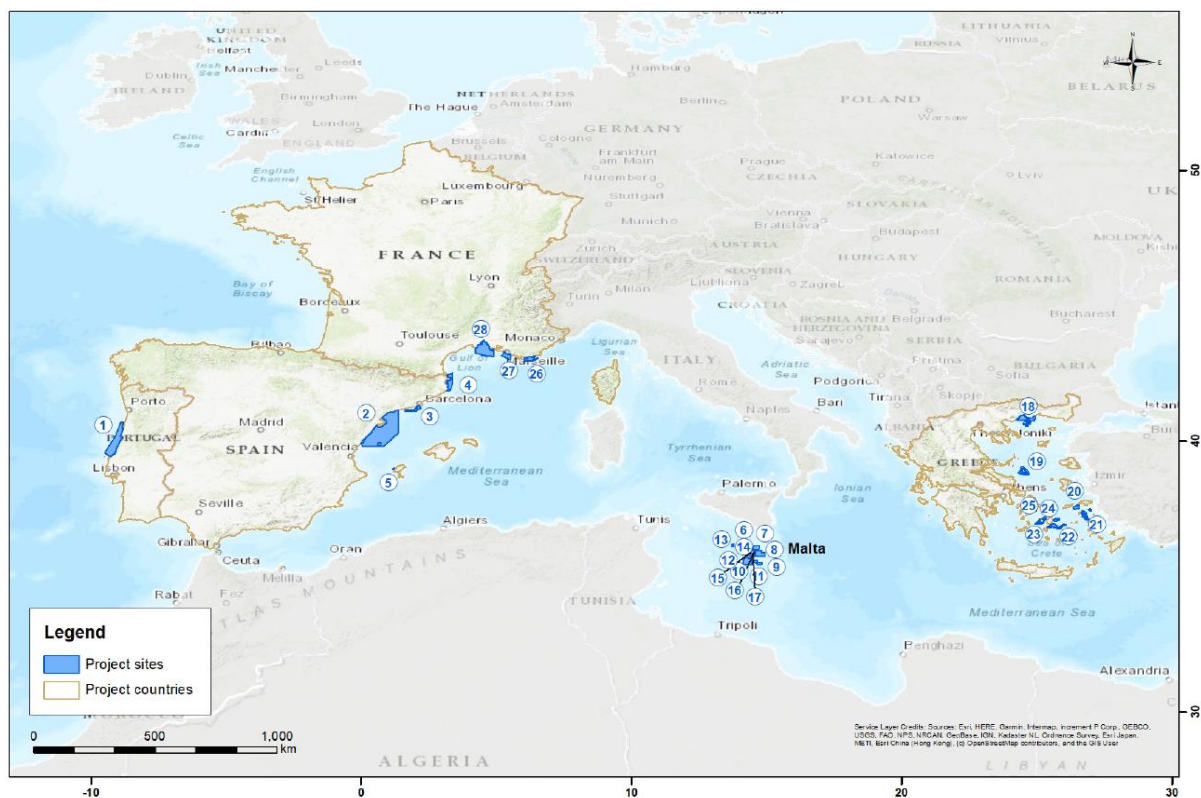


Figure 1. General map of the project sites included in the LIFE PanPuffinus! project.

Table 1. Description of the project sites included in the project.

Country	Project site number	Project site name	Natura 2000 code(s)	Surface (ha.)	Importance for the conservation of species/habitats targeted
Portugal	1	Aveiro-Nazaré	SPA PTZPE0060	292,928.6	This site is part of an important migratory corridor for seabirds, but also relevant as a resting and feeding ground. It is particularly significant for BS during the post-breeding season (42.8% of the BS global population are estimated to use this site in autumn). In Portugal, BS bycatch occurs mainly in the periods of greatest concentrations of the species in different fishing gear (namely demersal longline, gillnets and purse seine), representing 8.2% mortality of the BS population.
Spain	2	Ebro Delta-Columbres shelf	SPA and ES0000512	901,708.6	The site is one of the main feeding grounds for BS with common presence of 7,000-14,000 individuals. This is an area of high productivity, and of great importance for various species during winter and migratory passages, rich in marine resources and important fishing area holding several artisanal fleets.

Country	Project site number	Project site name	Natura 2000 code(s)	Surface (ha.)	Importance for the conservation of species/habitats targeted
	3	Llobregat Delta marine area	SPA ES0000513	38,661.4	The site is a very important feeding ground for BS (800-5,400 ind.), YS (300-1,400 ind.), Scopoli's shearwater (450-1,900 ind.) and Audouin's gull, which also reproduces in the Llobregat Delta. This is also one of the main wintering areas for the Mediterranean gull.
	4	Empordà marine area	SPA ES0000514	85,444	Important marine feeding site for YS (600-4,300 ind.), BS (150-5,100 ind.) and the Scopoli's shearwater (100-1,150 ind.). It holds a population of Mediterranean shag (~40 pairs). The area is also important for fisheries, mainly of small pelagic fish, with several fishing ports, mainly comprised by SSF fleets. Bycatch occurrence has been reported previously in the area.
	5	W Ibiza islets	SPA and SCI ES5310023	2,537	The site holds more than 10% of the global population of BS (360 pairs). It also holds colonies of Scopoli's shearwater (250-500 pairs) and Audouin's gull (400 pairs), European Storm-petrel (500-1,000 pairs), and the Mediterranean shag (11-50 pairs). Bycatch occurrence has been reported previously in the area.

Country	Project site number	Project site name	Natura 2000 code(s)	Surface (ha.)	Importance for the conservation of species/habitats targeted
Malta	6	Żona fil-Baħar fit-Tramuntana	SPA MT0000106	31,901.5	The site is relevant for seabirds, with a breeding population of Scopoli's shearwater. The area comprises a Maltese fisheries management zone. Investigating bycatch in this site is relevant for SS and YS.
	7	Żona fil-Baħar tal-Grigal	SPA MT0000107	35,164.7	A population of 380 to 450 individuals of YS regularly use this site during the breeding season.
	8	Żona fil-Baħar fil-Lvant	SPA MT0000108	62,508.8	The site was identified as an important area for European Storm-Petrel and YS, with an estimated population of 380 to 450 individuals during the breeding season.
	9	Żona fil-Baħar fix-Xlokk	SPA MT0000109	21,915.8	The site comprises of coastal and offshore marine areas recognised for their importance for seabirds, specially Scopoli's shearwater during the breeding season. Investigating bycatch in this site is relevant for SS and YS.
	10	Żona fil-Baħar fin-Nofsinhar	SPA MT0000110	83,486	The site holds important colonies of Scopoli's shearwater and YS, with an estimated population of 460 to 770 individuals of YS during the breeding season.

Country	Project site number	Project site name	Natura 2000 code(s)	Surface (ha.)	Importance for the conservation of species/habitats targeted
	11	Żona fil-Baħar fil-Lbiċ	SPA MT0000111	25,595.2	The site is important for Scopoli's shearwater, European Storm-petrel and YS during the breeding season. A population of 840 to 1,350 individuals of YS were estimated at the site during the breeding season.
	12	Il-Baħar ta' Madwar Għawdex	SPA MT0000112	55,632.5	The site is important for Scopoli's shearwater, and YS. A YS population of 3,270 to 4,650 individuals were estimated at the site during the breeding season.
	13	Żona fil-Baħar fil-Majjistral	SPA MT0000114	5,589.8	The site comprises of coastal and offshore marine areas recognised for their importance to seabird populations either as staging, foraging or transiting areas, and due to its importance for European Storm-petrel during the breeding season. Investigating bycatch is relevant for SS and YS.
	14	L-Inħawi tar-Ramla tat-Torri u tal-Irdum tal-Madonna	SPA and SCI MT0000009	74.9	The site holds an internationally important breeding population of YS (375- 600 breeding pairs), a small colony of Scopoli's shearwater, (20-40 breeding pairs), and a small colony of European Storm-petrel (1-10 pairs).

Country	Project site number	Project site name	Natura 2000 code(s)	Surface (ha.)	Importance for the conservation of species/habitats targeted
	15	Kemmuna and Kemmunett	SPA and SCI MT0000017	294.6	The site holds 125-185 breeding pairs of YS and 30-50 breeding pairs of Scopoli's shearwaters. During spring and autumn migration the area is important for many protected bird species that use the island a stopover site during passage.
	16	Qammiegh to Ras il-Pellegrin (incl. Majjistral NHP)	SCI MT0000024	413.0	The site is one of the largest YS colonies in the Maltese Islands, with 240-360 breeding pairs within Majjistral NHP, and a small satellite colony of 25 to 45 pairs at Ċumnija, just north of the park boundaries. Several other species use the area as a stopover site during migration. Due to the YS colony, the site has been proposed as an SPA.

Country	Project site number	Project site name	Natura 2000 code(s)	Surface (ha.)	Importance for the conservation of species/habitats targeted
	17	Il-Gżejjer ta' San Pawl (Selmunett)	SCI MT0000022	10.8	Selmunett is an IBA (MT012). The YS colony on St. Paul's Island was once thought to have been lost. However, it was rediscovered again in 2013. It is now estimated to hold 45 to 75 breeding pairs. Due to the YS colony, the site has been proposed as an SPA.
Greece	18	Thassos island, Kavala Gulf and islets	SPA GR1150012 and SCI GR1150014	93,019	This site constitutes one of the most important areas for seabirds in the Northern Aegean Sea. Thassos island is one of the most important nesting sites, on a European level, for the Mediterranean shag. YS even though does not breed in the site, holds records of 500-2,000 individuals that use the site for foraging, especially during spring. The Gulf of Kavala and surrounding areas comprise one of the most important fishing grounds in Greece. Mass incidents of YS bycatch in gillnets have been recorded.

Country	Project site number	Project site name	Natura 2000 code(s)	Surface (ha.)	Importance for the conservation of species/habitats targeted
	19	Skyros island and islets	SPA GR2420009	53,010.6	Although, the site holds a small breeding population of YS (20-50 pp, 0.5% of the national population) the site comprises an important feeding ground which regularly attracts large flocks of YS during the late breeding season and the post-breeding season, exceeding 5,000 individuals. The foraging range of shearwaters breeding on islets of the site extends far beyond the marine areas of the SPA. The site is considered important for work with artisanal fishers on bycatch and for assessment of bycatch rates in the SSF vessels using the area.
	20	Fournoi island and islets	SPA GR4120006 SCI GR4120004	24,068.9	A large mixed colony of YS and Scopoli's shearwater is located on one of the site's islets, holding an estimated population of 800-1,000 pairs of each species. These are the third largest colonies for both species on a national scale. The highest raft count recorded here amounts to 2,500 individuals on one single evening at a small distance from the colony islet. The wider area comprises important fishing grounds. Bycatch in fishing gear has also been reported, especially for shearwaters, Audouin's Gull and the Mediterranean Shag.

Country	Project site number	Project site name	Natura 2000 code(s)	Surface (ha.)	Importance for the conservation of species/habitats targeted
	21	Northern Dodecanese islands and islets	SPA GR4210034, SCI GR4210010	47,123.2	The site hosts the second largest colony of YS in the country (1,440-2,020 pp), 17% of the national population and 6% of the global population. The marine area comprises an important feeding ground, while large rafts are often observed in the vicinity of colony islets. Bycatch in fishing gear has been reported in the region.
	22	Mikres Cyclades islands and islets	SPA GR4220021 SCI GR4220013	56,020.7	This site is very important for YS, as it hosts the third largest colony of the species in the country and the second most important population in the region of Cyclades after Gyaros (Project site 25), with a breeding population of 1,050-1,410 pp (12% of the national population and 4% of the global population). The marine region comprises important foraging grounds for seabirds and especially shearwaters. The area is an important sailing destination, although marine traffic and tourist infrastructures are still limited. Illegal fishing methods are still in use and is potentially a risk zone for YS.

Country	Project site number	Project site name	Natura 2000 code(s)	Surface (ha.)	Importance for the conservation of species/habitats targeted
	23	Paros island and islets	SPA GR4220025 SCI GR4220017	25,711.8	This is one of the few sites in Greece where all three species of the Procellariiformes breed: YS (20-50 pp), Scopoli's shearwater and European Storm-petrel). The marine area around Paros receives intense marine traffic of hundreds of passengers, commercial and tourist vessels mostly during the tourist season. This situation creates a considerable risk of marine pollution and oil spills. In addition, an important fleet of SSF exist. Bycatch in nets and longlines pose another threat for seabirds at sea, mainly for the shearwaters and Mediterranean Shag.
	24	Syros island and islets	SPA GR4220032 SCI GR4220018	2,903	The site holds a small breeding population of YS (10-20pp) and of the Scopoli's shearwater (10-20pp) and Mediterranean Shags. Syros holds a very important commercial and fishing port, as well as shipyard. The site is considered important for work with artisanal fishers on bycatch.

Country	Project site number	Project site name	Natura 2000 code(s)	Surface (ha.)	Importance for the conservation of species/habitats targeted
France	25	Gyaros island and islets	SPA and SCI GR4220033	26,036.9	It hosts the largest YS colony of the country (3,570 – 7,350 pp), 45.2 - 56.5% of the national population, 14.6 - 20.7% of the global population and 14.5 – 21% of the EU population. Recent assessments indicate that YS are mostly vulnerable to bycatch in bottom longlines.
	26	Iles d'Hyères	SPA FR9310020	47,905	The site holds a large population of YS, with 6,670 pairs (4,890-9,200; 98-99% of the national population), and 25% of the French population of the nesting Cory's shearwater. European shag also nests in the area.
	27	Iles Marseillaises - Cassidaigne	SPA FR9312007	39,158	The site is of international importance for the conservation of three species of Procellariiformes: YS, Cory's shearwater and European Storm-petrel, and the only French site where the three species coexist. It is the second breeding place for YS in France (30 to 50 pairs). The Gulf of Marseille is an area of high biological productivity, relevant as feeding ground and rafting areas for pelagic seabirds, being also an important fishing area.

Country	Project site number	Project site name	Natura 2000 code(s)	Surface (ha.)	Importance for the conservation of species/habitats targeted
	28	Camargue	SPA FR9310019	220,574	This marine site is a zone of high biological productivity, used as feeding and resting areas by various species of seabirds: YS (2,000 ind.), Scopoli's shearwater (100-300 ind.). Also, it is a significant wintering area for the Northern gannet, European shag, Razorbill, Great crested grebe, loons (3 species) and scoters (2 species).

3.2. Questionnaire surveys

Questionnaire surveys to fishers were conducted by observers in the harbours of project sites but also other sites during 2021-2022. The questionnaire surveys were designed to provide spatio-temporal data of gear, target species, fishing grounds, fishing effort and an initial overview of the occurrence of seabird bycatch throughout the region, focusing on shearwaters. This approach comprised the first step in collecting coarse-scale seabird bycatch data and in covering a large area and a wide range of fishing gears. The questions included in the questionnaires were based on the experience of SEO/BirdLife and SPEA, since both NGOs conducted questionnaire surveys in previous projects, and also on the template developed by the GFCM in the MedBycatch project (<https://www.fao.org/gfcm/activities/environment-and-conservation/med-bycatch-project/en/>) in collaboration with BirdLife International (FAO 2019). A common template of the questionnaire was created and in each country of the project a few questions were adapted to the local reality.

The questionnaire is divided in four main parts:

- **General part** regarding the basic data of the fisher and the fishing vessel.
- **Fishing gear and effort:** characteristics of the gear and detail of the fishing habits, including the fishing effort by gear along the year (number of fishing trips/year). A gridded map for each project site or area is provided to identify the fishing grounds for each particular fisher.
- **Seabird bycatch:** knowledge about seabirds and seabird bycatch occurrences and characteristics for each type of gear.
- **Mitigation measures:** knowledge about the mitigation measures used.

In Malta, France and Greece, questionnaires to fishers included information on the fishing effort and seabird bycatch for each type of fishing gear for the whole year and were performed only once with each fisher. In Portugal, observers visited the harbours approximately every three months and collected data on fishing effort and bycatch for each type of gear in the previous three months.

Apart from the data collected under the LIFE PanPuffinus! project, in Greece, a large number of questionnaires were provided, with very similar format, that were performed under a nationwide project entitled “Addressing the interaction between

small-scale fisheries and marine megafauna in Greece (InCa: 2020-2022)", implemented under the coordination of WWF Greece in collaboration with the Ichthyology Laboratory of the Biology Department of the Aristotle University of Thessaloniki (AUTH) and the Institute of Marine Biological Resources and Inland Waters of the Hellenic Center for Marine Research (HCMR) and other expert bodies (Pardalou et al., 2021; Tsikliras et al., 2022). In Spain, the data collected by SEO/BirdLife in 2018-2019 during the ZEPAMED project were included in the dataset (SEO/BirdLife, 2019).

3.3. Fisheries Institutions data

A comprehensive search was conducted for all available fisheries data in the project area. This includes reports published by national and regional fisheries institutions, universities, research centres and NGOs. The bibliography and previous reports made by the project partners are also included. In general, fishing statistics do not provide data with the level of detail required to know the fishing fleet of each port in which the project works and the distribution of the fleet by gear segment, and the data is often aggregated by region or gear type.

National and regional fishing institutions were contacted to request data that are not published and updated. Specifically, VMS and e-book data were requested. Depending on the country, the request for these data entailed different bureaucratic processes, and in general required making formal and informal requests and holding meetings with the departments involved. Generally, the process usually took on average at least one year of time until the data was obtained when obtained. The request required data with the maximum level of detail possible, but data were commonly supplied containing aggregated data derived from analysis processes.

Spanish and Portuguese Institutions (Secretaria General de Pesca SGP and Direção-Geral de Recursos Naturais, Segurança e Serviços Marítimos DGRM) provided VMS data. French institutions provided VMS data, as well as spatial-temporal data on SSF activities collected through annual surveys in large resolution and not covering all of the French Mediterranean EEZ. Greek institutions provided fishing effort data aggregated by large fishing regions. In Malta, the Department of Fisheries and Aquaculture DFA has provided data on the Maltese fishing fleet that includes

breakdown of fishing fleet licenses and spatio-temporal data on fishing effort by gear categories filtered.

The difficulty of obtaining comparable fishing effort data between countries led to the decision to use for the majority of the analysis and maps data obtained through the questionnaire surveys and through Global Fishing Watch GFW database (<https://globalfishingwatch.org/>), apart from Malta where data with high precision was provided. In Spain and Portugal even if VMS was of good resolution, the GFW data was used so as to be comparable between countries.

3.4. Data analysis

Questionnaire data

An Excel database was set up to include data from all different countries and make it available online to all project partners.

The classification of fishing gear used by the project in this report followed the classification used by ICES and in the MedBycatch project (FAO 2019) i.e. the International Standard Statistical Classification of Fishing Gear (ISSCFG). It corresponds to the Metier level 4 for the majority of the gear types, but in some cases several gear types were grouped when there was a low number of questionnaires of a similar gear type to the main gear type of the group and it had sense in relation of seabird bycatch to analyse them together (Table 2).

The data on the characteristics of each fishing gear type (i.e. length of nets, number of hooks) were analysed to describe each gear type.

The data on seabird bycatch were analysed and related to the fishing gear type and characteristics, as well as data on the use of mitigation measures.

The interviews from Portugal covering data on fishing effort and bycatch in the previous three months were analysed to calculate annual fishing effort and seabird bycatch in any season of the year. They were assigned to seasons according to:

- **Winter** (December, January, February): interviews performed between 16th January and 15th April.
- **Spring** (March, April, May): interviews performed between 16th April and 15th July.
- **Summer** (June, July, August): interviews performed between 16th July and 15th October.
- **Autumn** (September, October, November): interviews performed between 16th October and 15th January.

Table 2. Classification of fishing gear used in the LIFE PanPuffinus! project.

Gear types GFCM/FAO (Metier level 4)	Gear types code GFCM/FAO	Gear type Life PanPuffinus!
Purse seine with purse lines (purse seine)	PS	Purse seines
Seine nets (not specified)	SX	
Bottom otter trawls	OTB	Trawls
Midwater otter trawls	OTM	
Bottom trawls	TB	
Other trawls (not specified)	TX	
Boat dredges	DRB	Dredges
Gillnets and entangling nets (not specified)	GEN	Gillnets
Encircling gillnets	GNC	
Driftnets	GND	
Set gillnets (anchored)	GNS	
Combined gillnets-trammel nets	GTN	Trammel nets
Trammel nets	GTR	
Stationary uncovered pound nets	FPN	Stationary uncovered pound nets
Pots and traps	FPO	Pots
Handlines and pole-lines (hand operated)	LHP	Handlines, pole-lines, and trolling lines
Longlines (not specified)	LL	Longlines (not specified)
Drifting longlines	LLD	Drifting longlines
Set longlines	LLS	Set longlines

Fishing effort data analysis and maps

The fishing effort was calculated from questionnaires as the *mean fishing effort by fishing gear type and country*.

The spatio-temporal data on fishing effort were plotted on maps using the WGS84 coordinate system. Maps depict fishing effort in the grid cells of each region of the country included in the project. In the maps of France, Greece, Malta and Spain a grid cell of 0.1 degrees was used. In the maps of Malta, a grid of 0.1 degrees was used in the case of GFW data and 0.5 degrees in the case data from DFA were used (more detailed data). In the maps of Portugal, a slightly different grid was used (10 km x 10 km) because SPEA had already collected questionnaire data based on this national grid in all the previous works related to seabird bycatch.

The methodology applied to calculate fishing effort in each grid cell varied depending on the source of data available.

For the trawls, purse seine and to a lesser extent drifting longline fleets, which usually have larger vessels and VMS and Automatic Identification System (AIS) devices are installed, AIS data analysed by GFW was used. GFW collect AIS data, processes it, and apply a variety of algorithms and machine learning models to monitor the activity of fishing vessels at sea, classify vessels into categories and identify fishing events.

For the other fishing gear type of gillnets, trammel nets, and set longlines, which are usually used by SSF and vessels smaller than 12m in length without VMS or AIS devices, the spatio-temporal data on fishing effort data from the questionnaire surveys combined with breakdown of fishing fleet from fishing statistics were used. For each grid cell of the map with fishing activity declared in the questionnaires the total number of fishing days per year for each gear type was calculated. The sample collected through the questionnaire survey for each gear type in each country, or region, provided the spatial distribution of the fishing effort. The fishing effort (number fishing days/year) was calculated by dividing the mean fishing effort by the number of grid cells with recorded fishing effort. Fishing statistics with the breakdown of number of vessels by gear in each port or each group of ports (depending on data available) were used to estimate the approximate number of

vessels using each fishing gear type. From this, the sample of vessels coming from questionnaire surveys extrapolate the fishing effort and distribution of all the vessels.

Some fishing gear types were excluded because either the number of interviews done were too low to be significant, or they were not relevant to seabird bycatch or sometimes both. The omitted gear types were stationary uncovered pound nets, longlines (not specified), handlines, pole-lines, and trolling lines, pots and dredges.

4. Results

The results of the data collected from different sources are described in detail including the total number of fishing vessels and breakdown for each fleet segment, detailed description of the fleet by gear, the fishing effort by fleet segment and, target species and fishing grounds. It was not possible to collect detailed data on landings and discards through the questionnaire surveys due to the sensitive nature of this data from fishers, and the necessity to focus the interviews on seabird bycatch. For some countries general data on landings are provided.

The fishing statistics were collected from the following sources:

- **France:** reports from CRPMEN PACA (CRPMEM PACA, 2022) and IFREMER (Ifremer. Système d'Informations Halieutiques, 2022).
- **Greece:** data on the fleet derived from the GFCM fleet register, broken down by gear aided by a national report provided by AGR.E.R.I., 2020.
- **Malta:** data provided by the DFA in 2023.
- **Portugal:** data on the fleet derived from official fishing statistics (DGRM, 2020).
- **Spain:** data on the fleet derived from official fishing statistics from national and regional administrations and field collection in the harbours by SEO/BirdLife in previous projects in the period 2018-2021.

A total number of 4449 interviews by fishing gear type were collected (Table 3). Of which, 689 were collected during the questionnaire survey of the LIFE PanPuffinus! project during 2021-2022 and 3760 in other previous projects during 2018-2020.

Table 3. Number of interviews collected by country and fishing gear type.

Gear type LIFE PanPuffinus!	France	Greece	Malta	Portugal	Spain	Total
Purse seines	3	3	4	65	19	94
Trawls	4	0	0	41	21	66
Dredges	0	0	0	0	1	1
Gillnets	43	903	1	41	31	1019
Trammel nets	125	1661	10	129	58	1983
Stationary uncovered pound nets	0	1	0	0	14	15
Pots	2	0	1	98	14	115
Handlines, pole-lines, and trolling lines	1	0	1	0	1	3
Longlines (not specified)	0	0	3	0	0	3
Drifting longlines	16	45	16	0	0	77
Set longlines	26	933	4	52	55	1070
Unrecorded	0	0	3	0	0	3
Total	220	3546	43	426	214	4449

4.1. Fishing fleet by country

A description of the fishing fleet in the area covered (project sites and other areas) is provided. This includes the total number of fishing vessels and breakdown for each fleet segment by gear categories. The proportion of the fleet interviewed through the questionnaire surveys is included to establish the representativity of the survey for each gear category.

France

The region Provence-Alpes-Côte-d'Azur PACA has 800 km of coastline with four main ports that are the license ports of the four quartiers maritimes, and 88 landing ports. According to CRPMEM PACA 526 vessels (11,2 % of the French fishing fleet) were registered in 2021, of which 95% less than 12m in length and 5% more than 12m (CRPMEM PACA, 2022). The figures are very similar to those reported for 2021 by Ifremer, which indicates there were 535 vessels registered, 96% of which less than 12m length and 4% more than 12m, of which 464 were active (Ifremer. Système d'Informations Halieutiques, 2022).

Between August 2021 and October 2022, 31 landing ports (35,2%) of the PACA region were visited, including all the main ports. 18,3% of the active fishing fleet (85 vessels) were interviewed (Table 4), from which 94% were less than 12m in length and 6% more than 12m, matching approximatively the real proportion. The interviews were more concentrated in the Var (Toulon) sub-region or quartier maritime.

Table 4. Active vessels and proportion interviewed in questionnaire surveys in France.

Sub-region	Num. active vessels	Num. interviews	% interviewed
Alpes Maritimes (Nice)	79	11	13,9
Bouche-du-Rhone (Martigues)	135	16	11,9
Bouche-du-Rhone (Marseille)	111	17	15,3
Var (Toulon)	139	41	29,5
Total	464	85	18,3

Table 5. Fishing gear licenses per gear and per fishing port (Source: calculated from IFREMER 2022) and proportion that was interviewed.

Fishing gear licenses	Fishing port				Total	Num. interviews	% interviewed
	Marseille	Martigues	Nice	Toulon			
Purse seines	8	0	0	3	11	3	27
Trawls	8	4	0	7	19	4	21
Hooks and lines	26	28	30	45	129	43	33
Gillnet + trammel net	74	102	64	102	342	168	49
Pots	8	52	0	6	66	2	3

Most questionnaires gathered in France encompass polyvalent small vessels (vessel length under 12 m). For this kind of fleet, trammel nets were by far the most reported gear, followed by gillnets, set longlines and drift longlines (Fig. 2). For vessels above 12 m length only trawlers and purse seiners were accounted (Fig. 2).

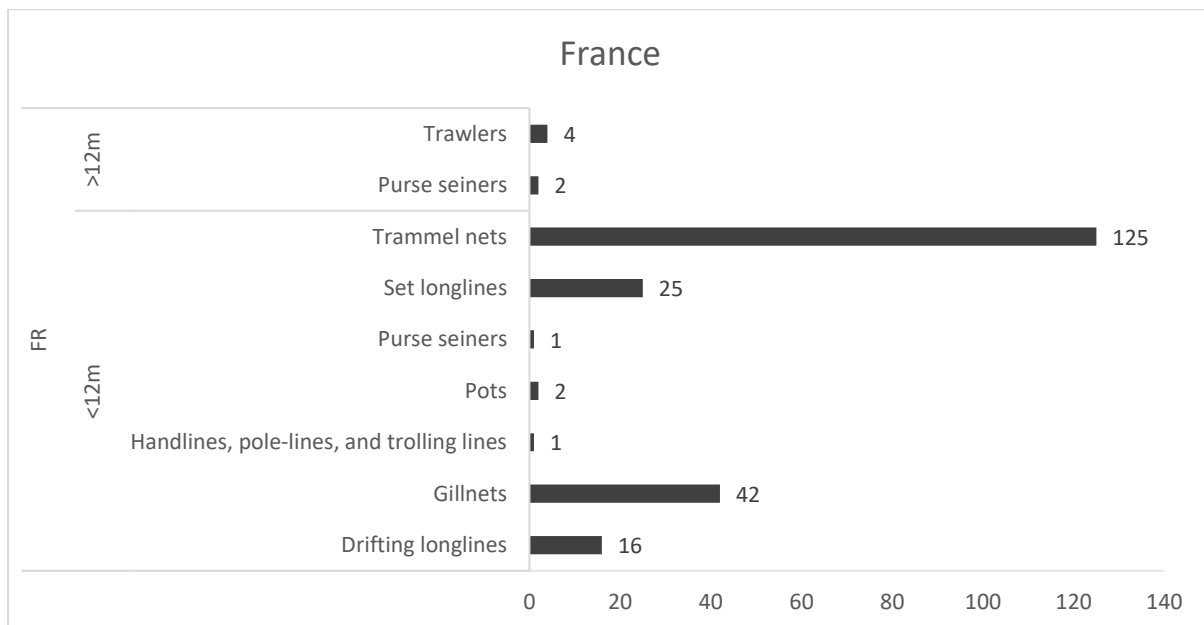


Figure 2. Number of questionnaires by fishing gear type and vessel length performed in France.

Trammel nets used by small vessels under 12 m can catch a wide variety of fish as well as molluscs and crustaceans, mainly those with benthic habits. Some species are almost exclusively fished using this gear (i.e. common sole *Solea solea*, stargazer *Uranoscopus scaber*, surmullet *Mullus surmuletus*, spiny lobster *Panulirus spp.* and cuttlefish *Sepia spp.*). Gillnets are also quite unspecific gears, targeting mainly benthopelagic (European seabass *Dicentrarchus labrax*, gilt-head sea bream *Sparus aurata*, saddled seabream *Oblada melanura* and white seabream *Diplodus sargus*), but also pelagic species, namely blue whiting *Micromesistius poutassou*, bogue *Boops boops* and European anchovy *Engraulis encrasicolus*. Several species, such as common dentex *Dentex dentex* and common pandora *Pagellus erythrinus* can be targeted by all trammel nets, gillnets and set longlines, while gurnard, wreckfish *Polyprion americanus* were only recorded for set longlines. Drifting longlines and hand, pole and trawling lines are used almost exclusively to big pelagic fish (Atlantic bluefin tuna *Thunnus thynnus* and swordfish *Xiphias gladius*) while traps or pots are used for catching octopus (Fig. 3). Information about targeted species reported for trawlers and purse seiners is displayed in figure 4.

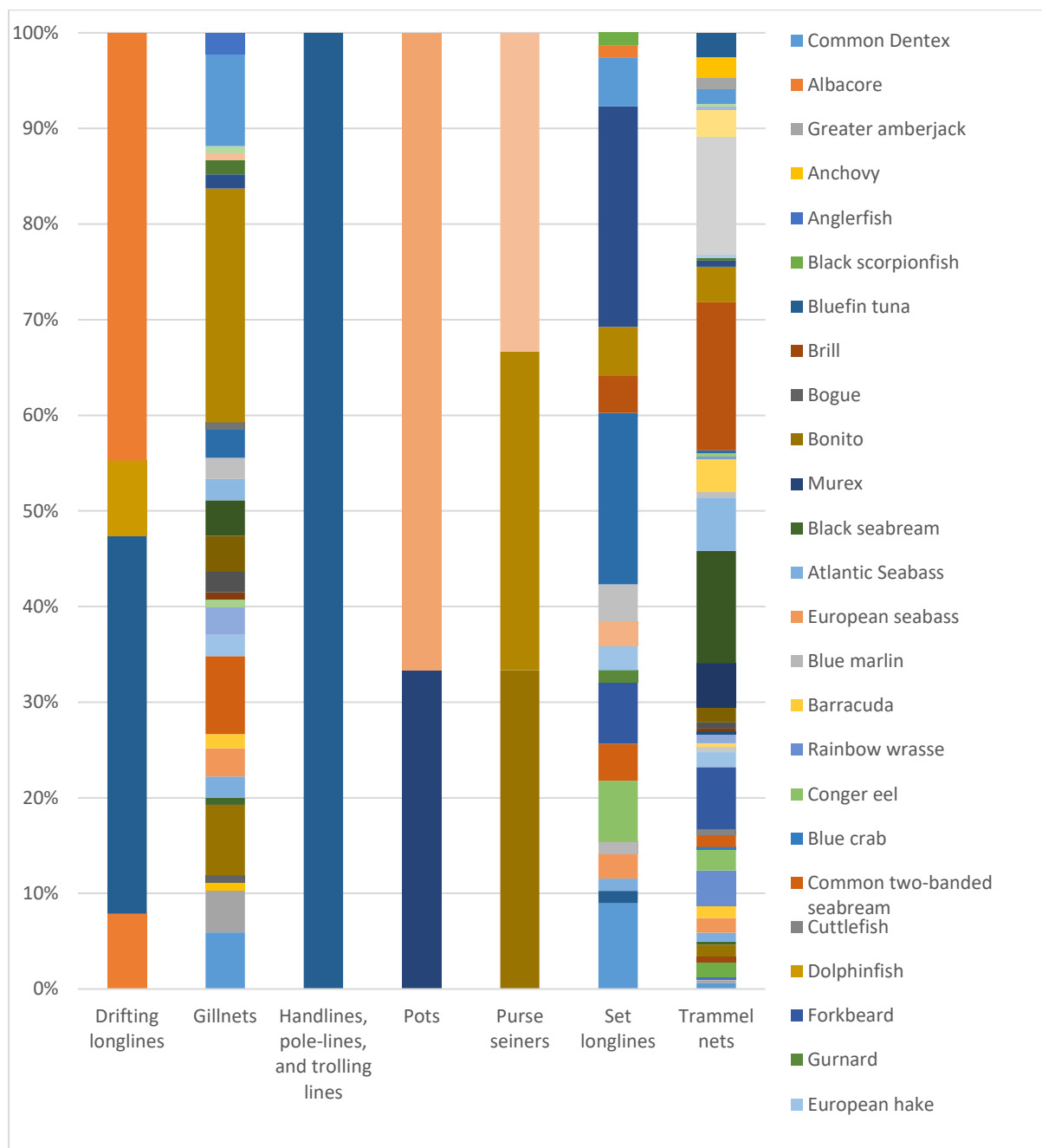


Figure 3. Target species by gear reported in questionnaires for vessels smaller than 12 m in length. Figures displayed represent relative frequencies of the answers.

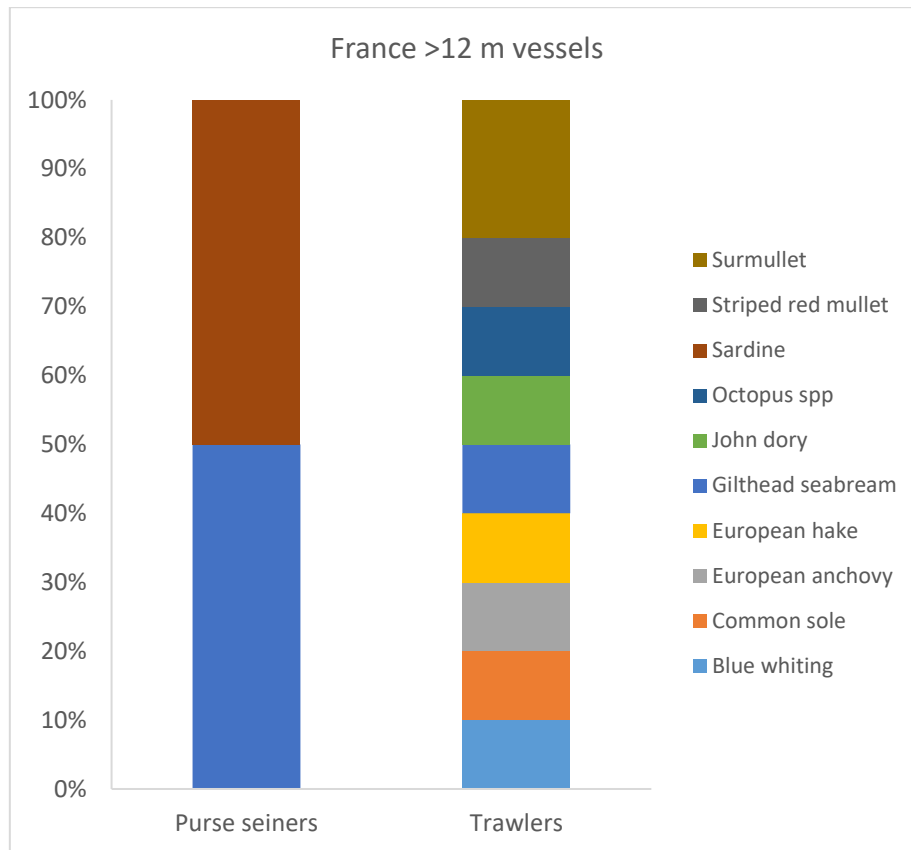


Figure 4. Target species by gear reported in questionnaires for vessels bigger than 12 m in length. Figures displayed represent relative frequencies of the answers.

Greece

Greece has a vast and complicated coastline of 16,452 km length, including numerous small islands and islets, that add to its topographic variability. Currently, 227 major port authorities have fishing vessels registered in their area of jurisdiction. The country's lacy coastline ultimately creates many more ports and heavens, resulting in more than 524 mooring sites (Pardalou *et al.*, 2021), out of which only 332 fishing ports are officially registered in the country (EU Master Data Register, 13 June 2022), complicating the monitoring of the SSF sector. On the other hand, large scale fisheries (trawls-OTB and purse seines-PS), as well as dredgers (DRB/DRH), vessels operating drift longlines (LLD), and those that are licenced to fish swordfish or bluefin tuna, are obliged to land their catch in specific ports, thus their presence is more predictable.

