

Ad hoc contracts on “King scallops (*Pecten maximus*) state of knowledge” and “King scallops fisheries management” in the English Channel (ICES divisions 7d,e)

Ref STECF 2305, 2306, 2307 and 2308

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March 2023



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Biology of King scallop relevant to management

For many years, a great deal of research has been carried out on the ecology and biology of pectinids in general, and the King scallop *Pecten maximus* in particular. A general review of the knowledge of the different species at a global level has recently been published (Shumway and Parsons Eds, 2016). Lavaud synthesized the knowledge on the biology of the King scallop in his thesis work (Lavaud, 2014, and all references therein).

Life cycle

P. maximus has a meroplanktonic life cycle (Figure 1), which means that part of its development takes place in the water column while the rest of its life is spent on the sea floor (Le Pennec et al., 2003). Eggs hatch after two days of development and larvae have a pelagic life that last between 24 and 32 days (Gruffydd and Beaumont, 1972; Samain et al., 1986; Casse, 1995), depending on temperature and food availability conditions. Then the larva sinks and settles on the sediment where it fixes to complete its metamorphosis (Buestel et al., 1982; Paulet et al., 1988; Le Pennec et al., 2003). This event consists of a major reorganization of all the tissues that will allow the young scallop to shift to a benthic life. The animal is transformed into a postlarva that will complete the development of its newly organized body while fixed to the substrate. The juvenile scallop then looks like a small adult and pursues its development for approximately one year.

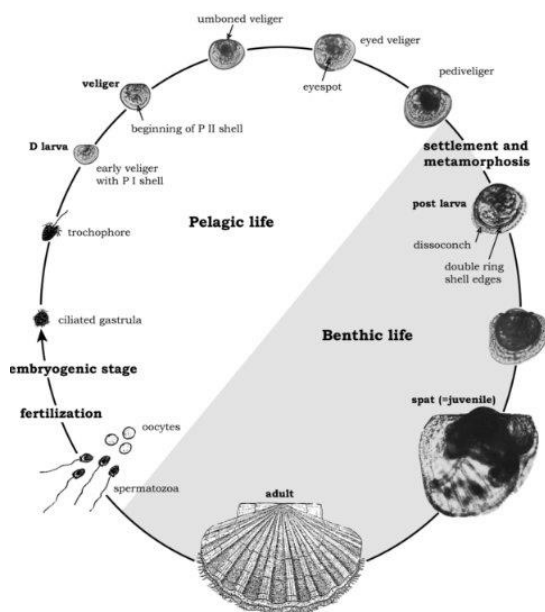


Figure 1. Life cycle of *Pecten maximus* (from Le Pennec 2003)

Reproduction

The reproductive activity of the great scallop starts during the second year (Tang, 1941; Mason, 1958). Maturity may be maintained almost all life along with a probable decrease in gamete production and release in older age-classes, like in other bivalve species (Vahl, 1985; Bricelj and Krause, 1992; Walker and Heffernan, 1996), which is likely due to disease/parasites (Ø. Strand pers. comm.). *P. maximus* is an asynchronous hermaphrodite spawner releasing between 4 and 20 billion spermatozoa and from 3 to 80 million oocytes in each spawning event (Paulet and Fifas, 1989; Paulet et al., 1997; Andersen et al., 2011; Suquet et al., 2012). There is considerable variation in the reproductive cycle of this

species (Mason, 1958; Comely, 1974; Lubet et al., 1987; Paulet et al., 1988; Strand and Nylund, 1991; Mackie and Ansell, 1993; Hold et al., 2013). Both external (temperature, food density, photoperiod, etc.) and internal (genetic) factors seem to be controlling certain features of the reproductive activity (Brand, 2006a). Even at a regional scale major discrepancies in the spawning strategy (number of spawnings, onset of gametogenesis) are observed (Paulet et al., 1988, 1995). Dynamic energy budget modelling successfully reproduces observed spawning cycles using temperature and food source as predictors (Gourault *et al.* 2019).

For successful cross fertilisation minimum densities are needed (to avoid allee effects); low densities may not only reduce the number of individuals contributing to the production of gametes but also reduces the synchronization of spawning and rate of gamete release. Maintenance of areas that have high densities is therefore a potentially important fishery management tool.

The seasonal cycle of gonad development significantly influences the distribution of fishing as fishers target scallops with well-developed roe (roe on scallop meat).

Larval dispersal

Scallop have very high fecundity and have a larval dispersal phase. The duration of the larval phase is temperature dependent and varies from approximately 14-32 days. Competency to settle and recruit successfully to the seabed also depends on accumulation of sufficient energy reserves during larval life and food concentration is therefore important (Le Pennec 2003). Variation in temperature, food supply and retention of larvae over substrates that are suitable for settlement are important sources of annual variation in recruitment (Hold *et al.* 2021). Larvae may need specific substrates such as hydroids on which to settle. In that case fishing activity of mobile gears may reduce the suitability of the seabed for scallop settlement by homogenizing substrate and reducing the fine scale complexity and topography of the seabed (Stewart and Howarth 2016).

Habitat requirements

Scallops inhabit sand, mixed sediments and gravel substrates and occur from lower intertidal areas to 100m in depth, although individuals can be found more deeply. At fine spatial scales abundance may vary significantly depending on substrate; Tully et al. (2006), using acoustic backscatter data as a proxy for sediment grain size, reported dramatically higher densities of scallop on gravel patches that were surrounded by sand and sand waves. This has significant implications for both the design and precision of scallop survey estimates of biomass and also the efficiency of fishing. Nevertheless, in other areas, such as the Bay of Saint-Brieuc and Bay of Seine high density of scallops occur mainly on sands. For example, the average density observed in the bay of Seine during the last stock assessment French survey in July 2022 was around 0.7 individuals/m², reaching nearly 4 scallops per m² in some very high density areas (Foucher, 2023, in press).

Spatial variation in growth

In the English Channel, King scallop populations are characterised by very rapid growth compared to other populations around the British Isles (Chauvaud *and al.*, 2012). Age of maturity is reached rapidly at 2 years of age for a size of around 80mm (Lubet, 1959). This value is used in all current work (Foucher *and al.*, 2015; Lawler and Nawri, 2022). This means that potentially, if the minimum catch sizes (100 mm in the Western Channel and 110 mm in the Eastern Channel) are respected, all individuals will reach their mature size at least one spawning period before their arrival in the fishery.

Scallops are distributed on the seabed below mixed and stratified water columns and therefore experience very different annual temperature regimes, water currents and food concentrations all of which affect growth rates. Size at age has been shown to vary along gradients of temperature and

bottom currents. Spatial variability in growth implies that the optimum harvest size and harvest rate would be different spatially.

Days available for growth rather than growth increment per day are temperature related suggesting a minimum temperature threshold is needed to achieve daily growth.

Stock structure

There are many scallop beds in the English Channel both in shallow coastal waters off the UK and French coast and in deeper water in the mid Channel. The distribution is mainly determined by substrate requirements of juvenile and adult scallop and, importantly, by larval supply; stock structure (connectivity between beds) is effectively determined by larval dispersal. A combination of genetics and ocean modelling of larval dispersal has been used to identify the stock structure of king scallops in the English Channel (Nicolle et al 2017, Handal et al 2020). Using the genetic structure of several King scallop samples from different sites in the English Channel, Handal *et al.* (2020) confirm “*the fact that even in a context of potentially high gene flow and recent divergence times since the end of the last glacial maximum, weak but significant spatial genetic structure can be identified at a regional scale*”.

Three major groups of strongly interconnected stocks including two or three stocks exhibiting high retention and self-recruitment rates and some peripheral stocks with a low self-recruitment rate can be defined: the North Brittany and Channel Islands, the eastern English Channel, and the SW of England (Figure 2). Within these groupings connectivity between scallop beds and the degree of self-recruitment varies and can best be described as a metapopulation. In that context information on the actual level of larval retention and the direction and larval transport between beds are key issues in scallop management. For instance, populations which supply larvae to surrounding beds are more important for conservation and management than populations which are only sinks for larval populations coming from elsewhere.

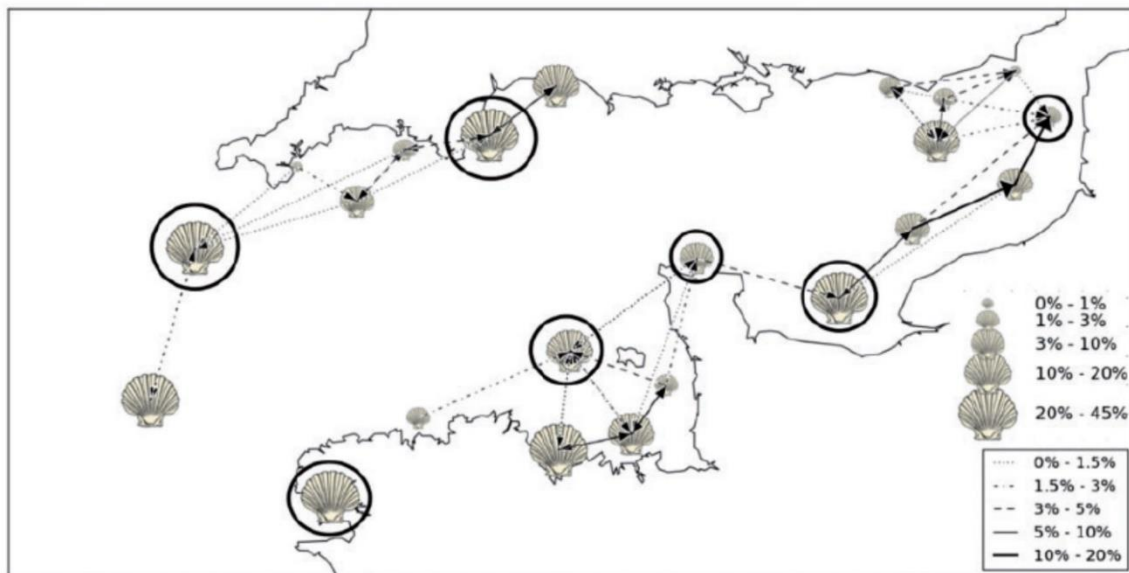


Figure 2. Representation of the local retention rate and the main dispersal connections among the local populations of the king scallop in the English Channel over 10 years. The retention rate of each local population is symbolized by the relative size of the scallop and the connectivity by lines. Cut-nodes are indicated by circles (from Nicolle et al., 2017)

Fishing activity

Fishing methods

Scallops are fished with dredges (Figure 3, Figure 4). The standard dredges used in offshore waters are the spring loaded New Haven type dredges which are deployed on beams on port and starboard sides of the vessel. The length of the beam and the number of dredges that can be towed is highly correlated with the overall length of the vessel. Dredges are usually about 0.80m in width. The spring loaded action of the toothed bar allows the teeth to flex backwards, preventing the dredge from snagging on harder ground, and also improves the catch efficiency of the dredge. The size of the teeth, their spacing, and the diameter of the mesh rings of the bag all affect catchability and selectivity.

French fleets operating in the Eastern Channel (Normandy and Hauts-de-France regions) also use so-called "English" dredges or New Haven type, with a standard width of 0.80m each. In North Brittany and in the Normandy-Breton Gulf, however, the majority of vessels use Breton (or French, depending on the name) dredges, which may be equipped with diving plates. Each dredge is usually 2m wide (Figure 3) which is deployed from the stern of the vessel. The fishing vessels are generally small and work in inshore waters, and tow directly (without beam) one or two dredges with a cable.

In some very small areas (Rance valley near Saint-Malo in France, Jersey waters), King scallops can be caught by diving, but the quantities caught remain very marginal compared to total landings.

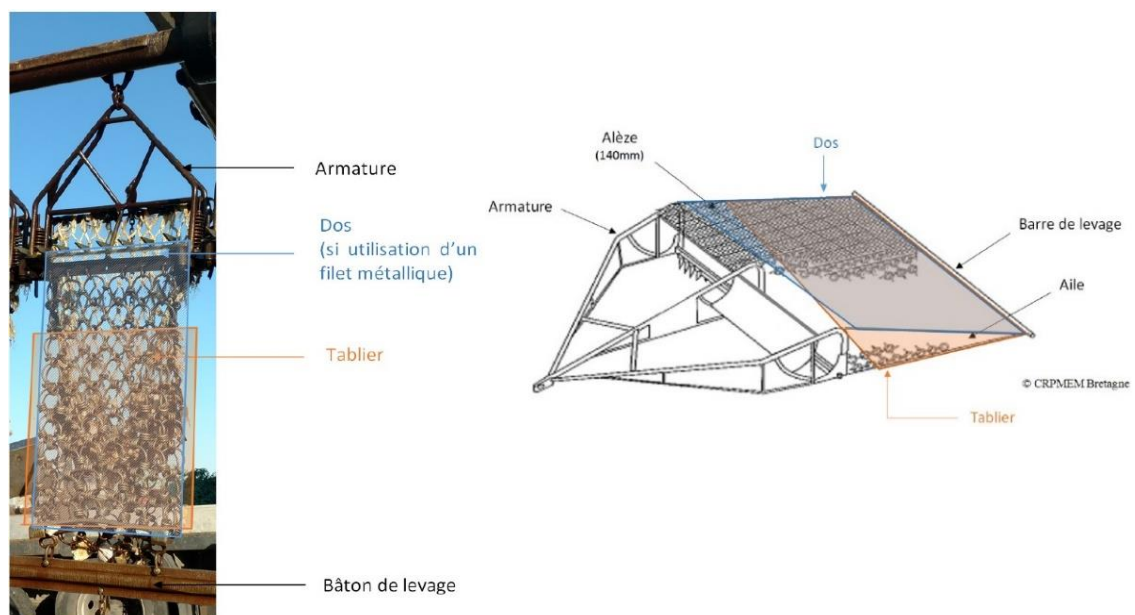


Figure 3. (Left) Single New Haven type dredge. (Right) "Breton" or "French" type dredge, the tooth bar is attached directly to the structure without springs. The dredge can be equipped with or without a diving plate.



Figure 4. Spring loaded New Haven type scallop dredges suspended on a beam ready for hauling on to the vessel (Irish vessel Celtic Sea)

Fishing fleet

The scallop fleet is 'operationally' specialized in that at least the larger vessels fishing in deeper water are set up for dredging. They cannot easily swap to trawling or other gears. Smaller vessels fishing in coastal waters may be more adaptable and seasonal in how they target scallop.

Ireland

Entry to the scallop fishery, irrespective of where the vessel fishes, is effectively limited and a secondary authorization, over and above the primary fishing licence is required for all vessels over 10m in overall length. Currently there are 7-8 vessels capable of fishing and actively fishing in the Channel. Irish vessels fish mainly in the eastern Channel although in some years the fleet is active in various locations in the western Channel. The fleet fishes in both UK and EU waters and up to the French 12nm limit. These vessels are over 18m in length and fish approximately 20-24 dredges.

