

COMMON SCHEME FOR THE MANAGEMENT OF FISHERY ACTIVITIES AT LOCAL LEVEL IN THE NORTHERN ADRIATIC REGIONS

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(Protocol on fishery and fish related data collection at local level)

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Abstract (English version)

The project ARGOS (ShARed GOVERNance of Sustainable fisheries and aquaculture activities as leverage to protect marine resources in the Adriatic Sea) is financed by the Italy-Croatia cross-border cooperation programme Interreg V-A 2014-2020, whose main goal is to pursue a sustainable common management of the fisheries resources.

The fisheries field in the Northern Adriatic Sea, during the last years, has encountered deep modifications to the conditions of the sea and of the fisheries' resources, induced by climate change. For instance, the increasing sea temperatures and the lack of raining brought to marked modifications in the marine habitats. Consequently, these facts resulted in a progressive decreasing of the typical species caught, whereas an increase in alien species has occurred, as jellyfish and ctenophores, which have complicated the daily fishing activities.

The project aims to provide the fishing sector with the possibility to receive the adequate instruments needed to understand the ongoing trends, to be able to adapt to them, with the purpose to protect the sea ecosystems, increase biodiversity, fish resources and increase also the value of the fish product.

In detail, the project, of which Friuli Venezia Giulia Autonomous Region is lead partner, intends to pursue the following aims:

- to promote an integrated approach for the management of the fish resources, common among the Regions faced on the Adriatic Sea, to protect the environment through multilevel actions (institutional, productive and technical-scientific);
- to improve the sea water quality, also by reducing the pressure of fishing and aquaculture activities;
- to drive the fishing and aquaculture activities to be more sustainable, not only from an environmental point of view, but also from economic and social sides.

ERSA FVG has been involved in the ARGOS project within the Work Package 4 (WP4) on the "Knowledge-based decision making process", with particular regard to the activity 4.2 whose aim has been to realize a "Common Scheme for the management of fishery activities at local level". As stated in the agreement ERS-2022-3893-P between Friuli Venezia Giulia Autonomous Region and ERS FVG signed on 15th March 2022, the Agricultural statistics and coordination of the rural activities service (SSR) of ERS FVG has operated for professional fishing data collection and analysis, with specific focus on the small-scale fisheries in the marine areas of Friuli Venezia Giulia and Veneto.

Fisheries are an important sector in the agri-food economy of both regions. ERS FVG, referring to its previous experience with the local operators of the fishing sector in Friuli

Venezia Giulia region, with the support of the Hunting and Fish Resources of Friuli Venezia Giulia Autonomous Region and thanks to the technical support of AGRITECO in Veneto region, has involved cooperatives, small-scale fisheries' consortiums and fishermen to run surveys. The collected information has enabled ERSA FVG to describe the updated situation of the small-scale fisheries sector in the Northern Adriatic.

The data collected regarded the species and the relative amounts caught during 2021, together with technical data of the boats examined. The on-board personnel (numbers of personnel, age, gender, study level, etc.), the costs of the activity management (costs of personnel on-board, fuel, reparations, etc.), the income (generated by the fishing activity and activities connected with tourism, i.e. fishing tourism) and possible aids were included in the survey. Furthermore, the ongoing biologic and ecological dynamics, regarding the effects of the climate change on the sea environment, the blooming of alien species, pollution and the decrease of nutrients available in the sea, were investigated during the surveys.

The data collection activity for the ARGOS project has involved 80 small-scale fishing vessels in Friuli Venezia Giulia region. In detail, 45 boats in the marine area of Marano Lagunare, 21 in the marine area of Grado, 5 in the marine area of Monfalcone and 10 in the Gulf of Trieste. Further 80 boats were investigated in Veneto region, in the marine areas of Caorle (21 boats), Venice (10), Chioggia (27) and Porto Tolle, Porto Levante and Scardovari (22), for a total amount of 160 boats within the two regions.

The main results raised from the survey confirmed the difficulties faced by the fishing sector in the last years, caused by the reduction of the species commonly caught, and the wide spread of alien species that stops the normal fishing activities.

The abundant presence of jellyfish (barrel jellyfish, *Rhizostoma pulmo*) during the spring-summer times and of ctenophores (sea walnut, *Mnemiopsis leidyi*) in the summer-autumn period of the year negatively affects the possibility for fishermen to sale and have remunerative fishings.

The barrel jellyfishes, for their jelly consistency – 98% made of water, cause damages to the fishing nets, because of their heavy weight due to their high number. Moreover, these organisms complicate the fish sorting activity and the fishermen risk to get in contact with the stinging substances secreted by this species.

The sea walnut is a non-indigenous (alien) species in the Adriatic Sea and is a voracious predator of zooplankton, eggs and larva of small fishes – in particular anchovies, and therefore can modify the equilibrium of the marine ecosystem. Ctenophores show a fast reproductive cycle and due to their mucilaginous nature, when they develop wide populations, they clog the nets and therefore stop the fishing of small size fishes, as sand melts.

The increase in the number of these alien species in the Northern Adriatic Sea is supposed to be connected with the progressive increase in the sea temperature, which has created favouring conditions for their reproduction. In addition, the presence of alien species that feed of plankton and small species created competition in the food chain. Therefore, fishes do not find any more adequate nutrition to reproduce and fishermen reported about a continuous decreasing of the common caught species.

The lack of raining is another environmental issue concerning the decrease of the nutrient levels available in the sea. The recent dry periods have abundantly reduced the normal rivers' flow, reducing the load of water in the lagoon and in the sea. This phenomenon has caused a reduction in water turnover and oxygenation. The shift of the saline wedge towards the rivers, due to the lack of freshwater, has affected the ecosystem of the lagoon and the sea, where an increase in salinity was registered.

The small-fisheries activities are run mostly individually by fishermen. Nevertheless, several cases of grouping within cooperatives and consortiums were recorded. The fishermen's average age in the marine areas of Friuli Venezia Giulia and Veneto ranges between 32 and 70 years old. The main range is between 45 and 55 years old. A general worry regarding the generational turnover has risen from the direct experience of fishermen, as fishing is a demanding activity, in terms of time invested and physical effort, compared to its income. The emerging environmental issues described risk to lower further the fishermen's profits.

The main costs regarding fishing activity are fuel, ship maintenance and nets purchase or repair. Nowadays, the fishing sector is facing the difficulties due to the general increase of the energy costs and inflation.

The fishing activity appears to be the only income source for the interviewed fishermen. They consider fishing tourism a potential valid alternative to income improvement. However, the high regulation does not allow them to practice it on their small boats.

Tourism connected to fisheries could develop in social implications, as people may experience directly the fishing activity and lifestyle. The interviewed fishermen wish a simplification of the regulations in order to be able to activate also this type of activities.

Despite the fast and intense changes that the small-fishing sector is facing, this way of fishing is sustainable as it is run through small size boats with low power engines, which have a reduced impact on the environment. Moreover, the use of fishing post gears, which are selective for target species, reduces the accidental fishing of non-interest species. This type of fishing, therefore, offers also to fishermen the possibility to specialize in the fishing of specific target species. The amounts of fishes harvested, moreover, are lower compared to other fishing activities, thus reducing the exploitation of the fishing stocks and preserving marine biodiversity.

Concerning environment, the small-fishing sector plays a central role also in the protection of the sea from plastic pollution. The fishermen are highly sensitive to this issue and pay attention to the management of plastics in terms of environmental protection.

Plastic management coming from the sea has been recently the topic of the project Fishing for future, financed by the European Maritime, Fisheries and Aquaculture Fund (EMFAF) 2014-2020 of Regione Veneto, with the aim of protecting and restoring biodiversity and marine ecosystem through the collection of the marine garbage by the fishermen during their daily fishing activity. Fishermen's participation at the project provided useful data for future planning in terms of environmental waste management. Meanwhile, fishermen were enabled to remove wastes from the sea and to dispose them properly, without incurring in fines or additional costs.

A positive aspect emerged from the survey. The coastal areas of Friuli Venezia Giulia and Veneto, where small-fishing activity is performed, are now cleaner from plastic waste compared to the past. Fishermen believe that a transition to eco-sustainable and eco-friendly materials is positive.

The ARGOS project, through the direct interview of fishermen, allowed the assessment of the current condition of the small-scale fishing sector in Friuli Venezia Giulia and Veneto, through the direct experience of fishermen, cooperatives, consortiums and trade associations. The fishermen involved wish a higher involvement in the activities related to preservation of the future of the small-fishing sector.

Abstract (Italian version)

Il progetto ARGOS (ShARed GOVERNance of Sustainable fisheries and aquaculture activities as leverage to protect marine resources in the Adriatic Sea) finanziato dal Programma di cooperazione transfrontaliera Interreg V-A Italia-Croazia 2014-2020, ha come obiettivo generale quello di perseguire una gestione sostenibile condivisa delle risorse ittiche.

Il settore della pesca nell'Alto Adriatico, negli ultimi anni, ha assistito a profondi mutamenti nelle condizioni del mare e delle risorse ittiche indotti dal cambiamento climatico. Ad esempio, l'innalzamento della temperatura dei mari e la riduzione delle piogge hanno comportato una modifica importante nell'habitat marino. Ne è conseguita una progressiva diminuzione delle specie tipicamente pescate, a fronte di un aumento di specie invasive, quali meduse e ctenofori, che hanno reso complicata la normale attività di pesca.

Attraverso il progetto si intende, quindi, dare agli operatori del settore gli strumenti necessari per comprendere le dinamiche in atto, per potersi adattare ad esse, al fine di tutelare l'ambiente marino, incrementare la biodiversità e le risorse ittiche, nonché per valorizzare i prodotti ittici.

Nello specifico, il progetto, di cui la Regione Friuli Venezia Giulia è lead partner, intende perseguire i seguenti obiettivi:

- *promuovere un approccio integrato per la gestione delle risorse ittiche e comune tra le Regioni che si affacciano sul Mar Adriatico, volto a tutelare l'ambiente attraverso azioni multilivello (istituzionale, produttivo e tecnico-scientifico);*
- *migliorare la qualità delle acque marine, anche riducendo la pressione delle attività di pesca e di acquacoltura sull'ambiente;*
- *rendere le attività di pesca e dell'acquacoltura maggiormente sostenibili non solo dal punto di vista ambientale, ma anche economico e sociale.*

ERSA FVG è stata coinvolta nel progetto ARGOS nell'ambito del Work Package 4 (WP4) sul "Processo decisionale basato sulla conoscenza", con particolare riguardo all'attività 4.2 in merito alla realizzazione di uno "Schema comune per la gestione delle attività di pesca a livello locale". Come da convenzione ERS-2022-3893-P tra la Regione Autonoma Friuli Venezia Giulia ed ERS FVG siglata in data 15 marzo 2022, il Servizio statistica agraria e coordinamento delle attività nel settore rurale (SSR) di ERS FVG ha operato per la raccolta e l'elaborazione dei dati attinenti alla pesca professionale, con specifico riguardo alla piccola pesca artigianale, presso le marinerie del Friuli Venezia Giulia e del Veneto.

Il comparto ittico costituisce un importante settore dell'economia agroalimentare in entrambe le regioni. ERS FVG, facendo riferimento alla pregressa esperienza con gli operatori del

settore ittico per quanto riguarda la Regione Autonoma Friuli Venezia Giulia, con il supporto del Servizio caccia e risorse ittiche della Regione Autonoma Friuli Venezia Giulia, e con il supporto tecnico di AGRITECO per la Regione Veneto, ha coinvolto le cooperative, i consorzi di piccola pesca e i pescatori per condurre un'indagine volta a riportare una fotografia aggiornata del settore piccola pesca artigianale nell'Alto Adriatico.

