Marine Management Organisation

Feasibility of a potential emergent octopus fishery

(MMO1440)

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Executive summary

In preparation of the Channel demersal non-quota species Fisheries Management Plan stakeholders anecdotally reported increases in octopus abundance in the southwest English Channel. This increase could constitute a potential emergent fishery, providing additional fishing opportunities and potentially reducing conflicts with crab and lobster pot fisheries in the area on which octopus predate. This study investigates the potential of an octopus-targeted fishery in southwest England.

The aim was to examine the potential viability of an octopus fishery and explore potential management measures associated with any such fishery. This report covers research activity up to 31st March 2025. The report includes fishers' observations of elevated octopus catches early in the 2025 season but this report was drafted in a context prior to the bloom of octopus occurring at time of publication.

A combination of literature review, fisheries landings data, case studies and stakeholder consultation were undertaken to evaluate the viability of an octopus-targeted fishery. The literature review focused on understanding octopus biology, population dynamics, distribution and seasonality. Landings data, comprised of catch and effort data from mobile and static gear fishers for the last eight years (2017 to 2024), were collated and used to explore recent trends in octopus landings. Two case study octopus fisheries were explored to understand octopus fishery management approaches; Asturias (north west of Spain) and Brittany (north west of France). The western Asturias octopus traps fishery is MSC-certified. Stakeholder opinions were sought through interviews and a workshop that was held to validate findings and draw out recommendations.

The findings reveal significant year-on-year variability in octopus landings, with marked fluctuations from one year to the next. Trawlers primarily operating in offshore waters land high quantities of octopus during winter months while potters fishing inshore land high quantities during summer months. Overall, trawlers account for the largest share of octopus landings although total landings from potters have been on the rise in the last three years. Findings from the literature review showed that the spawning and mating season for octopus is during the summer months, implying potential vertical migration to breed or lay eggs. However, landings data lack species differentiation between the endemic curled octopus (*Eledone cirrhosa)* and the larger Mediterranean common octopus (*Octopus vulgaris)*.

Stakeholder input highlights that the high volatility in octopus abundance presents challenges for establishing a reliable, targeted fishery. The catching sector especially indicated that they find it hard to invest in octopus pots due to the uncertainty and fluctuations in abundance. Others stated that abundance in their areas was too low to sustain a stable fishery. Market assessment shows that the seasonal and annual fluctuations affect the consistency of supply, influencing both pricing and the broader supply chain. Despite these challenges, octopus prices per kilogram have steadily increased over time. Stakeholders

therefore felt that there are opportunities towards the increased octopus abundance. Some stated that restrictions on other fisheries such as pollack, could drive fishers toward targeting octopuses, rather than catching them as bycatch. Others thought the increased abundance could provide an alternative fishery to turn to whilst crab stocks are not doing well. Stakeholders believe a targeted fishery could be viable in the future if the stock is stable.

Case studies from Spain (Asturias region) and France (Brittany) provide valuable insights into possible management strategies. The Spanish case study exemplifies a sustainable fishery with gear restrictions, fishing hour limits, tailored stock assessments, and research partnerships. In contrast, the French case study focuses on managing the socio-economic benefits and lacks a comprehensive framework to understand stock dynamics and variability. The case studies highlight two distinct approaches to octopus fishery management, underscoring the need for a comprehensive, adaptive strategy that could be tailored to local conditions in the southwest.

The study identifies key evidence needs, such as species identification during landing and multi-year surveys, that are essential to guide future management decisions. Joint research activities among the fishing industry, academia and fisheries managers on recruitment assessments will provide data to adapt management strategies to year-on-year changes.

In conclusion, while octopus numbers have increased recently causing concerns to both mobile and static gear fishers, their abundance is not consistent enough to support a targeted fishery. This study has five recommendations.

- Differentiation between octopus species needs to be part of a mandatory landing requirement.
- Real-time monitoring of octopus populations is needed to understand the volatile nature of the octopus stock and its presence in the English Channel. This needs to include recruitment surveys ideally conducted in the spring before the octopus mating and spawning season.
- Sentience guidelines for octopus need to be established. The introduction of sentience guidelines will improve the management of octopus fisheries and their marketability within the UK market and beyond.
- There is a need to establish a joint research project between the fishing industry, scientific institutions and government to monitor octopus abundance. Fostering collaboration between scientific surveys and the fishing community is crucial to achieving time-series recruitment indexes. Such collaboration could be used to monitor sea surface temperatures and other climate change impacts and to investigate the links and historical patterns of octopus presence.
- Clear objectives and targets for a potential octopus fishery in the future need to be established in line with the UK Joint Fisheries Statement.

1. Introduction

This report summarises the findings of a desk-based study assessing the feasibility of a potential emergent fishery for octopus in southwest England. It considers whether an octopus-targeted fishery is viable based on recent trends in octopus catches and stakeholder perceptions. The report identifies opportunities and threats emerging from the increased abundance of octopuses, priority issues to be considered before regulatory measures are put in place, and further research and monitoring needs including the need to understand broader environmental factors influencing octopus abundance.

In preparing the Channel demersal non-quota species Fisheries Management Plan, stakeholders anecdotally reported increases in octopus abundance in the southwest English Channel. There are stakeholder concerns over octopus eating lesser spotted dogfish eggs and preying on crabs and lobsters from pots, which could affect the income of fishers who rely on these species for their livelihoods. Therefore, octopus has been identified for management intervention within the Channel demersal non-quota species Fisheries Management Plan. The increase in octopus bycatch suggested a potential emergent fishery, which could provide additional fishing opportunities as well as reduce problems caused by increased octopus numbers. If a fishery is viable, it could be beneficial to aim towards a high-quality, high-value fishery, such as the Marine Stewardship Council (MSC) octopus fishery in Spain.

This report covers research activity up to 31st March 2025. The report includes observations by fishers of elevated catches of octopuses emerging through the early stages of the 2025 fishing season although analysis of fisheries data was limited to full years and covered up to the end of 2024. As such this report was drafted in a context prior to the bloom of octopus occurring at time of publication.

1.1 Background

Octopuses, belonging to the phylum Mollusca and class Cephalopoda, are widespread marine species found in various habitats, from tropical reefs to deep, cold waters. Octopuses can exhibit different activity patterns based on habitat, time of day and prey availability. They are also sensitive to environmental factors like temperature, substrate and seasonality. Octopus typically live in sheltered dens, with high-site fidelity, but also display seasonal and spatial migration depending on the availability of shelter, mating opportunities and food. An octopus gives birth only once in its entire lifetime. This singular act of reproduction defines a key aspect of their biology and dictates their short lives. Nevertheless, the short life cycle of fewer than two years, the patterns, ecology and behaviours of octopuses are yet to be fully understood.

Octopuses have been present in UK waters for over two centuries (Rees and Lumby, 1954). Historically, curled (also referred to as horned) octopus (*Eledone cirrhosa*) has been abundant along the British coast, while common octopus (*Octopus vulgaris*) has been predominantly present in the Mediterranean Sea and sub-tropical waters (Wilson, 2008). These two species are often caught by

small-scale fisheries or as bycatch in industrial fisheries using various gear types such as pots, nets and demersal trawlers. A significant drop in water temperature in the 1960s led to a crash in common octopus populations in British waters (Barrett et al., 2023). Since the 2010s, landings of octopus have been fluctuating in the UK, although their value has been steadily increasing (Barrett et al., 2023). Landings data typically lack distinction between octopus species, although the common octopus is the most prevalent in recorded landings into southwest ports.

Despite the fluctuating landings, recent media reports indicate that there has been a big rise in the abundance of octopus (Owen, 2025; Savva, 2025). The rising value of octopuses and their increased presence in the English Channel could constitute an opportunity to establish a well-managed fishery in the southwest of England. As octopuses are predators, they have historically come into conflict with lobster and crab fisheries, where it is thought octopus opportunistically feed on the crustaceans trapped inside fishing pots. Octopuses are not currently quota species, and not subject to Total Allowable Catch (TAC) limits. There is no current requirement to identify the catch to species level. Consequently, landings are often just recorded as unspecified octopus, leaving a knowledge gap about the current stock status and species presence in the UK. Further, gaps in population size and distribution hinder effective fishery management and stock assessment.

1.2 Project aim and objectives

The main objective was to investigate the potential viability of an octopus-targeted fishery in southwest England and explore potential management measures associated with any such fishery. The study had four specific objectives:

I. Assess the current abundance trends of common octopus and curled octopus in the southwest.
II. Scope out the opportunities that could be provided by establishing a targeted octopus fishery as well as the potential risks of both increasing octopus abundance and of the introduction of an octopus fishery.
III. Assess the viability and feasibility of setting up a targeted octopus fishery in southwest England including but not limited to:
    - how difficult it would be for fishers to diversify into octopus fishing
    - ethical consideration for catching and dispatching of octopus which is recognised as sentient
    - resilience of an octopus fishery to climate change
    - supply chain feasibility and potential for growth
IV. Provide recommendations on potential management measures, evidence/data and monitoring needs.

1.3 Project scope

The geographic scope is southwest England (International Council for the Exploration of the Seas (ICES) subarea 7e) because recent landings data show that most of the octopus landings come from the western English Channel and the Celtic Sea. The project scope encompasses offshore and inshore fishing vessels using mobile and static gear. A higher proportion of octopuses are caught in trawls than in pots, however, those caught in trawls are part of a mixed fishery and not specifically targeted. Therefore, the feasibility portion of the study focuses on the inshore vessels using pots as potting vessels are the fleet most likely to undertake an octopus-targeted fishery. Further, concerns over increases in octopus abundance reported by stakeholders came from the inshore potting fleet. These concerns were raised via the Fisheries Management Plans development process.

1.4 Report structure

The report is structured to provide a comprehensive overview of the tasks undertaken and the findings from the study. It is divided into five main sections including:

- Section 1: Introduction to the project
- Section 2: Approach and methods employed
- Section 3: Results
- Section 4: Discussion
- Section 5: Conclusions and recommendations

2. Approach and methods

A desk-based approach was undertaken in this study which involved five main activities. These include:

i. Literature review to understand octopus physiology and life traits, diet composition, population dynamics, distribution and seasonality.
ii. Primary data collection through stakeholder engagement.
iii. Secondary data collation.
iv. Review of two octopus fishery case studies; i) the artisanal MSC certified western Asturias octopus trap fishery Cofradías in Spain and ii) the Brittany octopus fishery in north France.
v. An online stakeholder workshop to validate findings and draw out management recommendations.

2.1 Literature review

A literature review was undertaken to understand the i) biology, life cycle, reproduction, and presence of octopus in the UK, ii) their activity patterns, and iii) seasonal fluctuations in population densities. To gather available literature, search terms were developed and used to identify both peer-reviewed scientific articles and grey literature. Searches were conducted through Google Scholar using Boolean logic ("AND", "OR", "NOT") to connect terms and widen the volume of the literature. Three key search categories related to species, topics and geography were used each with several terms to increase the relevance of the literature (Table 1). The search focused on gathering recent literature from 2014 to 2024, however, earlier literature was retained in the context of the historical presence of octopus in the UK. An additional search through Google was conducted to assess the presence of octopus in recreational fishers' catches. This search reviewed social media and forums commonly used by recreational fishers.

Table 1: Summary of search terms used to identify peer-reviewed and grey literature.

Species	Topics	Geographical scope
octopus	climate change	Cornwall
Octopus vulgaris	sentience	England
curled	vulnerability	UK
common	diet	Atlantic
horned	ecology	English Channel
Eledone cirrhosa	population	southwest
	life	

2.2 Primary data collection

Key stakeholders were consulted to understand the potential viability of an octopus-targeted fishery in the southwest. First, a list of producer organisations (PO), fishermen's associations and key people in various landing ports from the southwest was compiled (Table 2). The list included the three Inshore Fisheries

Conservation Authorities (IFCAs) (Cornwall, Southern, and Devon and Severn) that have jurisdiction over the southwest. Each stakeholder on the list was contacted through email and asked to provide any data they hold and names of key people for follow-up interviews.

Table 2: List of organisations contacted to take part in the study and whether they hold data or have people for follow-up interviews.

Organisation	Position	Area	Data	Interview follow-up
Sennen cove	Fisherman	Sennen Cove (4 under 8m static gear vessels)	Yes, the diary would be made available confidentially from one skipper	Yes
Cornish FPO	Representative	80 over 10m vessels 80 under 10m vessels	Yes, but not at species level and same as recorded by MMO	Yes
Western FPO	Representative	25 over 10m vessels 2 under10m vessels	Yes, but not at species level and same as recorded by MMO	Yes, PO has 4 offshore crabbers
SW FPO	Representative	All over 10m towed gear vessels	Yes, but not at species level and same as recorded by MMO	N/A
Porthoustock / Lizard	Skipper / owner	3 under 8m vessels	No	Yes
Looe Fishermen's Protection Association	Skipper / owner Chair	10 vessels in Looe	No	N/A
Plymouth Fishing and Seafood Association	Representative	Mixed vessels all under 15m	No	N/A
Padstow fisherman	Skipper / owner, local un-official rep	Under 10m shellfish vessels x 6	No	N/A
Hayle Fishermen's / Association	Skipper / owner Secretary	Under 10m 10 vessels	No	Yes

Newquay fisherman	Skipper / owner	Under 10m 10 vessels	No	N/A
South Devon Channel & Shellfish	Representative	60 member vessels	No	Yes
St Ives Fishermen's Association	Skipper / owner Acting chair	12 vessels all static gear under 10 m	No	N/A
Devon & Severn IFCA	Chief Fishery Officer		N/A	Yes
Cornwall IFCA	Chief Fishery Officer		Yes, some	Yes
Southern IFCA	Chief Fishery Officer		No	No

Second, a questionnaire was developed to gather any data that stakeholders had and to understand their perceptions towards key issues surrounding octopus in the southwest and the viability of an octopus-targeted fishery. The questionnaire (Annex 1) consisted mainly of open-ended questions. The questions were grouped into four broad categories to encapsulate the key issues being studied. These included:

- **Respondent details**. The first section required basic information from the respondent, including the number of years they have been fishing, main landing port, gear used, and ICES rectangles fished.
- **Catch data**. This second section of the questionnaire focused on gathering catch data at the species level that the respondent held. The questions required the respondent to indicate whether they have been catching octopus recently, whether they separate octopus catch by species and whether their annual catch for octopus has changed over the last five years. The respondent was then asked to provide the weight and value of their octopus catch for the different years.
- **Perceptions**. The third section required respondents to rank key issues surrounding octopus in the southwest (including stock availability, seasonality, and damage to crabs and lobsters) based on how important the issue is currently, and how important it will be in the future. Other questions in this section required respondents to provide their opinions on whether there are opportunities for establishing an octopus fishery in the southwest, and how viable an octopus-targeted fishery would be.
- **Market assessment**. The fourth section targeted buyers and sellers of octopus and required them to provide information on whether there was a ready market for octopus in their area, supply chain issues for octopus and whether there is potential for growth of an octopus-targeted fishery in the southwest.

Face-to-face interviews were conducted with ten vessel owners in south Devon and west Cornwall. Responses from the interviews were summarised for the two areas based on the issues under study.

2.3 Secondary data collation

Both fisheries-dependent and fisheries-independent data were sought to be used in this study. There are very few surveys that include octopus in their data collection programme. Data from the Cefas observer programme were requested, but these could not be made available to the required timescale. Further, it is understood that very few observer trips record octopus since it is a non-quota species. The assessment was therefore completed using landings data alone. Catch and effort data over the last eight years (2017 to 2024) were provided by the MMO. The catch data included the wet weight and value of octopus, crab, lobster, and other species reported by fishers and fish merchants to the MMO landed at various ports around the southwest of England. The data set included the year and month of fishing, trip duration, landing port, vessel length, fishing gear and ICES rectangle fished. A further subset of the 2024 catch data for the inshore fleet collected through the Record Your Catch App was made available. The Record Your Catch App is a service that can be used by English and Welsh under 10m (small-scale fishery) vessel owners and skippers fishing in UK waters to submit catch records (MMO, 2019).

The data were first filtered by geographical scope to select the southwest as ICES rectangles 27E3-E7 to 31E3-E7. The total annual weight and value of octopus were then tabulated from 2017 to 2024, with the data pooled for all octopus species codes and separately for each code used in the landing dataset. A comparison was made based on the weight landed using trawls versus that for pots over the eight years. The total weight of octopus for each month landed by trawlers and potters was used to compare the seasonal distribution of octopus catches for the two gear types. Similarly, to explore whether there are changes in landings of the key species targeted by potters, the weight and value of octopus were compared with that of crabs and lobsters. The number of trips with octopus landings was compared with those for crab and lobster for vessels potting and then plotted. The price per kilogram was calculated by dividing the value of the catch by the corresponding weight.

The weight of octopus landed in various southwest ports per year was used to visualise the spatial distribution of octopus catches grouped by ICES rectangle or sub-rectangle, where possible. These data were analysed using RStudio version 4.3, with packages including but not limited to *dplyr, tidyverse, ggplot2* and plotted. The base map was the ICES rectangles 27E3-E7 to 31E3-E7 that make up the southwest region. Similarly, the more disaggregated data for the inshore fleet for 2024 collected through the Record Your Catch app were plotted for the southwest at the sub-rectangle level.

2.4 Case studies

Two octopus fisheries that have recently been established were reviewed: i) the Western Asturias octopus trap fishery in Spain and ii) the Brittany octopus fishery in France. Management was reviewed in both fisheries to gain insights into the different approaches used and their outcomes. These two octopus fisheries present contrasting management approaches. The western Asturias fishery was set up with the explicit goal of achieving MSC certification, adopting a science-based, ecosystem approach from the outset, whereas the Brittany fishery emerged to address socio-economic challenges, focusing on industry-led decision-making and effort control.

