



Edible crab (*Cancer pagurus*)

Cefas Stock Status Report 2023

March 2024

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Cefas Stock Status report 2023: Edible crab (*Cancer pagurus*)

Introduction relevant to all stock units

Cefas has published reports describing the status of the edible crab (*Cancer pagurus*) stocks around the UK since 2012. It is planned to re-run the assessment periodically on a 2-3 year timescale. This report details the main findings of the assessments and provides background information describing how the assessments are undertaken, the data that are required, and description of the uncertainties associated with these assessments.

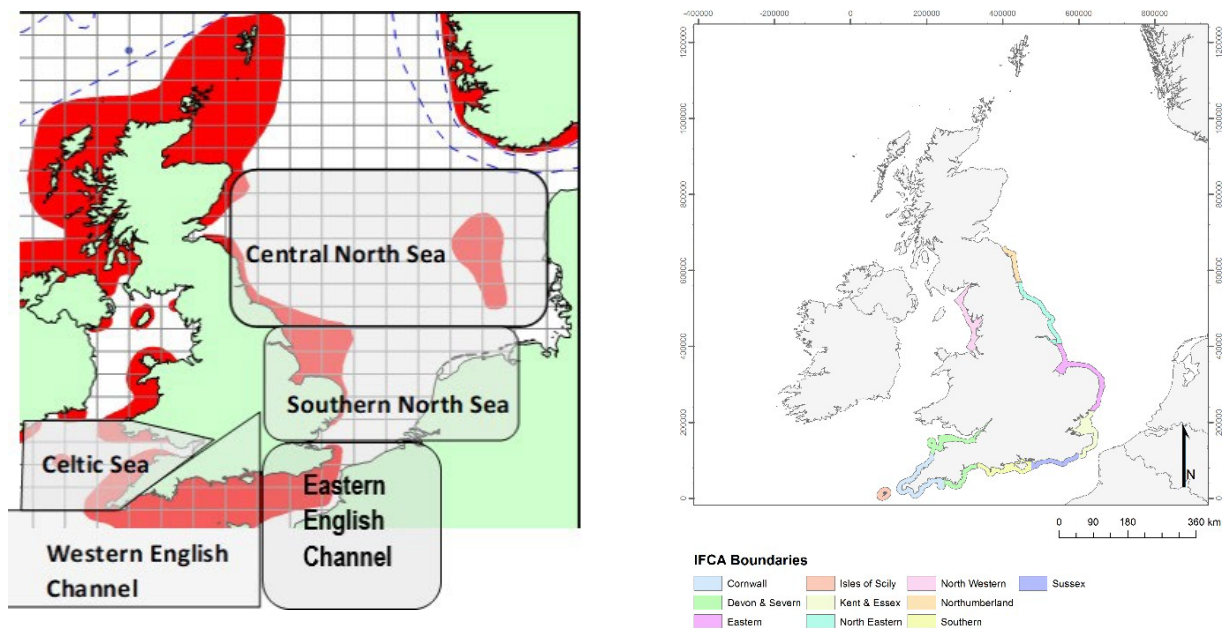


Figure 1. a) The Crab Fishery Units (CFU's) used for the assessment regions. b) The IFCA boundaries.

Biology

Edible crab can be found from Scandinavia to Portugal. Stock boundaries for edible crab remain poorly understood and both sexes move quite widely at times; females in particular have been shown to travel large distances in relation to spawning activity (Hunter *et al*, 2013). Egg carrying females are largely inactive over the winter brooding period but the eggs hatch in the spring and summer (Eaton *et al*, 2003; Thompson *et al*, 1995). After around five weeks in the plankton, the crab larvae settle on the seabed. Growth is dependent on the frequency of moulting as well as the increase in size on each moulting occasion and it typically takes about four or five years for a juvenile crab to grow to commercial size. Mating activity peaks in the summer when the female has moulted with spawning occurring in the late autumn or winter (Tallack, 2007).

Fishery Unit Definitions

There are five Crab Fishery Units (CFU) that have been defined for England. These units are based upon the understanding of larval distributions and development, hydrographic conditions and distribution of the

fisheries. Each CFU encompasses waters covered by international, national and local legislation which may be different within each region. Those CFU's are presented in Figure 1a. Fishery management jurisdiction is organised on two different scales around England. Beyond 6 nautical miles, Defra and the MMO are responsible for managing crab fisheries whereas from the coast out to 6 nautical miles, responsibility lies with the Inshore Fisheries and Conservation Authorities (IFCAs). There are 10 IFCAs within England, and their regions extend from the coast out to 6nm (see Figure 1b). The CFU and IFCA boundaries do not match, which can make interpretation of the results for each management unit challenging. However, given that one functional area is based on species biology and the other is based on governmental logistics, differences between boundaries are to be expected.

Data sources used

Landings come from the official MMO data records of all landings by English and Welsh vessels landing outside the UK, plus all landings into England and Wales by UK vessels. There have been changes in the way the MMO (and its predecessors) have gathered landings data. For larger vessels landings and effort are taken from the mandatory electronic logbooks. Prior to 2006, records of landings from smaller vessels ($\leq 10\text{m}$) were gathered by local officers. Since a change in legislation in 2006, sales note returns from merchants are used to support the landings declarations. Between 2006 and 2018, MMO landings data were also supplemented by self-reported records of landings from the Monthly Shellfish Activity Return (MSAR) forms, which began to be replaced by the self-reported Catch Recording App (Catchapp) in 2019. Since 2010, Cefas has used MSAR data to supplement MMO landings for the $\leq 10\text{m}$ fleet; from 2019 Catchapp data are also incorporated.

Fishing effort is derived from MSARs/ Catchapp for $\leq 10\text{m}$ vessels and electronic logbooks for $> 10\text{m}$ vessels. There is no requirement for potting fisheries to record the number of pots being fished, so in this report effort is measured as days fished.

Changes to reporting systems over time have predominantly improved the data quality but mean that landings and effort series cannot be viewed as coherent records through time. In particular the reported landings and fishing effort (days fished) increased substantially following the introduction of Buyers and Sellers legislation and the Restrictive Shellfish License Scheme in 2006. Since this period fishing activity data are thought to be generally more reliable, but some uncertainty remains.

Scientific officers visit ports to measure individual animals from catches and determine the ratio of landings by sex. Samples are also received from IFCA's and merchants in some regions, and these length samples are combined with Cefas' and scaled up to represent the total landings of crabs. Length distributions of data collected by Cefas and IFCA may differ due to logistical and operation differences, often (but not always) resulting in lower proportions of larger animals measured in IFCA samples than in Cefas samples. This may have an impact on the assessment outputs but the magnitude of any impact is expected to be relatively low.

Overall Landings trends

Figure 2 presents the total official landings data that is used within the assessments. Due to changes in the way landings have been reported, care should be taken when comparing back through time. Data from 2010 to present have been collected in a consistent manner. The overall landings increased from 2011 until 2018, followed by a slight decrease until 2022. The spring of 2018 saw extreme cold weather throughout the country and crab began to appear in pots very late in the season. In 2020-21, Covid restrictions and adjusting to the new requirements for exporters following the UK's exit from the EU affected fishing effort, prices and markets for crab. A mass mortality event occurred in Autumn 2021 in the North Sea, the cause of which is uncertain.

Figure 3.a presents the landings per ICES rectangle for 2022, and Figure 3.b presents the average landings per rectangle from 2016 to 2021.