According to the GFCM fleet register data (September 2022) the Greek fishing fleet is the largest in numbers operating in the Mediterranean Sea (>18.3%; $n = 12,265$ vessels), with a steady decrease since 2008. Nevertheless, the great majority of these vessels (93.84%; $n = 11,509$ vessels) are coastal and small-scale, of less than 12 m length (7.64 m mean length), of low engine power and tonnage (Tzanatos *et al.*, 2020). A nationwide study entitled “Addressing the interaction between small-scale fisheries and marine megafauna in Greece (INCA: 2020-2022)” revealed that during summer-autumn 2020 about 45% of the SSF vessels registered in official databases ($n = 14,442$ vessels) were essentially inactive, i.e., either ghost vessels or rarely, if ever, operating (Pardalou *et al.*, 2021), a percentage that far exceeds the estimated 18% for the same year (Directorate-General for Fisheries, 2021). This difference is attributed to the fact that in the case of the INCA project, vessels found in ports and operated at least part-time, were considered “active”, whereas in the case of DG Fisheries “active” were all those vessels operating at least once within the year (Touloumis *et al.*, 2021). Additionally, the national fisheries registry was still being updated at the time. According to the Hellenic Statistical Authority ELSTAT (2021), in 2020 the fisheries sector in Greece contributed an annual average employment of at least 18,535 employees, whereas the value of catches was estimated at about 238,190,400 euros, more than half being produced by the SSF sector.

Petza *et al.* (2017) have published a thorough review of the spatiotemporal restrictions of fishing activities for all gears in the Aegean Sea (GSA 22) and Cretan Archipelago (GSA23) and produced maps of permanent ($n = 440$) and seasonal ($n = 76$) Fisheries Restricted Areas (FRAs) (Fig. 5). Static gears (namely nets, traps and set longlines) of the SSF sector are restricted in only 10.2% of the FRAs.

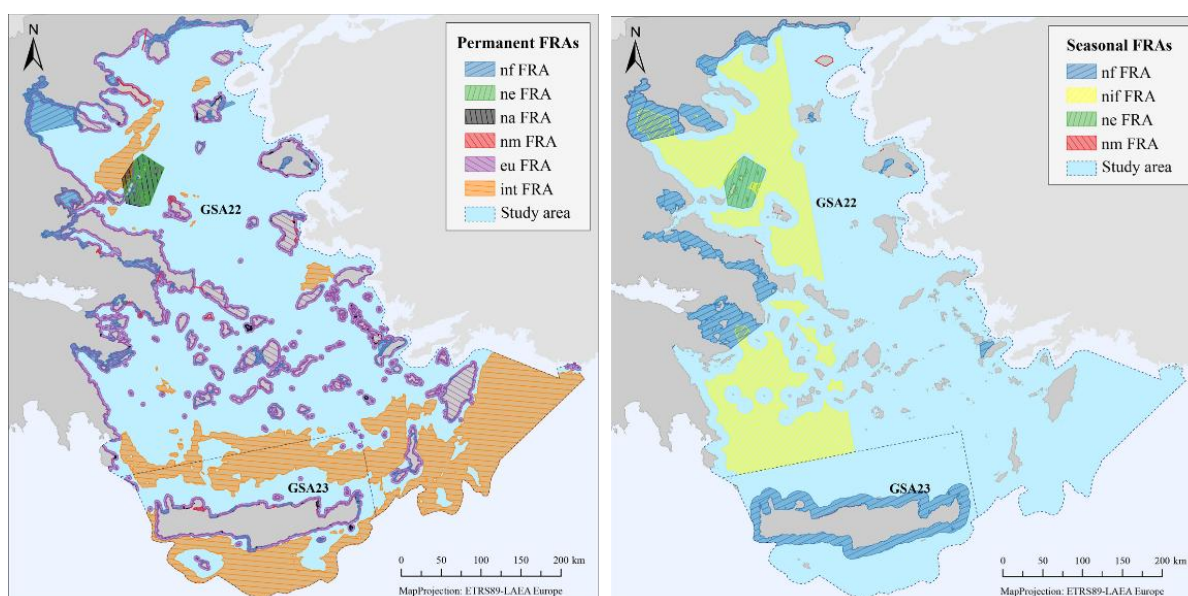


Figure 5. Left. Map of the 440 permanent Fisheries Restricted Areas (nf: national fisheries legislation, e: environmental legislation, a: archaeological legislation, m: maritime legislation, eu: European legislation, int: GFCM decisions). Right. Map of the 76 seasonal Fisheries Restricted Areas (if: national fisheries legislation in international waters) (Figures taken from Petza et al., 2017).

The majority of SSF vessels in Greece operates nets (mainly trammel-nets and gillnets) and set longlines as primary or secondary gear, targeting a variety of target species, depending on area, season and market demand, among other parameters. Fishers may not only choose to alternate between gears seasonally or even daily, but may also deploy different gears within the same day and in different fishing grounds. The multi-species and multi-gear character of the fishery, along with its dynamic nature pose multiple challenges in its monitoring, management and surveillance.

In Greece, the questionnaire surveys performed for vessels under and over 12 m length reveal trammel nets as the most reported gear overall, followed by gillnets and set longlines (Fig. 6).

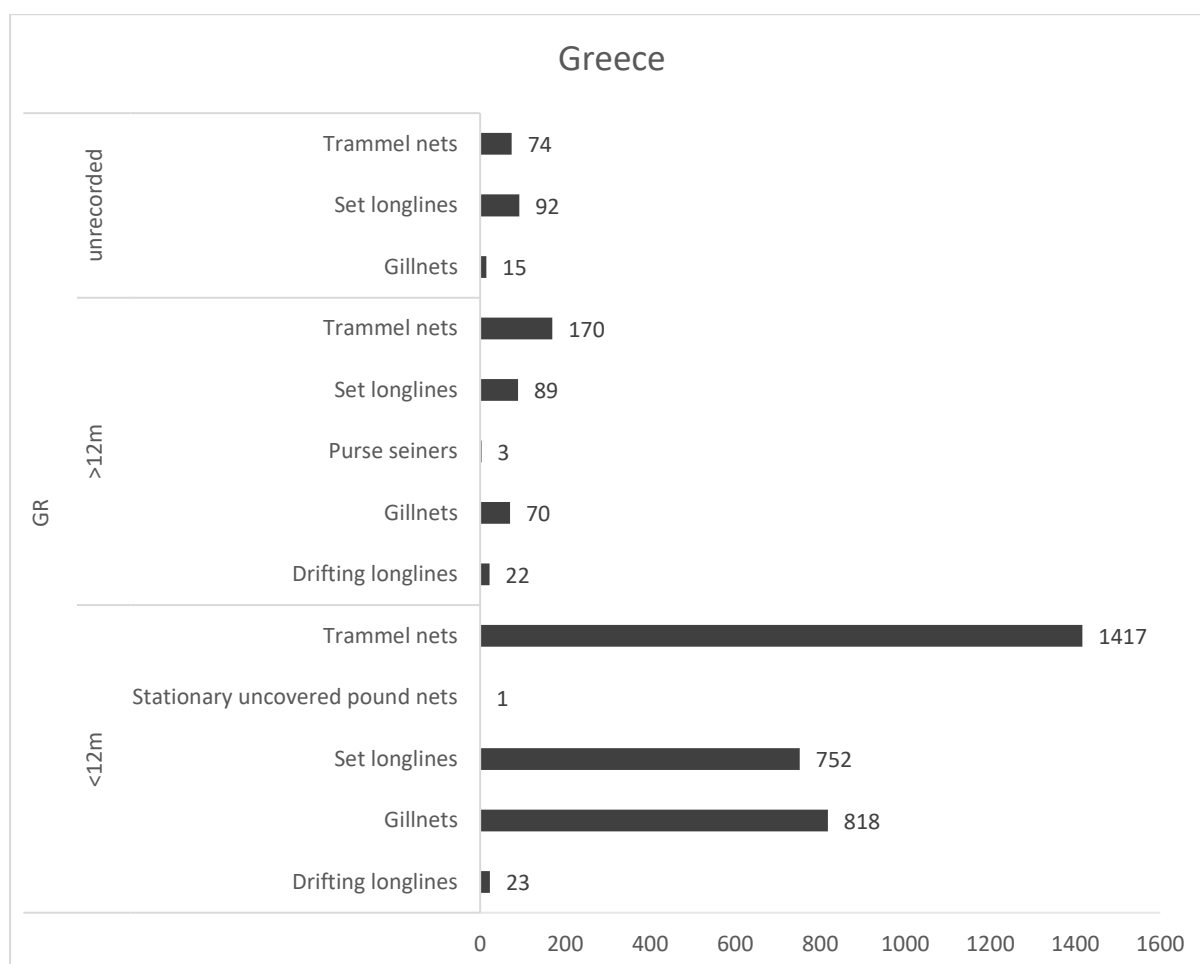


Figure 6. Number of questionnaires by fishing gear type and vessel length done in Greece.

For the purpose of this report, the Hellenic coastline and marine area have been divided in 12 sub-areas following the stratification of the Data Collection Framework (DCF; AGR.E.R.I., 2020) (Fig. 7).

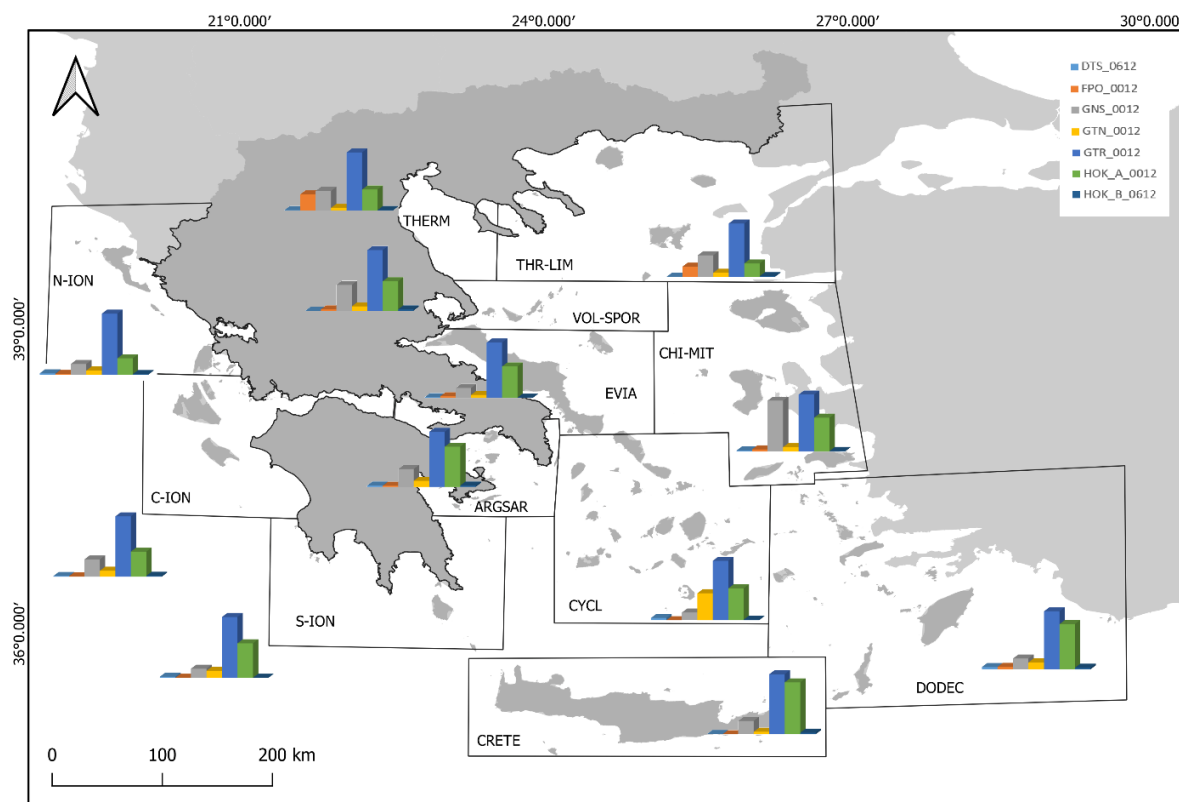


Figure 7. The 12 sub-areas which constitute the level of stratification in this report for the Greek fleet along with gear segments of the SSF fleet. The Ionian Sea (GSA20) comprises of sub-areas North Ionian (N-ION), Central Ionian (C-ION) and South Ionian (S-ION); the Aegean Sea (GSA22) comprises of sub-areas Thracian Sea-Limnos (THR-LIM), Thermaikos Gulf (THERM), Volos-Sporades (VOL-SPOR), Chios-Mytilene (CHI-MIT), Cyclades (CYCL) and Dodecanese (DODEC); the Cretan Archipelago (GSA23) corresponds to sub-area Crete (CRETE). Legend: DTS: Demersal trawlers and/or demersal seiners; FPO: Vessels using pots and/or traps; GNS: vessels using gillnets; GTR: vessels using trammel nets; GTN: vessels using combined nets (gillnets and trammel nets); HOK_A: vessels using handlines and set longlines; HOK_B: vessels using drifting longlines. The numbers denote vessel length: 0012 corresponds to vessels up to 11.9m length, 0612 corresponds to vessels between 6 to 11.9m length.

Table 6. Number of vessels by primary fishing gear stratified by sub-area, according to the 2018 fleet registry data.

Area	GSA20			GSA22								GSA23	TOTAL
Gear segment	N-ION	C-ION	S-ION	THERM	THR-LIM	VOL-SPO R	ARGS AR	CHI-MIT	EVIA	CYCL	DODE C	CRET E	
DTS_0612	7	9	7	3	1	0	20	9	7	13	19	1	110
FPO_0012	0	5	0	183	114	8	16	20	17	0	20	0	395
GNS_0012	59	226	59	223	245	148	263	501	112	44	89	87	2,170
GTN_0012	45	78	45	30	45	25	90	43	33	154	57	16	683
GTR_0012	397	789	397	664	609	347	814	561	632	340	477	394	7,021
HOK_A_0012 (LLS)	225 (212)	327 (303)	225 (212)	240 (222)	152 (138)	169 (154)	595 (553)	333 (303)	358 (337)	182 (172)	372 (347)	341 (316)	3,563 (3,308)
HOK_B_0612	8	11	0	4	6	8	20	11	2	3	13	10	90
TOTAL	733	1,445	733	1,347	1,172	705	1,818	1,445	1,161	736	1,047	849	14,032

Data on fishing effort (days at sea) are available for 2018, along with landings and corresponding values (Table 7), stratified per GSA, as reported in the Annual Fleet Report of 2019 (Directorate-General for Fisheries, 2020). Unfortunately, more detailed information for each of the 12 subareas studied is lacking. It can be seen that GSA22 produces the greatest portion of landings compared to GSA20 and GSA23, relying mainly on the catches of trammel nets (GTR), trawlers and purse seiners; it should be noted that the northern Aegean Sea (THERM, THR-LIM) hosts important fishing grounds in Greece (and the Eastern Mediterranean), contributing almost to half the country's annual catch production (ELSTAT 2021). In GSA20 and GSA23, the most important fishing gear is the trammel net in terms of landings as well as fishing effort, especially with regards to GSA20.

Table 7. Landings and fishing effort of 7 gear segments stratified by GSA. Fishing activity category in red corresponds predominantly to the large-scale fisheries sector. Gear Segment: FPO - pots and/or traps, GNS - gillnets, GTR - trammel nets, LLS - set longlines, OTB - bottom trawler, PS - purse seiner; Target species group: DEF - demersal fish, SPF - small pelagic fish; Mesh size (where applicable): ≥ 14 or 16 or 40: mesh size greater or equal to 14 or 16 or 40mm.

GSA	Fishing activity category Level 6	Landings (kg)	Effort (days-at-sea)	Value (€)
GSA20	FPO_DEF_0_0_0	208,666	8,400	1,314,597
GSA20	GNS_DEF_ ≥ 16 _0_0	911,647	95,536	7,694,312
GSA20	GTR_DEF_ ≥ 16 _0_0	2,756,993	388,292	25,150,833
GSA20	LLS_DEF_0_0_0	195,035	54,732	1,800,231
GSA20	OTB_DEF_ ≥ 40 _0_0	1,004,705	5,695	9,262,965
GSA20	PS_SPF_ ≥ 14 _0_0	2,466,491	4,867	8,407,721
GSA20	SB-SV_DEF_0_0_0	306,974	4,692	1,131,271
GSA20	TOTAL SSF	4,379,315	551,652	37,091,244
GSA22	FPO_DEF_0_0_0	2,605,271	40,589	15,949,468
GSA22	GNS_DEF_ ≥ 16 _0_0	6,057,588	353,904	48,221,755
GSA22	GTR_DEF_ ≥ 16 _0_0	6,526,480	525,694	54,083,067
GSA22	LLS_DEF_0_0_0	1,558,335	185,256	15,910,423
GSA22	OTB_DEF_ ≥ 40 _0_0	11,653,572	38,161	84,173,400
GSA22	PS_SPF_ ≥ 14 _0_0	24,858,524	30,010	83,982,985
GSA22	SB-SV_DEF_0_0_0	612,484	10,463	2,654,338
GSA22	TOTAL SSF	17,360,158	1,115,906	136,819,051
GSA23	GNS_DEF_ ≥ 16 _0_0	45,792	8,063	476,762
GSA23	GTR_DEF_ ≥ 16 _0_0	455,682	51,787	3,969,140
GSA23	LLS_DEF_0_0_0	22,298	14,503	152,907
GSA23	OTB_DEF_ ≥ 40 _0_0	364,606	1,514	3,024,779
GSA23	PS_SPF_ ≥ 14 _0_0	98,733	773	352,575
GSA23	SB-SV_DEF_0_0_0	32,251	437	137,219
GSA23	TOTAL SSF	556,023	74,790	4,736,028

Tzanatos *et al.* (2005) make a thorough review of the temporal and regional characteristics of the SSF in Greece for 2002. In this study 17 fishing gears and 62 target species are reported (Table 8).

Table 8. Combinations of fishing gear and target species per sub-area based on 2002 data (modified from Tzanatos et al. 2005). DFN: nets (gillnets, trammel nets, combined nets), LLS: set longlines, LHP: “Barkarola”, LTL: trolling line, LLD: drift longline, SB: boat seine. Lagoon: 5 gears typically used in lagoons and targeting the same species were grouped together. Sub-area VAR: various locations.

Sub-area	Gear	Target species	Season			
			W	Sp	Su	A
N-ION	DFN	<i>Pagrus pagrus</i> , <i>Dentex dentex</i> , <i>Diplodus</i> sp.	+	+		
N-ION	DFN	<i>Merluccius merluccius</i>	+			
N-ION	DFN	<i>Mullus barbatus</i> , <i>Trachurus</i> sp.				+
N-ION	LLS	<i>Pagrus pagrus</i> , <i>Dentex dentex</i> , <i>Diplodus</i> sp.	+	+		
N-ION	LLS	<i>Pagrus pagrus</i> , <i>Dentex dentex</i> , <i>Diplodus</i> sp., <i>Epinephelus marginatus</i>				+
C-ION	DFN	<i>Mullus surmuletus</i> , <i>Boops boops</i>		+	+	
C-ION	DFN	<i>Solea</i> sp.	+			+
C-ION	LLS	<i>Pagrus pagrus</i> , <i>Dentex dentex</i>		+	+	
C-ION	LLS	<i>Pagrus pagrus</i> , <i>Dentex dentex</i> , <i>Diplodus</i> sp., <i>Epinephelus marginatus</i>				+
C-ION	Lagoon	<i>Dicentrarchus labrax</i> , <i>Sparus aurata</i> , Mugillidae, <i>Anguilla anguilla</i> (W)	+	+	+	+
THR-LIM	DFN	<i>Pagrus pagrus</i> , <i>Mullus surmuletus</i>	+	+	+	+
THR-LIM	LLS	<i>Pagellus erythrinus</i> , <i>Diplodus</i> sp.		+	+	+
ARGSAR	DFN	<i>Boops boops</i> (W,Sp,A), <i>Mullus surmuletus</i>	+	+	+	+
ARGSAR	LLS	<i>Scorpaena</i> sp., <i>Pagellus erythrinus</i> , <i>Diplodus</i> sp. (Sp)	+	+	+	+
CYCL	DFN	<i>Boops boops</i> (W,Sp,A), <i>Mullus surmuletus</i>	+	+	+	+
CYCL	DFN	<i>Pagrus pagrus</i> , <i>Dentex dentex</i> , <i>Diplodus</i> sp., <i>Spondyliosoma cantharus</i> (Sp)	+	+		+
CYCL	DFN	<i>Mullus surmuletus</i> , <i>Palinurus elephas</i> , <i>Scorpaena</i> sp.		+	+	
CYCL	LLS	<i>Scorpaena</i> sp., <i>Pagellus erythrinus</i> , <i>Diplodus</i> sp. (Sp)	+	+	+	+
CYCL	LLS	<i>Pagrus pagrus</i> , <i>Dentex dentex</i> , <i>Diplodus</i> sp.	+	+		+
CYCL	SB	<i>Spicara smaris</i>	+			+
CYCL	LHP “Brakarola”	<i>Octopus vulgaris</i>	+			
DODEC	DFN	<i>Boops boops</i> (W,Sp,A), <i>Mullus surmuletus</i>	+	+	+	+
DODEC	DFN	<i>Pagrus pagrus</i> , <i>Dentex dentex</i> , <i>Diplodus</i> sp., <i>Spondyliosoma cantharus</i> (Sp)	+	+		
DODEC	DFN	<i>Sparisoma cretense</i>			+	+
DODEC	LLS	<i>Scorpaena</i> sp., <i>Pagellus erythrinus</i> , <i>Diplodus</i> sp. (Sp)	+	+	+	+

Sub-area	Gear	Target species	Season			
			W	Sp	Su	A
DODEC	LLS	<i>Pagrus pagrus</i> , <i>Dentex dentex</i> , <i>Diplodus</i> sp.	+	+		
DODEC	LLS	<i>Pagrus pagrus</i> , <i>Dentex dentex</i> , <i>Diplodus</i> sp., <i>Epinephelus marginatus</i>			+	+
DODEC	LHP "Brakarola"	<i>Octopus vulgaris</i>	+			
DODEC	LLD	<i>Xiphias gladius</i> , Thunnidae	+	+	+	+
VAR	DFN	<i>Penaeus</i> sp., <i>Mullus surmuletus</i>			+	
VAR	DFN	<i>Mullus surmuletus</i> , <i>Palinurus elephas</i> , <i>Scorpaena</i> sp.		+		
VAR	DFN	<i>Penaeus</i> sp., <i>Mullus barbatus</i> , <i>Merluccius merluccius</i> , <i>Sepia officinalis</i>		+		
VAR	DFN	<i>Trachurus</i> sp., <i>Scomber japonicus</i>				+
VAR	LLS	<i>Diplodus</i> sp., <i>Pagrus pagrus</i>			+	
VAR	LLS	<i>Lithognathus mormyrus</i>				+
VAR	LTL	<i>Katsuwonus pelamis</i> , <i>Sarda sarda</i>	+	+		+
VAR	LLD	<i>Xiphias gladius</i> , Thunnidae	+	+	+	+
VAR	SB	<i>Spicara smaris</i>	+			+

DCF landings data for the year 2014 show that the most important target species for the Greek SSF sector in terms of volume of landings are the European hake (*Merluccius merluccius*), the red mullets (*Mullus barbatus* and *M. surmuletus*-) and jack and horse mackerels (*Trachurus* spp.), various Sparidae, the common sole (*Solea solea*), the common octopus (*Octopus vulgaris*), the common cuttlefish (*Sepia officinalis*) and the caramote prawn (*Penaeus kerathurus*). The most important fleet segment in terms of fishing effort is the VL0612 (>70% in all cases in Table 7) (STECF 2015). Table 9 provides a more detailed view of the target species per gear for each GSA (20, 22 & 23) for the year 2014.

Table 9. Summary of the DCF landings 2014 data on most important target species in terms of volume of landings, for each GSA in Greece (STECF 2015).

GSA	Fishing gear	Species group	Main Target Species (75% cumulative percentage)
20	GNS	Demersal	<i>M. merluccius</i> , <i>M. barbatus</i> , <i>M. surmuletus</i> , <i>Trachurus</i> spp.
20	GTR	Demersal	<i>S. officinalis</i> , <i>S. aurata</i> , <i>M. barbatus</i> , <i>M. surmuletus</i> , <i>O. vulgaris</i> , <i>S. solea</i> , <i>M. merluccius</i> , <i>Pagellus</i> spp.
20	LLS	Demersal	<i>Trachurus</i> spp., <i>S. aurata</i> , <i>M. merluccius</i>
22	FPO	Demersal	<i>O. vulgaris</i>
22	GNS	Demersal	<i>M. barbatus</i> , <i>M. surmuletus</i> , <i>S. pilchardus</i> , <i>M. merluccius</i> , <i>Scomber</i> spp., <i>B. boops</i> , <i>Trachurus</i> spp.
22	GTR	Demersal	<i>S. officinalis</i> , <i>M. surmuletus</i> , <i>M. barbatus</i> , <i>S. solea</i> , <i>Pagellus</i> spp., <i>O. vulgaris</i> , <i>P. kerathurus</i> , <i>S. aurata</i>
22	LLS	Demersal	<i>Pagellus</i> spp., <i>Diplodus</i> spp., <i>S. aurata</i> , <i>Pagrus pagrus</i>
23	GNS	Demersal	<i>S. aurata</i> , <i>Pagellus</i> spp.
23	GTR	Demersal	<i>M. surmuletus</i> , <i>M. barbatus</i> , <i>B. boops</i> , <i>S. officinalis</i> , <i>Pagellus</i> spp.
23	LLS	Demersal	<i>Pagrus pagrus</i> , <i>Diplodus</i> spp.

According to the questionnaire surveys in small vessels, trammel nets, gillnets and set longlines can be used for catching certain species of demersal fish, such as common pandora *Pagellus erythrinus*, European hake *Merluccius merluccius*, European seabass *Dicentrarchus labrax* and several species of seabreams and dentex. Trammel nets were more frequently reported for the most benthic species (i.e. Common sole *Solea solea*, stargazer *Uranoscopus scaber*), while pelagic fish (i.e. Bogue *Boops boops*, chub mackerel *Scomber japonicus*) are also caught with gillnets. Grouper *Epinephelus* spp, wreckfish *Polyprion americanus* and Red Porgy *Pagrus pagrus* are usually target species for set longlines, while drifting longlines are employed for Atlantic bluefin tuna *Thunnus thynnus* and swordfish *Xiphias gladius* (Fig. 8). For vessels exceeding 12 m in length, target species are similar regarding trammel nets, gillnets and set or drift longlines. Purse seiners aim at European anchovy *Engraulis encrasicolus* and chub mackerel *Scomber japonicus*, almost exclusively, according with answers provided in the inquiry (Fig. 9).

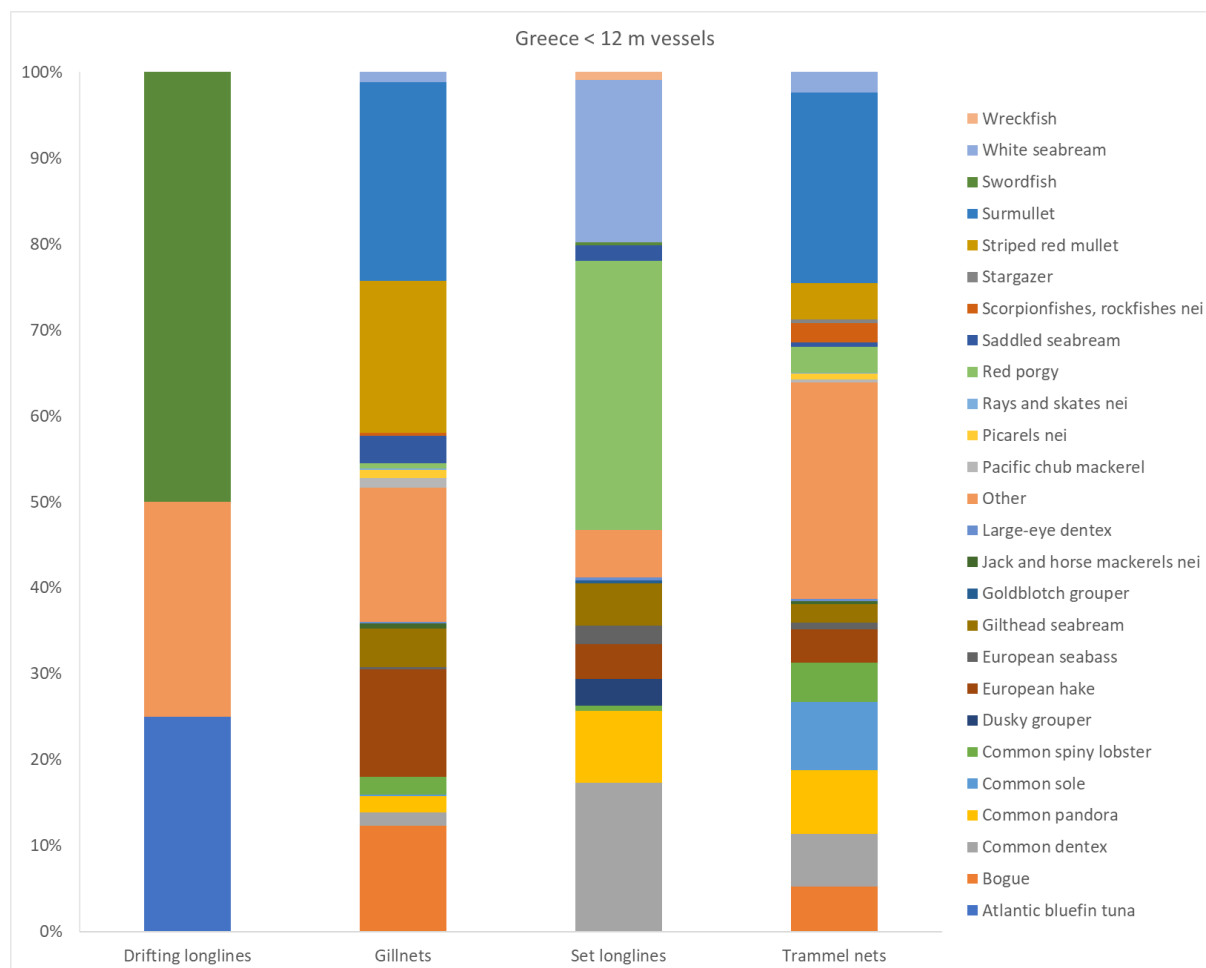


Figure 8. Target species by gear reported in questionnaires for vessels smaller than 12 m in length. Figures displayed represent relative frequencies of the answers.

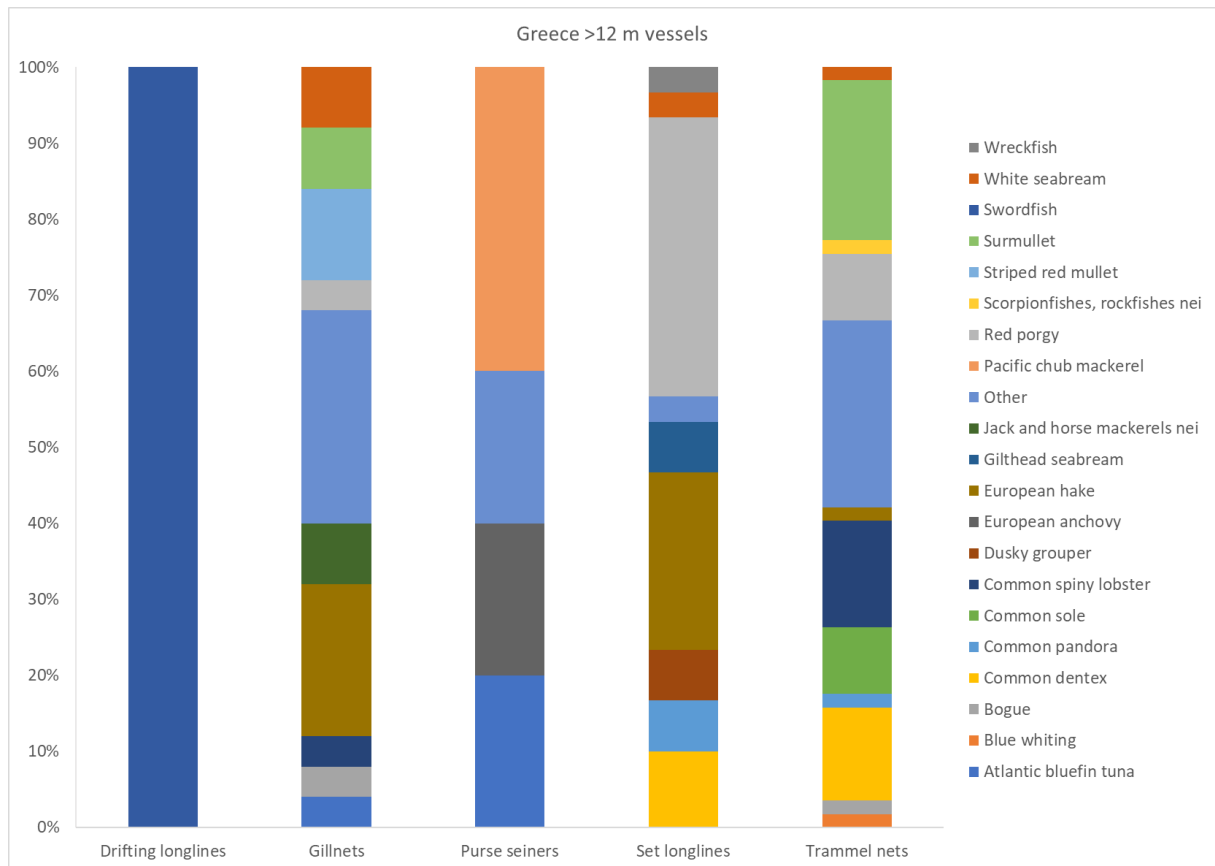


Figure 9. Target species by gear reported in questionnaires for vessels larger than 12 m in length. Figures displayed represent relative frequencies of the answers.

Discards in Greece are only monitored through the on-board and on-shore biological sampling scheme provisioned in the DCF, since discards are not usually declared in the official forms handed to the authorities by fishers (e.g., ERS reporting) (Kavadas *et al.* 2021), despite the Landing Obligation (LO) in force since 2019. Recent data on SSF discards reveal that their numbers have increased, constituting 17% of the total catch, whereas they are dominated in many cases by alien species (Villasante *et al.* 2019). Tsagarakis *et al.* (2014) review estimates on SSF discards for Greece (Table 10).

Table 10. Discard ratios in Greece (Taken from Tsagarakis et al. 2014).

Region	GSA	Fishing gear	Discards (%)	Reference
E. Ionian	20	GTR	12.9	Vassilopoulou et al. 2007
C. Aegean	22	GNS	5.1	Stergiou et al. 2002
Aegean	22	GTR	10.6	Vassilopoulou et al. 2007
C. Aegean	22	GTR	14.7	Gonçalves et al. 2007
C. Aegean	22	LLS	3.2	Stergiou et al. 2002
Aegean & Ionian	20 & 22	SB	10	Petrakis et al. 2009
Patraikos gulf	20	GTR, GNS, LLS	10	Tzanatos et al. 2007
Ionian	20	GNS-HKE	29.5	Tzanatos et al. 2007

Malta

Malta has 252,81 km of coastline with 44 home ports (some located in the same bay), Mġarr being the most important on the island of Gozo and Marsaxlokk on the island of Malta. The fishing fleet is composed of 859 vessels in 2021, with the vast majority considered as small-scale vessels, 93% less than 12m, and only 7% more than 12m in length. The fleet fishes mainly with hooks and lines (53%) and gillnets and entangled nets (32%) (EUMOFA, 2023).

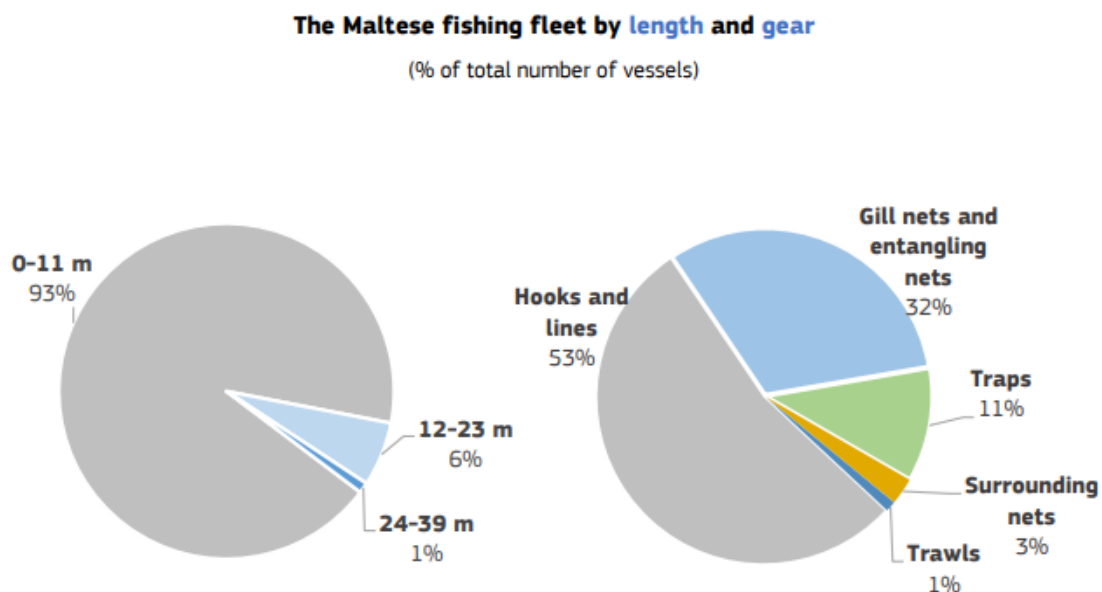


Figure 10. The Maltese fishing fleet by length and gear (EUMOFA, 2023).