By evaluating these two existing examples of octopus fishery management, the case studies highlight the strengths and limitations of each approach. In doing so, effective management strategies can be identified, drawing upon valuable experiences to understand what is necessary for developing a sustainable octopus fishery. Analysing fisheries with differing approaches demonstrates how clear objectives and tailored management frameworks can shape a fishery's outcome. Comparing a science-based certification model with a socio-economically-driven method shows the trade-offs and benefits within each system. Ultimately, the case studies demonstrate that the success of a fishery depends on its initial clearly defined goals, with management practices aligned to the objectives in an adaptable strategy.

2.5 Stakeholder workshop

A key part of the project involved organisation of an online workshop with key stakeholders involved in fisheries management, science and policy, including representatives of producer organisations, fishermen's associations, and IFCAs. The workshop aimed to present preliminary findings from the project and gather further insights from the participants. The workshop was also an opportunity for participants to discuss issues related to the establishment of an octopus-targeted fishery as well as the potential risks of both increasing octopus abundance and the introduction of an octopus fishery. The workshop started with a presentation summarising the key findings from the landings data, stakeholder consultation, literature review and case studies. The presentation was followed by a question-and-answer session where the project team expanded/clarified specific aspects of the findings. The final session of the workshop was an open discussion centred around the key issues, including the abundance of octopus, opportunities and threats, management and evidence needs. The key points raised during the discussion were recorded.

3. Results

3.1 Octopus life cycle and presence in English southwest waters

Both common and curled octopus are widely distributed across the Mediterranean Sea and northeastern Atlantic, reaching as far as the English Channel and North Sea coastlines. They live on the continental shelves, usually between 20 and 200m deep, but can also be found as deep as 700m. They are often caught by targeted small-scale fisheries or industrial vessels as bycatch in hand jigs, pots, trammel nets, traps and bottom trawls (Arechavala-Lopez et al., 2018). Although the two species can appear similar, the curled octopus has a distinct yellowish, reddish-orange or brownish red with a rust-coloured spotted body, and prefers soft and sandy bottoms (FAO, n.d.). Another distinctive feature is that whilst the common octopus has two rows of suckers in the tentacles, the curled octopus only has one.

3.1.1 Biology, physiology and population

The common octopus has a short life cycle, with growth rates varying significantly between individuals, dependent on diet and temperature. The life expectancy of the common octopus is between 12 and 15 months. The spawning season is typically between April and July, with a following period of high juvenile mortality during the paralarvae (planktonic larval stages) and settlement stages of the juveniles. Common octopus shows seasonal vertical movements, which are more typical in large and mature individuals. Other studies have, however, shown high site fidelity and no vertical migration unless looking for food and mating opportunities (Mereu et al., 2015).

The common octopus becomes sexually mature at different sizes, with the lowest threshold in the Mediterranean being considered a mantle length of 11.9cm for females, and 10.3cm for males on average. This corresponds to an average weight of 1.3 – 1.8kg for females, and 1.3kg for males (Cuccu et al., 2021; Papadopoulo et al., 2024). In the northeast Atlantic, it is estimated that the size of first maturity for common octopus is 13.5 – 14.4cm in females and 9.5 – 9.7cm in males, measured as mantle length, equivalent to a body weight of 1 - 2.4kg for females (DEFRA, 2023).

Females protect the eggs under dens or rocks until they hatch, a behaviour which in almost all cases leads to death by starvation for the female, or death shortly after the eggs have hatched. In conditions of limited food, shelter and mating opportunities, octopuses can undergo long-distance movements (Arechevala-Lopez et al., 2018). Vertical seasonal migration has also been associated with the reproductive patterns of octopus in the Atlantic Spanish waters. Studies indicate that the hatching peak in Galician waters occurs in late summer and autumn, with spawning taking place in spring when mesozooplankton is abundant and dispersive conditions are minimal (Otero et al., 2007). Upwelling-related retention processes have been previously identified as important factors affecting recruitment variation in this species. The seasonal and vertical nature of the common octopus is also influenced by several environmental factors, such as seafloor morphology, chlorophyll-a concentration, sea surface temperature and salinity (Garcia-Martinez et al, 2017). Although

octopuses make seasonal vertical movements based on their size and maturity, others, like those that spawn in deeper waters do not migrate vertically (Arechevala-Lopez et al., 2018).

The adaptation to environmental variations is fundamental for the survival and settlement of juvenile octopus, as the substrate type and characteristics of the bottom can influence survival, relocation, and therefore population density and distribution (Arechevala-Lopez et al., 2018). The population of octopus is at peak density between summer and autumn when juveniles have settled after the spawning season. Mortality is most common just before settlement when juveniles and paralarvae have not found shelter in dens. For this reason, population density and distribution are highly variable and influenced by environmental factors (Arechevala-Lopez et al., 2018). The typical habitat of the common octopus is rocky shores, seagrass, and sandy bottoms that offer shells or structures to be used as dens. Octopus actively select dens to avoid predation and competition and remain sheltered for most of their lifetime. Once settled, the common octopus can show different levels of site fidelity to their dens. It has been observed that octopus tend to remain longer in areas where their preferred prey is available, suggesting an overall high site fidelity (Mereu et al., 2014; Fuente and Iglesias, 2010).

The curled octopus shares life traits with the common octopus, although landings of curled octopus are significantly lower. In northern Atlantic waters, the curled octopus can live up to 17 months, and the largest individuals are usually caught in deeper waters and in summer (Regueira et al., 2014). Population and stock models suggest that curled octopus are highly abundant in shallow waters during spring and early summer but can migrate quickly offshore to deeper water in the winter season (Fernández, 2017). The curled octopus reproduces between March and August, resulting in an increase in population density in spring/summer, and peak mortality after spawning in autumn (FAO, n.d.). In the central Mediterranean Sea, the size at first maturity for both sexes of curled octopus is estimated as a mantle length of 9.3cm for females and 8.3cm for males (Donnaloia et al., 2010). In the northern Atlantic, it is estimated that the size of the first maturity of a curled octopus is at a mantle length of 10.1 – 13.5cm in females equating to a body weight of 400 – 1000g, and 9.1 – 10.9cm in males for a weight of 200g (DEFRA, 2023).

Like the common octopus, the curled octopus can show vertical migration after mating, with females migrating to shallow water to spawn, laying eggs on rocky substrate in a similar way to the common octopus. Studies and habitat suitability assessments have highlighted that curled octopuses prefer sandy bottoms and aggregate in areas of high productivity with sea-surface temperatures of 20 – 22°C. During autumn, recruits can usually be found in shallower waters (<200m) in the northeast Atlantic, while adults roam in deeper habitats (Regueira et al., 2014).

Considering octopus reproduce once in their lifetime, it is crucial to account for the size at first maturity to properly manage and preserve spawning biomass for sustainability (Donnaloia et al., 2010). Comparisons from the trawl fisheries in the north of Spain (Galicia) show different catchability between sexes during

different life stages, with females becoming more vulnerable to fishing in spring, while a proportion of males remain in deeper waters after mating. Females lay their eggs in dens and remain sheltered until the eggs hatch, a behaviour that would reduce their exposure to fishing, while males can be captured throughout their lives (Regueira et al., 2015). The sale price of curled octopus is also generally lower than common octopus, except for the seasonal increase in price in Italy during the summer season (Lishchenko et al., 2021).

Both species have a similar diet, which has been studied using the stomach content of octopus in the Mediterranean and the Atlantic Spanish coast. The diet composition and preference can change depending on the maturity, fishing ground and season, but overall, their diet consists of crustaceans, teleost fish, echinoderms, molluscs and polychaetes (Regueira et al., 2016). It has been observed that bivalves dominated the diet of larger octopuses, while in smaller individuals, crustaceans were the most common prey (Lishchenko et al., 2021).

An extensive study in Spain found octopuses' stomachs contained 131 taxa belonging to 18 phyla, 57 orders and 95 families, demonstrating variety in diet choices (Escolar et al., 2024). Juveniles showed the greatest variety in prey composition, while adults showed stronger prey preference and less diet diversity (Escolar et al., 2024). The difference in prey composition during the life cycle of octopus is also documented between pre- versus post post-settlement. During the planktonic stage, the most common prey are decapod larvae, followed by copepods, brittle stars and cladocerans (water fleas). Once settled and in the juvenile stage, amphipods become the most frequently occurring prey, followed by hydrozoans, decapod crustaceans and bivalves. In the subadult and adult stages, crabs, molluscs and teleost fishes are the primary prey, while brooding females cease feeding after spawning (Escolar et al., 2024).

3.1.2 Vulnerability

Octopuses are cryptic species, as they spend a great portion of their lives in dens. They are cosmopolitan animals that can be present in a wide variety of climates and habitats. Overall, the common octopus is highly tolerant to environmental parameters, being able to survive outside of water for around one hour and showcasing a remarkable physiological recovery from stress (Peng et al., 2022). Despite this, their survival is greatly influenced by the availability of shelter and the surrounding environment. For example, changes in food and shelter availability have been linked to migration in the Mediterranean Sea, with a predominance of females migrating to habitats with better food and shelter opportunities (Lishchenko et al., 2021).

In the context of climate change and global warming, changes in temperature, salinity and prey availability influence the distribution and presence of octopus. For instance, water temperature determines the timing of the onset and duration of the spawning period for common octopus, which can directly affect the trends in catches and their seasonality if sexual behaviour is altered. This is because in the summer, females breed eggs in dens, where they are unavailable to fishing gear (Lishchenko et al., 2021). Changes in salinity are another limiting factor for the presence and abundance of the common octopus. In a scenario of decreased bottom salinity or increased freshwater runoff, the feeding pattern and

survival of octopus can be at risk, as low salinity has been linked to reduced food consumption and the cessation of feeding (Lishchenko et al., 2021).

The forecast trend for 2070 to 2100 under scenario RCP 2.6 is an increase of 1.5°C above pre-industrial levels in sea surface temperature, along with alterations in other parameters such as pH, available oxygen, and CO_2. In a scenario of +1.5°C warming, the distribution and presence of the common octopus is expected to shift toward higher latitudes, a pattern that would affect the ranges of other cephalopods too, such as cuttlefish and squid. The changes in octopus presence would mean increased abundance at latitudes above 70 degrees north (north of Iceland), as well as a higher diversity and abundance of cephalopods including common cuttlefish and squid. In an RCP 8.5 scenario, ocean warming would cause increasing sea surface temperature in northern Europe, providing an optimal thermal range for cephalopod survival (Schickele et al., 2021).

Other typical regions, such as the Mediterranean Sea, could see a significant decrease in octopus presence under all warming scenarios, with pH (i.e. ocean acidification) being the most influential factor on habitat suitability (Boavida-Portugal et al., 2022). Habitat reduction is one of the main causes of octopus migration under climate change, with common octopus at risk of local extinction under the most extreme climate forecasts, mainly due to increased benthic salinity and sea surface temperature (Borges et al., 2022).

As ocean warming drives species expansion northwards, the abundance of octopus is expected to increase at high latitudes. Typically, animals inhabiting colder climates show increased body size compared to the same species living in warmer regions (Atkinson, 1994). While climate change may cause a reduction in habitats at sub-tropical latitudes, octopus populations could find suitable habitats in temperate and sub-polar regions as sea surface temperatures increase. This implies that octopus stocks may become more valuable to fisheries in the next decades as they are predicted to increase in both body size and abundance in UK waters.

Ocean warming could make octopus more accessible to fisheries in northern latitudes in terms of species presence, distribution and body size. Fisheries would benefit from the predicted poleward shifts in species richness, but may need to follow a precautionary principle, such as considering temperature-induced recruitment variability and adjusting catch limits to body size (Boavida-Portugal et al., 2022; Schickele et al., 2021). For example, it has been projected that an increase in octopus abundance northward may increase top-down impacts on lower trophic levels (e.g. crustacean, planktivorous fish), potentially influencing the productivity of the lower trophic level species (Schickele et al., 2021).

The presence of other species, especially predators, could increase the vulnerability of octopus populations, in conjunction with fishing pressure. For instance, coastal and inshore fisheries where octopus are prey for moray eels, conger eels and groupers, this can significantly influence the presence and abundance of octopus. On the other hand, in coastal areas where predator

presence is scarce, the main limiting factors for octopus are the presence of dens and competition with other octopus (Arechevala-Lopez et al., 2018). With the emergence of new potential fisheries in the northern Atlantic, understanding the vulnerability of octopus to fishing pressure is important to forecast the long-term sustainability of the fishery. Firstly, the seasonal nature of octopus requires management to ensure that spawning and recruitment do not coincide with fishing seasons. By avoiding the reproductive season, the vulnerability of common octopus to fishing is similar between males and females, as assessed in an experimental fishery between September and April along the eastern Atlantic coasts (Arechevala-Lopez et al., 2018; Otero et al., 2007).

In the case of high-impact fishing such as trawling, octopuses, including the curled octopus, show evidence of psychological distress, including a compromised immune response (Barragán-Méndez et al., 2019). However, several studies have documented the fast recovery after stressful situations, suggesting a medium vulnerability to fishing pressure and bycatch if discarded alive. Considering the life cycle and behaviour of the common octopus, the spawning season represents the period of highest vulnerability for males, as they remain available to fisheries while females move inside dens to care for the eggs until hatching. When females retreat into dens and caves to protect the eggs, they can become inaccessible to traps and other fishing gear, as they do not leave the dens until the eggs have fully hatched, ceasing all feeding and predating activities (Arechevala-Lopez et al., 2018). While other fishing methods, such as spearfishing, can still capture females inside dens, males remain vulnerable to all fishing methods during this period, as they continue feeding.

Several factors influence octopuses' presence, including food availability, predators, climate change and habitat, as well as seasonality. Management should rely on a census of stock status and demographics, as a common practice in fisheries management. However, the lack of stock assessments for octopus is an important limiting factor when investigating a potential fishery. Direct underwater observations by visual census are often unsuitable for this species due to its cryptic ability, shelter use and wide vertical distribution (>200m depth). Tagging and tracking are generally unsuccessful with octopus, as they can remove tags, and can move beyond the geographical limits of a study area (Mereu et al., 2014). Nevertheless, the bulk of demographic models are built from time series of monthly catches, fishing landings and efforts based either on fishery-dependent (i.e. landings, interviews) or on fishery-independent data like experimental fishing surveys (Arechevala-Lopez et al., 2018).

3.1.3 Presence in the UK

For the last two hundred years, octopuses have been widely present in British waters (Rees and Lumby, 1954). The curled octopus has been captured and documented across British waters, while the common octopus has been a resident predominantly in the English Channel with hotspots in the western Channel off the southwest coast of England (Bielli et al., 2024). Historically, their presence was more abundant during warmer years, and their interference with crab and lobster fisheries became evident in the 20th century. During the late 1940s, octopus numbers increased to unprecedented levels, in what were considered the years of the "*octopus plague*" (Rees and Lumby, 1954). In the

late 1960s, British waters recorded a particularly cold period, with sea surface temperature dropping to around 6°C in winter. This sudden decrease in water temperature led to a crash in octopus populations, particularly the common octopus, and octopus presence around the British Isles became sporadic (Barrett et al., 2023).

Since the return of octopus to English waters in the past decades, landings have been stable, while the price and value of octopus increased significantly between 2011 and 2021. Although the two species show distinct physical differences, such as two versus one row of suckers on their tentacles, landings often do not differentiate between the two species. A recent study on trawl surveys and ICES landing data suggests that there is limited coexistence of these two species according to independent fishery surveys and biodiversity data (such as the Ocean Biodiversity Information System and the Global Biodiversity Information Facility) i.e. they don't occupy the same areas. Observation of curled octopus over the past ten years suggests that the populations are expanding and growing in the UK, while the common octopus remains rarer but with a positive trend (Barrett and Brazier, 2024).

With the increase in sea surface temperature over the last ten years, octopuses have been spotted and landed as bycatch in the English Channel both in the UK and in northern France. In the English Channel, octopus is caught primarily as bycatch in otter and beam trawls, but also dredges, drift and fixed nets intended for other species. Octopus catches occur in the first and last quarters of the year, corresponding to the winter season. ICES 7e and 7d areas are hotspots for octopus catches in UK waters. The capture occurs in the form of landed bycatch by inshore vessels (within the western end of the Channel) and as part of a mixed demersal winter fishery using trawls and dredges (DEFRA, 2023). European vessels contribute to a minimal share of octopus catches in UK waters, with octopus catches concentrated in the ICES 7e area (DEFRA, 2023).

Information on the recreational sector for octopus in the UK is limited. The recent Defra review on curled octopus (pp. 16) stated that "*there is no data on the significance of this stock to the recreational sector, but it is thought to be limited*" and there is no data to indicate a significant presence of common octopus either for recreational fishers (Defra, 2023). There are no reports of octopus within the Sea Angling Diary for the recreational sector, nor are there any records in Cefas' Angling Library records (Cefas, 2024).

An alternative source of information is social media, as recreational fishers often share their catches and thoughts on publicly available forums. Social media did not produce any viable information, as occasional videos and records of octopus sightings in the same area might be biased and duplicated by several users for the same octopus individual. One of the most common platforms is World Sea Fishing (https://www.worldseafishing.com), which includes anecdotal evidence and discussion of octopus sightings throughout British waters. For example, one recreational fisher reported an octopus sighting in 2016 and *"[hearing of] a few [octopuses] caught around Dorset shores, caught on rod and line with bait or squid lures*". On the same forum, another fisher confirmed sightings in Scotland - "*Three years ago* [in 2013] *I was fishing from my kayak North of Arbroath and*

had three about the size of my fist on one drift and another one on another further out. I was fishing in Fife a couple of weeks later and caught another" (World Sea Fishing, 2022).

Other users confirmed the increase in catches further south on the English coast, reporting that "*Since last October [2021] we've seen a huge increase in numbers off Plymouth*" and "*up until this weekend I have only caught one, and seen another caught, on Saturday I had three on one drift (not the same one 3 times) then moved 2-300 yds and got another first drop*" in 2020 (World Sea Fishing, 2020). However, another recreational fisher argued that octopuses have been common off the southern coasts, including Wales, for decades, reporting that he came across octopus "*when crabbing right from the 1970's so don't think it's unusual, in fact, I remember the first one and that was at Newton*" (World Sea Fishing, 2009).