I dati raccolti hanno riguardato le specie e i relativi quantitativi pescati durante il 2021, oltre a dati tecnici relativi alle imbarcazioni in esame, al personale di bordo (numero di operatori, età, genere, livello di studio, ecc.), ai costi dell'attività (spese per personale di bordo, carburante, manutenzione, ecc.), al reddito (attività di pesca, pescaturismo o ittiturismo) e a possibili sovvenzioni. Nell'analisi, inoltre, sono state investigate le attuali dinamiche biologiche ed ecologiche citate: l'effetto dei cambiamenti climatici sull'ambiente marino, la massiccia presenza di specie aliene, l'inquinamento, la riduzione dei nutrienti disponibili presenti nei mari.

L'attività di raccolta dati per il progetto ARGOS ha coinvolto 80 imbarcazioni di piccola pesca artigianale in Friuli Venezia Giulia, e più precisamente nelle marinerie di Marano Lagunare (45 imbarcazioni), Grado (21), Monfalcone (5) e Trieste (10) e 80 imbarcazioni nel Veneto, nelle marinerie di Caorle (21), Venezia (10), Chioggia (27), Porto Tolle, Porto Levante e Scardovari nell'area del delta del Po (22), per un campione complessivo di 160 imbarcazioni tra le due regioni.

I principali risultati emersi dall'indagine confermano le difficoltà che il settore sta attraversando da alcuni anni, a causa della ridotta presenza di specie ittiche abitualmente pescate, e la grande diffusione di specie invasive che ostacolano l'abituale attività di pesca.

*La presenza massiva di meduse (polmone di mare, *Rhizostoma pulmo*) durante il periodo primaverile-estivo e di ctenofori (o noci di mare, *Mnemiopsis leidyi*) nel periodo estivo-autunnale, grava sulla possibilità per i pescatori di uscire in mare ed avere una pesca proficua. I polmoni di mare, per la loro consistenza gelatinosa – composta per il 98% di acqua, sono causa di danneggiamenti alle reti da pesca, per via del loro eccessivo peso poiché presenti in elevato numero. Questi organismi, inoltre, rendono difficoltosa la cernita del pescato, con il rischio per gli stessi operatori di entrare in contatto con le sostanze urticanti presenti in questa specie.*

La noce di mare è una specie non indigena (aliena) nel Mar Adriatico ed è un vorace predatore di zooplancton, uova e piccole larve di pesci, in particolare le acciughe, e può quindi modificare l'equilibrio dell'ecosistema marino. Gli ctenofori si riproducono velocemente e per la loro natura mucillaginosa, quando presenti in grandi popolazioni, intasano le reti rendendo di fatto impossibile la pesca di specie ittiche di piccole dimensioni, come ad esempio i latterini.

Si ritiene che l'aumento di queste specie aliene nei mari dell'Alto Adriatico sia legato al progressivo aumento della temperatura dei mari che ha creato le condizioni ideali per la loro riproduzione. La presenza di specie aliene che si alimentano di plancton e piccoli pesci ha creato, inoltre, una competizione nella catena alimentare, per cui i pesci non trovano più l'adeguato nutrimento per riprodursi, e di fatto gli stessi pescatori hanno testimoniato la progressiva diminuzione delle specie abitualmente pescate.

Altro fattore ambientale considerato tra le cause dell'impoverimento del livello dei nutrienti disponibili in mare è la carenza di piogge. I recenti periodi di prolungata siccità hanno ridotto notevolmente la normale portata dei fiumi, riducendo l'apporto di acque in laguna e in mare, fenomeno che ha sfavorito il ricambio delle acque stesse e la loro ossigenazione. Lo spostamento del cuneo salino verso i fiumi per assenza di acque dolci ha comportato anche un effetto sull'ecosistema della laguna e dei fiumi stessi, dove la salinità è aumentata.

L'attività di piccola pesca è risultata essere condotta prevalentemente in maniera individuale dai pescatori, sebbene esistano molteplici situazioni di raggruppamento all'interno di cooperative e consorzi. L'età media dei pescatori nelle marinerie del Friuli Venezia Giulia e del Veneto è compresa tra 32 e i 70 anni, con una fascia prevalente variabile tra 45 e 55 anni. Dalle testimonianze dirette dei pescatori è emersa una diffusa preoccupazione per quanto riguarda il ricambio generazionale, essendo un tipo di attività molto impegnativo, in termini di orari e sforzo fisico, e poco remunerativo, a cui si aggiungono le emergenti problematiche ambientali sopra indicate che rischiano di ridurre ulteriormente il margine di guadagno dei pescatori.

I costi prevalenti che i pescatori si ritrovano a sostenere sono: il costo del carburante, la manutenzione delle barche e l'acquisto o la riparazione delle reti. Come tutti i settori produttivi, quindi, anche il comparto ittico sta fronteggiando gli attuali aumenti legati all'aumento del costo dell'energia e dell'inflazione.

L'attività di pesca appare essere l'unica fonte di reddito per i pescatori intervistati, i quali, sebbene abbiano visto nel pescaturismo e ittiturismo potenziali valide alternative per l'integrazione del reddito, non lo ritengono praticabile per l'eccessiva regolamentazione che non sempre può essere realizzata a bordo delle piccole imbarcazioni di cui dispongono. L'attività turistica legata al mondo della pesca potrebbe contribuire anche ad un risvolto sociale, per cui le persone possono avvicinarsi al mondo della pesca facendone direttamente esperienza. I pescatori intervistati auspicano che ci possano essere delle semplificazioni per la realizzazione anche di questo tipo di attività.

Nonostante i repentini e intensi cambiamenti che il settore della piccola pesca deve affrontare, questa tipologia di pesca è considerata un'attività sostenibile, in quanto viene condotta con imbarcazioni di piccola dimensione e motori a bassa potenza che hanno un ridotto impatto sull'ambiente. Inoltre, grazie all'utilizzo di attrezzi da posta, che hanno il vantaggio di poter essere selettivi per il tipo di specie ittica pescata, viene ridotta la pesca accidentale di specie

non di interesse. Questo tipo di attività offre quindi anche la possibilità ai pescatori di specializzarsi nella raccolta di particolari specie. I quantitativi di pesce pescato, inoltre, sono più contenuti rispetto ad altri tipi di pesca, fattore che riduce lo sfruttamento degli stock ittici preservando la biodiversità del mare.

Dal punto di vista ambientale, il settore della piccola pesca è risultato giocare un ruolo centrale anche per quanto riguarda la tutela del mare dall'inquinamento da plastica. I pescatori stessi si sono dimostrati molto sensibili al tema, attenti anche alla problematica della gestione della plastica, in termini di protezione dell'ambiente.

Il tema della gestione dei rifiuti provenienti dal mare è stato anche recentemente al centro del progetto Fishing for future, progetto finanziato dal Fondo Europeo per gli Affari Marittimi e la Pesca (FEAMP) 2014-2020 della Regione Veneto, con l'intento di proteggere e ripristinare la biodiversità e l'ecosistema marino attraverso la raccolta dei rifiuti presenti in mare da parte dei pescatori durante la loro abituale attività di pesca. La partecipazione alle attività da parte degli operatori professionali ha condotto alla raccolta di dati utili per le programmazioni future in tema di gestione dei rifiuti ambientali e allo stesso tempo ha permesso ai pescatori di portare a terra e smaltire correttamente i rifiuti senza conseguenze, quali multe o costi aggiuntivi.

Dall'esperienza diretta dei pescatori è emersa una nota positiva, legata al fatto che i mari, nelle zone interessate dalla piccola pesca in Friuli Venezia Giulia e Veneto, risultano ora più puliti rispetto ad alcuni anni fa. I pescatori ritengono positiva una transizione a materiali ecosostenibili e rispettosi dell'ambiente.

Il progetto ARGOS, attraverso l'indagine condotta con gli operatori del settore, ha permesso di fornire una valutazione della condizione attuale del settore della piccola pesca in Friuli Venezia Giulia e in Veneto, attraverso la diretta esperienza sul campo di pescatori, cooperative di pescatori, consorzi di piccola pesca e associazioni di categoria. Gli stessi pescatori auspicano un maggior coinvolgimento per poter preservare il futuro della piccola pesca artigianale.

1. THE SMALL-SCALE FISHING SECTOR

In the Northern Adriatic regions, beside the professional or industrial fishing, a flourishing small-scale coastal fishing is carried out both in the sea and in the lagoon with appropriate fishing gears [1]. The small-scale fishery in the European Union (EU) is at the center of attention of the Common Fisheries Policy and finds particular consideration in the new EMFAF which reserves measures for the development of sustainability for small-scale coastal fishing [2].

“Small-scale fishery” or “artisanal small-scale fishery” is defined as the fishing practiced by vessels with an overall length (LOA) of less than 12 meters not using towed gears [3]. Small-scale artisanal coastal fishing, by convention, is also defined as an activity “carried out by boats with a LOA less than 12 meters, with tackle gear, ferret, longlines, lines and harpoons, operating within 12 miles from the coast, as well as with other systems that are locally used in the coastal sea areas” [1].

The artisanal fishing is therefore carried out along the coasts with small boats and with a small crew, generally one or two people. The activity takes place mainly during the day, as the fishermen sail during the night, or early in the morning, and return back during the day. Traditional fishing gears (gill nets, pots, traps, hooks, lines, etc.) are used and the choice depends on the target species [4, 5]. In sea fishing, in some cases, electronic instruments (such as sonar, echo sounder and positioning instruments, such as radar and GPS global positioning systems) can also be used, which make fishing safer and more effective [4, 5].

Gill nets are among the most common tools, which are left into the sea: fishes, molluscs and crustaceans that end up in the nets remain trapped there until they are recovered.

The pots and the traps are small cages that are lowered to the seabed. The capture takes place without the intervention of the fisherman, since the prey, generally encouraged by bait, enters the cages and remains trapped inside them.

Hooks and lines consist of one or more units tied to a cable and a lead. The use of these tools requires the active intervention of the fisherman: the lines, in fact, are lowered and kept under continuous control by the fishermen for the recovery of the catch [5].

The various systems and fishing gears are periodically removed to carry out the necessary cleaning and maintenance operations [4].

The artisanal fishing is a profession that takes place throughout the year. For vessels with a size of less than 10 meters, indeed, there is no obligation of fishing ban.

In periods when fishing is less intense, fishermen engage in secondary activities, such as nets and boats' maintenance [4].

1.1 Friuli Venezia Giulia

Fish production in Friuli Venezia Giulia consists of sea fishing (of fish, molluscs and crustaceans) conducted in the waters of the main maritime areas (Marano Lagunare, Grado, Monfalcone and Trieste) and a preponderant part that derives from aquaculture.

The sea-fishing sector was characterized in 2021 by 251 active companies, where the prevailing legal form was found to be the sole proprietorship (90%). In 2021, the number of sole proprietorships active in Friuli Venezia Giulia (228 companies) decreased by -1.3% compared to the previous year, while partnerships increased (78 companies, +1.3%). Joint-stock companies (17) and other forms of business (13) remained stable [6].

The small-scale fishing sector is included in the above-mentioned context and is widely spread in all the marine areas of the region. The regional maritime fleet in 2021 was made of 343 vessels, of which the 69.4% were small boats with a length of less than 12 meters, a sign of a prevailing artisanal fishing along the coasts. The remaining part was made up of boats with greater length, to which belong, for example, boats with bottom trawl nets operating in the open sea, dredges and purse seine [7].