The Maltese fishery is a relatively small industry of a typically Mediterranean artisanal type and is frequently described as a multi-species and multi-gear fishery, with most of the fishers switching from one gear to another several times throughout the year.

Table 11. Number of unique vessels by gear in Malta in 2021 (DFA 2023).

Fishing gear	Count of vessels
Bottom otter trawl	16
Combined gillnets-trammel nets	313
Drifting longlines	686
Lampara nets	234
Midwater otter trawl	1
Purse seine	13
Set gillnets	439
Set longlines	819
Set surface longlines	99
Trammel net	759

In the questionnaire surveys, drifting longlines are the fishing gear most represented, considering both big and small vessels. For small vessels (<12 m) trammel nets and longlines are the most recorded gears (Fig. 11).

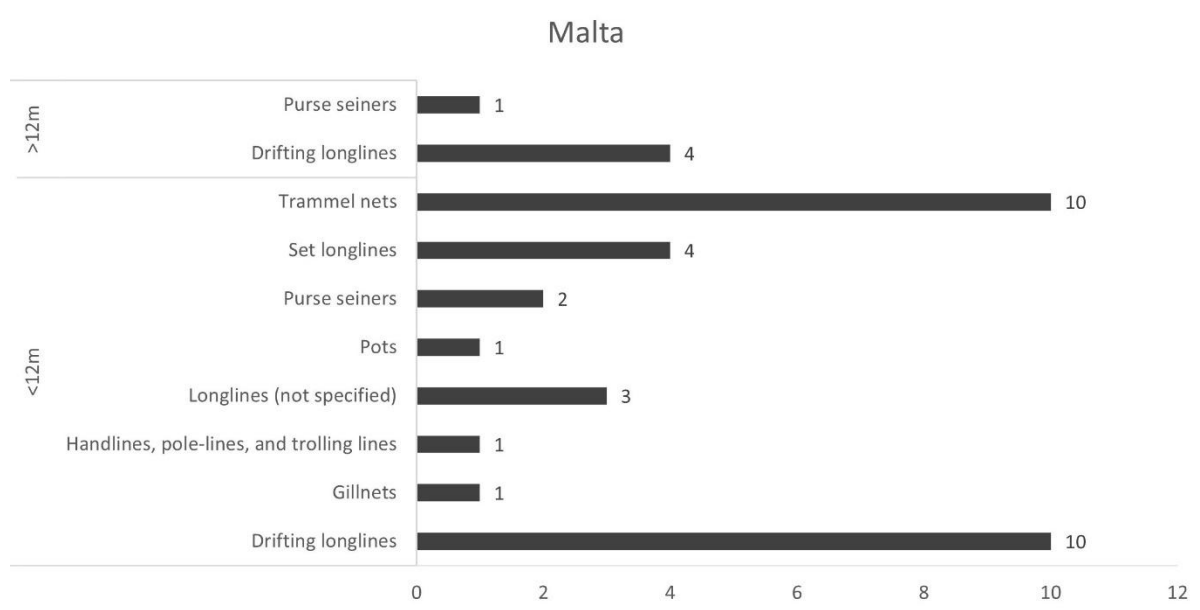


Figure 11. Number of questionnaires by fishing gear type and vessel length in Malta.

The target species reported in the questionnaire surveys for drifting longlines are mainly big pelagic fish, namely Atlantic bluefin tuna *Thunnus thynnus* and swordfish *Xiphias gladius*, for purse seines are primarily common dolphinfish *Coryphaena hippurus* (Fig. 12 and 13). Trammel nets, set longlines and pots are reported only for vessels under 12 m in length. Nets are employed for fishing a number of demersal (i.e. red-striped mullet *Mullus surmuletus*, scorpionfish *Scorpaena spp.*, cuttlefish *sepia spp.*) and pelagic bogue (*Boops boops*) species. Set longlines mentioned common pandora *Pagellus erythrinus*, gurnard *Trigla spp.* and red porgy *Pagrus pagrus* as the main target species and pots are only used for *Octopus octopus spp.*, but sample size is low for these gears (Fig 11).

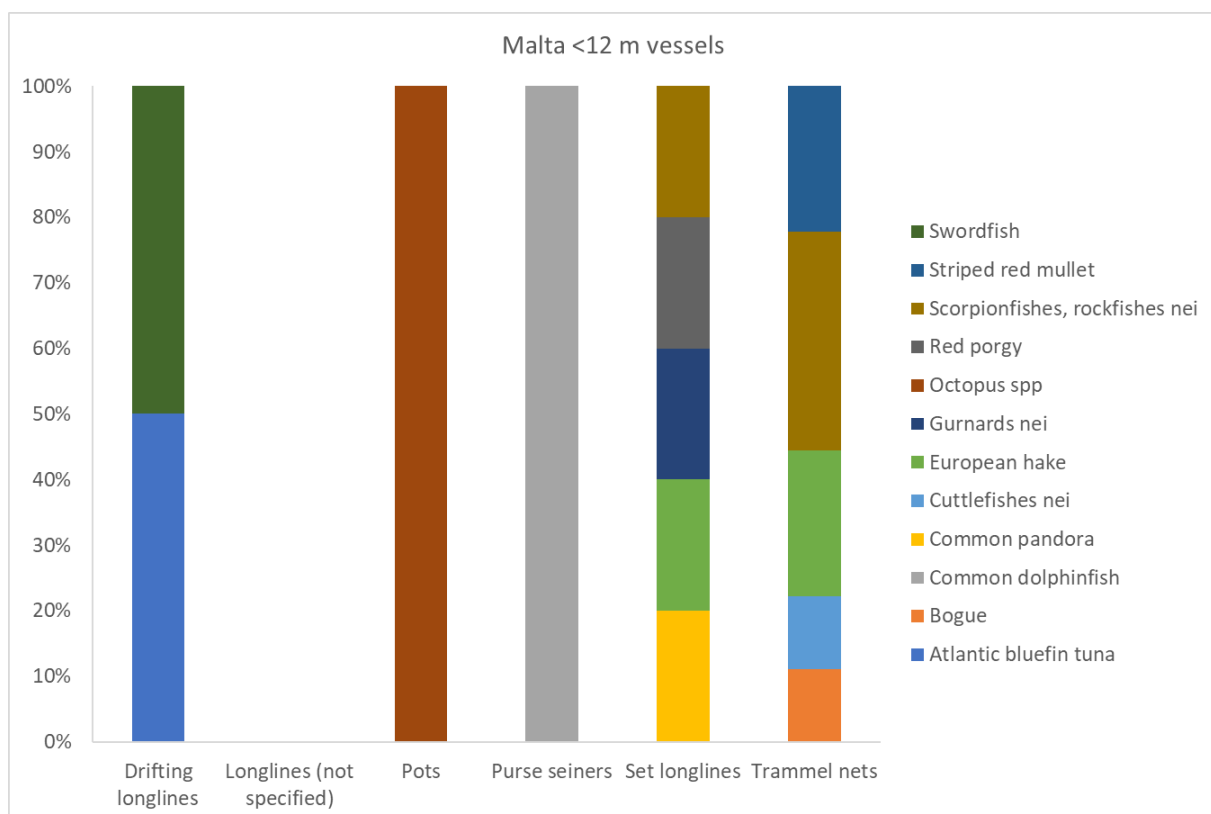


Figure 12. Target species by gear reported in questionnaires for vessels smaller than 12 m in length. Figures displayed represent relative frequencies of the answers.

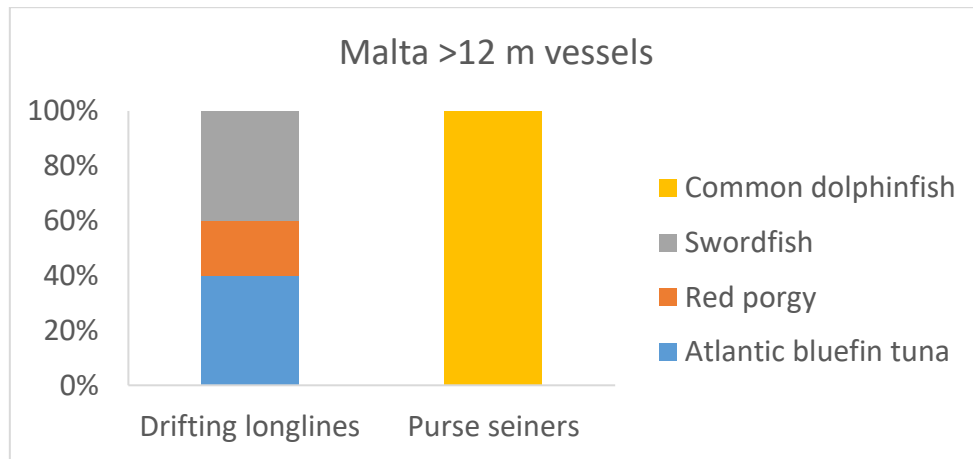


Figure 13. Target species by gear reported in questionnaires for vessels bigger than 12 m in length. Figures displayed represent relative frequencies of the answers.

Portugal

In 2022, there were 3,875 fishing vessels authorized to operate in Portugal. The licensed vessels authorized to operate represented 50.9% of the total number of registered vessels (7608 vessels). The number of registered fishermen in 2022 stood at 14,159, 758 fewer (-5.1%) than in 2021. Of the total number of licensed vessels (3,875 units), 90.8% had a license to operate with longlines, 64.8% with nets, 45.3% with traps, 24.1% with other gear, 17.5% with trawling and only 7.7% with purse seine. Around 79% of licensed vessels were less than 10 meters long and the polyvalent fleet represents a significant proportion of the national fleet. In 2022, total catches of the Portuguese fleet reached 165,801 tonnes (INE, I.P., Lisboa · Portugal, 2023).

The study area of Aveiro-Nazaré SPA is located in the Center region of Portugal, that includes the following main fishing ports: Aveiro, Figueira da Foz, Nazaré and Peniche. Of these, Aveiro, Figueira da Foz and Nazaré are the surveyed fishing ports under LIFE PanPuffinus! project. The Center region has the largest number of registered vessels, with 1863 units, corresponding to 24.5% of the total for the country and the highest catch (31,8%).

There is no official data available on the number of vessels operating in the study area (with around 150Km of coastline). There is information on the fishing licenses

given by governmental entities by fishing port, but this source of data has 2 limitations:

- There may be licenses that are not being used by the vessels.
- There is a significant number of vessels registered in other ports, but seasonally operating from the surveyed fishing ports (particularly relevant for purse seine fleet which moves around the Portuguese coast depending on Sardine availability).

Nevertheless, there are 357 fishing licenses attributed to nets (gillnet + trammel net), 134 licenses for pots, 208 for longline, 18 for purse seine and 26 for trawl, making a total of 743 licenses attributed in 2020 in the ports of Aveiro, Figueira da Foz and Nazaré (See Table 12).

Table 12. Number of fishing gear licenses attributed in 2020 by DGRM per gear and per fishing port and proportion that was interviewed.

Fishing gear licenses	Fishing port			Total	Num. unique vessels interviewed*	% interviewed
	Aveiro	Figueira da Foz	Nazaré			
Purse seine	3	6	9	18	37	206
Trawl	11	15	0	26	27	104
Gillnet	83	36	30	149	29	19
Trammel net	98	58	52	208	64	31
Pots	58	27	49	134	46	34
Longline	53	84	71	208	28	13

* Each vessel could have been interviewed more than one time along the survey. Here only number of unique vessels interview is represented.

The most common gear licenses are the longline and trammel nets, followed by gillnets and pots. Gillnets and trammels nets represent more than 40% of the total number of licenses. Purse seiners and trawlers, exhibit lower numbers than other licenses, however they represent an important fleet in the area that accommodates purse seiners from other base ports outside of the area.

The observation effort of the questionnaires varied with fishing gear, purse seine and trawl being the best covered and longline the least. Nevertheless, the main target gears (namely purse seine, gillnet and trammel net) were covered satisfactorily.

The surveys performed in Portugal show that trammel nets are widely used in Portuguese fisheries, even in large boats (>12 m length). Pots seem to represent an important gear employed in both vessel lengths, while the purse seines rank second in the list of gears most frequently reported for vessels over 12 m, followed by trawls and gillnets. As for vessels under 12 m in length, set longlines and gillnets are the third and fourth most referred gears in the questionnaires, after trammel nets and pots (Fig. 14).

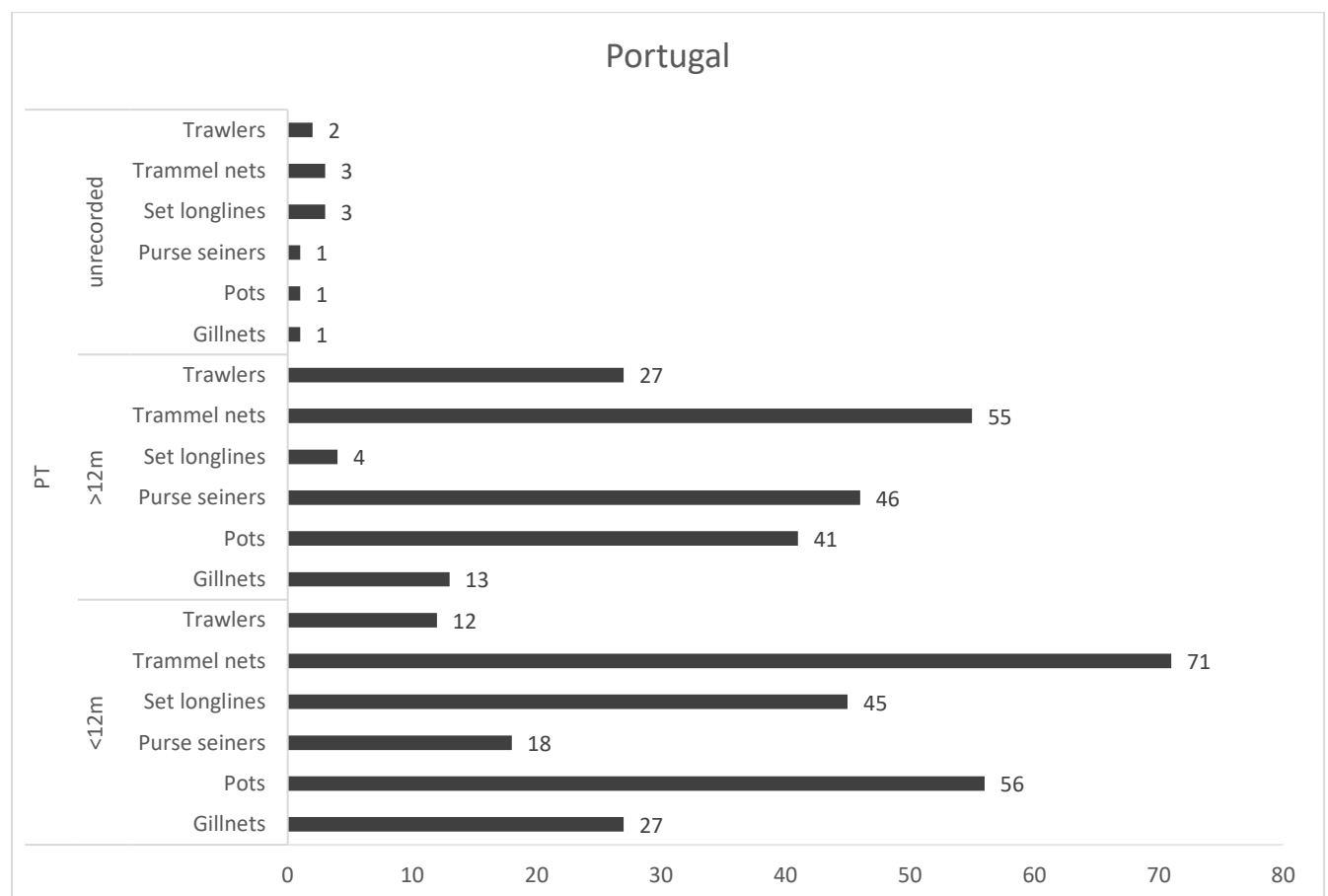


Figure 14. Number of questionnaires by fishing gear type and vessel length performed in Portugal. Questionnaires performed for three-months periods, thus each vessel could be interviewed in different seasons.

Spain

In 2021, in the Mediterranean fishing area of Spain there were 2,304 fishing vessels registered with a mean length of 12,6 m. 62,7% of the fleet correspond to small-scale fleet of polyvalent vessels. The project covers almost all the Mediterranean area apart from East Andalucía, including the Balearic Islands, Catalonia, Valencia community and Murcia, where the small-scale polyvalent fleet is the most numerous (60,5%), followed by trawlers (28,3%) and purse seiners (7,8%) (Table 13).

Table 13. Number of fishing vessels by fleet segment and by regions of the project in Spain (Spanish fishing fleet census, 2019).

Fishing fleet segment	Region				Total	%
	Balearic Islands	Catalonia	Murcia	Valencian Community		
Trawlers	36	224	23	207	490	28,3
Small scale polyvalent vessels	276	341	129	301	1047	60,5
Drifting longlines	1	13	5	6	25	1,4
Purse seiners	8	66	20	41	135	7,8
Set longlines	5	26	0	2	33	1,9
Total	326	670	177	557	1730	100

The small-scale fleet can operate with multiple gear licenses alternating between them along the year. There are no official statistics available to estimate the proportion of use of each fishing gear in this fleet segment. The proportion of vessels using the fishing gear types in the ports that are included in the project areas in Spain were calculated using the official statistics and field knowledge acquired in the ports (Table 14).

In Spain, the information collected through questionnaires shows that larger vessels (> 12 m) are mainly trawlers and purse seiners. The Mediterranean small-scale fleet is mostly comprised by fishing vessels smaller than 12 m in length operating mainly with trammel nets, set longliners and gillnets, and pots in some areas. Stationary uncovered pound nets are specific of an area in Murcia region (Fig 15).

Table 14. Number of fishing vessels by fishing gear type in the ports of the regions of the project in Spain where interviews were performed and the proportion (%) of vessels interviewed. Data from the Spanish fishing fleet census (2019) as well as field knowledge were used to calculate fishing gear type of the small-scale fleet.

Gear type	Region				Total	Num. vessels interviewed	% interviewed
	Balearic Islands	Catalonia	Murcia	Valencian Community			
Purse seines	8	36	6	6	56	19	33,9
Trawls	21	117	8	57	203	21	10,3
Gillnets	37	18	23	30	108	31	28,7
Trammel nets	86	43	25	30	184	58	31,5
Drifting longlines	0	7	4	0	11	0	0,0
Set longlines	34	86	15	15	150	55	36,7

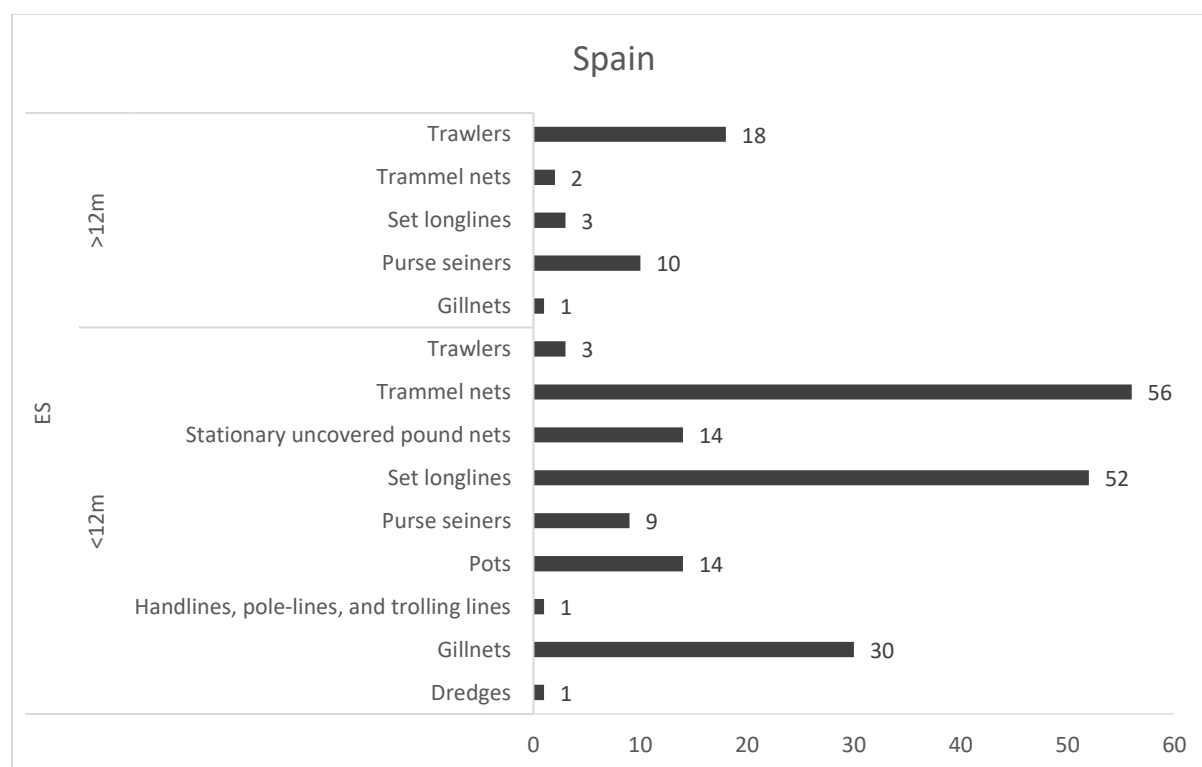


Figure 15. Gears reported in questionnaires for small scale fleets, considering vessels bigger or smaller than 12 m. Figures displayed represent frequencies of the answers.

The target group of species reported in trammel nets and gillnets encompass a variety of catches including different groups of fish, crustaceans and molluscs, while set longlines are aimed at several species of fish in both large and small fishing boats. Pots target molluscs exclusively (Fig. 16). Trawlers over 12 m in length target several fish groups, whereas purse seiners report pelagic fish as their main catch (Fig. 17).

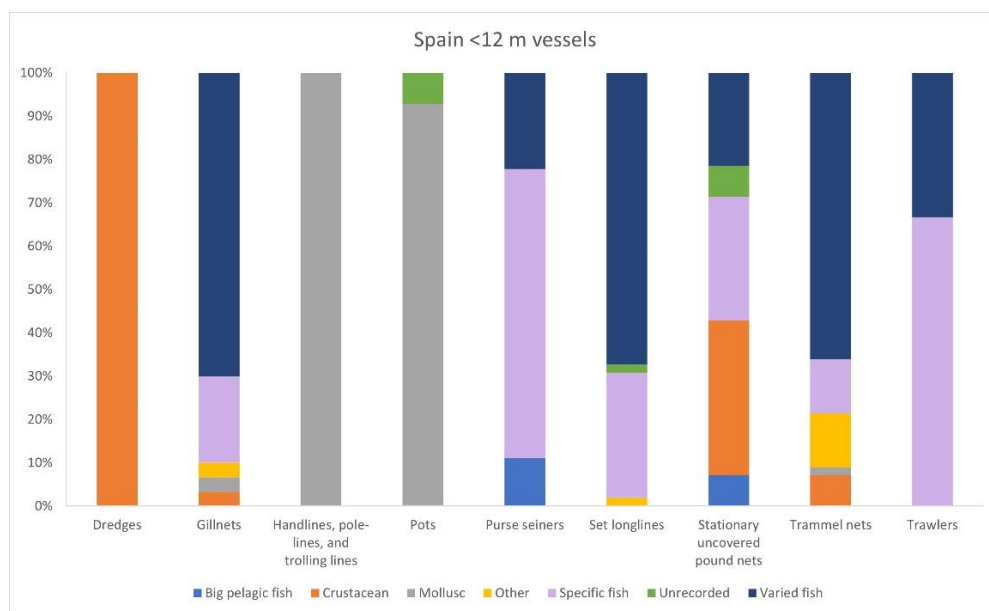


Figure 16. Target species by gear reported in questionnaires for vessels smaller than 12 m in length. Figures displayed represent relative frequencies of the answers.

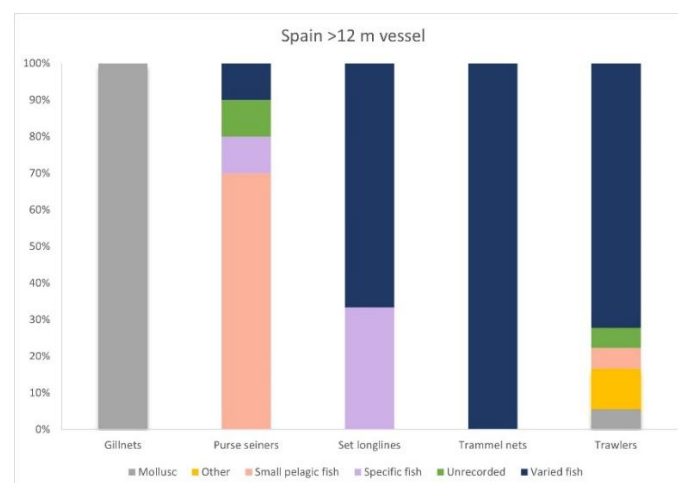


Figure 17. Target species by gear reported in questionnaires for vessels bigger than 12 m in length. Figures displayed represent relative frequencies of the answers.

4.2. Fishing fleet by gear

In this section, an overview of the fishing gear types studied in the areas of the project is presented for each country, including the general description of the fishing gear type and the main characteristics of each one and the target species. When possible, the fishing effort is divided by vessel length (<12m and >12m).

Purse seines

The purse seine is made of a long wall of netting framed with floatline and leadline and having purse rings hanging from the lower edge of the gear, through which runs a purse line which allow the pursing of the net. It is an efficient gear for catching large and small pelagic species that are shoaling. Light attractions are used in some fisheries to concentrate the fish (FAO, 2023).

Most gears reported in the questionnaires as purse seine gear type refer to purse seine (PS), and only two do not indicate the type of seine net used (SX). The length of the net in small vessels (< 12 m) is highly variable, between 100 m and 500 m, though most of them are around 300 m or less. For large vessels (>12 m) the most common net length in Spain is 330 m, while in Malta the gear can get up to 6.000 m and almost a 1.000 m in Portugal (Table 15).

Table 15. Length of the purse seine gear reported in interviews.

Purse seines	Length of the gear (m)	
	<12 m vessels	>12 m vessels
France	400	400
Greece	-	400-1000
Malta	200	6000
Portugal	200-500	200-960
Spain	108-360	300-330

According to the questionnaire survey pelagic fish is the main catch reported in most countries, such as sardine *Sardina pilchardus* (most reported in France), common dolphinfish *Coryphaena hippurus* (main catch in Malta) as well as European anchovy *Engraulis encrasicolus* and Pacific chub mackerel *Scomber japonicus* (important catches in Greece). In Portugal the main target species are sardine *Sardina pilchardus*, Atlantic horse mackerel *Trachurus trachurus*, Atlantic chub mackerel *Scomber colias* and European anchovy *Engraulis encrasicolus*. In Greece the main target species are Pacific chub mackerel *Scomber japonicus*, Atlantic bluefin tuna *Thunnus thynnus*, Atlantic bonito *Sarda sarda*, common dolphinfish *Coryphaena hippurus*, sardine *Sardina pilchardus*, European anchovy *Engraulis encrasicolus*, and gilthead seabream *Sparus aurata*.

Trawls

The trawl gear type in the questionnaires correspond to bottom otter trawls (OTB) (66,7%), bottom trawls (TB) (28,8%), midwater otter trawls (OTM) (1,5%), and other trawls (not specified) (TX) (3%). Bottom trawl is constructed like a cone-shaped net that is towed on the bottom. It consists of a body ending in a codend, which retains the catch (FAO, 2023). In the Mediterranean fisheries, the most common type of bottom trawling is the single boat bottom otter trawl which consists in a trawl towed on the seabed by one boat with its horizontal spread maintained by a pair of otter boards. These gears are the most frequently reported in the questionnaires in Spain, France and Portugal (OTB, TB, and TX), usually operated by vessels measuring more than 12 m. This fleet was not targeted by questionnaires in Greece. In France the use of single boat midwater otter trawls (OTM) was also reported. This gear consists of a cone-shaped net that is towed in midwater using a pair of otter boards to spread the net horizontally (FAO, 2023). According to the information reported in the survey, the trawling nets can measure from tens to a few hundred meters, being highly diverse even in the same country.

According to the questionnaire survey trawlers can target several marine species, including fish, crustaceans and molluscs. Some of the reported catches encompass surmullets *Mullus spp.*, blue whiting *Micromesistius poutassou*, common sole *Solea solea*, European anchovy *Engraulis encrasicolus*, European hake *Merluccius merluccius*, John Dory *Zeus faber* and Octopus *spp.*

Gillnets

A set gillnet is a long rectangular netting anchored or otherwise fixed to the seabed to catch fish when they come in contact with it. The set gillnet is held open vertically in the water by a headrope usually with floats, and by a footrope weighted with sinkers. The main mechanism of capture is by gilling, but can also be by wedging, snagging and entangling (FAO, 2023).

In the questionnaire survey the gillnet gear type included set gillnets (anchored) (GNS) that represented the large majority (96%) as well as few questionnaires where gillnets and entangling nets (not specified) (GEN), encircling gillnets (GNC) and driftnets (GND) were reported. Driftnets (or drift gillnet) (GND), is a type of gillnet that is not fixed to the seabed but is allowed to drift with the current. For the purpose of this report this type was included in the fishing gear type of gillnets and was reported in only two interviews in France and Portugal.

In the study areas most vessels using gillnets are small- to medium-sized (<12 m). Vessels >12 m were only relevant in Portugal in this study. The total net lengths used can vary from tens of meters to several thousands (Table 16). The net height ranged between 0.5 and 20 m and the mesh size between 20 and 100 mm.

In Spain, the net lengths were mostly 1000 m (50-3000m) in small vessels. Similar sizes were reported in France (50-5000 m), with most reporting 500-800 m. In Greece certain nets can be more than 9000 m long, even for small vessels (< 12 m) and most small vessels reported net lengths of 1000 m, 1500 m, 1800 m, 2500 m, 2000 m, 3000 m and 500 m, in this order, while the net lengths in large vessels (>12 m) were around 2000 m. In Malta gillnets were reported only in small vessels (<12 m) with an estimate net length 2170,4 m provided by fishing statistics (DFA). Among the surveyed countries, the longest nets are used in Portugal, achieving 12000 m in bigger vessels (> 12 m). However, most cases recorded are small vessels that make use of nets of 600 m in length.

Table 16. Range length of gillnets from questionnaire surveys for France, Greece, Portugal and Spain and from fisheries statistics in Malta (DFA).

Country	Length of gillnet (m)	
	<12 m vessels	>12 m vessels
France	50-5000	-
Greece	55-9100	240-7280
Malta	2170,4	-
Portugal	300-2400	1575-12000
Spain	50-3000	2000

According to the questionnaire surveys gillnets are quite unspecific gears, targeting mainly benthopelagic (European seabass *Dicentrarchus labrax*, gilthead seabream *Sparus aurata*, saddled seabream *Oblada melanura* and white seabream *Diplodus sargus*), but also pelagic species, namely blue whiting *Micromesistius poutassou*, bogue *Boops boops*, mackerel *Scomber spp.* and European anchovy *Engraulis encrasicolus*.

Trammel nets

A trammel net (GTR) consists of two/three layers of netting with a slack small mesh inner netting between two layers of large mesh netting within which fish will entangle. The net is kept more or less vertical by floats on the headrope and mostly by weights on the ground rope (FAO, 2023). Combined gillnets-trammel nets (GTN) are also a bottom-set gear that consists of two parts: an upper one being a standard gillnet where semi-demersal or pelagic fish may be gilled and a lower part being a trammel net where bottom fish may entangle (FAO, 2023). Trammel nets (GTR) and combined gillnets-trammel nets (GTN) are included in the gear type of trammel nets in this report as both include a trammel net and very similar in relation to seabird bycatch. In the questionnaire surveys trammel nets (GTR) represent 97% of the trammel net gear type.

In the surveyed countries trammel nets are the most common type of nets and mainly used by small vessels (<12 m), with nets usually ranging 1000 or 2000 m length,

while in large vessels (>12 m) the most frequently recorded net length was 5000 m (Table 17). Net heights range between 0.5-20 m, but the most common measures were 1.5-2 m. Mesh size was usually 100-200 mm in the case of the external mesh and between 20 and 40 mm for the internal one. Combined gillnets-trammel nets are only utilised in small vessels (< 12 m) with a similar length as trammel nets.

Table 17. Range length of trammel nets from questionnaire survey for France, Greece, Portugal and Spain and from fisheries statistics in Malta (DFA).

Country	Length of trammel net (m)	
	<12 m vessels	>12 m vessels
France	200-5000	-
Greece	60-9310	288-10972
Malta	3793 (GTN) 1627 (GTR)	-
Portugal	200-5000	500-18000
Spain	40-5000	2000-6437

According to the questionnaire survey trammel nets can catch a wide variety of fish as well as molluscs and crustaceans, mainly those with benthic habits (i.e. common sole *Solea solea*, stargazer *Uranoscopus scaber*, surmullets *Mullus spp.*, spiny lobster *Panulirus spp* and cuttlefish *Sepia spp.*, scorpionfish *Scorpaena spp.*).

Set longlines

A set longline (LLS) consists of a mainline and snoods with baited hooks at regular intervals and which is set, in general, on or near the sea bottom. The number of hooks, distance of snoods on the main line and length of the snoods depends on the target species, the handling capacity and technology used (FAO, 2023).

In the surveyed countries in small vessels (< 12 m) the length of the line can range from a 150 to 24000 m, though generally the most reported line size is 3000 m. Larger vessels (>12 m) may hold lines up to 44000 m, yet the most utilised ones are around 13000 m. The number of hooks set per day varies according to the line length, being on average 1000 hooks/day in small vessels (< 12 m) and between 1500 and

2500 for larger vessels (> 12 m) (Table 18). In Malta questionnaires from small vessels (<12 m) reported 800 hooks/day and for all vessels 4656 hooks/day are estimated (DFA).

Table 18. Length of set longlines and number of hooks set per day from the questionnaire survey.

Country	<12 m vessels		>12 m vessels	
	Length of set longlines (m)	N° hooks/day	Length of set longlines (m)	N° hooks/day
France	500-14000	50-1500	-	-
Greece	400-24000	11 - 6500	450-44000	250-5000
Malta	3704	800	-	-
Portugal	120-7200	200-10000	12800	4500-9000
Spain	150-13725	200-2500	4500-33000	2200-4500

According to the questionnaire survey several species, such as common dentex *Dentex dentex* and common pandora *Pagellus erythrinus* can be targeted by all trammel nets, gillnets and set longlines. In general, the main target catches for set longlines are reported to be carnivorous benthic species such as gurnard *Trigla spp.*, grouper *Epinephelus spp.*, wreckfish *Polyprion americanus* and red porgy *Pagrus pagrus*, in both large and small fishing boats.

The bait used is selected according to the expected catch, thus, mackerel *Scomber spp.*, sardinella *Sardinella spp.*, Squid species as well as octopus *Octopus spp.* and cuttlefish *Sepia spp.* are the most common baits used in most countries. In Spain, however, the main bait are cephalopods such as octopus *Octopus spp.* and squid species, followed by sardinella *Sardinella spp.* and sardine *Sardina pilchardus*, crabs also being common.

Drifting longlines

Drifting longlines (LLD) consist of a mainline with relatively long snoods with baited hooks, yet in this case, the gear is kept near to the surface or at a certain depth by means of regularly spaced floats (FAO, 2023).

The questionnaire survey was in general not focused on this fishing gear because it is used by larger vessels (>12 m) and there is little previous evidence of seabird

bycatch in this fleet. In France, Greece, Malta and Portugal the interviews were focused on small vessels (<12 m). The number of hooks set per day varied according to the line length (Table 19). In Malta, apart from the questionnaire survey, fishing statistics estimate a mean of 6112 hooks/day for vessels of all lengths (DFA).

Table 19. Length of drifting longlines and number of hooks set per day from questionnaire survey.

Country	<12 m vessels		>12 m vessels	
	Length of drifting longlines (m)	N° hooks/day	Length of drifting longlines (m)	N° hooks/day
France	1800-37000	150-1500	-	-
Greece	2100-31500	300-1750	16000-46000	500-800
Malta	16-64820	400-3000	64820-74080	2000-2800
Portugal	-	-	-	-
Spain	-	-	-	-

According to the questionnaire survey drifting longlines are employed in all countries for Atlantic bluefin tuna *Thunnus thynnus* and swordfish *Xiphias gladius* and the main baits employed to attract these big predators are Atlantic mackerel *Scomber colias* and chub mackerel *Scomber japonicus*, sardinella *Sardinella spp.*, as well as squid species and artificial baits, to a lesser extent. In Malta, the use of Crevalle jack *Caranx hippos* is also reported for drifting longlines.

4.3. Fishing effort

This section presents all data collected in relation to fishing effort from the different fishing gear types in the different countries of the project. The fishing effort, expressed as the number of fishing days per year, was calculated from fisher replies in the questionnaire survey (Table 20).

In the fishing gear types and countries where a representative number of questionnaires was not collected or not available, data on the fishing effort is not presented. This is the case in general for fishing gear type groups previously known to produce low or zero seabird bycatch in each country and in which less effort was placed during the survey.

Table 20. Fishing effort by country and fishing gear type group expressed as the number of fishing days/year $\pm$ standard deviation and (number of interviews).