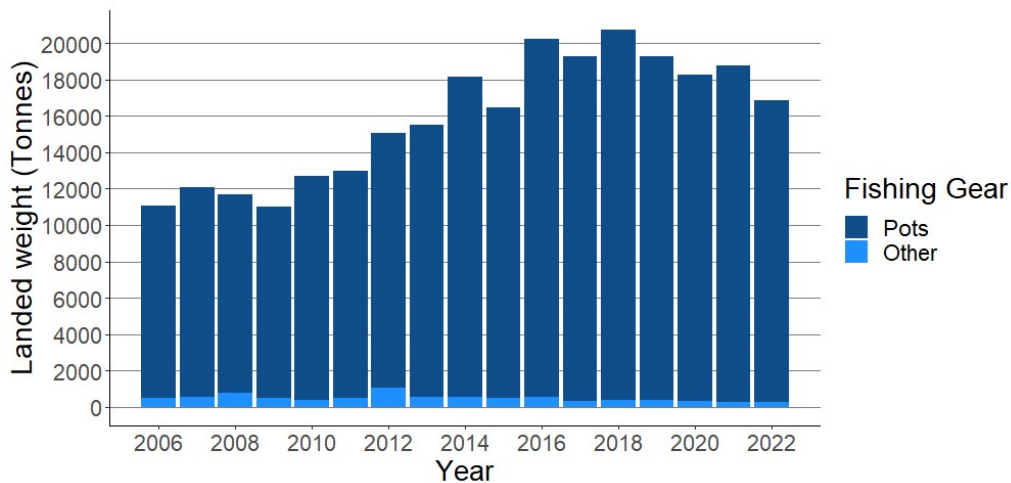


Figure 2 –Official landings by English and Welsh vessels landing anywhere plus landings into England and Wales by UK vessels.

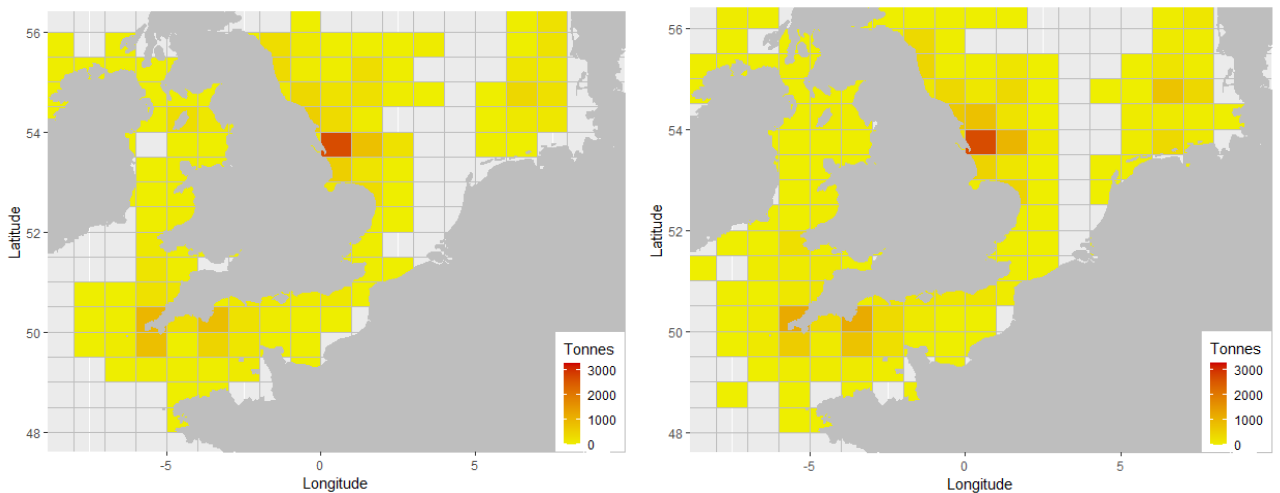


Figure 3.a) –Live landings per ICES rectangle of English and Welsh vessels landing anywhere plus landings into England and Wales by UK vessels for 2022; b) – Average landings per ICES rectangle from 2016 to 2021

Assessment Methodology

Most major fish stocks in the north east Atlantic are assessed using methods which monitor the change in numbers over time for animals born in a particular year. This is possible because most finfish have bony structures which retain annual growth rings.

Crustaceans shed their shell each time they moult and do not retain structures that can be easily used to determine their age, so an alternative assessment method has to be employed. The methodology used in this assessment follows the change in shape of the length frequency (numbers-at-length) from one year to the next. As animals get older, they grow and die; the interplay of these two vital functions dictate how many animals at a given size there are in the population. Armed with knowledge of the growth rate of animals and the rate of natural death (M) assumed to be 20%, the shape of the length frequency curve can be used to infer the rate at which the fishery is removing individuals.

For further details of the Length Cohort Analysis approach see Appendix 1: Stock Assessment Methods.

Reference point definition

A stock assessment result can indicate what the exploitation rate might be and how big the stock might be, but this is of limited use to fishery managers without any context. The production of reference points aims to give managers benchmarks to see whether the management structure is being effective and whether fishing rates are above or below these points.

Reference points can be determined to achieve a number of different management objectives. For instance, managers could simply want to ensure that the fishery was unlikely to collapse the stock, or alternatively managers could want the fishery to derive maximum long-term profit from the stock.

Within the Joint Fisheries Statement (Defra, 2022), one of the precautionary objectives is to restore and maintain populations above biomass levels capable of producing Maximum Sustainable Yield (MSY). For crustacean fisheries, scientists have to do length-based assessments due to difficulties in ageing, which cannot directly calculate MSY and so rely upon alternative ways to estimate it.

This assessment uses 35% of virgin Spawner per Recruit (SpR, the ratio of spawning biomass produced by a length class if 35% of the population is fished compared to an unfished population) as the MSY level proxy, and this is commonly used around the world to estimate the fishing rate likely to deliver MSY. A second point termed a limit reference point has also been calculated and having fisheries operating beyond this level is considered to carry higher risk to the production of further generations. This value is defined as 15% of virgin SpR.

Uncertainty

Fishery stock assessments are never perfect and assessment models will never exactly replicate reality. Scientific data collection (in this case landed numbers-at-length) are taken from a relatively small number of landings and then scaled up to represent the whole landings, a process which cannot be exactly correct, but should be broadly representative of the population as a whole. Samples are bootstrapped, or re-sampled to create many more simulated samples, to provide 5% and 95% confidence limits. Not all landings will be recorded as there are exemptions from reporting requirements for small scale fisheries and recreational landings.

An assessment model is an attempt to simplify the real world into a few key structures and functions, so the assumptions made in the process will cause the modelled system to depart from reality. These fishery stock assessments capture the main processes and data streams so that the final estimate of fishing rate and/or stock size is broadly correct.

For these assessments the key uncertainties come from:

- the scientific understanding of growth and natural death rates
- the representativeness of the landings used to collect length samples
- the assumptions within the assessment model of
 - a) The population being at equilibrium (constant recruitment)
 - b) The spatial coverage of the population is constant, and all size ranges are equally available to the fishery
 - c) Fishery statistics are complete and accurate
 - d) An assumed mortality rate of 20%

Cefas has a research program which continually searches to improve our understanding of processes governing population dynamics and there are currently projects focussing on disease and mortality rates of edible crab around the English coast. We are also working with the MMO to ensure that landings statistics are as complete and accurate as possible and working with the IFCAs to ensure maximum efficiency and best practice in data collection.