France

The French fleet is mainly made up of small, multi-purpose coastal vessels, mainly operating in French territorial waters (also in Jersey waters in the Normandy-Breton Gulf). Access to the two most productive seabeds in French waters, the Bay of Saint-Brieuc in the Western Channel and the Bay of Seine in the Eastern Channel, is regulated by a system of fishing licences, which limits the size of vessels (13 m in Saint-Brieuc and 16 m in the Bay of Seine). A few slightly larger vessels (between 16 and 18 m) targeting King scallops almost exclusively remain in Normandy, particularly in the harbour of Dieppe. These vessels work mainly offshore, in European and British waters in the Eastern Channel.

The number of King scallop fishing licences is also limited. The number of vessels targeting King scallops in the Channel has been relatively stable over the last 10 years. In 2021, 516 French vessels (33 in Hauts-de-France, 234 in Normandy and 249 in Brittany) fished this species in the Channel (Figure 5) (Source: Système d'Information Halieutique

<https://archimer.ifremer.fr/doc/00802/91376/97209.pdf>).

Saisonnalité des principaux métiers

NOMBRE DE NAVIRES ACTIFS PAR MOIS ET PAR MÉTIER

Métiers	Jan.	Fév.	Mars	Avr.	Mai	Juin	Juil.	Aout	Sept.	Oct.	Nov.	Déc.
Dragues à coquille St-Jacques	480	480	449	374	171	1			6	447	516	511
Casiers à grands crustacés	78	131	170	220	265	286	258	204	162	147	130	126
Casiers à buccin	89	135	138	143	155	149	143	127	108	117	124	127
Chaluts de fond à poissons démersaux et benthiques	116	117	129	130	135	140	151	148	154	108	96	100
Chaluts de fond à céphalopodes	55	36	35	47	59	63	71	95	117	115	114	73
Chaluts de fond à soles	37	35	46	62	89	72	96	90	106	85	64	27
Trémails à soles	48	67	86	68	49	60	53	46	55	48	45	40
Filets maillants à poissons démersaux et benthiques	46	42	50	33	43	48	49	69	68	75	67	64
Trémails à poissons démersaux et benthiques	33	32	52	56	61	58	68	63	57	56	55	53
Dragues à bivalves hors coquille St-Jacques et moules	40	43	44	42	20	33	34	16	38	54	56	62

de 0 à 102 navires
 de 103 à 205 navires
 de 206 à 309 navires
 de 310 à 412 navires
 de 413 à 516 navires

Figure 5. Seasonality of the main métiers in France, and number of active vessels per month. Scallop dredging on top line (Source: Ifremer SIH)

UK

The UK fleet is a mix of smaller coastal vessels and larger vessels which fish offshore.

The UK Government undertook a consultation in 2021 on fishing capacity in vessels under 15m the number of which are not restricted. The scallop and shellfish industry/government management groups had identified the management of the under 15m scallop fleet and latent capacity (unused licences and entitlements) within the over 10m scallop and shellfish fleet as significant issues for future management of scallop stocks and fisheries. The number of scallop vessels under 15m was 186 in 2019 and 156 in 2020 with an average of 100 and 85 days at sea in 2019 and 2020 per annum respectively. The number of vessels over 15m was 76 and 70 in 2019 and 2020 respectively with average days at sea of 170 and 134 in 2019 and 2020 respectively (Quintana et al 2020).

Landings

King scallop is the most valuable single species fishery in the Channel. In the eastern Channel landings increased from 17000 tonnes in 2015 to 34000 tonnes in 2021. The increase was mainly due to the French fleet which accounted for almost 25000 tonnes in 2021. The UK account for about 7000-9000 tonnes. Ireland, Netherlands and Belgium have, in contrast, relatively low landings in this area (Figure 6).

In the western Channel landings increased significantly to 23000 tonnes in 2021 compared to less than 15000 tonnes in the previous years from 2014. Both French and UK landings increased in 2021. Other countries have minor landings by comparison.

Today, the King scallop is the most valuable species in French fisheries. In 2021, French landings in the Channel reached a total value of more than 100 million Euros (for an average price of 2.64€/Kg) (Source: Ifremer SIH). Using those unit value prices the total value of the English Channel scallop fishery for all countries combined is in the region of €150m.

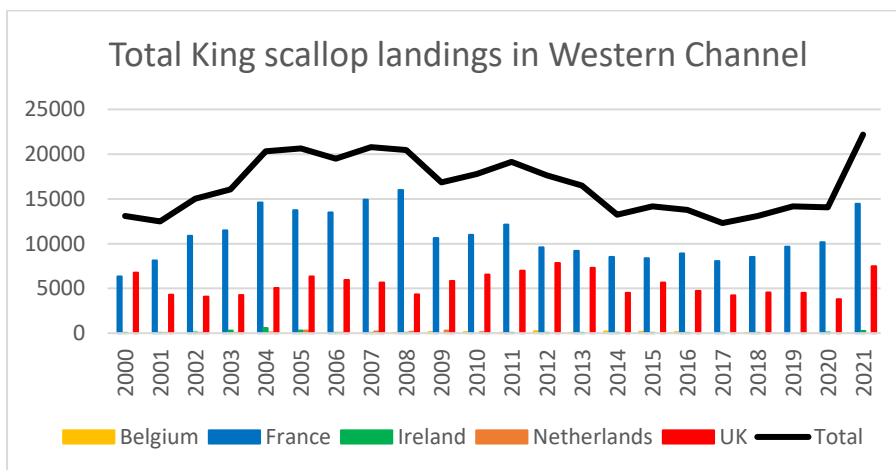
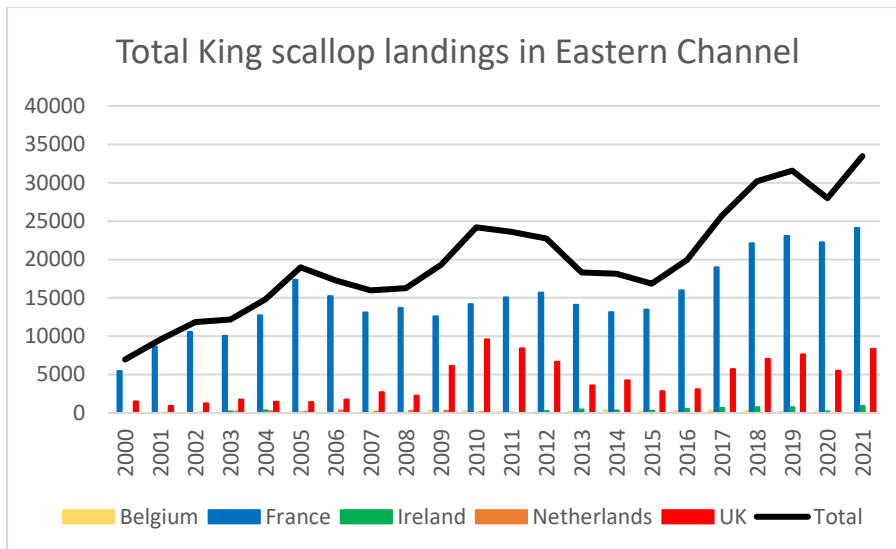


Figure 6. Trends in landings of scallop in the western and eastern channel 2000-2021 by country

Spatial distribution of fishing

Total landings from the Channel peaked in 2021 at over 51000 tonnes. The majority of these landings were from the south (French <12nm) and east of the Channel (Figure 7, Figure 8, Figure 9, Figure 10, Figure 11). ICES rectangles 29F0, 28E9, 27E9 (French coast), 26E7 (French coast) are generally the most important areas.

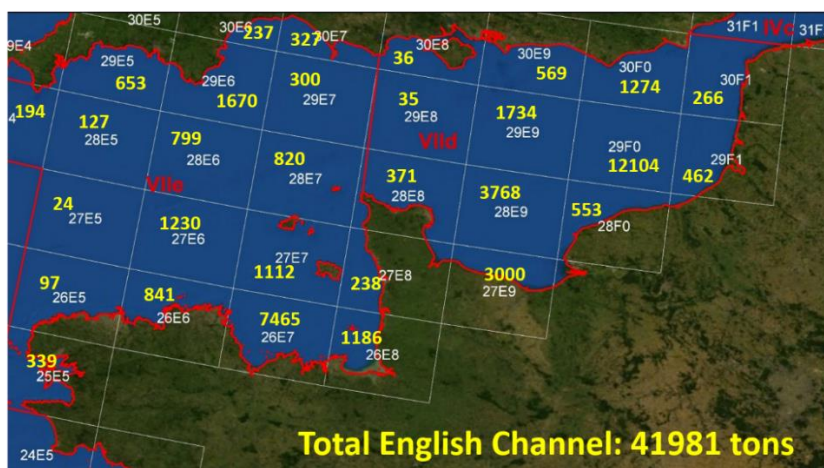


Figure 7. Spatial distribution of scallop landings in the channel in 2010

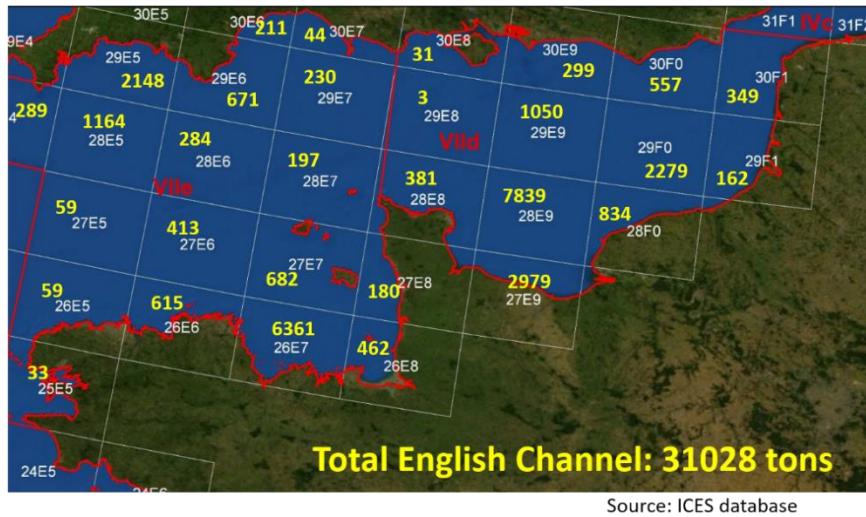


Figure 8. Spatial distribution of scallop landings in the channel in 2015

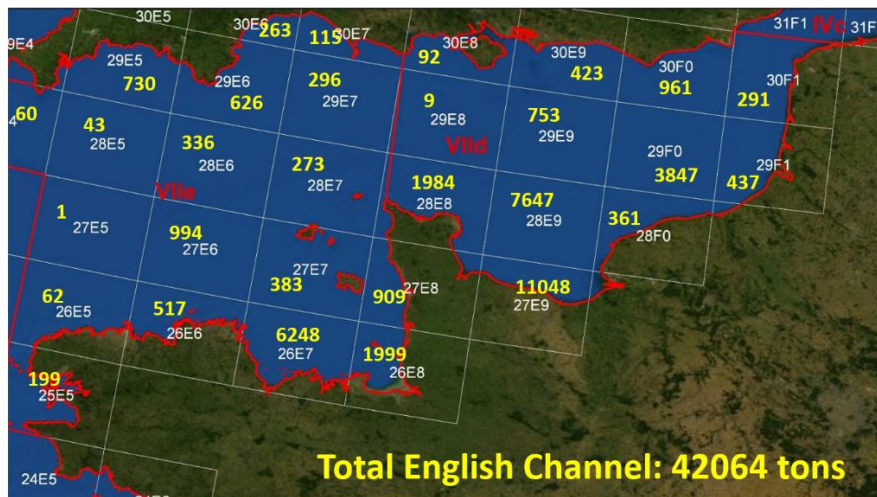


Figure 9. Spatial distribution of scallop landings in the channel in 2020

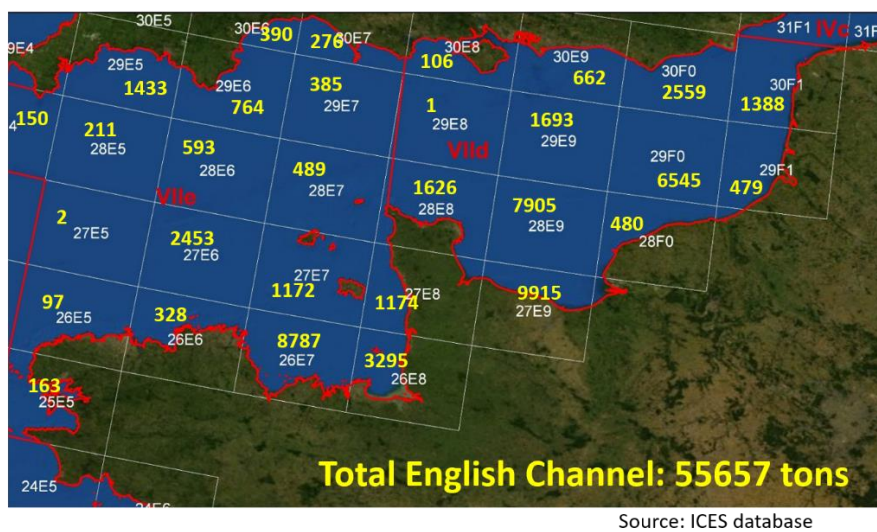


Figure 10. Spatial distribution of scallop landings in the channel in 2021

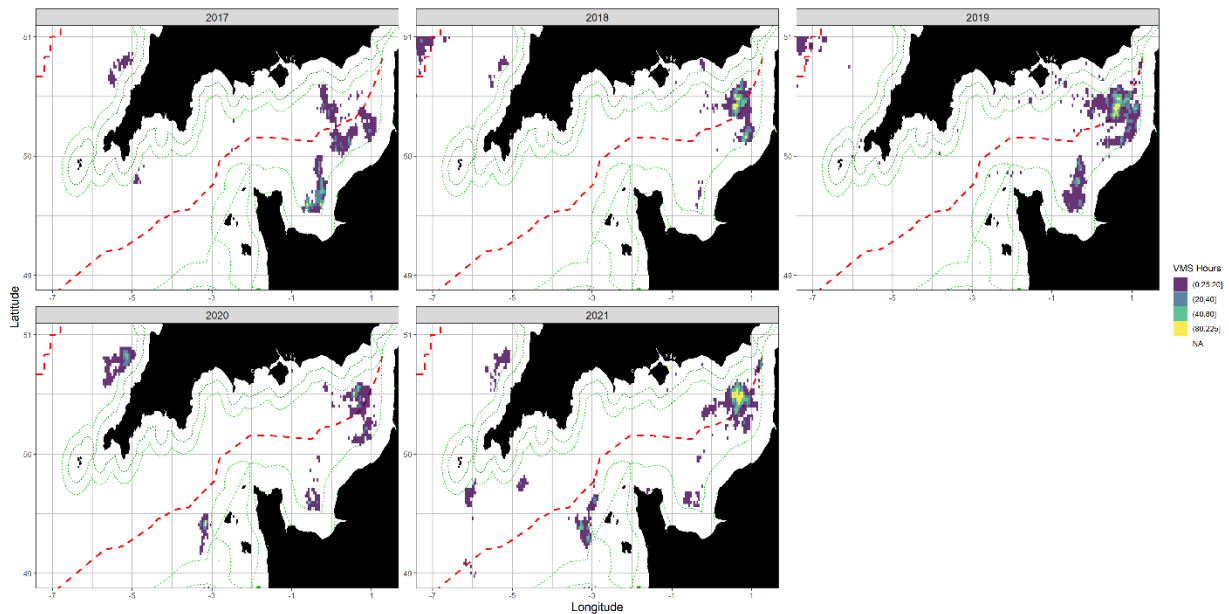


Figure 11. Spatial distribution of fishing by the Irish fleet in the Channel 2017-2021 derived from VMS data.