Fishing gear type	France	Greece	Malta	Spain	Portugal
Purse seines	-	-	-	167 $\pm$ 83 (14)	138 $\pm$ 31 (65)
Trawls	186 $\pm$ 36 (4)	-	-	193 $\pm$ 56 (21)	206 $\pm$ 48 (41)
Gillnets	120 $\pm$ 70 (43)	193 $\pm$ 72 (902)	n/a	138 $\pm$ 82 (27)	146 $\pm$ 44 (41)
Trammel nets	129 $\pm$ 78 (125)	188 $\pm$ 70 (1650)	64 $\pm$ 69 (7)	166 $\pm$ 71 (48)	148 $\pm$ 43 (129)
Drifting longlines	86 $\pm$ 36 (16)	201 $\pm$ 62 (45)	80 $\pm$ 73 (8)	-	-
Set longlines	113 $\pm$ 65 (26)	175 $\pm$ 69 (928)	-	118 $\pm$ 69 (42)	113 $\pm$ 34 (52)
Pots	-	-	-	99 $\pm$ 50 (12)	179 $\pm$ 47 (98)

4.4. Fishing grounds and fishing effort

The fishing grounds and fishing effort of each fishing gear type in the different project areas of the countries involved in the project (France, Greece, Malta, Portugal and Spain) are presented in separated maps. The metric of fishing effort presented depends on the source of the data.

Purse seines

The spatial distribution of fishing effort of purse seiners is presented in the following maps. The data originate from the GFW database, using AIS processed data from 2020. With respect to Malta maps based on VMS/GPRS data provided by the DFA from 2021 are also added.

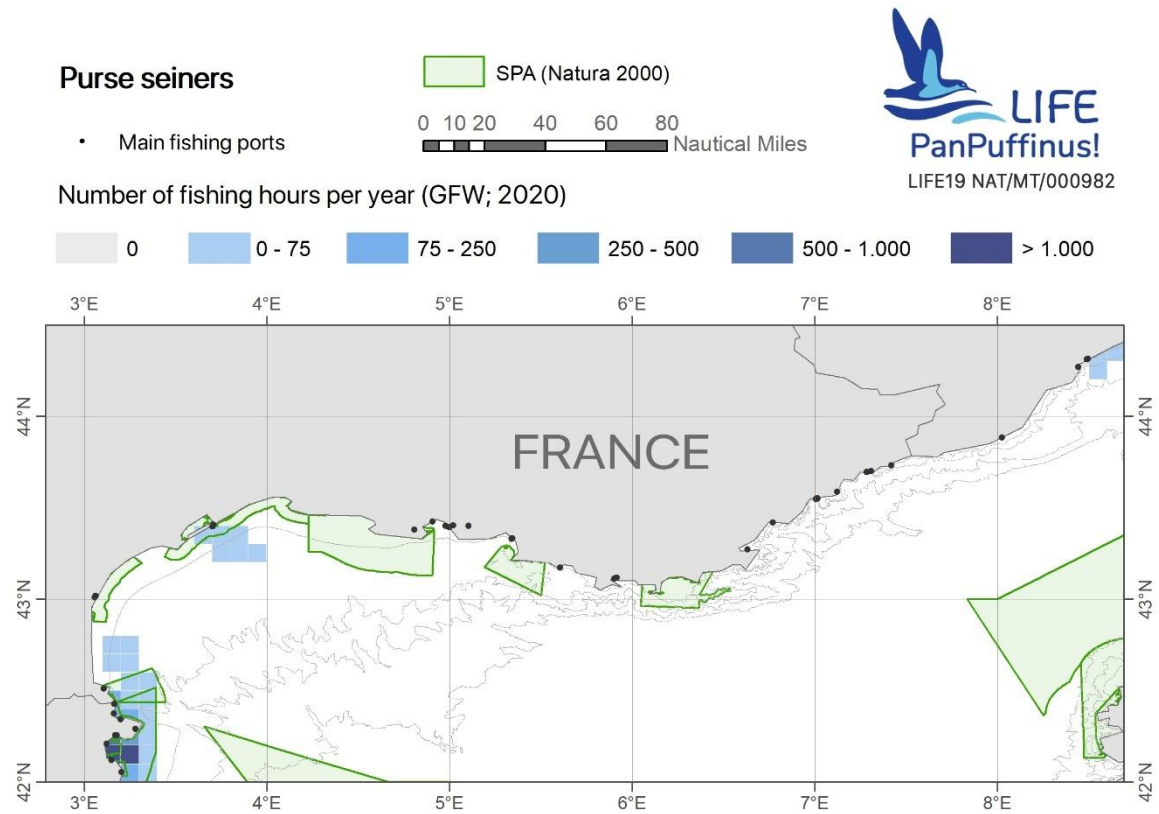


Figure 18. Fishing effort of purse seiners in France (GFW, 2020).

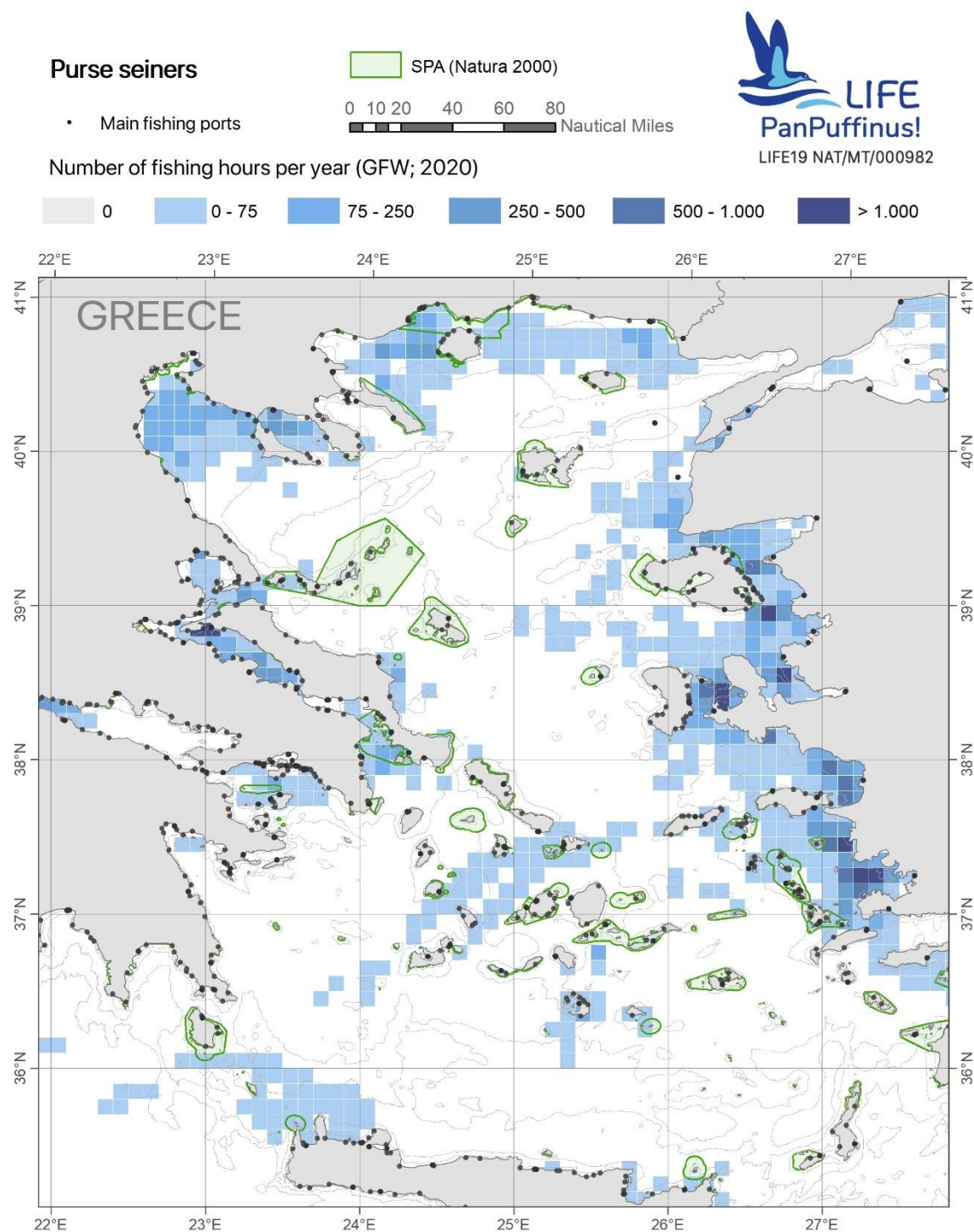


Figure 19. Fishing effort of purse seiners in Greece (GFW, 2020).

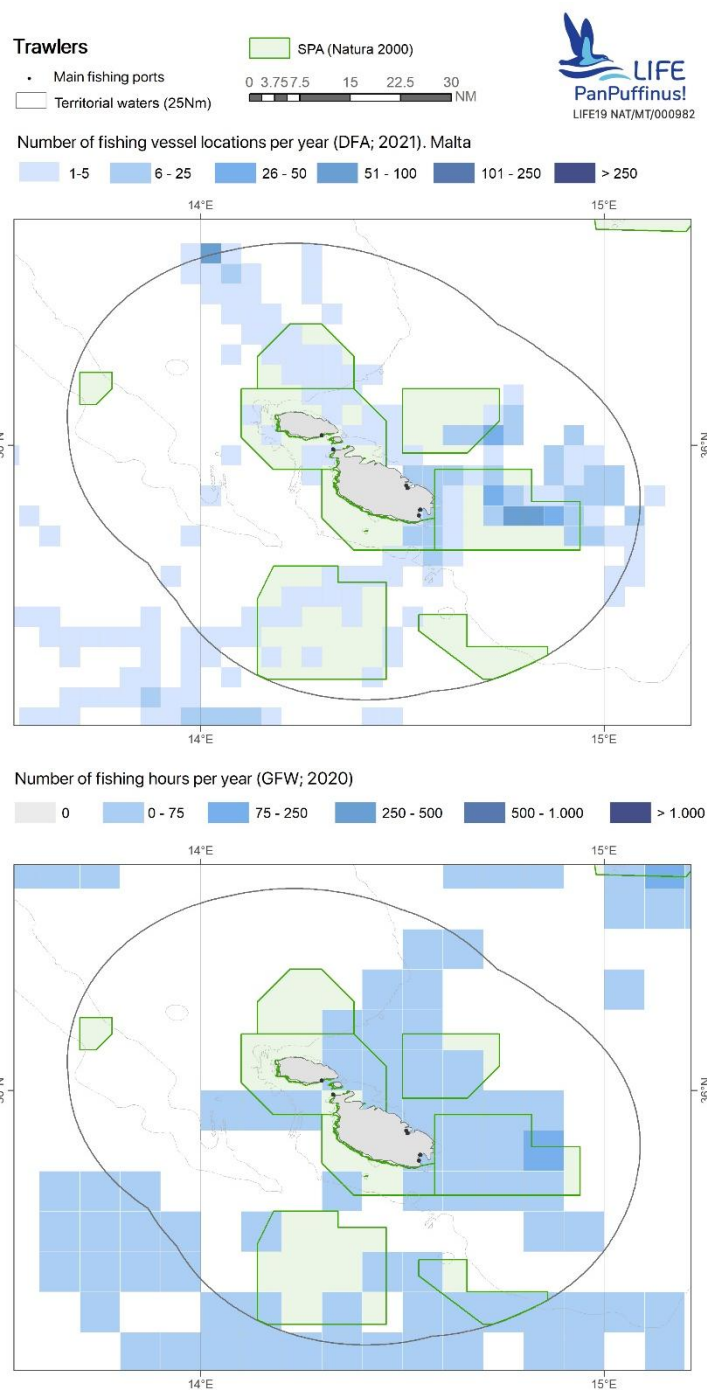
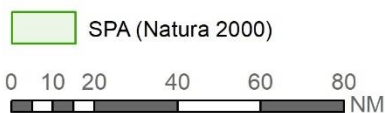


Figure 20. Fishing effort of purse seiners in Malta. Top (DFA, 2021), Below (GFW, 2020).

Purse seiners

- Main fishing ports



Number of fishing hours per year (GFW; 2020)

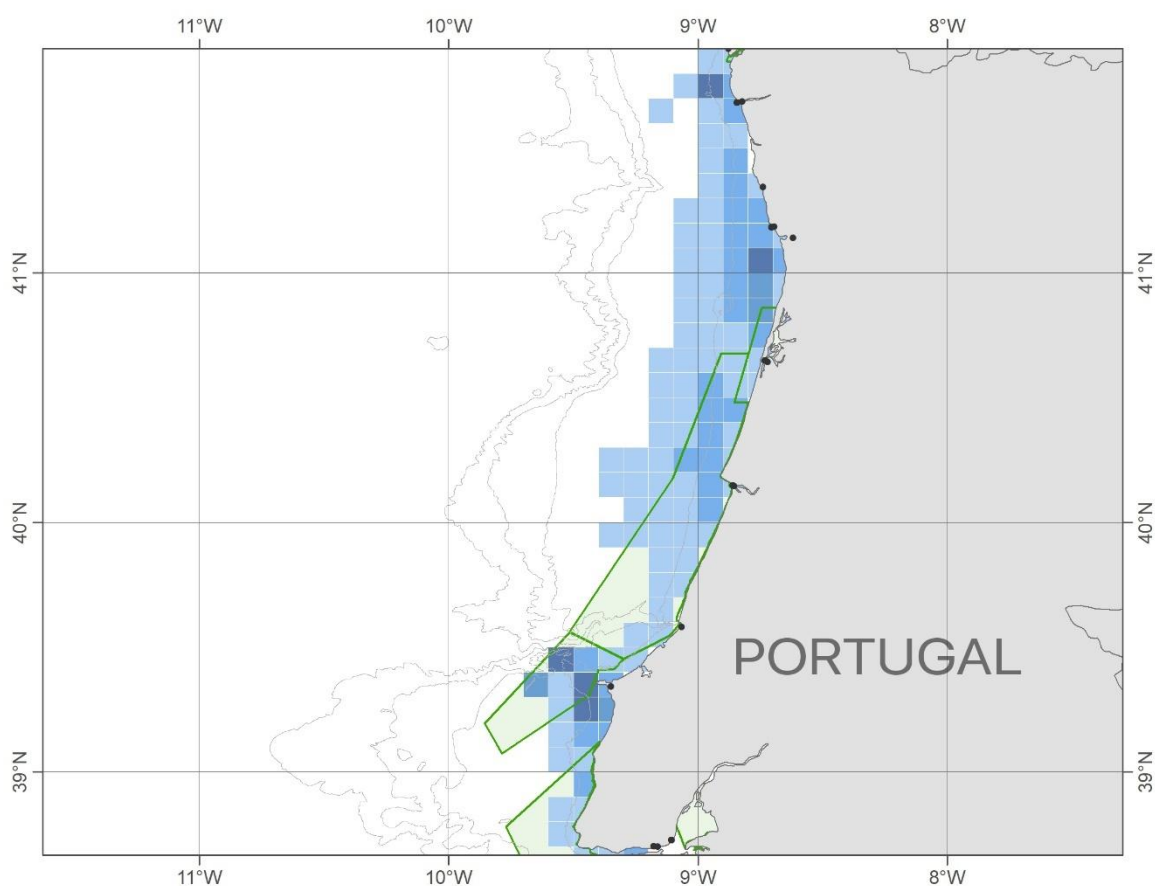


Figure 21. Fishing effort of purse seiners in Portugal (GFW, 2020).

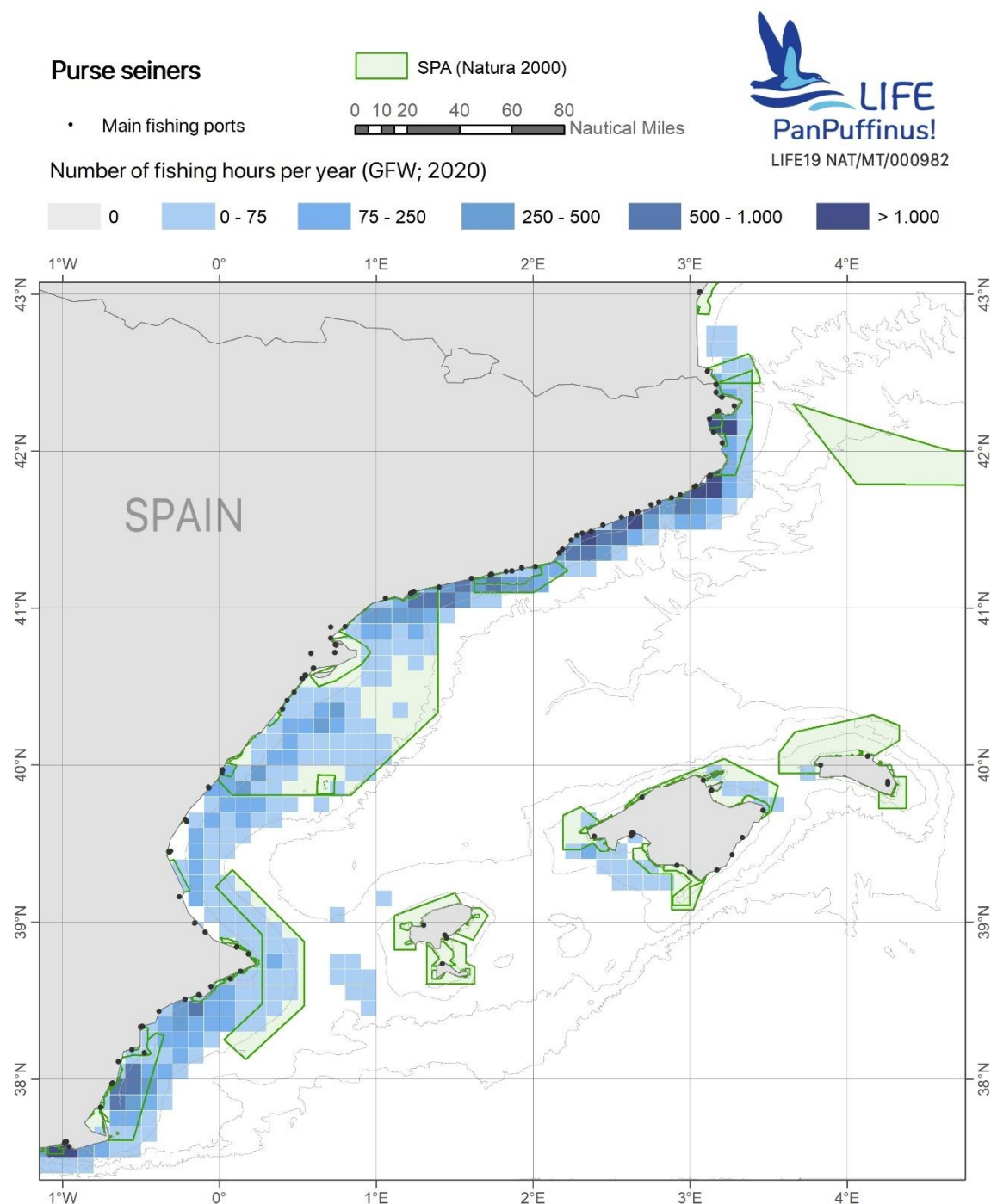


Figure 22. Fishing effort of purse seiners in Spain (GFW, 2020).

Trawls

The spatial distribution of fishing effort for trawlers is presented in the following maps. The data originate from the GFW database, using AIS processed data from 2020. With respect to Malta maps based on VMS/GPRS data provided by the DFA from 2021 are also added.

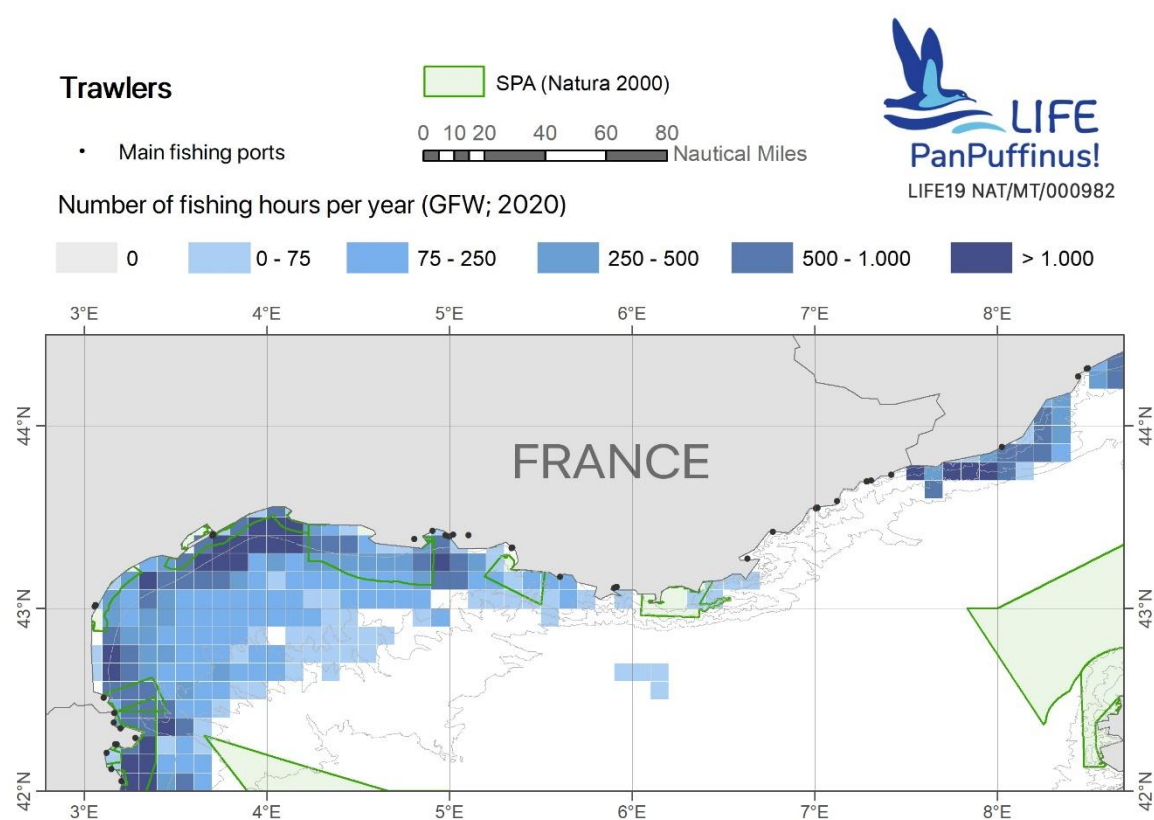


Figure 23. Fishing effort of trawlers in France (GFW, 2020).

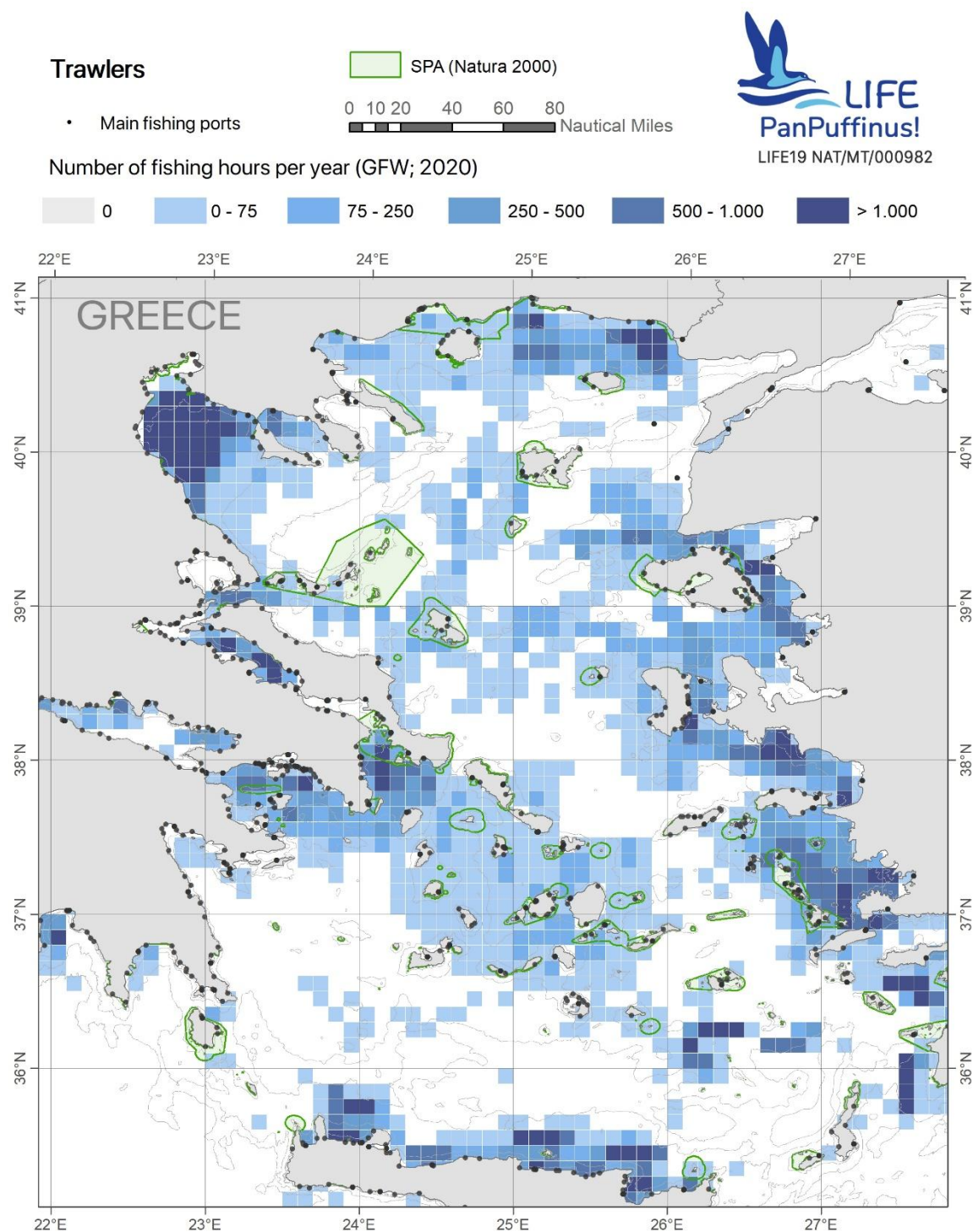


Figure 24. Fishing effort of trawlers in Greece (GFW, 2020).

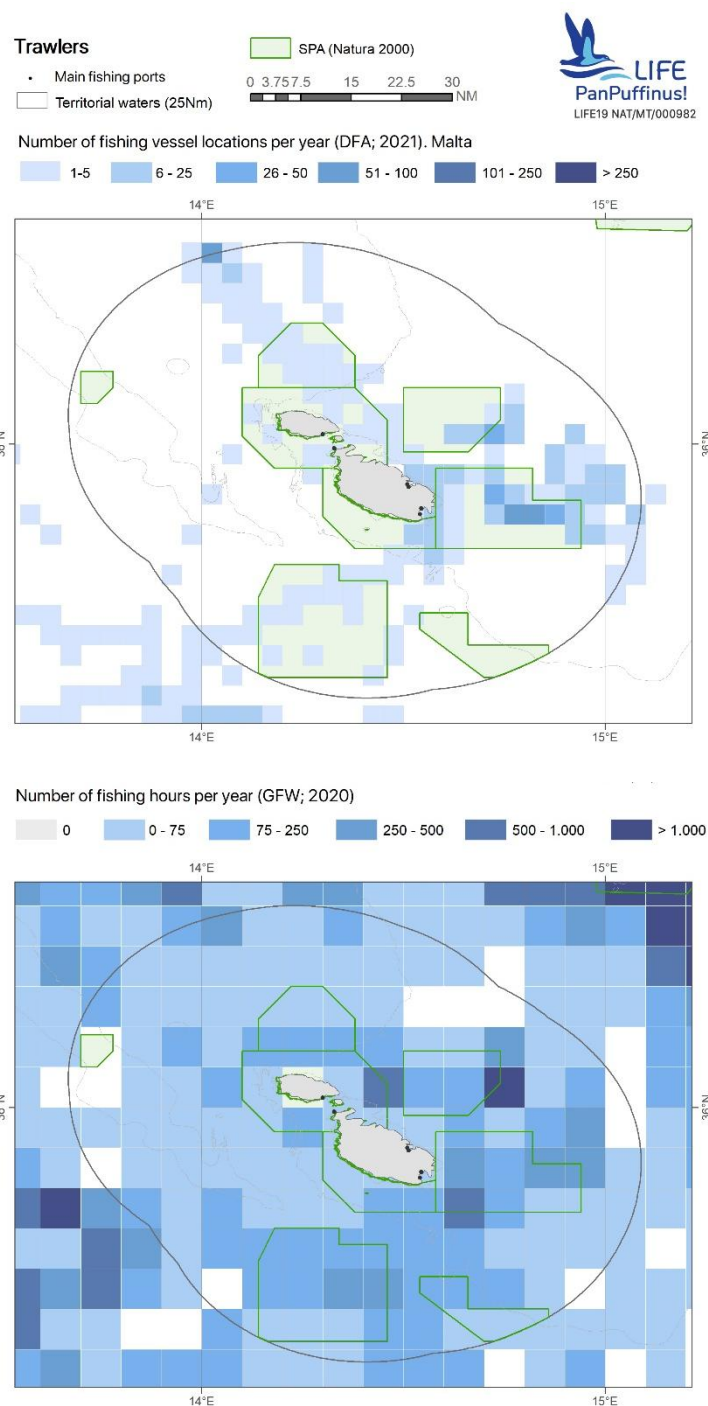
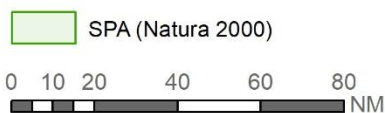


Figure 25. Fishing effort of trawlers in Malta. Top (DFA, 2021), Below (GFW, 2020).

Trawlers

- Main fishing ports



Number of fishing hours per year (GFW; 2020)

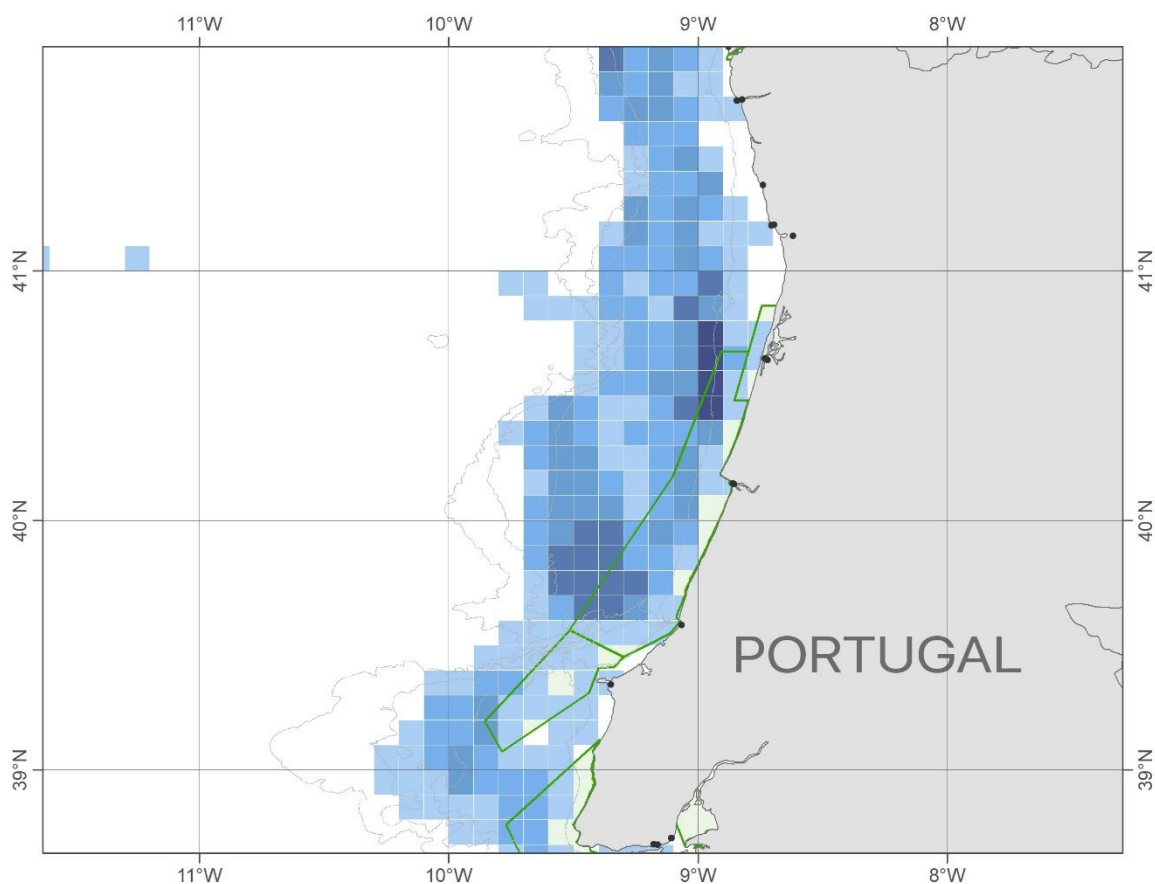


Figure 26. Fishing effort of trawlers in Portugal (GFW, 2020).

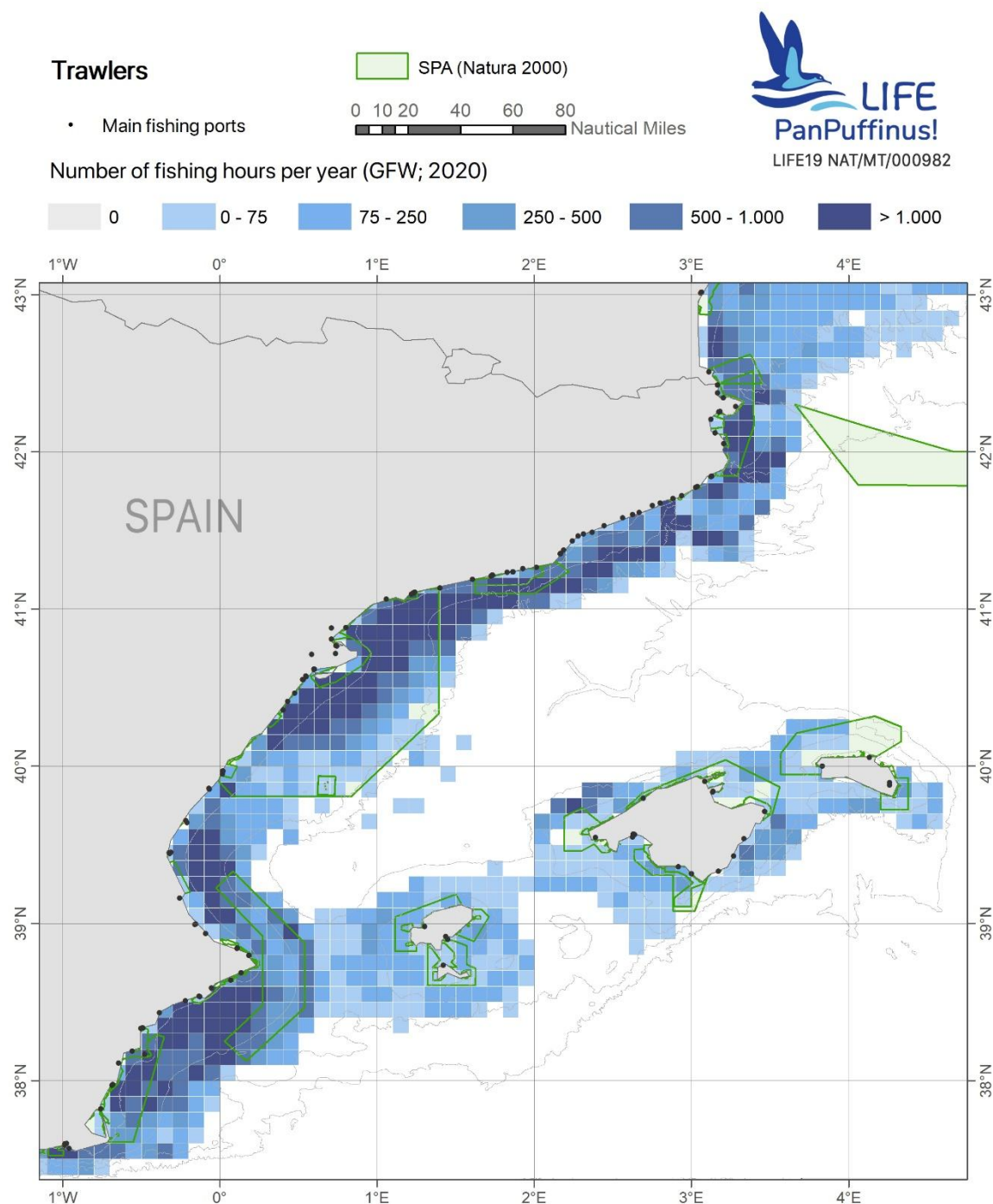


Figure 27. Fishing effort of trawlers in Spain (GFW, 2020).

Gillnets

The spatial distribution of the fishing effort of gillnets is presented in the following maps. The source of the data originates from the questionnaire survey for France (2021-2022), Greece (2020-2022), Portugal (2021-2022), Spain (2018-2019) combined with the number of vessel licenses by fishing gear type from fishing statistics. The sample size of the data collected was too low to produce a representative map for Malta.