Given the uncertainty in the input data and assessment model it is acknowledged that the precise value of any estimate of fishing mortality and stock size is uncertain but has sufficient reliability to indicate rates on a high- medium-low scale, and changes over time.

2023 Assessments

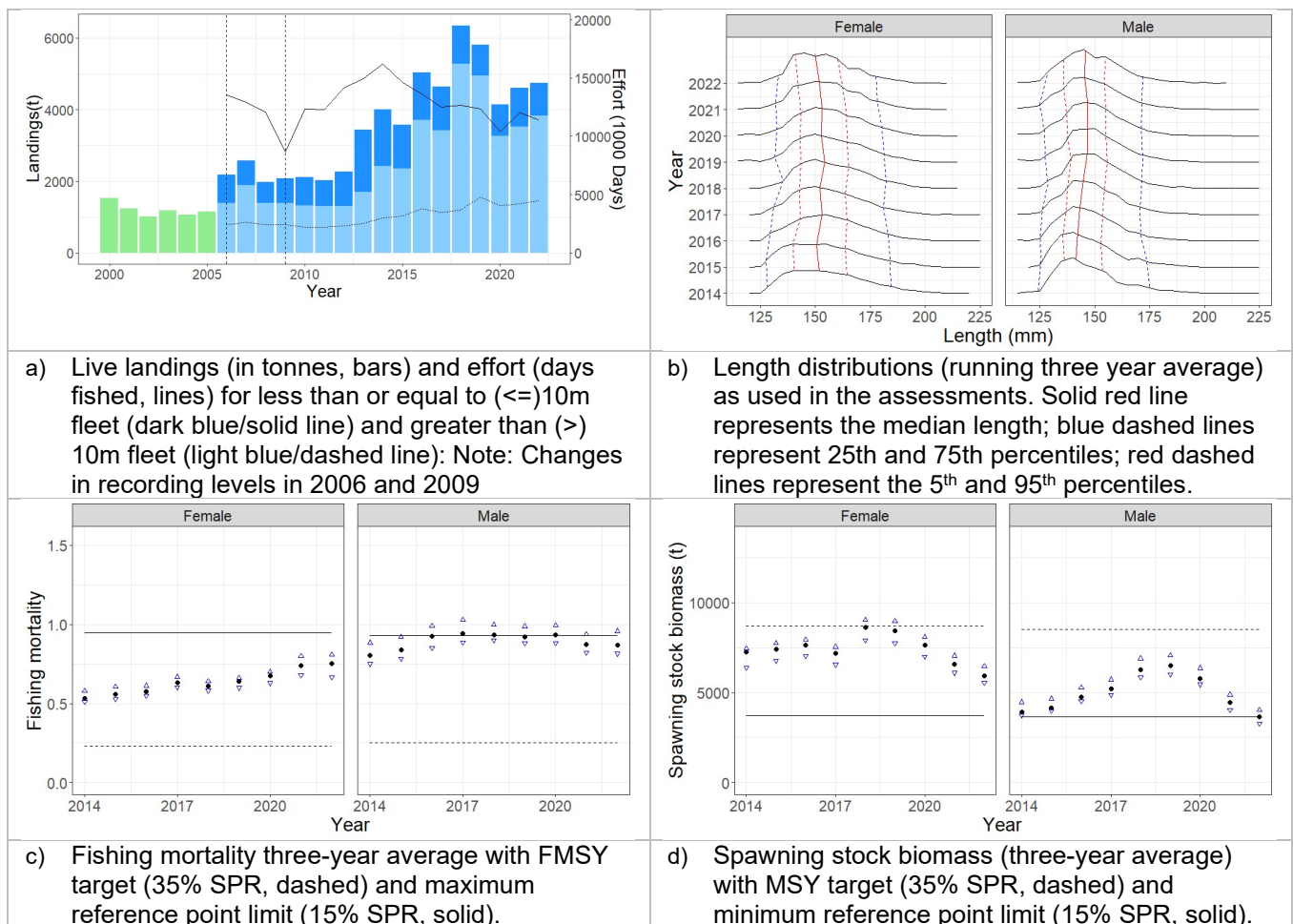
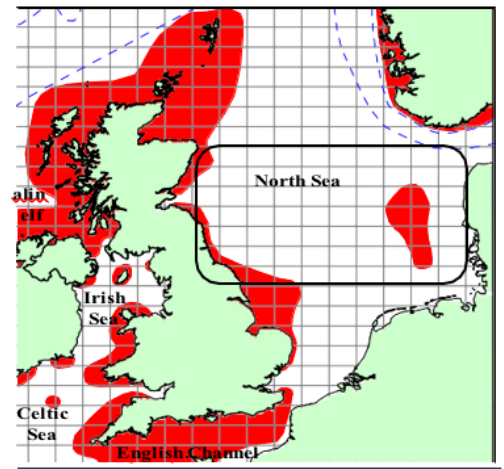
The stock status in some years may have changed compared to previous assessments as a result of recent revisions made in the data processing. The protocols for processing individual length samples used to estimate the size composition of annual landings were reviewed, which has resulted in a greater number of samples being incorporated, including a number of samples that previously had been excluded because they were missing ancillary data. Specifically, samples with missing landings data were previously not included in the processing, however the revised protocol allows them to be included by assuming that the sample represents the entire catch of that trip. While this may underestimate the proportion of total catch that this sample represents, total exclusion was considered to have a greater potential bias on the annual estimates compared to including them with lesser weight than they may actually represent. For some stocks this has led to a change in the estimates of annual size composition which has implications for the assessment of stock status.

The length distributions displayed are averaged over three years as these are the used by the assessment and directly correspond to the assessment output figures, so appear different from those in the previous assessment report which showed individual years.

Cefas Stock Status 2023: Edible crab (*Cancer pagurus*) in the Central North Sea

Sustainability Status

Minimum Conservation Reference Size (MCRS)	At the MCRS, around 100% of males and 97% of females landed should be sexually mature.
Discarding	High discard survival assumed to be > 90%.
Exploitation rate	Between the MSY and reference point limit for males and females
Stock size	Between the minimum and MSY reference point for females, at the limit reference point for males
Confidence	Expansion of the fishery may be masking scale of declines in stock



Sampling levels

Table 1. Number of vessels sampled and total sample numbers (male and female combined) in the Central North Sea assessment for the last ten years, collected by Cefas and IFCA. All vessels sampled landed into Central North Sea English ports.

Year	Number of Vessels sampled		Cefas samples used		ICFA samples used		Total	
	No. <=10m	No. >10m	No. samples	No. individuals	No. samples	No. individuals	No. samples	No. individuals
2013	278	64	50	4,632	12	1,690	62	6,322
2014	300	70	45	3,669	25	1,543	70	5,212
2015	289	77	55	3,442	19	2,400	74	5,842
2016	253	96	55	4,304	50	4,268	105	8,572
2017	234	88	56	5,381	0	0	56	5,381
2018	269	103	52	5,728	0	0	52	5,728
2019	300	123	65	6,345	42	10,844	107	17,189
2020	299	137	53	4,052	9	1,278	62	5,330
2021	301	132	34	2,889	9	631	43	3,520
2022	285	138	52	4,038	6	1,567	58	5,605

Fishery overview and developments

General comments on the available data are contained in the introduction section. Reported landings increased substantially from 2012 until 2018 with a sharp drop in 2020 and a subsequent increase. Effort has decreased for the <=10m fleet since 2014 while effort for the >10m fleet has been increasing.