There have been reports from scientific divers sighting significant numbers of common octopus including a female with eggs, indicating that common octopus may be breeding in British waters. The results are summarised in Hiscock and Earll's 2024 report. Sightings of common octopus persisted throughout 2023, particularly around the Isles of Scilly and along the southern coastline from Devon to Dorset.

3.1.4 Ethical concerns in the supply chain

Cephalopods, including octopus, are renowned for showing cognitive behaviours that are commonly observed in vertebrates, including highly developed perception, learning and memory abilities. The ability to adapt their behaviour to complex conditions and challenges suggests that they possess profound cognition and awareness, including causal reasoning, future planning, and mental attribution (Schnell et al., 2020). Unique to octopus is the presence of more neurons in the tentacles than there are in the brain, developing into neural circuits that are poorly explored and studied (Olson et al., 2025). Consequently, the understanding of octopus behaviour, intelligence and cognition is limited to anecdotal evidence, and the extent of their capabilities remains incomprehensible to modern biology and neurology experts.

In the UK, the Animal Welfare (Sentience) 2022 Act recognised cephalopods, including octopus, as sentient animals. Although the Act does not include a definition of "sentience", other parties, such as the Scottish Animal Welfare Commission (2021), defined it as "the ability to have physical and emotional experiences, which matter to the animal, and which can be positive and negative". Several inquiries have raised questions since the publication of this Bill, including objections to the comparison of animal rights and welfare, implementation and influence in policymaking, and the scope of the Bill (Animal Welfare (Sentience) Bill, 2022).

In Europe, Council Regulation No 2010/63/EU considers cephalopods as animals who can experience pain, suffering, distress, and lasting harm. The Regulation states that cephalopods must be kept in conditions that meet their welfare needs, and all procedures must minimise pain and suffering. However, the Regulation has no specific guidelines for humane slaughter, other than it

should be performed through humane and compassionate methods. With non-governmental organisations (NGOs) campaigning for tailored policies for cephalopods and crustaceans, animal sentience is an issue that still needs addressing.

Fishing

The process of fishing and catching octopus can be a cause of distress for octopus. For example, traps may be brought onboard at significant speed, causing injuries and stress as the octopus try to escape. When caught as bycatch by nets and trawls, the prolonged compression from nets and catch weight can also be a source of injury and distress (Pereira and Lourenço, 2014). A recent consultation commissioned by Defra reviewed extensive evidence on the definition of sentience against eight criteria, identifying octopus as sentient animals with high/very high confidence (Birch et al., 2021). Octopus are at risk of experiencing distress and death during capture and transportation, and distress during slaughter. Large-scale, non-selective methods such as trawling should be avoided due to their negative effects on both animal welfare and the environment (Sykes et al., 2023).

In the case of bottom trawls, octopuses typically die due to compression in the trawls or die of physical trauma or asphyxiation soon after being offloaded on board. Capture methods like pots and traps are considered more selective and better to use for octopus. Pots and traps made of natural, non-toxic, and non-abrasive surfaces can further promote the welfare and well-being of trapped octopus, reducing the risk of lacerations and physical damage (Sykes et al., 2023). On the other hand, pots and traps can attract both adults and juveniles or females that need to lay eggs. In addition, confinement in a small space can cause distress, limb amputation from aggression, auto-mutilation, and cannibalism of large octopuses eating smaller individuals. These behaviours are aggravated the longer the octopus spends inside a trap or pot before being hauled onboard (Birch et al., 2021).

Transportation

If octopus are transported alive, and are not killed immediately after capture, precautions and best practices should avoid and limit any stress or pain caused to the octopus during transportation. There is a lack of research specifically examining the welfare implications of various capture and transport methods for cephalopods. However, a working group within the Federation of European Laboratory Animal Science Associations (FELASA) is currently developing best-practice guidelines for the capture and transport of these animals. Cephalopods require water with high oxygen levels, and extended transport can reduce oxygen and increase nitrate levels (Birch et al., 2021, Sykes et al., 2023). To prevent this, the use of an air stone or aerator is recommended when necessary. Additionally, if the animals release ink into the water and it isn't removed or the animal isn't transferred, the ink can coat the gills and cause harm. On the other hand, common octopus appear to exhibit some resistance to stress during handling and transport (Birch et al., 2021).

To reduce the stress from handling and transferring octopus, Sykes et al. (2023) suggest separating each octopus into a pot and placing them into a

container/tank filled with seawater and oxygenated air. Corks need to be used as sealing systems and placed on top of each pot to prevent the octopuses from escaping or unscrewing the lids. Containers of cylindrical-conical shape (such as Demijohn baskets) have also been used as a transportation method, with the lower part of the basket filled with seawater and the remaining part being air that is circulated through multiple holes in the cork (Sykes et al., 2023).

Slaughter

The European Food Safety Authority (EFSA) considers a killing method to be "humane" if it stuns or renders the animal instantly unconscious in less than one second before death. Gradual unconsciousness should not cause pain or suffering, such as in the case of anaesthesia or chemical slaughter (EFSA, 2004). Currently, the only slaughter method accepted as "humane" for octopuses is via pharmacological overdose and subsequent decerebration (surgical removal of the central nervous system), a practice that is not suitable for animals for human consumption (Birch et al., 2021).

Octopus are generally slaughtered by several methods, including clubbing the head, slicing the brain, reversing the mantle (muscular sac behind the head that contains all the organs), asphyxiation in a net, and chilling in ice (Pereira and Lourenço, 2014). Octopus bycaught in trawls are often hauled onboard dead, or die of asphyxiation before being iced and frozen, both of which are methods of welfare concern (Birch et al., 2021). In European fisheries, inhumane methods are often used in artisanal fisheries. Mechanical methods are the most common slaughter techniques used for octopus by inducing damage to the brain, such as cutting between the eyes (midline incision) or decapitation (by severing the head from the mantle collar). The extent and type of suffering that such methods cause to octopuses are unclear as they have a decentralised nervous system, which is still poorly understood from a biological perspective (Fiorito et al., 2015; Andrews et al., 2013). These methods are challenging to implement and require skilled operators due to the difficulty of restraining the animals. For these reasons, scientific literature advises against using mechanical methods unless the animal has already been anaesthetised (Fiorito et al., 2015). Considering a large-scale octopus fishery, mechanical methods, such as cutting or puncturing the brain, have a high risk of being inefficient due to the training involved in handling octopus and the volume of catch involved in a commercial setting (Birch et al., 2021).

Electrical stunning is regarded as the most humane method for aquatic animals, being commonly used in farmed fish and crustaceans (Andrews et al., 2013). The immediate interruption of nervous system function provides a fast and effective method to prevent the nervous system from feeling pain. Nevertheless, after stunning, a second kill method is often required. Further research is needed to assess the efficiency of electrical stunning and potential welfare concerns, considering factors like species differences, body weight, sex, and water temperature (Andrews et al., 2013). Additionally, this method would need to be specifically designed for octopus and scientifically tested to confirm its effectiveness as a humane slaughter method (Fiorito et al., 2015; Andrews et al., 2013).

Currently, there are no humane methods for slaughtering octopus for human consumption or at the commercial level, nor are there codes of best practice or voluntary guidelines (Birch et al. 2021). Research organisations, like the Association for Cephalopod Research (CephRes), have been exploring different stunning methods in cephalopods for fisheries, aiming to identify the most humane methods to kill cephalopods (Fiorito et al. 2015).

3.2 Changes in abundance

3.2.1 Temporal distribution

In total, 440 UK registered vessels carried out 23,659 fishing trips between 2017 and 2024 and landed catch in southwest ports. Vessels were both over 10m (n = 217) and under 10m (n = 419) in length and used seven main gear types (Table 3). It is common for some vessels, especially those under 10m, to use more than one gear on the same trip. Therefore, vessels that operate more than one gear were considered a unique "count" for each gear they operate. In other words, if a vessel deploys both pots and nets, these were considered two separate counts, as the main aim was to identify trends for the potting fleet. For vessels over 10m, most were trawlers, constituting 72% of the southwest fleet. The under 10m includes vessels that mainly use a mixture of pots and traps (31%), and gillnet and entangling nets (29%) (Table 3).

Table 3: Total number of vessels and gear combination present in the raw data, grouped by fishing gear and vessel length (source: MMO, 2025). Note that a vessel can use more than one gear type.

Gear	Under 10m vessels	Over 10m vessels
Dredges	17	32
Gear unknown	1	0
Gillnets and entangling nets	122	9
Hooks and Lines	84	0
Pots and traps	131	17
Seine nets	0	1
Trawlers	64	158
Total	**419**	**217**

Landings data show that between 2017 and 2024, 87% of octopus landings were recorded using generic octopus codes "Octopus nei" and "Octopus etc nei", where "nei" stands for "not elsewhere included". Generic octopus is registered using two separate but similar codes, OCT (Octopus, etc. nei) as advised by the UK Government, or OCZ (Octopus nei) as advised by the FAO (MMO, 2017; FAO, n.d.). The curled octopus code (EOI) started being used in 2022, although there are few records submitted. The common octopus (OCC) has been used across all years, constituting 12% of the landings between 2017 and 2024.

The years with the highest volume of landings of all octopus codes reported were 2019 with 325 tonnes, followed by 2017 with 277 tonnes, and 2020 with 254 tonnes. The year with the lowest landings was 2024, with 121 tonnes (Table 4).

Table 4: Octopus (tonnes) landed by UK vessels into southwest ports by species codes. The weight was rounded to the nearest integer value. Zero present catches too small to be rounded while null cells indicate that no catches were recorded (source: MMO, 2025).
N.B. FAO alpha species codes are as follows: curled or horned octopus (EOI, *Eledone cirrhosa*), common octopus (OCC, *Octopus vulgaris*), and generic octopus (OCT, OCZ, as octopus nei).

Species codes	2017	2018	2019	2020	2021	2022	2023	2024	Total
EOI	null	null	null	null	null	0	0	0	0
OCC	18	37	50	34	29	29	24	18	238
OCT	259	194	275	220	185	213	165	102	1613
OCZ	0	0	0	0	null	0	0	null	0
Total	**277**	**231**	**325**	**254**	**214**	**241**	**188**	**121**	**1851**

Considering the weight of octopus landed in the most recent eight-year period, trawlers were responsible for 97% of the landings. Potters started landing higher amounts of octopus in 2022, increasing from <0.5 tonnes to over 5 tonnes. Data show that 2023 had the highest landings by potters in these eight years, with 21 tonnes of octopus landed (Table 5).

Table 5: Octopus (tonnes) landed by UK vessels into southwest ports for the two main gears of interest, trawls and pots, for all vessels under and over 10 metres in length (source: MMO, 2025).

Species codes	2017	2018	2019	2020	2021	2022	2023	2024	Total
Trawls	276	229	323	253	213	233	164	114	1805
Pots	0.0	0.1	0.5	0.1	0.0	5.3	21.1	6.0	32.7

For under 10m potting vessels, while 2023 had the highest octopus landings with 13 tonnes, it also had the highest crab landings (26 tonnes) and lobster (15 tonnes). For these vessels, crab landings increased until 2020, then dropped in 2021, and rose again in the later years until 2024. For lobsters, the trend is similar, with maximum landings in 2023 of 15 tonnes (Table 6).

Table 6: Annual landings (kg) of octopus, crab (edible and spider) and lobsters in the southwest region for under 10m potting vessels (source: MMO, 2025).

Year	Crab	Lobster	Octopus
2017	570	27	24
2018	766	74	117
2019	3,878	1,163	491
2020	2,664	367	145
2021	118	321	63
2022	11,966	4,993	4,374
2023	26,318	15,228	13,558
2024	23,576	8,840	2,511

Octopus landings show a seasonal pattern, which differs between the two main gear types. For trawlers, the peak landings occur in November to January, during which 120 to 140kg of octopus are landed on average per trip (Figure 1). However, between April and July, landings decrease to 30 to 45kg per trip. Given most of these vessels fish offshore, it can be inferred that octopus is more abundant in deeper waters during winter months.

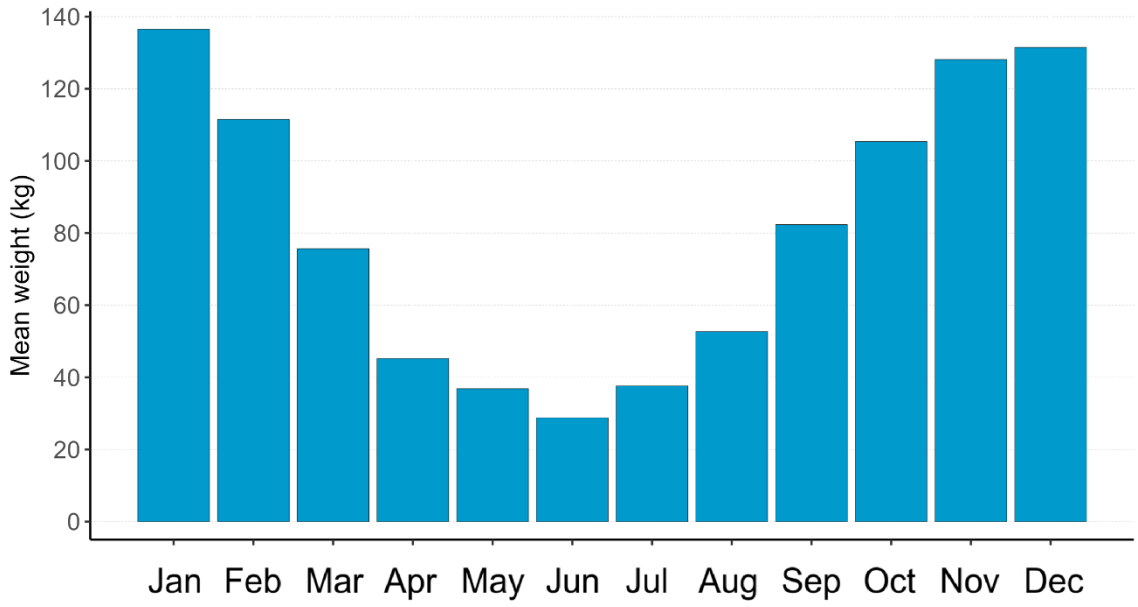

Figure 1: Monthly average octopus landings in the southwest per fishing trip for trawling vessels between 2017 and 2024 (source: MMO, 2025).

Overall, 88% of potting vessels are under 10m in length, primarily targeting crabs and lobsters. The peak months for octopus landings by the inshore potting fleet are May and June, with an average catch of 24kg and 21kg per trip, respectively. The winter months (January, February and March) show the lowest landings, with an average of less than 9kg per trip across the three months.

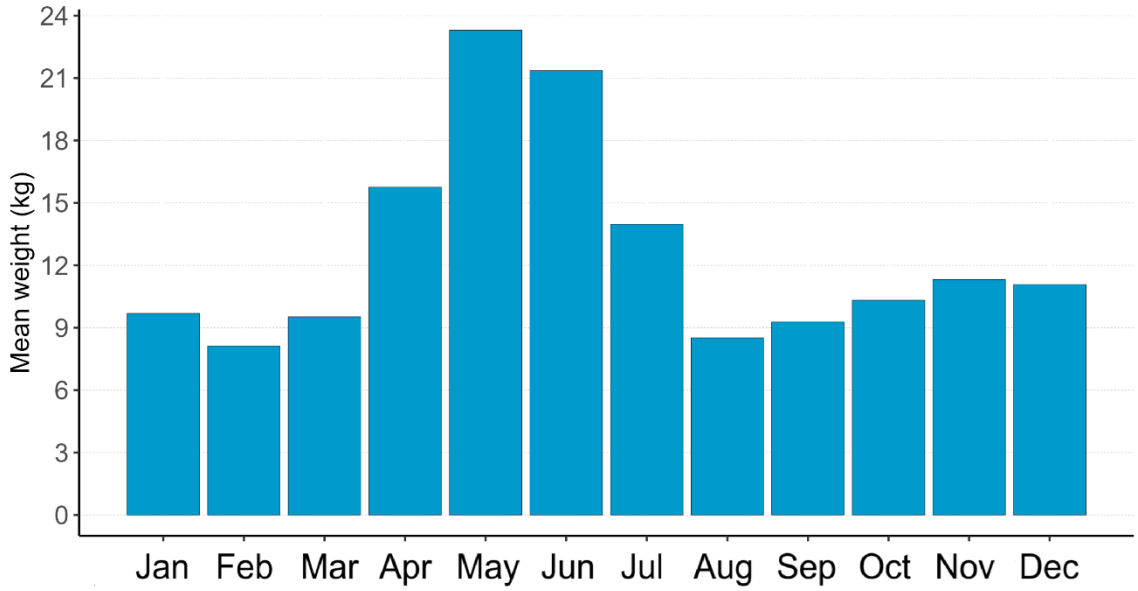

Figure 2: Monthly average octopus landings per fishing trip in the southwest for potting vessels between 2017 and 2024 (source: MMO, 2025).

The average crab and lobster catch per trip also shows seasonal trends, with landings increasing between May and July. On average, the potting vessels land the highest quantity of lobsters in June, with almost 39kg per fishing trip (Figure 3). Catches in the summer months remain high until they experience a strong decrease in late autumn and early winter. A potting vessel catches the highest quantity of crab in November, with 650kg per trip on average, followed by October with 450kg per trip, and July with approximately 430kg. November is the month with the lowest lobster landings, with just 15kg per fishing trip.