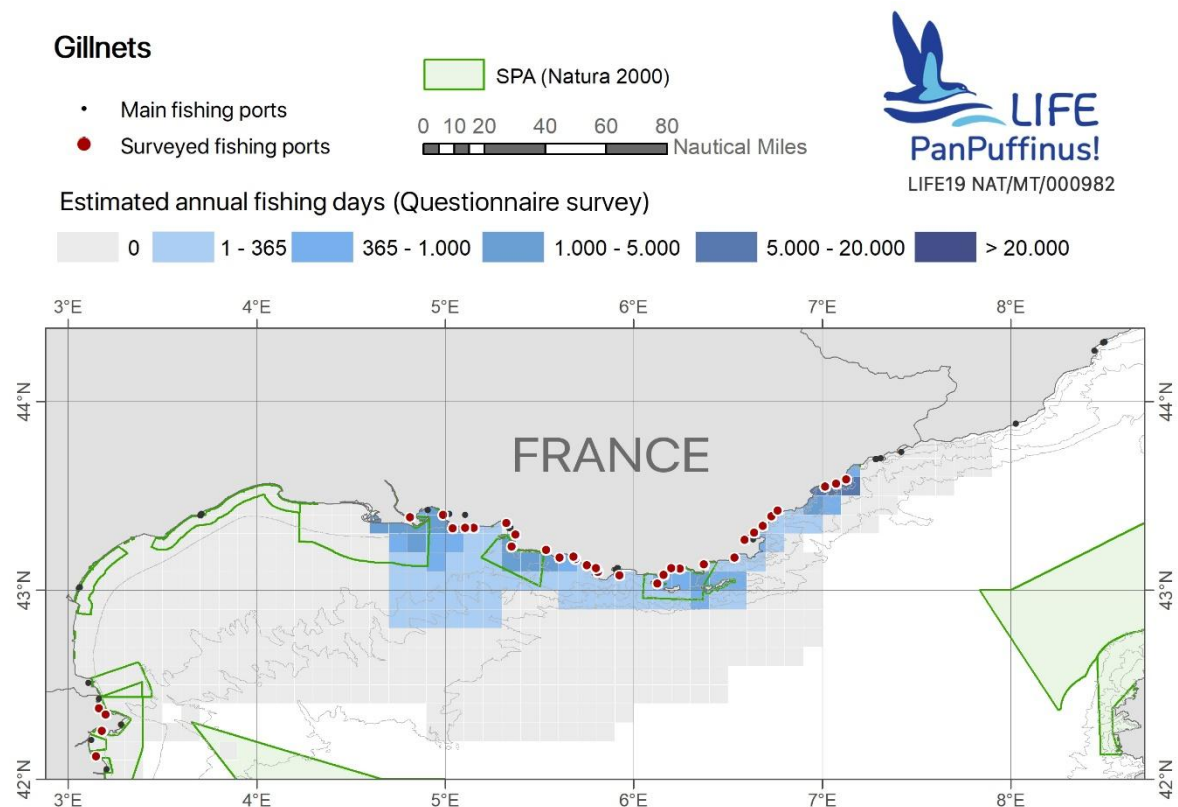
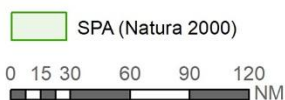


Figure 28. Estimated fishing effort of gillnets in France based on data from the questionnaire survey (2021-2022) and fishing statistics (Ifremer. Système d'Informations Halieutiques, 2022).

Gillnets

- Fishing ports
- Surveyed fishing ports



Estimated annual fishing days (Questionnaire survey)

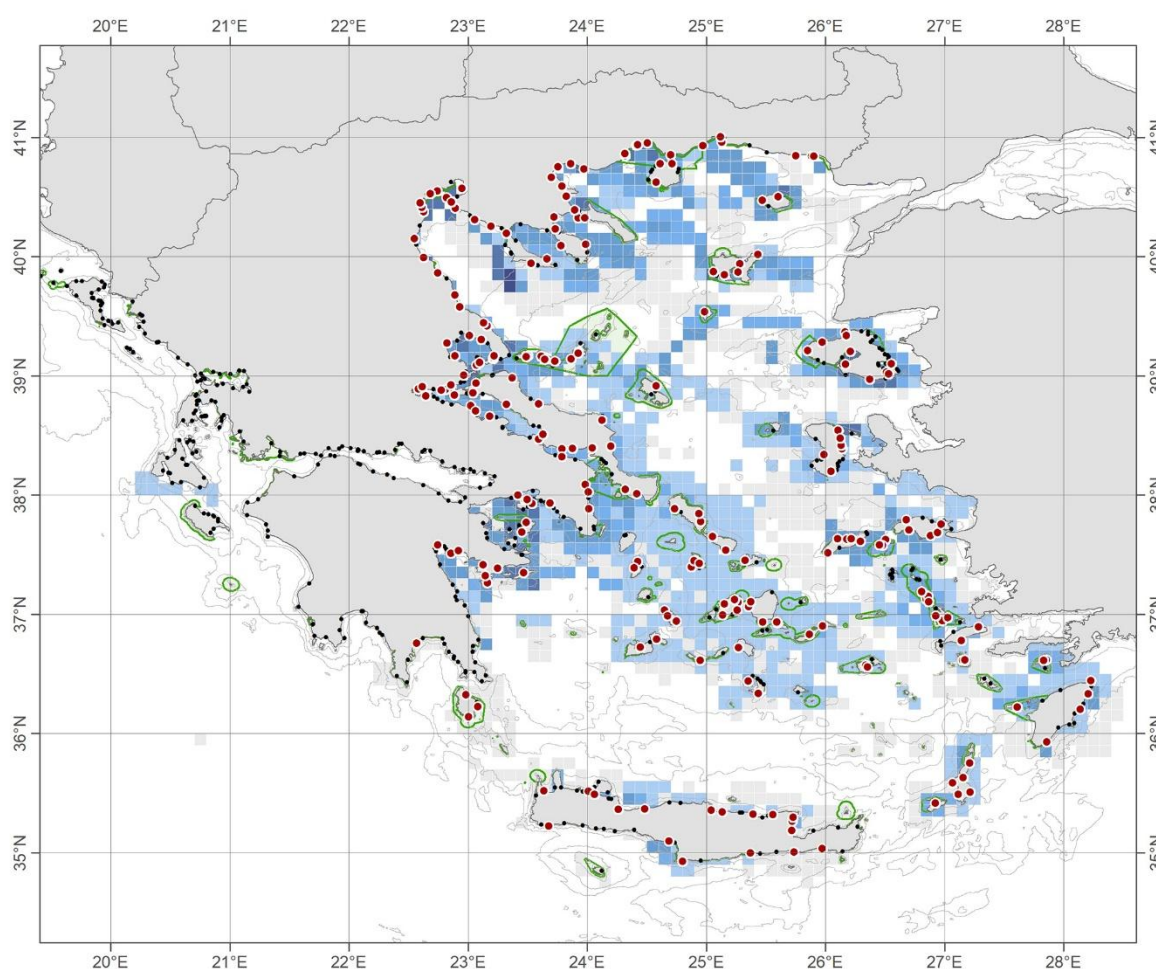
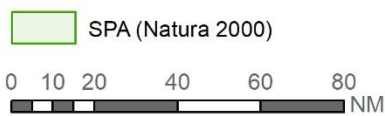


Figure 29. Fishing effort of gillnets in Greece based on data from the questionnaire survey (LIFE PanPuffinus! project 2021-2022 and INCA project 2020-2022) and fishing statistics (AGR.E.R.I., 2020).

Gillnets

- Main fishing ports
- Surveyed fishing ports



Estimated annual fishing days (Questionnaire survey)

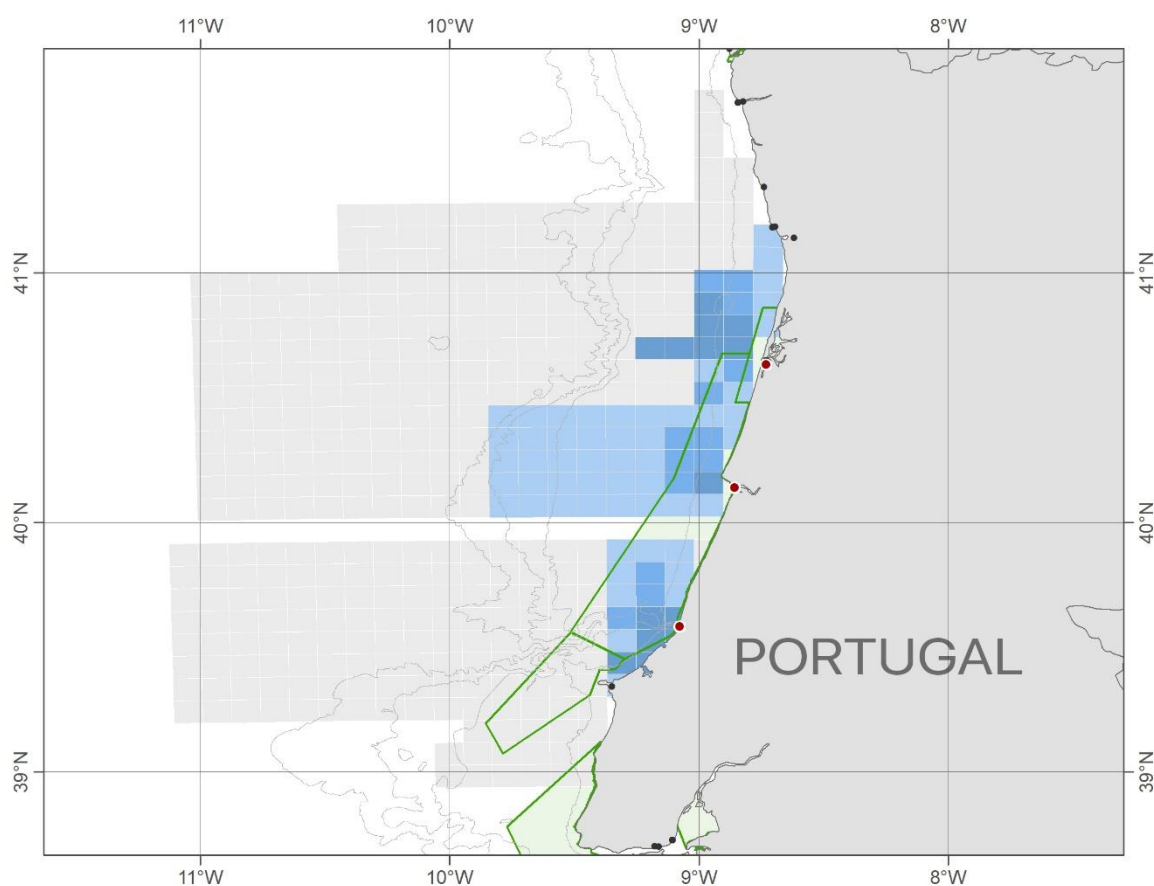
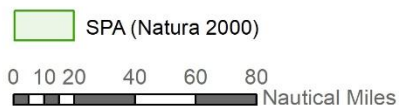


Figure 30. Fishing effort of gillnets in Portugal based on data from the questionnaire survey (2021-2022) and fishing statistics (DGRM, 2020).

Gillnets

- Main fishing ports
- Surveyed fishing ports



Estimated annual fishing days (Questionnaire survey)

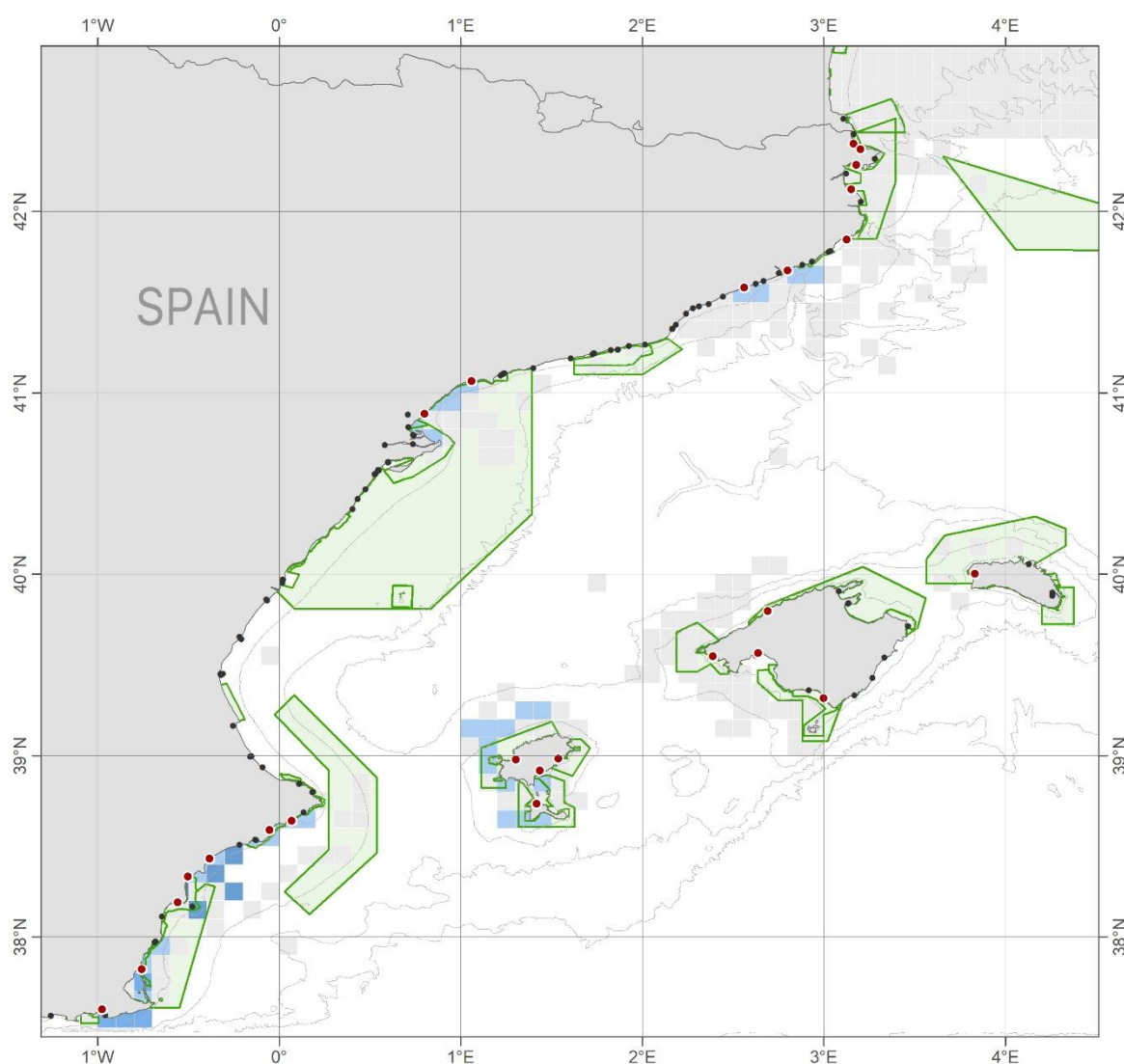


Figure 31. Fishing effort of gillnets in Spain based on data from the questionnaire survey (2018-2019) and fishing statistics (2018-2021).

Trammel nets

The spatial distribution of the fishing effort of trammel nets is presented in the following maps. The source of the data originates from the questionnaire survey for France (2021-2022), Greece (2020-2022), Portugal (2021-2022), Spain (2018-2019) combined with the number of vessel licenses by fishing gear type from fishing statistics. With respect to Malta, maps are based on VMS/GPRS data provided by the DFA from 2021.

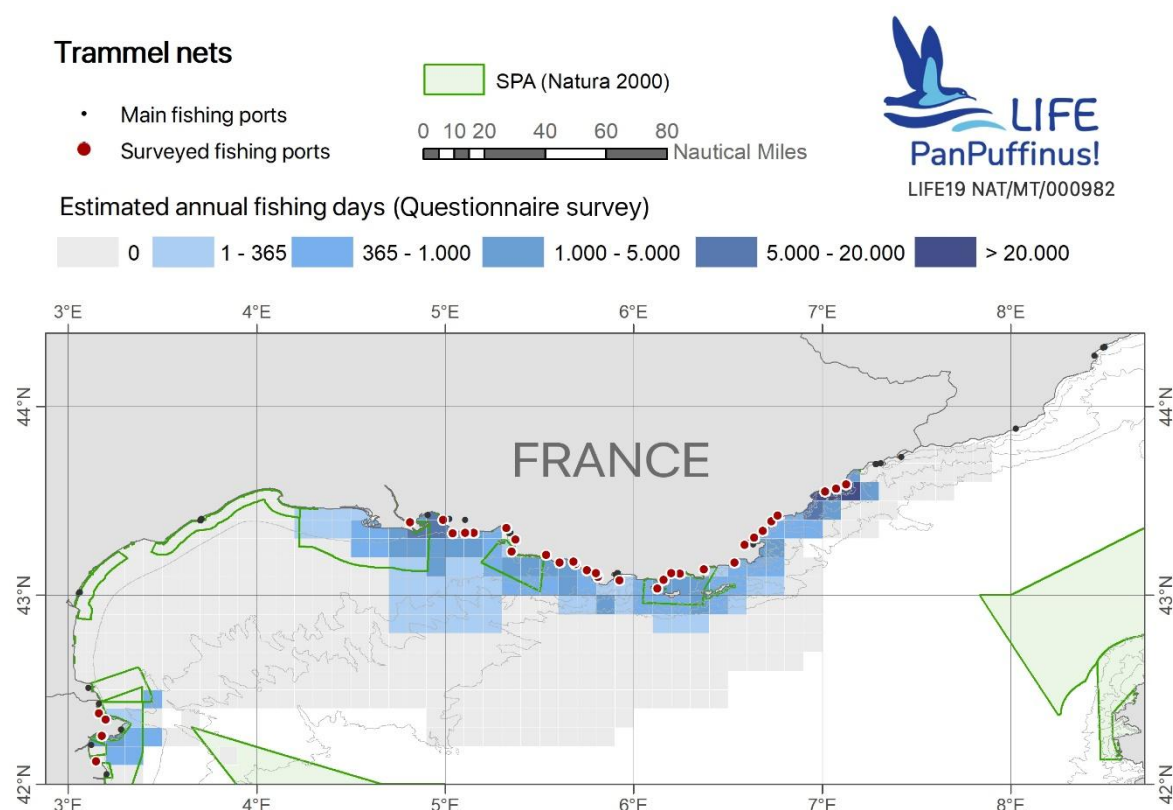
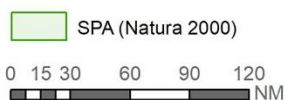


Figure 32. Estimated fishing effort of trammel nets in France based on data from the questionnaire survey (2021-2022) and fishing statistics (Ifremer. Système d'Informations Halieutiques, 2022).

Trammel nets

- Fishing ports
- Surveyed fishing ports



Estimated annual fishing days (Questionnaire survey)

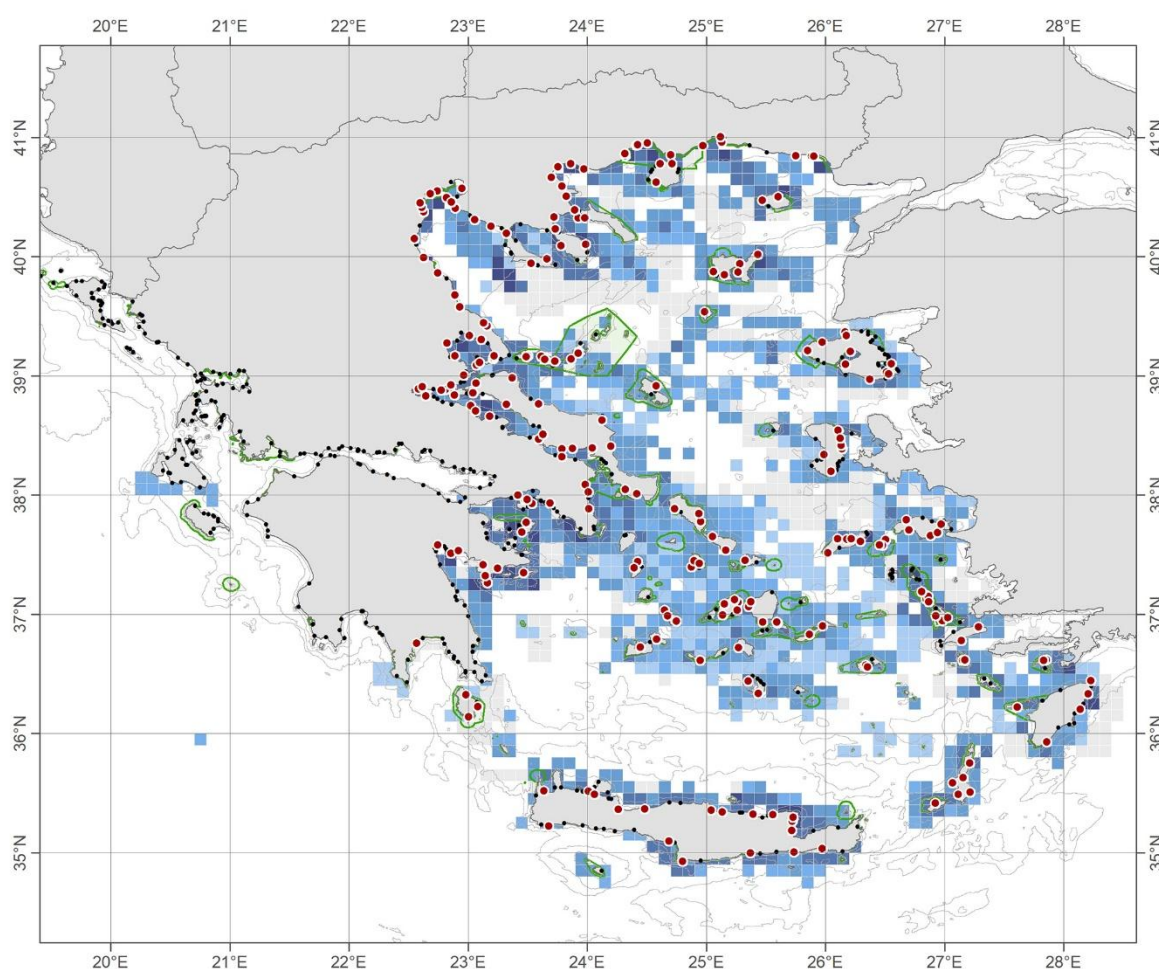
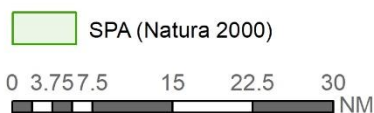


Figure 33. Fishing effort of trammel nets in Greece based on data from the questionnaire survey (PanPuffinus! project 2021-2022 and INCA project 2020-2022) and fishing statistics (AGR.E.R.I., 2020).

Trammel nets

- Main fishing ports
- Territorial waters (25Nm)



Number of fishing vessel locations per year (DFA; 2021). Malta

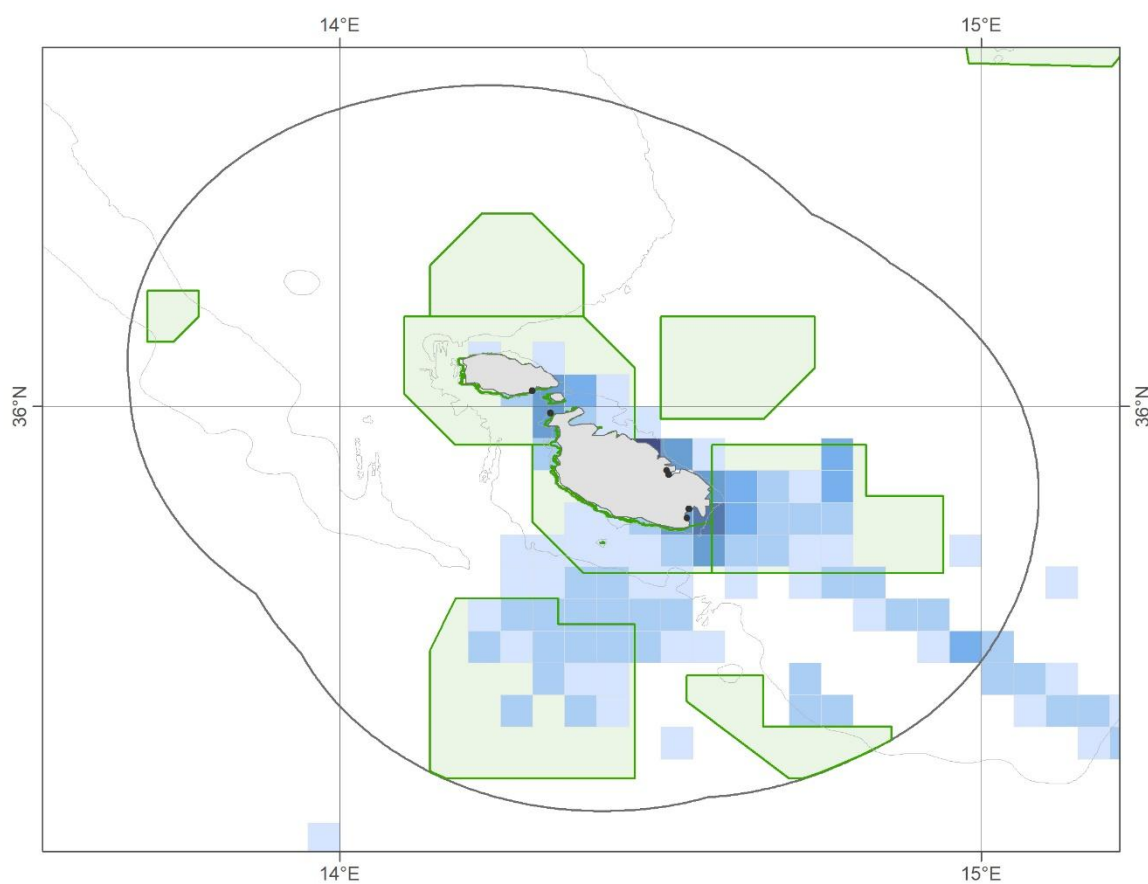
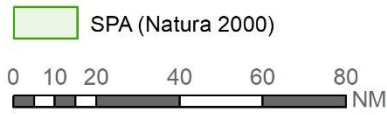


Figure 34. Fishing effort of trammel nets in Malta (DFA, 2021).

Trammel nets

- Main fishing ports
- Surveyed fishing ports



Estimated annual fishing days (Questionnaire survey)

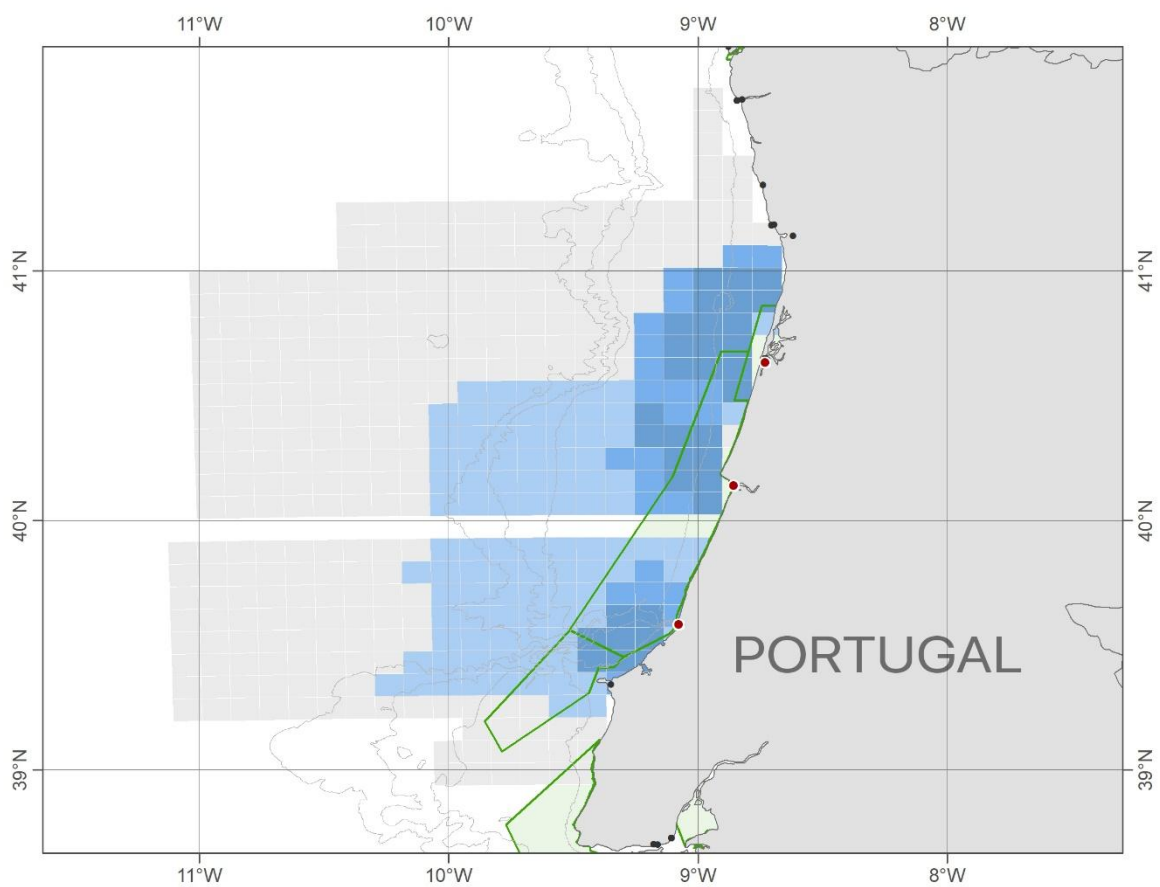
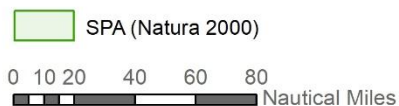


Figure 35. Fishing effort of trammel nets in Portugal based on data from the questionnaire survey (2021-2022) and fishing statistics (DGRM, 2020).

Trammel nets

- Main fishing ports
- Surveyed fishing ports



Estimated annual fishing days (Questionnaire survey)

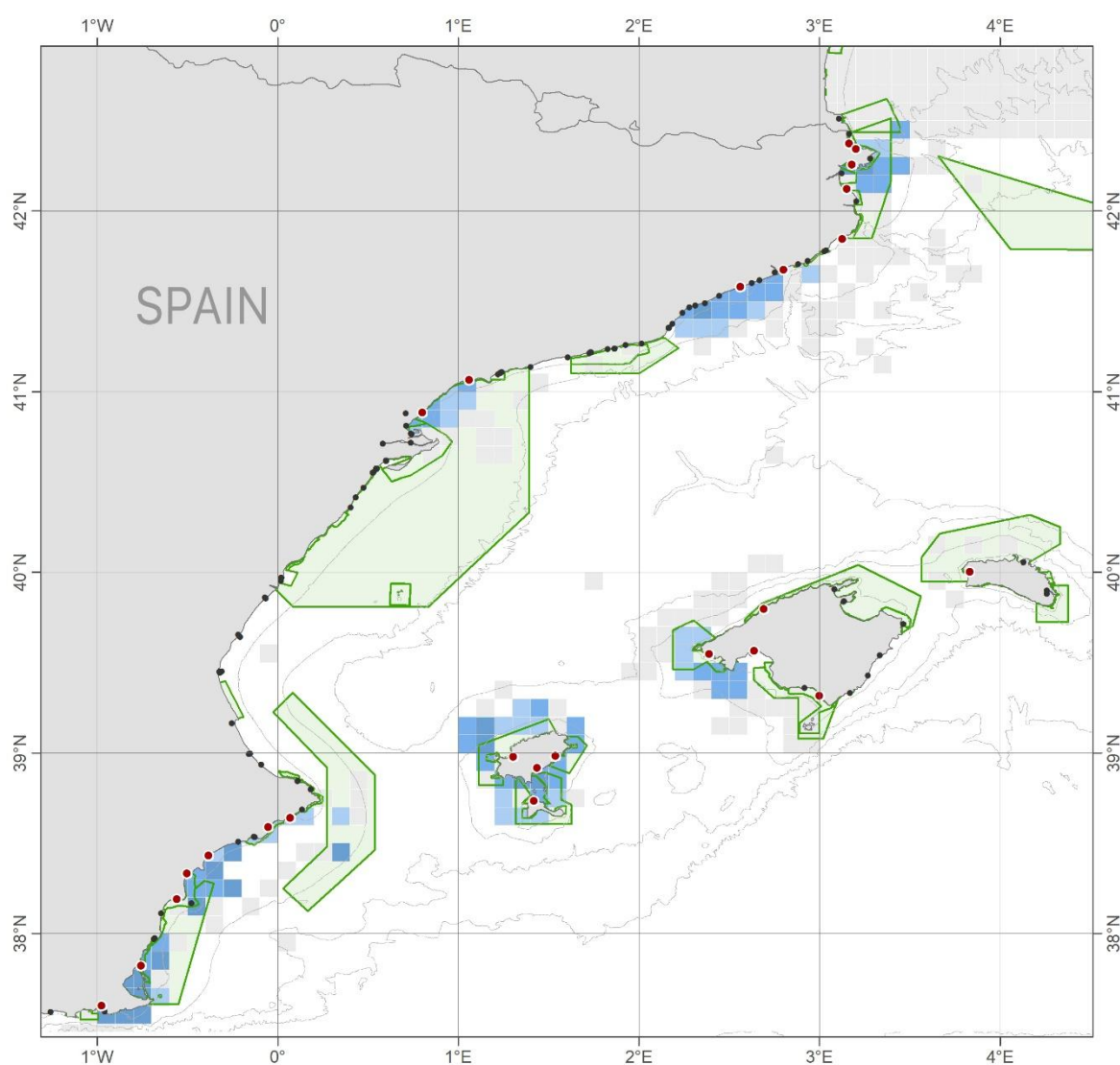


Figure 36. Fishing effort of trammel nets in Spain based on data from the questionnaire survey (2018-2019) and fishing statistics (2018-2021).

Drifting longlines

The spatial distribution of fishing effort is presented in the following maps. The data originate from the GFW database, using AIS processed data from 2020. With respect to Malta, maps based on VMS/GPRS data provided by the DFA from 2021 are also added.

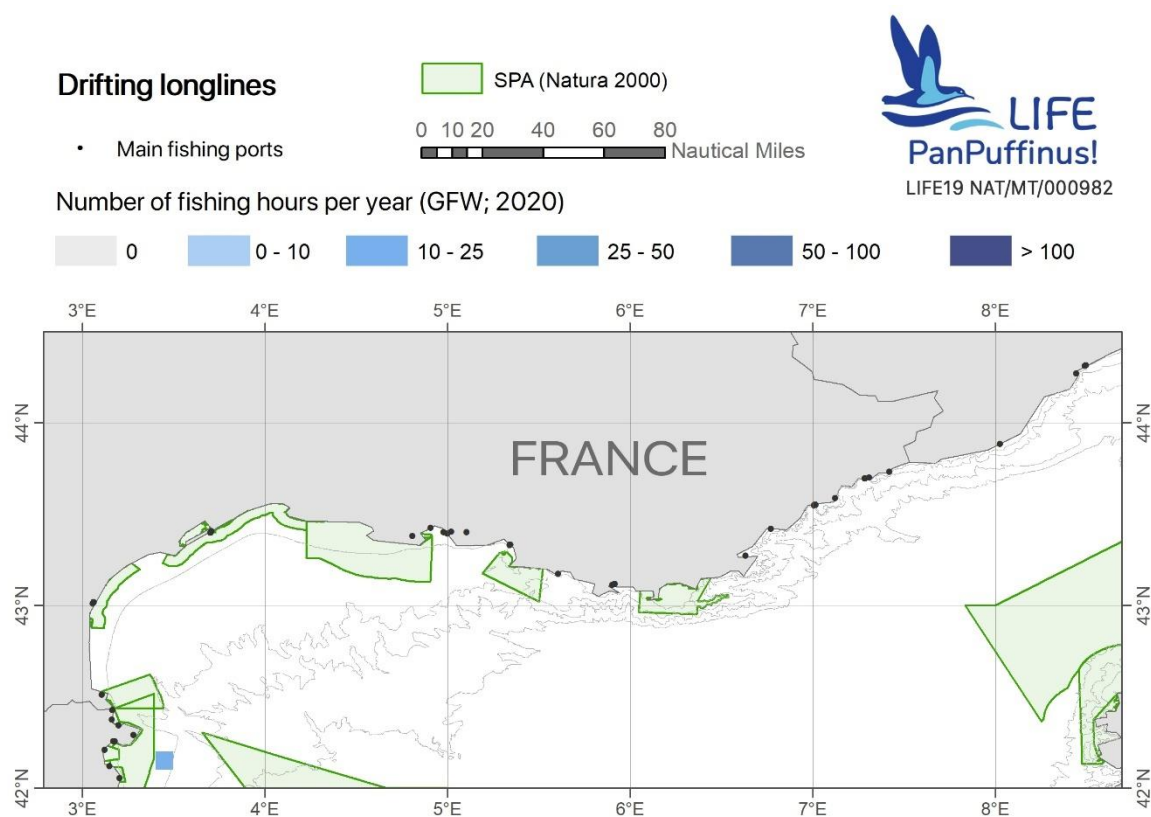


Figure 37. Fishing effort of drifting longlines in France (GFW, 2020).