Biological sampling levels have been good with over 50 samples per year apart from slightly lower levels in 2020 predominantly due to Covid impacts. IFCA length data have been incorporated into the Central North Sea assessments for all years except for 2017-2018.

Fishing mortality is between the target and limit reference points for males and females. Estimates of spawning stock biomass are between the target and limit levels for females and at the limit for males, and have declined since 2019 for both sexes. The increasing fishing mortality estimate for females is a result of the loss of the largest size animals from the catches. The status of the stock in relation to the reference points has decreased since the previous assessment in 2019, largely due to the recent decrease in biomass.

Anecdotal information suggests a recent expansion of fishing activity in both pot numbers and distribution. These factors are likely to be partially responsible for the increase in landings in 2018-2019 which the model interprets as an increase in spawning stock. The spawning stock status should therefore be treated with caution. Some technology creep is likely to have occurred as either vessels or hauling equipment have been upgraded, improve efficiency. There has also been some transition to higher capacity vessels capable of handling substantially larger numbers of pots. The inshore fishery has seen an increase in pots hauled and pots set across the North Eastern IFCA range.

As well as the more traditional fisheries off Yorkshire and Northumberland, a fishery off the Danish coast prosecuted by large nomadic English vessels has developed over the last decade. The fishery in this area has increased in range with the decline of trawling, as operators target grounds beyond 6nm. Data from the Danish coast fishery from GB registered vessels, or vessels landing into England and Wales are included in this assessment.

Covid restrictions in 2020-2021 caused a reduction in fishing effort, lower prices and fishers selling directly to the public. In autumn 2021 a mass crustacean mortality event occurred inshore near the River Tees south to Scarborough, the cause of which remains uncertain. Storm Arwen in November 2021 caused damage and loss of pots which resulted in lower landings in subsequent weeks.

Fishery Management measures

- UK and EU Minimum Conservation Reference Size (MCRS) of 130mm carapace width (CW) apply north of 51°N. National legislation also restricts the proportion of the crab landings which is detached claws caught by pots or creels to less than 1% by weight of total catch. A by-catch limit of no more than 75kg per day of crab claws taken by other gear types can be landed.
- National legislation restricts the number of shellfish licences available (in England and Wales) and also prohibits landing of berried and soft crabs.
- Local IFCA legislation varies and is detailed in the table below.

Table 2. Regional byelaws on Central North Sea crab fisheries.

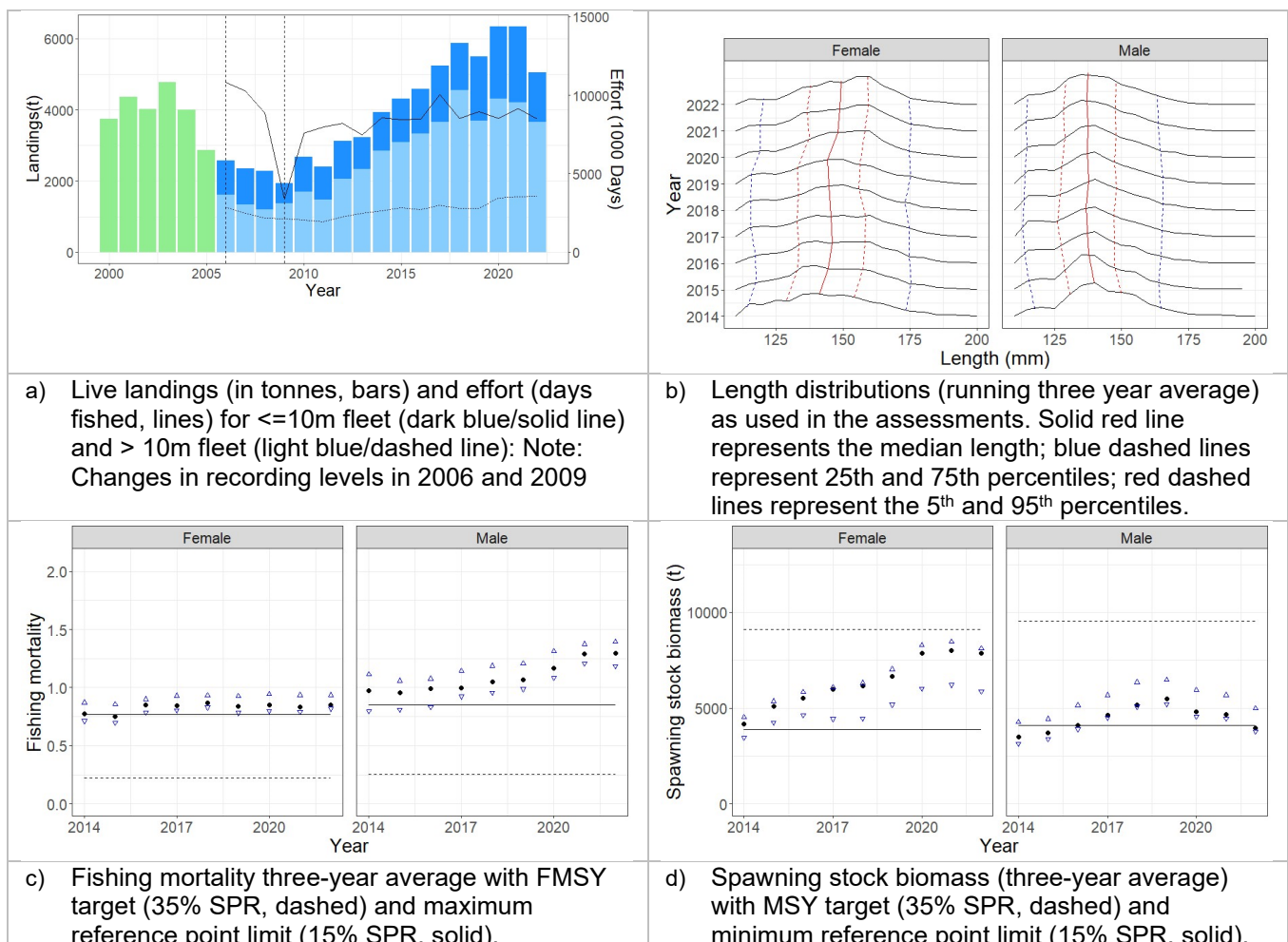
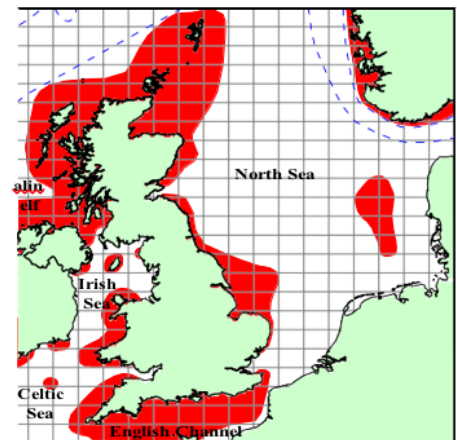
Type of Byelaw	Northumberland IFCA	North Eastern IFCA
Shellfish permits	Yes	Yes*
Minimum Conservation Reference Size	Yes – 130mm	Yes – 140mm
Maximum Pot Limit	Yes - 800	No
Escape Gaps	No	Yes*
Maximum Vessel Length	Yes -12m	Yes – 10m/14m (some areas)
Towed Gear Restrictions	No	No
Prohibits the Use of Crab for Bait	Yes	Yes
Prohibits the Removal of Parts of Crabs	Yes	Yes

*Only applicable within the previous North Eastern Sea Fisheries Committee District

Cefas Stock Status 2023: Edible crab (*Cancer pagurus*) in the Southern North Sea

Sustainability Status

Minimum Conservation Reference Size	At the MCRS's applied in this region around 99% of males and 92-96% of females landed should be sexually mature.
Discarding	High discard survival assumed to be > 90%.
Exploitation rate	High. Above the maximum reference point limit for males and females.
Stock size	Between minimum reference point limit and target for females, at the limit for males.
Confidence	Expansion of the fishery in the last 5 years may be masking declines in stock



Sampling levels

Table 1. Number of vessels sampled and total sample numbers (male and female combined) in the Southern North Sea assessment for the last ten years, collected by Cefas and IFCA. All vessels sampled landed into Southern North Sea English ports.