Table 1: technical characteristics of the fleet in the maritime areas of Friuli Venezia Giulia in 2021

Maritime areas	Number of small-scale fishery vessels	Percentage of small-scale fishery vessel compared to the whole fleet (%)	Overall length (m)	Overall tonnage (GT)	Overall engine power (kW)	Average age (years)
Marano Lagunare	121	69,9%	878	172	5,909	40
Grado	66	76,7%	457	124	2,168	36
Trieste	29	59,2%	211	67	994	47
Monfalcone	22	62,9%	163	47	1,034	39
Total	238	69,4%	1,709	410	10,105	40

Source: data extracted from the EU Fleet register and processed by ERSA FVG [7]

The maritime areas of Marano Lagunare and Grado are the main ones in terms of size and fleet. In 2021, Marano Lagunare's fleet counted 173 vessels registered in the EU Fleet register

[7], of which 121 of small-scale fishery. Grado's fleet counted 86 total vessels, of which 76.7% of small-scale fishery. In the marine areas of Trieste and Monfalcone, 29 and 22 small-scale fishing boats were registered in 2021, respectively, compared to a fleet composed of 49 and 35 total boats in their respective marine areas (Table 1). The technical parameters measured in the individual marine areas are proportional to the number of registered boats. It is evident the oldness of the small-scale fishing vessels, as the average age at regional level is of 40 years; the oldest vessels are found in the Trieste fleet, where the average age rises to 47 years (Table 1).

The main gear used in Friuli Venezia Giulia's marine areas appear to be trammel nets (49.6%), followed by traps and pots (18.8%), set gill nets (anchored, 16.2%) and fyke nets (15.4%) [7].

1.2 Veneto

The coastal areas of Veneto region are divided into the maritime areas of Caorle, Venezia, Chioggia and extend to area of the Po River (Porto Tolle, Porto Levante e Scardovari).

Table 2: technical characteristics of the fleet in the maritime areas of Veneto in 2021

Maritime areas	Number of small-scale fishery vessels	Percentage of small-scale fishery vessel compared to the whole fleet (%)	Overall length (m)	Overall tonnage (GT)	Overall engine power (kW)	Average age (years)
Caorle	97	60,2%	654	152	2,159	1994
Venice	26	26,2%	195	54	781	1982
Chioggia	46	20,7%	362	115	1,919	1990
Po River area	101	62,3%	640	133	2,552	1976
Total	270	41,9%	1,851	454	7,411	1986

Source: data extracted from the Fleet register EU and processed by ERSA FVG [7]

The small-scale fishing sector in Veneto had a fleet of 644 vessels in 2021 [7]. Small-scale fishing is also widespread in Veneto in all the region's maritime areas, but in a different way than in Friuli Venezia Giulia. In Veneto, in fact, small-scale fishing is not the predominant form, as only 41.9% of the total fleet is engaged in this type of fishing, which is concentrated in the maritime areas of Caorle and the Po River (Table 2). The remaining fleet is made up of trawl

boats, the “volante”, which are engaged in offshore fishing, and the dredges, which are dedicated to harvesting clams and smooth clams.

The largest fleet in terms of fleet size is that of Chioggia with 222 total boats, of which only 20.7% fall under the classification of small-scale fishing. It is followed by the maritime area of Porto Tolle, Porto Levante and Scardovari with 162 total boats, of which 101 (62.3%) belong to small-scale fishery, and the maritime area of Caorle with 161 total boats of which 60.2% are of small-scale fishery. Finally, the Venice maritime area (which includes the Pellestrina area and the Venice and Burano areas) had 99 total boats in 2021, of which only 26.2% were of small-scale fishery [7]. The average age of Veneto's small-scale fishing vessels is 36 years, with the lowest average age recorded in the maritime areas of Caorle - 28 years, and the highest in the marine area of Porto Tolle, Porto Levante and Scardovari - 46 years (Table 2).

The main gear used in Venetian maritime areas appears to be set gill nets (42.1%), followed by trammel nets (26.8%), traps and pots (19.3%) and fyke nets (13.4%). Some hydraulic dredges, during the fishing ban, are used to apply for gillnet gear licenses. To operate in the gillnet fishery, the operator needs a permit, which is issued by the Harbour Master's Office [1].

The data reported on Veneto's small-scale fishing fleet can be traced to the definition of small-scale fishing, according to which it includes vessels less than 12 meters in length that operate with non-trolled gear. It should be pointed out here, however, that there are some vessels belonging to the Veneto fleet that, although they measure over 12 meters in length, operate exclusively with gill gears.

2. AIMS OF ARGOS PROJECT

The overall objective of ARGOS (ShARed GOVERNance of Sustainable fisheries and aquaculture activities as leverage to protect marine resources in the Adriatic Sea) project, funded by the Interreg V-A Italy-Croatia 2014-2020 cross-border cooperation program, is to pursue a shared sustainable management of fishery resources.

The fisheries sector in the Northern Adriatic Sea has witnessed profound changes in sea conditions and fishery resources in recent years induced by climate change. Rising sea temperatures, drought phenomena, reduction of nutrients in the food chain and increased presence of alien species have led to a major change in the marine habitat, with the occurrence of various problems for the fisheries sector.

Through the project, therefore, it is intended to give the fishing sector the opportunity to receive the necessary tools to understand the dynamics at work and to adapt to them, providing the sector's operators with the means to protect the marine environment, increase biodiversity and fishery resources, as well as to enhance the value of fish products.

Specifically, the project, of which the Friuli Venezia Giulia Region is lead partner, aims to promote an integrated approach for the management of fishery resources and common among the Regions bordering the Adriatic Sea, aimed at protecting the environment through multilevel actions (institutional, productive and technical-scientific); improving the quality of marine waters, also by reducing the pressure of fishing and aquaculture activities on the environment; and making fishing and aquaculture activities more sustainable not only from an environmental point of view, but also from an economic and social one.

ERSA FVG was involved in the ARGOS project under Work Package 4 (WP4) on 'Knowledge-based decision making' with particular regard to Activity 4.2 on the implementation of a "Common scheme for fisheries management at the local level'. According to the ERS-2022-3893-P agreement between the Friuli Venezia Giulia Autonomous Region and ERS FVG, signed on March 15, 2022, ERS FVG's SSR operated for the collection and processing of data concerning professional fishing, with specific regard to small-scale artisanal fishing, at the maritime areas of Friuli Venezia Giulia and Veneto.

ERSA FVG, referring to its previous experience with fishery operators, thanks to the support of the Hunting and Fishery Resources Service of the Autonomous Region of Friuli Venezia Giulia, and with the technical support of AGRITECO for the Veneto Region, involved fishery operators to conduct a survey aimed at reporting an updated snapshot of the small-scale artisanal fishery sector in the Northern Adriatic.

2.1 Data collection and analysis method

As stipulated in Annex A to the ERS-2022-3893-P agreement between the Friuli Venezia Giulia Autonomous Region and ERSA FVG, signed on March 15, 2022, the data collection activity involved a total sample of 160 boats divided between the Friuli Venezia Giulia region and the Veneto region. The data collection activity for the ARGOS project involved 80 vessels in Friuli Venezia Giulia, more specifically located in the maritime areas of Marano Lagunare (45 boats), Grado (21), Monfalcone (5) and Trieste (10). Data from other 80 vessels in the Veneto region were surveyed, divided as proportionally as possible to the various maritime areas in the coastal stretch: the maritime area of Caorle (21 boats), Venice (10), Chioggia (27), Porto Tolle, Porto Levante and Scardovari in the Po River area (22).

Data were collected through the administration of questionnaires (see Annex 1) standardized for all regions participating to the project. The data collected covered the species and related quantities caught by individual vessels in the various months of 2021. In addition, technical data related to the vessels under study, data related to the crew (number of operators, age, gender, level of education, etc.), costs of the activity (expenses for crew, fuel, maintenance, etc.), income (fishing activity, fishing tourism or ichthyic tourism) and possible subsidies (COVID-19 grants) were also examined. Current biological and ecological dynamics (e.g. climate change on the marine environment, massive presence of alien species, pollution, and reduction of available nutrients) present in the seas were also investigated in the analysis.

The sample of vessels subject to data collection was identified based on the definition of small-scale fisheries. In the sample of boats identified, an attempt was made, as far as possible, to have good representativeness of boats of all sizes, identifying boats falling into the following LFT classes: 0-6 meters, 6-10 meters and 10-12 meters. In addition, the presence and use of typical small-scale fishing gears (gill nets, longlines, pots, etc.) was verified, and boats using other gears (e.g. dredges) were excluded.

Fishermen's cooperatives, small-scale fishing consortia and trade associations were involved in both regions, through which it was possible to identify the vessels of interest for data collection, to collect the relevant catch data in the year 2021 on a monthly basis, and to track down the fishermen who owned the vessels and were interviewed. The meetings were held in-person in order to have direct involvement of the fishermen and industry stakeholders in the project.

The data were collected in a database and the main results that emerged have been reported in the present report.

3. RESULTS EMERGED FROM DATA COLLECTION

3.1 Fleet and boarding personnel

At the data collection stage, fishermen were interviewed regarding the type of vessel and fleet on board.

From the relevant technical data, the vessels included in the sample appear to be diversified in the maritime areas with respect to their size (LFT). Concerning Friuli Venezia Giulia region, in the Marano Lagunare fleet, the most numerous with 45 vessels surveyed, more than 93% of them measured an LFT between 6 and 10 meters. In the Grado and Trieste fleets, boats of all sizes were present, while in Monfalcone only boats under 10 meters were surveyed. In Veneto, in the Chioggia fleet more than 92% of boats had a LFT greater than 6 meters, with a predominance of boats (more than 55%) with LFTs greater than 10 meters. In contrast, in the maritime areas of Caorle and Chioggia, only boats with LFT less than 10 meters were detected.

The surveys showed that the small-scale fishing sector is characterized by boats mainly operated by fishermen on an individual basis, although there exist also company-type forms and enterprises with personnel hired as employees. Fishermen mostly join cooperatives or consortia. Fishermen generally join cooperatives because the corporate structure offers services, such as advice on tax compliance and license renewal, as well as quick and efficient marketing of the caught product [4].

All fishermen interviewed are male of Italian origin in both regions. They range in age from 32 to 70 years old, with different levels of education: 68.9% of the fishermen returned to the data collection have a middle school license, 23.3% have a high school diploma, and only 7.8% have an elementary school license.

Fishermen's testimonies revealed a lack of generational turnover. Although there are some active fishermen with ages under 45 (accounting for 19% of respondents), 41.7% of fishermen are between 45 and 55 years old, and the remaining 39.3% are between 55 and 70 years old. In some cases, the boats surveyed were found to be operated by fishermen close to retirement age, who carry out the activity more for passion than for profitable purposes. It follows that, in these cases, the quantities caught are small.

According to the testimonies collected during the course of the activities, the lack of young people interested in the fishing industry can be attributed to the fact that fishing is a very demanding activity, in terms of hours and physical effort, and not very profitable. The people who continue in the activity are driven by great passion, and generally, the young people who choose to pursue this career come from a fishing family.

Direct interviews to fishermen revealed a general concern for the future of small-scale fishing, both from those who already have many years of experience and from younger people, due to emerging environmental issues and the reduced profitability of the activity itself.

3.2 The problems of small-scale fishing sector connected to climate change

The fishing industry and, in particular, small-scale fisheries, has witnessed in recent years the changing marine environment and the species in it as a result of climate change. The seasons are no longer marked throughout the year. Less cold winters and summers with increasingly frequent heat waves have led to higher sea temperatures, resulting in changes in the marine habitat. The main changes noted through interviews with fishermen showed changes in the presence of fish species in the waters of the Northern Adriatic Sea.

According to fishermen, fish tend to be transient rather than sedentary, particularly in the areas of Monfalcone and the Gulf of Trieste, and due to rising sea temperatures they tend to seek refuge in deeper, cooler waters, making themselves less available for fishing. These factors affect the availability of fishable product. The lack of settlement also seems to be related to the lack of available nutrients in the food chain.

