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Report
Cruise SO 765 of FRV „SOLEA“
22.07. –11.08.2020

Chief scientists: Dr. Wolfgang Nikolaus Probst & Dr. Vanessa Stelzenmüller

Objectives

1. Participation in the German Small-Scale Bottom Trawl Survey (GSBTS) to monitor the fish fauna in 5 out of 12 small areas (boxes),

2. Investigation of the hydrographical conditions within the boxes (vertical distribution of temperature, salinity and turbidity).

3. Experimental fisheries in the vicinity of two offshore windparks located in the German EEZ

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1. Narrative

FRV "Solea" left Cuxhaven on the 22nd of July 2020 and started its scientific program the following day in Box P (see Figure 1). In general, the scientific program consisted of three days with 7 hauls per day within each box. Each day at least two CTD casts were deployed. The scheduled personnel exchange was carried out around noon of the 1st of August in Cuxhaven. The scientific program continued from the 2nd until the 11th of August. The vessel returned to Cuxhaven on the 11th of August 2020.

During this year's survey a total of 91 hauls with the cod hopper trawl net and an additional 26 accompanying CTD casts were conducted in five boxes of the GSBTS assigned to FRV "Solea". In addition, an experimental box W and the vicinity of an offshore windfarm close to the island of Helgoland was sampled.

Like in previous years the actual sequence of sampling in the boxes was adapted to the prevailing weather conditions (Box H (British EEZ; 3 days), Box E (German EEZ; 4 days), Box N (German EEZ; 2 days), Box K (Danish EEZ; 2 days), and Box P (German EEZ; 1 day)(Figure 1). Box F was omitted from this year's survey due the experimental fishing around two offshore windfarms. A summary of the activities during SB780 within each box is given in Table 1 and a summary of the total sampling effort within the GSBTS survey program by box and year for the cod hopper is presented in Table 2.

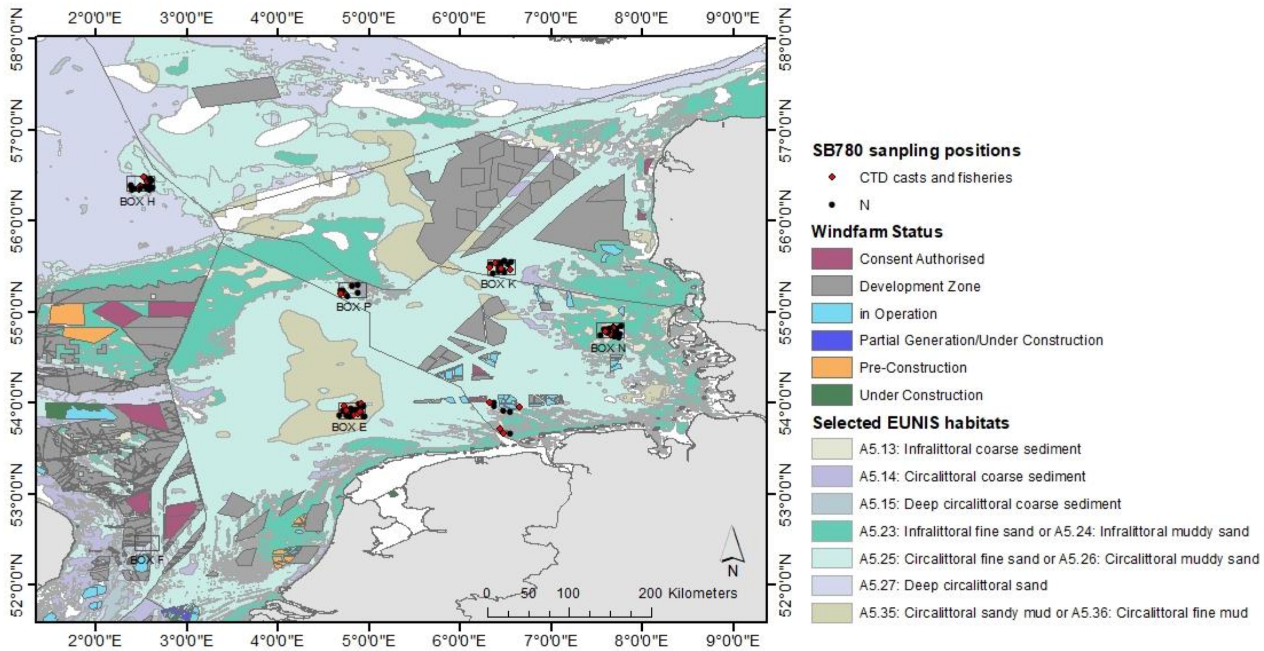


Figure 1: Positions of German small scale bottom trawl survey "boxes" (10 x 10 nm) monitored by the research vessel „Solea" during cruise no. 780 and sampling stations as mid positions indicating fishing activity (black dot) or fishing in combination with a CTD cast (red dot) per GSBTS box with intersecting EUNIS habitats categories and offshore windfarm locations.

