SUSSEX CRUSTACEAN POTTING SURVEY

A 5 YEAR BASELINE: 2021 TO 2025 POTTING SURVEY TO ASSESS THE IMPACT OF THE SUSSEX NEARSHORE TRAWLING BYELAW

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AUTHORS: FRANCESCO MARZANO,
SAM FANSHAWE

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Executive summary

In the late 1970s, there were well established kelp beds between Selsey and Shoreham-by-Sea. This biodiverse environment played a key ecological role in providing shelter, feeding, and nursery grounds for marine life, including commercially important crustaceans. However, by the end of the 1990s, 96 per cent of the kelp had disappeared. Factors contributing to the decline in kelp include increases in water temperature, storm damage and abrasion of the seabed by trawl fishing gear.

In 2015, an inshore habitat map produced by researchers at Sussex Inshore Fisheries and Conservation Authority (IFCA) informed ongoing discussion within Sussex IFCA regarding effective ecosystem-based management for the recovery of essential fish habitats, such as kelp. Over subsequent years, Sussex IFCA, who manage the area from the shoreline out to 6 nautical miles, developed new legislation which aimed to protect essential fish and marine habitats to support sustainable inshore fisheries: the Sussex IFCA Nearshore Trawling Byelaw 2019.

The Sussex IFCA Nearshore Trawling Byelaw 2019 (herein 'the byelaw') received ministerial signoff and therefore became enforceable in March 2021, prohibiting trawling over 304 square kilometres of nearshore seabed. In addition to the IFCA statutory responsibility to monitor the byelaw, Blue Marine and partners of the Sussex Kelp Recovery Project established an extensive monitoring and research programme to support the byelaw with the aim to understand the ecological, social and economic value of essential fish habitats.

Part of this research includes a programme of potting surveys undertaken by Blue Marine to understand the impact of the byelaw on commercial crustacean fisheries, specifically European lobster (*Homarus gammarus*) and brown crab (*Cancer pagurus*) (also known as edible crab). The first surveys were carried out in 2021, within six months of the introduction of the byelaw, establishing a baseline against which future changes can be measured.

From 2021 through to 2025, data was collected on crab and lobster abundance, carapace size, weight, sex ratio and condition at 12 sites around Selsey, both within and outside the trawling exclusion zone, with the help of local fishermen. The survey was also carried out in Brighton and Eastbourne; however, these surveys were not carried for five years and therefore fall outside of this reports scope.

From these surveys, a five-year baseline dataset has been collated from Selsey in the western part of the trawling exclusion zone. Analysis of these datasets provides an indication of where any changes in crab and lobster populations have occurred inside and outside the trawling exclusion zone over time.

Overall, the results from the five-year dataset at Selsey showed no significant differences in crab or lobster abundance between sites inside and outside the trawling exclusion zone or

between the years 2021 through to 2025. This is not expected, as the final year's survey was undertaken four years and five months after the introduction of the Nearshore Trawling Byelaw in 2021, and ecological recovery of rocky reef habitats has been shown to take five to ten years after bottom towed gear has been prohibited. Areas inside and outside can, therefore, be considered similar in terms of their state for European lobsters and brown crabs over the period of the study.

Despite some variation, there were no significant changes in year-to-year population sizes, and no factors were identified as a significant driver of observed fluctuations. The number of brown crabs recorded at the survey sites in Selsey decreased as depth increased. Other metrics, such as carapace size and weight for both brown crab and European lobster fluctuated, with some statistically significant differences between years, but no significant change was recorded over the full five-year period.

Overall, although statistically significant changes have not yet been detected, the first five years of monitoring have established a valuable ecological baseline for crab and lobster in the Selsey fishery and provide an important reference point for evaluating the long-term effects of the Sussex IFCA Nearshore Trawling Byelaw 2019 on local habitats and commercially important species.

Contents

Introduction

In the late 1970s, there were well established kelp beds between Selsey and Shoreham-by-Sea. This biodiverse environment played a key ecological role by providing shelter, feeding and nursery grounds for many important marine species including European sea bass, black seabream, European lobster and common cuttlefish[1]. These fish populations have supported commercial fisheries and local communities across Sussex for many years. Kelp also can improve water quality through nutrient filtration and can prevent coastal erosion by acting as a buffer from the impacts of waves and storms[2].

However, by the end of the 1990s, 96 per cent of the kelp beds had disappeared, along with the high biodiversity and abundance of species they supported and the ecosystem services they provided[3]. Factors contributing to the decline in kelp include increases in water temperature, storm damage and abrasion of the seabed by trawl fishing gear.

In 2015, an inshore habitat map produced by researchers at Sussex Inshore Fisheries and Conservation Authority (IFCA), who manage the area from the shoreline out to 6 nautical miles, showed how habitats in the area had changed and informed ongoing discussions about kelp's role in the ecosystem. Over subsequent years, Sussex IFCA developed new legislation which aimed to protect essential fish and marine habitats and support sustainable inshore fisheries: the Sussex Nearshore Trawling Byelaw (2019).

Blue Marine Foundation worked with Sussex Wildlife Trust, Marine Conservation Society, University of Portsmouth and Big Wave Media as part of the Help our Kelp campaign to mobilise public support for the Nearshore Trawling Byelaw.

The Sussex Nearshore Trawling Byelaw 2019 came into effect on 18 March 2021, prohibiting trawling over 304 square kilometres of seabed (Figure 1), creating one of the largest inshore areas closed to trawling in England and instigating the UK's first kelp recovery project.

Following the introduction of the byelaw, Blue Marine and Help our Kelp partners created a new partnership encompassing Sussex IFCA, Universities and local authorities to deliver the Sussex Kelp Recovery Project (SKRP), which aims to 'champion, study and facilitate the restoration of Sussex kelp to support a thriving and sustainable marine ecosystem'[4].

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[1] Norderhaug, K.M., Christie, H., Fosså, J.H. and Fredriksen, S., 2005. Fish-macrofauna interactions in a kelp (Laminaria hyperborea) forest. *Marine Biological Association of the United Kingdom. Journal of the Marine Biological Association of the United Kingdom*, *85*(5), p.1279.
[2] Duarte, C.M., 2017. Reviews and syntheses: Hidden forests, the role of vegetated coastal habitats in the ocean carbon budget. *Biogeosciences*, *14*(2), pp.301-310.
[3] Williams, C. and Davies, W., 2019. Valuing the ecosystem service benefits of kelp bed recovery off West Sussex. *Report for Sussex IFCA. London: New Economics Foundation*.
[4] Sussex Wildlife Trust. 2022. *Sussex Kelp Restoration Project*. Available at: https://sussexwildlifetrust.org.uk/helpourkelp

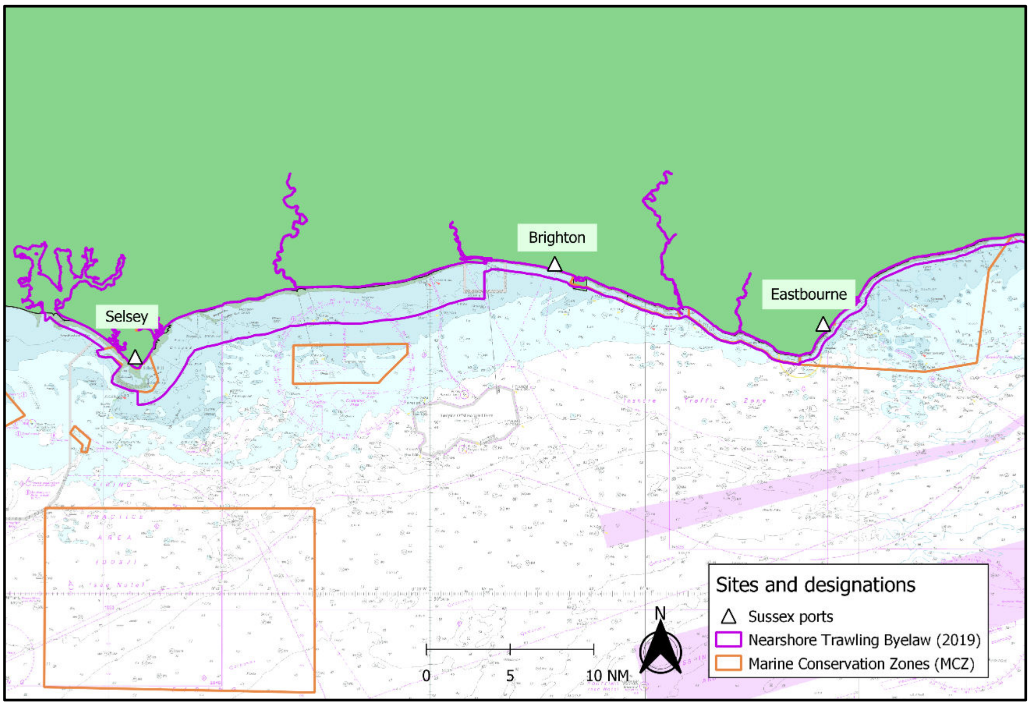

Figure 1: Sussex's ports, MCZs and the Nearshore Trawling Byelaw

One of the SKRP aims is to support an extensive research programme to 'understand the ecological, social and economic value of essential fish habitats, including kelp, and the Sussex IFCA Nearshore Trawling Byelaw', using a range of methods including:

- Annual Baited Remote Underwater Video (BRUV) to assess recovery of mobile fauna
- Annual towed video assessments of benthic recovery
- Environmental eDNA surveys
- Commercial fish surveys
- Socio-economic benchmarking to assess the impacts of essential fish habitat recovery on the local socioeconomics of relevant stakeholders

The results from regular annual species and habitat monitoring will contribute to a comprehensive assessment of the ecological, social and economic changes resulting from the ecological changes after the removal of some pressures.

Recent literature has highlighted the importance of kelp for crustacean fisheries. Smale *et al.* (2022)[5] has quantified the use of kelp forest habitat by commercially important crustacean species in the UK. Crustacean species were observed in all kelp habitats in this study. Brown crab (*Cancer pagurus*) and velvet swimming crab (*Necora puber*) were the most abundant, although spider crab (*Maja brachydactyla*), European lobster (*Homarus gammarus*) and common prawn (*Palaemon serratus*) were also recorded. They found:

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[5] Smale, D.A., King, N.G., Jackson-Bué, M. and Moore, P.J., 2022. Quantifying use of kelp forest habitat by commercially important crustaceans in the United Kingdom. *Journal of the Marine Biological Association of the United Kingdom*, *102*(8), pp.627-634.

- An association between commercially valuable crustaceans and kelp habitats, which is of particular importance due to the large market value and existing local fisheries of these animals.
- Positive relationship between the amount and structural complexity of kelp species and the amount of their associated commercially valuable species - evidence of the role of kelp as a foundation species that can provide space, food and protection to a number of organisms.
- Most individuals found in kelp habitats were juveniles or sub-adults. This has been associated with kelp's relatively high structural complexity, making kelp a good nursery ground.

To understand the impact of the byelaw on commercial crustacean fisheries, potting surveys have been undertaken since 2021 as part of a collaborative study between Blue Marine, Sussex IFCA and local fishermen. The study aims to understand the long-term effect of the exclusion of bottom trawling on brown crab (*Cancer pagurus*) and European lobster (*Homarus gammarus*) populations (Figure 2), to monitor changes in the fishery over time with ecological changes and potential habitat recoveries following pressure removal. Crab and lobster potting has a long history in West and East Sussex. Due to the known association of crab and lobster with kelp habitat, it is hoped that the recovery of kelp can help to support and sustain the crab and lobster fisheries in this area.

Working with fishermen in Sussex, we can actively engage the fishing community in the research, incorporate their local knowledge into survey planning and design, and gain an insightful understanding of the causes of any patterns or trends observed. Year One of the programme began in 2021, where data was collected to establish a baseline that can be compared against in future years. Year Two, Three and Four were conducted in 2022, 2023 and 2024 respectively. Surveys were also carried out at sites in East Sussex from Brighton (2022-2024) and Eastbourne (2022 only), and as these were not undertaken consistently over the five-year period, they are not included in this five-year report.

This report outlines the potting survey undertaken in Selsey in Year Five (2025) and compares the data collected on crab and lobster to the findings of previous years to assess general trends and whether there has been any recovery inside the trawling exclusion zone since its designation in March 2021.

Figure 2: Brown crab (Cancer pagurus, left) and European lobster (Homarus gammarus, right)

Commercial Fisheries in Sussex

The Sussex inshore marine environment has a wide diversity of habitats and species that support rich inshore fishing grounds. Whelk, lobster, crab and cuttlefish are all important commercial fishing species in Sussex inshore waters[9].

There are six key fishing communities along West Sussex: Emsworth (Chichester Harbour), Selsey, Bognor Regis, Littlehampton, Worthing and Shoreham-by-sea. Selsey landings are mainly focused on shellfish, with lobster, crab and whelk being the main species landed in terms of value[3]. Landings in Bognor Regis are dominated by lobsters, with low landings of some other demersal species such as cod and shellfish (mainly crabs). Mixed inshore fisheries also operate in Eastern Sussex. Crab and lobster potting effort is higher out of Eastbourne, but a range of species are also landed, such as whelks, cuttlefish, bass, cod and bream.