Seasonal distribution of fishing

In France, King scallop fishing is only allowed during the winter period, from 1 October to 15 May of the following year. A strong seasonal signal is, therefore, observed for French landings in all sectors of the Channel (ICES divisions 7d and 7e). Fishing is particularly intense during the opening of the Bay of Seine, from November to March. In the Western Channel, French landings occur from November to May, corresponding to the general opening period (Figure 12).

The UK and Irish fleets, fishing outside 6nm, are not constrained by a summer closed season, they can harvest scallops all year round. Nevertheless, in recent years in the Eastern Channel there is a certain seasonality based on the French opening period, due in particular to the Franco-British-Irish agreements signed for King scallop fishing in these areas. In the Western Channel, the areas exploited by the French and the British are radically different, the French fleet in the south of the area in French territorial waters and in the Normandy-Breton Gulf, the British fleet in the north of the area in waters under UK jurisdiction. British landings in the latter area take place all year round, but are more important in summer. Irish activity is highest in quarter 4 in the eastern Channel and particularly just outside the French 12nm zone at this time (Figure 13).

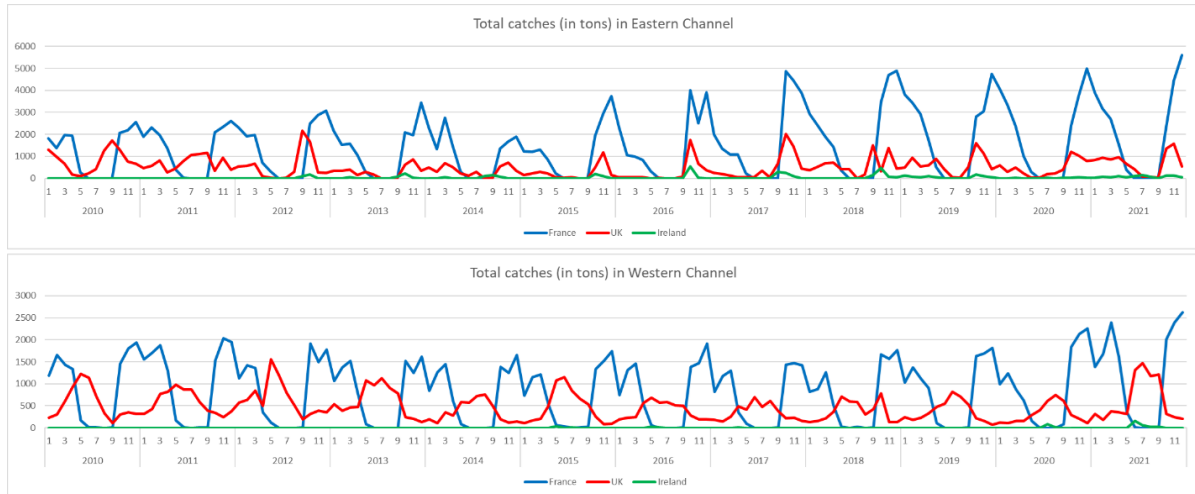


Figure 12. Seasonality of King scallop landings in the English Channel (2010-2021) (Eastern Channel top figure, Western Channel bottom figure).

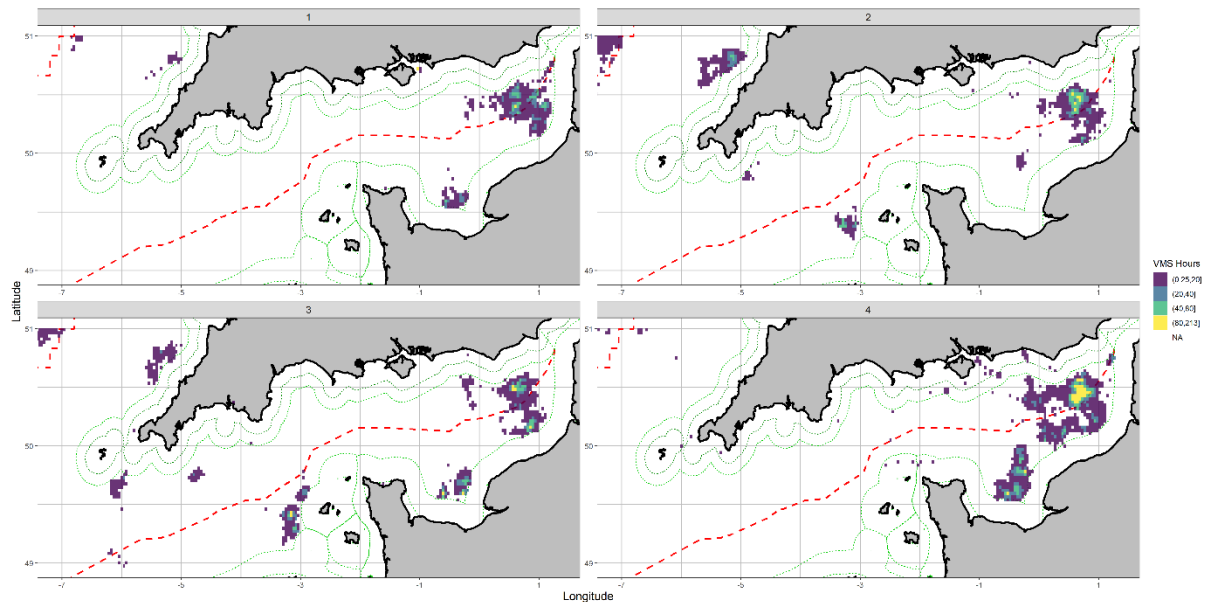


Figure 13. Seasonal and spatial distribution of scallop fishing by the Irish fleet by quarter (2017-2021 combined).

Seasonality in Eastern Channel

Seasonality is very marked in the Seine Bay (ICES rectangles 27E9 and 28E9), exploited almost exclusively by the French fleet. The most important months in terms of landings are November and especially December (before the end-of-year holidays). These landings have been steadily increasing in recent years, particularly since 2016 (Figure 14). The northern and central parts of the Eastern Channel, exploited more by British fleets, have a less marked seasonality. The 29F0 rectangle is exploited in a similar way by the two countries, but also to a lesser extent by the Irish fleet (Figure 15).

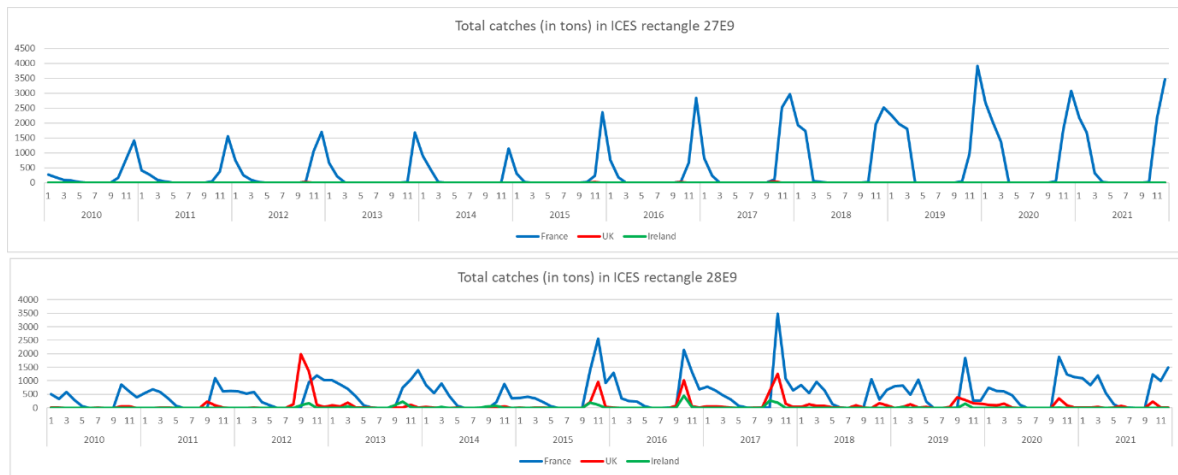


Figure 14. King scallop landings (2010-2021) in the bay of Seine (Eastern Channel, ICES rectangle 27E9 and 28E9).

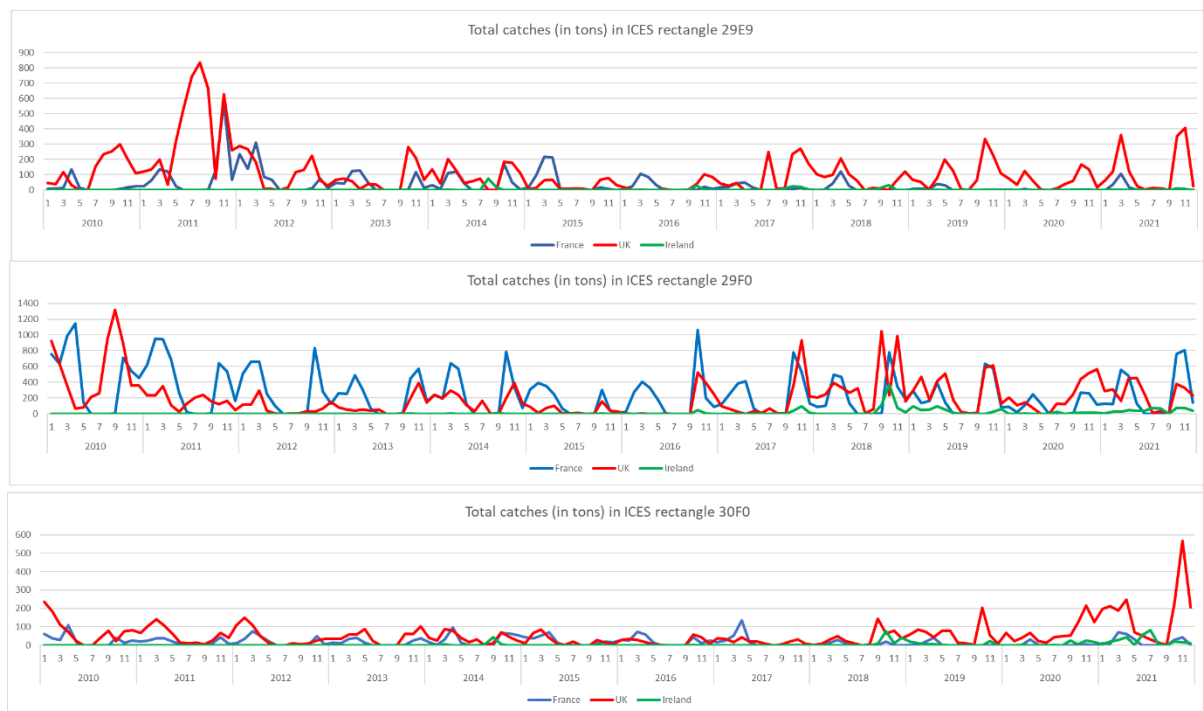


Figure 15. King scallop landings (2010-2021) in the northern and central parts of Eastern Channel.

Seasonality in Western Channel.

There are two distinct seabeds in the Western Channel. The first is located in the north, and exploited exclusively by the British fleet, mainly in summer (Figure 16). The second is located to the south of the area in French waters, exploited only by the French fleet (Figure 17), with the exception of rectangle 27E7, which is also exploited by the few dredgers from Jersey and occasionally by British vessels.

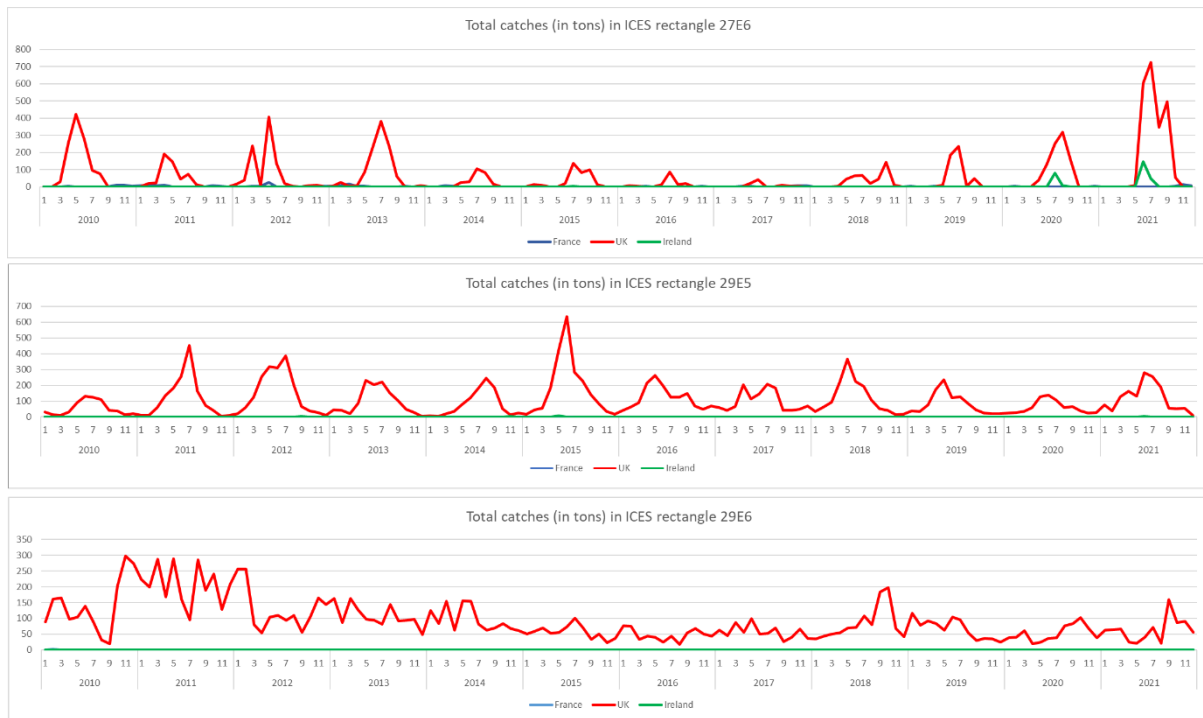


Figure 16. King scallop landings (2010-2021) in the northern part of Western Channel.