Year	Vessel size		Cefas samples used		ICFA samples used		Total	
	No. <=10m	No. >10m	No. samples	No. individuals	No. samples	No. individuals	No. samples	No. individuals
2013	190	67	22	2,170	5	556	27	2,726
2014	167	58	42	3,745	5	459	47	4,204
2015	183	64	61	6,086	18	3,553	79	9,639
2016	185	65	73	8,089	23	3,446	96	11,535
2017	197	75	70	8,008	25	6,701	95	14,709
2018	198	67	46	6,357	28	7,618	74	13,975
2019	229	76	84	11,309	0	0	84	11,309
2020	242	99	59	6,565	0	0	59	6,565
2021	251	83	65	9,668	0	0	65	9,668
2022	275	87	46	6,236	6	861	52	7,097

Fishery overview and developments

General comments on the available data are contained in the introduction section. Reported landings in the Southern North Sea assessment region have increased steadily since 2011, plateauing in 2020 with a sharp drop in 2022. Effort for <=10m vessels has remained relatively stable, with effort increasing slowly since 2011 for the >10m fleet.

Biological sampling levels have been good with over 50 samples per year since 2015. IFCA length data have been incorporated into the Southern North Sea assessments for all years up to and including 2018. As mentioned in the Introduction, the lack of samples from IFCA sources in recent years may have an impact on the assessment results but the magnitude of this impact is expected to be relatively low.

Exploitation level of Edible Crab in the Southern North Sea is high for both sexes (Figure c) and, although stable for females, is above the level required for Maximum Sustainable Yield. At the very high levels of exploitation level estimated for males, very small changes in the length distributions have apparently large influences on the exploitation level. Although there is no obvious change in the length distributions from the figures, close inspection of the data reveals that small changes are indeed responsible for the increase in estimated exploitation rate.

The spawning stock biomass is between the reference target and limit for females and at the limit for males. The status of the stock has not changed since the last assessment in 2019.

Anecdotal information suggests a recent expansion of fishing activity in both pot numbers and distribution.

These factors are likely to be partially responsible for the large increase in landings which the model interprets as an increase in spawning stock. The spawning stock status should therefore be treated with caution.

Reported landings and fishing effort increased substantially following the introduction of Buyers and Sellers legislation and the Restrictive Shellfish License Scheme in 2006. Since this period fishing activity data are thought to be generally more reliable but the integrity of the time series, especially fishing effort, is uncertain.

This stock supports three distinct fisheries, the Holderness fishery off Yorkshire, and two Norfolk fisheries. There are strong seasonal fluctuations in the fisheries with the spring fishery (March – May) seeing the highest catch rates.

The components of the Norfolk fishery are typified by small beach-launched vessels and larger harbour-based vessels, the former being more restricted in their activity by weather. There is a difference in the

preferred size of crab by processing division, big processors preferring larger crab (>125mm) during late winter whereas the smaller processors will take all sizes. In spring- early summer there is more demand for MCRS (115mm) crab for tourist/day-tripper market (bite size crab). Through the summer, processors tend to take all sizes as the availability of crab reduces (owing to the biology of the animals).

Some technology creep has occurred as either vessels or hauling equipment has been upgraded to improve efficiency. There has been considerable upgrading within the fleet with some operators moving towards higher capacity vessels, operating in the more lightly exploited grounds further offshore.

Covid restrictions in 2020-2021 caused a reduction in fishing effort, lower prices and fishers selling directly to the public.

Fishery Management measures

- UK and EU Minimum Conservation Reference Size (MCRS) of 130mm carapace width (CW) apply north of 51° N. National legislation also restricts the proportion of the crab landings which is detached claws caught by pots or creels to less than 1% by weight of total catch. A by-catch limit of no more than 75kg per day of crab claws taken by other gear types can be landed.
- National legislation restricts the number of shellfish licences available (in England and Wales) and also prohibits landing of berried and soft crabs.
- A derogation to the national legislation sets an MCRS of 115mm in the Eastern IFCA area. Local IFCA legislation varies and is detailed in the table below.

Table 2. Regional byelaws on Southern North Sea crab fisheries.

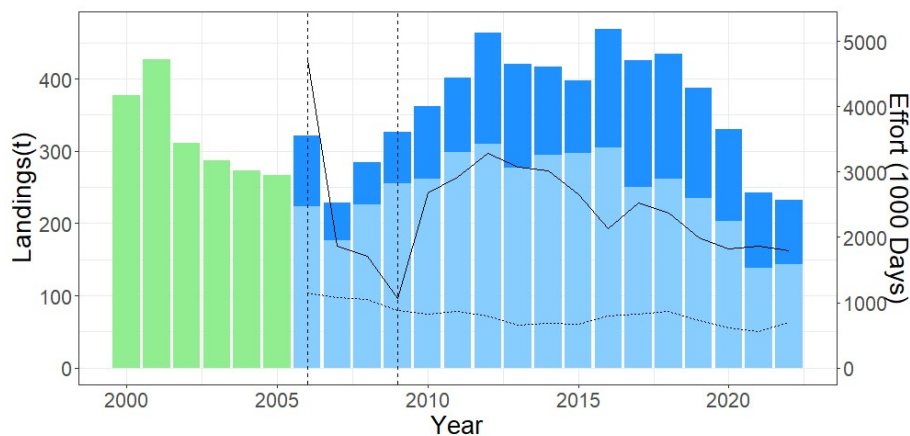
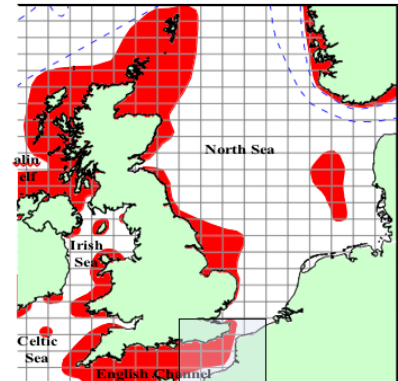
Title of Byelaw	North Eastern	Eastern	Kent & Essex
Shellfish permits	Yes*	Yes*	Yes**
Minimum Conservation Reference Size	Yes – 140mm	Yes – 115mm	Yes – 130mm
Maximum Pot Limit	No	No	No
Escape Gaps	Yes*	Yes*	Yes**
Maximum Vessel Length	Yes – 10m/14m (some areas)	No	Yes – 14m
Towed Gear Restrictions	No	Yes	Yes
Prohibits the Use of Crab for Bait	Yes	Yes	Yes
Prohibits the Removal of Parts of Crabs	Yes	Yes	Yes

*Only applicable within the previous North Eastern Sea Fisheries Committee District ** Only applicable in some areas of District

Cefas Stock Status 2023: Edible crab (Cancer pagurus) in the Eastern English Channel

Sustainability Status

Minimum Conservation Reference Size	At the MCRS's applied in this region around 100% of males and 95-99% of females landed should be sexually mature.
Discarding	High discard survival assumed to be > 90%.
Exploitation rate	Unknown- data insufficient for assessment
Stock size	Unknown- data insufficient for assessment
Confidence	No recent assessments: sparse data increases uncertainty in assessment results.