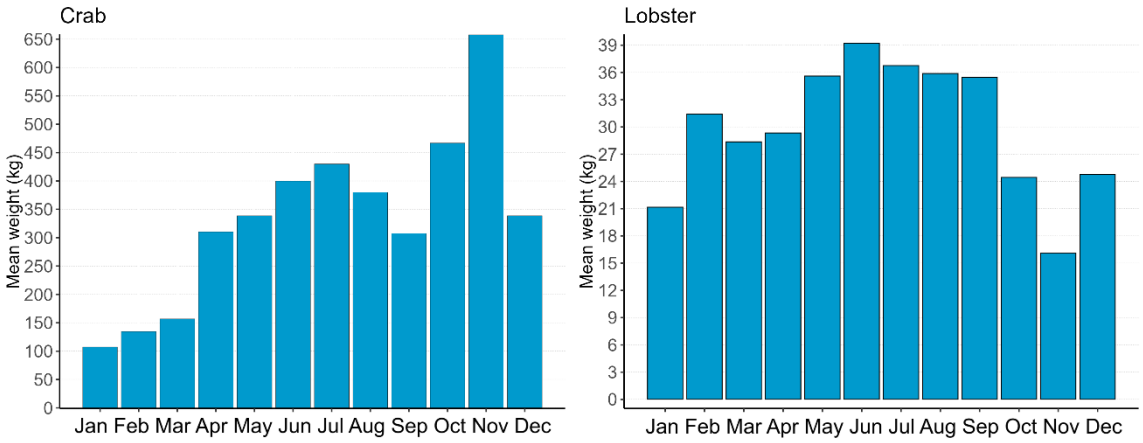

Figure 3: Average crab (edible and spinous spider) and lobster landings per fishing trip in the southwest for potting vessels between 2017 and 2024 (source: MMO, 2025).

The trend in the number of trips for potting vessels per year where octopus were landed shows that the recent increase in abundance of octopus started in 2021 and reached its peak in 2023 and then dropped in 2024 (Figure 4). The trips landing octopus during this period were much higher than those with crab and lobster. This result matches stakeholder views that abundance of octopus started increasing in 2022 and was particularly high in 2023 before dropping in 2024, but still well above historic levels.

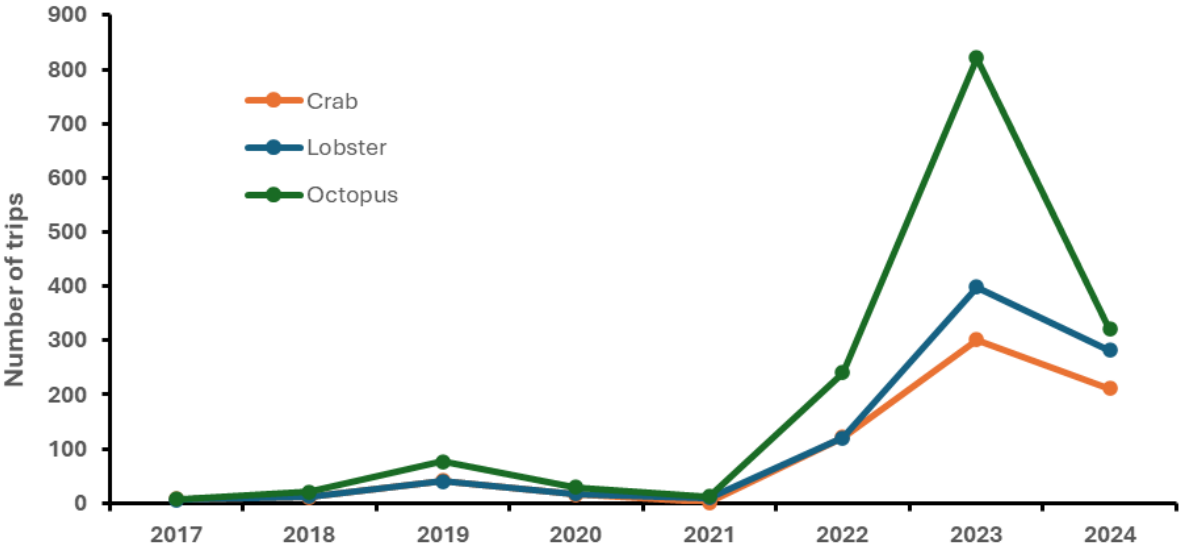

Figure 4: Trends in the number of trips with octopus, crab (edible and spider) and lobster landings for under 10m potting vessels in the southwest between 2017 and 2024, shown as annual average values (source: MMO, 2025).

3.2.2 Spatial distribution

The spatial distribution of octopus landings shows that four ICES rectangles had the highest abundance across the eight years (Figure 5). The greatest portion of landings were caught in ICES rectangle 29E6 and 29E5 off the coasts of Plymouth, Torquay and Salcombe. The offshore rectangles 28E6 and 28E5 also show a high volume of octopuses.

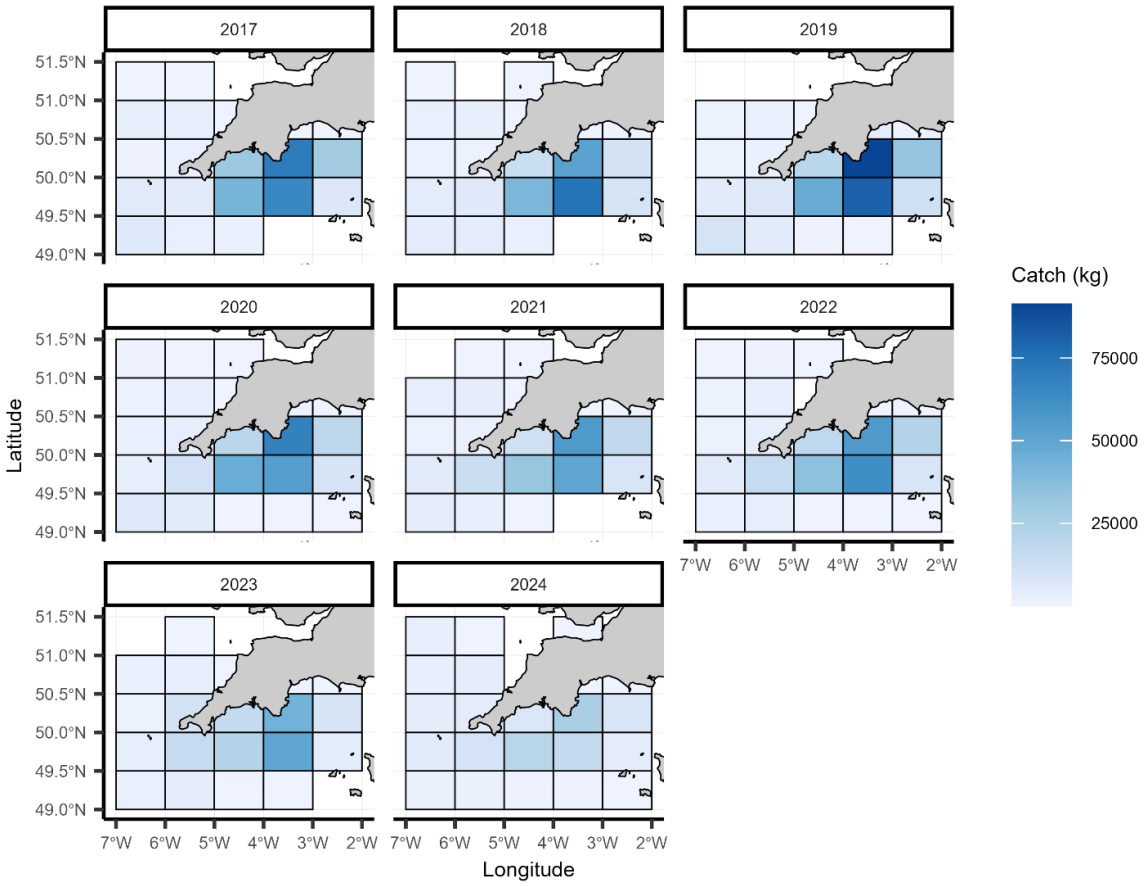

Figure 5: Annual octopus catch (kg) by ICES rectangle for all fishing gear and all vessel categories (source: MMO, 2025).

The breakdown of landings by ICES sub-rectangle based on data from the Record Your Catch App for 2024 for the under 10m vessels shows that south Devon and west Cornwall have the highest abundance of octopus (Figure 6). The sub rectangles 29E65 and 29E49 show the largest catches of octopus, with more than 600kg caught in 2024. Areas further away from the coastline show a gradual decrease in octopus catches, suggesting that most octopuses are caught close to the shoreline by potters. Sub-rectangles further east also see considerably lower octopus catches than in the central and western areas (Figure 6). These data corroborate findings from the interviews which indicated that the Inshore Potting Agreement (IPA) and around the Lizard have high

octopus abundance. The IPA[1] is a zonal and temporal fishery management system designed by inshore fishers to reduce conflict between static gear and towed gear and is regulated through a fishing licence condition.

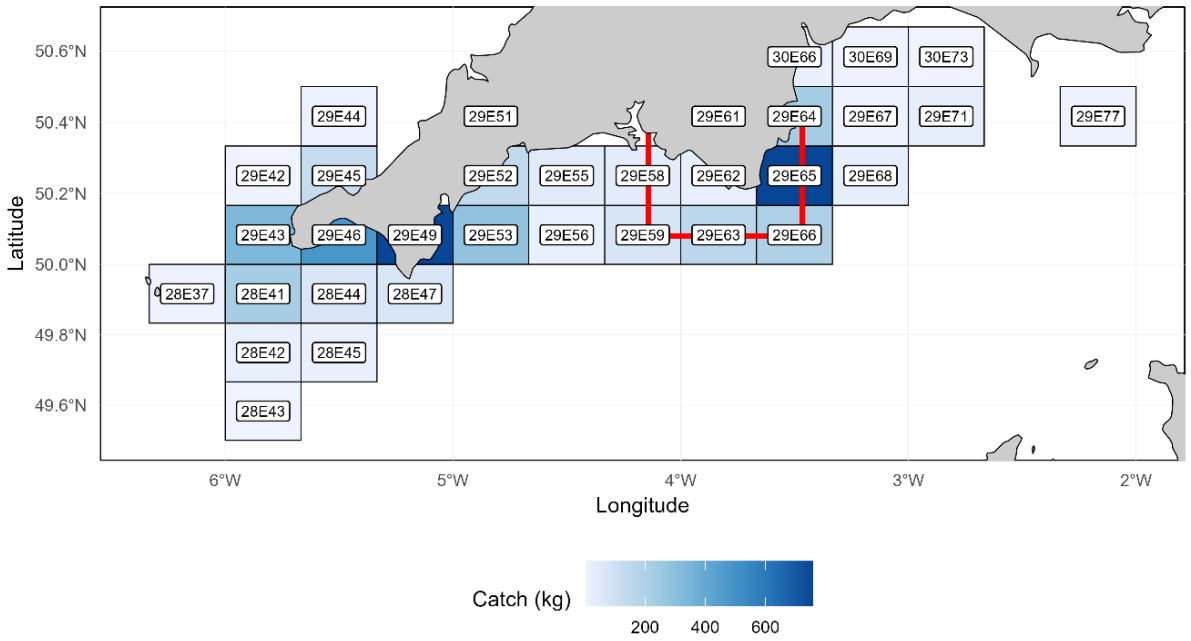

Figure 6: Octopus landings in 2024 based on data collected through the Record Your Catch App for under 10m vessels, showing the sub rectangles with highest catches. The box in red is the area covered by the Inshore Potting Agreement (IPA).

3.3 Stakeholder perceptions

Findings from the initial consultation showed that stakeholders hold little data on octopus, and any information held did not identify to species. Most of these data are reported to the MMO through landing statistics. The information gathered from the stakeholders also indicated that the octopus fishery has two main components: (i) an offshore fishery comprised of bycatch of small octopus which has been going on for 20 years, and (ii) an inshore fishery that has emerged in the most recent three to four years. This fishery takes place mostly over hard ground and is probably linked to predation on lobsters and crabs. The bulk of the fishery is located within coastal waters from Land's End to Newlyn (possibly around the Lizard) and in south Devon around Salcombe / Start point potting area. Other areas covered by the consultation where local stakeholders confirmed occasional catches only include Padstow, Newquay, Hayle, St Ives, Falmouth / Helford, Mevagissey, Looe and Plymouth.

[1] DSIFCA (2024) South Devon Inshore Potting Agreement – Trawling and Crabbing chart 2025. https://www.devonandsevernifca.gov.uk/enforcement-and-legislation/south-devon-ipa-trawling-crabbing-chart/#:~:text=The%20Inshore%20Potting%20Agreement%20(IPA,off%20the%20South%20Devon%20coast. Accessed 03/06/25.

3.1.1 Catching sector

The fishers who took part in the interviews use all types of pots (including whelk pots) for fishing in ICES rectangles 29E6 and 29E4 (Table 7). In south Devon, the vessel owners indicated that octopuses have been abundant throughout the IPA, while in west Cornwall, octopuses were abundant in certain hotspots including 2-3 areas within 0.5nm of the coast. Respondents indicated that they catch octopus as bycatch using normal shellfish bait, with peak catches in May and June. When asked to share their observation of recent trends, the vessel owners stated that they saw an increase in octopus in 2022, followed by a big increase in 2023 and very little in 2024. Interviews were conducted up to the third week of February and thus reflect observations to that date. Respondents from south Devon stated that 2025 is likely to show high abundance since in the first three weeks of February, they landed 300 – 600kg per boat in pots. Skippers indicated that the developments in 2025 are similar to the pattern of recent years, where octopuses are first caught in pots in November as juveniles, then in beam trawls in the mid-Channel in late January / early February and later in the inshore waters in May and June.

Table 7: Summary of responses from interviews with the catching sector.

	South Devon	West Cornwall
No. of skippers	3	7
Vessel sizes	9.5m to 14m	5m to 9m
Crew size	2-3	1
Gear	Pots – all types, including whelk pots and parlours	Pots – mostly hard eye and soft eye larger parlours
Stat rectangle	29E6; the same amount of gear is being worked in the Inshore Potting Area for over 30 years.	29E4 (within 0.5nm of the coast within 2-3 tightly defined areas regarded as 'hotspots')
Ports	Dartmouth, Salcombe	Sennen, Newlyn
Peak months	May-June (February in 2025)	May-June
Seabed types	All (mud, sand and rock)	Hard rough ground
Soak time	2-4 days	2-4 days
Bait	Normal shellfish baits	Normal shellfish baits
Target Y/N	Indirectly	Indirectly
Immediate dispatch	No	Only 1 vessel
Fishery pattern	2022 – saw an increase 2023 – big increase in landings 2024 – absent 2025 – from 21/02 9 to 12 boxes per boat in recent days (300-600kg)	2022 – saw an increase 2023 – big increase in landings 2024 – absent 2025 – not started yet
Management	Greater concern was attached to the impact on shellfish stocks which is the staple year-round fishery.	The greater concern refers to the impact on shellfish stocks which are the staple year-round fishery

	South Devon	West Cornwall
	Felt hard to manage something which was presumed to be very fast-growing and at an end-of-life cycle	Suitable grounds are limited. The areas have also had limited effort in previous years but 2025 could be very different.
Price in 2023	£4.50/kg to £8.60/kg	£7-8/kg average
Other points raised	Shared agreement over the need to understand the biology of the species and answer some questions about breeding, and migration patterns to inform real-time management. If management is required, why? What would the objective be? Also, asked how the French and Spanish manage their octopus fisheries.	

Respondents were asked to rank key issues surrounding octopus in the southwest based on how important the issue is currently, and how important they believe it will be in the future. Ranking of the main issues surrounding octopus provided by respondents indicates that damage to crabs and lobsters in pots, market price, availability of markets and abundance of stock hold the highest importance to potters. All respondents gave high scores to these issues, stating that they are of high importance now and will be in the future (Figure 7).

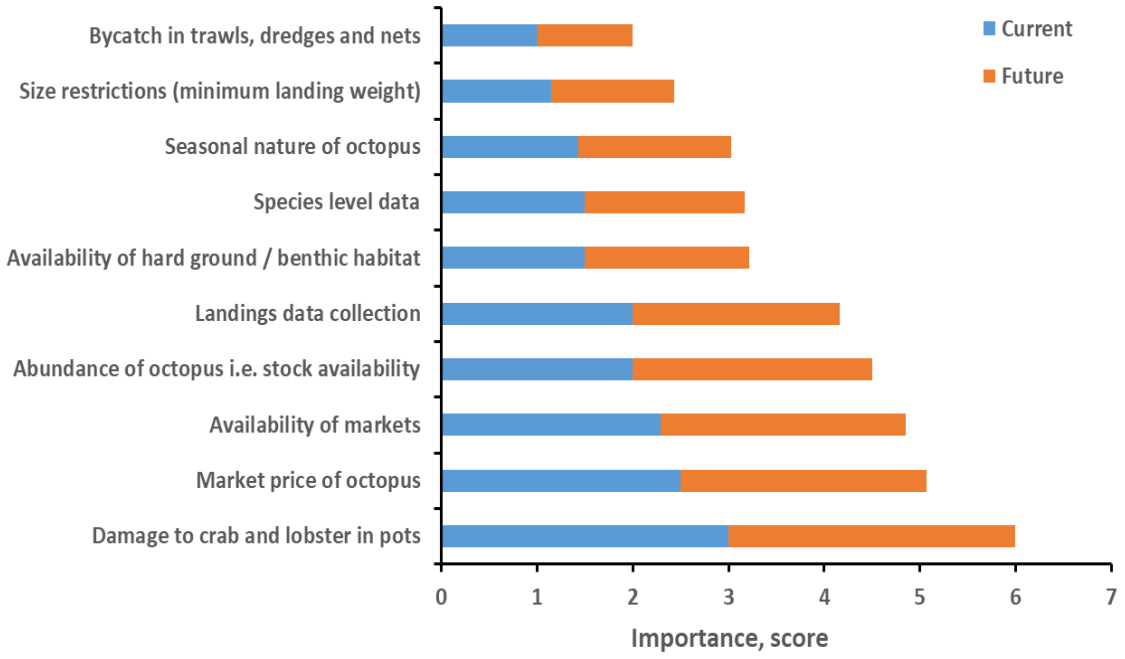

Figure 7: Relative importance of current and future key issues surrounding octopus in southwest England. Scoring was based on a scale of 1 - 3 where 1 is low importance and 3 is high importance.