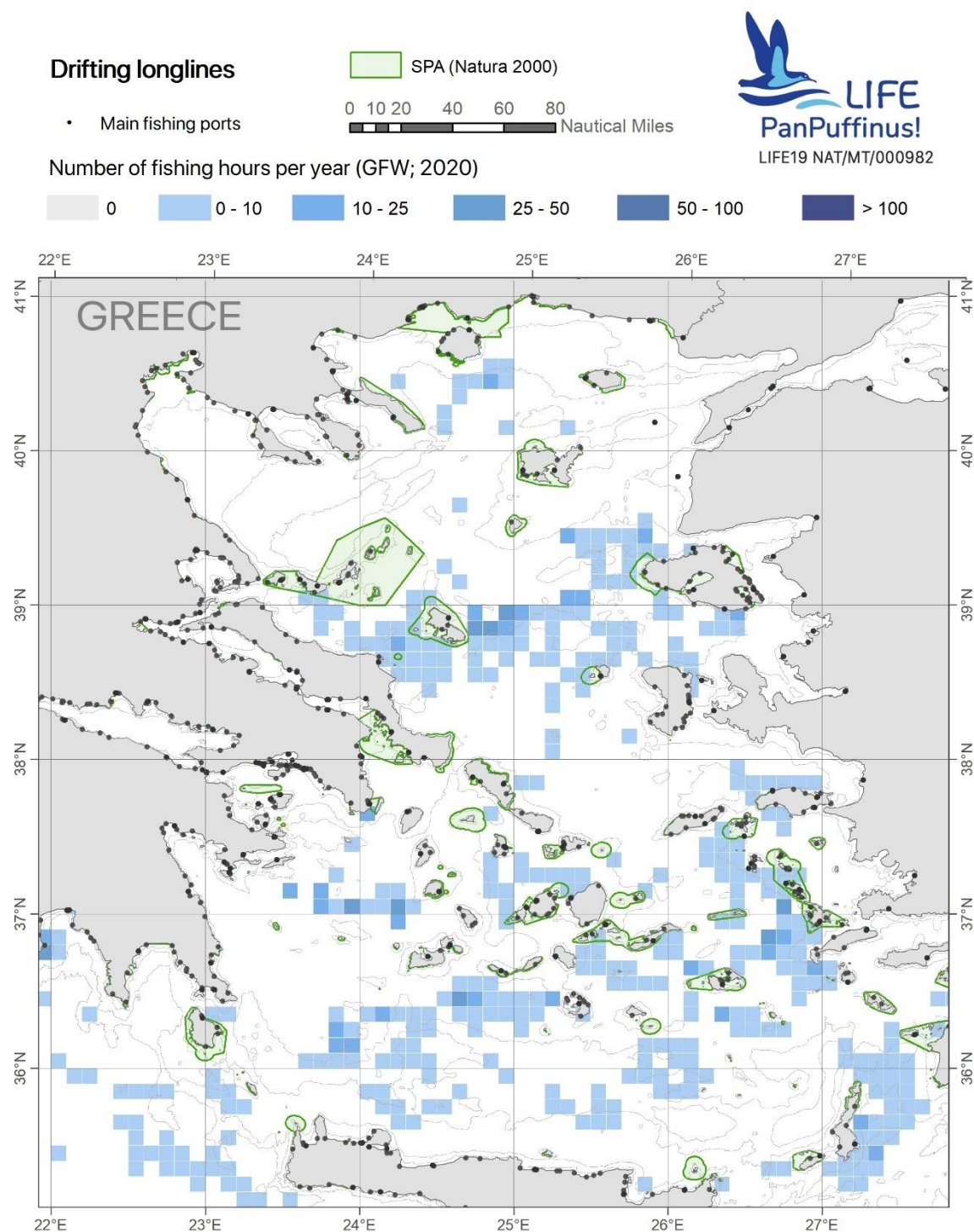


Figure 38. Fishing effort of drifting longlines in Greece (GFW, 2020).

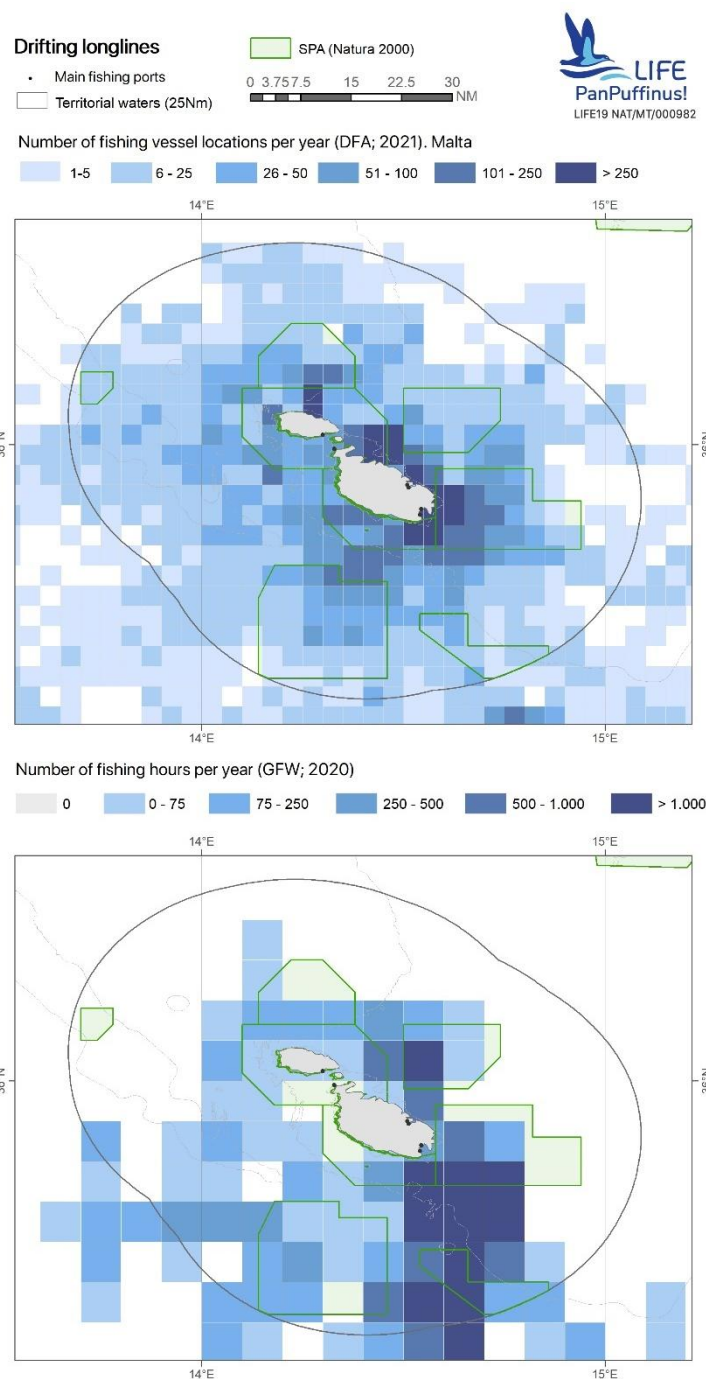
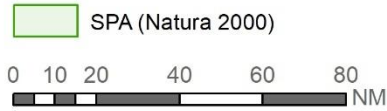


Figure 39. Fishing effort of drifting longlines in Malta. Top (DFA, 2021), Below (GFW, 2020).

Drifting longlines

- Main fishing ports



Number of fishing hours per year (GFW; 2020)

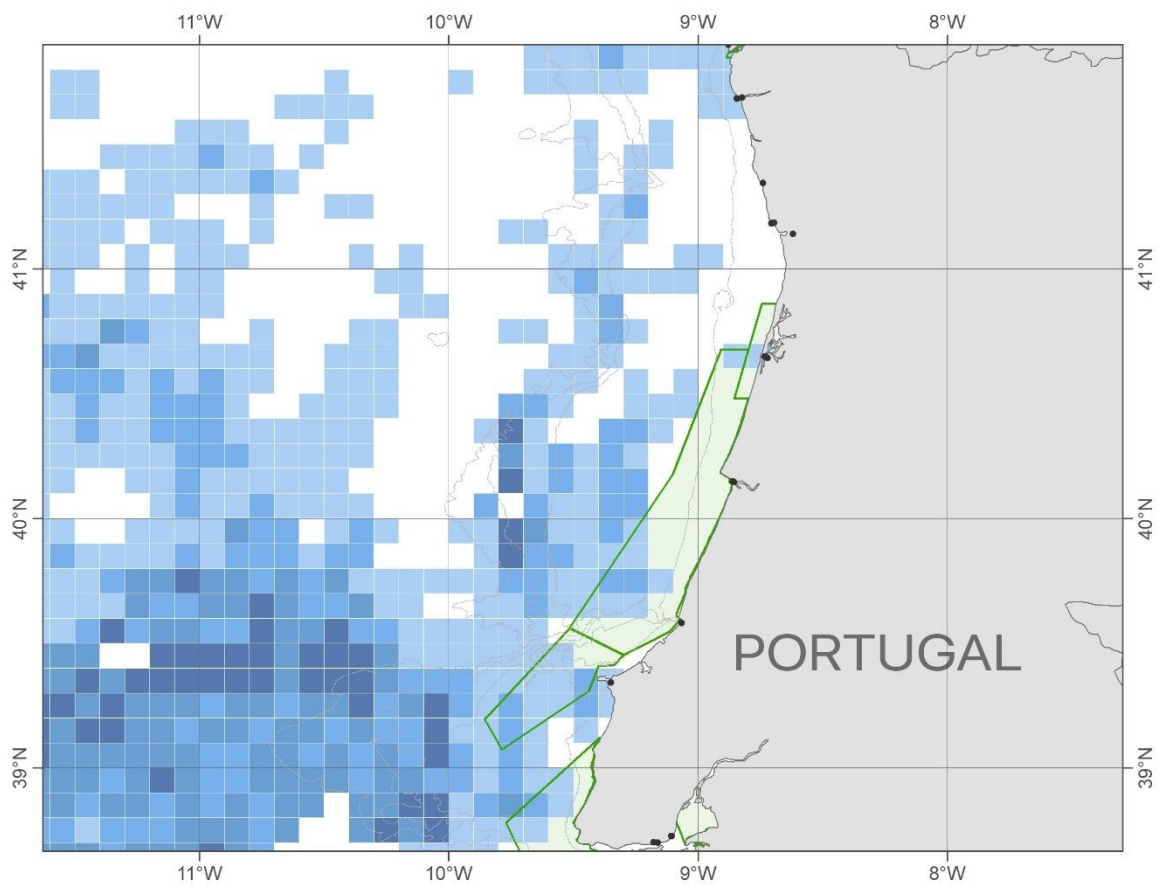


Figure 40. Fishing effort of drifting longlines in Portugal (GFW, 2020).

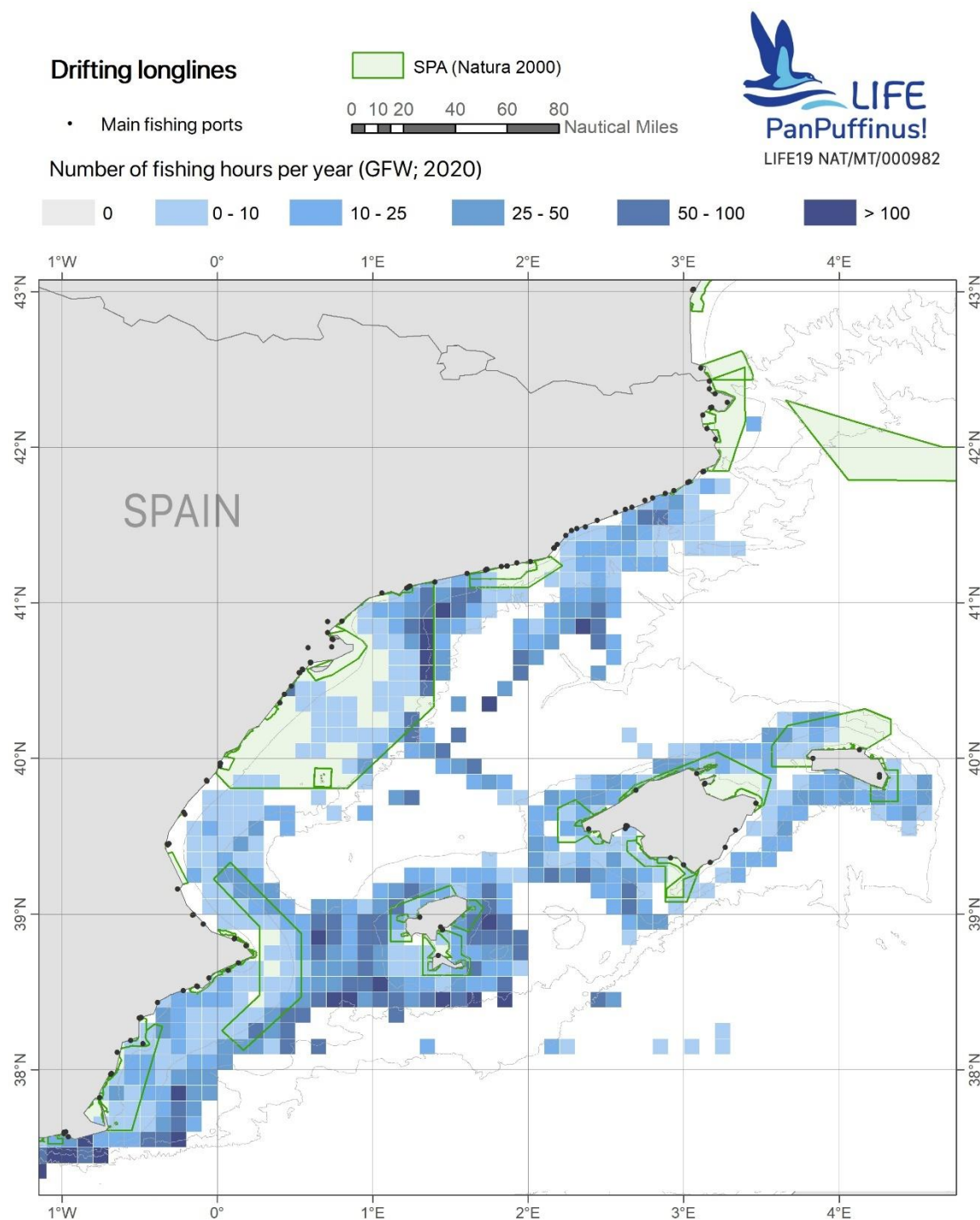


Figure 41. Fishing effort of drifting longlines in Spain (GFW, 2020).

Set longlines

The spatial distribution of the fishing effort of set longlines is presented in the following maps. The source of the data originates from the questionnaire survey for France (2021-2022), Greece (2020-2022), Portugal (2021-2022), Spain (2018-2019) combined with the number of vessel licenses by fishing gear type from fishing statistics. With respect to Malta, maps are based on VMS/GPRS data provided by the DFA from 2021.

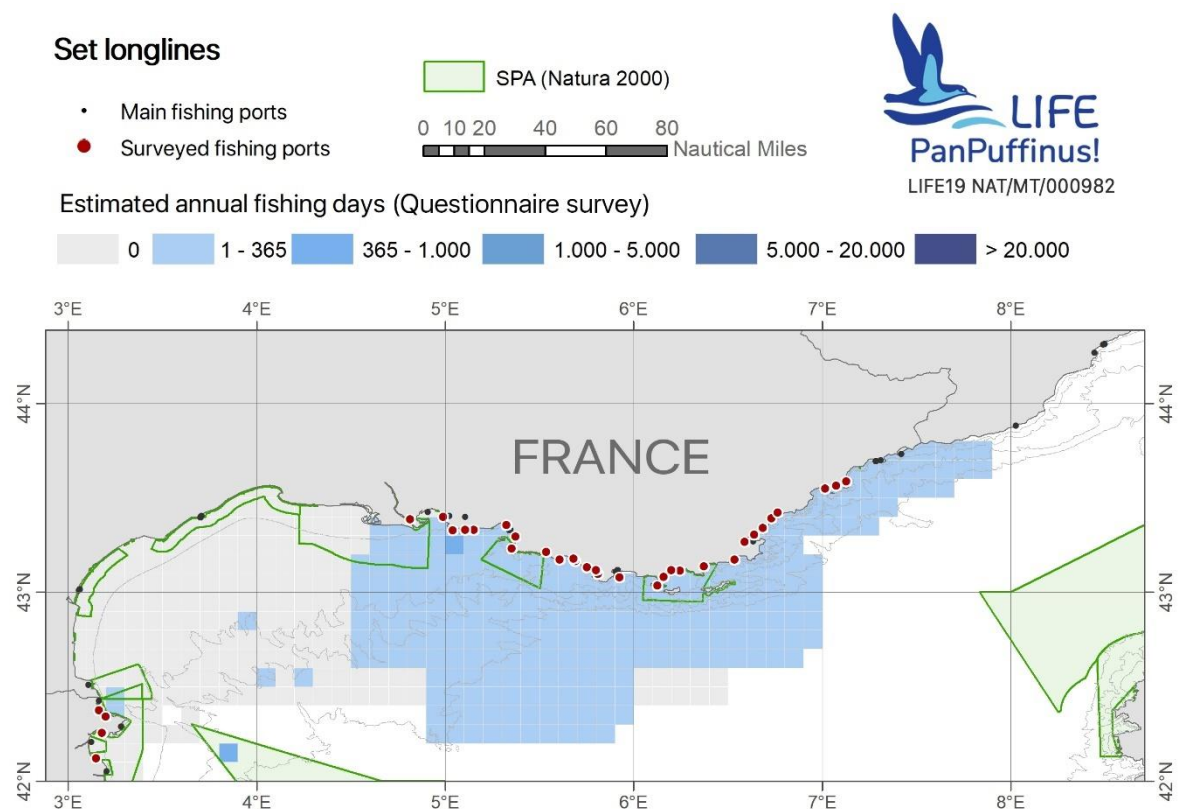
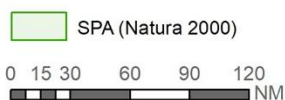


Figure 42. Estimated fishing effort of set longlines in France based on questionnaire survey (2021-2022) and fishing statistics (Ifremer. Système d'Informations Halieutiques, 2022).

Set longlines

- Fishing ports
- Surveyed fishing ports



Estimated annual fishing days (Questionnaire survey)

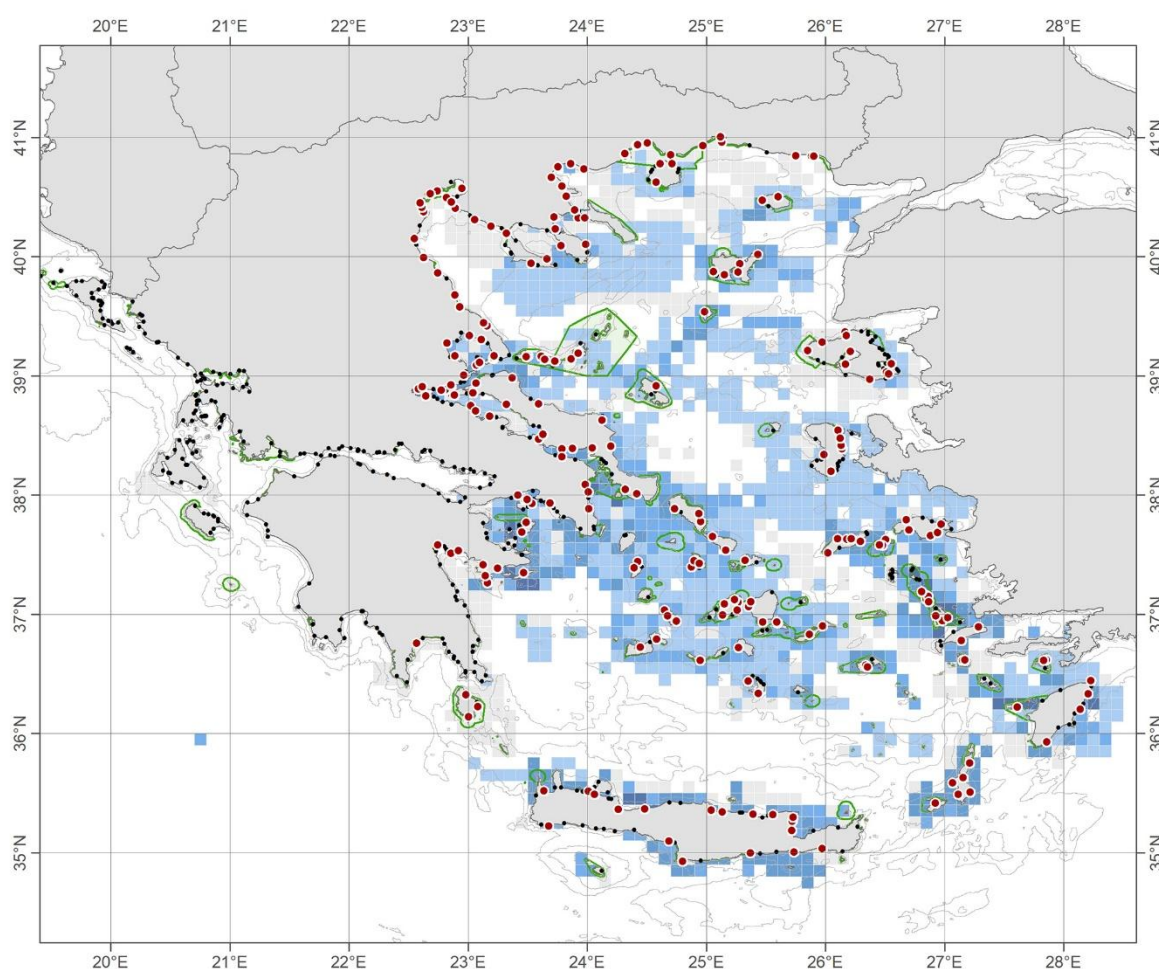
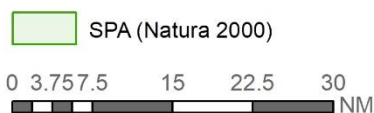


Figure 43. Fishing effort of set longlines in Greece based on data from the questionnaire survey (PanPuffinus! project 2021-2022 and INCA project 2020-2022) and fishing statistics (AGR.E.R.I., 2020).

Set longlines

- Main fishing ports
- Territorial waters (25Nm)



Number of fishing vessel locations per year (DFA; 2021). Malta

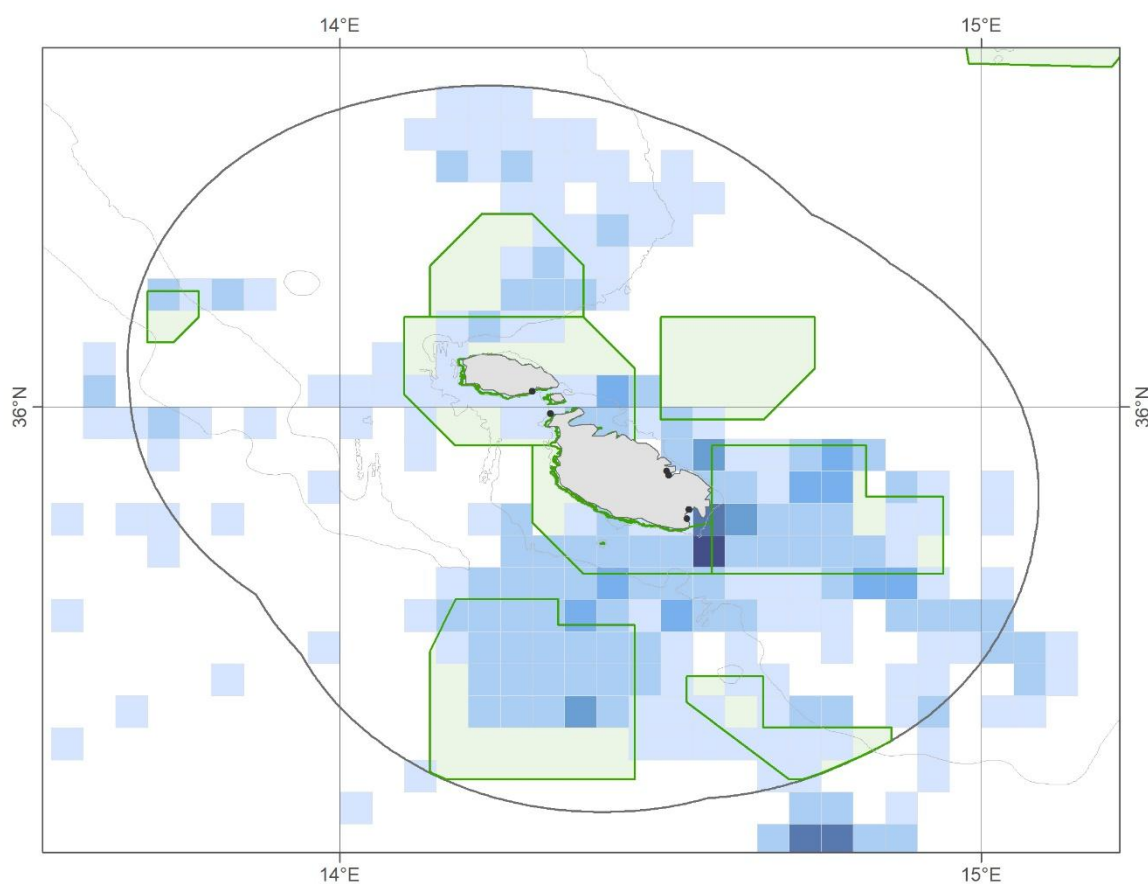
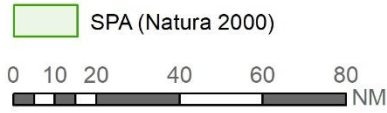


Figure 44. Fishing effort of set longlines in Malta (DFA, 2021).

Set longlines

- Main fishing ports
- Surveyed fishing ports



Estimated annual fishing days (Questionnaire survey)

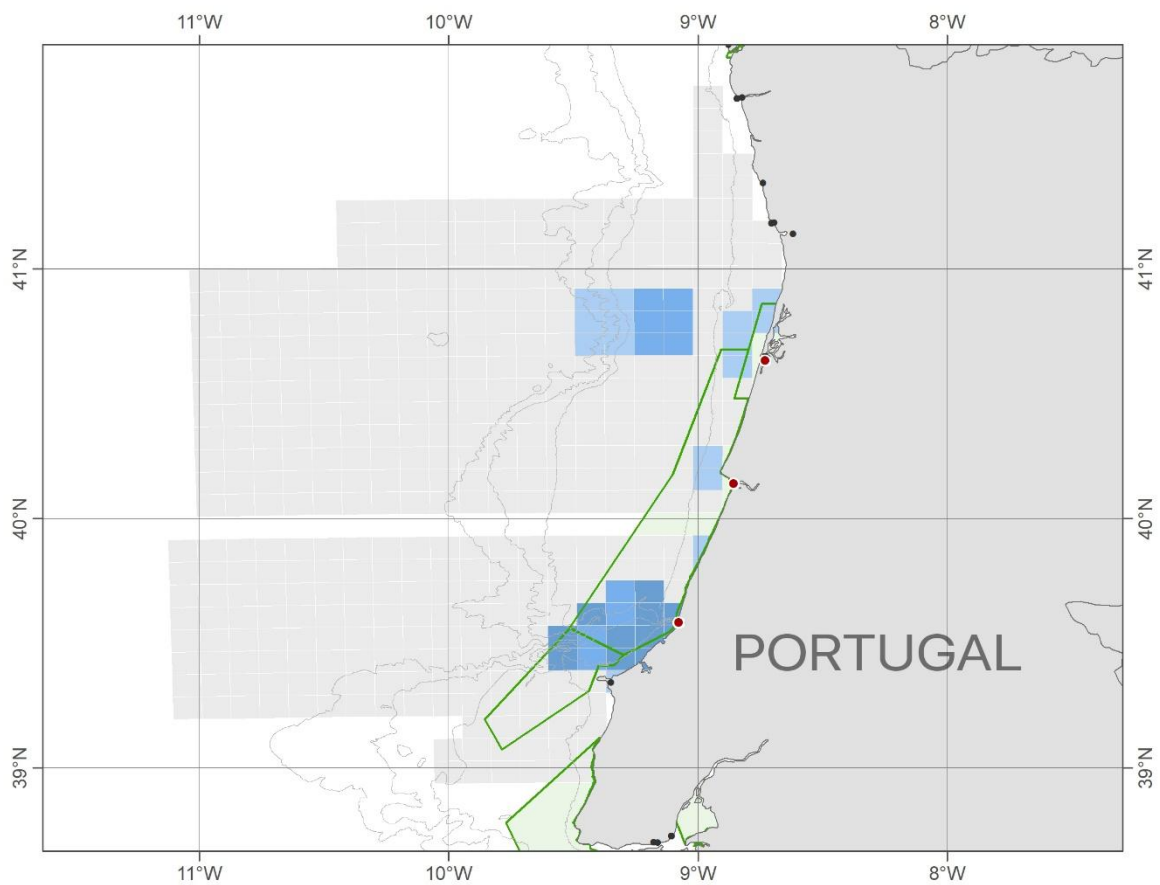
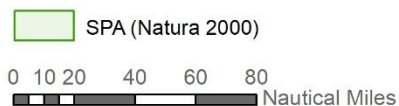


Figure 45. Fishing effort of set longlines in Portugal based on data from the questionnaire survey (2021-2022) and fishing statistics (DGRM, 2020).

Set longlines

- Main fishing ports
- Surveyed fishing ports



Estimated annual fishing days (Questionnaire survey)

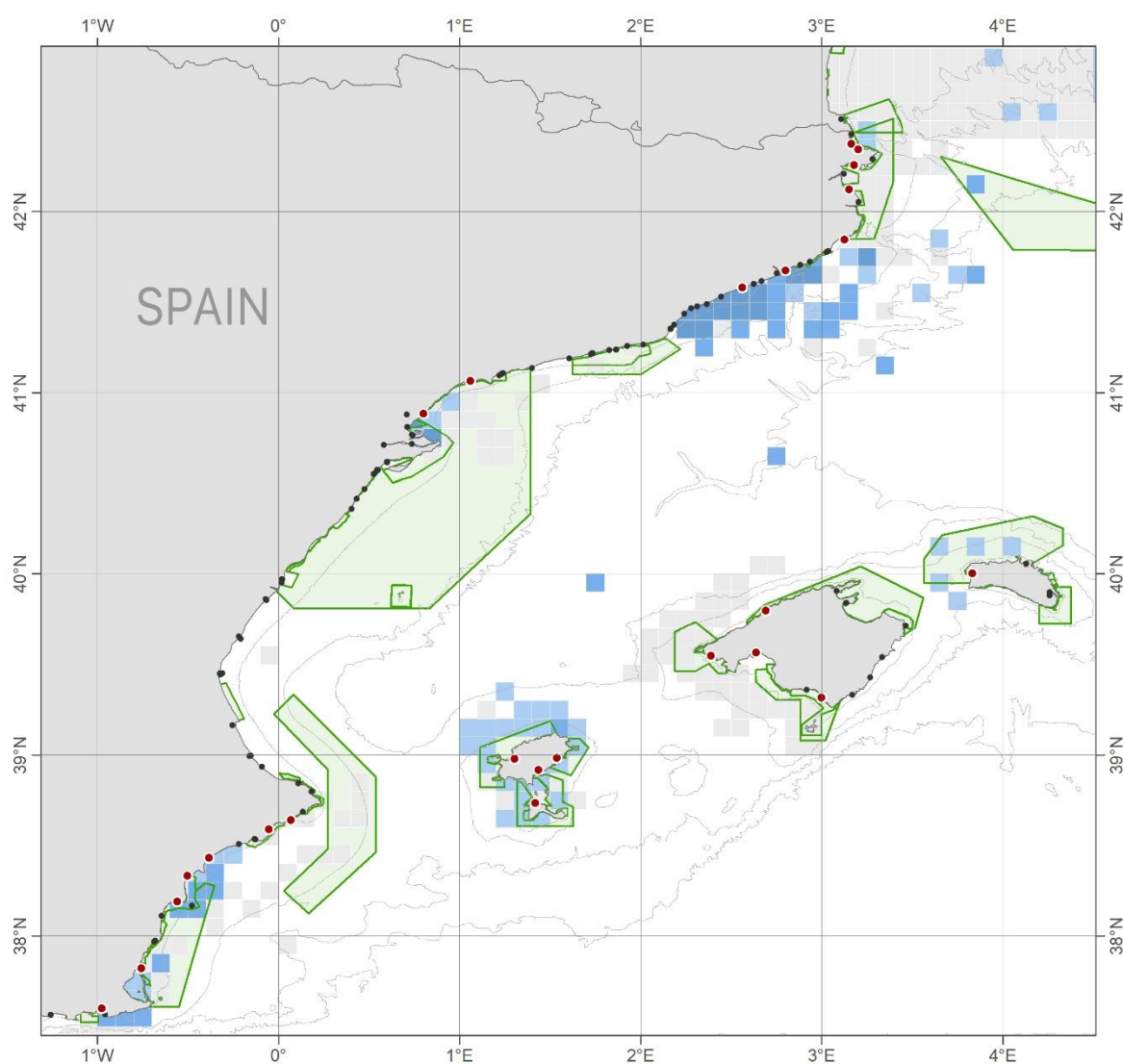


Figure 46. Fishing effort of set longlines in Spain based on data from the questionnaire survey (2018-2019) and fishing statistics (2018-2021).

4.5. Bycatch: most threatening gears and fishing practices

Data on seabird bycatch based on the questionnaire survey are presented by fishing gear type. The data collected in the questionnaires of all countries includes the occurrence of seabird bycatch for each gear and species affected. Other questions about seabird bycatch included the effect of seabirds on the fishing activity, the frequency of bycatch events, the year average of captures, the annual average of bycatch events, at what point during the fishing operations does bycatch occur, in which season does seabird bycatch occur, and the proportion of dead and alive seabirds bycaught. These other questions were answered by few fishers and do not allow for a standardised analysis in all the cases.

Even though it was not the main focus of the survey, data on bycatch of other taxa such as marine mammals or turtles was collected, mainly in Greece.

In France, Portugal, and Greece information about the spatial distribution of the seabird bycatch was collected. In Malta the number of interviews performed do not allow to present representative data on the spatial distribution of seabird bycatch. In Spain the questionnaire survey performed in 2018-2019 did not collect spatial distribution of the seabird bycatch.

Seabird bycatch occurrence

In Table 21 the occurrence of seabird bycatch (yes/no responses) by fishing gear type and country is presented for a general overview. Seabird bycatch occurrence varies greatly between countries and gear types, and it is presented separately by gear below. Within each country bycatch occurrence varies greatly between gears, but in any case, Greece, and after France reported in general lower bycatch occurrence than Malta, Spain and Portugal.

Table 21. Percentage of questionnaires and (total number of questionnaires of the sample size) with seabird bycatch reported by fishing gear type and country. In the case of Portugal, the values refer to percentage of vessels interviewed with seabird bycatch reported in at least one season and (number of vessels interviewed).

Fishing gear type	France	Greece	Malta	Spain	Portugal
Purse seines	-	-	-	42,1 (19)	24,3 (37)
Trawls	-	-	-	57,1 (21)	29,6 (27)
Gillnets	32,6 (43)	1,9 (903)	-	58,1 (31)	44,8 (29)
Trammel nets	37,6 (125)	4,9 (1661)	0 (9)	66,7 (57)	43,1 (65)
Stationary uncovered pound nets	-	-	-	84,6 (13)	-
Drifting longlines	25 (16)	11,1 (45)	42,9 (14)	-	-
Set longlines	26,9 (26)	12,3 (928)	33,3 (3)	79,6 (54)	14,3 (28)
Longlines (not specified)	-	-	66,7 (3)	-	-
Pots	-	-	-	0 (14)	2,2 (46)

Purse seines

Significant effort was made to interview the purse seine fleet in Portugal and to a lesser extent in Spain in order to establish the occurrence of seabird bycatch. This was considered important as seabird bycatch on BS was known to happen in Portugal (Oliveira et al. 2015) and there were no previous indications of bycatch occurrence in this gear in other countries.

Seabird bycatch events in the purse seine fleet was reported by 42,1% of vessels in Spain and 24,3% in Portugal. In Portugal, occurrence of seabird bycatch was similar both for smaller than 12 m and larger than 12 m vessels, but much higher in vessels smaller than 12 m in Spain (Table 21 and 22).

Table 22. Percentage of questionnaires with seabird bycatch reported in purse seine fleet by vessel length in Spain and Portugal (total number of questionnaires). In Portugal refers to percentage of vessels interviewed with seabird bycatch reported in at least one season and (total number of vessels interviewed).

Vessel length	Spain	Portugal
<12m	22,2 (9)	23,1 (13)
>12m	60,0 (10)	25,0 (24)

In Spain bycatch affects at least four species. The species most commonly bycaught in the fleet are shearwaters (42,9% *Puffinus* sp. and 14,3% *Calonectris diomedea*), gulls (42,9%) and cormorants (42,9%) (Table 23). The individuals bycaught result mostly as dead in 25% and as alive in 75% of the bycatch events.

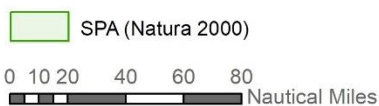
In Portugal bycatch affects at least six species. The species most commonly bycaught in the fleet are gulls (77,8%) and shearwaters (33,3% BS and 11,1% unidentified shearwaters) (Table 23). The individuals bycaught result mostly as dead in 33,3% of the vessels, as alive in 33,3% and half as alive and half as dead in 33,3%. The season with most events of bycatch was autumn when bycatch of gulls and BS occurs. Seabird bycatch occurs in the central and northern part of the Aveiro-Nazaré SPA, occurring in a wider central area in autumn (Fig. 47).

Table 23. Proportion (%) and (number of questionnaires) with seabird bycatch in purse seine fleet by species and country.