Live landings (in tonnes, bars) and effort (days fished, lines) for <=10m fleet (dark blue/solid line) and > 10m fleet (light blue/dashed line): Note: Changes in recording levels in 2006 and 2009

Sampling levels

Table 1. Number of vessels sampled and total sample numbers (male and female combined) in the Eastern English Channel assessment for the last ten years, collected by Cefas and IFCAs. All vessels sampled landed into Eastern Channel English ports.

Year	Vessel size		Cefas samples used		ICFA samples used		Total	
	No. <=10m	No. >10m	No. samples	No. individuals	No. samples	No. individuals	No. samples	No. individuals
2013	98	11	0	0	0	0	0	0
2014	92	10	17	1,366	0	0	17	1,366
2015	123	16	6	701	0	0	6	701
2016	97	17	5	270	0	0	5	270
2017	109	16	15	2,044	0	0	15	2,044
2018	112	15	9	1,416	0	0	9	1,416
2019	94	14	5	347	0	0	5	347
2020	86	12	4	397	0	0	4	397
2021	85	18	1	40	0	0	1	40
2022	106	15	1	137	0	0	1	137

Fishery overview and developments

General comments on the available data are contained in the introduction section. Reported landings in the Eastern English Channel have fluctuated with a general decreasing trend over the available time series. Effort for the =<10m fleet has shown a similar trend to the landings, whereas no increase in effort is evident in the >10m fleet.

Sampling levels have been less than 20 samples per year for all years. While the numbers of samples per tonne landed is relatively high in comparison to other stock areas in some years, the number of animals per sample is lower than most areas and there is a high level of variation in size composition between samples. The combination of these factors means that the length data are too uncertain to run any form of analytical assessment. The exploitation status of the stock of Edible Crab in the Eastern English Channel is currently unknown.

The main fishery occurs during late summer to autumn, when fishers target mature female crabs as they carry out their migration westward through the channel towards spawning grounds.

Fishery Management measures

- UK and EU Minimum Conservation Reference Size (MCRS) of 130mm carapace width (CW) apply north of 51° N. South of this latitude an EC and UK MCRS of 140mm CW is enforced.
- Sussex IFCA have a shellfish permit scheme in place. This stipulates that no vessels larger than 14m in length can fish in the district and limits potting effort by restricting the number of pots (specifically crab or lobster pots) at 300 within 3nm from the coast and 600 pots from 3-6nm.

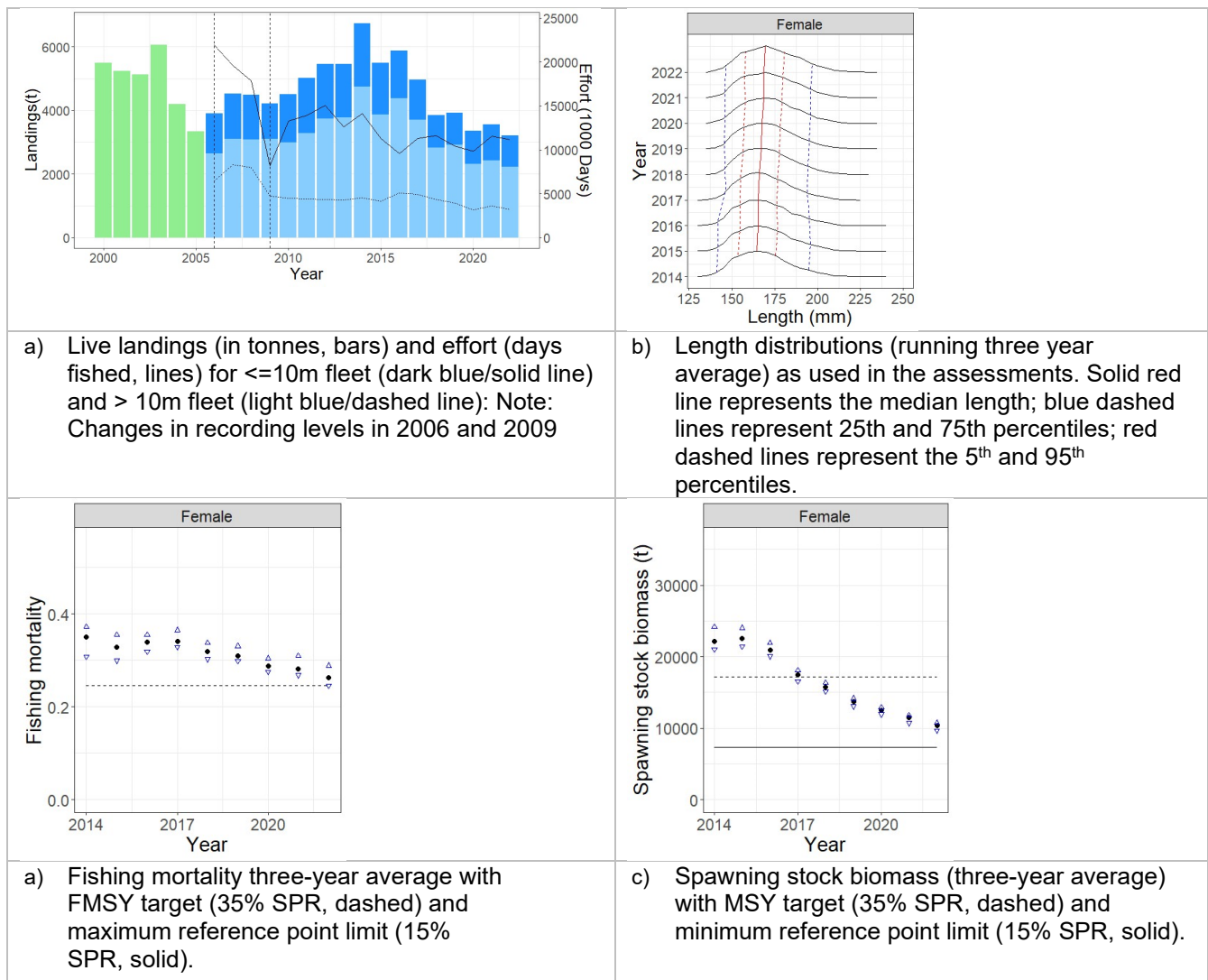
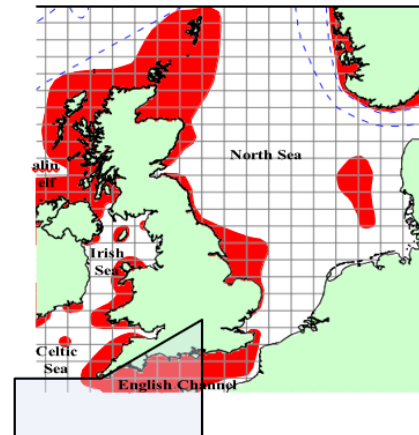
Table 2. Regional byelaws on Eastern English Channel crab fisheries.