Table 1. Total number of valid cod hopper (KJN) hauls and CTD casts during SO 780. OWP indicates sampling stations allocated in the vicinity of the offshore windfarms Borkum Riffgrund and Riffgat.

Box	KJH hauls	CTDs
BOX E	20	6
BOX F	-	-
BOX H	21	6
BOX K	16	4
BOX N	17	4
BOX P	8	2
OWF	9	4
Total	91	26

Table 2. Total sampling effort (cod hopper hauls) in the standard GSBTS boxes per survey year.

Year	BOX E	BOX F	BOX H	BOX K	BOX N	BOX P	Total
1990	8	28	-	-	-	-	36
1991	28	28	27	24	-	-	107
1992	28	21	23	19	-	-	91
1993	27	23	25	27	-	-	102
1994	19	25	27	26	-	-	97
1995	21	25	26	24	-	-	96
1996	28	26	17	28	-	-	99
1997	6	18	25	26	-	-	75
1998	17	20	25	23	-	-	85
1999	10	27	17	30	-	-	84
2000	-	-	-	-	8	-	8
2001	18	24	27	22	17	-	108
2002	15	17	17	9	-	-	58
2003	15	24	23	24	-	24	110
2004	19	17	23	17	15	16	107
2005	14	16	20	14	20	14	98
2006	-	-	16	24	19	-	59
2007	23	22	24	12	21	16	118
2008	21	22	21	18	21	18	121
2009	24	22	21	15	22	16	120
2010	21	21	21	16	21	14	114
2011	10	-	21	7	21	21	80
2012	21	-	21	7	21	18	88
2013	21	21	21	21	23	18	125
2014	21	21	23	18	17	24	124
2015	22	23	21	21	17	18	122
2016	12	12	21	14	16	18	93
2017	15	14	15	17	16	18	95
2018	21	-	14	21	21	15	92
2019	-	-	16	21	20	16	73
2020	20	-	21	16	17	8	82
Total	**525**	**517**	**619**	**561**	**353**	**292**	**2863**

2. Results

2.1. Long-term trends in catch compositions

Trawl durations were constantly close to 30 min and the trawl speed ranged around 3.6 kn across all valid hols (Table 3). Mean depth in sampled boxes varies between 20 and 70 m.

Table 3. Summary of mean catch depth (m), mean vertical net opening (m), mean trawl duration (min), mean trawl speed (kn), mean length of trawl warp (m) and mean distance between trawl doors (m), and of all valid hols per box.

Box	mean depth (m)	mean vertical net opening (m)	mean trawl duration (min)	mean trawling speed (kn)	mean length trawl warp (m)	mean distance trawl doors (m)
BOX E	39.2	3.23	30	3.70	241	51.60
BOX H	70.2	3.50	30	3.63	400	61.21
BOX K	40.2	3.28	30	3.69	250	55.92
BOX N	20.4	2.84	30	3.70	150	50.19
BOX P	34.0	3.54	30	3.66	186	55.88

In Figures 2 to 6 for each GSBTS box the annual catches (kg 30min^{-1}) of the species contributing at least 0.5% to the cumulative total catch across all sampling years as well as long-term trends in mean cpue per haul (kg 30 min-1) are displayed. Between a number of ten and thirteen species contributed the most to the overall biomass caught in the respective GSBTS boxes.