Lagoons and adjacent marine waters are complex coupled ecosystems, where inputs from river currents and tidal cycles shape plankton populations [8]. Phytoplankton, in particular, is a key component in the dynamics of marine ecosystems, contributing half of the world's primary production [9]. Studies conducted between 2011 and 2020 in lagoon and marine waters of the Gulf of Venice showed high levels of phytoplankton in the spring and summer period. The lagoon waters are characterized by a peak in the summer period, while in the marine waters near the coast the seasonal cycle of phytoplankton appears more irregular with alternating peaks between spring and early fall. This trend seems to be modulated by an alternation between depletion of available nutrients and sporadic nutrient inputs, which is typical in the Northern Adriatic [8]. A slightly different trend was recorded between 2010 and 2017 in the waters of the Gulf of Trieste, where phytoplankton levels increased starting in March and peaked in May. Levels gradually decreased from June onwards keeping low throughout the summer, then increased slightly in the autumn period [9].

Phytoplankton, being at the base of the food chain, is directly influenced by abiotic variables and is highly sensitive to environmental changes. For these reasons, phytoplankton is considered an indicator of water quality and climate change-induced effects [8, 9]. Temperature and salinity were found to be factors most correlated with the variability of phytoplankton in the waters of the Gulf of Trieste, particularly with the seasonality of its component species. Temperature was associated with phytoplankton in the waters in the summer period, salinity with the autumn period, and nutrients (dissolved inorganic nitrogen

and silicates) with the winter period [9]. A similar correlation between seasonality and temperature, dissolved inorganic nitrogen and silicates was found in the lagoon and marine waters of Venice, where chlorophyll content was also found to be higher in the summer period [8].

Over the past 4-6 years, fishermen interviewed have detected an increase in water salinity and sea temperature. It is evident from the surveys in the Gulf of Trieste [10] that over the past 40 years, despite annual temperature fluctuations, there has been a gradual increase in sea temperatures, confirming the fishermen's direct accounts.

Lack of rainfall is another factor affecting the status of marine waters and the presence of fish species in them, as it brings about changes in the water flowing through rivers into the sea. Rivers tend to carry mud, therefore, rainy years are favorable for the proliferation of species such as eels, while dry years allow the development of other species that need clear waters. Consequently, the occurrence of more or less rainy years is something that can have a positive or negative impact on the fishery, depending on the species caught.

Recently, the prolonged absence of rainfall and the drought phenomena recorded in 2022 led to the movement of the saline wedge toward the rivers, due to the upwelling of seawater. For example, in the Monfalcone fleet, which is developed in an enclosed basin within the Gulf of Trieste, the absence of fresh water due to the lack of rainfall has led to an increase in salinity due to tidal effects. These phenomena change the salinity of the waters, a factor that strongly impacts the natural habitat of the rivers and lagoon by going to affect biodiversity.

The salinity of the Adriatic Sea is mainly related to the freshwater input from rivers flowing into the Northern Adriatic, with values ranging from 38.5‰ in the southern part of the Adriatic Sea to less than 36.0‰ in the Po River area [10]. Drought phenomena have also led to an increase in salinity in the waters of the coastal areas of the Northern Adriatic Sea. In fact, as also reported by the fishermen interviewed, the absence of prolonged rainfall has caused a sharp reduction in the supply of water to the lagoon and the sea, disfavoring the exchange of water and its oxygenation. This is believed to be among the causes of the depletion of the level of available nutrients in the food chain.

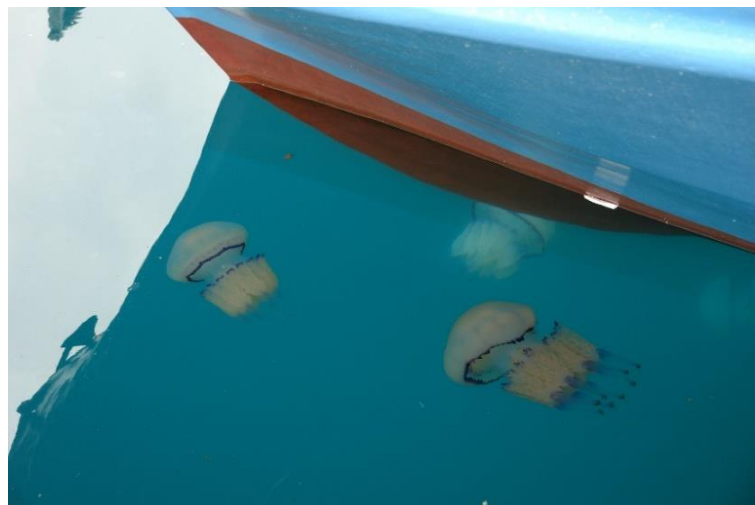
Long-term trends of temperature, salinity and dissolved oxygen in waters indicate a weakening of circulation in Adriatic waters, such as the exchange between the waters of the Ionian and Adriatic Seas [10]. This decrease could substantially affect the presence of aquatic organisms and nutrient transport, including to coastal areas [10]. Surveys on the presence of phytoplankton conducted in the Gulf of Trieste [9] showed an important decrease in its proliferation in the period between late winter and early spring in recent years. If the role of temperature in phytoplankton availability and salinity increase is confirmed, it could have

strong implications regarding the effect of climate change on phytoplankton dynamics in the long term [9].

At the same time, the massive presence of alien species, such as jellyfish (or barrel jellyfish, *Rhizostoma pulmo*) (Figure 1) and ctenophores (or sea nuts, *Mnemiopsis leidyi*) have invaded the seas and created many difficulties to fishermen and to the marine ecosystem [11]. These species, in fact, have found a great spread in the Northern Adriatic Sea especially in recent years.

The barrel jellyfish has big dimensions, which can reach sizes of 50-60 centimeters in diameter and 10 kilograms in weight. The color is transparent in younger specimens and becomes milky in adult specimens, which have a bright blue-violet umbel edge [14]. All the fishermen interviewed agreed that when jellyfish enter fishing nets, since they are present in large quantities in the seas, they cause the breakage of the nets due to excessive weight. In addition, when sorting the catch, fishermen are exposed to the risk of getting in contact with the stinging substances in them.

Figure 1: jellyfish (or barrel jellyfish, *Rhizostoma pulmo*) during spring time in the sea of Trieste's Gulf



Source: ERSA FVG

This species proliferates in the seas of the Northern Adriatic Sea from April to June, with significant occurrences particularly in the Trieste area. Recent studies indicate that the massive proliferation that occurred in 2021 in the Gulf of Trieste was caused by a high presence of specimens, probably aided by abnormal sea temperature conditions, which were higher than normal and prolonged the breeding time of this species [13]. These jellyfish feed on many species, from phytoplankton to fish eggs, and the amount ingested is proportional to the size of the specimens [14]. It follows that the presence of large quantities of jellyfish in the Northern Adriatic Sea concurs to influence nutrient availability and modify the marine ecosystem. The effects of the residues of these species on the ecosystem itself also remain to be evaluated.

Ctenophores have been detected in the Northern Adriatic Sea in open sea, coastal zone waters and lagoons, where they proliferate between August and November at temperatures between

13°C and 29°C and salinity ranging between 11 and 38 [11]. These species are nonindigenous (or alien) marine organisms native to the Western Atlantic that arrived in the Black Sea in the 1980's via ship ballast. In 1988, proliferation in the Black Sea reached levels, which created serious damage to the fishing industry as predators of zooplankton, eggs and small larvae of fish, especially anchovies. These organisms, because of the increase in water temperature, have also found spread to the coastal and lagoon areas of the Northern Adriatic Sea, where they have been present since 2016 and are detrimental to the fishing industry as they can change the balance of the marine ecosystem [12]. In the presence of an abundance of food, although they are small, they reproduce quickly giving rise to rather large swarms. This can be a problem since the gelatinous mass that springs from these swarms can clog fixed gill nets [12] blocking the flow of water and the fishing activity, especially the one conducted with coulters and tight-mesh nets, as is the case for dairy fish, for example.

It should be pointed out here that fishing days during the year are limited because of these periods of high proliferation of alien species, one in the spring-summer period, coinciding with the cuttlefish fishing season, and the other in the summer-autumn period.

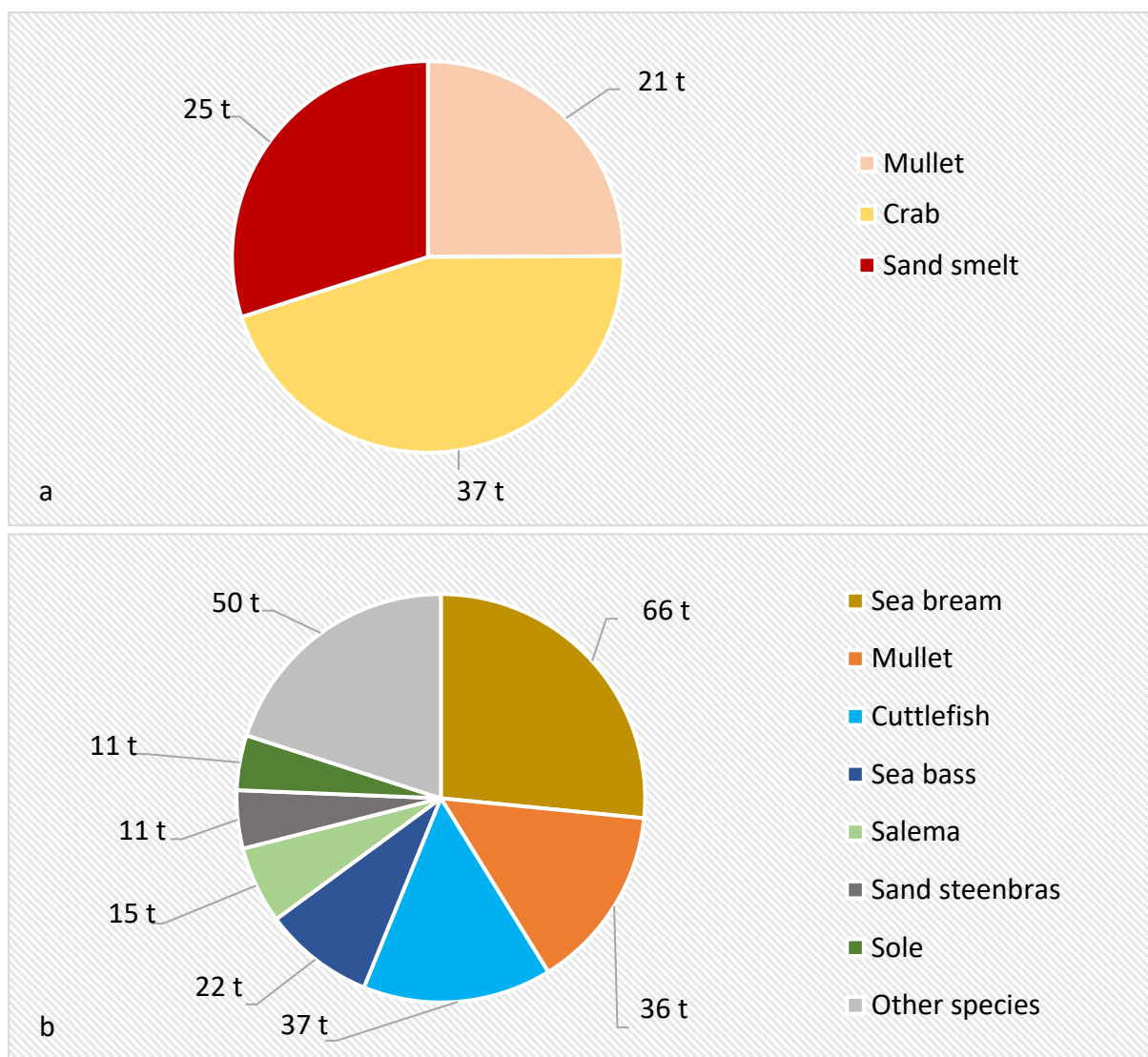
Another species that fishermen have found to be increasing is the blue crab (or swimmer crab, *Callinectes sapidus*), although not to invasive levels. Larger quantities have been detected in maritime areas in Veneto than in those in Friuli Venezia Giulia. This species is considered harmful because it causes nets to break with its claws, although it is considered by some fishermen a possible resource as a revenue species. In the areas of Marano Lagunare and Grado, moreover, the proliferative increase of unknown algae and greenhouse fish has been detected.