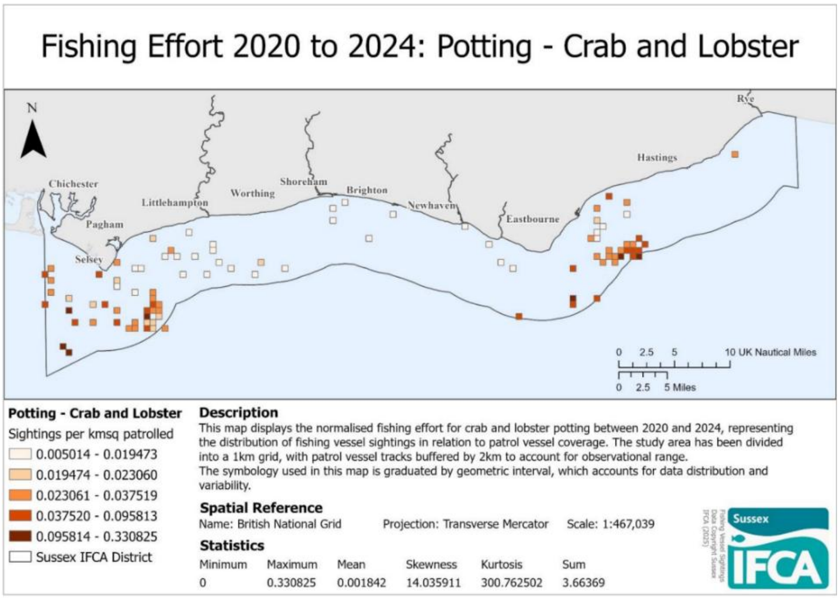

Figure 3: Fishing effort for crab and lobster potting across West and East Sussex from 2019-2024[6]

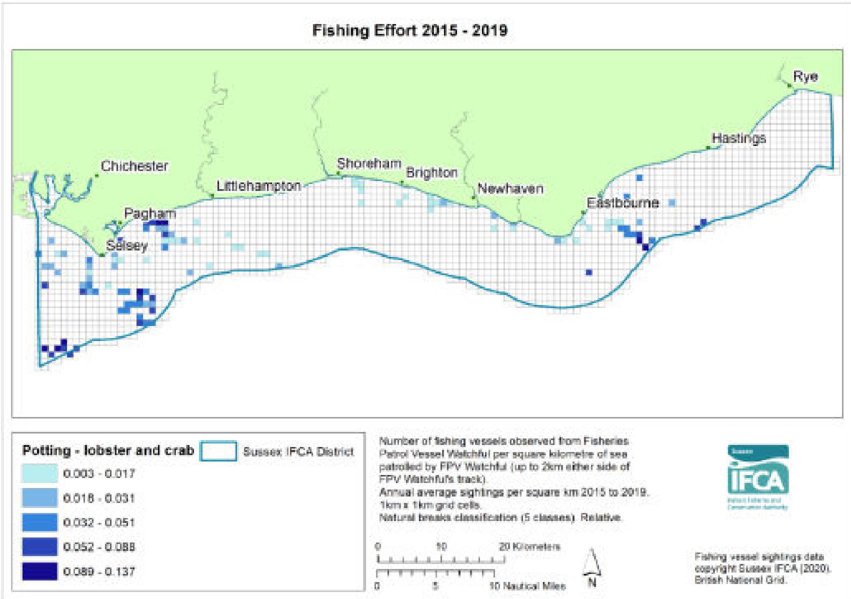

Figure 4: Fishing effort for crab and lobster potting across West and East Sussex between 2015-2019[7]

[6] Sussex IFCA. 2025. *Sussex Inshore Fishing Effort Report 2020-2024*. Available at: https://www.sussex-ifca.gov.uk/conservation-research

[7] Sussex IFCA (2020). *Fishing vessel sightings data*. British National Grid.

Potting is one of the most widespread fishing methods in Sussex, occurring across 21.1 per cent of the IFCA district[6]. In Sussex, whelk potting is the most common potting type occurring across 14.9 per cent of the district. Lobsters and crab potting come second, occurring across 4.9 per cent of the district[6]. Crab and lobster potting fishing effort mostly occurs between Chichester Harbour and Littlehampton, and between Shoreham and Hastings (Figure 3, Figure 4), as these areas are associated with preferential crustacean rocky reef ground.

The crab and lobster fishery in West and East Sussex is a small-scale inshore fishery that mostly uses boats of 10 m or under with inkwell or parlour pots. Commercial and recreational potting in Sussex is currently managed through the Sussex IFCA Shellfish Permit Byelaw 2015[8]. This byelaw contains a range of measures to manage multiple fisheries including crustacean within the Sussex IFCA District. Measures include mandatory escape hatches (80x45 mm) fitted to parlour pots, limits on pot numbers, no v-notched or ovigerous (berried) lobsters to be landed and a requirement for catch returns to be submitted to Sussex IFCA.

In 2024, 911 tonnes of shellfish were landed in Sussex's ports. The catch returns data from Sussex IFCA showed that the four main shellfish species landed across Sussex in 2024 were whelks (746.1 tonnes, 82 per cent), cuttlefish (111.3 tonnes, 17 per cent), brown crab (39.3 tonnes, 4 per cent) and lobster (13.8 tonnes, 2 per cent)[9]. Lobster landings per unit effort (LPUE) have remained relatively constant across the district from 2017 to 2024, with a decline from 2017 to 2022 and then a partial recovery since[9]. Brown crab have generally declined across the district[9]. The direction and magnitude of this trend varied between ICES sub squares the four spatial reporting areas within the Sussex IFCA district used to monitor local fishing activity[9] (Figure 5).

LPUE for lobster declined from 2017 (0.09 kg/pot) to 2021 (0.05 kg/pot) but has increased over the three-year period from 2022 (0.07 kg/pot), 2023 (0.09 kg/pot), and 2024 (0.11 kg/pot)[9]. Brown crab LPUE has steadily declined from 2018 (0.48 kg/pot) to 2024 (0.17 kg/pots)[9]. Lobster is a seasonal fishery in Sussex with the highest LPUE occurring during the summer (May-June) and the lowest from November to February. Brown crab is slightly more seasonal than lobster, with the peak in the season higher relative to the rest of the year. Crab LPUE peaks in November and December and is low from February to June.

[8] Sussex IFCA. 2015. *Shellfish Permit Byelaw 2015*. Available at: https://www.sussex-ifca.gov.uk/regulations

[9] Sussex IFCA Shellfish Permit Catch Returns Data Summary 2024. Available at: https://www.sussex-ifca.gov.uk/conservation-research

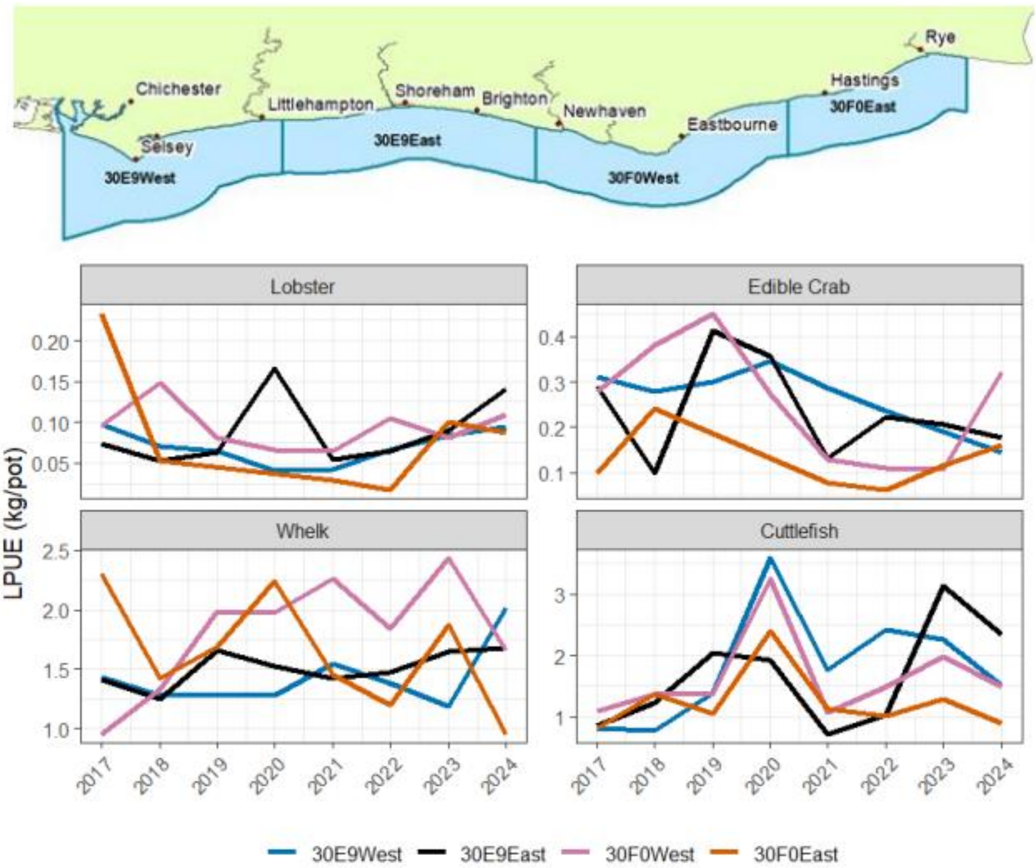

Figure 5: Landings per unit effort of the four key shellfish species across Sussex in 2024[9].

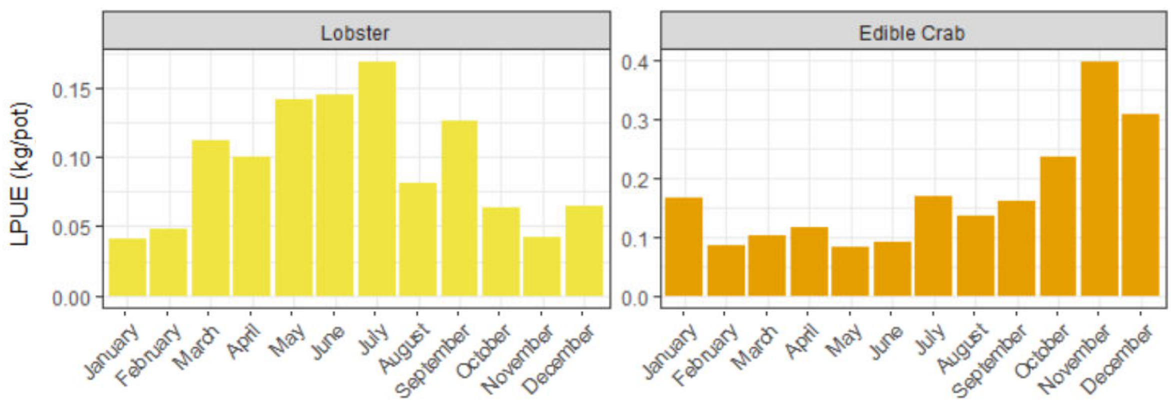

Figure 6: Weight of landings per unit effort (wright per pot) across the months of the year for European lobster (left) and brown crab (right) in 2024[9].

Environmental Pressures in Sussex

Concerns have been raised by local fishermen and other marine users around human activities, other than trawling, that could have impacts on the quality of the marine environment in Sussex, and therefore, the crab and lobster populations (Appendix A). Sedimentation is one considerable concern[10]. Blue Marine, in collaboration with Sussex Kelp Recovery Project and wider partners, is leading a review of the sources and impacts of sediment to inform future action. High levels of sedimentation from a range of sources, such as aggregate dredging and disposal[11], coastal erosion, land run-off, sewage pipes and industrial development, can have impacts on crab and lobster migration, health and reproduction. These environmental pressures could have an impact on the efficacy of the Nearshore Trawling Byelaw 2019 for these key fisheries, so it is important that this is considered as this study progresses.

Research Aims and Hypotheses

Research shows that there is a positive association between the abundance of lobster and crab and kelp beds[12]. There is also a positive relationship between the amount and structural complexity of kelp species and the abundance of associated commercially valuable species. This is due to the role that kelp plays in providing space, food and refuge from predators[12]. Therefore, we predict that as essential fish habitats recover during the study, and if remaining pressures do not limit this recovery, the abundance of both crab and lobster will increase. It would also be expected for there to be a greater range of crab and lobster sizes (more mature and juvenile individuals) and that individuals caught would be in better condition. As this study is only the fifth year of a longer-term monitoring programme, we would not yet expect to see significant differences between years and treatments, due to the time it takes for essential fish habitats, including kelp and associated species to recover.

This study aims to:

- Investigate the effect of the trawling exclusion zone, implemented under the Nearshore Trawling Byelaw 2019, on commercial crustacean fisheries by collecting and comparing data on European lobster and brown crab inside and outside the designated area.

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[10] Sussex Kelp Restoration Project. 2022. *Sediment in Sussex coastal waters – Sea user survey results. A report prepared for the SKRP by Blue Marine Foundation and Wayforward Brighton*. Available at: https://sussexkelp.org.uk/news/reportsandpublications

[11] Cooper, K.M., 2005. Cumulative effects of marine aggregate extraction in an area east of the Isle of Wight- a fishing industry perspective. *Science series technical report. Centre for Environment, Fisheries and Aquaculture Science*, *126*, p.28.