- In Box P cpue values (Fig. 2 top and bottom) were highest for dab (*Limanda limanda*) and European sprat (*Sprattus sprattus*). In 2020, only a total number of 8 hauls have been sampled in Box P, which have caused the lowest total cpue since 2003. For the majority of the selected species mean cpue's were well below the median of the previous years. An exception are catches of plaice (*Pleuronectes platessa*), which continued to decrease over the last five years.
- In Box H (Fig. 3 top and bottom) highest cupe values were detected for dab, haddock (*Melanogrammus aeglefinus*) and whiting (*Merlangus merlangus*). Catches of haddock were clearly increased compared to previous years. Only one individual for each species was caught for European hake (*Merluccius merluccius*), turbot (*Psetta maxima*) and poor cod (*Trisopterus minutus*).
- In Box N (Fig.4 top and bottom) cpue values were highest for dab and Atlantic mackerel (*Scomber scombrus*). The downward trend of catches continued in 2018 for dab, plaice and grey gurnard (*Eutrigla gurnadus*). Catch es of Atlantic horse mackerel (*Trachurus trachurus*) remained at levels well below the all-time median. Only o ne individual was caught for instance for turbot or brill (*Scophthalmus rhombus*).
- In Box K (Fig. 5 top and bottom) the catches of dab and plaice were highest in weight and where well above th e median value of the respective time series. Since 2015 the catches of herring (*Clupea harengus*) remained at very low compared to previous years. In contrast, catches of plaice were well above the median value. Compa red to all previous years European hake and American plaice (*Hippoglossoides platessoides*) were not caught.
- In Box E (Fig. 6 top and bottom) catches were highest in numbers and weight for dab, whiting and European sprat. One individual of the deep sea species blackbelly rosefish (*Helicolenus dactylopterus*) was caught like in boxes H and K in the previous year.