Title of Byelaw	Southern	Sussex	Kent and Essex
Shellfish Permits	Yes	Yes	No
Minimum Conservation Reference Size	No	Yes – 140mm	No
Maximum Pot Limit	No	Yes-300<3m, 600<6m	No
Escape Gaps	No	Yes	Yes
Maximum Vessel Length	Yes – 12m	Yes – 14m	Yes – 14m
Towed Gear Restrictions	Yes	No	No
Prohibits the Use of Crab for Bait	No	No	Yes
Prohibits the Removal of Parts of Crabs	No	No	Yes

Cefas Stock Status 2023: Edible crab (*Cancer pagurus*) in the Western English Channel

Sustainability StatusD

Minimum Conservation Reference Size	At the MCRS's applied in this region around 100% of males and 99% of females should be sexually mature
Discarding	High discard survival assumed to be > 90%.
Exploitation rate	Between limit and target reference point required to achieve MSY for females
Stock size	Between limit and target level required to achieve MSY for females
Confidence	Recent expansion of the fishery may be masking scale of declines in stock



Sampling levels

Table 1. Number of vessels sampled and total sample numbers (male and female combined) in the Western English Channel assessment for the last ten years, collected by Cefas and IFCA. All vessels sampled landed into Western Channel English ports.

Year	Vessel size		Cefas samples used		ICFA samples used		Total	
	No. <=10m	No. >10m	No. samples	No. individuals	No. samples	No. individuals	No. samples	No. individuals
2013	316	83	22	3,505	0	0	22	3,505
2014	322	78	48	6,304	6	369	54	6,673
2015	322	80	57	7,633	9	1,040	66	8,673
2016	287	88	52	7,271	1	32	53	7,303
2017	312	84	48	6,885	1	51	49	6,936
2018	333	92	42	7,243	10	431	52	7,674
2019	394	78	47	8,431	0	0	47	8,431
2020	387	74	23	3,917	0	0	23	3,917
2021	428	78	37	6,810	0	0	37	6,810
2022	445	71	40	6,421	0	0	40	6,421

Fishery overview and developments

General comments on the available data are contained in the introduction section. Reported landings in the Western English Channel increased for several years, reaching a peak in 2014 followed by a steady decrease. Low landings are now a cause of concern, particularly for inshore vessels in this region who are limited by area and ground availability to maintain their catch rates. There has been an increase in the last few years of vivier vessels fishing large numbers of pots.

Biological sampling levels have been good with over 40 samples per year since 2014. IFCA length data have been incorporated into the Western English Channel assessments from 2014 until 2018. As mentioned in the Introduction, the lack of samples from IFCA sources in recent years may have an impact on the assessment results but the magnitude of this impact is expected to be relatively low.

Fishing mortality of female Edible Crab in the Western English Channel is between the limit and target level required to reach MSY and is estimated to be decreasing. The general upward trend in the size distribution of females captured is interpreted by the model as a decrease in exploitation rate (i.e. animals are living longer and get to be larger). However the change in animal size distribution could also partly result from decreasing recruitment. There is no index of recruitment available to draw on, but the general declining landings may suggest that recruitment has been lower in recent years. The rate of decline in fishing mortality suggested by the assessment should therefore be viewed with some caution. Spawning biomass for females is between the target and limit and has been decreasing since 2015. There are insufficient data on male crabs to undertake an assessment on this portion of the stock. The status of the stock in relation to the reference points has not changed since the previous assessment in 2019.

Very low level of landings for males present the assessment methodology with significant problems in determining exploitation level and stocks size for males. The relative lack of males in the landings is likely to result from the males occurring on ground not covered by the fishery (either in space or time) and therefore this portion of the stock is offered a degree of protection. As it is the size of the female portion of the stock which mainly governs the potential to produce further generations, it is considered appropriate to characterise the status and exploitation rate of this stock on the fishery statistics for females.

The Western Waters Regime places a limit upon the number of kilowatt days that the >15m potting fleet can use within ICES area VII. From 2013 active management has been introduced leading to reductions in the number of days fished within this stock area.

Since 2008 there has been an increase in the vessel numbers and pots used in the Lyme Bay area since the Lyme Bay Statutory Instrument came into being. However, it is not clear if this represents new activity or a relocation of activity from neighbouring areas. In large areas of the Devon and Severn IFCA district there is little opportunity to increase the area covered or number of pots on the ground due to the potential for gear conflicts with mobile fishing.

Covid restrictions in 2020-2021 caused a reduction in fishing effort, lower prices and fishers selling directly to the public.

Fishery Management measures

- UK and EU and Minimum Conservation Reference Size (MCRS) of 140mm applies, but off Devon and Cornwall UK law stipulates an MCRS of 150 for females and 160mm for males. It also restricts the proportion of the crab landings which is detached claws caught by pots or creels to less than 1% by weight of total catch. A by-catch limit of no more than 75kg per day of crab claws taken by other gear types can be landed.
- National legislation restricts the number of shellfish licences available (in England and Wales) and also prohibits landing of berried and soft crabs.
- Cornwall IFCA applies an MCRS of 150mm for females and 160mm for males. Local IFCA legislation varies and is detailed in the table below.
- There are mid-channel potting agreements in place in this region.

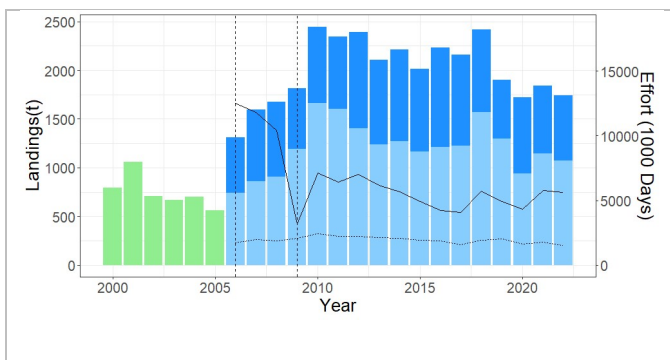
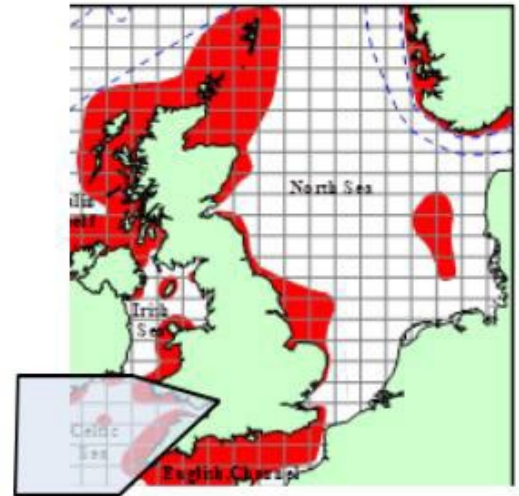
Table 2. Regional byelaws on Western English Channel crab fisheries.