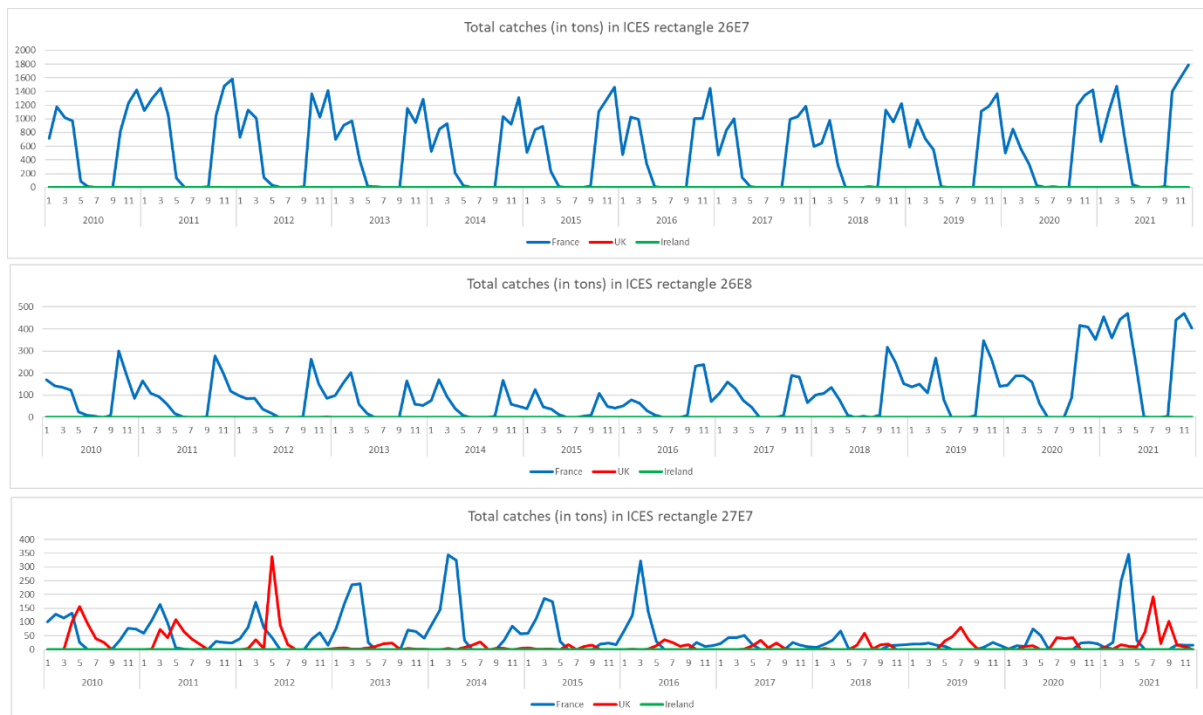


Figure 17. King scallop landings (2010-2021) in the southern part of Western Channel.

By-catch commercial species

There is little information on by-catch of commercial species by scallop dredgers. Due to the selectivity of the dredges on French vessels, there are practically none, with the exception of a few turbot. In offshore scallop fisheries and depending on area fished by-catch of queen scallop (*Aequipecten opercularis*), monkfish (*Lophius spp*), brown crab (*Cancer pagurus*), spider crab (*Maja brachydactyla*), plaice (*Pleuronectes platessa*), sole (*Microstomus*, *Microchirus*) and rays (*Raja spp.*) occur. The effects

of by-catch on the status and productivity of these species is unclear. The footprint of the offshore scallop fishery in the Channel, Irish Sea and Celtic Sea collectively is significant and total by-catch raised to scallop fleet effort by be important. If scallop dredges encounter these species generally in offshore fisheries some level of unseen mortality is also likely due to contact with the dredge. This mortality also affects scallop.

Szostek et al (2017) provide the following information on by-catch in the Channel scallop fishery: The mean proportion of scallop dredge by catch biomass in the English Channel was 19% of total catch biomass. The proportion of individual by catch species in dredge catches were low, therefore scallop dredging is unlikely to cause a substantially increase the population mortality of individual commercially fished species beyond that caused by the target fisheries for those species. The discard rate of finfish and shellfish of commercial value from the king scallop dredge fishery in the English Channel was between 18-100% with a higher rate of discarding occurring in the eastern English Channel compared to the west. Regional assessment and if necessary management of by-catch may therefore be considered.

Links and potential spatial conflicts with other fisheries

There may be some métiers conflicts between dredgers and vessels engaged in passive arts (nets and traps). Such conflicts are relatively rare on the French side due to the seasonality of the scallop fishery, with the large majority of vessels using either trawls or nets during the summer months.

On the other hand, in the Eastern Channel, there have been serious conflicts between the British and French fleets in recent years, with the British fleets coming to exploit the scallops at the limit of French territorial waters during the fishing summer closure in France (August and September). This conflict partially ended with the signature of agreement between France and UK, respectively in 2013 and 2018.

Static gears (in particular pot fisheries for crustaceans and whelk in the channel) and scallop dredging may come into contact in the Channel. Dredging by larger scallop vessels in particular may conflict with static gears. Some local bye-laws occur in the UK 0-6nm zone to reduce conflict between mobile and static gears (eg Lyme Bay UK).

The spatial overlap and potential conflict between scallop dredging and static gears could be estimated using logbook and VMS data for UK, Irish and French vessels. This analysis has not been done.

Data collection for stock assessment

Surveys

All scallop surveys conducted by France and UK use dredging on board commercial or research vessels. There may in addition also be limited use of underwater TV methods. Survey design and methods of analysis vary. The low efficiency of scallop dredges is a major uncertainty in estimation of biomass from these surveys although dredge efficiency has been estimated in numerous areas and ground types (ICES WGScallop). Generally statistical interpolation of the survey data is difficult on coarse grids in offshore surveys but may be more feasible for coastal stocks.

UK

Surveys are undertaken in the main scallop beds in the western and eastern Channel in UK waters and in EU waters. The surveys include all areas fished, as identified from VMS data 2009-2016, and also areas where scallop are distributed in lower densities, contribute to spawning potential, but are not fished. The areas have no VMS activity and may be unsuitable for fishing with dredges. Stratified

random design dredge surveys have been undertaken by CEFAS since 2017 (Figure 18, Figure 19). A survey grid is used to allocate sampling effort where a number of survey stations are allocated within valid grid cells which are cells with some VMS activity. Almost all grid cells within a bed are sampled to ensure broad spatial coverage. Sample data are raised to grid cell (block) and the mean density within the cell and the surface area of the cell provides the raised estimate of density (abundance) within the cell. Underwater video methods may be used in areas unsuitable for dredging or in Marine Protected Areas (MPAs). Various dredge efficiencies are applied to the survey station data based on information on seabed type provided by the Skipper of the survey vessel. The methods have been discussed at ICES WGScallop.

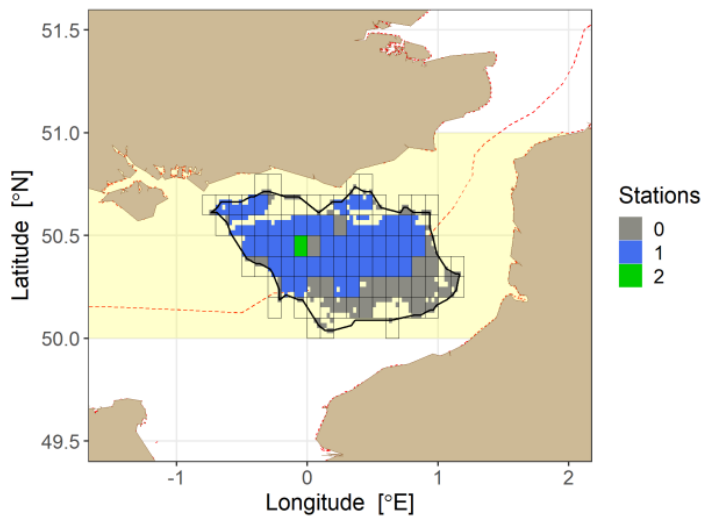


Figure 18. Number of stations visited during the 2020 UK dredge survey within each sampled block of Bed 7.d.1 (Area 27.7.d.N). The dashed red line indicates the boundary of the UK EEZ.

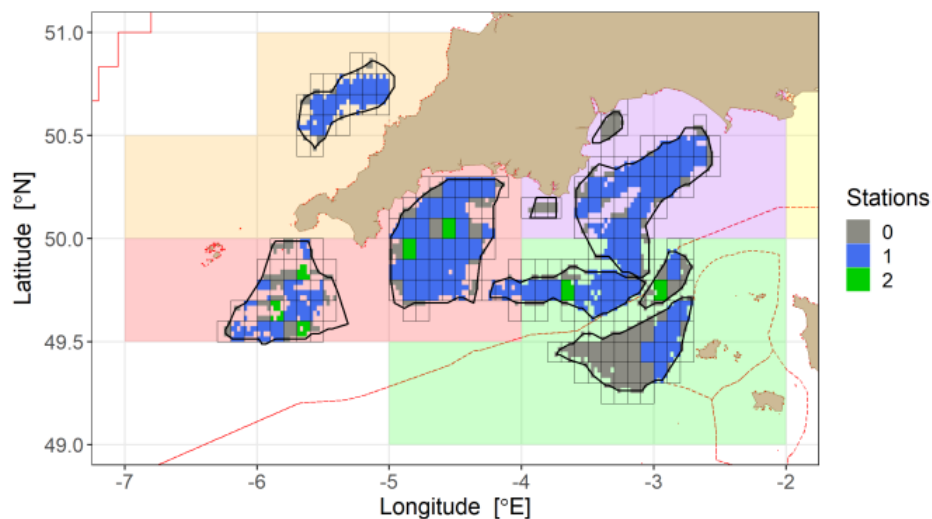


Figure 19. Number of stations visited during the 2020 dredge survey within each sampled block of Beds 7.e.1-8 and 7.f.1 within the assessment areas of ICES Divisions 27.7.e and 27.7.f. The dashed red line indicates the boundary of the UK EEZ, as well as those of the Channel Islands.

France

The two main King scallop fishing areas in the Channel (Bay of Saint-Brieuc in western Channel and Bay of Seine in Eastern Channel) are assessed by an annual scientific survey conducted by Ifremer. These two surveys are the oldest fishery surveys conducted by France, COSB (COquilles Saint-Brieuc) started in 1974, COMOR (COquilles Manche ORientale) in 1976. The 2 surveys follow the same protocol (Stratified random design), use the same vessel (R/V Thalia) and the same gear (a French dredge equipped with 50mm ring diameter for both, a second dredge with 72mm ring diameter for COMOR), for which the effectiveness is known (through diving operations). The protocol is fully standardized since 1992, and all data is banked into Ifremer databases. Around 115 stations are carried out each year for COSB (done in August, early September), a little more, between 150 and 170, for COMOR (done in July). All King scallops (or a sample) caught are aged, measured and weighted. All associated species are identified and at least counted.

The geographical coverage of COSB extends from the French Brittany coast to the 12nm limit (Figure 20).

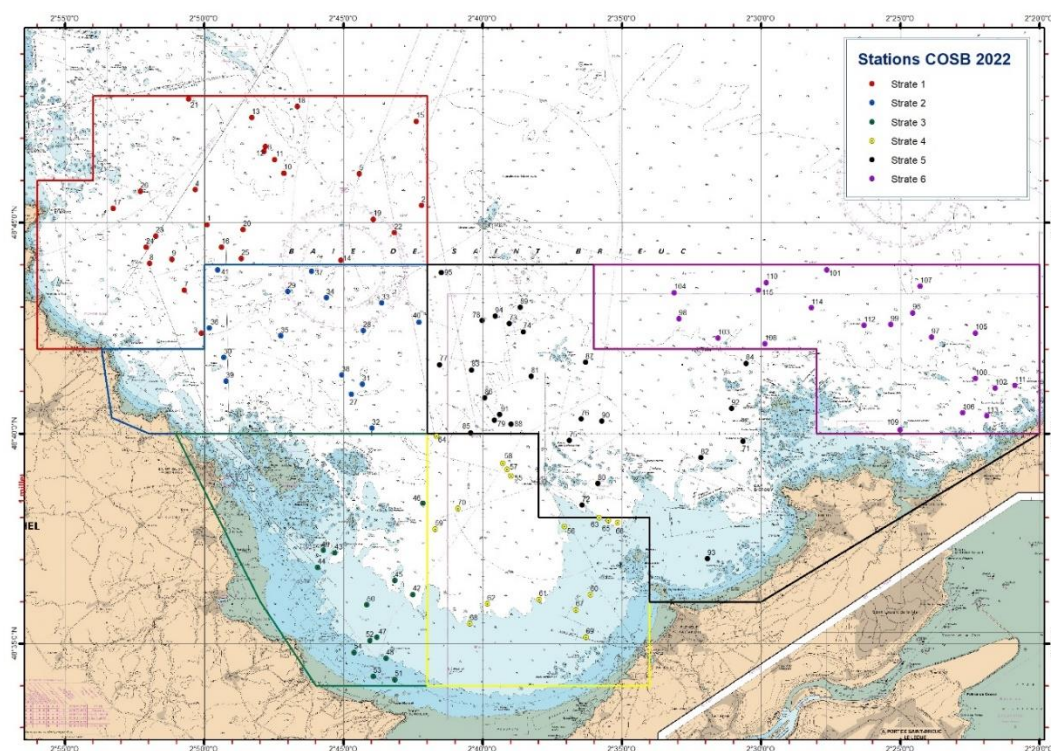


Figure 20. Spatial distribution of dredge samples during COSB2022 (6 strata, 115 stations). Each tow is 200m long.

COMOR's coverage is wider (Figure 21), from the Normandy coast in the south to parallel 49°48' in the north, including European waters (ICES rectangle 28E9).