Species	France	Greece	Malta	Spain	Portugal
Common scoter (<i>Melanitta nigra</i>)	-	0	-	0	11,1 (1)
Cormorants (Phalacrocoracidae)	-	0	-	42,9 (3)	11,1 (1)
Northern gannet (<i>Morus bassanus</i>)	-	0	-	0	11,1 (1)
Petrels and shearwaters (Procellariidae)	-	0	-	0	11,1 (1)
<i>Puffinus</i> sp	-	0	-	42,9 (3)	0
Balearic shearwater (<i>Puffinus mauretanicus</i>)	-	0	-	0	33,3 (3)
Scopoli's shearwater (<i>Calonectris diomedea</i>)	-	0	-	14,3 (1)	0
Cory's shearwater (<i>Calonectris borealis</i>)	-	0	-	0	11,1 (1)
gulls (Lariidae)	-	0	-	42,9 (3)	77,8 (7)
Yellow-legged gull (<i>Larus michahellis</i>)		100 (1)		0	0
Total	-	100 (1)	-	100 (7)	100 (9)

Purse seiners (Portugal)

- Surveyed fishing ports
- Main fishing ports



Number of vessels reporting seabird bycatch events

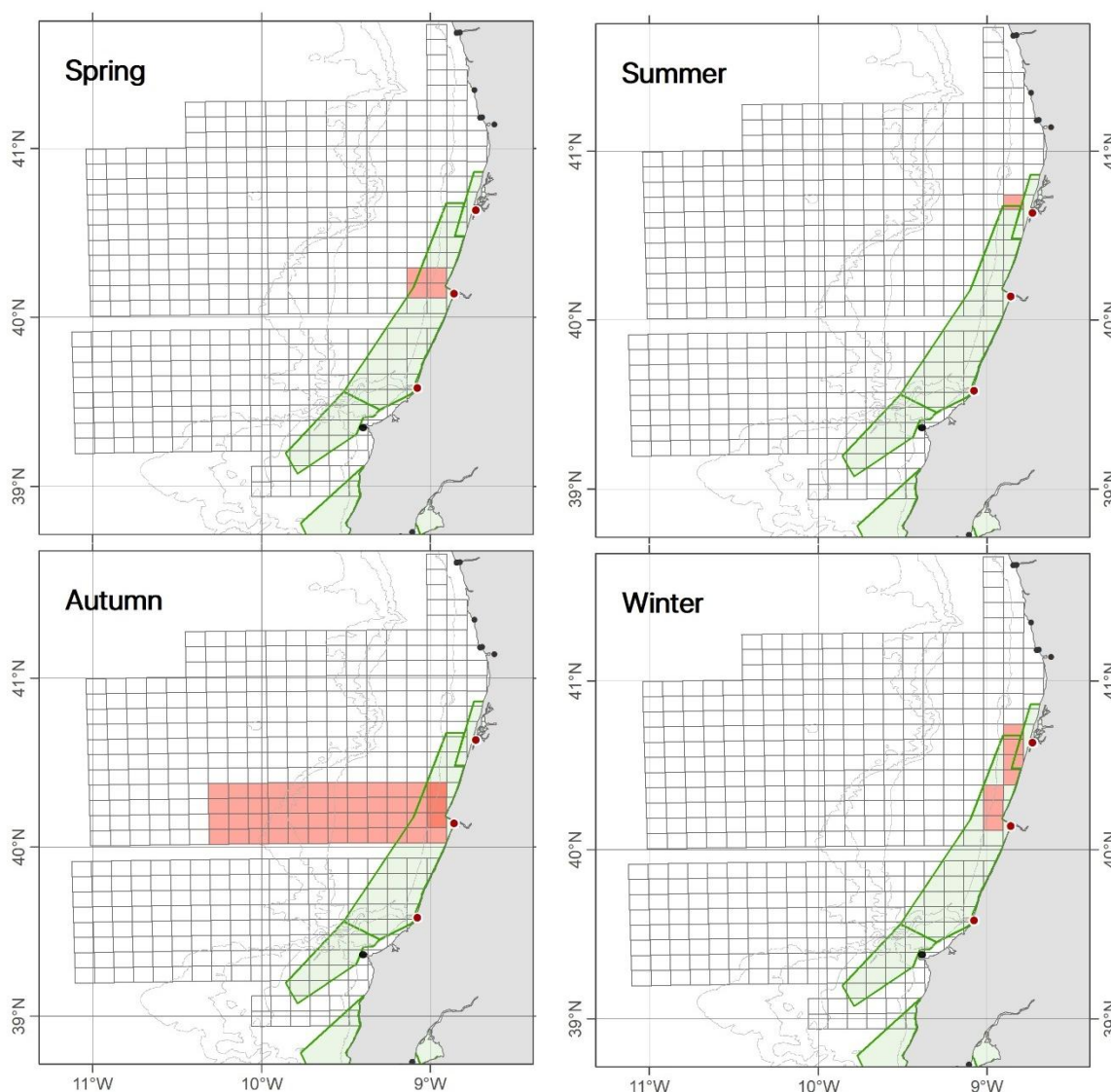


Figure 47. Distribution of seabird bycatch in purse seine fleet in the north of Portugal showing number of vessels reporting seabird bycatch events by season. Source: questionnaire survey 2021-2022 of interviews covering three-month periods.

Trawls

Trawl is a fishing gear with evidence of low seabird bycatch occurrence in previous studies, therefore it was not a priority in this study. The effort done during the questionnaire survey was limited and only relevant data was collected for Spain and opportunistically for Portugal, and in a lesser extent in France.

In Portugal 29,6% of the trawlers interviewed reported seabird bycatch, occurring only in bigger vessels (> 12 m) with higher incidence (42,1%). In Spain 57,1% of the trawlers interviewed reported seabird bycatch, being more common in bigger vessels (> 12 m) (61.1%). In France no seabird bycatch was reported on trawlers (Table 21 and 24).

Table 24. Percentage of questionnaires with seabird bycatch reported in trawlers by vessel length in France, Spain and Portugal (total number of questionnaires). In Portugal refers to percentage of vessels interviewed with seabird bycatch reported in at least one season and (total number of vessels interviewed).

Vessel length	% Seabird bycatch		
	France	Portugal	Spain
<12m	-	0 (6)	33,3 (3)
>12m	0 (4)	42,1 (19)	61,1 (18)

In Spain bycatch affects to at least four species. The species most commonly bycaught in the fleet are seagull (83,3%) (Table 25). The individuals bycaught result mostly as dead in 50% of the vessels and as alive in 50%.

In Portugal bycatch affects at least two species. The species most commonly bycaught in the fleet is Northern gannet (100%) and gulls (14,3%) (Table 25). The individuals bycaught result mostly as dead in 100% of the vessels. The season with most events of bycatch was autumn and winter. Seabird bycatch occurs in the northern part of the study area, most of it outside but close to the limit of the Aveiro-Nazaré SPA (Fig. 48).

Table 25. Proportion (%) and (number of questionnaires) with seabird bycatch in trawl fleet by species and country.

Species	France	Greece	Malta	Spain	Portugal
Alcidae	-	-	-	8,3 (1)	0,0
Cormorants (Phalacrocoracidae)	-	-	-	8,3 (1)	0,0
Northern gannet (<i>Morus bassanus</i>)	-	-	-	0,0	100 (7)
Petrels and shearwaters (Procellariiformes)	-	-	-	8,3 (1)	0,0
Gulls (Lariidae)	-	-	-	83,3 (10)	14,3 (1)
Total	-	-	-	100 (12)	100 (7)

Trawlers (Portugal)

- Surveyed fishing ports
- Main fishing ports

SPA (Natura 2000)

0 10 20 40 60 80
Nautical Miles

Number of vessels reporting seabird bycatch events

0 1 2 - 3 4 - 5 6 - 10 > 10

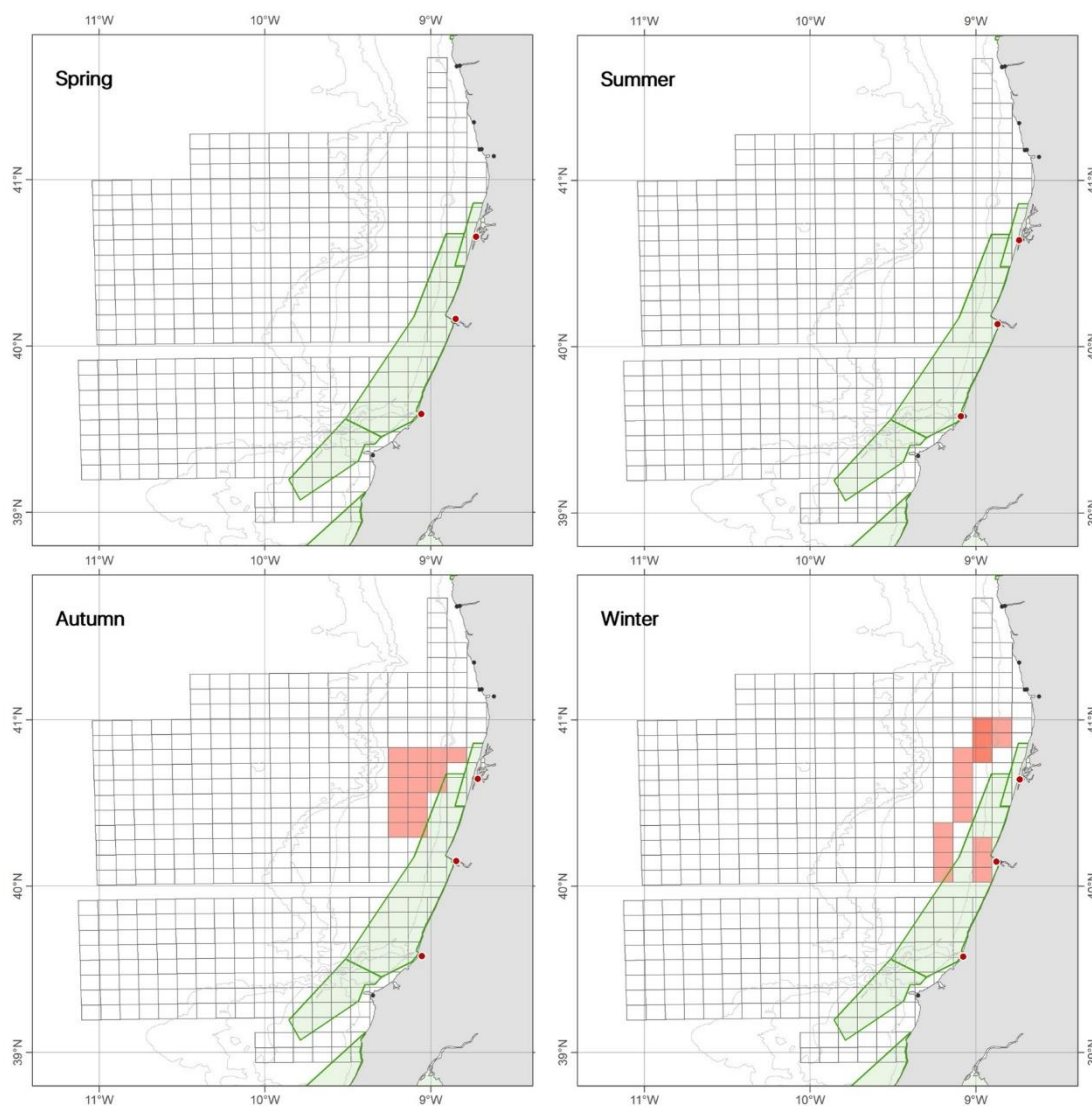


Figure 48. Distribution of seabird bycatch in trawl fleet in the north of Portugal showing number of vessels reporting seabird bycatch events by season. Source: questionnaire survey 2021-2022 of interviews covering three-month periods.

Gillnets

The questionnaire survey included a significant number of vessels in France, Spain and Portugal and a large sample in Greece. The occurrence of seabird bycatch in vessels fishing with gillnets could be considered high in France (32,6%), Spain (58,1%) and Portugal (44,8%), and it was low in Greece (1,9%) (Table 21).

Bycatch in gillnets affects at least eight seabird species, with differences between countries. In the Mediterranean countries (France, Greece and Spain) cormorants (Great cormorant and European shag) are the seabird group most commonly affected.

In France bycatch affects only cormorants (Table 26).

In Greece bycatch affects mainly the European shag (63,2%) and Yelkouan shearwater (26,3%) (Table 26). Individuals bycaught result mostly as dead (90%) and are mainly caught while the gear is within the water (83,3%), and in few vessels can happen only during hauling (8,3%) or during setting and hauling (8,3%). Bycatch occurrence in gillnets is scarce all along the coast where the questionnaire survey was performed, with a some incidence in the north Aegean close to Kavala Gulf, in the western Sporades and in Lesbos, Psara, Oinousses and Ikaria islands (Fig. 49). Bycatch in gillnets seems not to be frequent in the country as this gear type is left in the water for a short period of time since it usually targets sensitive species, such as sardines, surmullets and small pelagics.

In Spain bycatch affects mainly cormorants (91,7%) and *Puffinus* species (16,7%), and individuals bycaught result mostly as dead (100% of vessels) (Table 26).

In Portugal bycatch affects in medium-high levels to at least five families/species, namely gulls (63,2%), Northern gannet (36,4%), alcids (36,4%), Common scoter (27,3%) and Cory's shearwater (18,2%), individuals bycaught result mostly as dead (100% of vessels) (Table 26). Bycatch occurred in spring and summer in the north part of the Aveiro-Nazaré SPA around Aveiro, and in autumn and winter around Figueira da Foz in the central area of the Aveiro-Nazaré SPA. In the southern part of the Aveiro-Nazaré SPA, the area with bycatch occurrence is smaller around Nazaré in spring and winter (Fig. 50).

Table 26. Proportion (%) and (number of questionnaires) with seabird bycatch in gillnets by species and country.

Species	France	Greece	Malta	Spain	Portugal
Alcidae	0	0	-	0	36,4 (4)
Black-necked Grebe (<i>Podiceps nigricollis</i>)	0	0	-	8,3 (1)	0
Common scoter (<i>Melanitta nigra</i>)	0	0	-	0	27,3 (3)
Cormorants (<i>Phalacrocoracidae</i>)	100 (10)	15,8 (3)	-	91,7 (11)	0
European shag (<i>Gulosus aristotelisi</i>)	0	63,2 (12)	-	0	0
Northern gannet (<i>Morus bassanus</i>)	0	0	-	0	36,4 (4)
<i>Puffinus</i> sp	0	0	-	16,7 (2)	0
Yelkouan shearwater (<i>Puffinus yelkouan</i>)	0	26,3 (5)	-	0	0
Cory's shearwater (<i>Calonectris borealis</i>)	0	0	-	0	18,2 (2)
Seagulls (Lariidae)	0	5,3 (1)	-	0	63,6 (7)
Total	100 (10)	100 (19)	-	100 (12)	100 (11)

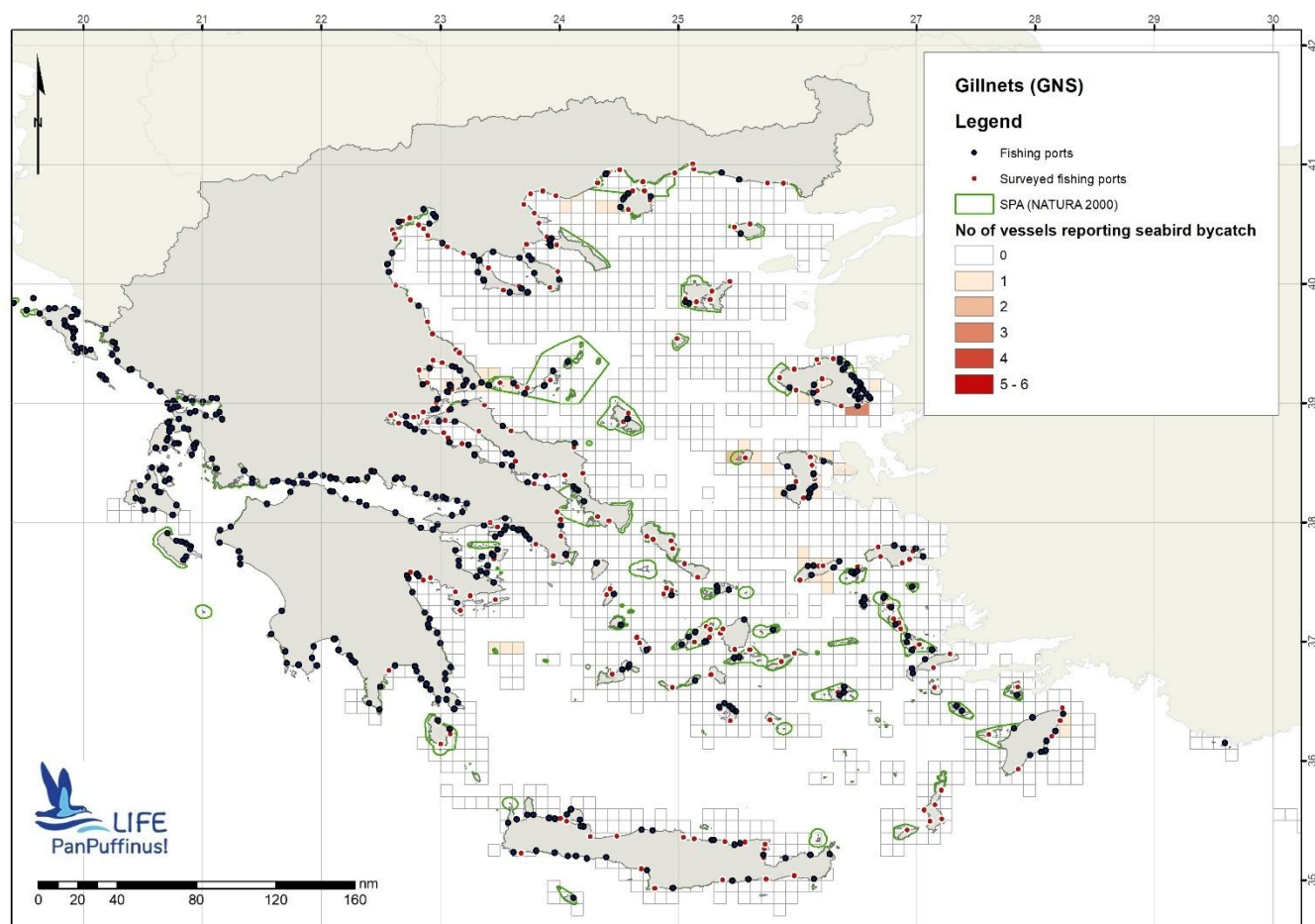


Figure 49. Bycatch on gillnets in Greece presented as the number of vessels reporting bycatch events by year in the questionnaire survey (PanPuffinus! project 2021-2022 and INCA project 2020-2022).

Gillnets (Portugal)

- Surveyed fishing ports
- Main fishing ports

SPA (Natura 2000)

0 10 20 40 60 80 Nautical Miles

Number of vessels reporting seabird bycatch events

0 1 2 - 3 4 - 5 6 - 10 > 10

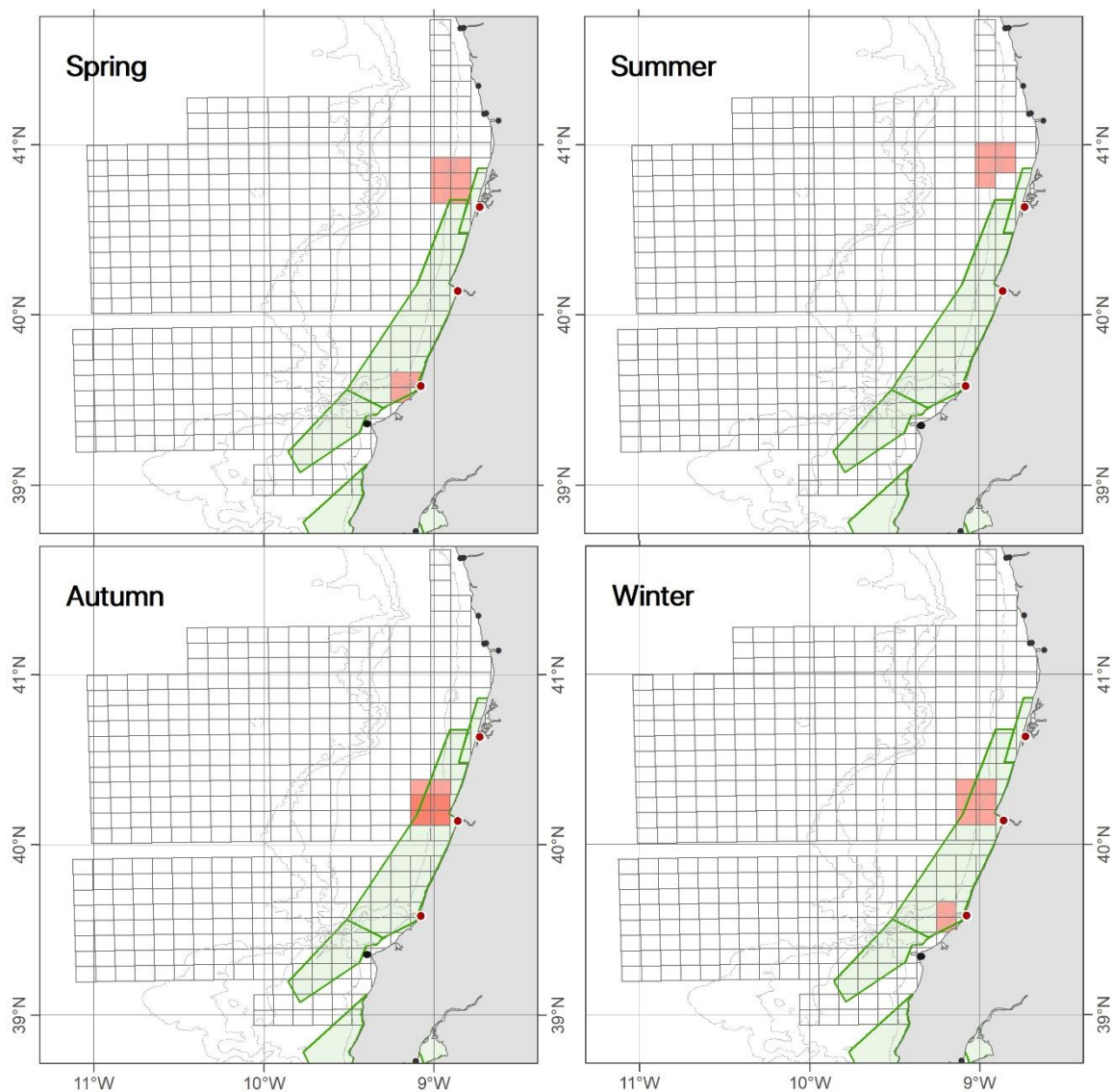


Figure 50. Seabird bycatch on gillnets in Portugal presented as the number of vessels reporting seabird bycatch events by season based on the questionnaire survey (2021-2022).

Trammel nets

The questionnaire survey included a significant number of vessels in France, Spain and Portugal and a large sample in Greece. The occurrence of seabird bycatch in vessels fishing with trammel nets could be considered high in France (37,6%), Spain (66,7%) and Portugal (43,1%), low in Greece (4,9%), and in Malta occurrence of seabird bycatch was not recorded (Table 21).

Bycatch in trammel nets affects at least 11 seabird species, with differences between countries. In the Mediterranean countries (France, Greece and Spain) cormorants (Great cormorant and European shag) and seagulls are the seabird groups most commonly affected.

In France bycatch affects mainly cormorants (100%) and in lower proportion seagulls (16,7%) (Table 27).

In Greece bycatch affects at least five species, mainly European shag (70%), and to a lesser extent Yelkouan shearwater (25,7%) (Table 27). Individuals bycaught result mostly as dead (100% of vessels) and are mainly caught while the gear is in the water (73,3% of vessels), and in few vessels can happen only during hauling (6,7% of vessels), during setting and hauling (6,7% of vessels), or during setting (3,3% of vessels). Bycatch occurrence is recorded in small numbers all along the coast where the questionnaire survey was performed, with a higher incidence in the areas of Chalkidiki coast, Kavala Gulf, Samothraki island and Argolikos Gulf, but also recorded around Pagasitikos Gulf, Lesvos and Psara islands, southern Cyclades and the Turkish coast close to Chios island (Fig. 51). Through the LIFE PanPuffinus! project it has become evident that the incidences of bycatch in trammel nets are much more widespread and go unreported. Especially in the Gulf of Kalloni in Lesvos island, YS bycatch is common in trammel nets targeting cuttlefish and mass incidents do occur frequently from February till May, when a significant number of YS forage during the day.

In Spain bycatch affects mainly cormorants (86,1%) and *Puffinus* species (19,4%), and individuals bycaught result mostly as dead (100% of vessels) (Table 27).

In Portugal bycatch affects in medium-high levels to at least eight species, standing out Northern gannet (71,4%), different alcids (unidentified 28,6%, Common murre

25%, Razorbill 10,7%), and gulls (46,4%), and in lower proportion Common scoter (27,3%), shearwaters (unidentified 7,1%, Cory's shearwater 7,1%, and Balearic shearwater 7,1%) and cormorants (3,6%), and individuals bycaught result mostly as dead (96,3% of vessels)(Table 26). Bycatch occurrence is widespread all along the coast of the Aveiro-Nazaré SPA. In spring is concentrated in the central and northern part of the SPA. The rest of the year occurs all along the coast of the SPA with a higher incidence in autumn (Fig. 52).

Table 27. Proportion (%) and (number of questionnaires) with seabird bycatch in trammel nets by species and country.

Species	France	Greece	Malta	Spain	Portugal
Alcidae	0	0	-	2,8 (1)	28,6 (8)
Balearic shearwater (<i>Puffinus mauretanicus</i>)	0	0	-	0	7,1 (2)
Common murre (<i>Uria aalge</i>)	0	0	-	0	25 (7)
Common scoter (<i>Melanitta nigra</i>)	0	0	-	0	10,7 (3)
Cormorants (Phalacrocoracidae)	100 (18)	7,1 (5)	-	86,1 (31)	3,6 (1)
European shag (<i>Gulosus aristotelis</i>)	0	70 (49)	-	0	0
Great Cormorant (<i>Phalacrocorax carbo</i>)	0	4,3 (3)	-	0	0
Divers (<i>Gavia</i> sp.)	0	1,4 (1)	-	0	0
Northern gannet (<i>Morus bassanus</i>)	0	0	-	0	71,4 (20)
Petrels and shearwaters (Procellariidae)	0	0	-	0	7,1 (2)
<i>Puffinus</i> sp	0	0	-	19,4 (7)	0
Yelkouan shearwater (<i>Puffinus yelkouan</i>)	0	25,7 (18)	-	0	0
Cory's shearwater (<i>Calonectris borealis</i>)	0	0	-	0	7,1 (2)
Razorbill (<i>Alca torda</i>)	0	0	-	0	10,7 (3)
Seagulls (Lariidae)	16,7 (3)	1,4 (1)	-	8,3 (3)	46,4 (13)
Total	100 (18)	100 (70)	-	100 (36)	100 (28)

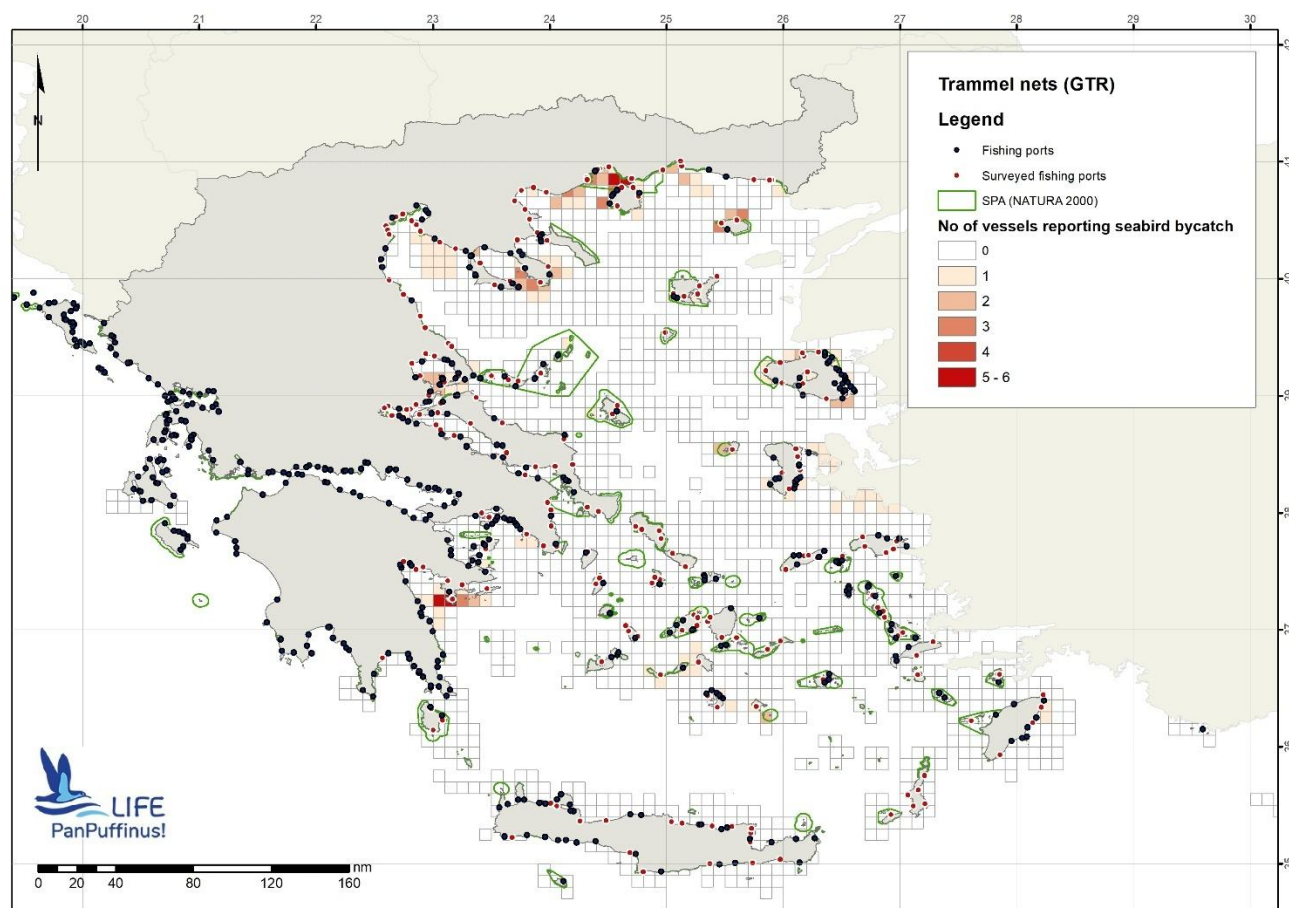
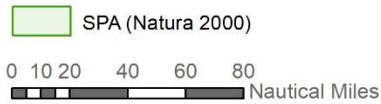


Figure 51. Bycatch on trammel nets in Greece presented as the number of vessels reporting bycatch events by year in the questionnaire survey (PanPuffinus! project 2021-2022 and INCA project 2020-2022).

Trammel nets (Portugal)

- Surveyed fishing ports
- Main fishing ports



Number of vessels reporting seabird bycatch events

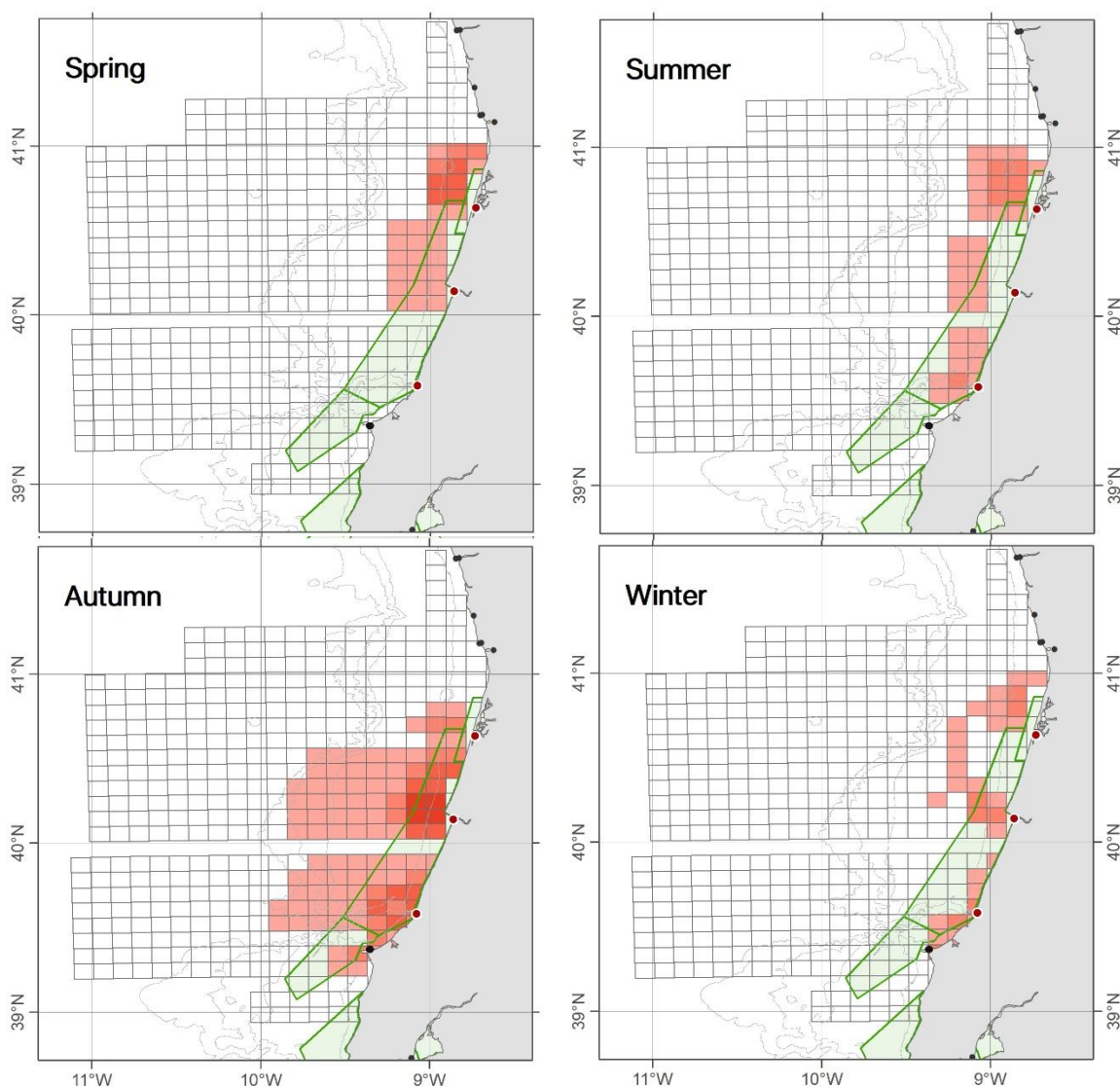


Figure 52. Seabird bycatch on trammel nets in Portugal presented as the number of vessels reporting seabird bycatch events by season based in questionnaire survey (2021-2022).

Drifting longlines

In general, there is little previous evidence of seabird bycatch in this fleet, but studies focused generally on larger vessels (>12 m). In France, Greece and Malta the questionnaire survey then focused on small vessels (<12 m), and in both Spain and Portugal this gear type was not surveyed.

Seabird bycatch occurred in all countries in different proportion of the fleet fishing with drifting longlines. In Greece occurrence of seabird bycatch was relatively low with 11,1% vessels reporting bycatch, in France was 25%, and in Malta was much higher with 42,9% (Table 21).

Bycatch affects different seabird species in each country (Table 28). In the Mediterranean countries (France, Greece and Malta) gulls and shearwaters are the seabird groups most commonly affected. In France bycatch affects cormorants, shearwaters and gulls. In Greece bycatch affects mainly Yelkouan shearwater and gulls. In Malta bycatch affects mainly Scopoli's shearwater. It should be taking in account that the results are based in a low number of vessels in each country that detailed the species in the questionnaire survey.

Table 28. Proportion (%) and (number of questionnaires) with seabird bycatch in drifting longline fleet by species and country.

Species	France	Greece	Malta	Spain	Portugal
Cormorants (Phalacrocoracidae)	33,3 (1)	0	0	-	-
European shag (<i>Gulosus aristotelis</i>)	0	25 (1)	0	-	-
Northern gannet (<i>Morus bassanus</i>)	0	0	0	-	-
Petrels and shearwaters (Procellariiformes)	33,3 (1)	0	0	-	-
Scopoli's shearwater (<i>Calonectris diomedea</i>)	0	0	100 (5)	-	-
Yelkouan shearwater (<i>Puffinus yelkouan</i>)	0	75 (3)	0	-	-
Seagulls (Lariidae)	33,3 (1)	50 (2)	0	-	-
Yellow-legged gull (<i>Larus michahellis</i>)	0	0	20 (1)	-	-
Total	100 (3)	100 (4)	100 (5)	-	-

In Malta, the country with higher occurrence of seabird bycatch, despite the small sample (n=14) there is still evidence that seabird bycatch in surface or drifting longlines is a more prevalent problem than previous documented in a questionnaire

survey of 146 fishers done in 2007 when the majority of seabird bycatch occurred in bottom longlines (99.5%) (Dimech *et al* 2008). The season when more incidents occur is spring (5) and summer (3). Bycatch occurs more frequently during the setting phase of the fishing process and in some cases during hauling, being more frequent that seabirds are retrieved dead (60%) than alive (40%). 66,7% of the fishers using drifting longlines think that seabirds have a negative effect in their activity, mainly due to bait loss.

In Greece, a representative sample of questionnaires with spatial distribution of seabird bycatch was collected to represent it in maps. Bycatch occurrence is mainly recorded in the Dodecanese archipelago from Leros to Chalki islands, which is also the most important region for this gear type (Fig.53).