[12] Bertocci, I., Araújo, R., Oliveira, P. and Sousa-Pinto, I., 2015. Potential effects of kelp species on local fisheries. *Journal of Applied Ecology*, *52*(5), pp.1216-1226.

Objectives:

- Compare the traits (body size/weight and conditions) and abundance data collected from consecutive annual surveys since the introduction of the Nearshore Trawling Byelaw 2019, to monitor crustacean population changes over time across the survey area.
- Investigate how depth may affect crab and lobster abundance obtained across the survey area.

Methodology

Site Selection

Sites were chosen inside and outside the Nearshore Trawling Byelaw 2019 area (stated as 'trawling exclusion zone' throughout the report) using bathymetry maps to select suitable rocky reef areas. However, after the pilot study proved unsuitable, local fishermen's knowledge was used to find areas of 'known' ground that supports the local crab and lobster fishery (Figure 7). 12 sites were selected around Selsey Bill inside and outside the trawling exclusion zone. These sites were surveyed annually from 2021 to 2025 (Figure 7, red sites; Table 1). Six sites were selected in Brighton in 2022, the sites were revised in 2023 with the help of local fishermen, and the revised sites were surveyed in 2023 and 2024 and not repeated in 2025 due to funding and fishermen availability (Table 1). The six sites surveyed in Eastbourne in 2022 (Table 1), were not repeated in 2023, 2024 and 2025 due to lack of funding and fishermen availability. All sites selected were between 2-17 m depth (Site information in Appendix B).

Table 1: Summary table of the date, number and location of sites surveyed each year

<table>
<tr><th>Year</th><th>Survey period</th><th>Locations</th><th>Number of Sites Surveyed</th></tr>
<tr><td>2021</td><td>9-12 September</td><td>Selsey</td><td>12 (5 Inside and 7 Outside)</td></tr>
<tr><td rowspan="3">2022</td><td rowspan="3">23 August - 20 September</td><td>Selsey</td><td>12 (5 Inside and 7 Outside)</td></tr>
<tr><td>Brighton</td><td>6 (2 Inside and 4 Outside)</td></tr>
<tr><td>Eastbourne</td><td>6 (2 Inside and 4 Outside)</td></tr>
<tr><td rowspan="2">2023</td><td rowspan="2">14-25 August</td><td>Selsey</td><td>12 (5 Inside and 7 Outside)</td></tr>
<tr><td>Brighton</td><td>9 (5 Inside and 4 Outside)</td></tr>
<tr><td rowspan="2">2024</td><td rowspan="2">12-23 August</td><td>Selsey</td><td>12 (5 Inside and 7 Outside)</td></tr>
<tr><td>Brighton</td><td>9 (5 Inside and 4 Outside)</td></tr>
<tr><td>2025</td><td>5-8 August</td><td>Selsey</td><td>12 (5 inside and 7 outside)</td></tr>
</table>

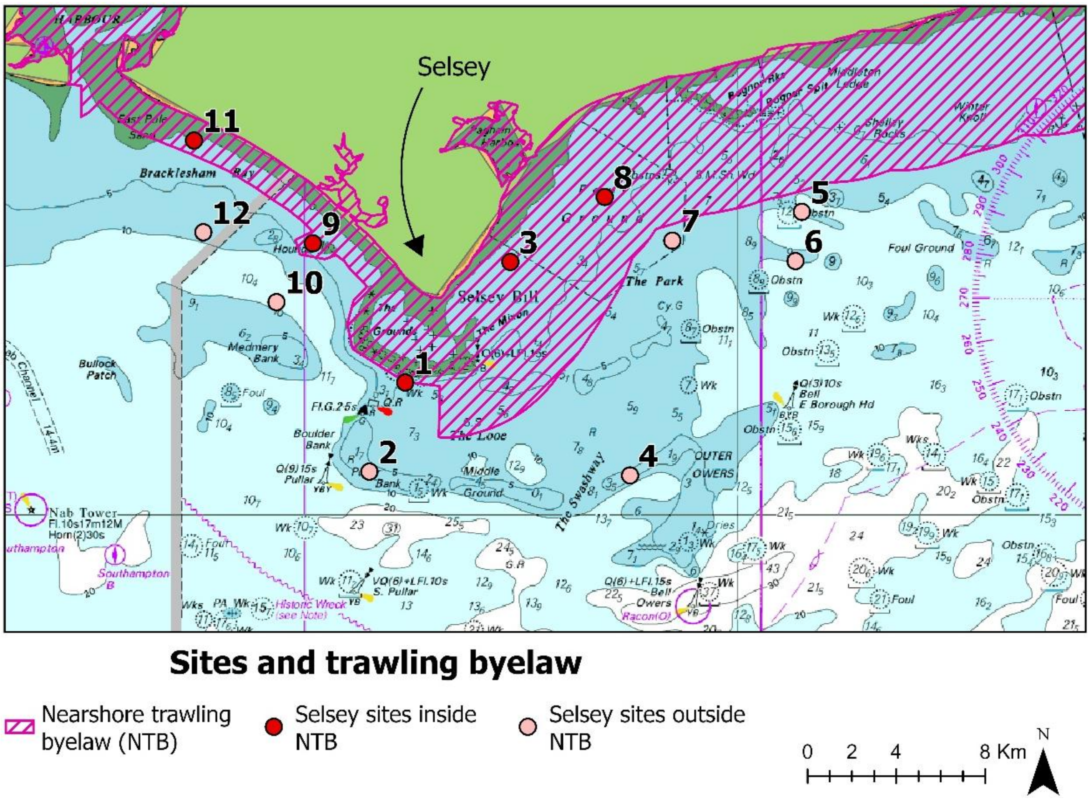


Figure 7: Survey sites used in data analysis across Selsey (2021-2025).

Some sites inside the trawling exclusion zone were also within Marine Conservation Zones (MCZs), with some sites around Selsey overlapping with Selsey Bill and the Hounds MCZ (UKMCZ0068). This does not affect the dataset as the management does not differ in these MCZs to the trawling exclusion zone.

Data Collection

Potting surveys were used to collect data on the key commercial species of European lobster and brown crab, and associated bycatch. The number of individual spider crab caught in the pots were also reported, as although not a commercially important species in Sussex, increased numbers have been observed in recent years and may have an impact on other crustacean species. Other metrics for spider crab were not recorded. This is because, as shown in other case studies such as Lyme Bay[13], this species has not been shown to respond to spatial protection measures due to its ability to live in a variety of habitats, including degraded habitats.

Local fishermen and their vessels were hired to support the survey, taking Blue Marine researchers on board to set and retrieve the pots. Pots were divided into strings of 19 to 20 and one string was left at each site to soak for 24 hours depending on weather and

[13] Rees, A. 2019. *The Lyme Bay experimental potting study*. Available at: https://pearl.plymouth.ac.uk/handle/10026.1/16833

practicalities. While fishermen often deploy their pots for longer than 24 hours when fishing, this length of time provides a practical and consistent sample.

To reduce variability of environmental variables between years, surveys were carried out within the month of August every year, except in 2021 when sites were sampled in September (Table 1). Specific survey periods were: All pots were 'parlour' pots and were baited with 'gurnard' (*Chelidonichthys cuculus*). Escape gaps were closed following dispensation provided by Sussex IFCA for the specified period of the survey. This allowed a greater range of crustacean sizes to be caught to provide a representative sample of the whole population, including juveniles. In 2025, a total of 5 strings (98 pots) were set within the trawling exclusion zone, and a total of 7 strings (138 pots) were set outside the exclusion zone. There were no more than 60 pots deployed within 24 hours. This was a consistent method used in all years of the survey.

Gear was hauled and all individuals were identified. For crab and lobster, abundances were recorded and measurements including carapace length and width, weight, sex, condition and berried status were taken. Condition score was assessed based on physical health (Table 2) using a method outlined by Haig *et al.* (2016)[14]. Their index only mentions the presence or absence of black spots in index 1 of crustacean condition. However, in this study, the quantity of black spots present on a crab was also taken into consideration. For this study, "limited black spot lesions" would be classified in indexes 2 and 3, "black spots covering around 50 per cent of the carapace" in Index 4, and "large surface area of black spot lesions on the body" in Index 5. All catch was returned alive in the vicinity of where it was caught. Other species caught as bycatch were identified, noted and returned immediately to sea after identification (Appendix E).

Table 2: Crustacean conditions and description

Index	Description
1	All legs present. No black spot. No damage.
2	One or two legs missing
3	More than two legs missing (number of missing limbs noted)
4	One or both claws missing
5	One or both claws missing and some legs missing

Data Analysis

To understand the effect of the Nearshore Trawling Byelaw 2019 on commercial crustacean species over time, the independent variables in this analysis were 'Treatment' (split into two categories, inside the trawling exclusion zone (Inside) and outside the trawling exclusion zone (Outside) and 'Year' (2021 to 2025, to analyse differences between years).

[14] Haig, J.A., Bakke, S., Bell, M.C., Bloor, I.S., Cohen, M., Coleman, M., Dignan, S., Kaiser, M.J., Pantin, J.R., Roach, M. and Salomonsen, H., 2016. Reproductive traits and factors affecting the size at maturity of Cancer pagurus across Northern Europe. *ICES Journal of Marine Science*, *73*(10), pp.2572-2585.

To achieve the aims of the study and understand the effect of the byelaw on crab and lobster over time, the analysis undertaken in 2025, shown in the main report, included Selsey data only. This is because the data collected at Selsey is the only longer-term 5-year dataset; the data collected from sites off Brighton and Eastbourne has been presented in previous potting survey reports.

The metrics recorded for brown crab and European lobster were:

- Abundance
- Carapace size (and abundances < Minimum Conservation Reference Size (MCRS))
- Weight
- Condition score
- Sex ratio

Abundances were calculated as the number of individuals per pot for each site and then averaged per treatment for the graphs presented in the results. Results were normalised and expressed as Catch Per Unit Effort (CPUE), calculated by dividing the sum value of individuals caught per species divided by the number of pots on the string due to some strings having a missing pot. Univariate testing was performed using Generalised Linear Models (GLMs). A log transformation was applied to the data to meet model assumptions. All results are expressed to 2 decimal places.

The explanatory factors to assess the differences in abundance were Year (2021-2025), Treatment, and Depth. Two GLMs were used to analyse CPUE (Appendix C). Each GLM focused on either brown crab or European lobster. A stepwise selection process was used to investigate which variables best fit the model (Appendix C). Interactions and variables that were not significant were removed. However, treatment and year were retained in all models regardless of significance, as they were central to the hypotheses being tested. Therefore, the final models reported were not necessarily those that explained the most variance in the dataset, but those that best aligned with the experimental hypotheses and allowed for comparisons across treatments and years (Appendix C).

An additional dataset was created using only individuals below the MCRS, for which a GLM was used to understand the trends. Data were cleaned and error-checked before processing. Using the same explanatory variables as above (Year, Treatment, and Depth), a GLM with a binomial distribution was used to test the sex ratio, with females labelled as “1” and males as “0”. Carapace size and weight were both normally distributed. GLMs were used to model variation in weight, size, and catch per unit effort (response variables) as a function of year, depth, and treatment (explanatory variables). To test the condition score, an ordinal logistic regression model was used because the variable contains ordered categories (1–5). In this model, predictor coefficients describe how explanatory variables affect the probability of an individual being in a higher versus lower condition category based on the treatment they are caught in.

Results

Abundance

The abundance of individuals caught before the transformation to CPUE is shown in Table 3.

Table 3: Abundance of individuals caught in Selsey surveys

Species	Year	Overall Abundance	Inside NTB Abundance	Outside NTB Abundance
European lobster	2021	23	13	10
	2022	66	37	29
	2023	63	26	37
	2024	47	16	31
	2025	62	13	49
Brown crab	2021	66	34	32
	2022	45	20	25
	2023	26	4	22
	2024	47	8	39
	2025	25	11	14
Spider crab	2021	51	35	16
	2022	44	13	31
	2023	75	57	18
	2024	87	41	46
	2025	223	72	151

The CPUE of brown crabs in 2025 was on average slightly higher inside the trawling exclusion zone (0.11 ± 0.07) than outside the exclusion zone (0.10 ± 0.03). The abundance of brown crabs caught declined from 2021 to 2023, with a slight increase from 2023 to 2025 inside the trawling exclusion zone, and higher fluctuations in abundance outside the exclusion zone (Figure 8). Although trends are described, these were not statistically significant (Appendix C).