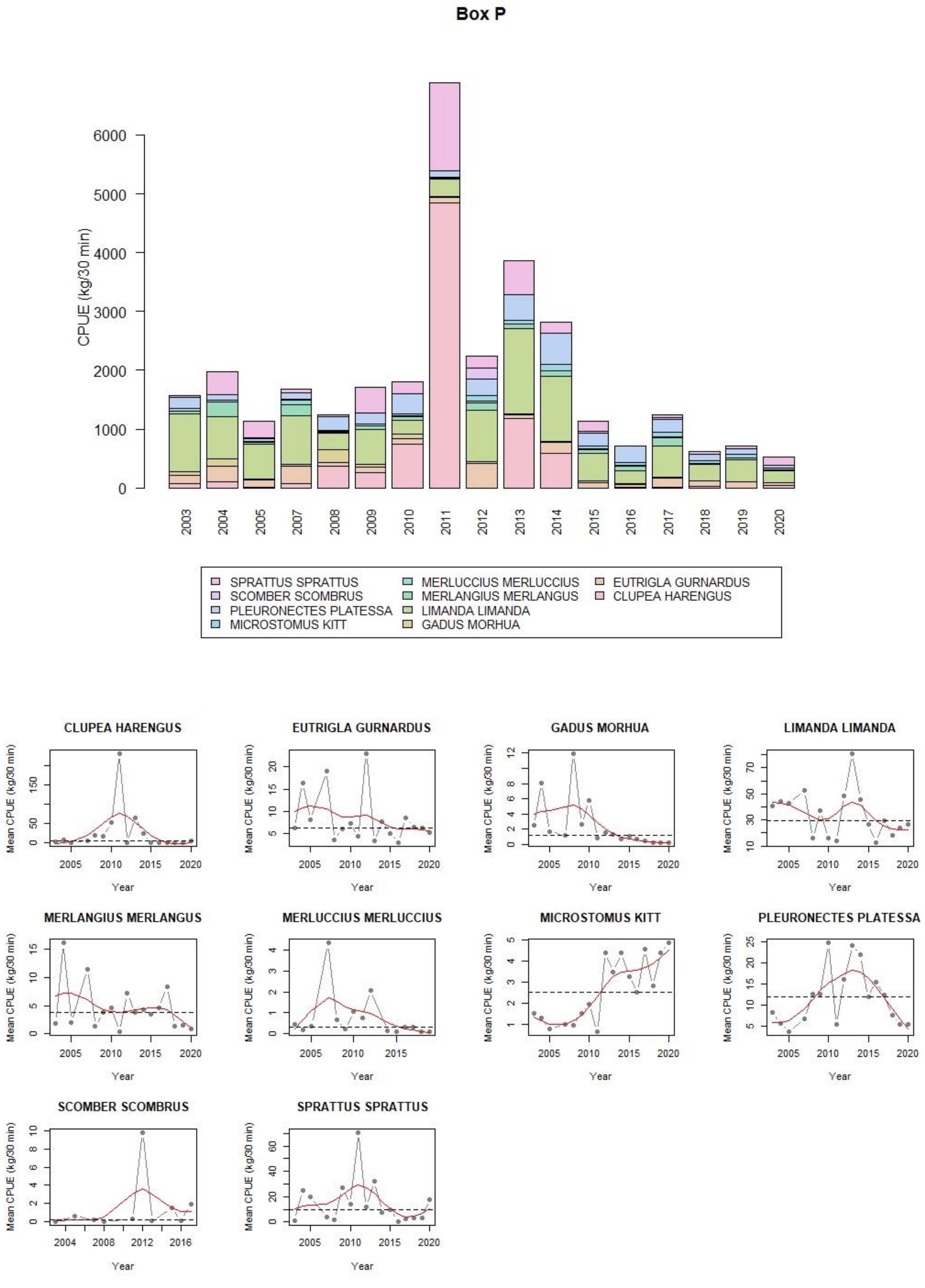


Figure 2: Summed CPUE (kg 30 min^{-1}) of the species contributing to least 99.5% to the cumulative biomass in Box P. Bottom: Long-term trends in mean CPUE per haul (kg 30 min^{-1}) of the selected species in Box P, with indicated median CPUE per haul value over all sampling years (dashed line).

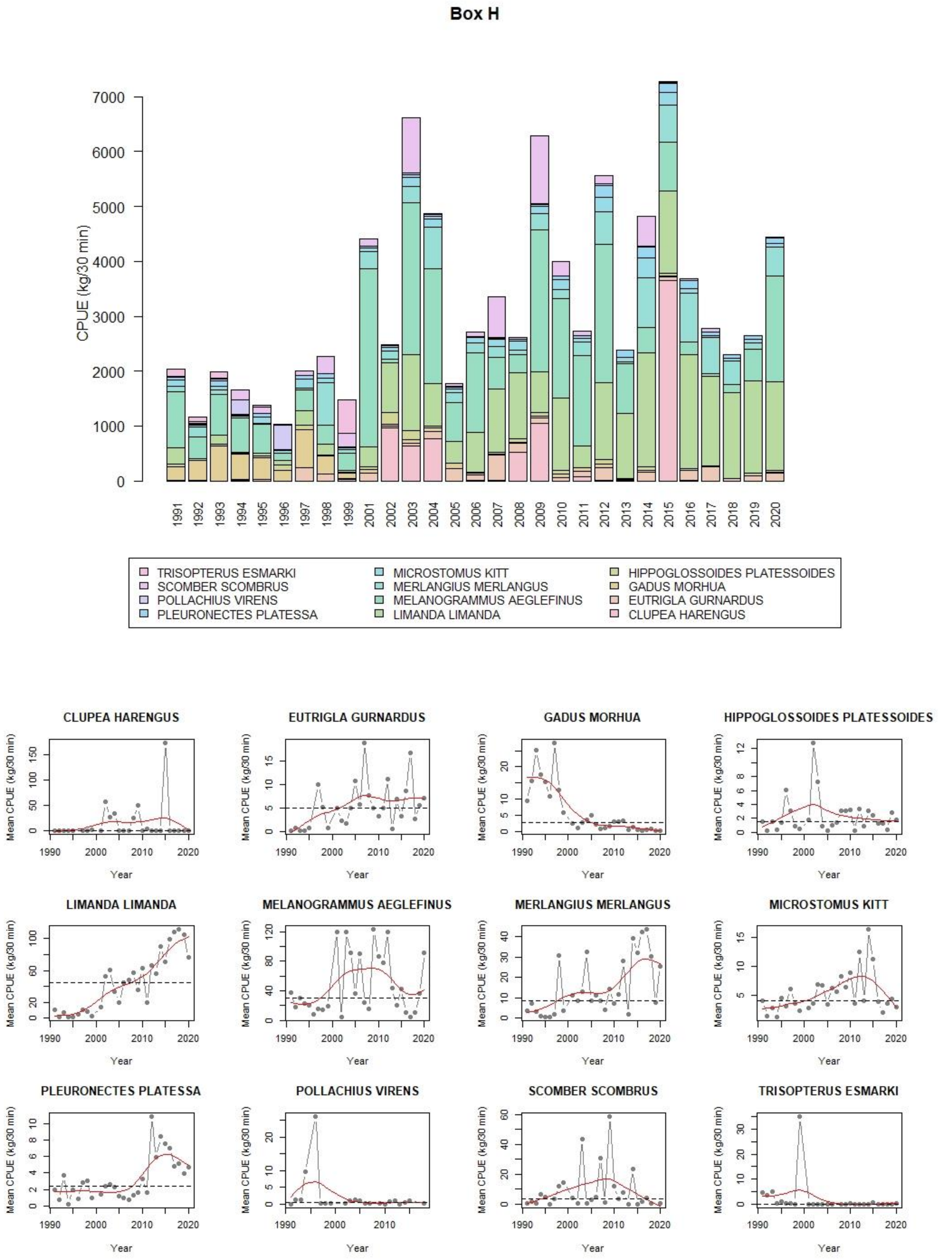


Figure 3: Top: Summed CPUE (kg 30 min^{-1}) of the species contributing to least 99.5% to the cumulative biomass in Box H. Bottom: Long-term trends in mean CPUE per haul (kg 30 min^{-1}) of the selected species in Box H, with indicated median CPUE per haul value over all sampling years (dashed line).