Respondents were asked to state the most significant factor(s) restricting them from targeting octopus (Table 8). Respondents' views show that uncertainty with octopus abundance and the yearly abundance fluctuations mean that they are not sure whether octopus will be available in enough quantities to support a targeted fishery. The sporadic nature of octopuses and lack of information on areas where octopuses will be abundant make it difficult for vessel owners to have confidence that the stock will support enough catches.

Table 8: Response to the question on the most significant factors restricting potters from targeting octopus. The number of times each factor was mentioned is given in brackets. The answers given in the table show the response and comments made. Number of respondents = 10.

Uncertainty (4)	Availability (3)	Investment (3)	Others (2)
With the catches	Not enough catches	Gear costs and set-up	Good information
Yearly fluctuations	Sporadic nature of the distribution of octopus	Not enough catch to invest	Time
	Locality and abundance		

When asked whether there are any opportunities for establishing an octopus-targeted fishery in the southwest, respondents gave positive answers (Table 9). However, they explained that it depends on whether octopuses are present, are more consistent and widespread. Otherwise, respondents feel that the seasonality and unpredictable nature mean that now is not the right time to set up a targeted fishery. This led two respondents to state that "in the future when numbers increase, there will be a strong chance octopus could become a targeted fishery". None of the respondents stated that they could not see any opportunities for an octopus targeted fishery.

Table 9: Responses to the question of whether there are any opportunities for a targeted octopus fishery. The number of times each response was given is stated in brackets. The answers given in the table show the responses and comments made. Number of respondents = 10.

Yes (6)	Possible (2)
Good opportunity	In the future if numbers increase
If they turn up	Strong chance it will improve so it could become a fishery
If they are more consistent and widespread	
Present, otherwise seasonal and unpredictable	

Similar opinions were provided by the respondents on whether an octopus-targeted fishery in the southwest would be viable (Table 10). The majority of

respondents stated ‘yes’ it would be viable but qualified that this would be on a seasonal basis and very uncertain at present.

Table 10: Responses to the question: is an octopus fishery viable in the southwest? The number of times each response was given is stated in brackets. The answers given in the table show the responses and comments made. Number of respondents = 10.

Viable (4)	Not viable (2)	Others (1)
Very viable	At present	Depends on their presence
Viable (seasonal)	Only as bycatch	
Viable (uncertain)		

The potters who were interviewed stated that an octopus fishery in the southwest has the potential to grow (Table 11). One respondent was optimistic that the growth potential is high while the majority indicated that it is either good or has the potential to grow. Similar to the views provided in the other questions, the growth potential is dependent on stock abundance, more data and information, and how an octopus fishery would be managed. Others added that the potential for growth will depend on weather patterns.

Table 11: Responses to the question: what is the potential for growth of an octopus-targeted fishery? The number of times each response was given is stated in brackets. The answers given in the table show the responses and comments made. Number of respondents = 10.

High (1)	Good (3)	Potential (3)	Others (1)
	Depends on more data and information	If octopus is present, it can grow to a fishery	Weather patterns are key
	As long as it is managed	Abundance needs to increase to support investment	
		Not predictable	

3.2.2 Market for octopus

In 2017, the UK consumed around 2,000t of octopus, with a preference for frozen products imported from abroad (Table 12). On a national scale, 378t of octopus were landed that year, and 1,869t were imported from abroad. Compared to landings and imports, the UK exports a significantly lower quantity of octopus, with 189t exported in 2017. Nevertheless, of the total consumed octopus in the UK that year, only 14% of it was fresh octopus, denoting a preference for processed or frozen products.

Table 12: Supply balances for all octopus products in 2017 for the UK (volumes in tonnes live weight equivalent. Source: European Market Observatory for Fisheries and Aquaculture Products, 2021).

Product	Landings	Import	Total supply (landings and imports)	Export	Apparent consumption
All octopus products (fresh, frozen, smoked, salted, or in brine)	378	1,869	2,247	189	2,059
Fresh octopus	378	3	381	86	295

According to the landings data analysed in Section 3.2, 277t of octopus were landed in the southwest in 2017, while FAO catch and European Market Observatory for Fisheries and Aquaculture Products (EUMOFA) elaboration of Eurostat-COMEXT suggest a national landing of 378t for the same year. With these considerations, it appears that 73% of the octopus landed in the UK occurred in the southwest in 2017.

The results from the buyers' data analysis can provide further insights into the UK market for octopus, such as the price per kilogram of octopus in the southwest and the product price depending on the fishing method. The market values and price per kilogram of octopus in the southwest are considerably higher for pots than for trawlers. This difference is likely due to the size and condition of octopus caught by trawlers, which can affect the selling price, something raised during the stakeholder workshop. Nevertheless, the average price of octopus has been steadily increasing above inflation rate for both gear types since 2017, reaching a maximum annual average in 2024 of £3.78/kg for trawlers, and £5.94/kg in 2022 for potters (Table 13).

Table 13: Average yearly price per kg (£/kg) for octopus caught in the southwest by pots and trawlers based on buyers' data (source: MMO, 2025).

Gear	2017	2018	2019	2020	2021	2022	2023	2024
Trawls	£1.17	£1.85	£1.85	£1.91	£2.38	£2.86	£2.90	£3.78
Pots	£1.49	£2.91	£4.22	£3.75	£4.07	£5.94	£4.65	£5.00

As part of the stakeholder engagement within this study, interviews were conducted in February 2025 with fish buyers and processors to gather information on local, regional and international interest in octopus as well as supply chain issues and potential growth. The information gathered, including

the current price for octopus, is summarised in Table 14. Findings show that the current UK market through food outlets and fish retail shops is limited to around 1t a day. The export market is good, and it is believed it could handle >4-5t a day, possibly more at present as demand on Brixham market in recent weeks [early February] has been strong (i.e. several buyers bidding). Respondents stated that there is an opportunity to upscale significantly, saying that the octopus market could be similar to the cuttlefish market which handles ~200t per week during peak times.

Table 14: Summary of responses from octopus supply chain interviews.

Question/ topic	UK food service	Export	UK retail
Processing required	Limited, usually sold whole and fresh but some customers buy tentacles only as a substitute for imported frozen octopus tentacle products.	Yes, sold fresh or frozen whole (Spanish processing is long simmered then industrial chemical clean, cutting off head to leave a crown with eight tentacles and then cutting into 4 (i.e. 2 tentacles per pack) then blast frozen).	No, sold whole and fresh but sorting is required as 1-1.5kg maximum, otherwise too expensive for UK consumers.
Sentience concerns	An increasing area of concern	No	Yes, has been raised by customers
Price point (auction price)	£7-10 per kg	£4-5 per kg	Below £7 per kg otherwise becomes too sensitive to price
Current market	Limited to around 1 tonne a day during May but less in February/March	Believed that the 'bulk' export market could handle > 4-5 tonnes a day, possibly more at present as demand on Brixham [in February] strong (i.e. several buyers bidding).	Limited growth in the market as prices/size sensitive and still seen as a niche/novelty product.
Future prospect	The market could grow but sentience best practices would need to be addressed.	Citing cuttle fish market of up to 200 tonnes a week at peak as similar. It is believed the export market would be the	Limited

Question/ topic	UK food service	Export	UK retail
		growth area if landings increased significantly.	
Companies interested in undertaking the supply chain role	Matthew Stevens Ltd (R Stein group), Wing of St Mawes (R Blanc group), Stephane Delourme (Ex-Exec Head Chef for Rick Stein group)	Whitelink Seafoods, Falfish, W Harvey & Sons	Falfish (Morrisons), Cornish Fishmonger

3.2.3 Workshop

The workshop (12th March) provided a stimulating discussion over two hours which included findings on recent trends in octopus species abundance in the southwest, opportunities and threats emerging from an octopus fishery, octopus biology and presence in UK waters and management approaches being applied in the Spanish and French octopus fisheries case studies. Table 15 highlights the key points raised during the open discussion.

Table 15: Key points raised during the stakeholder workshop.

Issue	Stakeholder sentiment
Increased abundance of octopus	• There is potential for establishing a targeted octopus fishery, but the population is highly volatile and fluctuates in different areas. The abundance in some areas is too low to sustain a stable fishery. • Restrictions on other fisheries, like pollack could drive fishers toward targeting octopus and not as bycatch. This could be a short-term solution to guarantee income while other stocks recover. • The overlap of octopus and crustacean fishing seasons creates challenges, as crustaceans are more valuable if caught outside the overlapping period. Ideally, these fisheries would have separate seasons to avoid conflict. • The marketability of octopus is affected by its supply fluctuations, making it difficult for the supply chain to rely on consistent pricing. Expanding to European markets may increase price stability, but it depends on demand. • Real-time data collection and monitoring of octopus populations are needed due to their volatile nature. • Collaboration with academic research institutes and the use of indicators for octopus, considering their short life cycle, will be crucial for sustainable management.

Issue	Stakeholder sentiment
Opportunities and threats	• Sentience concerns present a significant challenge, particularly in the handling and transport of octopus. Special containers or welfare guidelines are needed to improve their treatment on fishing vessels and during transportation, which would require funding and support. • In the UK market, sentience considerations are essential for consumer acceptance. However, for bulk exports, sentience concerns are less relevant, and imported octopus often competes on price, making it cheaper than locally caught UK octopus. • The introduction of sentience guidelines could improve the management of octopus fisheries and their marketability. • However, there are differing opinions on issues like minimum landing sizes, especially since some non-quota species, like cuttlefish, die post-spawning, which complicates the application of such measures to octopus.
Management of an octopus fishery	• Before implementing management measures, data collection should be prioritised to gather species-specific information and track the volatility of octopus populations. Regulations should be tailored for octopuses specifically to improve monitoring and data quality. • Real-time monitoring is essential, as traditional methods are not suitable for cephalopods like octopus. A dedicated survey, ideally conducted in the spring, could provide insights into octopus and other cephalopod populations. • Collaboration between the fishing industry and academic researchers could help provide more reliable data on octopus populations. This could include using tools like ID cards (Annex 2) for species identification, though this needs further discussion among stakeholders. • Funding and resources for data collection efforts are a concern, and the industry must prioritise long-term monitoring and adaptive management strategies to ensure sustainable practices.
Evidence Needs	• Long-term, comprehensive data is needed to understand octopus population trends and their impact on other species, like crabs and lobsters, as well as to assess the broader environmental factors influencing their abundance. • Environmental indicators, such as sea surface temperature, may provide insights into octopus population dynamics. Collaborating with academic research institutes could help understand these relationships. • A broader ecosystem approach is necessary, as factors like climate change, the availability of other species, and shifts in fish populations as predators (moray eels, groupers, snappers and some sharks) can affect octopus numbers. The involvement of EU counterparts in research could provide valuable comparative data from different regions.

Issue	Stakeholder sentiment
	• There is a need for more research into the potential impacts of larger-scale environmental cycles, such as the North Atlantic multidecadal oscillation, on octopus and other marine species. Identifying long-term cycles in population trends will be essential for understanding octopus stock changes.

The main concern regarding the abundance of octopus was the volatility of the stock, which fluctuates spatially and temporally. While there is potential to establish a targeted fishery, the abundance in some areas is too low to support a fishery. In addition, the overlap between octopus and crustacean fisheries complicates the situation, as both fisheries compete for investment e.g. in pots. Fluctuating octopus catches affect marketability, making the supply chain less reliable. It was suggested that real-time monitoring and species-specific data are crucial to managing this dynamic fishery.

Opportunities and threats were identified, particularly around the issue of sentience. The handling and transport of octopus pose welfare concerns, with calls for guidelines to improve their treatment on fishing vessels and during transport. While sentience is a key concern for the UK market, it is less relevant in bulk export markets where price competition is a major factor. The discussion highlighted the complexity of implementing measures like minimum landing sizes, as many cephalopods die post-spawning.

On management, it was emphasised that data collection and real-time monitoring should be prioritised before implementing regulatory measures. Collaboration between the fishing industry and academic institutes was seen as essential for accurate population tracking and sustainable management. Long-term monitoring is needed to track trends in octopus populations and their interaction with other marine species.

Finally, evidence needs were discussed, with stakeholders stressing the importance of understanding broader environmental factors that influence octopus populations, such as sea surface temperature and climate cycles. Collaboration with academic institutions could help establish critical indicators for effective management.

3.4 Case studies

3.4.1 The western Asturias octopus traps fishery

The western Asturias octopus fishery operates in the Cantabrian Sea (FAO area 27, ICES division VIIIc) and is divided into eastern and western fisheries. Both eastern and western Asturias fisheries are small-scale that primarily use octopus traps. However, the eastern fishery operates without a dedicated fishery management plan. Although regulations for the fishery are in place, including a three-month closure period (February to April), a 1kg minimum size limit and gear restrictions, they are inadequate to meet MSC standards for sustainable fisheries. The western Asturias octopus fishery has implemented a

comprehensive management plan (Octopus Fishery Management Plan - OFMP) which addresses this issue, and this more structured and adaptive approach has enabled the western fishery to meet the MSC certification requirements.

The western Asturias fishery, spanning from the western border of Gijón (near Galicia) to the western border of Asturias, currently possesses MSC certification for the fishing of common octopus (*Octopus vulgaris*) (Figure 8). Fishing takes place within the Principality of Asturias, between the Ria del Eo and the Ria de San Esteban de Pravia and wider Spanish territorial waters (<12 nautical miles) (Ainsworth et al., 2023).

The western Asturias octopus fishery obtained MSC certification in 2016 for its sustainable catch of common octopus in the Cantabrian Sea using pots. The fishery sought MSC certification to formally recognise the sustainability efforts through an independent, third-party assessment. Achieving MSC certification validated these efforts and consequently significantly improved the octopus market value. Prices increased from approximately €5.5/kg pre-certification (Daniels, 2023) to €10.15/kg in the 2023/2024 season (Ríos and Mora, 2025). The certification also led to improved collaboration between regulators and fishers, and expanded market access, particularly in the wider EU as well as USA markets, which now receive 90% of the total catch. Only 10% is sold locally.

Figure 8: Map of the MSC-certified western Asturias octopus fishery, operating in inner waters along the western coast shown in blue shading (copied from Ainsworth et al., 2023).

The fishery obtained funding from the Fisheries Directorate, the Fishing Guilds and the MSC to support certification. The fishery's journey to certification spanned six years, from its preparation in 2010, followed by a pre-assessment and market research in 2013 and 2014, subsequent development and implementation of action plans, and finally, the full assessment was launched in 2015. After a seven-month evaluation, the fishery was awarded certification in

2016. Following MSC protocol, an annual surveillance programme was conducted over the proceeding five years around the certificate anniversary to ensure continued compliance to the MSC standard and address the conditions identified during the initial assessment. A recertification process taking eight months was successfully completed in 2021.

The western Asturias octopus fishery is the first octopus fishery to receive MSC certification. Its robust and adaptive management framework ensures the long-term sustainability of common octopus stocks, and is achieved through regular stock assessments, effective monitoring, and co-management practices that involve stakeholder engagement at every stage of the decision-making process. Over the years, the fishery has demonstrated an ability to sustainably harvest octopus, while maintaining minimal impact on the overall octopus population. A core element of the fishery's operational strategy is its ecosystem-based approach. Fishing practices are carefully managed and closely monitored to ensure the protection of marine habitats, minimise bycatch, and support the long-term health of the surrounding ecosystem with which it interacts.

Underpinning these sustainable practices is a robust governance framework, with rules and regulations that ensure compliance (González et al., 2021). Governance begins at a national level with the Spanish government and its various ministries and agencies, filtering through to a regional level at the Principality of Asturias with well-structured regional and national collaborations. Though each entity along this structure has a distinct role, management is interconnected and is upheld through the Octopus Fishery Monitoring Commission (OFMC), the Certified Octopus Fishery Working Group (COFWG) and the Octopus Fishery Management Plan (OFMP). The main objective of the management plan is to ensure sustainable management of marine resources while minimising ecosystem impacts, requiring continuous annual monitoring studies to be able to adapt fishing efforts alongside the state of the stock. This management plan therefore involves collaboration between local authorities, fishers, scientists, and other stakeholders. Collectively, these parties aim to achieve sustainable harvest of octopus while maintaining the socio-economic wellbeing of local fishing communities.

The Unit of Assessment (UoA) describes the components of the fishery being assessed against the MSC Fisheries Standard, which defines the species, stock, fishing area, gear type, fleet and other eligible fishers. Seafood from this UoA is eligible to carry the MSC label. For the western Asturias fishery, the boundaries of the UoA are presented in Table 16.

Table 16: The Western Asturias Unit of Assessment (Ríos and Mora, 2025).

Species	Common octopus *(Octopus vulgaris)*
Stock	*Octopus vulgaris* stock from Asturian waters (metapopulation description).
Geographical area	Cantabrian Sea (FAO 27). ICES division VIIIc
Fishing gear	Artisanal baited octopus traps
Fishing Fleet included in the certification and client group	ARPESOS (Asociación de armadores de la pesquería de pulpo con certificado de sostenibilidad)
Other eligible fishers	The number of vessels in the OFMP has been around 40-50 vessels per season in the last 5 years. All vessels belong to a Fishers' Guild included in the Asturian OFMP and comply with the requirements stated at the certificate sharing published at the MSC website

Vessels and gear

There are 31 vessels included in the fishery, ranging from 5.7m to 12.6m in length, with 2 - 3 crew members. These vessels are equipped with small artisanal octopus pots and can obtain permits to change onboard gear types when wanting to target other species. However, only one gear type is allowed on board at any time and vessels must notify local authorities when switching gears. The maximum number of traps allowed is 125 per crew member, up to a maximum of 350 traps for vessels with three or more crew members.

The pots have a sturdy steel frame providing its structure, enclosed with a plastic mesh and looped with rope to attach the pot to a line (Figure 9). The octopus are attracted to the small pots using bait bags that are attached by a wooden toggle, luring them to crawl into the 11cm hard eye entrance. Bait frequently used includes mackerel, sardines, chicken carcass and artificial bait (a mixture of flour and gelatine). The pots are small, weighing approximately 5 kg each, with around 35 pots per line at intervals of 15m and are deployed on the seabed at depths of 14 – 22m. This fishing method is semi-passive, and gear remains static on the seabed while in operation. This is the only type of baited trap that is allowed under the MSC certification, and each pot costs €25.