3.3 The caught species

3.3.1 Friuli Venezia Giulia

Fishing activity, and small-scale artisanal fishing in particular, takes place throughout the year and follows the seasonal pattern of species in the sea. From the data on quantities caught, the main fish species harvested in the seas of the coastal areas of Friuli Venezia Giulia are sea bream, mullet, cuttlefish, crab, sand smelt, sea bass (or European bass), picked dogfish, sand steenbras and sole (Figure 2).

Figure 2: main fish species caught by small-scale fishing boats in the lagoon (a) and in the sea (b) in the Friuli Venezia Giulia region in 2021 - the numbers shown on the label refer to the total quantities (in tons, t) detected overall in the region's maritime areas - mullet are caught both in the sea and in the lagoon



Source: data processing by ERSA FVG

It should be reported here that fishing in the maritime areas of Friuli Venezia Giulia is alternated between sea and lagoon, which allows fishermen to supplement income and vary the types of species caught. As a result, among the most frequently caught species are some that are typical of lagoon waters (lagoon mullet, crab, sand smelt and sea bream juveniles, Figure 2a).

Some fishermen from the Marano Lagunare fleet in the spring period (April and May) specialized in fishing for juvenile fish and sea bream juveniles. In 2021, fifteen permits were granted by the Region to fish for sea bream juveniles, which are used in aquaculture and for extensive bream farming in the valleys.

Crabs are caught almost during all year-round, with predominant quantities between the months of June and October (Figure 3). The fishery of sand smelt characterizes the period between the months of April and November (Figure 3), although it is made difficult by the presence of sea walnuts that cause the nets to become clogged. Mulletts are caught in the lagoon, observing an increasing curve during the spring period, followed by a halt in the summer period, then resuming in October and continuing into the fall period (Figure 3).

Larger quantities of mullet come from the sea fishery, where they are mainly caught between November and February (Figure 3). In the fall-winter period, mainly sea bream, sea bass and sole are caught in the sea (Figure 3).

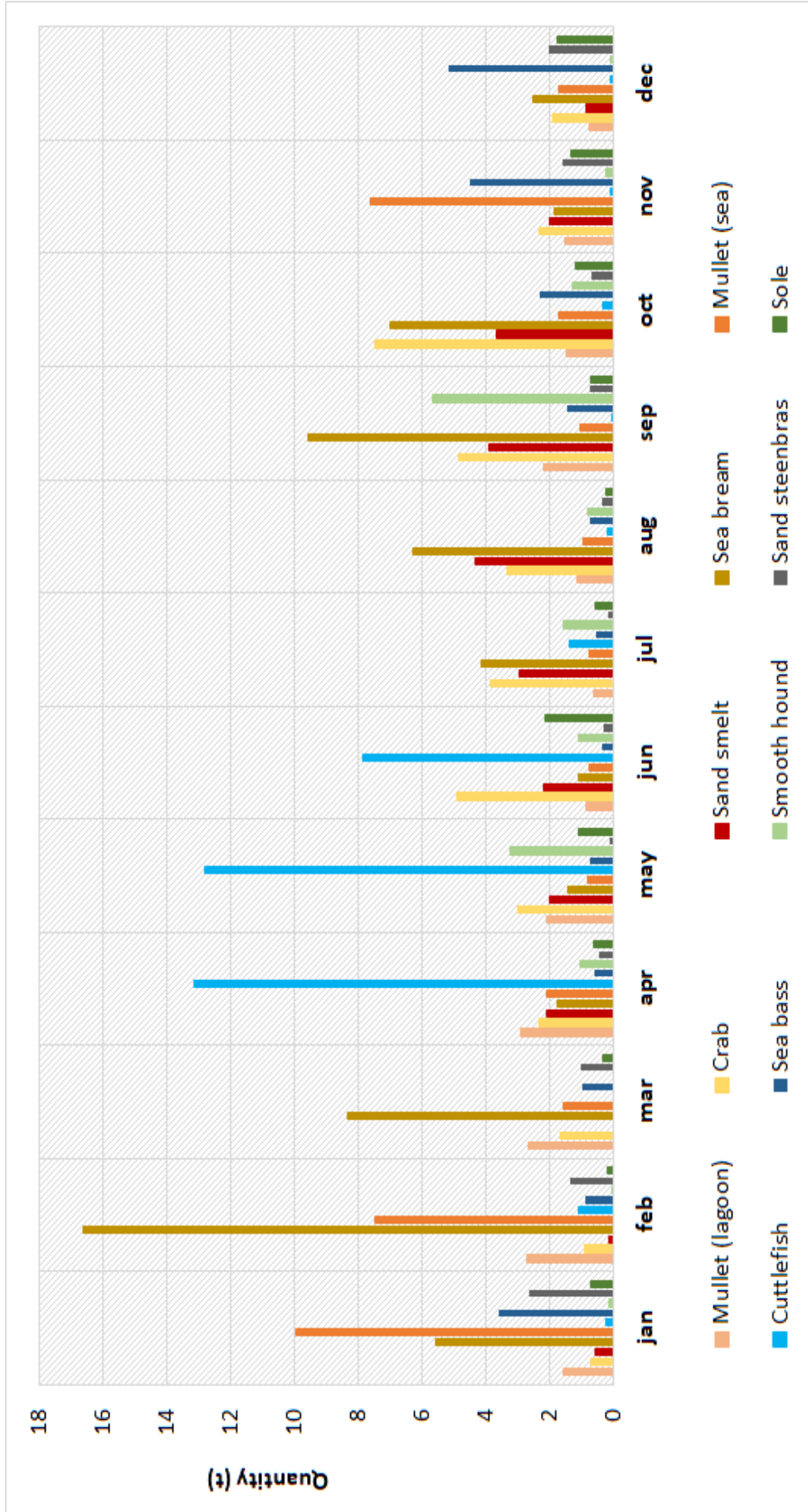
The spring period is characterized by cuttlefish fishing. Harvesting takes place throughout the year, but it is concentrated in the period between February and July, with a peak in April and May (Figure 3).

Cuttlefish fishing appears to be increasingly difficult for fishermen due to the lack of fishable product compared to past years. From the testimonies collected, many fishermen based their income on this species, and although cuttlefish are still among the most heavily caught species in the small-scale fishery sector, the reduction in their populations in the coastal areas of both regions is a cause for concern.

Given the fact that the cuttlefish fishery coincides with the period of proliferation of the barrel jellyfish and taking into consideration the ongoing climate changes described above, it is possible that the reduction in cuttlefish populations in the Northern Adriatic Sea was affected by changes in the marine ecosystem. There is a widespread opinion among fishermen that this species no longer find suitable conditions to proliferate.

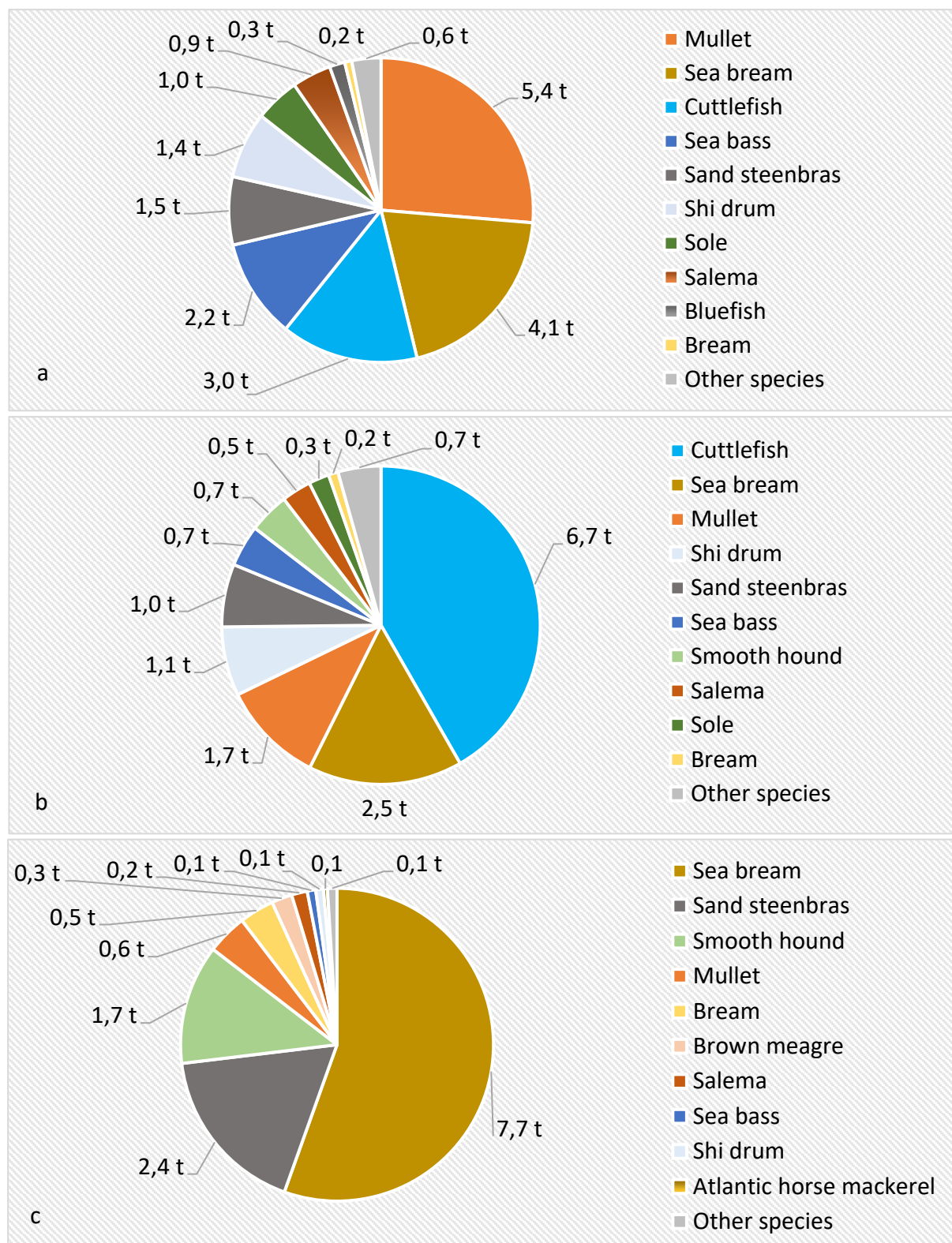
During the summer period, picked dogfish, whiting fish and ray are also typically caught. Picked dogfish belong to the most caught species among the boats involved in data collection (Figure 2b). However, fishermen point the attention on a progressive decrease in the presence of the species typically found in the maritime areas of Friuli Venezia Giulia. For example, it has been reported that mantis shrimps are no longer present in some of the Trieste's maritime area.