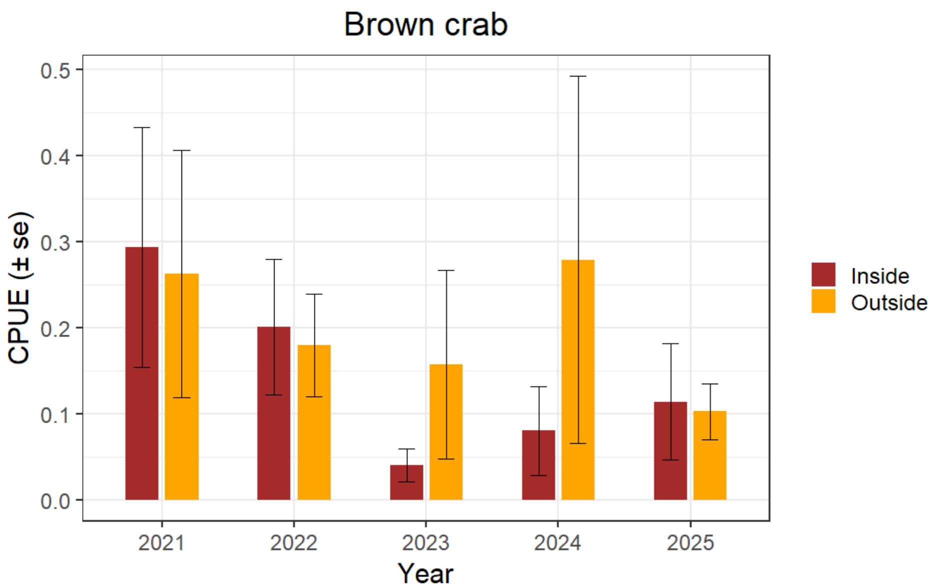


Figure 8: Mean abundance of brown crab caught inside and outside the trawling exclusion zone, from 2021 to 2025

Lobster CPUE in 2025 was on average higher outside the trawling exclusion zone (0.35 ± 0.11) than inside the designated area (0.13 ± 0.05). The abundance of lobsters inside the trawling exclusion zone increased from 2021 to 2022 and has decreased since year on year, whereas the abundance outside the trawling exclusion zone increased from 2021 to 2025 with a slight decline in 2024 (Figure 9). Although the interaction between year and treatment was not statistically significant, there was a significant overall increase in lobster abundance from 2021 to 2025 (Appendix C).

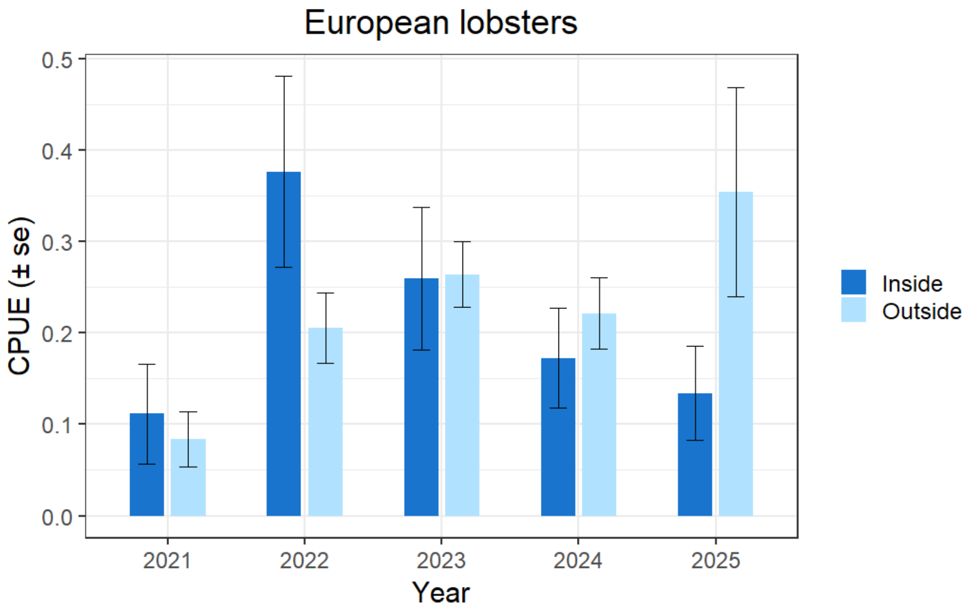


Figure 9: Mean abundance of European lobster caught inside and outside the trawling exclusion zone, from 2021 to 2025

Carapace size

In 2025, brown crabs on average had a smaller carapace size inside the trawling exclusion zone (115.73 ± 6.03 mm) compared to those caught outside the zone (126 ± 4.51 mm; Figure 10), showing a decrease in average size inside the trawling exclusion zone from 2024 (135.13 ± 2.57 mm), but an increase outside compared to 2024 (outside: 137.49 ± 2.52 mm). The results show relatively stable average carapace sizes, with natural fluctuations between years, both inside and outside the trawling exclusion zone between 2021 and 2025 (Figure 10). The significant trends obtained from the analysis showed a decrease in carapace size from 2021 to 2022 both inside and outside the trawling exclusion zone, and a significant increase from 2022 to 2024 inside and outside the trawling exclusion zone (Appendix C).

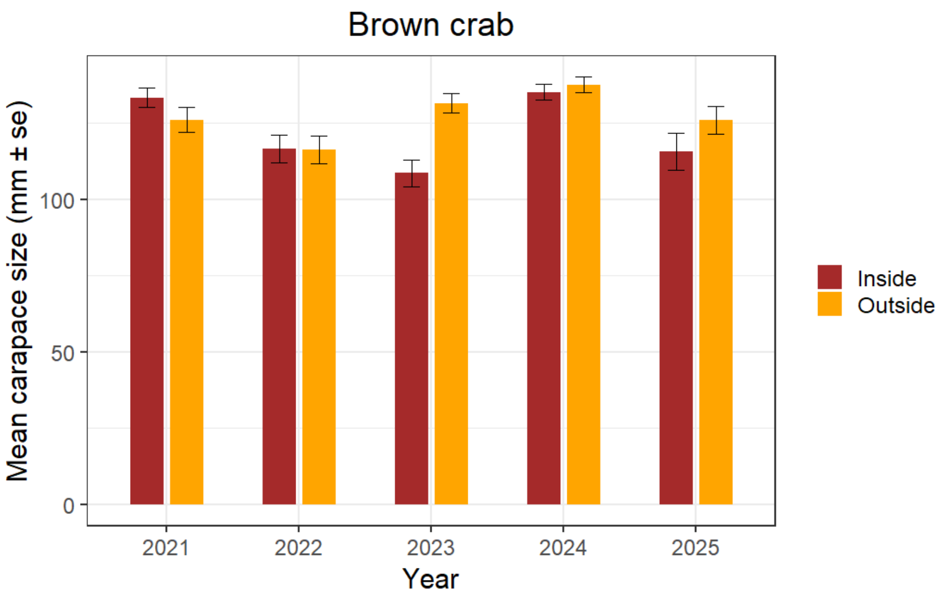


Figure 10: Mean carapace size of brown crabs caught inside and outside the trawling exclusion zone from 2021 to 2025

On average, in 2025 the carapace size of lobster was smaller inside the trawling exclusion zone (88.38 ± 4.17 mm) compared to outside (91.53 ± 1.77 mm), showing an increase of carapace size both inside and outside the trawling exclusion zone compared to 2024 (inside: 87.25 ± 2.99 mm, outside: 89.77 ± 2.74 mm). There was a slight reduction in average carapace size inside the trawling exclusion zone between 2021 and 2023, then an increase from 2023 to 2025. There was a slight increase outside the exclusion zone between 2021 and 2025 (Figure 11), but none of the differences were significant (Appendix C).

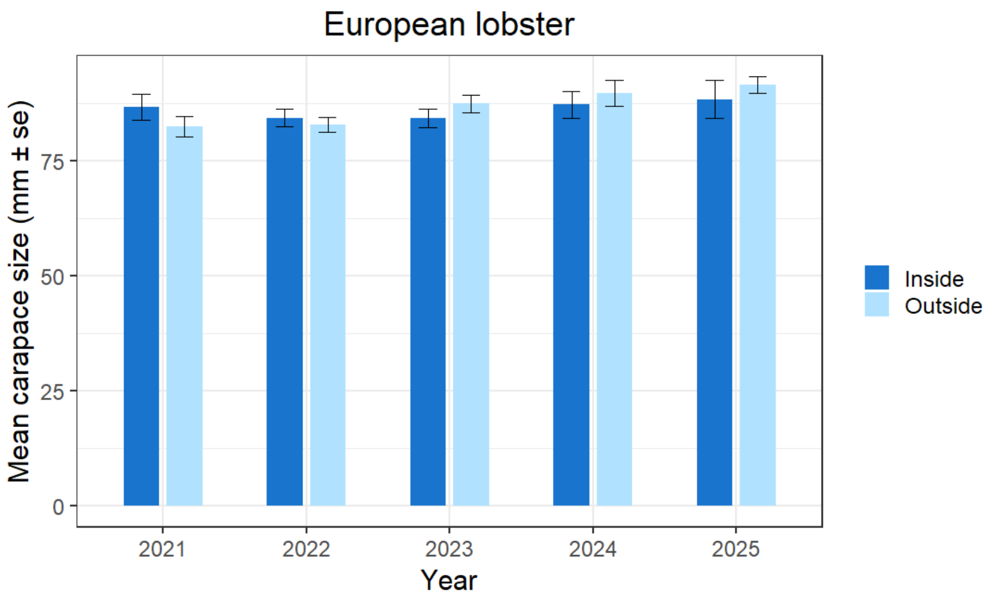


Figure 11: Mean carapace size of European lobsters caught inside and outside the trawling exclusion zone from 2021 to 2025

MCRS

The abundance of brown crab below Minimum Conservation Reference Size (MCRS) (<140 mm) was higher inside the exclusion zone (0.17 ± 0.07 mm) compared to outside (0.10 ± 0.03 mm), and both showed a decrease compared to 2024 (inside: 0.18 ± 0.03 mm, outside: 0.2 ± 0.15 mm). Catch Per Unit Effort of brown crabs was higher inside the trawling exclusion zone in 2021 and 2022. This reversed in 2023 and 2024 when the Catch Per Unit Effort was higher outside the exclusion zone and then reversed again in 2025 (Figure 12). No significant differences between treatments and years were identified (Appendix C).

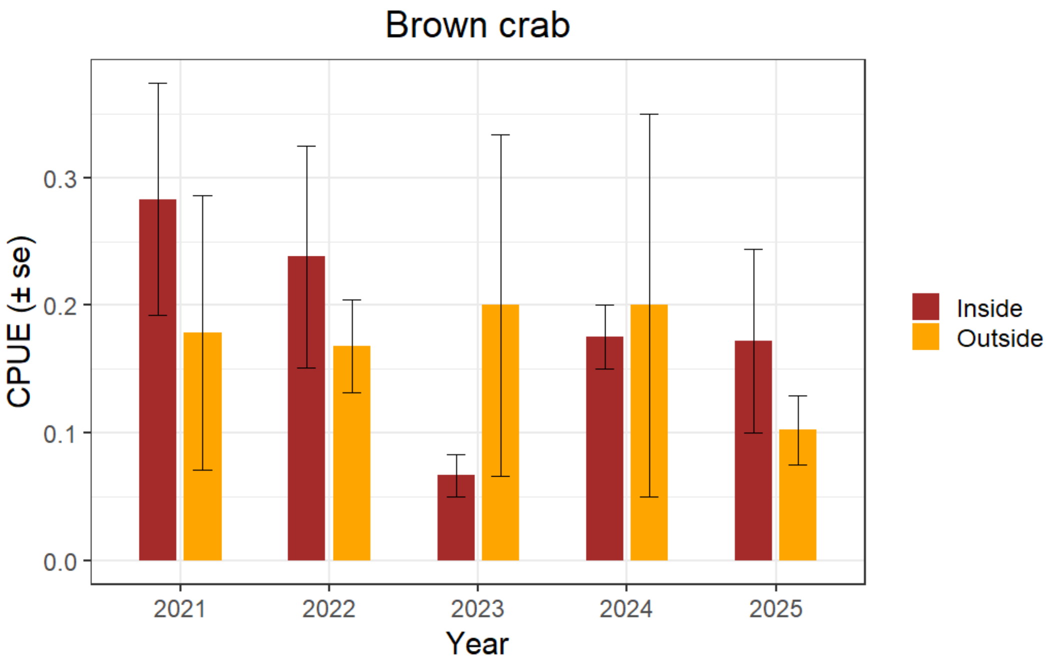


Figure 12: Mean abundance of brown crabs caught below MCRS inside and outside the trawling exclusion zone from 2021 to 2025

The abundance of lobster caught below the MCRS (<87 mm) was higher outside the exclusion zone (0.14 ± 0.04 mm) compared to inside in 2025 (0.09 ± 0.02 mm). Overall, the abundance of small lobsters <87 mm, both inside and outside the trawling exclusion zone has shown an increase from 2021 to 2022 and a decrease from 2022 onwards (Figure 13). No significant differences between treatments and years were identified (Appendix C).