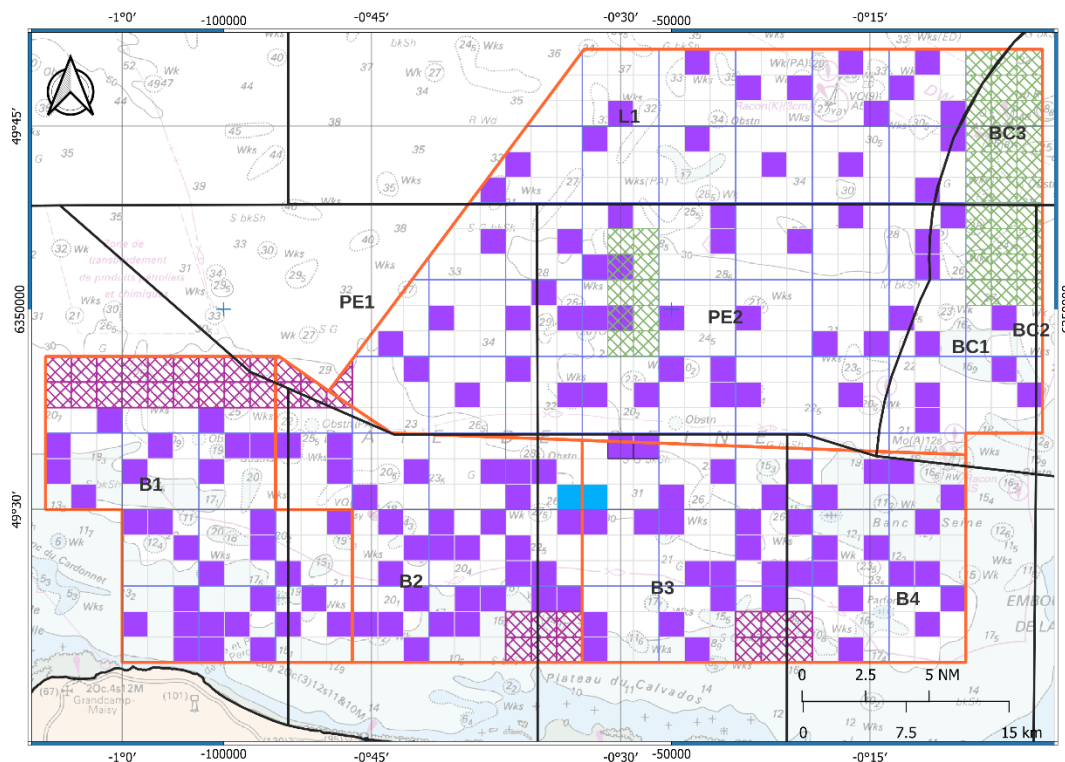


Figure 21. Distribution of sampling stations during COMOR2022 (5 strata, 152 stations). A $\frac{1}{4}$ nm tow is done in each 1nm square.

Ireland Belgium Netherlands

These countries do not undertake scallop surveys in the Channel

Observer at sea

We are not aware of any observer at sea programme on commercial scallop vessels in the Channel. Such observer work would be useful to identify scallop discard rates and also non-retained by-catch.

Port sampling

Port sampling can be used to obtain size and age distribution of scallop in the landings which theoretically could be used to provide raised estimates of landings by age as input to age based stock assessment or estimation of yield, biomass and spawner per recruit.

Ireland

Scallops landed by Irish vessels in the Channel are generally brought by sea or road to processors on the south east of Ireland. Ireland samples these scallop opportunistically and can trace the sample to ICES rectangle in the Channel or in other areas the vessels are fishing. Targets are not set and regular monthly or quarterly samples are difficult to obtain due to the mobility of the fleet which ranges across the Irish Sea, Celtic Sea and Channel.

France

France has a general port sampling programme in line with the data acquisition programme (EU DCF) necessary for stock assessment under the CFP. All major fisheries are sampled, including King scallop fisheries. The national sampling plan is drawn up by Ifremer (in consultation with the Directorate of Maritime Fisheries of the French Ministry of the Sea), so that the sampling is representative of all French fisheries.

UK

The UK have a port sampling programme that provides data on size and age distribution of landings into UK ports. CEFAS identifies sampling opportunities based on reports of vessel position at sea and requests a sample from the processor. The processor contacts the vessel to collect samples (the so called blue bag and red bag scheme). Sampling targets are variously defined based on the ICES rectangle the vessel is fishing in, a number of such samples per quarter and since 2018 are based on 1 sample per tonne of scallop landed by rectangle. Sampling strata are necessarily small given the spatial variability in scallop growth rates.

Fishery dependent data; logbooks and VMS

All jurisdictions deploy VMS systems on scallop vessels over 12m in length and Skippers are required to complete the official EU logbook or UK equivalent. Spatial data on fishing for vessels under 12m in length is less available.

Routines for linking logbook and VMS data are well developed nationally and at ICES level. These routines can, therefore, provide data on catch rates at reasonably high spatial resolution and within the limits of the 2 hr VMS ping frequency. Usually it is possible to allocate landings from operations in a fishing day to the VMS pings on the day and express LPUE as kgs.VMS^{-1} . This can be further refined by standardizing to the number of dredges and reporting as $\text{kgs.dredge}^{-1}.\text{VMS}^{-1}$. The number of dredges carried by vessels may be regulated to a maximum, be known from interviewing skippers or be derived from a relationship between vessels length, beam length and maximum number of dredges that can be carried on the beam.

Stock assessment methods

Surveys

Surveys by UK and France are separately used to estimate biomass of scallops in the Channel from which advice is developed. Exploitable biomass is estimated in these surveys. They are generally non-overlapping spatially. The estimation of dredge efficiency is a significant source of uncertainty.

France

The methodology used to estimate abundance indices and biomasses from data collected during the two COSB and COMOR stock assessment surveys is described in Vigneau *et al.* (2001).

UK

In the UK scientific reports the exploitation rate is estimated from the ratio of landings to survey biomass estimates in different scallop beds. These are presented relative to proxy reference points for sustainable harvest rates. Reference points $F_{0.1}$ and $F_{\text{spr } 35\%}$ are estimated from length cohort methods using scallop size distribution data and growth rate estimates. CEFAS caution against using F_{max} reference point as it provides for very high exploitation rates. Sustainable annual harvest rates, based on these methods, are 18-21%. Actual harvest rates are estimated to be substantially higher than this but this varies by area and year. CEFAS reports highlight a number of uncertainties in the survey estimates and difficulty in accessing international landings in recent years.

Indicators (LPUE and VMS metrics)

Fishery dependent metrics of relative abundance (Landings per unit effort) are or can be derived from logbook and VMS data. The nominal units of reporting depend on the information available.

LPUE indicators can also be derived from survey data. The advantage of fishery dependent data is its high volume and extensive spatial and temporal distribution.

Previous and ongoing work on spatio-temporal modelling of commercial logbook and VMS data have shown the potential to develop indices of abundance for scallop stocks (Murray et al., 2013). This can be particularly useful in areas where there are not targeted scallop scientific surveys. Additionally, commercial data provides highly resolved spatial and temporal datasets than scientific surveys. The modelling process involved, known as index standardization, attempts to remove effects (e.g. differences across vessel catchabilities, spatial-temporal variability, changes in fishing effort), other than real changes in stock abundance to provide unbiased indices of stock abundance. There are a wide range of modelling frameworks to attempt index standardization, from traditionally applied GLM's and GAM's to the recently developed sdmTMB or VAST. Resulting indices can then be used within stock assessment models, such as Surplus Production Models, to derive MSY reference points. Additionally, spatial-temporal standardization models provide useful insights about the spatial and spatial-temporal patterns of stocks, particularly relevant in scallops, as they exhibit strong aggregations and temporal variability. WGSCALLOP has progressed this area of research across several European scallop stocks (ICES WGScallop, 2021).

These data are currently underutilized due to issues with respect to data availability and data protection and data integration.

Surplus Production models

Reasonably long time series of catch, effort and catch effort metrics are available or can be estimated from UK, French and Irish fleets data and could be used in production model contexts to provide management advice. This has recently been attempted in France using the Catch (msy) model as described below and is a different approach to the estimation of reference points compared to the UK methods described above.

The CMSY+ surplus production model (Froese and al., 2017) has been used to assess the status of the different stocks. CMSY+ uses a Monte-Carlo simulation method. The model estimates fisheries reference points (MSY , F_{msy} , B_{msy}) as well as relative stock size (B/B_{msy}) and exploitation (F/F_{msy}) ratios from catch data or from catch and catch indices. Input priors are used and include a prior for resilience or productivity (r), and broad priors for the ratio of biomass to unfished biomass (B/k) at the beginning, an intermediate year and the end of the time series. Part of the CMSY+ package is an advanced Bayesian state-space implementation of the Schaefer surplus production model (BSM). The main advantage of BSM compared to other implementations of surplus production models is the focus on informative priors and the acceptance of short and incomplete (= fragmented) catch-per-unit-of-effort (CPUE) data. The model estimates could be improved if biomass, or CPUE or stock size index are available. The model also uses a catch only method (NA setting for other metrics).

In this report, four different data sets have been used and the assessments are shown below under Stock status:

- Bay of Seine (catches within ICES rectangles 27E9 and 28E9, and biomass series estimated by COMOR survey)
- Whole Eastern Channel (catch data and NA)
- Northern stock of Western Channel (Cornwall waters including 6 ICES rectangles 28E5 to 28E7 and 29E5 to 29E7)
- Southern stock of Western Channel (Granville Bay including the bay of Saint-Brieuc, four ICES rectangles 26E7, 26E8, 27E7 and 27E8 completed by a biomass series estimated by COSB survey).

Stock status

The status of scallop stocks in recent years in the Channel has been assessed mainly from surveys by France in French waters and by the UK in UK and EU waters. The French time series is much longer than the UK time series.

Biomass (survey trends)

French surveys

Bay of Saint-Brieuc (Western Channel)

The results of the 2022 assessment survey COSB2022 can be found in Fifas and Caroff (2022). The adult biomass (over 2 years old) and exploitable biomass (individuals larger than the 102mm MLS) has been steadily increasing since 2015. The level observed in September 2022 was the highest in the historical time series, with a very strong increase compared to the two previous years, which were already the highest on record (Figure 22). The harvest rate (landings: exploitable biomass) in 2022 was approximately 12%.

The 2021 cohort, which will recruit to the fishery at the end of 2023 or during 2024, is also the most abundant ever observed in the 40 year time series (Figure 23).

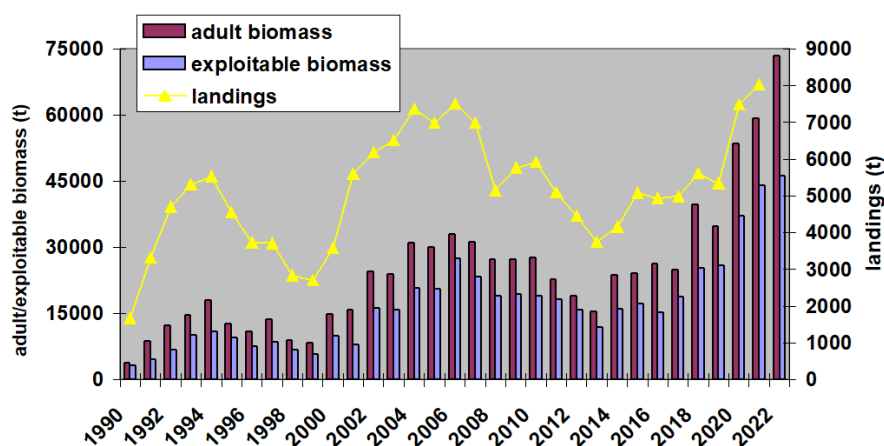


Figure 22. Trends of biomass and catches in the Bay of Saint-Brieuc, assessed by the French survey COSB (1990-2021).

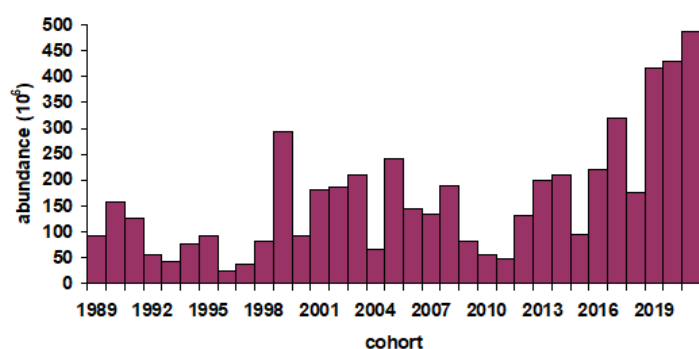


Figure 23. Abundance in the bay of Saint-Brieuc of the pre-recruit 2021 cohort.

The King scallop stock in the Bay of Saint-Brieuc has experienced strong fluctuations in abundance over the last five decades. The stock recently showed a strong decline during the 2000's and until the beginning of the 2010's. Since 2012, all year classes are above the long term average. In the past 3

years biomass and productivity have been at an all time high. This increase was probably caused by a synergy of various factors including exceptional recruitment linked to favourable hydro-climatic conditions, a stronger management system and a notable improvement in selectivity of the gears.

Bay of Seine (Eastern Channel).

All the results of the assessment survey COMOR 2021 can be found in Foucher and Varenne (2021), the report of 2022 survey is in press (Archimer, Ifremer's institutional repository). The COMOR surveys assess two main areas; the south of the Bay of Seine from the French coast to the 12 nm limit (French territorial waters, globally corresponding to the ICES rectangle 27E9) and the northern area (from the 12nm to the 49°48N parallel, called "Proche Extérieur" and globally corresponding to the southern half-part of 28E9).

In all years, the exploitable biomass of scallops observed outside the bay of Seine ("Proche Extérieur" area) is mainly comprised of two-year-old scallop recruiting to the fishery. As the stock biomass is driven by this annual recruitment the annual abundance indices have fluctuated from year to year, largely dependent on breeding success linked to environmental conditions during the larval phase. The abundance index for 2-year-old scallops showed a slight increase in 2022, but was still lower than the period 2012-2016 (Figure 24). However, there was a slight improvement in the abundance index of scallops 3 years and older in since 2020.

The size composition from the UK survey in 27.7.d.N (north eastern Channel) also shows a consistent normal distribution of size with a mode at the MLS of 110mm and an approximate range in size between 80-140mm (Lawler and Nawri 2022) suggesting that the exploitable biomass of this part of the stock is also recruitment dependent.

In the Bay of Seine (inner) the observed abundance indices has increased significantly for all age classes since 2016 (with the relative exception of 2019, essentially due to a sampling bias that occurred during the survey) (Figure 25).

In both areas, and more particularly in the Bay of Seine, biomass levels were the highest on record (Figure 26, Figure 27) in 2022 other than in 2012 in the outer Bay. In July 2022, the exploitable biomass in the Bay of the Seine was estimated to be more than 105,000 tonnes over the whole area, which was an increase of 31% compared to 2021, which was already a record high (Figure 28).