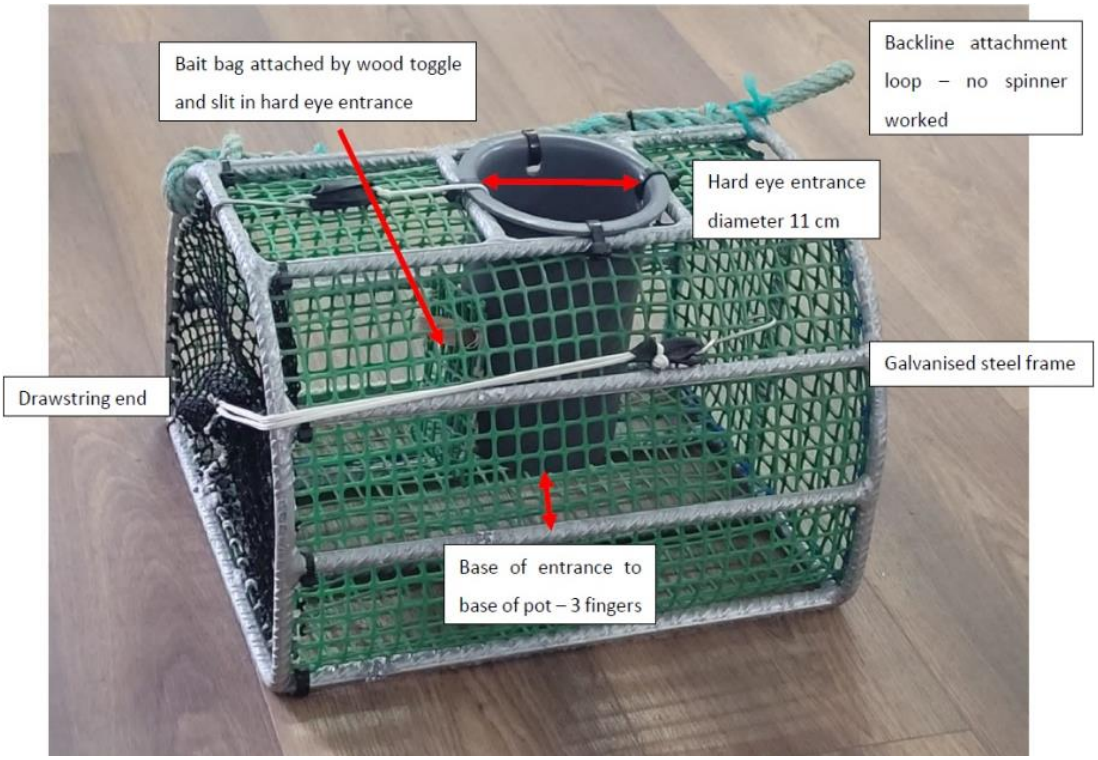

Figure 9: Pot allowed under the MSC certification in Asturias (Source: Daniels, 2023).

Traceability within the fishery

Once caught, octopus are stored in large barrels with drawstring mesh lids and are either brought directly to shore or are bagged and covered with ice for transportation. To ensure compliance with all regulations, vessels undergo at-sea and on-land inspections. Once lines are hauled onto the vessels, octopus are immediately killed and stored in separate buckets. Once landed, fishers transport their daily catch to designated auction points. Here, “guardapescas” fishery officers (Fishermen’s Guilds (cofradías) funded positions with fishery compliance, assurance, monitoring and reporting duties) weigh the octopus, checking compliance with the minimum landing size requirement, and record the total weight. Each vessel’s catch is electronically registered, and fishers receive a delivery note documenting their landings. The catch is then placed in cold storage until the auction takes place. At auction, sales are completed electronically to ensure continued traceability back to the vessel and landing date. To achieve this, each vessel has a unique identification code, and following auction sale, a batch code. For octopus sold as MSC-certified, a specific MSC certification code is assigned that clearly separates certified and non-certified products. Auction labels and invoices clearly show this information.

Vessels usually land at their home ports, however they may occasionally land and sell at neighbouring ports, where challenges can arise as vessels not included in the certificate may also use the same ports and auction facilities as certified vessels. The use of batch codes and certification labels at auction points serve as a preventative measure to avoid products mixing and ensures only eligible octopus will carry the MSC label.

The fishery has a well-defined traceability system that tracks octopus from the first point of sale, back to the point of capture within the UoA. Since vessels within this fishery exclusively target common octopus with baited pots, all catch is eligible for certification (González et al., 2021).

Role of data collection

In the western Asturias octopus fishery, data collection is critical for effective management and decision-making. It allows fishery management to closely monitor the health of octopus stocks and assess the effectiveness of management measures, making any changes accordingly. Regular data collection forms the basis of science-based management, to ensure octopus harvest is sustainable and possible environmental impacts are kept to a minimum. This information is necessary in determining fishing quotas, adjusting regulations and implementing adaptive management strategies to protect marine resources.

The data collected in this fishery covers a range of parameters including catch volume, octopus size, sex ratios and fishing effort, to be able to understand the common octopus population dynamics and to detect early signs of population decline. This biological data is also used to inform minimum conservation reference sizes and to establish closed seasons, such that the fishery continues to operate within sustainable limits. Socio-economic data is also collected to assess the impacts of regulations on the livelihoods of local fishing communities. This comprehensive data collection is an important aspect of the fishery that enables it to maintain its MSC certification, with evidence to meet sustainability requirements.

Monitoring tools and methods

A combination of traditional and modern tools is used by the fishery in effective monitoring and data collection. This includes observer programmes, geographic positioning systems (GPS) tracking and octopus tagging. Observer trips are conducted regularly throughout the fishing season to collect biological, catch and effort data, with private consultancies managing their implementation. The observers record a range of information from the size and number of octopus caught, to fishing practices used onboard vessels. GPS tracking allows for a real-time monitoring of fishing locations and is used primarily in spatial analysis of fishing effort, and to regulate fishing areas. Both practices of 100% GPS coverage and 2 days per month observer coverage (equating to approximately 1% of trips) are mandated across the entire UoA, enforced by the fishery officers (guardapescas).

Management and stakeholder participation

The fishery is built upon a co-management framework, bringing together diverse groups of stakeholders that each play a role in the fishery's governance and management, including fishers, local authorities, scientists and private consultancies. These groups come together to ensure the sustainable harvest of octopus, with responsibilities and decision-making being shared between regulatory bodies and those directly involved in fishing operations. The fishery has governmental oversight to ensure its management and protection, ensuring compliance with regulations and supporting data collection and monitoring

efforts. Research bodies also play a role, in providing scientific advice and supporting the development of management plans. Additionally, local fishers actively participate and contribute their knowledge to decision-making processes through Fishers' Guilds and working groups. This inclusive approach enables stakeholders to come together; those directly affected by management decisions can shape them, and scientific insight is integrated to balance sustainability with the livelihoods of local fishing communities.

Governance framework, management measures and enforcement

The governance of the fishery in the Principality of Asturias is coordinated through a structure involving regional and national authorities, each with their own distinct role, as seen in Figure 10.

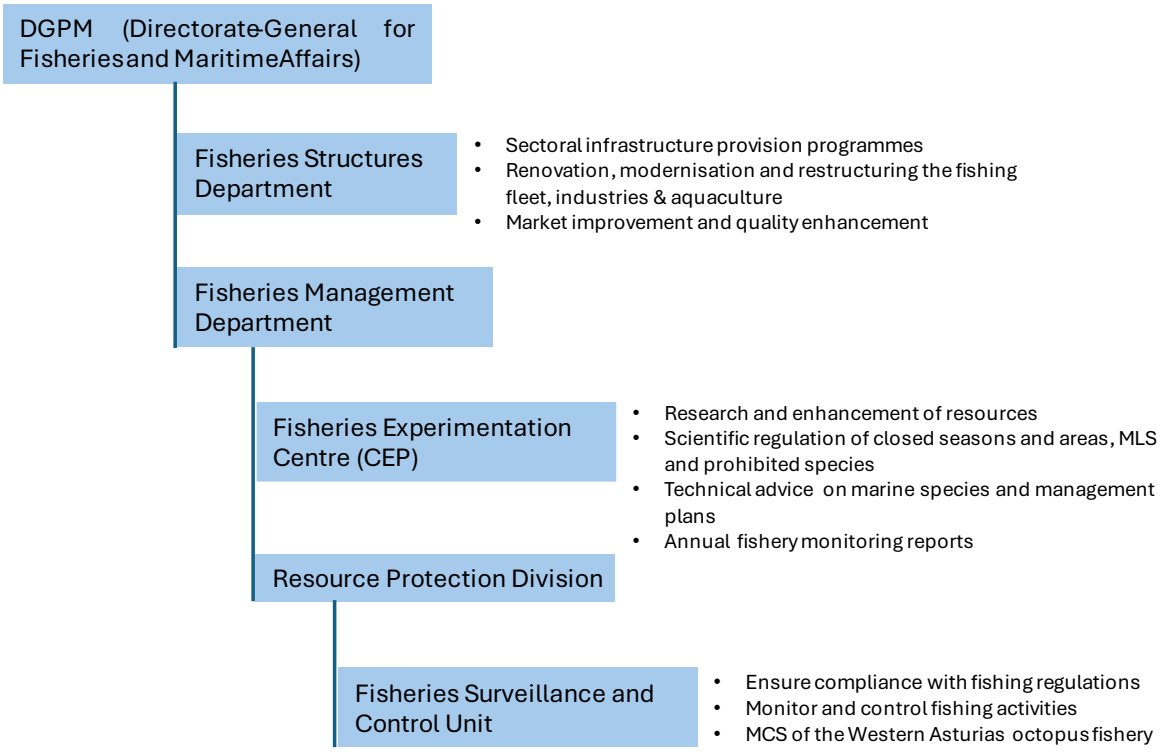

Figure 10: National governance structure of the western Asturias octopus fishery, detailing the key governmental, regulatory and research institutions involved in its management and oversight.

At a regional level, the Director General for Fisheries and Maritime Affairs (DGPM) is responsible for managing fishery resources and primarily operates through the Fisheries Structure Department and the Fisheries Management Department. The DGPM, through the fisheries departments, plays a key role in overseeing fishery management, ensuring compliance with regulations and supporting data collection and monitoring. The Fisheries Experimentation Centre (CEP) provides scientific guidance, informing the development of management measures. On a national level, the Spanish government supports and supplements regional efforts through its numerous ministries and agencies (Figure 11).

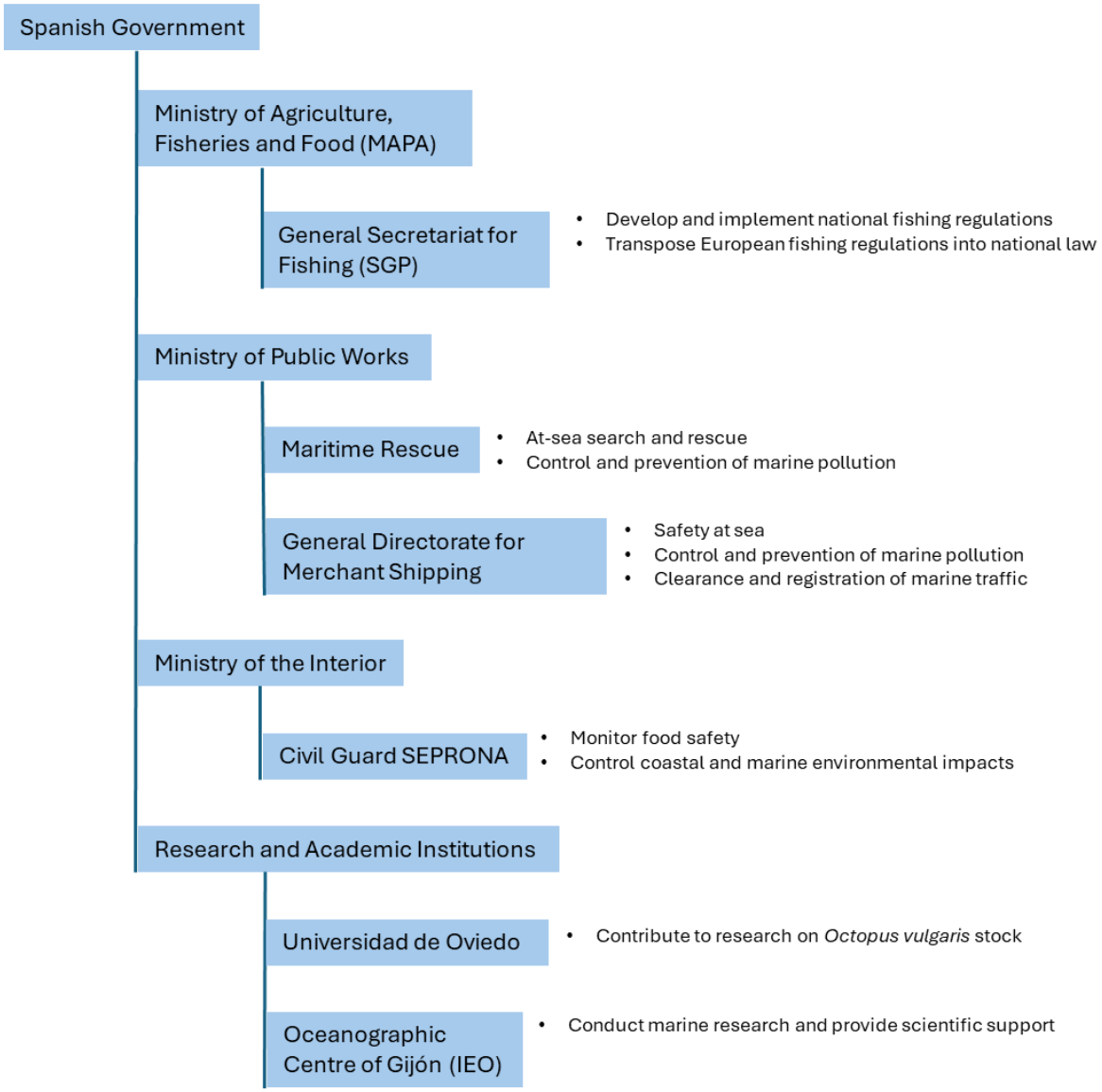

Figure 11: Organisation and roles of national and regional fisheries authorities, enforcement agencies, and scientific institutions involved in ensuring sustainable fishing practices.

Of particular importance is the Ministry of Agriculture, Fisheries and Food (MAPA) and the General Secretariat for Fishing (SGP) which implement EU regulations and develop the broader legal fisheries framework; the Ministry of Public Works that manages maritime safety, rescue services, and pollution control; the Ministry of the Interior, involved in food safety, poaching prevention, and environmental monitoring; and Research and Academic Institutions, such as the Universidad de Oviedo and the Oceanographic Centre of Gijón (IEO), that contribute marine research, particularly in stock assessments (Figure 11).

The western Asturias fishery therefore demonstrates both a centralised, top-down, and bottom-up, community-driven management. With regards to the centralised top-down approach, regulations, policies and management measures

are established and enforced by governmental bodies or other senior authorities. This takes place within the role of the DGPM, which ensures the fishery operates in a well-defined and science-driven management plan that aligns with wider national and international objectives. The bottom-up management is evidenced through the fishery's emphasis on local participation and stakeholder involvement, allowing those directly involved to shape management decisions and practices. This is facilitated through co-management and stakeholder collaboration, through the Fishers' Guilds and COFWG, providing opportunities to integrate local and practical knowledge. The OFMC also acts as a forum for stakeholders to present data, discuss issues and adapt strategies as necessary. This integration of a bottom-up and top-down approach creates a structured system with built-in flexibility, that is both science-based and community-driven, balancing legal obligations with local engagement, thereby improving compliance while supporting sustainability.

Regarding monitoring, control and surveillance (MCS), the Surveillance and Control Unit within the Fisheries Management Department is responsible conducting regular inspections at sea, at landing ports, and throughout the supply chain to ensure compliance. For the 2023/2024 fishing season, inspections of the western Asturias Octopus Fishery included:

- Land-based inspections of at least 15% of authorised vessels.
- Verification of the correct marking of 5% of trap gear.
- Onboard inspections of at least 5% of vessels while in operation.

The enforcement protocol ranges from verbal warnings for minor infractions, to formal complaints for violations of management measures, and sanctions for more serious violations. Sanctions may escalate to criminal procedures in cases of repeated offences, with monetary penalties collected by the Spanish Tax Agency (AEAT). Fishery officers (guardapescas), employed by the Fishers' Guilds (cofradías), collaborate with the Surveillance and Control Unit to monitor compliance with regulations in internal waters, assisting with inspections and reporting.

The Fishers' Guilds operate on a more local level, formed by fishers creating a self-governing body to manage fisheries within communities. These groups safeguard the socio-economic interests of fisheries, as well as promoting sustainable fishing practices and managing access to fishing grounds. Another function is to assist with the implementation of management plans. The regional government, in collaboration with the Guilds, produced the Octopus Fishery Management Plan (OFMP) that includes rules and regulations to balance fishing efforts with resource availability. These include seasonal closures, gear restrictions, individual vessel quotas, and mandatory reporting requirements. Only small-scale fishing vessels authorised by the OFMP are permitted to use octopus traps within a designated fishing area that stretches from the Eo estuary to the San Esteban de Pravia estuary. The management measures implemented provide an appropriate and effective legal framework that delivers sustainability goals in the western Asturias octopus fishery, aligning with the MSC principles 1 and 2 (MSC Fisheries Standard v2.01, SA4.3.1 and SA4.3.2). The legislation, agreements and policies governing those involved in managing the fishery must provide a framework for cooperation between national entities on management

issues, as appropriate for the context, size, scale or intensity of the fishery. In the case of this octopus fishery, this meant implementing fishing seasons that run from mid-December to mid-July, with slight date variations depending on the year. Moreover, fishing is restricted to daylight hours, and vessels must return by 17:00. All traps must be clearly marked to facilitate monitoring and compliance. This further extends to TACs; each vessel has a non-transferable annual quota of 10,000kg, contributing to an overall TAC of 162 tonnes. If 90% of the TAC is reached, daily catch reporting becomes mandatory to monitor landings. Vessels are required to have GPS/GPRS tracking devices for real-time monitoring of fishing locations and effort. Onboard observers and periodic inspections ensure compliance with management measures and contribute to ongoing assessments of the fishery's impact.