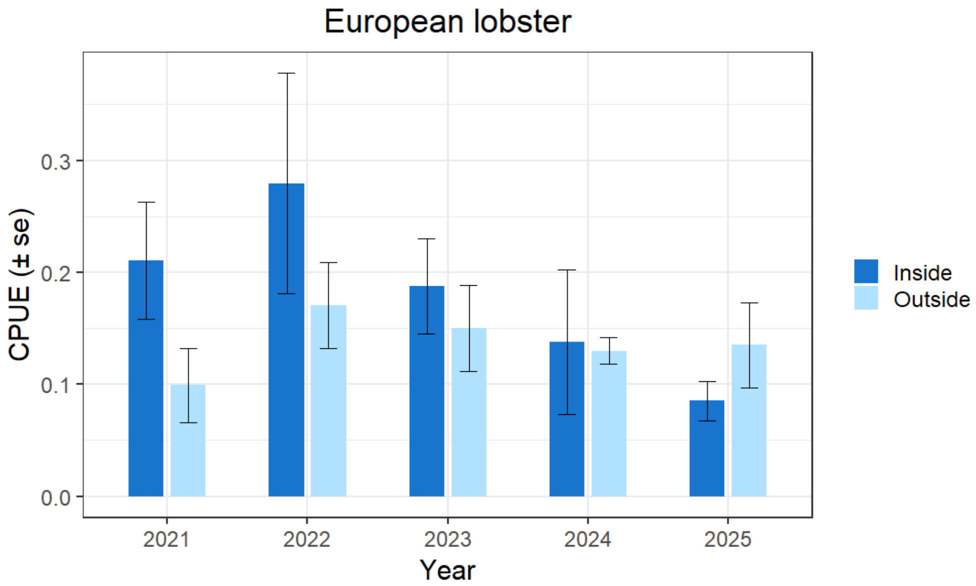


Figure 13: Mean abundance of European lobsters below MCRS inside and outside the trawling exclusion zone between from 2021 to 2025

Weight

In 2025, brown crabs were on average heavier outside the trawling exclusion zone (332.5 ± 33.17 g) compared to inside (233.82 ± 34.45 g). Brown crab average weight decreased from 2021 to 2022, then increased from 2022 to 2024 and decreased again in 2025 (Figure 14). Analysis showed a significant decrease in weight from 2021 to 2022 inside the trawling exclusion zone, followed by a significant increase from 2022 to 2024 inside the trawling exclusion zone. Brown crab weight outside the trawling exclusion zone also significantly increased from 2022 to 2024. (Appendix C).

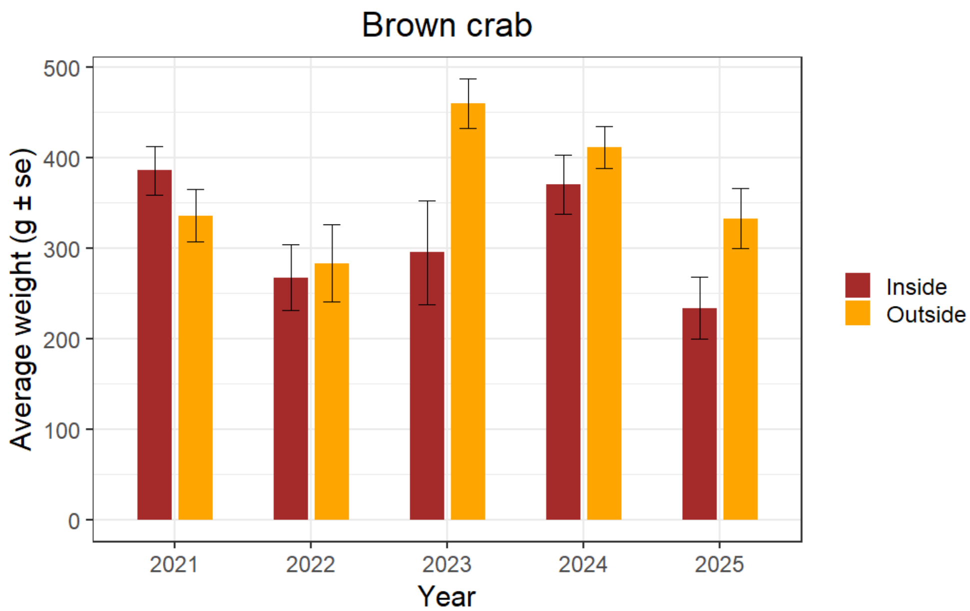
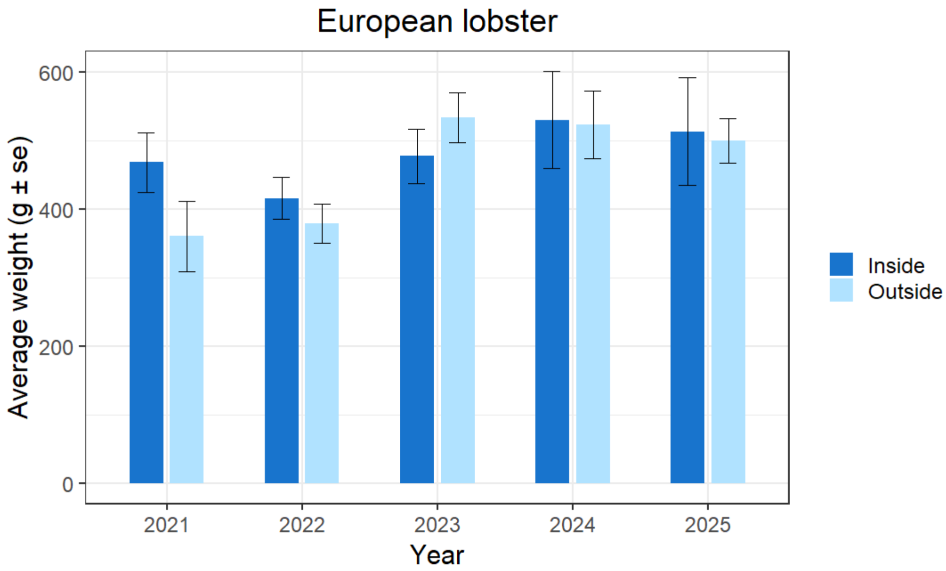


Figure 14: Mean weight of brown crab inside and outside the trawling exclusion zone from 2021 to 2025

In 2025, lobsters were on average heavier inside the trawling exclusion zone (513.69 ± 78.53 g) compared to outside (499.88 ± 32.62 g), showing a slight decrease in weight from 2024 (Figure 15). Lobster weight has varied between treatment and year (Figure 15), but no differences were statistically significant (Appendix C).



trawling exclusion zone from 2021 to 2025

Sex ratio

Inside the trawling exclusion zone, male brown crabs were caught in higher numbers compared to females in 2021, 2022, 2023, and 2025 but fewer males compared to females were caught in 2024. Outside the trawling exclusion zone, male brown crabs were caught in higher numbers than females in all five years (Figure 16). In 2025, the sex ratio was 54.5 per cent males to 45.5 per cent females inside the trawling exclusion zone (Figure 16A), and 71.4 per cent males to 28.6 per cent females outside the trawling exclusion zone (Figure 16B).

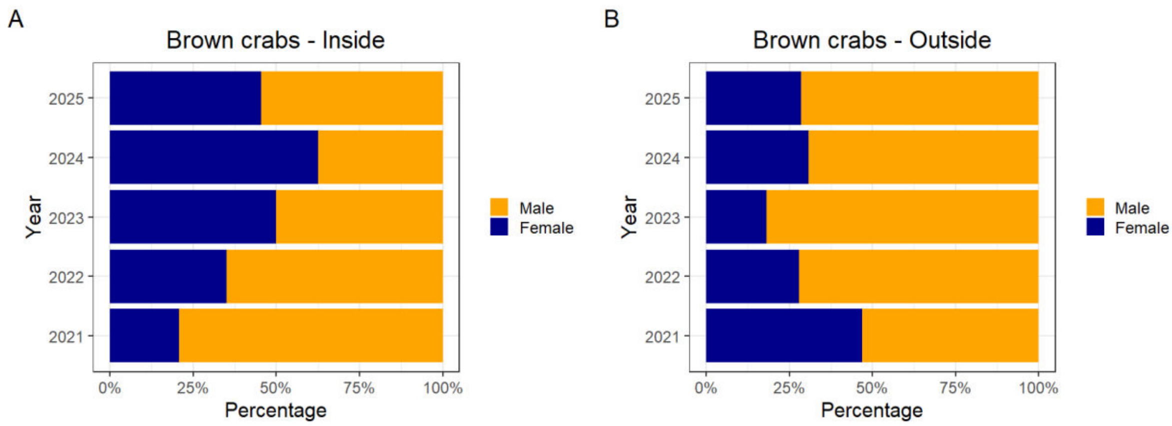


Figure 16: Sex ratio of brown crabs from 2021 to 2025, (A) inside and (B) outside the trawling exclusion zone

A higher proportion of male lobsters were caught inside the trawling exclusion zone from 2021 to 2023 and in 2025, whereas a higher proportion of females were caught in 2024 (Figure 17A). Outside the trawling exclusion zone, the ratios between males and females caught has been relatively stable in equal ratio (Figure 17B). In 2025, the sex ratio was 46.2 per cent females to 53.8 per cent males inside the trawling exclusion zone (Figure 17A), and 53.1 per cent females to 46.1 per cent males outside the trawling exclusion zone (Figure 17B).

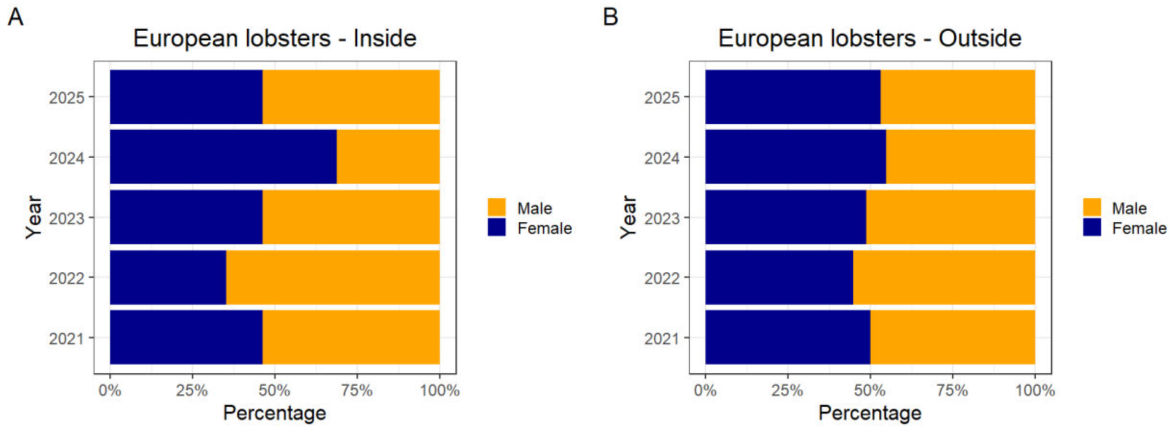


Figure 17: Sex ratio of European lobsters from 2021 to 2025 (A) Inside and (B) outside the trawling exclusion zone

Condition

Brown crab condition decreased from 2021 to 2022 in both inside and outside sites, with a higher number of crabs scoring condition 2 and 3, and fewer condition 1 (Figure 18). Brown crab condition both inside and outside the exclusion zone showed improvements from 2022 to 2024 with an increasing number of individuals caught scoring condition 1. The overall condition slightly worsened in 2025 with more individuals caught in condition 5. The proportion of individuals found in condition 1 was relatively similar between 2024 and 2025 both inside and outside the trawling exclusion zone (Figure 18), but more individuals were caught in condition 5, missing both claws (Figure 18A). Results included in Appendix D.

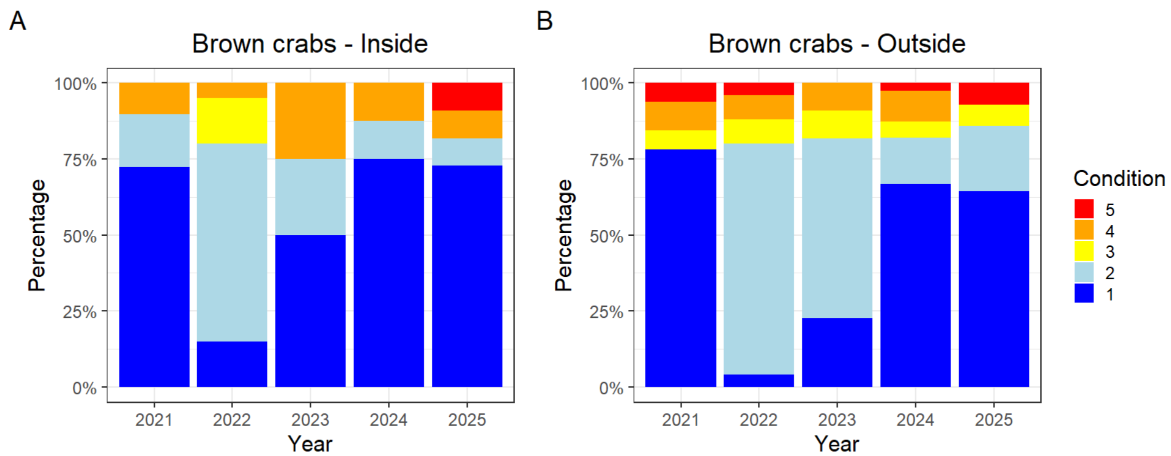


Figure 18: Percentage frequency of brown crab caught in each condition category from 2021 to 2025 and between (A) inside and (B) outside the trawling exclusion zone

The condition of lobsters has remained relatively constant from 2021 to 2024 (Figure 19). Individuals most frequently scored condition 1, showing lobsters of good condition. In 2023, 2024 and 2025 outside the trawling exclusion zone, some lobsters scored condition 5 (Figure 19B), meaning both claws were missing. In 2025, the lobster condition also worsened inside the byelaw area, but no individual was found with both claws missing (condition 5). Results included in Appendix D.