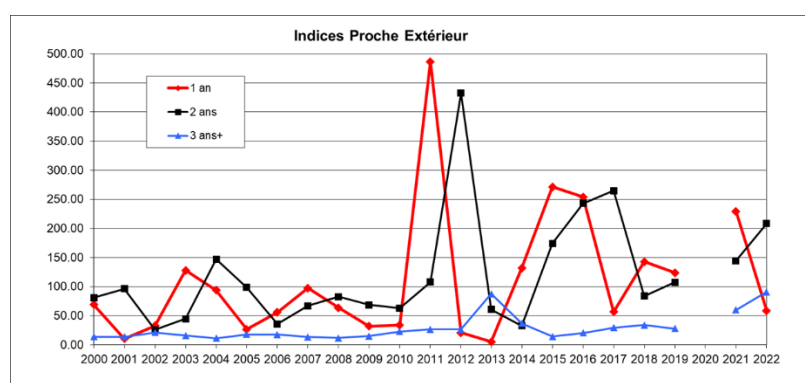


Figure 24. Trends of abundance indexes of King scallop (cohort 1, 2 and 3+) outside the bay of Seine, observed by French assessment survey COMOR (because of the COVID-19 there was no survey in 2020 in this area).

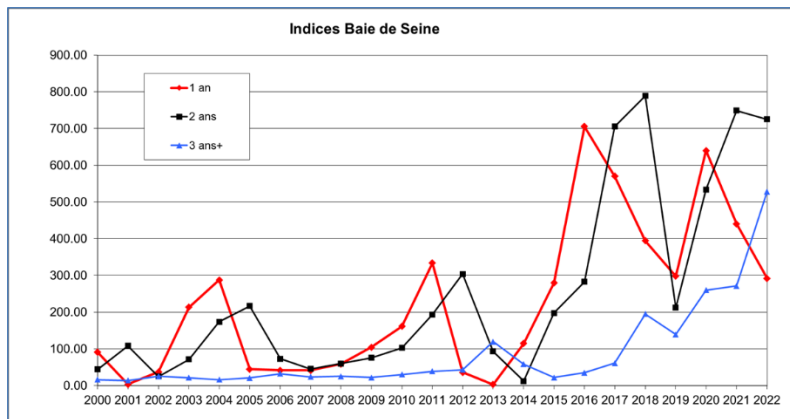


Figure 25. Trends of abundance indexes of King scallop (cohort 1, 2 and 3+) in the bay of Seine, observed by French assessment survey COMOR.

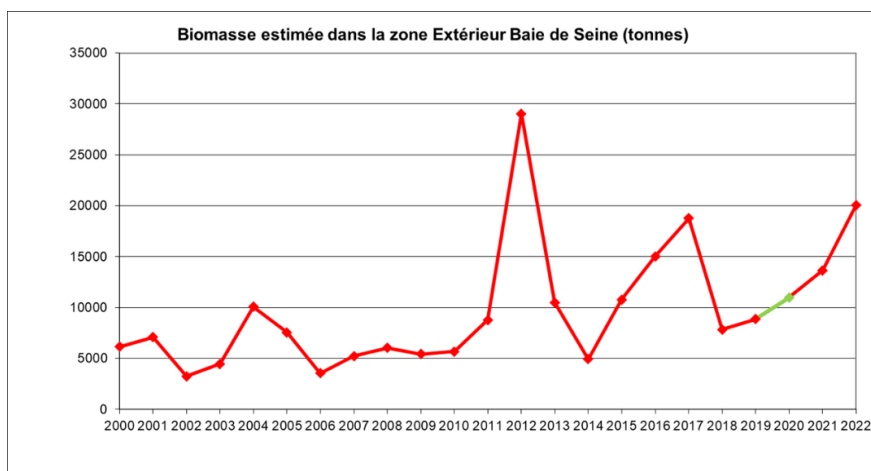


Figure 26. Trend of estimated biomass in the area "Extérieur baie de Seine".

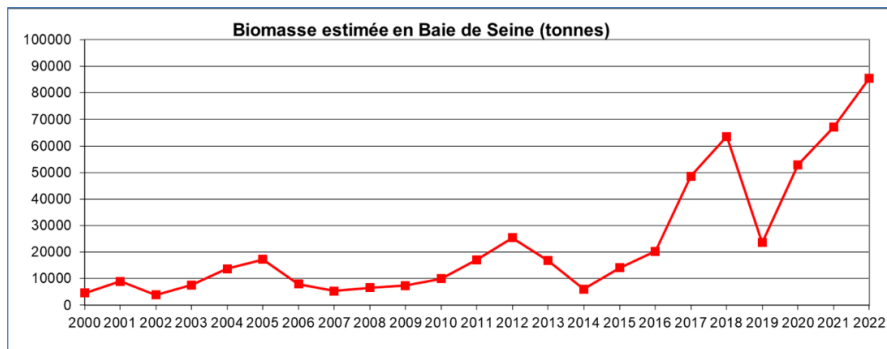


Figure 27. Trend of estimated biomass in the bay of Seine.

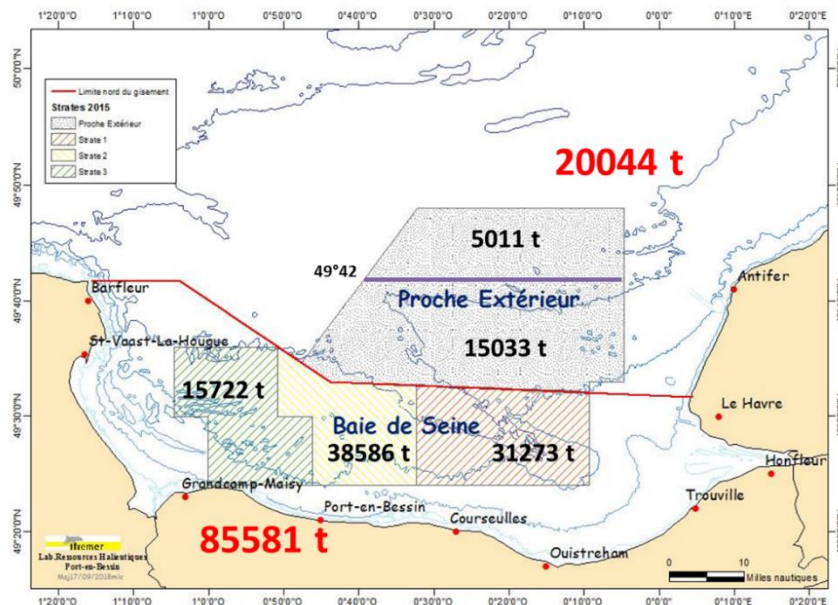


Figure 28. Total exploitable biomass in the Bay of Seine, estimated by COMOR2022.

UK surveys

Eastern Channel

Harvestable biomass, estimated from the UK surveys in the eastern Channel, increased from 2017-2021 (Figure 29). Hotspots of abundance occurred in the centre of the survey area in the UK EEZ in 2021. Sustainable harvest rates, based on F_{spr} and $F_{0.1}$ reference points and estimated from length based assessment are approximately 21% (Table 1). Fishing at the F_{max} reference point is likely to be a high risk strategy (Lawler and Nawri 2022).

Harvest rates in 2017 and 2018 were substantially above sustainable levels (in relation to reference points). Harvest rates were lower and in line with reference points in 2019 and 2020 as biomass estimates from the survey were higher in these years. However, the survey reports (Lawler and Nawri 2022) also indicate uncertainty in the international landings at the time they compiled the report which may have led to underestimation of harvest rates.

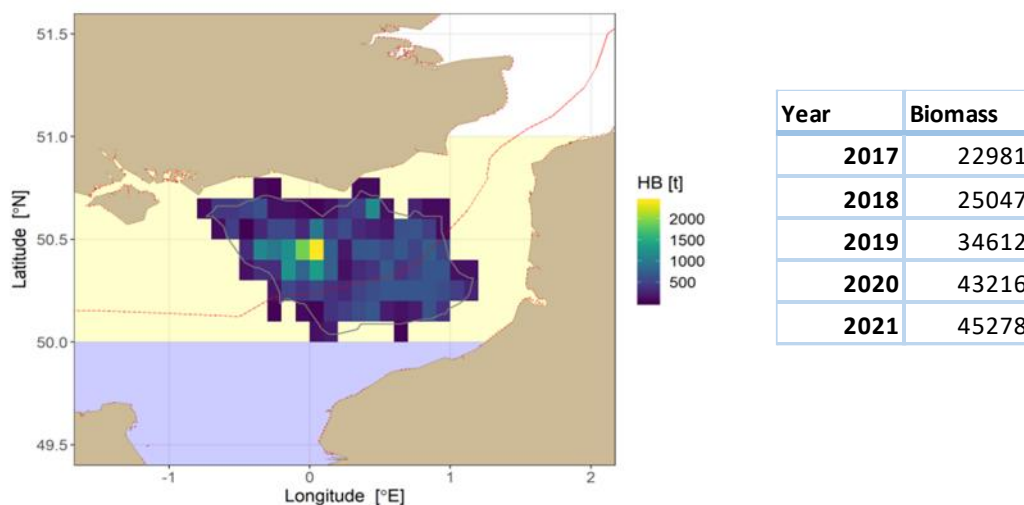


Figure 29. Harvestable biomass (tonnes) of scallop >110mm shell length in the eastern Channel during 2021. The red line is the boundary of EU and UK EEZ waters. Annual estimates of biomass in this area is shown in the Table. Taken from Lawler and Nawri (2022).

Table 1. Reference points for scallop stock in eastern Channel UK survey area. Taken from Lawler and Nawri (2022)

Reference Point	Fishing Mortality	Harvest Rate (%)	Spawner-per-Recruit	Fbar
F0.1	0.210	18.1	0.392	0.106
FSpR35%	0.252	21.5	0.350	0.127
Fmax	0.680	51.9	0.178	0.342

Western Channel

The UK surveys define and survey a number of scallop beds in the western Channel (Figure 30). The majority of these beds are in the UK EEZ but extend to EU and Channel Islands waters also. In 2021 hotspots of abundance and biomass occurred west of the Channel Islands. Inter annual variability in the biomass estimates in some scallop beds are very high presumably due to recruitment events and recruitment to above the minimum landing size. There is some uncertainty here given that the size distribution data from the annual surveys are quite similar.

Sustainable harvest rates for the western Channel are similar to those estimated for the eastern Channel at about 20-25%. Some beds experience extremely high harvest rates in some years as estimated from the ratio of survey biomass estimates to international landings and are well above sustainable levels. In other beds and depending on the year harvest rates may be sustainable.

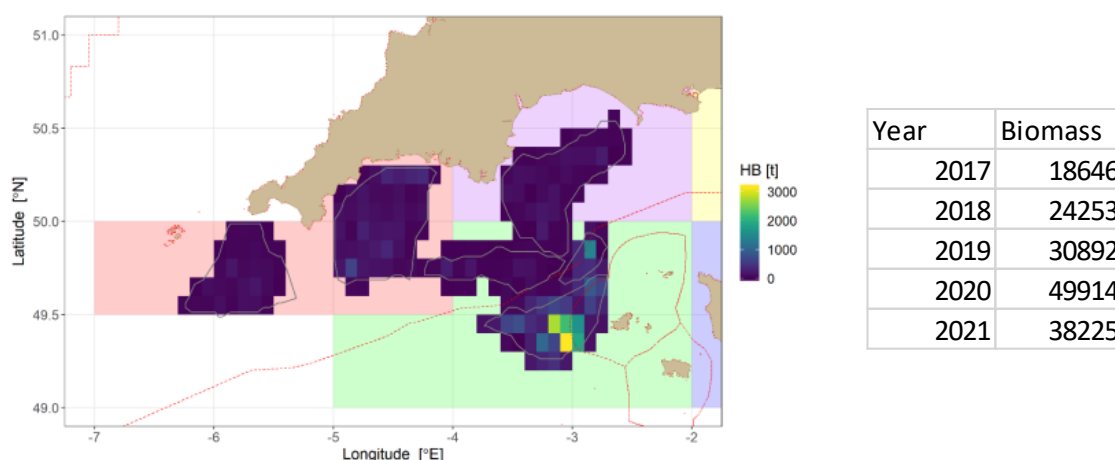


Figure 30. Harvestable biomass (tonnes) of scallop >110mm shell length in the western Channel during 2021. The red line is the boundary of EU, UK EEZ and Channel Is waters. Annual estimates of biomass in this area is shown in the Table. Taken from Lawler and Nawri (2022).

Surplus production models

France

Results of the Cmsy+ assessment are synthesized in the Kobe plots in Figure 31 and Figure 32. The stock in the Bay of Seine, in French territorial waters, was severely depleted in the early 2000's, with chronic overfishing. The situation has improved significantly over the last ten years. For the last five years, the stock could be considered in good condition. The situation is a little bit different at the Eastern Channel level, where globally the exploitation rate is less than in the Bay of Seine. The status of the stock could be considered in a good situation, but the recent trend with increase of fishing mortality may be a concern.

The status of the stocks are clearly different in the two parts of Western Channel. In the bay of Saint-Brieuc, as the Bay of Seine in Eastern Channel, was severely depleted at the beginning of the time series, and progressively improved. Today the exploitable biomass is significantly above the B_{msy} , and the exploitation ratio (F/F_{msy}) is less than 1. In the northern Western Channel, the assessment shows that B/B_{msy} is close to 1 and that F/F_{msy} is over 1 and that fishing mortality is likely to be too high.

Nevertheless, there is no evidence of significant stock depletion or very obvious overfishing and the stock status overall seems to be improving.

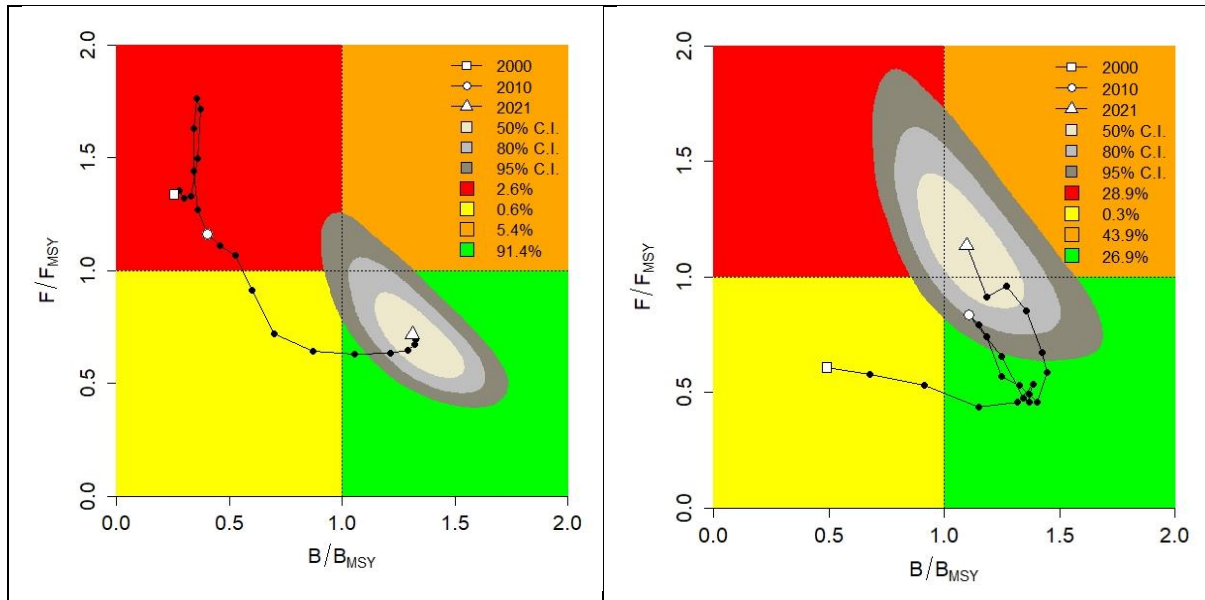


Figure 31. Kobe plots (stock status) for the Bay of Seine (left) and the Eastern Channel (right).