Title of Byelaw	Southern	Devon & Severn	Cornwall	Isles of Scilly
Shellfish Permits	Yes	Yes	Yes	Yes
Minimum Conservation Reference Size	No	Yes – 150mm (females), 160mm (male)	Yes – 150mm (females), 160mm (male)	No
Maximum Pot Limit	No	No	No	No
Escape Gaps	No	Yes	Yes	No
Maximum Vessel Length	Yes – 12m	Yes – 15.24m	Yes – 16.46m	Yes – 11m
Towed Gear Restrictions	No	Inshore Potting Agreement Area	No	Yes
Prohibits the Use of Crab for Bait	No	Yes	No	No
Prohibits the Removal of Parts of Crabs	No	Yes	Yes	No

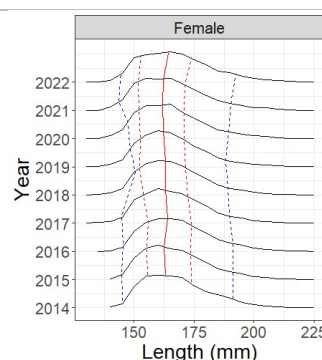
Cefas Stock Status 2023: Edible crab (*Cancer pagurus*) in the Celtic Sea

Sustainability Status

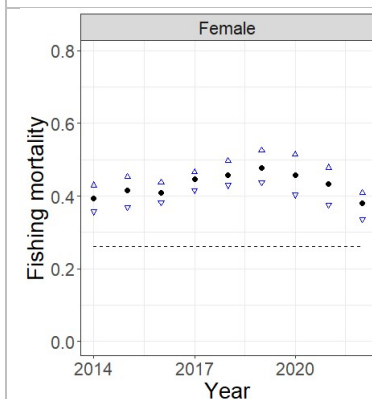
Minimum Conservation Reference Size	At the MCRS's applied in this region around 100% of males and 99% of females should be sexually mature.
Discarding	High discard survival assumed to be > 90%.
Exploitation rate	Moderate; between target and limit levels to achieve Maximum Sustainable Yield
Stock size	Moderate; below Maximum Sustainable Yield level but above minimum reference point limit for females
Confidence	Recent expansion of the fishery may be masking declines in stock



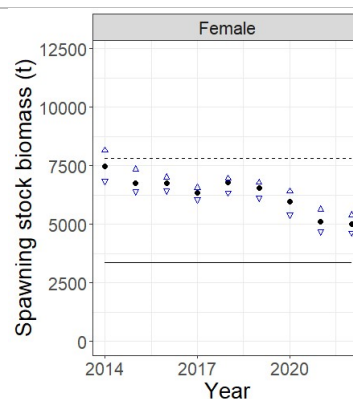
a) Live landings (in tonnes, bars) and effort (days fished, lines) for $\leq 10\text{m}$ fleet (dark blue/solid line) and $> 10\text{m}$ fleet (light blue/dashed line): Note: Changes in recording levels in 2006 and 2009



a) Length distributions (running three year average) as used in the assessments. Solid red line represents the median length; blue dashed lines represent 25th and 75th percentiles; red dashed lines represent the 5th and 95th percentiles.



b) Fishing mortality three-year average with FMSY target (35% SPR, dashed) and maximum reference point limit (15% SPR, solid).



c) Spawning stock biomass (three-year average) with MSY target (35% SPR, dashed) and minimum reference point limit (15% SPR, solid).

Sampling levels

Table 1. Number of vessels sampled and total sample numbers (male and female combined) in the Celtic Sea assessment for the last ten years, collected by Cefas and IFCA. All vessels sampled landed into Celtic Sea English ports.

Year	Vessel size		Cefas samples used		ICFA samples used		Total	
	No. <=10m	No. >10m	No. samples	No. individuals	No. samples	No. individuals	No. samples	No. individuals
2013	208	51	18	2,506	0	0	18	2,506
2014	218	40	31	4,713	13	994	44	5,707
2015	222	41	31	5,051	7	730	38	5,781
2016	205	43	41	5,238	16	975	57	6,213
2017	208	46	33	4,585	2	123	35	4,708
2018	186	42	31	3,626	21	1,328	52	4,954
2019	206	38	39	5,076	0	0	39	5,076
2020	245	40	16	1,087	0	0	16	1,087
2021	250	35	28	5,080	0	0	28	5,080
2022	259	35	45	7,666	0	0	45	7,666

Fishery overview and developments

General comments on the available data are contained in the introduction section. Reported landings in the Celtic Sea have fluctuated, with a slight decreasing trend since 2010. Fishing effort for the <=10m fleet has fluctuated through time with no evident trends, and effort in the >10m fleet has remained relatively stable.

Biological sampling levels have been moderate, with a minimum of 35 samples per year since 2014 apart from slightly lower levels in 2020 predominantly due to Covid impacts. IFCA length data have been incorporated into the Celtic Sea assessments from 2014 until 2018. As mentioned in the Introduction, the lack of samples from IFCA sources in recent years may have an impact on the assessment results but the magnitude of this impact is expected to be relatively low.

Fishing mortality in the Celtic Sea is above the target but below the limit level required to reach MSY for females. The spawning biomass of females is between the limit and target level required to reach MSY and has been declining since 2019. The status of the female portion of the stock has not changed since the last assessment in 2019.

There are insufficient data on male crabs to undertake an assessment on this portion of the stock. The very low level of landings for males presents the assessment methodology with significant problems in determining exploitation level and stocks size for males. The relative lack of males in the landings is likely to result from the males occurring on ground not covered by the fishery (either in space or time) and therefore current fishery practice is considered to offer a degree of protection to this part of the stock. As it is the size of the female portion of the stock which mainly governs the potential to produce further generations, it is considered appropriate to characterise the status and exploitation rate of this stock on the fishery statistics for females.

The potting fisheries on the Devon and Severn IFCA district's North Coast are seasonal with boats switching target species. In the winter/spring they target whelks until around April when the water temperature increases, and they target lobsters. Crabs are the main target through the autumn although they also form a bycatch in the summer lobster fishery. The ground targeted in the autumn is the optimal crab ground and is associated with movement of the females at this time of the year – they are likely to have mated and are very actively feeding. Males may be present on this ground at other times of the year

when the fishery is absent.

Covid restrictions in 2020-2021 caused a reduction in fishing effort, lower prices and fishers selling directly to the public.

Fishery Management measures

- UK and EU Minimum Conservation Reference Size (MCRS) of 140mm apply to ICES divisions VII f (Region 2 south of 56° N, except ICES Divisions VII d, e, f, and ICES Divisions IV b, c: 130 mm), but off Devon and Cornwall UK law stipulates an MCRS of 160mm for males. EC law also restricts the proportion of the crab landings which is detached claws caught by pots or creels to less than 1% by weight of total catch. A by-catch limit of no more than 75kg per day of crab claws taken by other gear types can be landed.
- National legislation restricts the number of shellfish licences available (in England and Wales) and also prohibits landing of berried and soft crabs.
- Cornwall IFCA applies a 150mm MCRS for female crabs and 160mm for males. Local IFCA legislation varies and is detailed in the table below.

Table 2. Regional byelaws on Celtic Sea crab fisheries

Title of Byelaw	Devon & Severn	Cornwall
Shellfish Permits	Yes	Yes
Minimum Conservation Reference Size	Yes – 150mm (females), 160mm (male)	Yes – 150mm (females), 160mm (male)
Maximum Pot Limit	No	No
Escape Gaps	Yes	Yes
Maximum Vessel Length	Yes - 15.24M	Yes - 16.46m
Towed Gear Restrictions	Inshore Potting Agreement Area	No
Prohibits the Use of Crab for Bait	Yes	No
Prohibits the Removal of Parts of Crabs	Yes	Yes

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Glossary

Cefas	Centre for Environment, Fisheries and Aquaculture Science.
EU	European Union
F	Fishing Mortality.
FMSY	The fishing effort which will produce Maximum Sustainable Yield.
IFCA	Inshore Fisheries and Conservation Authority.
M	Natural Mortality.
MCZ	Marine Conservation Zone
MMO	Marine Management Organisation
MSY	Maximum Sustainable Yield, the maximum landings which can be regularly taken while avoiding stock collapse.
SAC	Special Area of Conservation
SpR	Spawner per Recruit