Stakeholder involvement and decision-making
The OFMC was established to allow stakeholders such as fishers, scientists, and NGOs, to present information to inform management measures. This Commission is the key decision-making body that collects, evaluates and analyses data, subsequently used to propose and approve management measures. Recreational fishers, though not directly involved in such consultation processes, are also able to engage and make suggestions on regulations.

Collaboration across various actors keeps the fishery management well informed by a range of perspectives. In 2016 the COFWG was formed, representing fishers' interests. This group brings together vessel owners and representatives from local research bodies. This working group led to the formation of the Certified Octopus Ship Owners Association (ARPESOS), which maintains the fishery's MSC certification by ensuring sustainability requirements are being met. The COFWG assist with enforcement on a local level, and feedback to the OFMC.

Private consultancies, such as SIGMA, are responsible for managing key aspects of the fishery's monitoring programme. SIGMA was initially contracted to implement the OFMP observer programme. This consultancy also manages GPS tracking and octopus tagging. Data collected was reported directly to the CEP for subsequent analysis. This collaboration between public and private entities ensures that the fishery's management is transparent and effective.

Management of non-MSC activities
The governance framework also considers non-MSC activities, including recreational fishing and artisanal octopus fishing using other gear types. Recreational fishers are legally recognised and regulated. Surveys indicate their impact on octopus stocks is minimal, with an average daily catch of 0.23kg. Artisanal vessels using gear types other than baited pots include trammel nets, set gillnets, and longlines, and these vessels are allowed to retain up to 30kg of octopus per day as bycatch. Trawling activities may also occasionally catch octopus at depths of over 100m when fishing on the continental shelf, but these interactions are deemed not significant enough to impact the management of the certified fishery.

3.4.2 The Britanny octopus fishery

The common octopus has long been an inhabitant of the Breton coast, France, which forms part of their natural distribution. Following a particularly cold winter in the 1960s, harsh environmental conditions led to a sharp decline in octopus population numbers and the species was rarely sighted in this area, with landings only being anecdotal. In 2021, the coastal waters of Brittany experienced a surge in octopus numbers (Clouette, 2023). Fishers found that their hauls, though set to capture other species, were inundated with octopus preying on their target catch. It was clear that there had been a surge in octopus population numbers, and at local auctions, octopus were accounting for a third of all sales. This influx has since been attributed to warming waters and a milder winter the year prior, presenting favourable conditions for octopus recruitment and encouraging their migration towards the Breton coast.

This unprecedented volume of octopus landings raised concerns amongst fishers for their livelihoods; octopus is more difficult to sell in the north of France compared to the south, where it is more commonly consumed. Furthermore, most landings are exported internationally to southern Europe, mainly Portugal, Spain and Italy. Between 2021 and 2022, France saw its international octopus exports increase by 80%.

It was quickly realised that octopus presented a new, profitable opportunity. In 2022 in Concarneau, 1,200t of octopus were landed, an increase of 40 times from 2020, and were being sold for €7 to €11 per kg at local auctions with prices showing little variability. Following this, fishers began targeting octopus specifically, which put pressure on regional and departmental committees to establish fishing guidelines. In 2023, the Finistère Department introduced octopus licences and established their own regulations.

The French system operates in a co-management way that includes the direct involvement of fishers and their representatives. At the highest level is the Ministry of Ecology, Sustainable Development and Energy, responsible for fisheries management across France. The Comités Régionaux des Pêches Maritimes et des Élevages Marins (CRPMEM), or the Regional Committees for Maritime Fisheries and Marine Fish Farming, are the regional representatives for the fishing industry, responsible for setting management objectives and assigning specific tasks to other committees where appropriate. The CRPMEM are also responsible for distributing licences, which ensures a more precise management of local stock. The CRPMEM works closely with the CDPMEM, or the Departmental Committees. The CDPMEM represents French fishers and is responsible for resource management. Within these structures are specialised regional commissions that are related to a particular fishery or species, and local/regional fishers' representatives have the opportunity to advise on management of local stocks. Extending decision-making beyond the governmental level allows for a more participatory approach, giving fishers and stakeholders a degree of autonomy over fishery management (Picault and Lesueur, 2014).

Management regulations were established to maintain collaborative efforts between maritime fishing activities, and to sustainably manage both socio-

economic and environmental issues. Several regulations have been adopted in response to the exceptional proliferation of octopus in Brittany's territorial waters, particularly off Ille et Vilaine and Cotes d'Armus. The president of the CRPMEM Bretagne is responsible for ensuring enforcement, and violations may be prosecuted under the Rural and Maritime Fisheries Code. These regulations are detailed in Articles of the CRPMEM de Bretagne (2024a).

Regulations pertaining to Bretagne

- Gear regulations: Octopus may be caught using pots (FPO) or unspecified traps (FIX). The traps must not be fitted with more than one rigid, straight or conical trunking with a diameter not exceeding 140mm and must not include a partition on non-return device. Traps must have at least one escape hatch, positioned either on the lower part of the chamber or to one side. This hatch must be large enough to allow a rigid box measuring 79 × 44 × 100mm to pass through in wet and dry conditions. With regards to pots, these are defined as a rigid structure mounted on a spinneret that is weighed down and set on the seabed. Pots must be specifically designed to catch cephalopods, and include a permanent, unobstructed opening.
- Gear limitations: Each vessel is permitted to use a maximum of 200 traps per crew member, to a maximum of 400 per vessel. Exemptions apply for vessels holding a crustacean or whelk licence, though octopus catches must remain below 10% of the total live weight of all catches during any trip. Gear marking is mandatory for all passive gear types used in Brittany's territorial waters. This includes traps and pots used for octopus fishing.
- Other permitted fishing methods: Currently, fishing for octopus by hook-and-line, nets, trawls, and scuba diving, are all permitted in this region. Hook-and-line fishing includes the following gear codes: LHP, LHM, LLS, LLD, LTL, and each are limited to 3,000 hooks per vessel. Net fishing is only permitted for holders of net and canoe licences, which must be issued by the CRPMEM Bretagne. Fishing by nets, trawling and scuba diving are authorised and must comply with the specific technical measures that are outlined in both national and local regulations.
- Fishing seasons: There are currently no limitations upon fishing seasons. Fishing for octopus is currently permitted all year from January 1st – December 31st, and there are no time restrictions set.
- No vessel size limits nor catch limits are enforced.
- Reporting and compliance: Each licence holder must submit catch reports to the local Délégation à la Mer et au Littoral. When necessary, these reports and any supporting documents may be forwarded to the CDPMEM associated with the vessel.

Regulations Pertaining to Finistère

The increase in octopus catches in 2021 and 2022 also put pressure on the local departmental committee of Finistère, where the majority of octopus was being caught, to set up further octopus regulations. Finistère is split into a north and south division, each adopting their own fishing legislation in 2024. Further to the above-mentioned regional regulations of Brittany, the following apply within Finistère.

The following regulations apply to the territorial waters of southern Finistère (CRPMEM de Bretagne, 2024b).

- Octopus licences and catch limits: The Finistère departmental fisheries was set up in 2023 to grant licences and provide access to octopus. Two types of licences are in place: 1) Targeted octopus fishing licences and 2) Incidental octopus fishing licences. The licences are available for fishers who were fishing for octopus between 2021 to September 2022, and an exemption is in place for new fishers. Targeted octopus fishing is capped at 89 licences, while incidental catches are unlimited however, there is an annual maximum catch limit of 10 tonnes per vessel. When 80% of this catch limit is reached, the licence holder will be notified by the CDPMEM Finistère. Once 100% of the catch limit is reached, the licence is revoked. Licence specifications can be found in the technical measures of the deliberations of the CRPMEM de Bretagne.
- Fishing season: Fishing for octopus is currently permitted all year from January 1st – December 31st, though octopus fishing in the South Finistère department was prohibited from 01 July 2024 – 30 September 2024 inclusive. Within this period, retention of octopus was prohibited and caught individuals were required to be released back into the water.
- Fishing area: The authorised area for fishing is as follows: From Cap de la Chèvre in the west, following the coastline of Baie de Douarnenez to the meridian of Le Pouldu (03°32.00'W) in the east. The offshore boundary extends to the 12nm limit.
- Gear limits: The maximum number of traps, pots and similar gear (under codes FPO and FIX) is limited to 200 per crew member, with a maximum of 500 per vessel. The maximum length of lines is restricted to 500m.

The above regulations also apply to northern Finistère, with some exceptions and alterations, as listed below (CRPMEM de Bretagne, 2023).

- Octopus licences and catch limits: The number of octopus fishing licences is limited to 98, and no quota has been set for these. These licences may only be issued to vessels <16m, though exemptions may apply. Fishers without a licence may catch up to three tonnes of octopus per year.
- Gear limits: Octopus fishing using non-specific gear, i.e. parlour pots or traps, is prohibited. For fishers holding an octopus licence, the number of pots is limited to 300 per person per vessel, up to a maximum of 1,000 per vessel under 20m, and 1,200 for vessels over 20m overall, where exemptions to the licence apply. For those without such licence, the number of pots is limited to 200 per person per vessel, up to a maximum of 400 per vessel.
- Fishing area: The authorised fishing area is as follows: From the meridian of Locquirec to the parallel 48°10’N, excluding Baie de Douarnenez.

Finistère octopus market analysis

IFRAMERE Fisheries Information System (système d'informations halieutiques, SIH) was accessed to compare annual data from 2021 – 2023 for commercial fishing vessels, summarised at the departmental level of Finistère (Table 17). This source was used to address data gaps in the Finistère octopus market

which is less well-documented compared to that of the Western Asturias fishery. The focus on Finistère therefore aims to provide supplementary information and additional insights into a lesser-known octopus fishery.

Table 17: Annual octopus landings and market value (IFREMER, 2023).

Year	Landings (tonnes)	Market value (K€)	Average price (€/kg)	Percentage of total landings	Percentage of total market value
2021	1,208.95	8,181.76	6.77	0.66	3.04
2022	2,106.39	14,601.19	6.93	1.09	5.25
2023	1,694.00	10,767.12	6.35	1.04	4.14

From 2021 to 2022, there was a significant increase in octopus landings of approximately 74%. In 2023, landings decreased by around 20% compared to the previous year but remained higher than recorded landings for 2021. This demonstrates the fluctuations in octopus availability and/or fishing effort. The market value of octopus increased in tandem, rising by approximately 78% from 2021 to 2022, followed by a decrease of around 26% in 2023 compared to the year prior. Despite this decline, and following the trend in landing values, the 2023 market value remained higher than that of 2021. The average price per kg also peaked in 2022 and declined in 2023, falling below recorded values for 2021. This shows that while overall market value remained higher than in 2022, the unit price decreased. This decrease in price per kg was likely due to increased supply, changes in market demand and conditions, or the quality of landings.

Octopus landings represent a relatively small fraction of the total landings at Finistère, at around 1%. However, despite accounting for a small proportion of overall landings, octopus contributes a reasonable portion of the total market revenue, ranging over the years from 3% to 5%. Therefore, octopus has a relatively higher value compared to many of the other species that are landed at Finistère (Figure 12).

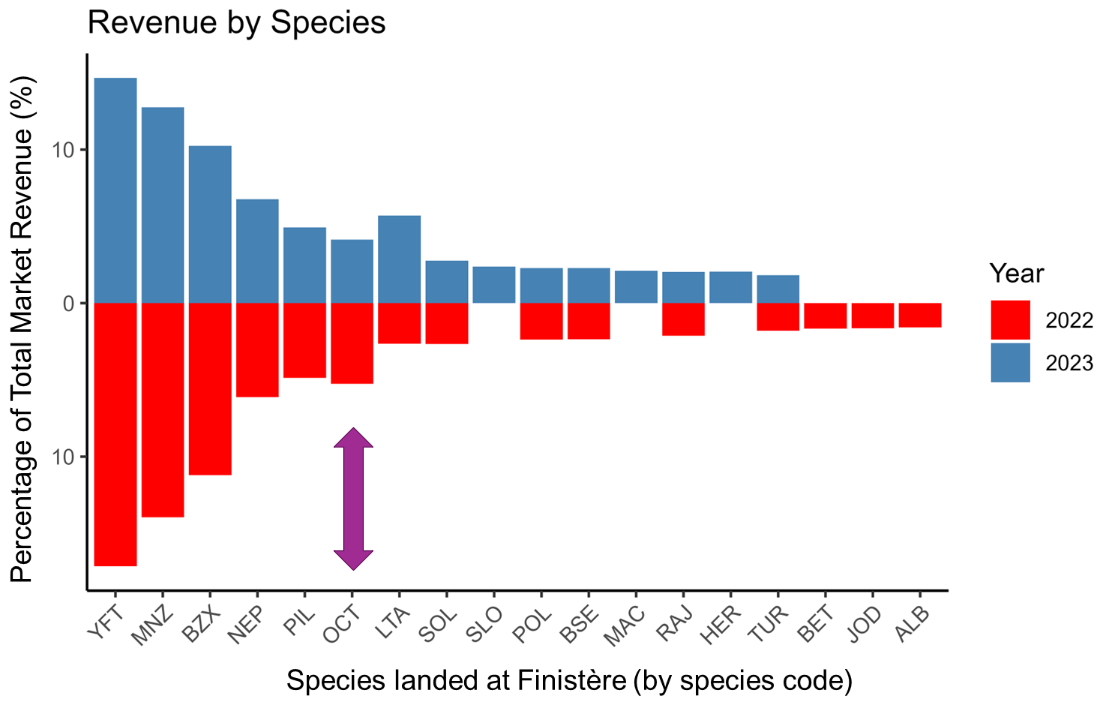

Figure 12: Percentage of the total market revenue for species landed at Finistère in 2022 and 2023 (Source IFREMER, 2023).
N.B. The species codes within the figure refer to FAO 3-alpha codes as follows: yellowfin tuna (YFT), Monkfish (MNZ), Sarda spp. (BZX), Norway Lobster (NEP), European pilchard (PIL), octopus (OCT), little tunny (LTA), common sole (SOL), pollack (POL), Black Sea Bass (BSE), Atlantic mackerel (MAC), Ray-finned fish (RAJ), Atlantic herring (HER), turbot (TUR), Betta spp. (BET), John dory (JOD), and Albacore tuna (ALB).

3.4.3 A comparison of the western Asturias and Brittany octopus fisheries

Both fisheries operate in structured management frameworks but show differences in their regulations, governance structures and sustainability measures. Regarding governance and management, Western Asturias and Brittany both have co-management systems in place, where decision-making is shared among government authorities and industry representatives. In Brittany, governance decision-making is decentralised and more industry-driven, spread across levels of governance through the regional (CRPMEM) and departmental (CDPMEM) fishery committees. The regional committee defines regional objectives and distributes licences, and the departmental committee implements more localised management. This differs from western Asturias, where the DGPM has a stronger, more central role in decision-making, stock assessments and enforcement. Regulations are therefore more directly tied to national policies from government agencies and scientific institutions.

The fisheries differ in their approach to regulatory frameworks and stock management. The western Asturias Octopus Fishery operates under a formalised Octopus Fisheries Management Plan, which includes TAC limits, vessel quotas, closed seasons, and minimum capture size limits to maintain stock sustainability and compliance with MSC. In contrast, Brittany does not impose such vessel or catch limits, and octopus fishing is permitted year-round.

Instead, Brittany's regulations are more focused on gear restrictions and technical specifications to control fishing effort. Additionally, the CRPMEM bears the authority to implement additional measures as and when necessary. Brittany's department is further divided into regional committees, and Finistère's Department is split into north and south regions. The Finistère Department restricts licences for targeted fishing only and catch limits apply only for fishers operating under an incidental octopus catch licence. Both north and south regions provide a geographical boundary to the limits of their management; beyond this, regulations either fall to the other departmental committees or the wider CRPMEM of Brittany.

When it comes to monitoring, control and enforcement, western Asturias operates under a highly structured enforcement system, involving GPS tracking, observer programmes, data reporting and regular inspections. Enforcement is down to the fishery officers from the guilds, and sanctioning powers are with the DGPM. Brittany's enforcement is contrastingly overseen at the regional level by the CRPMEM. Though reporting obligations are in place, data collection on bait use, discards, and stock health is less comprehensive compared with western Asturias.

Overall, the western Asturias fishery operates under a scientific-based management approach with clearly defined sustainability objectives, enabling them to meet MSC standards and obtain certification. In contrast, Brittany's fishery was created with the objectives of addressing socioeconomic concerns and reducing concerns amongst fishers, which has been successfully achieved through providing a structured framework for cohabitation, decentralised management, ensuring economic stability, and maintaining adaptability. Despite these milestones, the Brittany fishery would be unlikely to meet MSC requirements, due to a combination of factors, including a lack of a harvest control rule, TAC and formalised stock assessments. These gaps collectively limit a comprehensive assessment of fishery impacts and environmental implications of octopus fishing in this region are less understood.

3.4.4 Lessons learnt

Evaluating the management frameworks in place in both fisheries, as well as the fishery operations that arise from them, provides several key lessons that can inform best practices for octopus fisheries. It is worth noting that how these lessons should be applied will depend on the purpose and intention behind the establishment of a fishery. However, adopting these main takeaways will be particularly important for developing an ecosystem-based approach to fishery management, that could have a goal of obtaining MSC certification.