Figure 3: seasonal harvesting trend of the main species fished by small-scale fishery vessels in lagoon and sea in Friuli Venezia Giulia region during 2021



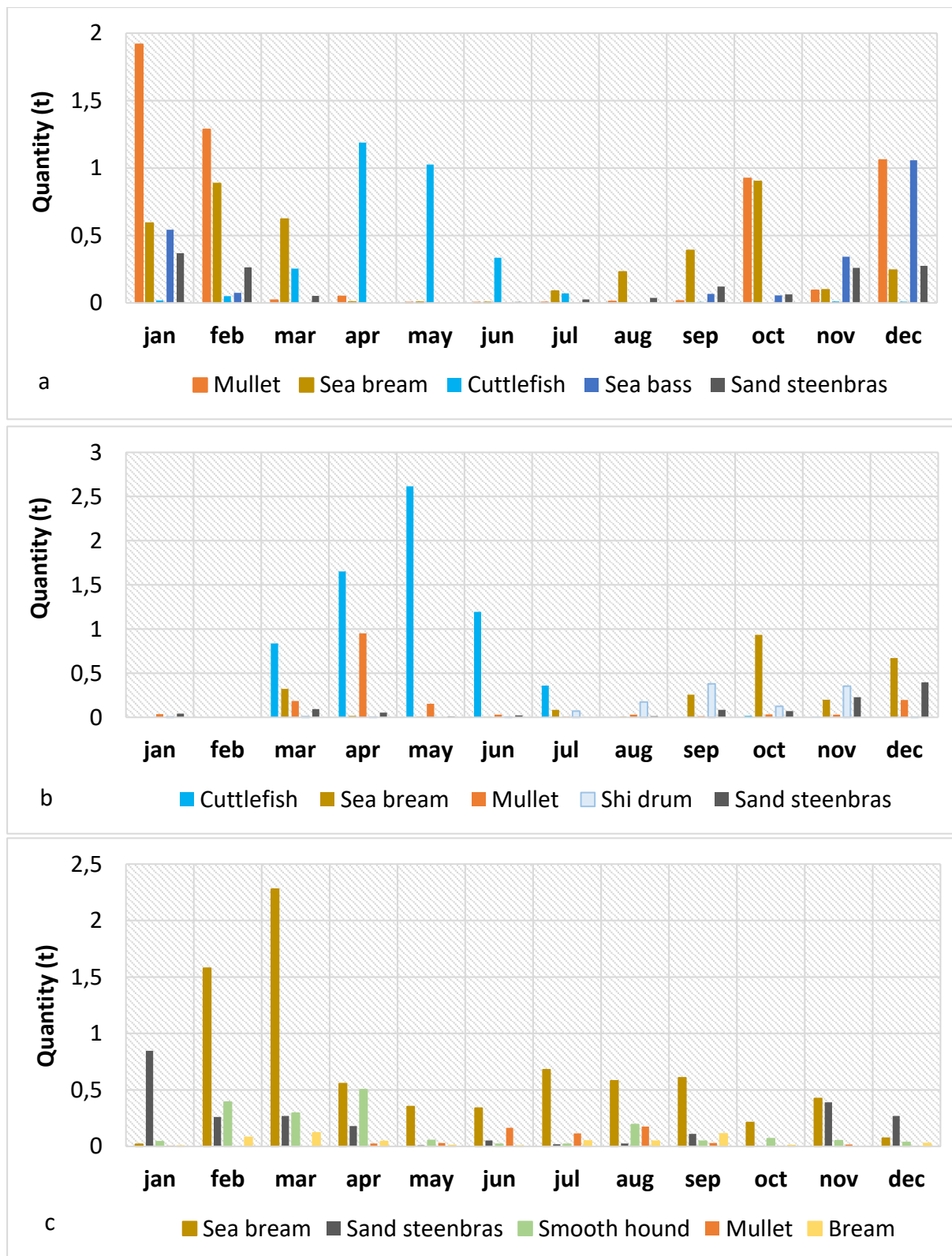
Source: data processing by ERSA FVG

Figure 4: main fish species caught in the sea by individual small-scale fishing boats representative of the Marano Lagunare (a), Grado (b) and Trieste (c) fisheries in the Friuli Venezia Giulia region in 2021 - numbers shown on the label refer to the total quantities (in tons, t) detected for the individual boats identified



Source: data processing by ERSA FVG

Figure 5: seasonal trends of the main fish species caught in the sea by individual small-scale fishing boats representative of the Marano Lagunare (a), Grado (b) and Trieste (c) fisheries in the Friuli Venezia Giulia region in 2021



Source: data processing by ERSA FVG

Detailed data of individual vessels confirm that the main species caught in the seas of Friuli Venezia Giulia are sea breams, cuttlefishs and mullets. At single boat level, there is a diversification in the activity of the fishermen who are also active in fishing minor species such as croaker, sand steenbras, smooth hound, salema and sole (Figure 4). This diversification follows the species's seasonality, so the species and related quantities caught on a monthly basis per individual boat (Figure 5) are also conditioned by the level of specialization of the fishermen who conduct them, in addition to the changes in the marine ecosystem, highlighted in Section 3.2.

Small-scale artisanal fishing is a selective fishery, which provides the opportunity for fishermen to specialize in harvesting certain fish species. According to some fishermen, however, this characterizing aspect of small-scale fishing is disappearing due to the reduced variety of fishable species. A general decrease in the amount of catch had already been recorded in the last five years, and the interviews revealed that the reduction in the variety of fishable species and their quantities has led the fishermen themselves to have to focus and specialize on harvesting the same fish species. As a result, reduced marine biodiversity also means a decrease in the diversification of the product on the market. This implies a possible risk of shrinking resources still available in the sea and may lead fishermen to be competitive with each other.

According to some fishermen, particularly in the Trieste area, the establishment of restocking barriers and the maintenance of protected water areas appears important for the preservation and the development of marine biodiversity. Fishermen are aware that the future of professional fishing in coastal areas is closely linked to the protection of marine ecosystems. In general, the small-scale fishing sector would also like to see greater involvement in the protection of marine waters and its biodiversity.

3.3.2 Veneto

The main fish species harvested in the seas of the coastal areas of Veneto is mullet, followed by cuttlefish, mantis shrimp, picked dogfish, sand smelt, sole, crab, goby, sea bream and sea snail (Figure 6).

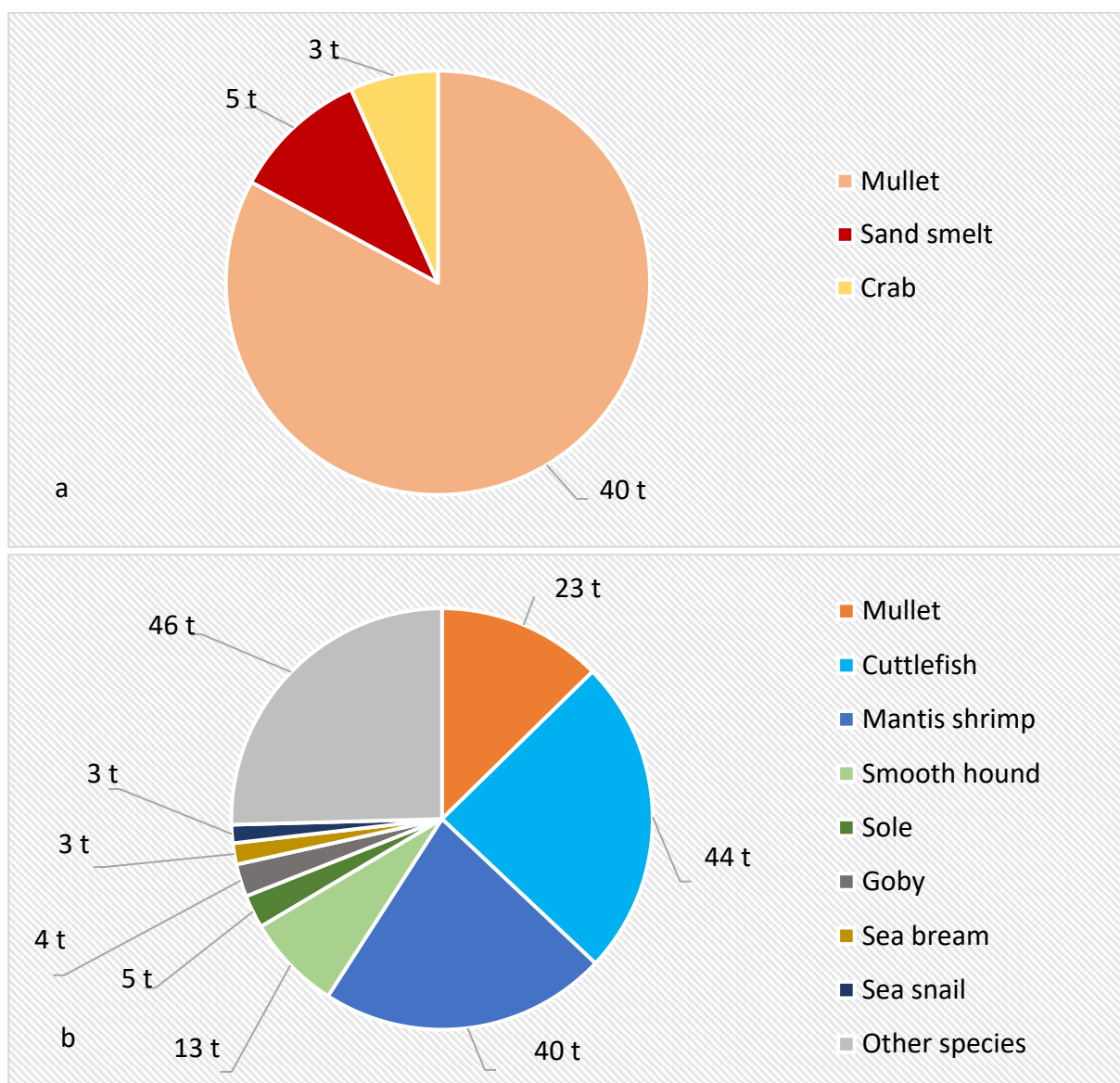
In Veneto, many fishermen alternate between fishing in the lagoon and fishing in the sea. In the Venetian lagoon, lagoon mullet, sand smelt and crab are caught (Figure 6a). In the sea, the predominantly caught species are sea mullet, cuttlefish and mantis shrimp, followed by picked dogfish, sole, goby, sea bream and sea snail (Figure 6b).

Sea mullet fishing takes place throughout the year, with a prevalence in the spring months peaking in June (Figure 7). The sea mullet fishery is also associated with the lagoon mullet

fishery, which follows a similar pattern to the one recorded in the Friuli Venezia Giulia's lagoon, with a peak in the spring period, and resumed during the fall after a summer decline (Figure 7).