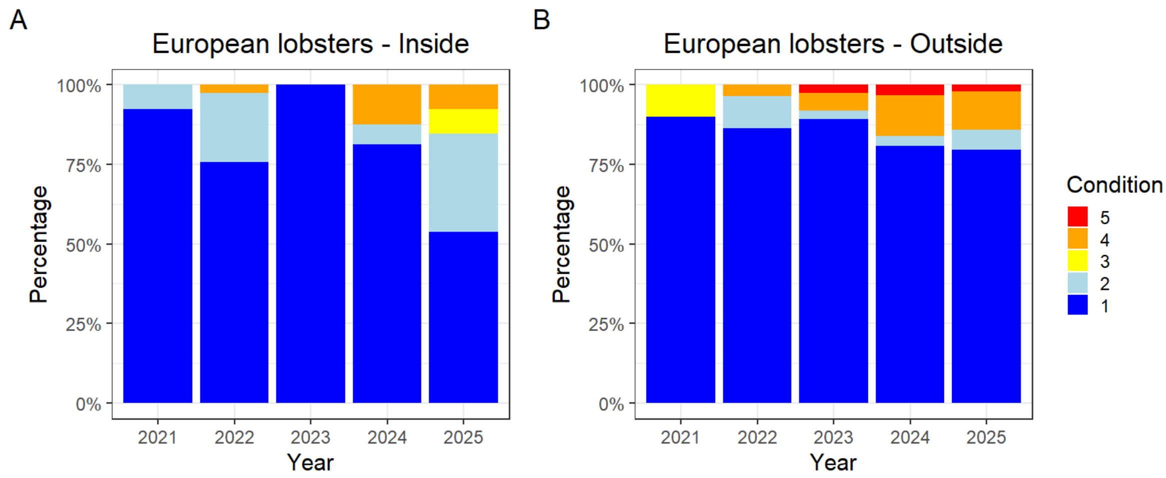


Figure 19: Percentage frequency of European lobsters caught in each condition category from 2021 to 2025 and between (A) inside and (B) outside the trawling exclusion zone

Since 2021, the mean condition index of brown crabs has been higher outside the trawling exclusion zone, compared to inside, except for 2025 when the condition was higher inside than outside the trawling exclusion zone (Table 4). European lobster on the other hand, had a higher average condition outside the trawling exclusion zone in 2021, 2023 and 2024, with higher average condition scores inside in 2022 and 2025 (Table 4).

Table 4: Mean condition index of brown crabs and European lobsters from 2021 to 2025

Year	Brown crab		European lobster	
	NTB	Outside	NTB	Outside
2021	1.41	1.66	1.08	1.2
2022	2.1	2.32	1.3	1.21
2023	2	2.05	1	1.3
2024	1.5	1.67	1.44	1.55
2025	1.73	1.64	1.69	1.51

Bycatch

Over the 5-year period, the composition of non-target species caught as bycatch inside the trawling exclusion zone has consisted of 50 per cent velvet swimming crabs, 37.5 per cent ballan wrasse, 6.3 per cent blenny and 6.3 per cent hermit crabs (Figure 20A). Outside the trawling exclusion zone, bycatch consisted of 45.4 per cent velvet swimming crabs, 27.3 per cent ballan wrasse, 13.6 per cent conger eel and 4.5 per cent each for sea urchin, whelk, and hairy crab (Figure 20B).

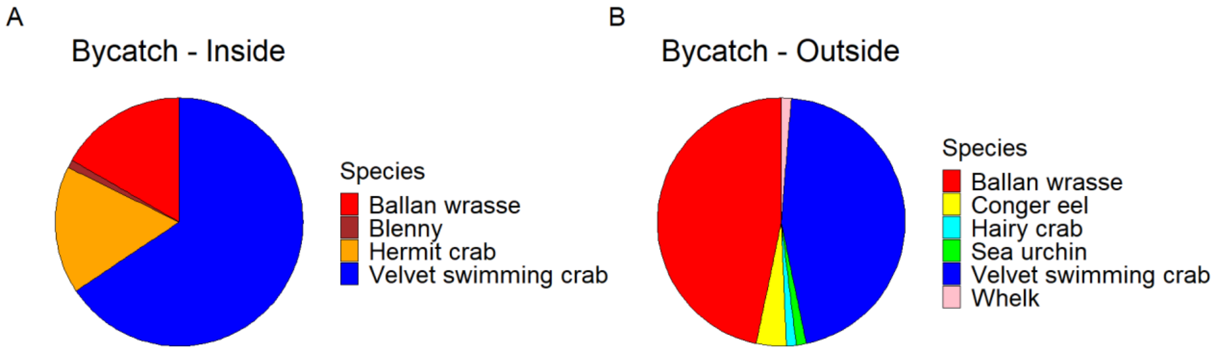


Figure 20: Bycatch caught in from 2021 to 2025 at Selsey A) inside and B) outside the trawling exclusion zone

Depth

Survey results indicate a negative effect of depth on brown crab abundance. As depth increases, the number of brown crabs decreased, but not significantly (Figure 21, Appendix C). Depth of survey sites did not influence the abundance of European lobster caught (Appendix C).

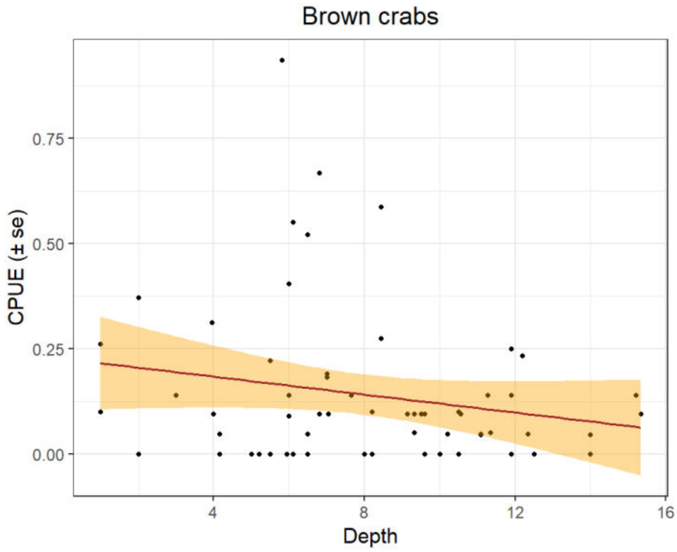


Figure 21: Brown crab abundance plotted against site depth

Discussion

The potting survey conducted from 2021 to 2025 in Selsey, West Sussex is part of a wider assessment investigating the ecological, social and economic changes resulting from the recovery of essential fish habitats following the introduction of the Sussex IFCA Nearshore Trawling Byelaw 2019 in March 2021. The study aimed to monitor population size and demographics of the commercially important brown crab (*Cancer pagurus*) and European lobster (*Homarus gammarus*), and to make inferences regarding any effect of introduced fisheries management, by collecting data from inside and outside the trawling exclusion zone on abundance, sex ratio, size, weight and condition. The results will be compared year on year to record trends that may be associated with wider ecosystem changes, such as signs of habitat recovery that once occurred within the region.

2025 was the fifth year of monitoring since the byelaw was introduced in March 2021. While significant changes in crab and lobster populations following introduction of the Nearshore Trawling Byelaw would not be expected within five years, some trends were of note.

Overall, brown crab abundance remained stable over time, the observed increase in average carapace size and weight across years may indicate enhanced survival and longevity. This pattern is consistent with a potential early signal of population recovery, where demographic changes in size structure are identified prior to detectable increases in abundance. In contrast, the results suggest that the removal of trawling pressure has not yet led to detectable changes in European lobster abundance, size, or weight, indicating either a delayed response to protection or that these metrics are influenced more strongly by factors other than trawling pressure, or depth.

Although not being statistically significant, some trends have been observed and are important to note. The abundance of brown crab shows an overall decrease from 2021 to 2025, with a temporary increase in 2024. European Lobster abundance varied over time, with higher abundances inside the Nearshore Trawling Byelaw area between 2021 and 2022, similar between inside and outside the area in 2023, and higher outside the nearshore trawling byelaw in 2024 and 2025. These trends should be revisited in future monitoring studies to assess if these findings show natural fluctuations of local crustacean species or the early stages of a response to the Nearshore Trawling Byelaw.

Another trend to consider is the condition of individuals caught. On average every year, brown crab condition has been better inside the trawling exclusion zone than outside the area, apart from 2025 where the condition was slightly better outside. Condition for European lobsters, was better inside than outside, apart from 2022 and 2025, where the average condition was slightly better outside.

The recovery of crab and lobster populations in Sussex will depend on the recovery of habitats, such as kelp beds, that are important to crab and lobster life history. It is likely that more effective management of other pressures affecting these populations and the habitats they rely on will also be necessary. Shifting ecosystem baselines due to sedimentation, water quality and climate change or changes in food web dynamics are all pressures that could have a detrimental impact[15,16,17]. Recovery of commercial crustaceans can also be hindered by continued high levels of potting [18,19].

Published studies reference the impact of aggregate dredging specifically on crustaceans in Selsey[11]. Fishermen had expressed their concern on how dredging operations may be removing juvenile lobsters, which are believed to be impacted by suspended sediment[11]. The report also highlights dredge disposal sites and areas of importance for brown crab in the early 2000's, identifying a clear overlap between these two. During the reported period, there had been an increase of the overlap area, and an overall decrease of brown crabs caught[11]. Blue Marine and project partners in the Sussex Kelp Recovery Project, such as Sussex Wildlife Trust[20], are working to gather evidence on sedimentation in Sussex to inform further research and action.

Conclusion and Recommendations

This five-year dataset has established a robust baseline for crab and lobster populations around Selsey Bill, where sites have been sampled annually for five years with commitment from the local fishermen being key. Further surveys and monitoring at these and other sites across Sussex would ensure development of a long-term dataset to assess the impact of the Sussex IFCA Nearshore Trawling Byelaw 2019 on brown crab and European lobster fisheries.

It was unfortunate, that it was only feasible to undertake surveys consistently on an annual basis throughout the five-year period at Selsey due to the availability of local fishing vessels in East Sussex.

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[15] Smale, D.A., 2020. Impacts of ocean warming on kelp forest ecosystems. *New Phytologist*, *225*(4), pp.1447-1454.

[16] Picard, M.M., Johnson, L.E. and Côté, I.M., 2022. Effects of sediment on spore performance as a potential constraint on kelp distribution. *Marine Pollution Bulletin*, *185*, p.114336.

[17] 22 Connell, S.D., 2007. Water quality and the loss of coral reefs and kelp forests: alternative states and the influence of fishing. Marine ecology. Oxford University Press, Melbourne, pp.556-568.

[18] Davies, B.F., Holmes, L., Rees, A., Attrill, M.J., Cartwright, A.Y. and Sheehan, E.V., 2021. Ecosystem Approach to Fisheries Management works—How switching from mobile to static fishing gear improves populations of fished and non-fished species inside a marine-protected area. *Journal of Applied Ecology*, *58*(11), pp.2463-2478.

[19] Rees, S.E., Ashley, M., Evans, L., Mangi, S., Sheehan, E.V., Mullier, T., Rees, A. and Attrill, M.J., 2021. An evaluation of the social and economic impact of a Marine Protected Area on commercial fisheries. *Fisheries Research*, *235*, p.105819.

[20] Sussex Wildlife Trust. 2024. *Sedimentation.* Available at: https://sussexwildlifetrust.org.uk/what-we-do/living-seas/kelp/sedimentation

If surveys are continued, the methodology could be enhanced by undertaking multivariate analysis and including measurement of additional environmental variables that could affect crab and lobster population dynamics, both historically and at present.

Analysis of sea water temperature on survey days and average seasonal sea water temperature at various depths from the first survey year up to the most recent survey could shed light on any effects of cold winters and marine heatwaves on crustacean abundance. Taking note of tide and wave exposure during surveys would also be useful. If time and resources allowed, undertaking surveys at the selected sites at different times of the year could provide more robust baselines against which to detect future changes. Additional research into the impact of sediment, pollutants and pathogens on the health and abundance of crustaceans would also complement the study.

Overall, although significant changes have not yet been detected, the first five years of monitoring have established a valuable ecological baseline for assessing future recovery of crab and lobster populations. The data highlight key trends and environmental factors influencing crustacean populations in west Sussex coastal waters and provide an important reference point for evaluating the long-term effects of the Nearshore Trawling Byelaw 2019 on local habitats and commercially important species.