Western Asturias Octopus Fishery (MSC-certified)

This fishery had MSC certification as its goal from the outset in 2010, three years before applying for an MSC pre-assessment. Their objectives were shaped towards scientific monitoring and ecosystem-based management. This structured approach allowed it to, in time, meet the necessary sustainability criteria. The main lessons learnt from the western Asturias octopus fishery are:

- Science-based management is essential for certification. The western Asturias fishery demonstrates the need for formalised stock assessments, defined harvest control rules, and data-driven decision-making. The structured, science-based approach that implements TACs, monitors recruitment levels and tracks fishing effort, are all key components that demonstrate an overall sustainable fishery that enables it to achieve MSC certification.
- Robust monitoring, surveillance and enforcement to ensure compliance. The fishery tracks all vessels through GPS monitoring on vessels to calculate total fishing effort, monitors catch through electronic reporting and subsequent electronic sales at auctions and enforces strict minimum size limits. These strong traceability and enforcement mechanisms help ensure compliance with legislation and prevent illegal and unregulated fishing.
- Stakeholder collaboration strengthens management. The co-management in place through the OFMC, Fishers' Guilds, and scientific institutions creates a scientific-led management framework, that can be adaptive and reactive and incorporates an inclusive decision-making framework. This effective co-management that encourages collaboration between fishers, regulators and scientists, works to improve compliance, fosters trust and supports long-term sustainability.
- Adaptive management addresses emerging challenges. Through certification, the Western Asturias fishery had to refine its discard strategies and bait monitoring and adjust various factors to maintain MSC certification. Responsiveness and informed adjustments were necessary for ongoing assessment, monitored at annual surveillances, for progress on the highlighted areas for improvement. This flexible and adaptive management framework enabled the fishery to adjust regulations according to new environmental data and the evolving MSC standard.

Brittany fishery (non-certified)

The Brittany fishery emerged in response to socio-economic concerns following a surplus of octopus populations and unintended catches. This provided fishers with a "framework of cohabitation", with the purpose of outlining permitted activities and regulating operations. With the objectives primarily aimed at managing fishers' operations in Brittany's coastal waters, stability was provided for the fishers. The following lessons were learnt from the Brittany's octopus fishery:

- A decentralised, industry-led model supports adaptability to stakeholder and fisher needs and concerns. Brittany's co-management system, split between a regional CRPMEM and departmental CDPMEM allows regional and localised decision-making. With the opportunity for direct fisher involvement and committees setting restrictions on gear, spatial limits and technical measures, it is possible to adapt regulations accordingly. This approach therefore encourages fisher engagement and balances this with scientific oversight.
- Fishing effort is managed through gear restrictions. The fishery does not assess stock status and instead of using TACs, Brittany regulates fishing effort by setting gear limits (amount permitted) and technical specifications. This attempt to manage effort is not scientifically backed

and does not substitute stock assessments or harvest control rules when aiming for long-term sustainability. However, it may provide fishers with reassurance about their allowed practice.

- Lack of stock assessments and TACs creates population uncertainty. The common octopus in Brittany's fishery is a non-quota species, operating without a TAC or stock assessment. This prevents the fishery from being able to respond to fluctuations in stock status, making it difficult to detect declines and adjust management. Even within small-scale artisanal fisheries, data collection and stock assessments are required to understand population trends and inform management decisions.

Blending components from both the western Asturias Octopus fishery and the Brittany fishery could create an effective framework in the UK. Data collection is essential for management and decision-making to be responsive to the stock status. Using this data would create well-informed catch limits, discard strategies, gear restrictions and harvest control rules. In both cases, fisher engagement is key; a co-management system should incorporate direct fisher input, with oversight from scientific bodies, to balance sustainable needs with safeguarding the fishers' livelihoods. An enforcement strategy with strong traceability, monitoring and surveillance, would be necessary to ensure both socioeconomic and marine sustainability.

4. Discussion

The main aim of this study was to investigate the potential viability of a targeted octopus fishery in southwest England and explore potential management measures for any such fishery. The results indicate that while octopus numbers have increased recently, causing concerns to both mobile and static gear fishers, their abundance is not consistent enough to support a targeted fishery at this time. Some messages running through the study are summarised below, based on the literature review, landings data, case studies, interviews and the workshop.

4.1 Increase in abundance of octopus

The octopus population is highly volatile and fluctuates on a spatial and temporal scale. Spatial analysis shows that the abundance in the inshore areas around Plymouth, Mevagissey and east of Brixham is too low to sustain a stable fishery. Abundance patterns also show a link between offshore catches in winter, and inshore catches in summer, suggesting a potential vertical migration for spawning or late in the life cycle. However, the temporal analysis does not show a clear relationship between high landings from offshore, and subsequent high landings from inshore. Further work is needed to investigate the trends in vertical migration, spawning timing, and environmental factors driving the abundance of octopuses in the southwest marine ecosystems.

Findings also show that annual and seasonal variations, affect the marketability of octopus and the potential growth in the supply chain. These supply fluctuations hinder consistent pricing by buyers, which further impacts the revenue fishers earn from their catches. Fishers indicated that they find it difficult to invest in octopus pots due to the uncertainty and fluctuations in octopus abundance. While expanding to European markets could increase price stability, it will depend on demand, and in most cases provide a lower price per kilogram than local sales. Further, this marketing route is subject to high competition from non-EU countries like Morocco and Mauritania, which have lower operational costs and selling prices. Despite this, results of the market assessment show that currently, there is a good market for octopus in the UK, the price has been steadily increasing in the past eight years, and there is potential for growth.

4.2 Opportunities and threats

There is general agreement across stakeholder engagement that the increased abundance of octopus could provide additional fishing opportunities. For instance, restrictions on other fisheries such as pollack, could drive fishers toward targeting octopus, rather than exploiting incidental octopus bycatch. Some fishers indicated that they view catching octopus as controlling an invasive species, while others thought it could provide an alternative fishery to turn to when crab stocks are not perceived as doing well. Therefore, they see the increased abundance of octopus as a fishery to potentially diversify into to generate income while other stocks recover. The uncertainty in octopus

abundance, including the annual variability, means that they consider it a short-term solution as stock abundance for the coming years is not guaranteed.

One of the major issues surrounding octopus ranked highly by fishers was damage caused to crab and lobster whilst in pots. Stakeholders perceived that octopus predate on crabs and lobsters, potentially eating eggs and juveniles and reducing the population available for fishing. The overlap of octopus and crustacean fishing seasons further creates challenges, as the crustaceans are the staple year-round fishery targeted by potters. Nevertheless, the present information does not enable us to draw strong conclusions on whether octopus presence is impacting the catches and market value of crabs and lobsters. Historically, octopus presence can change according to climate, as demonstrated in the 1960s and the increased presence of octopuses in Brittany. Considering the future landscape, the catches of octopuses have steeply increased in inshore areas in the past eight years, although an analysis based on a longer timeframe would help understand the links between stock variability and climate.

Findings show that sentience concerns present a significant challenge to any fishery development, particularly in the slaughter and transportation of octopus. Currently, different dispatch methods are used with some skippers using immediate dispatch while others landing them alive. The introduction of sentience guidelines, focused on humane slaughter, would be critical for the acceptance and expansion of octopus consumption in the UK and beyond. Further, the requirements to comply with wellbeing and ethical guidance would need to be applied to all fishing vessels landing octopus, including trawlers and potters. The use of stunners onboard can provide irreversible damage to the neural system of aquatic animals, ensuring that no pain is perceived during slaughter. In the case of an octopus, there is no humane killing method, but electrical stunning should be used before any mechanical killing method. The two actions should be performed as quickly as possible, to reduce the duration of a vegetative state of the animal on an ethical basis.

If live transportation is needed, adequate containers should be used, as fishers have reported that some octopus are capable of unscrewing lids from the boxes to attempt escape. Suitable containers should have a narrow entrance and a wide body, which should contain both seawater and oxygenated air through small holes. The container should be dark and not have any external stimuli to distress the octopus. Such practices would ensure a code of conduct is maintained onboard and during transportation and would consequently facilitate the wider distribution of octopus through the UK food service and retail.

4.3 Management of an octopus-targeted fishery

Findings indicate that before implementing management measures, data collection should be prioritised to gather species-specific information and track the volatility of octopus populations. While the overall feeling from stakeholders was that it is too early to establish an octopus-targeted fishery, there are various aspects that policy makers need to start considering, including catch limits,

minimum landing size, gear limits, fishing seasons and fishing areas. Current information is limited, and as such real-time data collection and monitoring of octopus stocks are needed due to their volatile nature. The development and use of indicators of octopus stock and recruitment (such as sex ratio and size), considering their short life cycle, will be crucial for sustainable management. Real-time monitoring is essential, as traditional survey methods are not suitable for cephalopods like octopus. A dedicated survey, ideally conducted in the spring, could provide insights into octopus and other cephalopod populations.

Clear objectives should be established to detail what management of the fishery aims to achieve. For example, this could consider a socio-economic approach like Brittany or a sustainable certification approach like western Asturias. Given the short life history of octopuses, an adaptive management framework with in-year modifications would be required and therefore the collection, processing and access of data should be streamlined. Such an approach would ensure timely access to relevant information, facilitating rapid and informed management responses and ensuring that any shifts in the octopus population can be quickly addressed. Because of the fast life cycle and high year-on-year variability, data collection should aim at ensuring a continuous multi-year programme.

4.4 Evidence needs

A robust biological data collection framework should be initiated to understand key aspects such as sex ratios, size, and fishing effort to guide management, should a targeted fishery be established. Collaboration between the fishing industry and scientific researchers could help provide more reliable data on octopus populations. This could include using tools like species identification cards (Annex 2), though this needs further discussion among stakeholders. It is worth noting that funding and resources for data collection are a concern, and the industry must prioritise long-term monitoring and adaptive management strategies to ensure sustainable practices. Collaboration between scientific surveys and the fishing community is also vital for developing time-series recruitment indexes. When fishers notice changes in octopus catches, they would be able to inform the scientists such that it could trigger coordinated survey expeditions to gather biological data on stock status.

Expanding the analysis of landings data over a longer timeframe will also help reduce data uncertainty and improve understanding of octopus stock trends. Furthermore, a multi-year data collection programme is essential to ensure the rigour and relevance of data amidst highly volatile annual stock variations. These data will also help assess environmental factors that influence octopus abundance. To gain a deeper understanding of these dynamics, environmental indicators, such as sea surface temperature, need to be considered.

Finally, a holistic ecosystem approach is also crucial, as climate change, availability of prey species, and changes in fish populations all play a role in determining octopus numbers. In this regard, involving EU counterparts in research initiatives can provide comparative data from various regions, enriching

the understanding of these complex dynamics. In addition, further research is needed to explore the potential impact of large-scale environmental cycles, such as the north Atlantic multi-decadal oscillation on octopus populations and other marine species. Identifying long-term population cycles will be critical for assessing fluctuations in octopus stocks over time.

5. Conclusion and recommendations

5.1 Conclusions

This study investigated the feasibility of setting up an octopus-targeted fishery in southwest England using an eight-year landings data set, stakeholder perceptions, and a supporting literature review including two case studies. The results show a strong year-on-year variation in octopus abundance, with high variability in catches. Trawlers land the highest quantity of catches from offshore waters during winter while inshore potting vessels catch the highest quantities of octopus between May and July. Stakeholders highlighted that the high volatility of octopus significantly affects the decision to set up a potential targeted fishery, as the fluctuations and seasonal variation also affect the supply and market price. The two case studies highlight two different frameworks to establish a potential fishery in the future, with western Asturias fishery in Spain representing an example of a sustainably certified fishery with restrictions on gear, daily fishing hours, tailored stock assessments, and partnerships with research and other stakeholders. On the other hand, in Brittany in France, the octopus fishery focuses on managing the socio-economic benefits, and while it lacks a framework to understand stock dynamics, it includes measures to manage fishing effort. The lessons learnt and the next steps forward to understanding the distribution and abundance of both octopus species in the southwest need to focus on understanding species composition, primarily through separating the species during landing, and with tailored multi-year fisheries independent surveys. Improving the understanding of recruitment can also inform adaptive management, potentially in partnership with the fishing industry. Finally, sentience guidelines need to be developed to address concerns over humane slaughter methods and ethical live transport of octopus by the UK market.

5.2 Recommendations

This feasibility study has the following recommendations:

- **Promote species identification and reporting:** species differentiation between both octopus species needs to be part of a mandatory landing requirement.
- **Real-time data collection and monitoring:** both fisheries dependant and fisheries independent monitoring of octopus populations is needed to understand the variable nature of the octopus stock and its temporal-spatial distribution in the English Channel. This needs to include in-year recruitment surveys for adults, ideally conducted in the spring before mating and spawning.
- **Establish sentience guidelines for the whole octopus supply chain:** the introduction of sentience guidelines will improve the management of octopus fisheries and their marketability within the UK market and beyond.
- **Foster collaboration between the fishing industry, academia and government:** collaboration between fishers, scientists, and regulators

strengthens compliance and allows different perspectives to be integrated into the management framework. Fostering collaboration between scientific surveys and the fishing community is crucial to achieving time-series recruitment indexes. Such collaboration could be used to monitor sea surface temperatures and other climate change impacts and to investigate the links and historical patterns of octopus presence.

- **Set clear objectives and targets for a potential fishery in the future:** setting a common and clear objective for a potential future fishery in line with the UK Joint Fishery Statement will inform decisions on the type of fisheries management measures that are suitable.

6. References

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7. Annexes

Annex 1: Stakeholder questionnaire

Location ….. …… Date ……

A. Your details

1. Your position (skipper/crew) ……

2. Vessel name …….

3. Years fishing ……

4. Main landing port …….

5. Vessel Length ……

6. Your main gear type ……..

7. 2nd gear type ……

8. 3rd gear type ……

9. Your top 3 target species
……

10. ICES rectangles fished
……

11. ICES sub-rectangles
……

B. Catch (for those with data)

12. Have you been catching octopus recently? Y/N
……

If yes, do you target them or just as by-catch?
……..

If no, please explain why not
……

13. If you have been catching octopus, do you separate your octopus catch by species? Y/N ……..

If so, please provide the weight (kgs) of your octopus landings by species for the last 5 years ……..

14. How has your annual catch for octopus changed over the last 5 years?

☐ Large decrease ☐ Decrease ☐ No change ☐ Increase ☐ Large increase

15. How has the proportion of catch between the two species changed over the last 5 years?

☐ Large decrease ☐ Decrease ☐ No change ☐ Increase ☐ Large increase

16. If there is variation, in your opinion what is driving this change?
……

17. Which months do you land the highest octopuses?
……..

18. Please provide the value of your octopuses landings in the different months.……

19. What is the price per kilo of the octopus you land?
……..

20. Has this changed over recent years? Y/N
……..

If so, what has driven this change
…….

21. Who do you sell your octopus catch to?
……

22. Is there a specific company in your port that buys octopus?
……

C. Perceptions

23. What are the main issues surrounding octopus in the south west? Rank the issues from most important to least important using 1 = most important, 2 = second most important, 3 = third most important etc. based on your recent experience, current and future knowledge of fisheries in the south west.

Issue	**How important was this issue in the recent past?**	**How important is this issue currently?**	**How important will this issue be in the future?**
Abundance of octopus i.e. stock availability			
Seasonal nature of octopus			

Size restrictions (e.g. minimum landing weight)			
Availability of markets			
Availability of hard ground / benthic habitat			
Damage to crab and lobster in pots			
Bycatch in trawls, dredges and nets			
Landings data collection			
Species level data			
Market price of octopus			
Please add any others below….			

24. Please feel free to comment on the above issues
……
……
……
……
……
……

25. What is the most significant factor(s) restricting you from targeting octopus?
……..
……
……
…….

26. Can you think of any opportunities for establishing an octopus fishery in the south west?
……
……
……..

27. What are the challenges towards establishing an octopus fishery in the south west?
……
……
…….

28. In your opinion, how viable is an octopus targeted fishery in the south west?
……
……
……..

D. Market assessment

29. Is there a ready market for octopus in your area?

……
……
……

30. Are there any supply chain issues for octopus that you can think of?
……
……
……

31. In your opinion, what is the potential for growth of an octopus targeted fishery in the south west?
……
……
……
……
……

32. Do you have any additional comments on this survey?
……
……
……
……
……

Many thanks for your support

Project team

Annex 2: Species identification cards that have been developed by MMO in collaboration with Cornish FPO to be used by the catching sector. Source MMO.

Marine Management Organisation

Common Octopus – *Octopus vulgaris*

Catch App Species Code - OCC

Identifying features	2 rows of suckers on tentacles
Minimum landing weight	750g
Quota / Non Quota	Non Quota
Can it be discarded?	Yes
Closed season?	No
Catch limit	No

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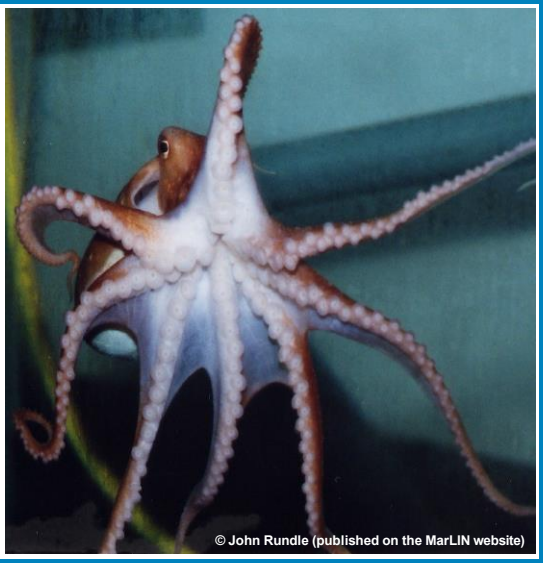
Marine Management Organisation

Curled / Horned / Lesser Octopus – *Eledone cirrhosa*

Catch App Species Code - EOI

Identifying features	1 alternating row of suckers on tentacles Rough skin
Minimum landing weight	750g
Quota / Non Quota	Non Quota
Can it be discarded?	Yes
Closed season?	No
Catch limit	No



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