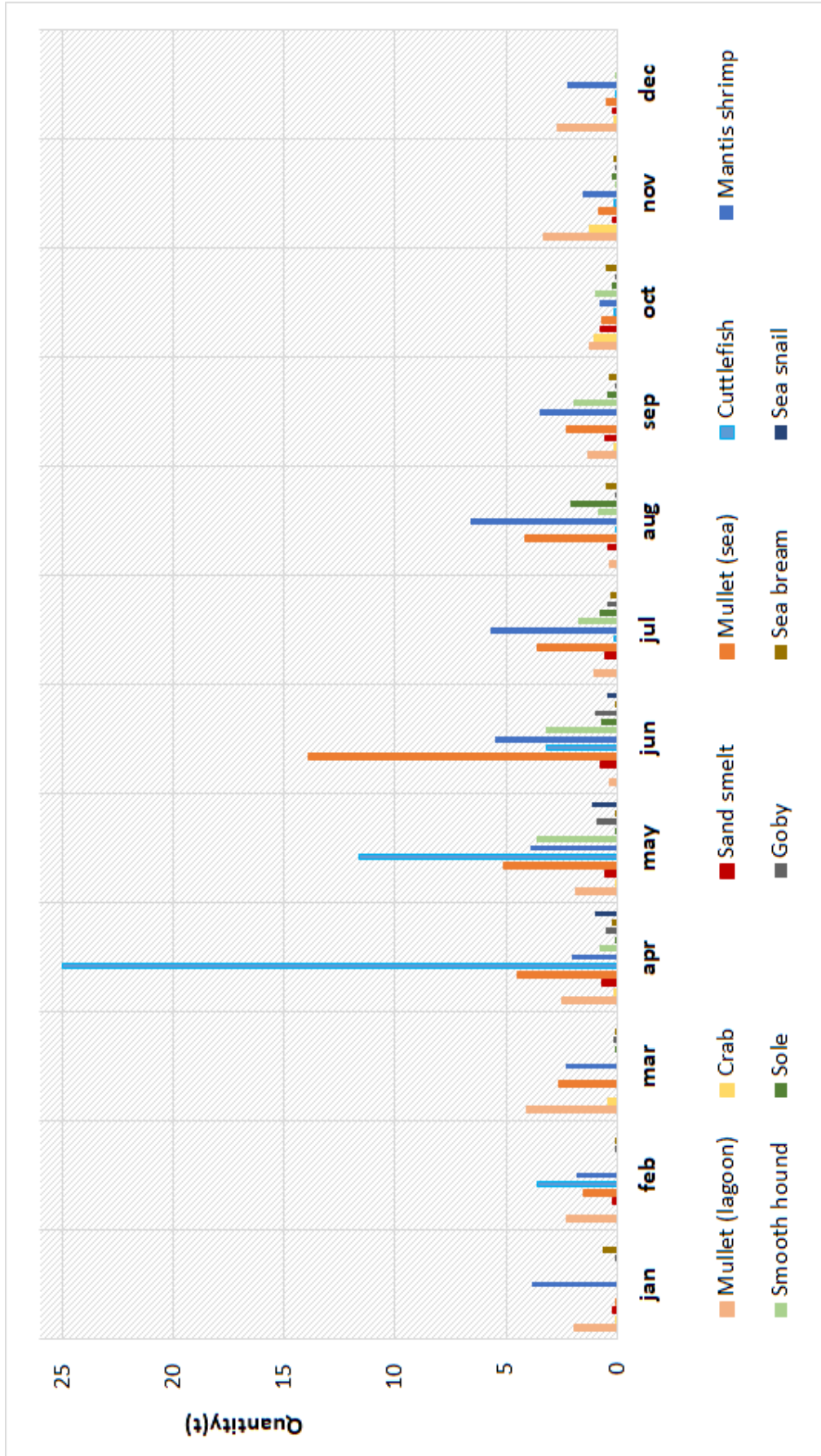
The cuttlefish harvesting period ranges between the months of February and June, with a peak in April (Figure 7). According to fishermen's reports, the quantities caught are lower compared to the past years.

Figure 6: main fish species caught by small-scale fishing boats in the lagoon (a) and in the sea (b) in the Veneto region in 2021 - the numbers shown on the label refer to the total quantities (in tons, t) detected overall in the region's maritime areas - mullet are species caught both in the sea and in the lagoon



Source: data processing by ERSA FVG

Figure 7: seasonal harvesting trend of the main species fished by small-scale fishery vessels in lagoon and sea in Veneto region during 2021

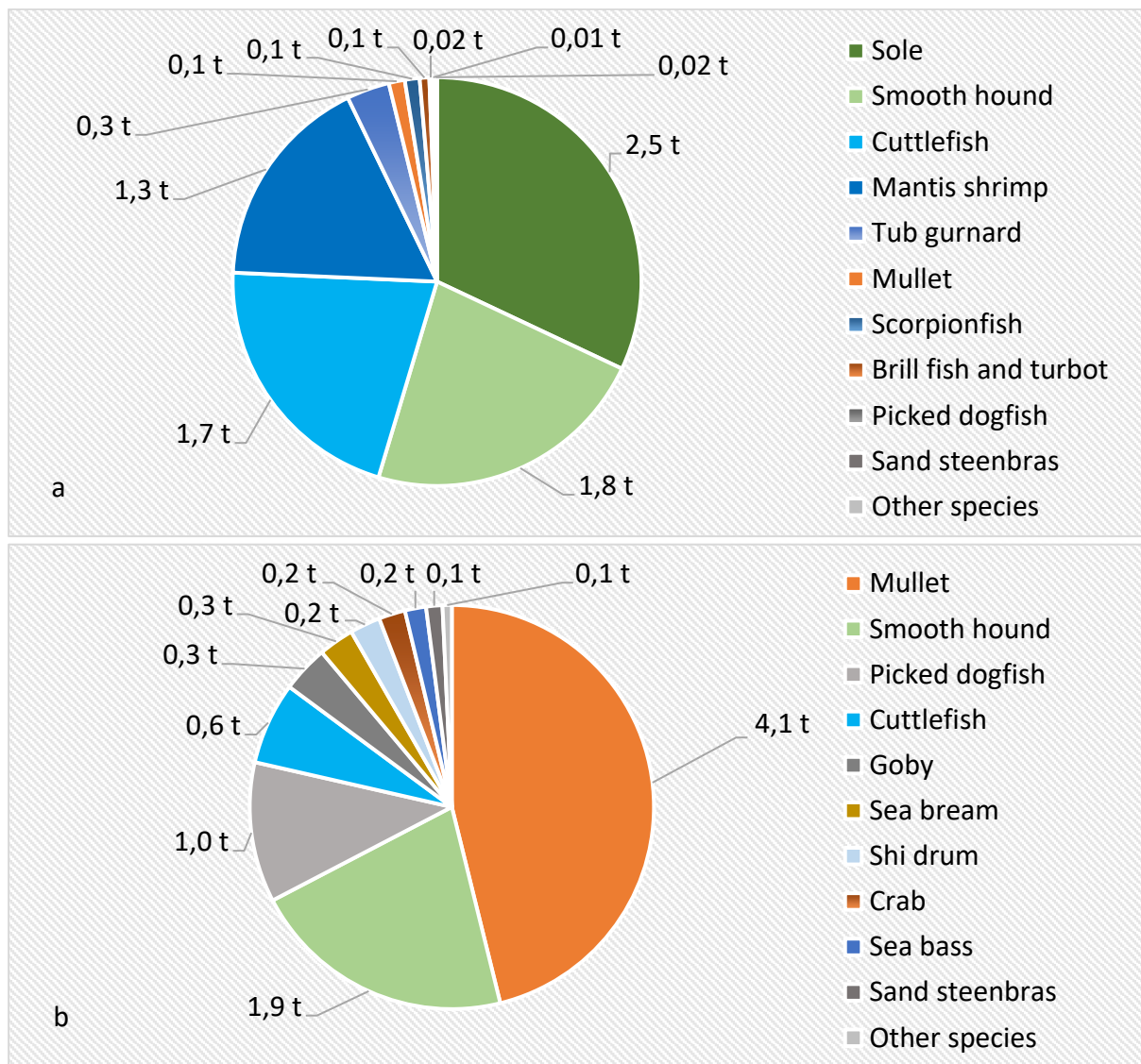


Source: data processing by ERSA FVG

The mantis shrimp fishery is concentrated in the summer period, mainly in the period between the months of June and August, and continues during the rest of the year with smaller quantities (Figure 7). According to some fishermen, the mantis shrimp fishery is more profitable than the cuttlefish fishery, although the exploitation of this resource raises concern because it could lead to a further reduction in fishable product.

Another species of interest to small-scale fisheries in the Veneto region is picked dogfish, caught from April to October, with harvests concentrated between May and June. Sand smelt, sea bass, crab and sea bream are species detected in smaller quantities compared to the past.

Figure 8: main fish species caught in the sea by individual small-scale fishing vessels representative of the Chioggia (a) and Po River (b) fisheries in the Veneto region in 2021 - the numbers shown on the label refer to the total quantities (in tons, t) detected for the individual vessels identified

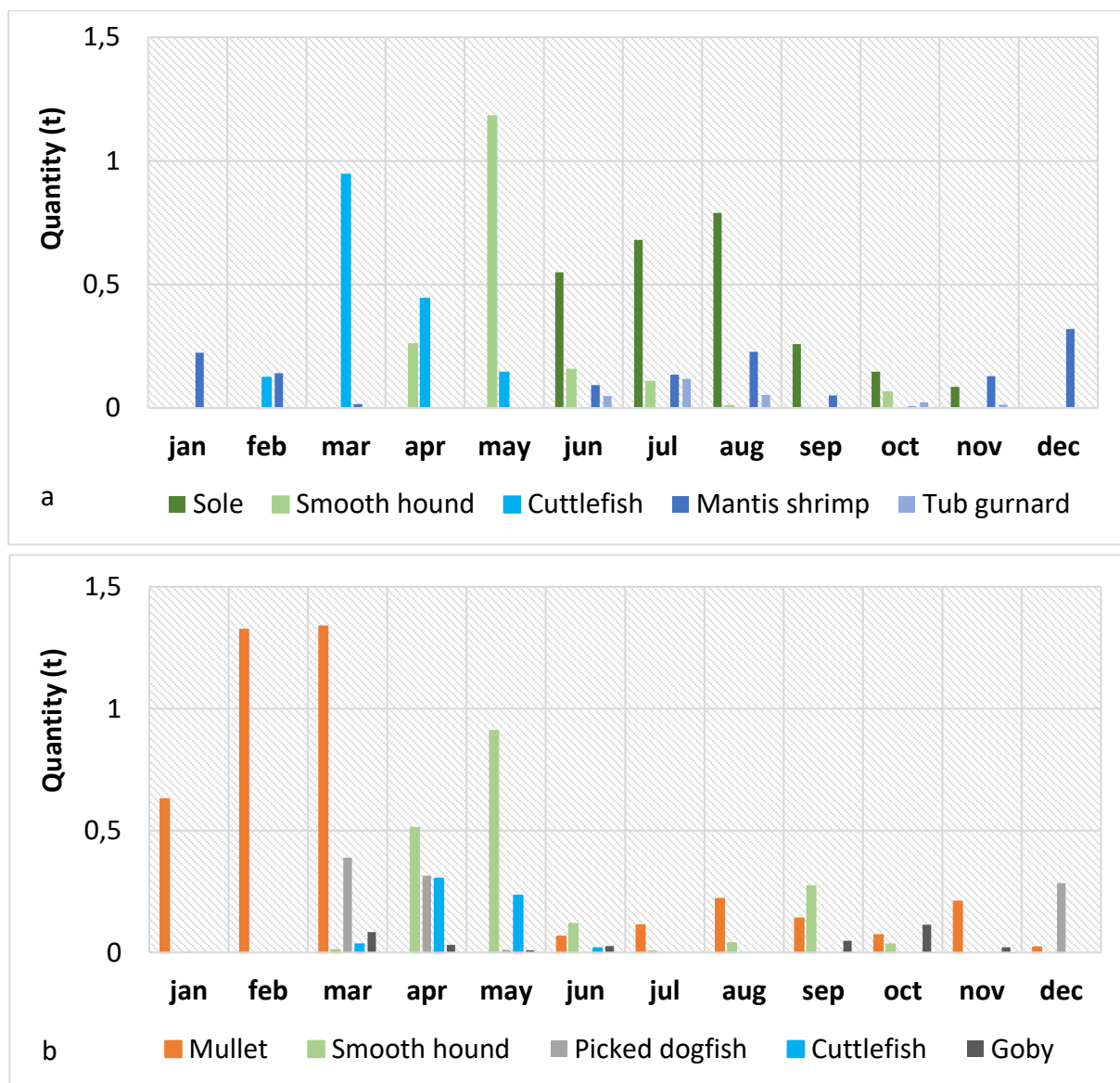


Source: data processing by ERSA FVG

Observing the details of the individual vessels, the Veneto region also shows a diversification in the species caught, including major species (mullet, smooth hound, sole and cuttlefish) and minor species (tub gurnard, picked dogfish, sand steenbras, Figure 8).