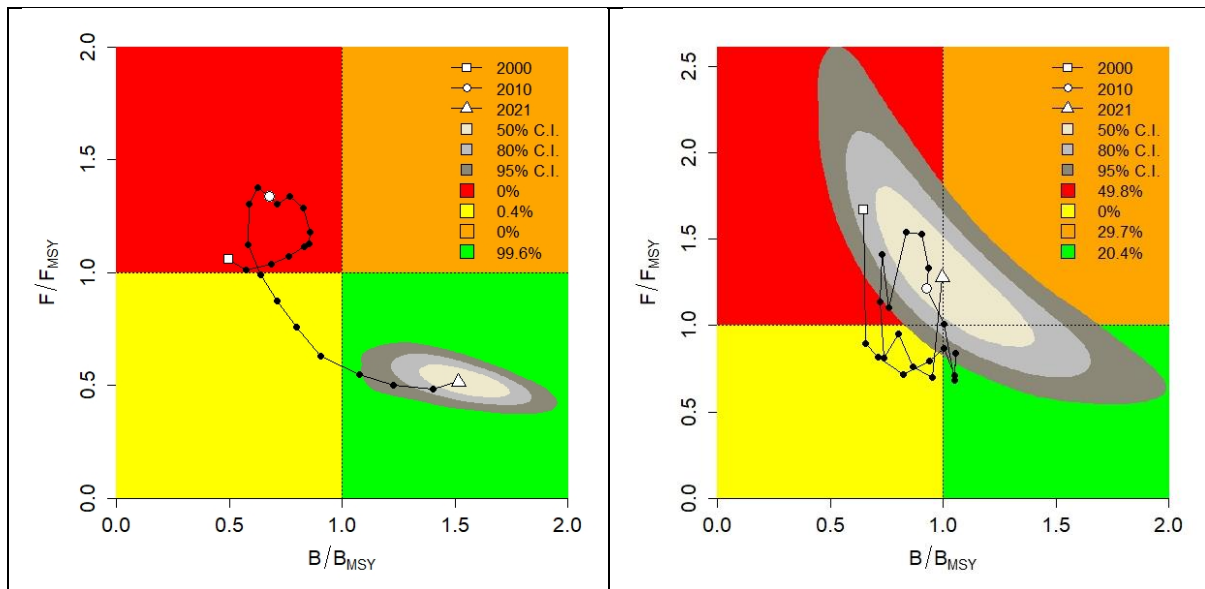


Figure 32. Kobe plots (stock status) for the Granville Bay of Seine, including the Bay of Saint-Brieuc (left) and the Northern waters of Western Channel (right).

LPUE metrics

Landing per unit effort ($\text{kgs}^{-1} \cdot \text{dredge}^{-1} \cdot \text{day}^{-1}$) in the Eastern Channel, derived from logbook and VMS data for the Irish fleet during the period 2000-2021, show high interannual variability but higher catch rates post 2011 compared to earlier years. This is somewhat consistent with the Cmsy assessment for

the Eastern Channel (Figure 33). The increase in biomass in the eastern Channel reported in the UK surveys in 2020 and 2021 is not reflected in the LPUE metric for the Irish fleet.

LPUE in the Western Channel was generally much lower than in the Eastern Channel during the period 2010-2019 but increased dramatically in 2020 and 2021. This is not consistent with the Cmsy assessment by France. On the other hand the UK surveys show increase in biomass in the western Channel in 2020 and 2021. Some fishing activity in 2021 by the Irish fleet occurred west of the Channel Islands in the area where the UK surveys indicated high abundance. Fishing in hotspots would bias the nominal LPUE index and its use as an indicator for overall stock status. Spatio-temporal modelling of these fishery dependent data is important in this respect.

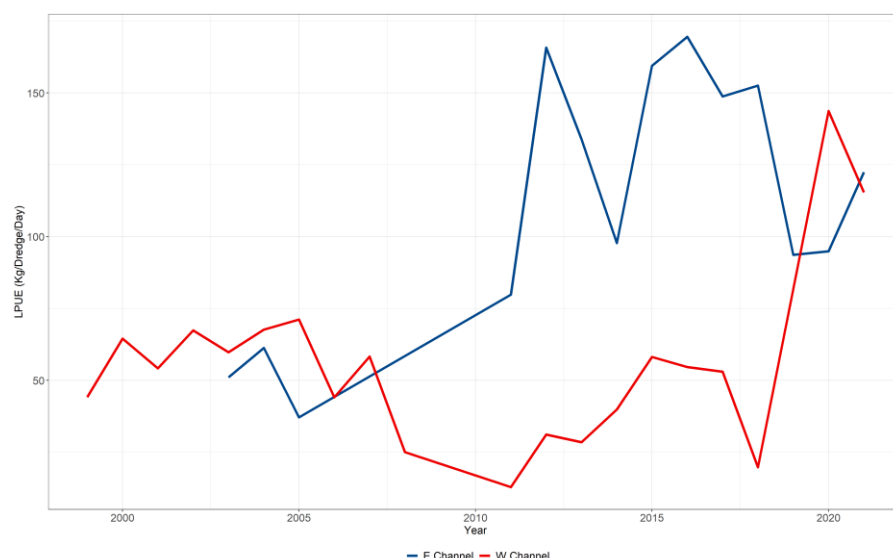


Figure 33. Nominal LPUE indicators for the Irish fleet fishing in the western and eastern Channel 2000-2021 and estimated from logbook and VMS data and a relationship between vessel length and number of dredges carried by the vessel.

Environmental effects of fishing

Seafloor integrity

Overall, the general effect of dredging is to cause homogenisation of substrates and topography through penetration, mixing, and flattening of sediments. Natural seabed features such as ripples, pits, and burrows can all be eliminated by scallop dredging.

Dredges damage and kill organisms attached to or present on the seafloor, such as hydroids, bryozoans, sponges, and maerl. In addition to reducing the capacity of an area to support other biodiversity the removal of such organisms can have severe consequences on scallop recruitment as they provide essential habitat for the settlement of scallops and other invertebrates; the damage inflicted upon such nursery habitats by fishing gears has been shown to negatively impact scallop recruitment whilst the protection of nursery habitats has been shown to enhance scallop settlement levels dramatically (Stewart and Howarth 2017).

Effects of scallop dredging on seafloor physical environment and its capacity to support marine fauna and flora communities is important given that

- The footprint of the fishery in the Channel is significant
- There are set targets for achieving good environmental status of the seafloor under Descriptor 6 of the Marine Strategy Framework Directive (MSFD)
- The effects may indirectly reduce the suitability of the habitat for settling scallop spat

Management

The management system for the King scallop fisheries in the English Channel is complex. It operates at three different geographical levels, European, national and local.

ICES is not presenting advice on stock status. The management rules for King scallop at European level are relatively limited. They are based on four Community regulations. The first two regulations concern the management of fishing effort and the quantity of fishing effort allocated per country. The third regulation establishes a system of European license and rules to apply, managed at the Member State level, for all fishing vessels targeting scallops. The fourth regulation (EU 2019/1241) deals with technical measures, and sets the minimum size for King scallops. Shelling the scallops onboard is also prohibited:

- Council Regulation (EC) No 1954/2003 of 4 November 2003 on the management of the fishing effort relating to certain Community fishing areas and resources and modifying Regulation (EC) No 2847/93 and repealing Regulations (EC) No 685/95 and (EC) No 2027/95¹,
- Council Regulation (EC) No 1415/2004 of 19 July 2004 fixing the maximum annual fishing effort for certain fishing areas and fisheries²,
- Commission Regulation (EC) No 1281/2005 of 3 August 2005 on the management of fishing licences and the minimal information to be contained therein³,
- Regulation (EU) 2019/1241 of the European Parliament and of the Council of 20 June 2019 on the conservation of fisheries resources and the protection of marine ecosystems through technical measures, amending Council Regulations (EC) No 1967/2006, (EC) No 1224/2009 and Regulations (EU) No 1380/2013, (EU) 2016/1139, (EU) 2018/973, (EU) 2019/472 and (EU) 2019/1022 of the European Parliament and of the Council, and repealing Council Regulations (EC) No 894/97, (EC) No 850/98, (EC) No 2549/2000, (EC) No 254/2002, (EC) No 812/2004 and (EC) No 2187/2005⁴

In May 2022, the latter technical measures regulation was revised after consultation with the NWWAC (North Western Waters Advisory Council) scallop focus group to introduce biological closure measures in certain areas of the English Channel. This is the reference regulation in force today:

- Commission Delegated Regulation (EU) 2022/1357 of 25 May 2022 amending Regulation (EU) 2019/1241 of the European Parliament and of the Council as regards king scallops (*Pecten maximus*) in the English Channel⁵

In France, the King scallop fishery is managed by the application of a ministerial decree ("*Arrêté du 21 août 2020 portant approbation d'une délibération du Comité national des pêches maritimes et des élevages marins relative aux conditions d'exercice de la pêche à la coquille Saint-Jacques*"⁶) which sets out the general rules for the management of the fishery (in terms of number of licences authorised, technical measures and organisation of the fishing season). This general system is supplemented locally for the main seabeds at the regional level (in Normandy and Hauts-de-France) by prefectural decrees ("*Arrêté n°142/2022 Portant réglementation de la pêche à la coquille Saint-Jacques (Pecten*

¹ <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32003R1954&from=FR>

² <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32004R1415&from=FR>

³ <https://eur-lex.europa.eu/legal-content/FR/TXT/?uri=CELEX:32005R1281>

⁴ <https://eur-lex.europa.eu/legal-content/FR/TXT/?uri=CELEX:32019R1241>

⁵ http://data.europa.eu/eli/reg_del/2022/1357/oj

⁶ <https://www.legifrance.gouv.fr/eli/arrete/2020/8/21/MERM2022315A/jo/texte>

maximus) dans le secteur Manche Est, campagne 2022-2023"⁷) or locally (in Brittany) by decisions taken by professional organisations delegated by the French government to manage local stocks (for example "Délibération du Comité Régional des Pêches Maritimes de Bretagne n°2022-018 «Coquilles Saint-Jacques - Côtes d'Armor» du 24 octobre 2022 fixant les conditions de pêche des coquilles Saint-Jacques dans les Côtes d'Armor"⁸).

Minimum landing size

In UK waters, the minimum landing size (MLS) at which King scallop may be retained is 100 mm shell length, except for the Irish Sea (Division 7a to the north of 52°30N) and the Eastern Channel (Division 7d), where it is 110 mm. These values originate from EU legislation (Regulation EU 2019/1241 above) and are now retained in the corresponding UK legislation.

The UK restricts the size of King scallop that can be carried on board to 110mm if the vessel has fished both in ICES divisions 7d and 7e in a single trip.

In France, the MLS is 110mm in Division 7d and 102mm in Division 7e (Western Channel). The first official regulatory text setting the MLS in 7e at 102mm has not been found, but this MLS is notified each year in the local texts (see footnote 8). This measure has been in place for more than 30 years and has historically been validated and accepted by all French fleets.

Gear restrictions and selectivity

UK

Regulation of the design of scallop dredges variously include specifications on the ring size on the bag of the dredge, tow bar length and diameter, number of teeth per dredge, total weight of the dredge and attachments (details in UK Scallop Fishing Order 2012; SI 2283/2012).

The selectivity of the dredge determined by tooth spacing on the tooth bar and the ring size in the bag of the dredge is not knife edged. Furthermore the circular rings become worn and distorted during fishing and have to be replaced periodically. The current 75mm dredge rings select 50% of scallops ($S_{50\%}$) over about 92mm shell length (Hervas Abad 2008).

The internal diameter of the rings on the bag (belly) of the dredge, where selection for size primarily occurs, is 75mm. The French industry have proposed at the NWWAC to increase the diameter to 85mm throughout the Channel. The ring size is currently the same in the east and west Channel even though the MLS is 100mm in the west and 110mm in the east inferring that mechanical or hand grading is necessary on deck to ensure compliance with the minimum size in the east Channel (presuming that the 75mm efficiently retains scallop over 100mm in the western Channel).

The UK and Irish fleets primarily use the spring loaded New Haven dredge which is typically 0.83m wide, with 6.5cm space between the teeth on the tooth bar, teeth are 8-10cm long and subject to wearing (shortening) over time during fishing. The spring loading enables the dredge tooth bar to spring backwards when it hits an obstacle. This enables fishing on harder ground types and also reduces the volume of stone in the catch.

The UK restricts the number of dredges a vessel can carry and deploy to 16 dredges in waters adjacent to England out to a line drawn 12 nautical miles from baselines (SI 2283/2012).

⁷ <https://www.comite-peches-normandie.fr/crpmem-article-535-30-arretes-campagne-csj-2022-2023>

⁸ http://www.bretagne-peches.org/modules/kameleon/upload/2022-018_csj_cotes_d_armor_b2.pdf

France

The technical measures relating to fishing gear are detailed in the ministerial decree of 21 August 2020. Since 31st of December 2020 in the Eastern Channel (7d) and 1st of October 2021 in the Western Channel (7e), King scallop fishing is only authorised in France using dredges with a minimum internal ring diameter of 97mm. It was 92mm since the beginning of the 2000s.

This generalized switch to 97mm ring diameter allowing gear selectivity at larger shell size on a national scale followed an initial experiment in the Bay of Saint-Brieuc for the fleet concerned for the whole 2018-2019 fishing season (and positive feedback from fishermen at the end of the season). The results of the SELEDRA project (Foucher *et al.*, 2020) carried out in the Eastern Channel in 2019 confirmed this improvement in selectivity when the ring diameter increases, while maintaining catches of commercial-sized scallops. They have allowed the acceptance of this increase in ring diameter by the French industry, and the implementation of this increase in national regulations from 2021.