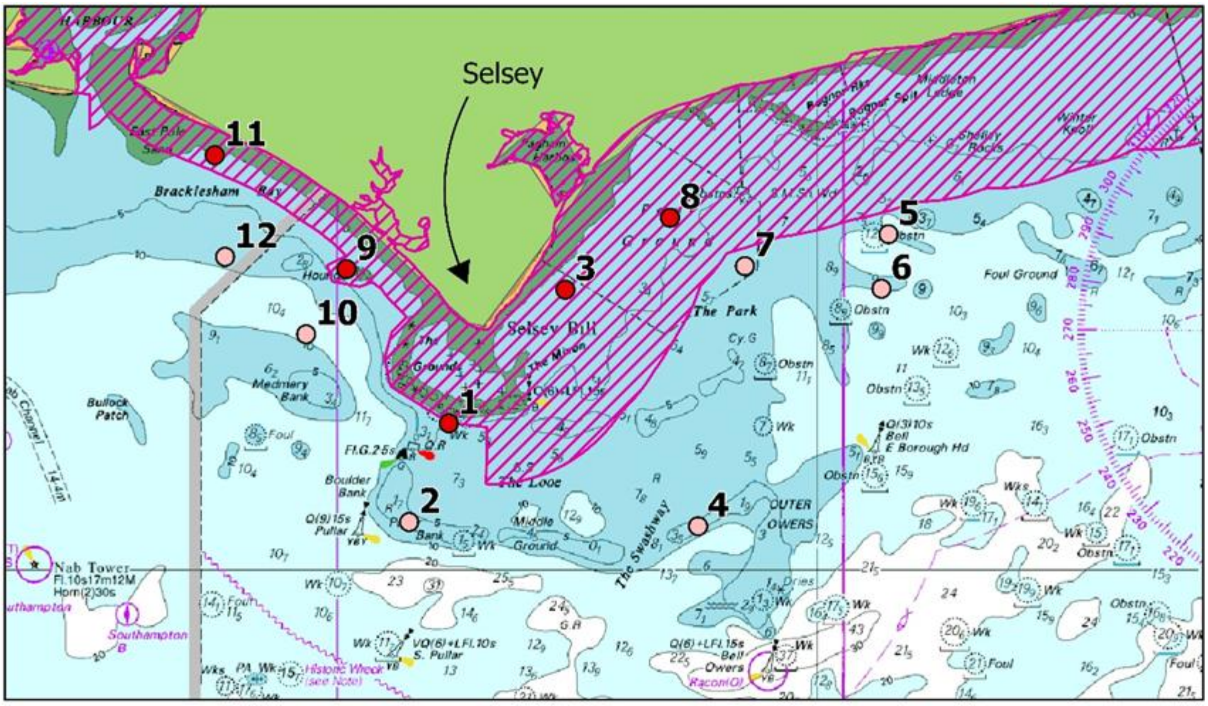
Appendix A –Key Points Raised by Local Sussex Fishermen Between 2021-2025

- All fishermen were worried about increased sedimentation in the area. Increased sediment loads can smother rocky reef habitat and fill in holes where lobsters (especially juveniles) hide.
- The fishermen noted that local divers have seen increased sediment on the rocky reefs.
- Fishermen in Brighton explained that they noticed a sudden drop off in lobster numbers from around 2017.
- Potential reasons for lobster declines were suggested as: sedimentation from the adjacent wind farm; algae or algal blooms; American lobsters released in the Channel; sewage regularly pumped into Brighton Marina that contains chemicals; waste dumping outside of Brighton Marina; dredge spoil from Brighton Marina dredging that is dumped outside the harbour; or all of the above.
- Brighton fishermen noticed their pots were coming up with 'gritty black mud and sediment'. Suggestions that chemicals in the water caused the sediment to stick together.
- In 2024, fishermen in Brighton said there was less gritty black mud and sediment coming up with the pots.
- Important that Blue Marine shares all research and results with local fishermen. The lobsters caught in 2024 looked dormant/weak at both Brighton and Selsey – fishermen have connected this behaviour to warmer waters
- Selsey fisherman reported 55 dead crabs coming up in pots at the end of September
- Selsey fisherman highlighted that populations of inshore fisheries stocks were supported by the offshore populations, with the offshore populations being overfished by large fleets.

Appendix B – Sites, Co-Ordinates and Depths

Table 5: Selsey sites coordinates and respective depth

Site	Latitude (DM.m)	Longitude (DM.m)	Depth (m)
Site 1	50’42.13	00’48.19	2
Site 2	50’40.71	00’48.97	7
Site 3	50’43.80	00’45.67	2
Site 4	50’40.58	00’42.89	6
Site 5	50'44.84	00'37.61	4
Site 6	50'42.54	00'36.21	7
Site 7	50’44.18	00’41.39	6
Site 8	50’44.88	00’43.28	3
Site 9	50’44.18	00’50.30	1
Site 10	50’42.86	00’50.83	6
Site 11	50’45.81	00’53.35	1
Site 12	50’44.76	0’53.07	5



Sites and trawling byelaw

Nearshore trawling byelaw (NTB) · Selsey sites inside NTB · Selsey sites outside NTB

Appendix C – GLM analysis tables and post-hoc

Asterisks (#) highlight which model was used

Abundance

Table 6: Model selection using AICc for brown crab abundance

	Logged CPUE ~	*logLik*	*AICc*	*delta*	*weight*
	Year * Treatment * Depth	28.2268	9.8623	37.5419	0.000000004083
	Year + Treatment + Depth + Year:Treatment + Year:Depth + Treatment:Depth	26.1036	-3.6358	24.0438	0.000003484153
#	Year + Treatment + Depth + Treatment:Depth	21.7864	-21.9728	5.7068	0.033413792273
	Treatment + Depth + Treatment:Depth	18.9913	-26.8715	0.8081	0.386963655782
	Treatment + Depth	18.2034	-27.6796	0.0000	0.579619063708

Table 7: GLM analysis of brown crab abundance

Predictors	*estimate*	*std.error*	*t. value*	*p.value*
(Intercept)	0.3288	0.1150	2.8592	0.0061
Year2022	-0.1807	0.0915	-1.9755	0.0535
Year2023	-0.1344	0.0743	-1.8097	0.0761
Year2024	-0.0723	0.0741	-0.9758	0.3337
Year2025	-0.0823	0.0756	-1.0888	0.2813
TreatmentOutside	0.2588	0.1389	1.8640	0.0680
Depth	-0.0188	0.0152	-1.2371	0.2216
TreatmentOutside:Depth	-0.0163	0.0167	-0.9767	0.3332

Table 8: Model selection using AICc for European lobster abundance

	Logged CPUE ~	*logLik*	*AICc*	*delta*	*weight*
	Year * Treatment * Depth	50.1954	-34.0750	32.7421	0.00000007699
	Year + Treatment + Depth + Year:Treatment + Year:Depth + Treatment:Depth	47.6193	-46.6673	20.1498	0.00004176790
	Year + Treatment + Depth + Year:Depth + Treatment:Depth	45.5937	-57.2744	9.5427	0.00839763733
#	Year + Treatment + Depth + Treatment:Depth	44.2085	-66.8171	0.0000	0.99156051777

Table 9: GLM analysis of European lobster abundance

Predictors	*estimate*	*std.error*	*t.value*	*p.value*
(Intercept)	0.1552	0.0791	1.9608	0.0553
Year2022	0.1501	0.0630	2.3837	**0.0208**
Year2023	0.1300	0.0511	2.5433	**0.0140**
Year2024	0.0820	0.0510	1.6084	0.1138
Year2025	0.1075	0.0520	2.0673	**0.0437**
TreatmentOutside	-0.1859	0.0956	-1.9451	0.0572
Depth	-0.0114	0.0105	-1.0863	0.2824
TreatmentOutside:Depth	0.0251	0.0115	2.1848	**0.0334**

Carapace size

Table 10: Model selection using AICc for brown crab carapace size

	Carapace size ~	logLik	AICc	delta	weight
	Year * Treatment * Depth	-896.6953	1840.3317	8.0384	0.01087
#	Year + Treatment + Depth + Year:Treatment + Year:Depth + Treatment:Depth	-897.9979	1833.2000	0.9066	0.38435
	Year + Treatment + Depth + Year:Treatment + Year:Depth	-898.7300	1832.2933	0.0000	0.60478

Table 11: GLM analysis of brown crab carapace size in Selsey

Predictors	*estimate*	*std.error*	*t.value*	*p.value*
(Intercept)	127.9690	9.2621	13.8165	**<0.001**
Year2022	11.3269	12.0299	0.9416	0.3476
Year2023	-14.2948	21.5513	-0.6633	0.5079
Year2024	11.4341	13.2537	0.8627	0.3894
Year2025	-17.3069	14.7118	-1.1764	0.2409
TreatmentOutside	-7.5622	4.5857	-1.6491	0.1007
Depth	0.7184	1.1804	0.6086	0.5435
Year2022:TreatmentOutside	64.6117	17.8131	3.6272	**0.0004**
Year2023:TreatmentOutside	31.6196	11.6445	2.7154	**0.0072**
Year2024:TreatmentOutside	10.4197	8.5607	1.2172	0.2250
Year2025:TreatmentOutside	12.3078	13.9691	0.8811	0.3794
Year2022:Depth	-13.7160	3.8784	-3.5366	**0.0005**
Year2023:Depth	-1.4251	2.6187	-0.5442	0.5869
Year2024:Depth	-1.3968	1.6050	-0.8703	0.3852
Year2025:Depth	0.1674	2.1062	0.0795	0.9367

Table 12: Post-hoc analysis of brown crab carapace size with Year and Treatment

contrast	*estimate*	*SE*	*df*	*t.ratio*	*p.value*
Year2021 Inside - Year2022 Inside	85.0563	20.1853	194	4.2138	**0.0016**
Year2021 Inside - Year2023 Inside	24.3087	9.8183	194	2.4758	0.2882
Year2021 Inside - Year2024 Inside	-1.6186	7.3279	194	-0.2209	1.0000
Year2021 Inside - Year2025 Inside	16.1308	6.8274	194	2.3627	0.3543
Year2021 Inside - Year2021 Outside	7.5622	4.5857	194	1.6491	0.8220
Year2022 Inside - Year2023 Inside	-60.7476	21.9854	194	-2.7631	0.1568
Year2022 Inside - Year2024 Inside	-86.6749	20.9918	194	-4.1290	**0.0022**
Year2022 Inside - Year2025 Inside	-68.9255	20.8224	194	-3.3102	**0.0362**
Year2022 Inside - Year2022 Outside	-57.0495	17.2128	194	-3.3144	**0.0358**
Year2023 Inside - Year2024 Inside	-25.9273	11.3845	194	-2.2774	0.4085
Year2023 Inside - Year2025 Inside	-8.1779	11.0690	194	-0.7388	0.9992
Year2023 Inside - Year2023 Outside	-24.0574	10.7035	194	-2.2476	0.4282
Year2024 Inside - Year2025 Inside	17.7494	8.9343	194	1.9867	0.6094
Year2024 Inside - Year2024 Outside	-2.8575	7.2289	194	-0.3953	1.0000
Year2025 Inside - Year2025 Outside	-4.7455	13.1950	194	-0.3596	1.0000
Year2021 Outside - Year2022 Outside	20.4446	5.9565	194	3.4323	**0.0249**
Year2021 Outside - Year2023 Outside	-7.3109	6.7761	194	-1.0789	0.9862
Year2021 Outside - Year2024 Outside	-12.0383	4.5054	194	-2.6720	0.1927
Year2021 Outside - Year2025 Outside	3.8230	10.4868	194	0.3646	1.0000
Year2022 Outside - Year2023 Outside	-27.7555	7.6402	194	-3.6328	**0.0129**
Year2022 Outside - Year2024 Outside	-32.4829	5.7233	194	-5.6756	**0.0000**
Year2022 Outside - Year2025 Outside	-16.6216	11.0649	194	-1.5022	0.8899
Year2023 Outside - Year2024 Outside	-4.7274	6.5720	194	-0.7193	0.9994
Year2023 Outside - Year2025 Outside	11.1339	11.5268	194	0.9659	0.9938
Year2024 Outside - Year2025 Outside	15.8613	10.3562	194	1.5316	0.8778

Table 13: Model selection using AICc for European lobster carapace size

	Carapace size ~	*logLik*	*AICc*	*delta*	*weight*
#	Year * Treatment * Depth	-1001.6136	2049.0933	0	1

Table 14: GLM analysis of European lobster carapace size in Selsey

Predictors	*estimate*	*std.error*	*statistic*	*p.value*
(Intercept)	71.6253	10.7866	6.6402	**0.0000**
Year2022	3.9477	11.6749	0.3381	0.7356
Year2023	29.1153	14.9560	1.9467	0.0527
Year2024	-1.1652	15.6408	-0.0745	0.9407
Year2025	32.0501	14.0440	2.2821	**0.0234**
TreatmentOutside	15.1731	25.0650	0.6053	0.5455
Depth	2.0028	1.3606	1.4720	0.1423
Year2022:TreatmentOutside	-5.3214	28.4196	-0.1872	0.8516
Year2023:TreatmentOutside	-27.9212	28.4815	-0.9803	0.3279
Year2024:TreatmentOutside	17.8245	29.2496	0.6094	0.5428
Year2025:TreatmentOutside	-17.1397	34.8798	-0.4914	0.6236
Year2022:Depth	3.8329	2.9916	1.2812	0.2013
Year2023:Depth	-4.5094	2.0558	-2.1935	0.0292
Year2024:Depth	0.4284	2.0885	0.2051	0.8377
Year2025:Depth	-4.5558	1.9527	-2.3331	**0.0205**
TreatmentOutside:Depth	-2.4567	2.7216	-0.9027	0.3676
Year2022:TreatmentOutside:Depth	-3.8195	4.3539	-0.8773	0.3812
Year2023:TreatmentOutside:Depth	4.9126	3.2299	1.5210	0.1296
Year2024:TreatmentOutside:Depth	-1.2589	3.2789	-0.3840	0.7013
Year2025:TreatmentOutside:Depth	4.1644	3.5847	1.1617	0.2465