Veneto region’s fishermen also follow the seasonality of fish species (Figure 9), which allows them to have an income during the different months of the year, although specialization in certain species does not guarantee a constancy in the quantities caught throughout the year. In fact, for many of the boats involved in the survey, the species caught were attributable to only a few species (e.g. picked dogfish, goby or cuttlefish).

Figure 9: seasonal trends of the main fish species caught in the sea by individual small-scale fishing boats representative of the Chioggia (a) and Po River (b) fisheries in the Veneto region



Source: data processing by ERSA FVG

3.4 Socio-economic aspects of the small-scale fishing activities

The activity of small-scale fisheries is based on the seasonality of species in the sea. The changes noted in the availability of species in the sea for the reasons described in the previous paragraphs (increased water temperature, massive presence of invasive alien species, etc.) have led fishermen to reduce their days of activity or to sail for smaller quantities compared to the past. In both regions, fishermen alternate between fishing in the sea and in the lagoon to supplement income.

The profitability of small-scale fishing depends on the quantities of fish caught, the selling price that fishers are able to extract at fish markets, and the costs of running the business. The prevailing costs that fishermen face are the cost of fuel, boat maintenance and the purchase or repair of nets. Data collected highlight that the cost of fuel varies in proportion to the size of the boat and the number of fishing days caught. It must be remembered that not all fishing days can be equally profitable for this type of fishing, so fishermen must be shrewd in evaluating fishing areas, weather conditions, management of time in the sea, time of delivery of catch at the market, and other factors in order to make fishing as efficient as possible. To keep the cost of nets down, many fishermen have learned to assemble and repair them themselves, incurring only the cost of materials. Boat maintenance generally involves servicing and painting the hull, which is done every 1 to 2 years, depending on wear and tear. Like all productive sectors, the fishing industry is facing current increases related to rising energy costs and inflation.

Other fishing activities that can supplement income include fishing and ichthyic tourism, which consist of combining historical fishing activities, usually carried out by local fishermen, with alternative cultural tourism [15].

According to Legislative Decree No. 4/2012, fishing tourism is the activity covered by professional fishing, carried out in maritime and inland waters, of boarding people who are not part of the crew on fishing vessels for tourism-recreation purposes. The ichthyic tourism, according to the same decree, includes activities falling under professional fishing, hospitality, recreational, educational, cultural and service activities, aimed at the proper enjoyment of aquatic ecosystems and fishery resources and the enhancement of the socio-cultural aspects of fishing enterprises exercised through the use of one's home or an available facility.

The regional law in Friuli Venezia Giulia No. 3/2022 regarding the regulation of fishing tourism, ichthyic tourism and activities related to professional fishing and aquaculture, and the regional law in Veneto No. 28/2012 and subsequent amendments and additions on the regulation of agritourism, ichthyic tourism and fishing tourism, also aim through these activities to promote the local fish product, to develop sustainable production practices, to enhance the valley-

lagoon heritage and the artifacts of local tradition, as well as all other typical products of the region.

However, these activities were found to be seldom practiced by fishermen in both Friuli Venezia Giulia and Veneto. When interviewed, fishers uniformly expressed the opinion that such activities could be a viable supplement to income from fishing but, at present, it appears to be a scarcely viable avenue because the conditions required for implementation are not always feasible on the small boats used by fishers. Some fishermen reported that they have received a great demand for carrying out the activities, which is seen as a very good possibility for the future if it will be developed in simplified ways.

In 2021, the majority of fishers interviewed applied for the COVID-19 grant, which amounted to about 1,000 euros. Vessels with LFT greater than 10 meters received the all-inclusive allowance of 30 euros, in case of suspension from work resulting from mandatory and non-mandatory temporary cessation measures (fishing ban), as provided by Interministerial Decree No. 1/2022. The purpose of the biological standstill is to allow an optimal reproduction phase of the species affected by fishing in order to protect and increase their stocks.

3.5 Presence of plastic in the sea

Pollution from plastics in the sea is a global phenomenon that has a significant effect on marine biodiversity. Plastics can accumulate in different marine compartments (such as on the sea surface or in sediments) and break down into tiny debris that can be ingested by marine species and enter the food chain [16, 17]. Marine species that consume these plastics face health issues such as mortality and reproductive complications. It follows that the presence of plastics in the sea has ecological implications and repercussions on human health [17].

One positive note emerged from the direct experience of fishermen: the seas in areas affected by small-scale fishing are currently cleaner than they were a few years ago. Almost all of the fishermen interviewed reported a sharp reduction in the amount of plastic in their nets. In order to get a full picture of the situation, some fishermen felt that the assessment should be extended to include offshore trawling.

Fishermen have shown themselves to be very sensitive to the issue, attentive also to the issue of plastic management, in terms of protecting the environment and in particular the sea, which constitutes for them not only a source of income, but is the environment in which they live and which they intend to protect. One aspect that concerns them closely is the use of Styrofoam boxes. There is widespread concern among fishermen that plastic causes serious harm to the seas, and they positively see a transition to environmentally friendly and sustainable materials.

The issue of waste management from the sea has also recently been the focus of the “Fishing for future project” [18], a project funded by the Veneto Region's 2014-2020 FEAMP funds, with the aim of highlighting the role that fishermen play in the management of resources and the marine and lagoon environment. The focus of the project was, in fact, to protect and restore biodiversity and the marine ecosystem through the collection of sea litter by two cooperatives of fishermen from Veneto during their usual fishing activities. Participation in the activities by the professionals led to the collection of useful data for future planning on environmental waste management and at the same time allowed the fishermen to bring ashore and properly dispose of the waste without consequences such as fines or additional costs [18].

4. CONCLUSIONS

Sustainability is a central theme for today's production processes in all sectors, which includes the fishing industry. Among the different types of fisheries, small-scale fishing turns out to be one of the activities that most respect this concept.

Small-scale artisanal fishing is practiced with boats less than 12 meters in length, operating within 12 miles of the coast, and is distinguished from other fishing methods by the use of selective and low environmental impact gear. Small-scale artisanal fishing gears, in fact, allow only specific target species to be caught, thanks to the use of nets with more or less tight meshes that allow the capture of fish of the desired size within the size margins set by law. This feature allows small-scale fisheries to minimize the catch of non-target species, or species that cannot be sold, and to harvest only the necessary quantities of fish [5]. Fishing small and selected quantities keeps the available marine resources in balance and preserves their biodiversity.

It has been estimated that small-scale fisheries globally produce 40% of the total catch caught between inland and marine waters [19] and, therefore, play an important role in the fishing world. The ARGOS project, through the survey conducted with those working in the sector, was able to provide an assessment of the current condition of the small-scale fishing sector through the direct field experience of fishermen, fishermen's cooperatives, small-scale fishing consortia and trade associations in the regions of Friuli Venezia Giulia and Veneto.

Although small-scale fisheries maintain a sustainable approach in their daily activities, major changes in marine biodiversity have been noted in recent years by fishermen themselves in the maritime areas of Friuli Venezia Giulia and Veneto. Multiple factors are involved in the development of the lagoon and marine ecosystem that characterizes the two regions involved in the study (the alternation of seasons, the water flow through rivers and lagoon, tides, etc.). The recent decrease in biodiversity is an indicator of the changes that are occurring at the marine ecosystem level.

The causes can be traced to the sudden climatic changes that have been occurring for a number of years: the displacement of the seasons, less cold winters and summers with prolonged periods of heat that have led to a progressive increase in the temperature of marine waters. Lack of rainfall, in addition, does not allow adequate turnover of river and lagoon waters, resulting in increased salinity of both marine and mixed waters, as well as reduced oxygenation of waters. All this has resulted in a lack of nutrients along the food chain, compounded by a conspicuous decrease in the normal amount of fish caught in the sea and an increase in alien species, which have become invasive and unmanageable.

Because of emerging environmental issues due to climate change and the reduction of fishable fish stocks, there is widespread concern among fishermen about the future of small-scale coastal fisheries. The average age of working fishermen in the two regions involved in the data collection is over 45 years old, and some boats were found to be operated by people close to retirement, who carry out the activity more for passion than for income purposes. The lack of generational turnover is due to the fact that fishing activity is very demanding in terms of physical effort and time commitment and is unprofitable. The situation could be further aggravated if changes in the ecosystem persist.

The small-scale fishery is based on the seasonality of the species in the sea, and to supplement income in the lagoon areas many fishermen alternate between fishing in the sea and in the lagoon.

Currently, no other income supplementation opportunities have been found among fishermen. Fishing tourism activities are considered attractive by fishermen as opportunities both for income supplementation and for dissemination of knowledge about the fishing world to people. These activities could meet the project's goal of also increasing the economic and social sustainability of fishing activities but, according to fishermen's testimonies, needs to be developed in more simplified ways.

The small-scale fishing sector has been very sensitive to the issues of climate change, protection of ecosystems and marine biodiversity, and pollution. The amount of plastic collected in the seas was found to be less than years ago, a sign of a general concern for the quality of the environment and its protection. Fishermen can play an active role in removing plastic from the seas through dedicated projects.

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Annex 1

ARGOS STRATEGIC PROJECT

ShARed GOvernance of Sustainable fisheries and aquaculture activities as leverage to protect marine resources in the Adriatic sea

Questionnaire for fishing data collection

Section 1 – data related to vessels and fishing activity

Section 2 – data related to economic aspects

Section 3 – social data

Section 4 – changes in the fishery world

Section 1 – data related to vessels and fishing activity

Section 1.1 – Vessel

Vessel name	_____	No. License plate	_____
Year of construction	_____	Tonnage (GT)	_____
Engine power (kW)	_____	LOA (m)	_____
No. Boarded personnel	_____	No. Employees	_____
Principal gear	_____	Second gear	_____
Mooring port	_____	Working days	_____

Section 1.2 – gears and caught species

Gear type _____			
Month	_____	No. Fishing days/month	_____
List of caught species and quantities (kg)			
Species	Quantity (kg)	Species	Quantity (kg)

Section 2 – economic data

Gross annual income in euro* _____

* gross salable production, direct subsidies (fishing ban, COVID-19 contributions, *de-minimis* contributions), other revenues (fishing tourism, ichthyic tourism)

Costs for boarded personnel in euro _____

Fuel costs in euro _____

Maintenance costs in euro _____

Section 3 – social data

Section 3.1 – Activity type:

<input type="checkbox"/>	Hydraulic dredger	<input type="checkbox"/>	Longlines	<input type="checkbox"/>	Pair trawlers
<input type="checkbox"/>	Bottom trawl	<input type="checkbox"/>	Hooks and lines	<input type="checkbox"/>	Aquaculture
<input type="checkbox"/>	Gill nets	<input type="checkbox"/>	Purse seine	<input type="checkbox"/>	Other: _____

Total number of employees: _____

Number of males: _____

Male average age: _____

Number of females: _____

Female average age: _____

Section 3.2 – Education level and fishing operators' nationality

- Elementary school _____%
- Middle school diploma _____%
- Higher school diploma _____%
- Degree _____%

Nationality

- Italian _____%
- European Union _____%
- Non-European Union _____%

Section 4 – changes in the fishery world

In this section, fishing operators are asked to provide opinions, information, observations, etc. about climate change, presence of alien species and the presence of plastic in marine environment.