At the NWWAC scallop focus group in January 2023, the French industry proposed to increase the diameter to 97mm throughout the Channel. This proposal is submitted to the NWWAC Council in March 2023. In addition, the use of beams of up to 12 meters in length is also proposed for the whole Area 7.

The arrangement and mounting of the rings is also regulated (square mounting). If the back of the dredge is equipped with a net, the mesh size of the net must not be less than 140mm stretched. For New Haven dredges, each individual dredge is 80cm wide, equipped with 8 teeth of 10 to 12cm each. The maximum authorized in France is 16 dredges per vessel (usually fixed on 2 beams of 8 dredges each). Breton dredges are 2 meters wide, with generally 18 teeth per dredge. A maximum of 2 Breton dredges are allowed on board.

Seasonal closures

UK

A byelaw established in 2004 by the Sussex IFCA imposed a closed season inside 6nm between June 1st and October 31st.

Following a call for evidence the UK closed ICES area 7d king scallop fishery between 1 August and 30 September 2022 to all vessels over 10 m in length.

The Marine Management Organisation (MMO), acting on behalf of all four UKFAs, sought views on proposals to close UK waters in the ICES area 7d and Lyme Bay in ICES area 7e to the king scallop dredge fishery in summer of 2023. The proposed closures are to protect the stock during spawning in area 7d and limit depletion of the stock in area 7e due to displacement of fishing effort.

The options for proposed 7d King scallop closures are:

- ✓ 15 May to 30 September 2023 – a closure period that aligns with the EU closure of 7d to the King scallop dredge fishery.
- ✓ 1 July and 30 September 2023 – an extension of the 2022 closure to offer further protection of the species during the spawning period.
- ✓ 1 August and 30 September 2023 – the same closure period as 2022.
- ✓ The proposed 7e King scallop dredge fishery closure is: a closure of Lyme Bay (ICES rectangles, 30E6, 30E7, 29E6 and 29E7) aligning to the agreed closure length in ICES area 7d.

The closures would apply to EU and UK scallop dredge vessels and will consider whether to exclude 12 m and under vessels from the closure.

A national consultation is currently underway (ends 19th March) in the UK on the issue of summer closure:

<https://www.gov.uk/government/consultations/call-for-evidence-ices-area-7d-and-lyme-bay-king-scallop-dredge-fishery-closure>

France

Since the beginning of King scallop fishing in France more than 50 years ago, fishing has only been allowed during the winter period, from 1st of October (often the first Monday of October) to 15th of May of the following year. These opening dates are officially fixed by ministerial decree (the last decree of 21 August 2020 is the one in force today). Fishing King scallops is therefore strictly forbidden in France during the summer period, which corresponds to the period of breeding and maximum growth of the species.

During the open (fishing) season there are additional restrictions on each of the main scallop beds.

In the Bay of Seine, the opening of the scallop fishery takes place successively in three stages:

- offshore from 1st October until 15th of May,
- between the limit of the French 12nm (off Normandy) and the parallel 49°42N in the north, from 1st of November until 15th of May,
- in the French territorial waters in the Bay of Seine (between the French coast and 12nm limit) and all along Normandy to the North, opening the third week of November until middle of March. The dates (and especially the closure date) are defined each year depending on the results of the assessment survey and the yields during the fishing season.

Moreover, in the bay of Seine, a rotational closure has been in place since 2016. Therefore, each year, part of the Bay of Seine remains closed for biological reasons throughout the fishing season. This rotational closure seems to have very positive effects on the resource, increase in local densities and exploitable biomass, but also improvement in the survival of juveniles (ICES 2023; Mogeon and al, 2023 in Press). Each year, the closed area (corresponding to one production area, see below paragraph on HAB monitoring) in the bay of the Seine is determined according to the results of the COMOR survey, with the area richest in juveniles being generally chosen.

In addition to these opening periods, a system of authorized fishing hours is in place. In the offshore areas, between 3 and 5 trips per week are allowed (depending on the time of year). In the Bay of Seine, only 3 days (at the beginning of the season) and 4 days (at the end of the season) are allowed. Within these fishing days, a system of timetables is set up. During the last season, only 2 hours of fishing per trip were allowed throughout the season. This system is very flexible, and is adjusted as the fishing season progresses, by decisions taken by the industry organizations, and enforced by the French Administrative Authority.

Following a recommendation from the NWWAC scallop focus group, the closure to King scallop fishing from 15th of May to 1st of October in ICES Divisions 7d and 7e South has been transcribed into European law (see footnote 5), as it is the case for the French fisheries. The area between the French 12nm limit and 49°42N off Normandy, on the other hand, is closed to all fleets from 15 May to 15 October.

In the bay of Saint-Brieuc, some sectors (corresponding to the highest densities) could be open later than the global starting date of 1st of October. During all fishing season, only two (or sometimes three)

days per week are allowed for fishing, and only 3/4h or 1 hour/day. The system is organized on a flexible schedule, week after week. If the weather is bad, remedial days are organized. Landings could be done only in some harbours (defined in the Regulation text) and all landings should be weighed.

TAC and quotas

In the bay of Saint-Brieuc, a global TAC is estimated from results of the Ifremer assessment survey COSB. This TAC is proposed to the Brittany industry and is followed for that year. When the TAC is reached, the fishing season ends even if the date of 15th of May is not reached. This is usually the case every year.

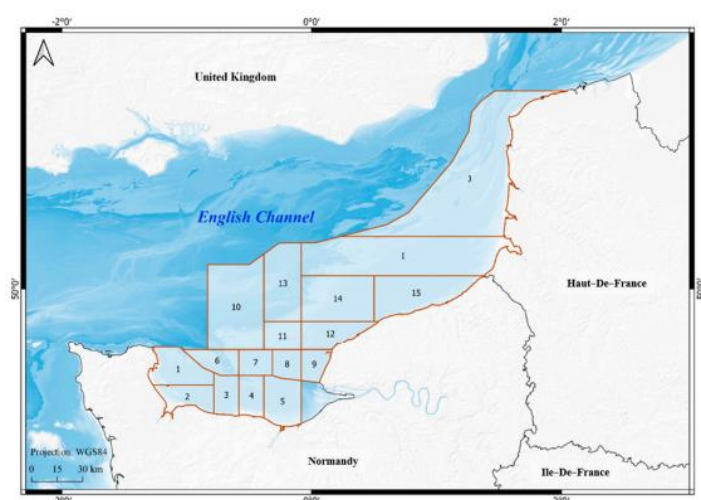
There is no TAC in Eastern Channel, even if it is possible to estimate one using the assessment survey COMOR. The reason for not implementing a TAC is that it is impossible to monitor day to day the landings because all the harbours are not equipped with an auction hall in Normandy. In contrast, there is a quota per vessel and per trip (with three levels depending on the size of the vessel), which corresponds more to a maximum quantity allowed per day. This "quota" is set out in national regulations (ministerial decree of 21 August 2020).

There are no catch limits for UK vessels.

HABS management and fishery closures

France

Harmful algal bloom (HABs) events that result in the accumulation of various toxins in scallop (King and Queens) are common in the English Channel (DSP very common, ASP more rare, PSP has so far never arrived). Production areas have been established between Ifremer, health services and industry for all waters under French jurisdiction for the monitoring of biotoxins in King scallop. Management decisions are taken to balance the economic losses resulting from closure of the fishery and the public health risk (Figure 34). In recent years' significant fishery closures have occurred due to HABs off the French coast (Pérez Agúndez et al 2022). The last severe closure due to ASP was in 2015 (areas 5, 8 and 9 closed a significant part of the year), only a HAB closure due to domoïc acid (DSP) has taken place since then.



Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	I	J	All
Days closed 2018-2019	0	0	0	0	0	5	20	24	151	5	11	64	49	13	119	0	9	470

Figure 34. Scallop management or production areas off the French coast used to manage risk to human health from biotoxins in scallop. The number of days where the fishery was closed in 2018-2019 in each zone due to biotoxins (Domoïc Acid) is shown underneath (from Pérez Agúndez et al 2022).

The production areas are smaller in size than the ICES rectangle based sampling used by Ireland and UK. A sample of King scallop is taken in each area before the opening of the fishery and every 15 days throughout the season. Fishing is only allowed in the production area if the results of the analyses comply with European thresholds.

Producers and consumers can check online in real time all analysis results (for example <https://bulletinrephytox.fr/accueil/Rephy/bulletin-2021-D%C3%A9pt%2014-76-50-041>).

It should be noted that these production areas are also used in the Bay of Seine (areas 1 to 5) for the rotational closure implemented since 2016, with the chosen zone remaining closed throughout the fishing season.

Ireland

The biotoxin sampling frequency for wild scallops fished from offshore scallop grounds is weekly. Each offshore site (ICES Statistical rectangle) when fished requires one sample of scallops for biotoxin analysis per week. Producers can check online ([Latest Shellfish Safety Data | Marine Institute](#)) if harvesting notifications and restrictions from offshore sites or ICES statistical rectangles are in place. If biotoxins exceed thresholds these rectangles are closed to fishing.

UK

Under retained EU law Regulation (EC) 853/2004, scallops can be harvested from unclassified areas. Harvesting of wild scallops can be permitted if the controls in this regulation are followed and ensure that the end product is safe to eat <https://www.food.gov.uk/business-guidance/biotoxin-and-phytoplankton-monitoring>

Effort management

Scallop are managed under the EU Western Waters effort regime (Council Regulation 1415/2004) which sets annual days at sea allocations for scallops (and other species). The objective of the Regulation is to limit the maximum amount of fishing effort that can be exerted in given areas, and control access of vessels to Member States' sea areas (i.e. vessels can only fish in areas where effort has been allocated). The annual kwday allocations for Area VII are:

- ✓ France: 7.4 million Kwdays Area VII
- ✓ Ireland: 0.5 million Kwdays Area VII
- ✓ UK: 3.3 million Kwdays Area VII
- ✓ Belgium: 0.35 million Kwdays Area VII
- ✓ Netherlands: 0.15 million Kwdays Area VII

Within the UK, this effort pool is administered by the Marine Management Organisation (MMO) in a system which sets a maximum number of days per quarter that any vessel with a scallop entitlement may fish. These limits are revised on a quarterly basis. In recent years, the Western Waters effort regime has been limiting for UK vessels, however, the effort restrictions are not considered to be restrictive on French activity.

Fleet management

Ireland

Entry to the Irish over 10m scallop fleet is capped. There is a specific pool of capacity (kws, GTs) in the Irish fleet licenced to fish for scallop. This was established in 2006 following a decommissioning programme.

UK

The UK fleet comprises a mix of large (> 15 m) nomadic vessels, and smaller (10 – 15 m) vessels with a more local range. Scallop fishery management in the UK limits the number of licenses for scallop vessels longer than 10 m. The Scallop Fishing (England) Order 2012 applies to British vessels operating in English waters and places restrictions on the number of dredges that can be employed at any one time. It also specifies technical measures defining the type of dredge that can be used

The UK Government undertook a consultation in 2021 on fishing capacity in vessels under 15m the number of which are not restricted. The scallop and shellfish industry/government management groups had identified the management of the under 15m scallop fleet and latent capacity (unused licences and entitlements) within the over 10m scallop and shellfish fleet as significant issues for future management of scallop stocks and fisheries. The number of scallop vessels under 15m was 186 in 2019 and 156 in 2020 with an average of 100 and 85 days at sea in 2019 and 2020 per annum respectively. The number of vessels over 15m was 76 and 70 in 2019 and 2020 respectively with average days at sea of 170 and 134 in 2019 and 2020 respectively (Quintana *et al.* 2020).

France

The number of fishing vessels allowed to target King scallop is defined within the ministry decree of 21st August 2020. Today, for ICES Areas 4 and 7:

- Hauts-de-France: 59 licenses
- Normandy: 303
- Brittany: 370

732 licenses are so allocated in the Channel. In Eastern Channel, the “Bay of Seine” license required to have access to the French territorial waters imposes a maximum length of 16 meters. The huge majority of the French dredger fleet is made up of vessels under 16 meters. A dozen of vessels between 16 and 18 meters in size, targeting scallops, remain in “Haute-Normandy”, mainly based in the port of Dieppe. In the western coast of Normandy on the Cotentin peninsula, dredge vessels are all under 16 meters.

Along the Brittany coast, and especially in the bay of Saint-Brieuc where the license limits the size of vessels to 13 meters, the fleet is extremely coastal with a short range. In this region, there are a few larger vessels (notably in Saint-Malo), all under 16 meters, but which do not have access to the bay of Saint-Brieuc fishery.

By-catch regulation

European Union fishery management rules currently apply to EU and UK scallop fisheries and restrict retained by-catches of commercial TAC species to a maximum of 5% of the total catch weight of scallops.

Summary and issues to consider in the management of scallop

The biology, fishery and scientific assessment for scallop as described above point to some important considerations for management of the fishery

1. Data from UK and French surveys, surplus production models and fishery dependent indicators show some similarity in outputs with respect to the status of King scallop stocks in the Channel. Nevertheless, integration of data, standardisation of methods and integrated assessments of the main stocks would represent a significant improvement in advice for management
2. Data for scientific assessment is currently underutilised. This is particularly the case for the use of combined logbook-VMS data. Data and methods are not standardised across jurisdictions and the approaches to stock assessment are different.
3. Data from logbooks combined with VMS can provide information on effort and catch at higher spatial resolution than ICES rectangle. Given the different jurisdictions managing and fishing in the Channel access to this higher resolution data is essential.
4. Some beds may be more important than others for supply of recruitment and therefore a more precautionary approach to harvesting in these beds could be developed.
5. Optimum harvest size and harvest rate will vary for each stock because growth rates are very different across the Channel.
6. Optimising yields in recruitment driven stocks can be achieved by appropriate timing of harvests (avoiding of growth overfishing)
7. Maintaining good environmental status of the seafloor and its marine communities is important for scallop settlement and recruitment.
8. Maintaining areas of high density or managing on the basis of density of King scallops could be important to ensure high fertilization success and to avoid depensation in recruitment.
9. The spatial and temporal patterns of settlement and recruitment may be difficult to predict in offshore areas of the Channel (although it has been shown that the central areas of the Eastern Channel follow a similar dynamic to that of the Bay of Seine).
10. High annual variation in recruitment indicates that advice on harvesting could vary unpredictably. Ideally the industry would be aware of this as it could affect the economics of fishing in a given year.
11. Latent capacity in the licenced fleets could put pressure on the economics of fishing for King scallop if this capacity was activated.
12. Scallop dredging has significant effects on the seafloor and the footprint of the fishery is substantial.
13. The management of King scallop from a fisheries perspective takes place in a background of fishery closures due to HABs events and biotoxin accumulation in scallop.
14. Favouring more selective gear for all scallop fisheries in the Channel may have a very positive effect on the exploitable resource and future recruitment.

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