Weight

Table 15: Model selection using AICc for brown crab carapace size

	Weight ~	*logLik*	*AICc*	*delta*	*weight*
	Year * Treatment * Depth	104.3775	-161.6781	11.1454	0.002896
	Year + Treatment + Depth + Year:Treatment + Year:Depth + Treatment:Depth	103.8802	-170.4700	2.3535	0.234958
#	Year + Treatment + Depth + Year:Treatment + Year:Depth	103.8663	-172.8235	0.0000	0.762145

Table 16: GLM analysis of brown crab weight

Predictors	*estimate*	*std.error*	*statistic*	*p.value*
(Intercept)	0.3068	0.0931	3.2947	**0.0012**
Year2022	0.1304	0.1122	1.1617	0.2468
Year2023	0.0454	0.1841	0.2465	0.8056
Year2024	0.0908	0.1211	0.7503	0.4540
Year2025	-0.1040	0.1318	-0.7890	0.4311
TreatmentOutside	-0.0644	0.0419	-1.5357	0.1263
Depth	0.0120	0.0135	0.8892	0.3750
Year2022:TreatmentOutside	0.5078	0.1466	3.4638	**0.0007**
Year2023:TreatmentOutside	0.2412	0.0969	2.4886	**0.0137**
Year2024:TreatmentOutside	0.1085	0.0724	1.4992	0.1355
Year2025:TreatmentOutside	0.1293	0.1156	1.1187	0.2647
Year2022:Depth	-0.1090	0.0330	-3.2995	**0.0012**
Year2023:Depth	-0.0198	0.0234	-0.8475	0.3978
Year2024:Depth	-0.0163	0.0161	-1.0096	0.3140
Year2025:Depth	-0.0066	0.0196	-0.3347	0.7382

Table 17: Post-hoc analysis for Year and treatment of brown crab weight

contrast	*estimate*	*SE*	*df*	*t.ratio*	*p.value*
Year2021 Inside - Year2022 Inside	0.6223	0.1616	189	3.8498	**0.0061**
Year2021 Inside - Year2023 Inside	0.0914	0.0811	189	1.1266	0.9814
Year2021 Inside - Year2024 Inside	0.0217	0.0607	189	0.3571	1.0000
Year2021 Inside - Year2025 Inside	0.1493	0.0563	189	2.6534	0.2009
Year2021 Inside - Year2021 Outside	0.0644	0.0419	189	1.5357	0.8760
Year2022 Inside - Year2023 Inside	-0.5310	0.1763	189	-3.0111	0.0848
Year2022 Inside - Year2024 Inside	-0.6006	0.1679	189	-3.5763	**0.0157**
Year2022 Inside - Year2025 Inside	-0.4730	0.1664	189	-2.8426	0.1300
Year2022 Inside - Year2022 Outside	-0.4434	0.1405	189	-3.1564	0.0569
Year2023 Inside - Year2024 Inside	-0.0697	0.0930	189	-0.7490	0.9991
Year2023 Inside - Year2025 Inside	0.0580	0.0902	189	0.6429	0.9997
Year2023 Inside - Year2023 Outside	-0.1767	0.0874	189	-2.0232	0.5838
Year2024 Inside - Year2025 Inside	0.1276	0.0724	189	1.7627	0.7575
Year2024 Inside - Year2024 Outside	-0.0441	0.0590	189	-0.7476	0.9991
Year2025 Inside - Year2025 Outside	-0.0649	0.1077	189	-0.6023	0.9999
Year2021 Outside - Year2022 Outside	0.1145	0.0477	189	2.4004	0.3316
Year2021 Outside - Year2023 Outside	-0.1498	0.0575	189	-2.6034	0.2234
Year2021 Outside - Year2024 Outside	-0.0868	0.0379	189	-2.2887	0.4013
Year2021 Outside - Year2025 Outside	0.0200	0.0875	189	0.2291	1.0000
Year2022 Outside - Year2023 Outside	-0.2643	0.0623	189	-4.2432	**0.0014**
Year2022 Outside - Year2024 Outside	-0.2013	0.0448	189	-4.4930	**0.0005**
Year2022 Outside - Year2025 Outside	-0.0944	0.0907	189	-1.0415	0.9892
Year2023 Outside - Year2024 Outside	0.0630	0.0552	189	1.1411	0.9797
Year2023 Outside - Year2025 Outside	0.1699	0.0962	189	1.7653	0.7560
Year2024 Outside - Year2025 Outside	0.1069	0.0859	189	1.2437	0.9642

Table 18: Model selection using AICc for European lobster carapace size

	Weight ~	*logLik*	*AICc*	*delta*	*weight*
#	Year * Treatment * Depth	-1001.6136	2049.0933	0	1

Table 19: GLM analysis of European lobster weight

Predictors	*estimate*	*std.error*	*statistic*	*p.value*
(Intercept)	71.6253	10.7866	6.6402	**0.0000**
Year2022	3.9477	11.6749	0.3381	0.7356
Year2023	29.1153	14.9560	1.9467	0.0527
Year2024	-1.1652	15.6408	-0.0745	0.9407
Year2025	32.0501	14.0440	2.2821	**0.0234**
TreatmentOutside	15.1731	25.0650	0.6053	0.5455
Depth	2.0028	1.3606	1.4720	0.1423
Year2022:TreatmentOutside	-5.3214	28.4196	-0.1872	0.8516
Year2023:TreatmentOutside	-27.9212	28.4815	-0.9803	0.3279
Year2024:TreatmentOutside	17.8245	29.2496	0.6094	0.5428
Year2025:TreatmentOutside	-17.1397	34.8798	-0.4914	0.6236
Year2022:Depth	3.8329	2.9916	1.2812	0.2013
Year2023:Depth	-4.5094	2.0558	-2.1935	**0.0292**
Year2024:Depth	0.4284	2.0885	0.2051	0.8377
Year2025:Depth	-4.5558	1.9527	-2.3331	**0.0205**
TreatmentOutside:Depth	-2.4567	2.7216	-0.9027	0.3676
Year2022:TreatmentOutside:Depth	-3.8195	4.3539	-0.8773	0.3812
Year2023:TreatmentOutside:Depth	4.9126	3.2299	1.5210	0.1296
Year2024:TreatmentOutside:Depth	-1.2589	3.2789	-0.3840	0.7013
Year2025:TreatmentOutside:Depth	4.1644	3.5847	1.1617	0.2465

MCRS

Table 20: Model selection using AICc for brown crab abundance below MCRS

	CPUE ~	*logLik*	*AICc*	*delta*	*weight*
	Year * Treatment * Depth	23.6202	38.7596	61.8912	0.00000000000002319
	Year + Treatment + Depth + Year:Treatment + Year:Depth + Treatment:Depth	22.9621	12.5558	35.6874	0.00000001136010456
	Year + Treatment + Depth + Year:Depth + Treatment:Depth	20.5929	-2.6342	20.4974	0.00002258620621188
#	Year + Treatment + Depth + Treatment:Depth	18.1734	-12.8923	10.2393	0.00381387038307884
	Treatment + Depth + Treatment:Depth	15.6785	-19.7355	3.3961	0.11677328991830149
	Treatment + Depth	15.1203	-21.1880	1.9436	0.24140900979470439
	Depth	14.8735	-23.1316	0.0000	0.63798123233757564

Table 21: GLM analysis of brown crab abundance below MCRS

Predictors	*estimate*	*std.error*	*t.value*	*p.value*
(Intercept)	0.4478	0.1341	3.3392	**0.0020**
Year2022	-0.1978	0.1010	-1.9591	0.0581
Year2023	-0.1057	0.0875	-1.2072	0.2355
Year2024	-0.0379	0.0878	-0.4317	0.6686
Year2025	-0.0487	0.0833	-0.5846	0.5626
TreatmentOutside	0.1980	0.1514	1.3082	0.1993
Depth	-0.0281	0.0166	-1.6931	0.0993
TreatmentOutside:Depth	-0.0144	0.0183	-0.7864	0.4369

Table 22: Model selection using AICc for European lobster abundance below MCRS

	CPUE ~	*logLik*	*AICc*	*delta*	*weight*
#	Year * Treatment * Depth	57.4174	-30.8348	0	1

Table 23: GLM analysis of European lobster abundance below MCRS in Selsey

Predictors	*estimate*	*std.error*	*t.value*	*p.value*
(Intercept)	1.8684	1.9800	0.9436	0.3548
Year2022	-1.2459	1.9827	-0.6284	0.5357
Year2023	-1.7659	1.9901	-0.8873	0.3837
Year2024	-1.5103	1.9890	-0.7593	0.4551
Year2025	-1.7801	1.9854	-0.8966	0.3788
TreatmentOutside	-2.0612	1.9959	-1.0327	0.3120
Depth	-0.2632	0.3141	-0.8377	0.4104
Year2022:TreatmentOutside	1.5336	2.0087	0.7635	0.4526
Year2023:TreatmentOutside	1.9942	2.0117	0.9913	0.3314
Year2024:TreatmentOutside	1.9498	2.0159	0.9672	0.3431
Year2025:TreatmentOutside	1.9727	2.0153	0.9788	0.3374
Year2022:Depth	0.0672	0.3187	0.2110	0.8347
Year2023:Depth	0.2757	0.3155	0.8740	0.3908
Year2024:Depth	0.2311	0.3152	0.7330	0.4707
Year2025:Depth	0.2627	0.3147	0.8348	0.4121
TreatmentOutside:Depth	0.2970	0.3154	0.9414	0.3559
Year2022:TreatmentOutside:Depth	-0.0882	0.3217	-0.2740	0.7864
Year2023:TreatmentOutside:Depth	-0.2981	0.3171	-0.9402	0.3565
Year2024:TreatmentOutside:Depth	-0.2751	0.3171	-0.8676	0.3942
Year2025:TreatmentOutside:Depth	-0.2852	0.3166	-0.9007	0.3767

Appendix D – Conditions ordinal logistic regression

Table 24: Ordinal logistic regression for brown crab's condition, (A) Predictors table and (B) Thresholds table.

(A) **Brown crab ordinal logistic regression**

Predictor	**Value**	**Std. Error**	**t value**	**p value**
TreatmentOutside	0.2083	0.3679	0.5662	0.5712
Year2022	2.1540	0.4759	4.5260	**6.0e-06**
Year2023	1.6265	0.4741	3.4302	**0.0006**
Year2024	0.4061	0.4671	0.8693	0.3846
Year2025	0.3994	0.5377	0.7427	0.4577
Depth	0.02147	0.0701	0.3061	0.7595

(B)

Thresholds	**Value**	**Std. Error**	**t value**	**p value**
1|2	1.3349	0.5485	2.4335	**0.0150**
2|3	3.0526	0.5834	5.2317	**1.7e-07**
3|4	3.5271	0.5972	5.9053	**3.5e-09**
4|5	4.9965	0.6969	7.1696	**7.5e-13**

Table 25: Ordinal logistic regression for brown crab's condition in Selsey, (A) Predictors table and (B) Thresholds table.

(A) **European lobster ordinal regression model**

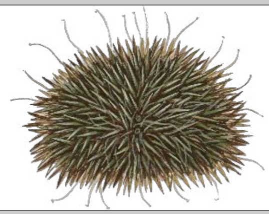
Predictor	**Value**	**Std. Error**	**t value**	**p value**
TreatmentOutside	-0.2913	0.5744	-0.5071	0.6121
Year2022	0.9678	0.9546	1.0137	0.3107
Year2023	-0.2586	0.9043	-0.2859	0.7749
Year2024	1.0574	0.8319	1.2709	0.2037
Year2025	1.3877	0.9061	1.7215	0.0851
Depth	0.01650	0.1010	0.1632	0.8703

(B)

Thresholds	**Value**	**Std. Error**	**t value**	**p value**
1|2	2.3895	1.0067	2.3734	**0.0176**
2|3	3.2062	1.0210	3.1399	**0.0017**
3|4	3.3119	1.0238	3.2348	**0.0012**
4|5	5.2926	1.1570	4.5742	**4.8e-06**

Appendix E – Bycatch Latin Names

Table 25: Bycatch species identified during survey in 2024

Common name	Latin name	Picture of species
Ballan wrasse	*Labrus bergylta*	
Blenny	*Lipophrys pholis*	
Conger eel	*Conger conger*	
Green sea urchin	*Psammechinus miliaris*	
Hairy crab	*Pilumnus hirtellus*	
Velvet swimming crab	*Necora puber*	
Hermit crab	*Pagurus bernhardus*	
Whelk	*Buccinum undatum*