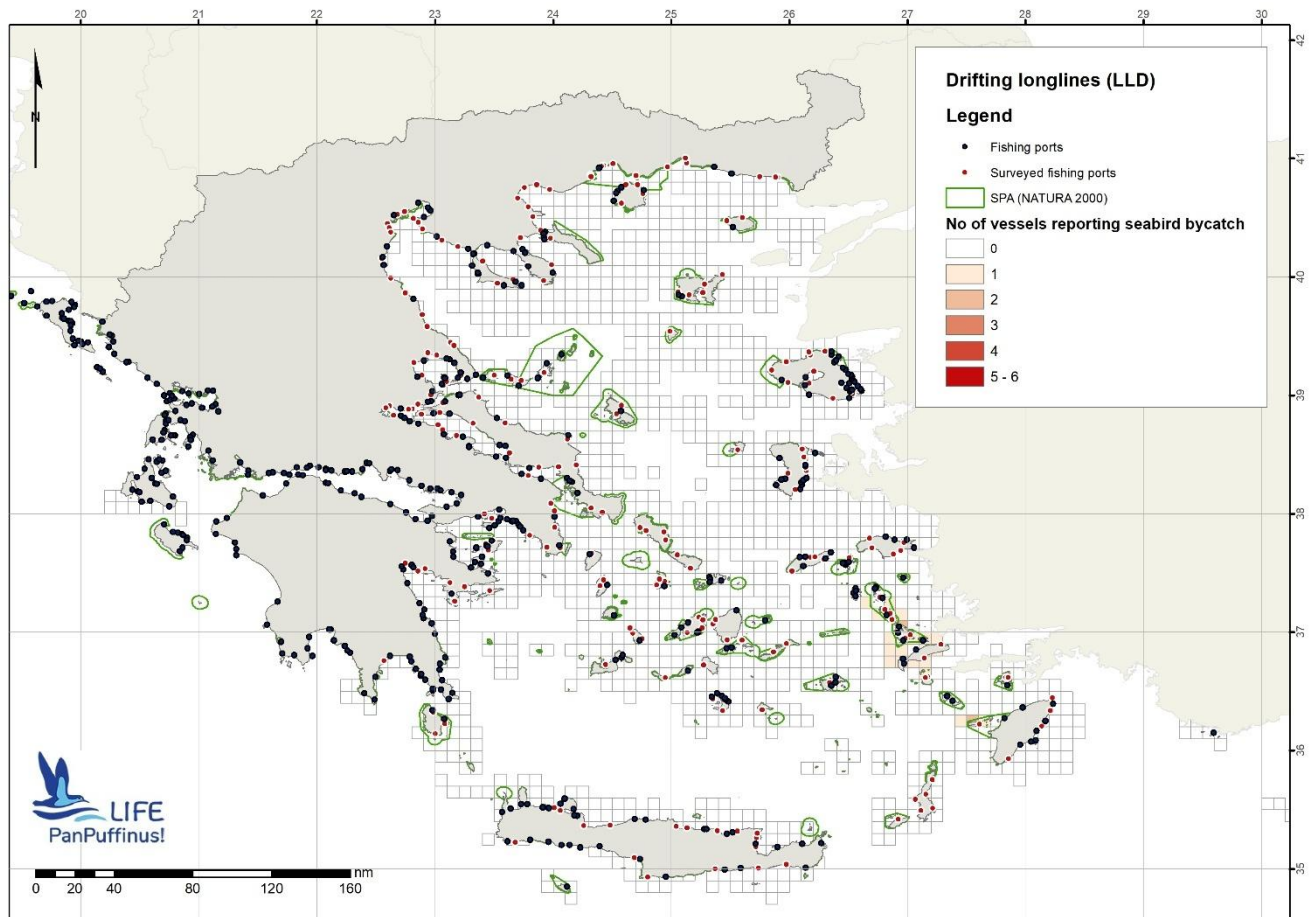


Figure 53. Bycatch on drifting longlines in Greece presented as the number of vessels reporting bycatch events by year in the questionnaire survey (LIFE PanPuffinus! project 2021-2022 and INCA project 2020-2022).

Set longlines

In general, set longline is the gear with most evidence of seabird bycatch in the Mediterranean, especially for shearwaters.

Seabird bycatch occurred in all countries in different proportion of the fleet fishing with set longlines. In Portugal and Greece occurrence of seabird bycatch was relatively low with 10% and 14,3% of vessels reporting bycatch respectively, in France was 33.3%, in Malta 33,3%, and in Spain was much higher with 79,6% (Table 21).

Bycatch affects different seabird species in each country (Table 29). In the Mediterranean countries (France, Greece, Malta and Spain) gulls and shearwaters are the seabird groups most commonly affected. In France bycatch affects cormorants, shearwaters and gulls. In Greece bycatch affects at least six species, especially shearwaters (Yelkouan and Scopoli's), with a very high occurrence of Yelkouan shearwater (60,4%), and in lower levels Yellow-legged gull and European shag. In Malta bycatch affects only Scopoli's shearwater. In Spain bycatch affects at least six species, being sgulls and shearwaters the most common with higher levels; and Northern gannet, cormorants and skuas having lower occurrence. In Portugal bycatch affects only gulls (Table 29). It should be taken into account that the results for Malta and Portugal are based on a low number of vessels that mentioned only certain species in the questionnaire survey and thus it is likely that even more species are affected.

Table 29. Proportion (%) and (number of questionnaires) with seabird bycatch in set longline longline fleet by species and country.

Species	France	Greece	Malta	Spain	Portugal
Audouin's Gull (<i>Larus audouinii</i>)	0	1,1 (1)	0	0	0
Cormorants (Phalacrocoracidae)	50 (2)	1,1 (1)	0	21,4 (9)	0
European shag (<i>Gulosus aristotelis</i>)	0	11,0 (10)	0	0	0
Great Cormorant (<i>Phalacrocorax carbo</i>)	0	1,1 (1)	0	0	0
Northern gannet (<i>Morus bassanus</i>)	0	0	0	21,4 (9)	0
Petrels and shearwaters (Procellariiformes)	50 (2)	0	0	9,5 (4)	0
<i>Puffinus</i> sp	0	0	0	40,5 (17)	0
Yelkouan shearwater (<i>Puffinus yelkouan</i>)	0	60,4 (55)	0	0	0
Scopoli's shearater (<i>Calonectris diomedea</i>)	0	17,6 (16)	100 (2)	52,4 (22)	0
Seagulls (Lariidae)	25 (1)	11,0 (10)	0	78,6 (33)	100 (2)
Yellow-legged gull (<i>Larus michahellis</i>)	0	13,2 (12)	0	0	0
Skuas (<i>Stercorarius</i> spp)	0	0	0	4,8 (2)	0
Total	100 (4)	100 (91)	100 (2)	100 (42)	100 (2)

In Greece for 66,7% of the vessels, bycatch occurs only during setting, but it can happen too with the gear in the water (18,5% of vessels) or setting and hauling

(14,8% of vessels), being more frequent that seabirds are retrieved dead (65,2% of vessels) than alive (26,1% of vessels).

In Malta, the sample size is too small so as to extract any conclusion, but there is evidence of seabird bycatch in setting longlines as previous documented (Dimech et al 2008). Bycatch occurs more frequently during the setting phase of the fishing process and in some cases during hauling.

In Spain it is more frequent that seabirds are retrieved dead (57,1% of vessels) than alive (42,9% of vessels).

In Greece and Portugal, a representative sample of questionnaires with spatial distribution of seabird bycatch was collected and represented in maps. In Greece bycatch occurrence is widespread all along the coast where questionnaires were performed, with a higher incidence in Chalkidi area the Dodecanese archipelago, and lower in eastern Lesvos island, Chios and Psara islands, the central Cyclades region, as well as the Saronikos Gulf (Fig. 55). In Portugal seabird bycatch occurred mainly in winter in all the Aveiro-Nazaré SPA, and outside its border in the northern part (Fig. 56).

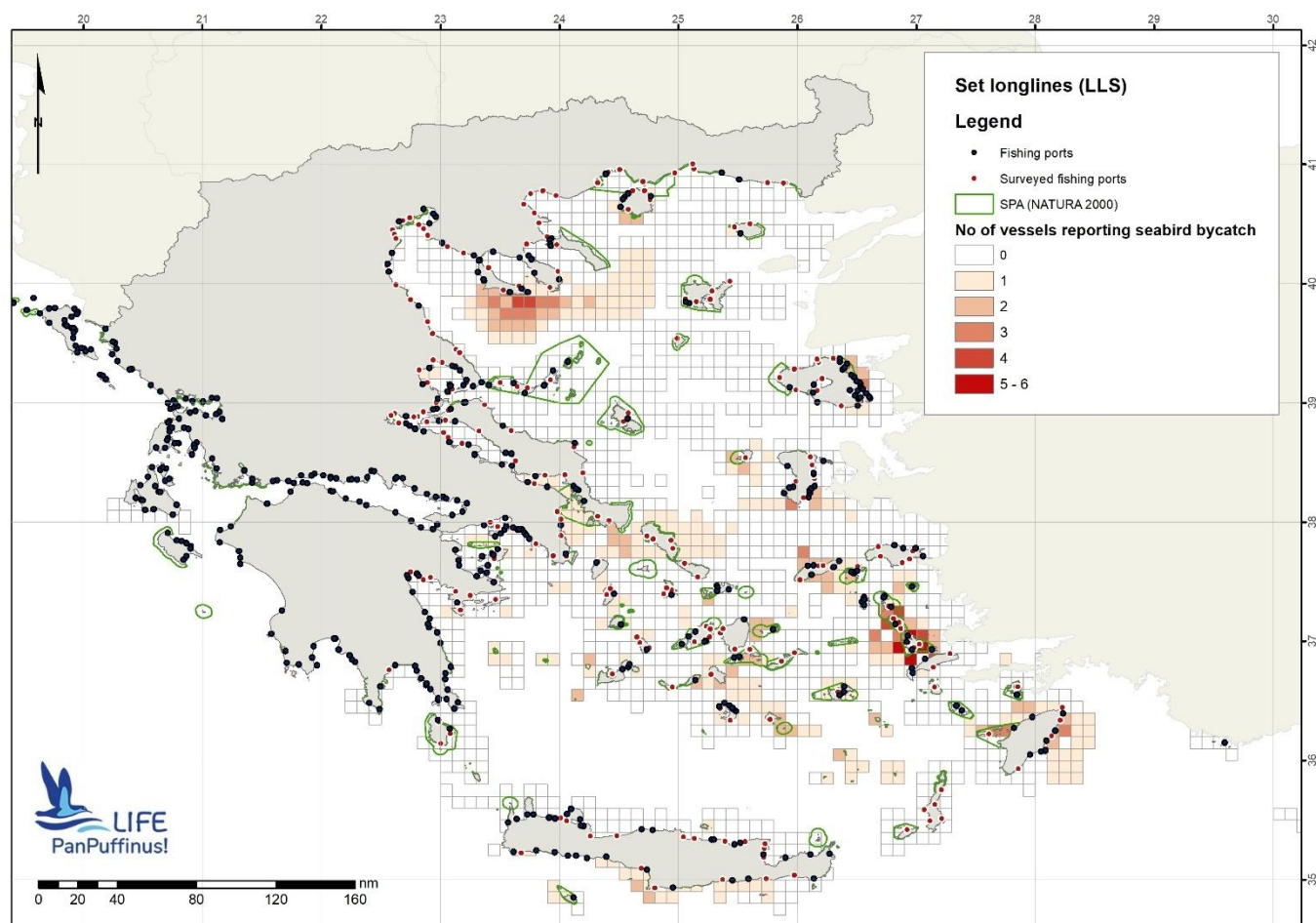
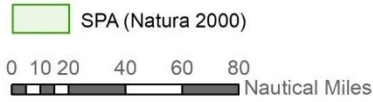


Figure 55. Bycatch on set longlines in Greece presented as the number of vessels reporting bycatch events by year in the questionnaire survey (PanPuffinus! project 2021-2022 and INCA project 2020-2022).

Set longlines (Portugal)

- Surveyed fishing ports
- Main fishing ports



Number of vessels reporting seabird bycatch events

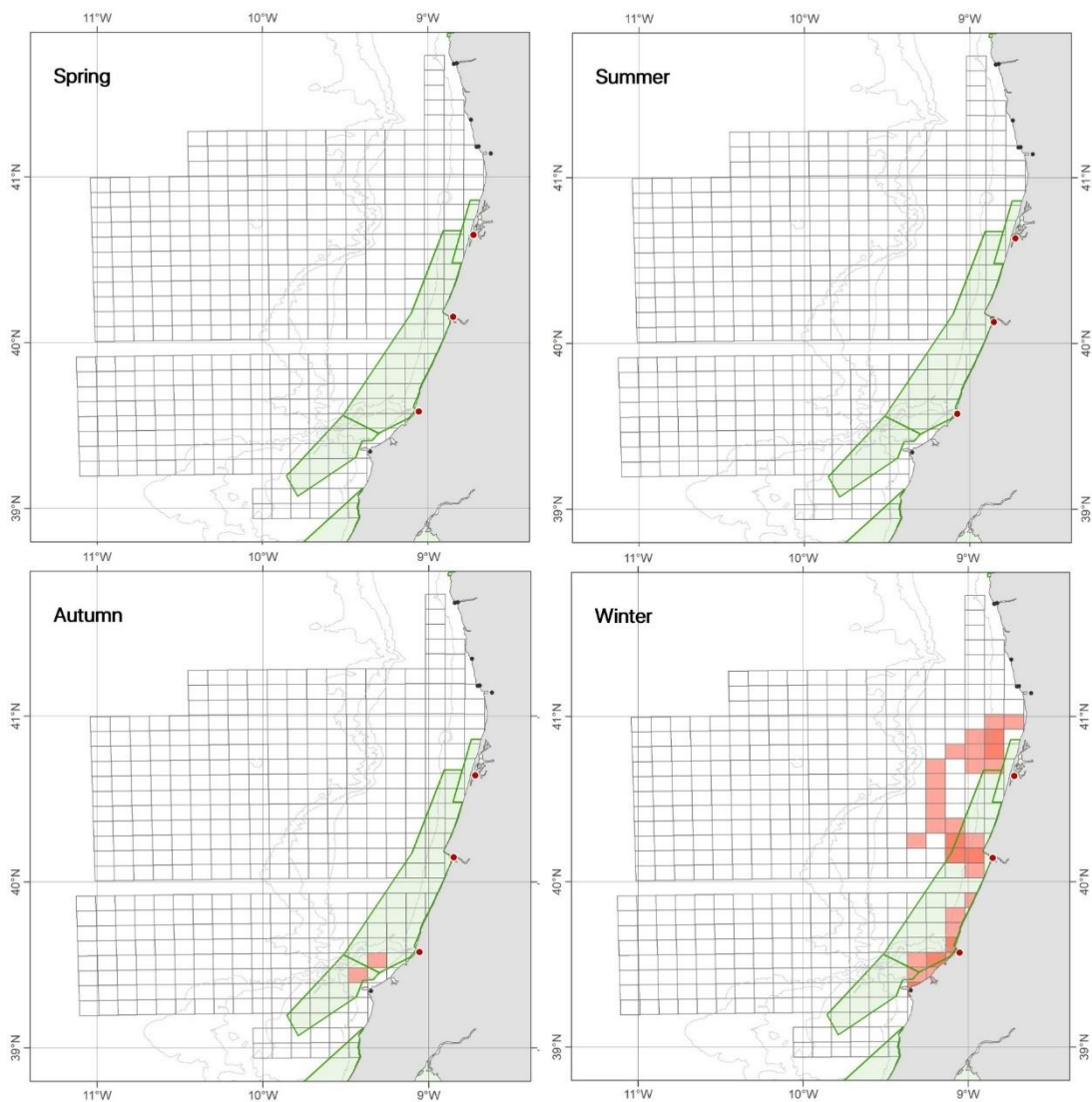


Figure 56. Seabird bycatch on set longlines in Portugal presented as the number of vessels reporting seabird bycatch events by season based on the questionnaire survey (2021-2022).

4.6. Mitigation measures

In the questionnaire survey there was a section in the interviews dedicated to the use of mitigation measures to avoid seabird bycatch. Fishers were asked about the mitigation measures they used to avoid seabird bycatch. The different measures were standardised and classified in individual measures and categories were created for measures attending to the same principle (Table 30).

Table 30. Classification of the mitigation measures.

Mitigation measure category	Mitigation measure
Avoid attraction	Avoiding full net at the surface
	Changed bait morphology
	Changed bait species
	Changed hook colour
	Cover captures/bait
	Discard/offal management
	Hooks baited in advance
	Man-made bait
	Net cleaning
	Reduce lighting
Change fishing	Avoid area/changing area
	Seasonal changes
Change fishing technique/behaviour	Bigger mesh net size
	Night - setting (avoid setting at dawn and/or dusk)
	Placement of extra weights on LL
	Short settings
	Slow setting
	Stop setting if birds present
	Stop setting LL if birds caught, and release it to avoid more
	Under-water setting devices
Distract birds	Distract birds - Spill oil drops in the sea
	Distract birds - throw bait
Scare noise	Noise generation
	Pingers
Scare odour	Olfactory repellent
Scare visually	Bird-scaring - Buoys
	Bird-scaring - Kites

Mitigation measure category	Mitigation measure
	Bird-scaring - Lines (paired)
	Bird-scaring - Lines (single)
	Bird-scaring lines
	Dead bird to scare
	Net Led lights
	Net panels

In general mitigation measures are used to scare birds away, avoid attraction of birds to the vessels, or avoid encounters with birds. The measures used varied depending on fishing gear. It is suspected that for some gear types, mainly trawls and purse seines, mitigation measures are applied to avoid disturbance by seabirds, mainly gulls, rather than to avoid seabird bycatch. Thus it is often difficult to ensure that the fisher's answer is referring to a specific measure aiming to avoid bycatch or to avoid just disturbance.

In the table 31 the percentage of use of mitigation measures by fishing gear type and country is shown. The use of mitigation measures by gear type and the sample size varies greatly between countries, not recommending showing a percentage of use by gear for all countries together. Only fishing gear types with a sample size of at least 10 interviews by country are shown. In the case of Greece, the questionnaire survey has a large sample size and includes data of mitigation measures for other taxa such as marine mammals, marine turtles, rays and sharks that is detailed in the table 32.

Table 31. Percentage of use of seabird bycatch mitigation measures by fishing gear type and country.

Fishing gear type	France	Greece	Malta	Spain	Portugal
Gillnets	100	12	-	8,7	6,7
Trammel nets	100	7,7	-	6	5,4
Drifting longlines	100	0	-	-	-
Set longlines	100	28,3	-	68,6	9,1
Longlines (not specified)	-	-	90	-	-
Purse seines	-	-	-	23,1	2,8
Trawls	-	-	-	4,8	0
Pots	-	-	-	0	4,4

Table 32. Percentage of use of bycatch mitigation measures by fishing gear type and marine fauna taxa groups in Greece.

Fishing gear type	Marine mammal	Marine turtle	Ray	Seabird	Shark
Gillnets	8,6	3,7	4,7	12	0
Trammel nets	8,3	5,8	1,0	7,7	0
Drifting longlines	-	20	-	0	7,1
Set longlines	5,3	5,8	2,9	28,3	0
Longlines (not specified)	-	-	-	-	-
Purse seines	-	-	-	-	-
Trawls	-	-	-	-	-
Pots	-	-	-	-	-

The use of seabird bycatch mitigation measures is very high in France (100%) in comparison with the other countries. All vessels fishing with gillnets, trammel nets, drifting longlines and set longlines claim to use at least one bycatch mitigation measure. Indeed, these métiers produce generally few discards, which is a mitigation measure although fishers do not implement it to reduce seabird bycatch.

In Greece the percentage of use of seabird mitigation measures is lower than 10% for vessels fishing with trammel nets (7,7%) and 12% for gillnets. The use of mitigation measures is more common in set longlines (28,3%). For the other gear types, the sample size is too low to be analysed. For other marine fauna, the use of mitigation measures is low, being less than 10% for all taxa groups and gear types except for the use of mitigation measures for marine turtles in drifting longlines (20%).

In Malta there is a very high use of mitigation measures in longlines (90%), being 80% of interviews for drifting longlines. The low sample size did not allow to calculate the use of mitigation measures for other gears.

In Spain the percentage of use of mitigation measures is lower than 10% for trawls and nets (gillnets and trammel nets), higher for purse seines (23%) and very high for set longlines (68,6%).

In Portugal the percentage of use of mitigation measures is lower than 10% for vessels fishing with gillnets, trammel nets, set longlines, purse seines and trawls. Set longlines is the gear with higher use of mitigation measures (9,1%).

Purse seines

In the purse seine fleet five mitigation measures to avoid seabird bycatch have been identified (Table 33).

Table 33. Seabird bycatch mitigation measures used in the purse seine fleet by country.

Mitigation measure category	Mitigation measure	France	Greece	Malta	Spain	Portugal
Avoid attraction	Avoiding full net at the surface	x		n/a		
	Discard/offal management	x		n/a	x	
	Net cleaning	x		n/a		
Change fishing technique/behaviour	Night - setting	x		n/a	x	
Scare noise	Noise generation			n/a	x	

In general, night - setting and discard/offal management are the most used mitigation measures in the purse seine fleet, but in no country a relevant part of the fleet applies mitigation measures.

By country, only in Spain and Portugal a relevant number of vessels were interviewed to allow analysis of the data. In Portugal only 2,8% of the fleet apply mitigation measures but the measures applied are not known. In Spain 23,1% of the fleet uses mitigation measures consisting in three measures. The questionnaire survey included only three purse seiners in Greece that did not use mitigation measures and three purse seiners in France that used four different mitigation measures.

It is suspected that in general mitigation measures are applied to avoid disturbance by seabirds, mainly gulls, rather than to avoid seabird bycatch. Purse seine fishing commonly takes place at night across most countries, following target species activity, thus night setting in this circumstance is not usually identified as a mitigation measure for seabirds.

Trawls

In the trawl fleet five mitigation measures to avoid seabird bycatch have been identified, being the same than in the purse seine fleet (Table 34).

Table 34. Seabird bycatch mitigation measures used in the trawl fleet by country.

Mitigation measure category	Mitigation measure	France	Greece	Malta	Spain	Portugal
Avoid attraction	Avoiding full net at the surface	x	n/a	n/a		
	Discard/offal management	x	n/a	n/a		
	Net cleaning	x	n/a	n/a		
Change fishing technique/behaviour	Night - setting	x	n/a	n/a		
Scare noise	Noise generation		n/a	n/a	x	

Only in Spain (21 vessels) and Portugal (26 vessels) a relevant sample size was interviewed, showing that mitigation measures to avoid bycatch are not implemented in the fleet (0% in Portugal and 4,8% in Spain). Only one trawler in Spain generates noise to scare birds. In France the three vessels interviewed used several mitigation measures. It is suspected that in general mitigation measures are applied to avoid disturbance by seabirds, mainly gulls, rather than to avoid seabird bycatch.

Gillnets

In the gillnet fleet eight mitigation measures to avoid seabird bycatch have been identified (Table 35).

Table 35. Seabird bycatch mitigation measures used in the gillnet fleet by country.

Mitigation measure category	Mitigation measure	France	Greece	Malta	Spain	Portugal
Avoid attraction	Avoiding full net at the surface	x		n/a		
	Discard/offal management	x		n/a		
	Net cleaning	x		n/a		
Change fishing	Avoid area/changing area		x	n/a		
Change fishing technique/behaviour	Bigger mesh net size			n/a	x	
	Night - setting	x	x	n/a	x	
Scare noise	Noise generation	x		n/a		
Scare visually	Bird-scaring - Buoys		x	n/a	x	

The use of mitigation measures to avoid seabird bycatch in gillnets is low across all countries (Greece 12%, Spain 8,7%, Portugal 6,7%), apart from France (100%). The small number of fishers reporting the use of mitigation measures in Spain, Greece and Portugal is too low to assume that the measures they use are representative of the measures used in the fleet. In Portugal the two fishers reporting the use of mitigation measures did not identify the measure used. In France all fishers reported the use of mitigation measures, the majority combine a wide range of two or three measures, being night-setting, discard and/or offal management, avoiding the full net at the surface and net cleaning as the most used.

Trammel nets

In the trammel net fleet eight mitigation measures to avoid seabird bycatch have been identified (Table 36).

Table 36. Seabird bycatch mitigation measures used in the trammel net fleet by country.

Mitigation measure category	Mitigation measure	France	Greece	Malta	Spain	Portugal
Avoid attraction	Avoiding full net at the surface	x		n/a		
	Discard/offal management	x		n/a		
	Net cleaning	x		n/a		
Change fishing	Avoid area/changing area		x	n/a		
Change fishing technique/behaviour	Bigger mesh net size			n/a	x	
	Night - setting	x	x	n/a		x
Scare noise	Noise generation	x	x	n/a		
Scare visually	Bird-scaring - Buoys		x	n/a		

The use of mitigation measures to avoid seabird bycatch in trammel nets is low across all countries (Greece 7,7%, Spain 6%, Portugal 5,4%), apart from France (100%), and lower than in gillnets. In Spain and Portugal only one measure was reported. In Greece four measures were reported but each measure was used by a low number of fishers. In France all fishers reported the use of mitigation measures, the majority combine a wide range of two or three measures, being night-setting, discard and/or offal management, avoid the full net at the surface and net cleaning the most used.

Drifting longlines

In the drifting longline fleet eight mitigation measures to avoid seabird bycatch have been identified (Table 37).

Table 37. Seabird bycatch mitigation measures used in the drifting longline fleet by country.

Mitigation measure category	Mitigation measure	France	Greece	Malta	Spain	Portugal
Avoid attraction	Discard/offal management	x			n/a	n/a
	Man-made bait			x	n/a	n/a
Change fishing technique/behaviour	Night - setting (avoid setting at dawn and/or dusk)	x			n/a	n/a
	Placement of extra weights on LL	x			n/a	n/a
	Stop setting if birds present			x	n/a	n/a
Distract birds	Distract birds - throw bait			x	n/a	n/a
Scare noise	Noise generation	x			n/a	n/a
Scare visually	Bird-scaring - Buoys	x		x	n/a	n/a

Only in Greece and France the sample size is higher than 10 interviews, and in Spain and Portugal this fleet was not interviewed. In France all the fleet uses one or more mitigation measures being night-setting, extra weights on longline and discard/offal management were very common. In Greece mitigation measures are not used to avoid seabird bycatch, but seasonal changes, changes in bait morphology and man-made bait are used to avoid marine turtle, shark and ray bycatch. In Malta even with a low sample size it seems the use of mitigation measures to avoid seabird bycatch is very common, mainly throwing bait to distract birds and the use of bird-scaring buoys.

Set longlines

In the set longline fleet 20 mitigation measures to avoid seabird bycatch have been identified. It is the higher number of mitigation measures across fishing gears and it is the fleet with the higher percentage of use of mitigation measures across countries and gears (Table 38).

Table 38. Bycatch mitigation measures used in the set longline fleet by country.

Mitigation measure category	Mitigation measure	France	Greece	Malta	Spain	Portugal
Avoid attraction	Changed bait morphology		x	n/a		
	Changed bait species		x	n/a	x	
	Cover captures/bait			n/a	x	
	Discard/offal management	x	x	n/a		
	Hooks baited in advance			n/a	x	
Change fishing	Avoid area/changing area			n/a	x	
	Seasonal changes		x	n/a		
Change fishing technique/behaviour	Night - setting (avoid setting at dawn and/or dusk)	x	x	n/a	x	x
	Placement of extra weights on LL	x	x	n/a	x	
	Short settings			n/a	x	
	Slow setting			n/a	x	
	Stop setting if birds present			n/a	x	
	Stop setting LL if birds caught, and release it to avoid more			n/a	x	
Distract birds	Distract birds - Spill oil drops in the sea			n/a	x	
	Distract birds - throw bait	x		n/a	x	
Scare noise	Noise generation	x	x	n/a	x	
Scare visually	Bird-scaring - Buoys	x	x	n/a	x	
	Bird-scaring - Kites			n/a	x	
	Bird-scaring lines			n/a	x	
	Dead bird to scare			n/a	x	

Fishers use measures from several categories: measures to avoid attraction, to change their fishing areas/seasons, to change their fishing techniques or behaviours, to distract birds, to scare with noise or visually, showing that seabird bycatch is a common problem in set longlines. The mitigation measures used most across countries by order of use are night-setting, placement of extra weights on the longline, use of bird-scaring buoys, discard/offal management and noise generation.

In France all the fleet uses one or more mitigation measures being night-setting, placement of extra weights on the longline and while discard/offal management is also very common. In Greece, around one third (28,3%) of the fleet uses mitigation

measures, mainly night-setting, placement of extra weights on the longline and bird-scaring buoys being the most common measures used. In Malta, this fleet was not interviewed, although in some interviews longline type was not identified and it is possible that a few were set longlines, however it was not possible to analyse the data. In Spain, 68,6% of the fleet use a large set of 17 mitigation measures, mainly bird-scaring buoys, bird-scaring lines, night-setting, placement of extra weights on the longline being the most common ones. In Portugal, only one fisher reported to use night-setting as mitigation measure for seabirds, but 95% of fishers reported not bycatch of seabirds.

5. Conclusion

France

France has a significant fishing industry spread across its entire coastline. In 2021, the Provence-Alpes-Côte d'Azur (PACA) region on the Mediterranean coast, where the PanPuffinus! project takes place, counted more than 500 fishing vessels, primarily polyvalent (trammel nets, gillnets, set longlines, and drift longlines), with a length of less than 12 meters. This region is also home to the majority of the French yelkouan shearwater population and a part of the Scopoli's shearwater population.

Bycatch rates are notably higher for nets (gillnets and trammel nets) and set longlines when considering the number of fishers who have accidentally caught a seabird during their careers. However, seabird bycatch events, particularly involving shearwaters, seem to be rare in the PACA region, with generally rates of less than one individual per year. While cormorants and gulls are the most commonly bycaught species, shearwaters have only been reported as bycaught by drift longlines. Bycatch rates also vary between subregions, with more frequent incidents near Martigues and the Camargue than in other parts of PACA.

These results may be attributed to good practices already voluntarily or unintentionally implemented by fishers, particularly in the management of discards and night setting. While many fishers adopt these practices as part of their fishing activities, they are not specifically aimed at reducing seabird bycatch, as these events are infrequent. Despite the low occurrence of seabird bycatch, some significant events involving the bycatch of multiple individuals during a single fishing operation could still occur. Simple mitigation measures, as tested in the PanPuffinus! project, could be easily adopted by fishers to prevent such incidents, benefiting both shearwaters and other seabird species.

LPO continued interviewing fishers in 2024, beyond the timeframe for this report and collecting an additional 62 questionnaires not included in this analysis. This work will continue in 2025 with to better represent the heterogeneity of the fisheries in PACA region, especially in the Martigues quartier maritime where seabirds bycatch seems

to be more frequent than in the Toulon quartier maritime where most of the interviews used for this analysis were realized.

Greece

Greece holds the largest fishing fleet in the Mediterranean, 93% of its vessels being coastal and small-scale, of less than 12 m (>11,500 vessels). In addition the country has an extended mainland and insular coastline with more than 500 fishing ports, 332 of which are officially registered. SSF vessels in Greece mainly operate nets (trammel-nets and gillnets) as well as longlines, targeting a variety of target species, depending on area, season and market demand. In addition, fishers often alternate between gears seasonally or even daily, and often also deploy different gears within the same day. Thus, monitoring of the SSF sector activity is very complex and challenging. Within the current project, results were greatly enhanced by the fortunate availability and provision of a large dataset (>900 questionnaires) from the InCA project: 2020-22 (Pardalou et al., 2021; Tsikliras et al., 2022) which allowed much greater coverage of sites and gears.

Fishing hotspots include many SPA areas which are important foraging grounds for most seabirds: coastal species like the European shag and the Audouin's gull and also pelagics such as the Yelkouan and Scopoli's shearwaters. More than 32-36% of the global breeding population of the YS breeds in Greek SPAs, and 90% of this breeds in the Greek projects sites.

Fisher interviews in Greece reported lower seabird bycatch than any other country in the project's target area. Low seabird bycatch is also reported in the National DCF programme. This is unexpected, since seabird bycatch has been previously reported as significant for certain species and seasons through questionnaires in the LIFE07/NAT/GR/000285 project and via on-boards and fisher direct communication during the current LIFE PanPuffinus! project. It seems that Greek fishers are hesitant to report bycatch, but also do not consider seabird bycatch as something important and of interest to report, while often DCF observers and fishers do not have seabird identification skills. HOS continued interviewing fishers in 2024 and will continue also in 2025 in order to check for changes in fisher reporting after the implementation of the project, especially in sites where HOS presence has been more continuous.

Nevertheless, data collected and analysed to-date confirmed that seabird bycatch was mainly recorded in set longlines (67%), drifting longlines (11%) and trammel nets (5%) and gillnets affecting especially the European shag (trammel nets and gillnets), Yelkouan shearwaters (trammel nets) and Yelkouan and Scopoli's shearwaters (set longlines). Most seabird bycatch in nets occurs when the gear is in the water, while in set longlines, bycatch takes place mainly during setting.

Seabird bycatch is currently being monitored by HOS through on-boards in Kalloni Gulf, Lesvos, where 15-30,000 YS individuals forage on anchovies on a daily basis from February till April. Bycatch seems to be significant, with most individuals being captured in mass events in trammel nets during the day, while the gear is in the water. Tagging of foraging YS individuals is also implemented in order to locate the overlap of foraging grounds with fishing activities. Thus trammel nets and set longlines are considered those gears causing most seabird bycatch in Greece and this is why these gears were selected as the focus of mitigation measures trials. In addition, set longlines are also being monitored for seabird bycatch in several project SPA sites.

The current analysis showed that most seabird mitigation measures in Greece are used in set longlines (28.3%), while only 7.7% of vessels fishing with trammel nets and 12% with gillnets use seabird mitigation measures. HOS has identified a significant bycatch hotspot in Kalloni Gulf, Lesvos, in trammel nets, which went undetected through the fisher questionnaire process. In order to address the issue, HOS is implementing systematic mitigation monitoring on-board trials using contrast panels. Since seabird bycatch does not significantly affect the fishing process and catch but also does not damage the fishing gear, not many mitigation measures have been adopted by fishers on their own accord. On the contrary, mitigation measures have been well-developed in set longlines since seabird bycatch decreases the catch and seriously affects the fishing process. Nonetheless, Scary bird devices are being trialled by HOS in 3 SPA sites so as to test for their effectiveness and demonstrate their simplicity to fishers.

Malta

Malta's fishing industry is predominantly small-scale, with 93% of vessels under 12 m in length. The fleet uses mainly hooks and lines (53%), followed by gillnets and entangling nets (32%). The fishery is characterized by a multi-species, multi-gear approach, with fishers switching between gears depending on the season, target species, and market demand. Fishing hotspots includes SPA areas such as Żona fil-Baħar fit-Tramuntana, Il-Baħar ta' Madwar Għawdex, Żona fil-Baħar tal-Grigal, Żona fil-Baħar fil-Lvant and Żona fil-Baħar fil-Lbiċ, which also coincide with foraging and habitats for Yelkouan shearwater. Despite the small scale of the fishing sector, the geographic and temporal overlap between fishing effort and seabird hotspots highlight the importance of monitoring and managing bycatch risks in these waters.

Yelkouan shearwaters are at risk of bycatch as they occur in areas which overlap with fishing activities. Preliminary results published in 2008 study, indicated that Yelkouan shearwater bycatch is mainly associated with bottom longlines. However, recent seabird bycatch data are limited, and the scale of the problem remains poorly quantified. The recent data collected reveals that the scale of Scopoli's shearwater bycatch by drifting longlines is higher than previously understood, exceeding the estimates reported in the 2008 study. Furthermore, the questionnaire survey and informal discussions with trammel net fishers reported no seabird bycatch, leading BirdLife Malta to focus on hook-based fisheries, where bycatch risks seem higher. Ongoing efforts to gather more comprehensive data through surveys and monitoring programs are essential to better understand the scale of the issue. BirdLife Malta continued interviewing fishers beyond the timeframe for this report. In the following years (2023-2024), an additional 62 questionnaires were carried out and were not included in this analysis. Moreover, continuous logbook data collection during the LIFE PanPuffinus! project period appears to have improved data on seabird bycatch.

Currently, mitigation measures implemented on fishing vessels are minimal. In some cases, fishers have adopted different mitigation measures particularly in drifting longline fisheries, such as "Bird-scaring – Buoys", and "throwing bait to distract birds". As part of LIFE PanPuffinus! project, efforts to address bycatch have included pilot studies testing mitigation methods such as the "Bird-scaring - Kites ". Further

testing is required to understand the effectiveness of measures, and currently, the adoption of mitigation practices is not uniform across the fleet.

Spain

Spain has an important fishing sector in the study area in the Mediterranean coast (Balearic Islands, Catalonia, Valencia community and Murcia) consisting in more than 2000 fishing vessels operating, and around 60% of them are small-scale fleet of polyvalent vessels. In the Balearic Islands breed all the global population of the Balearic shearwater, and in the Catalonia and Valencia community feed the majority of it during breeding season, overlapping with fishing areas.

The analysis done in LIFE PanPuffinus! project of questionnaires done in 2018-2019 during the previous ZEPAMED project and the fisheries data collected from different sources allowed to estimate fishing effort across various fishing gears operating in the region. The effort was focused on set longlines and set nets (gillnets and trammel nets), the gear types with more previous evidence of seabird bycatch. The data collected confirmed that set longlines have the higher level of seabird bycatch, affecting especially shearwaters (*Puffinus* species and Scopoli's shearwater). The fact that more than 40% are captured alive means that study of post release survival and training to handle captures is necessary. Gillnets, trammel nets and purse seiners showed a lower level of shearwater bycatch of *Puffinus* species, but some attention should be put on them to confirm that do not suppose a threat for Balearic shearwater. Besides, bycatch level of cormorants in gillnets and trammel nets could suppose a threat for the European shag that several projects have studied in the past years.

The implementation of mitigation measures in set longlines, the most threatening gear for *Puffinus* species, is high, but the effectivity of the measures already applied by fishers should be proven and the C1 action should focus the effort on testing measures in this gear and propose the most effective measures for the mitigation toolkit. Despite the high level of cormorant bycatch, mitigation measures implementation in gillnets and trammel nest is very low and other projects should focus on finding effective measures to reduce it.

Portugal

Portugal has an important fishing sector, both economically and socially, supporting numerous fishing communities. Around 80% of the fleet consists of small-scale fishing vessels, mainly polyvalent boats licensed to operate different fishing gears. The project's intervention area, the Aveiro-Nazaré SPA, includes three important fishing ports and hosts a significant percentage of the global population of the Balearic shearwater.

Through the LIFE PanPuffinus! project, it was possible to estimate fishing effort across various fishing gears operating within the SPA. The primary observation effort focused on gears with previously documented evidence of bycatch, namely gillnets, trammel nets, and purse seines. Data collected from questionnaires conducted between 2021 and 2022 support this assumption, showing lower levels of seabird bycatch in trawl and longline fisheries. For these gears, the most critical period appears to be autumn-winter, and the most frequently reported species include gulls and gannets. It may be worthwhile to explore these fishing gears in future projects to better understand the conditions in which bycatch occurs and the factors influencing bycatch.

For purse seines and gillnets (including both gillnets and trammel nets), bycatch levels are more significant. In the case of purse seines, autumn seems to be the peak season for bycatch, which coincides with the peak passage of the Balearic shearwater in the region. Gillnets and trammel nets are the most concerning, affecting various species, including gulls, gannets, auks, shearwaters, and common scoters. Captured individuals are found already dead.

Despite the concerning bycatch levels reported by fishers, there is no indication of significant use of mitigation measures. It is therefore crucial to focus on testing mitigation measures for gillnets and purse seines as part of action C1, as well as to invest on disseminating existing measures and demonstrating their effectiveness and ease of use.

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