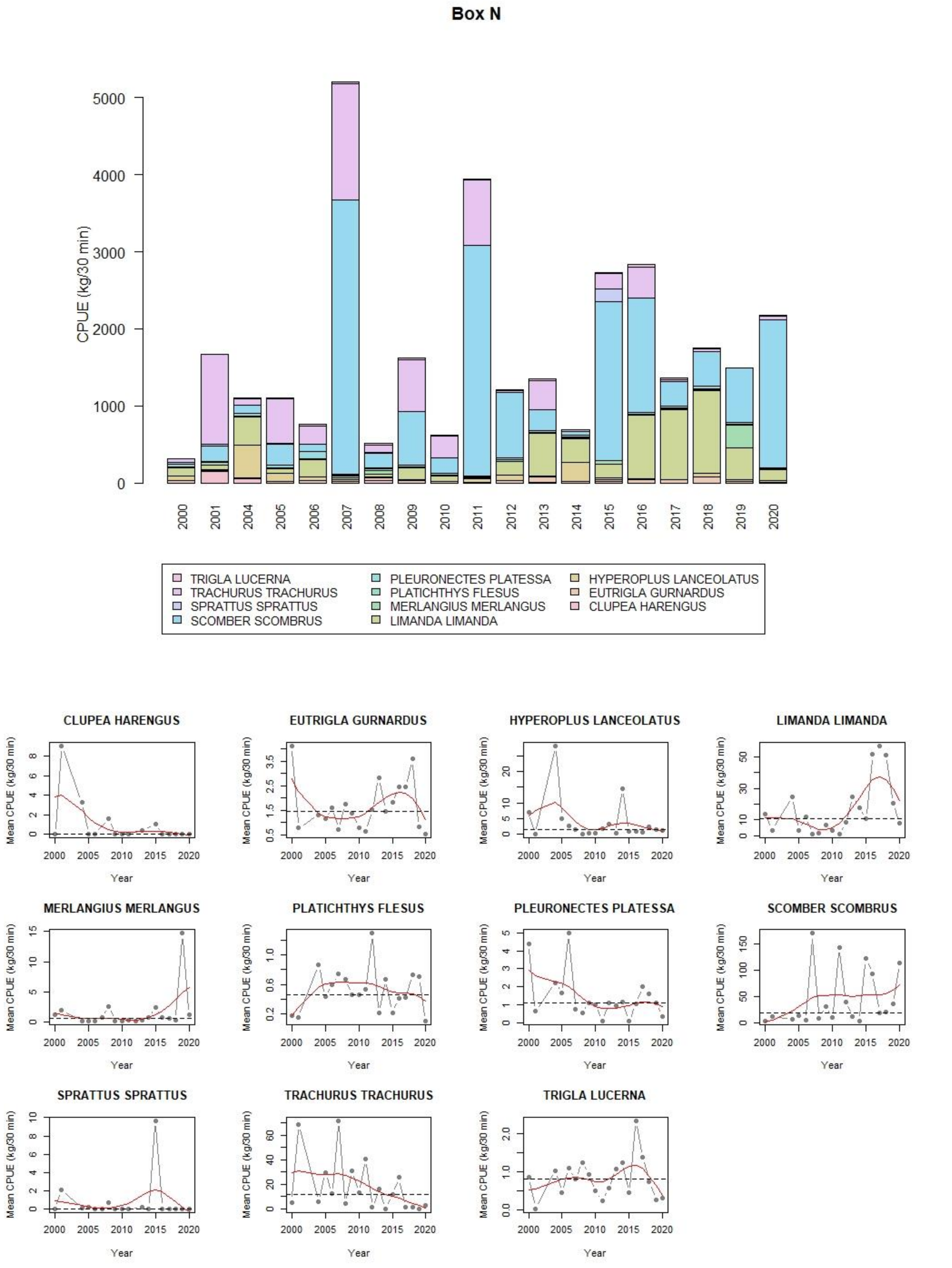
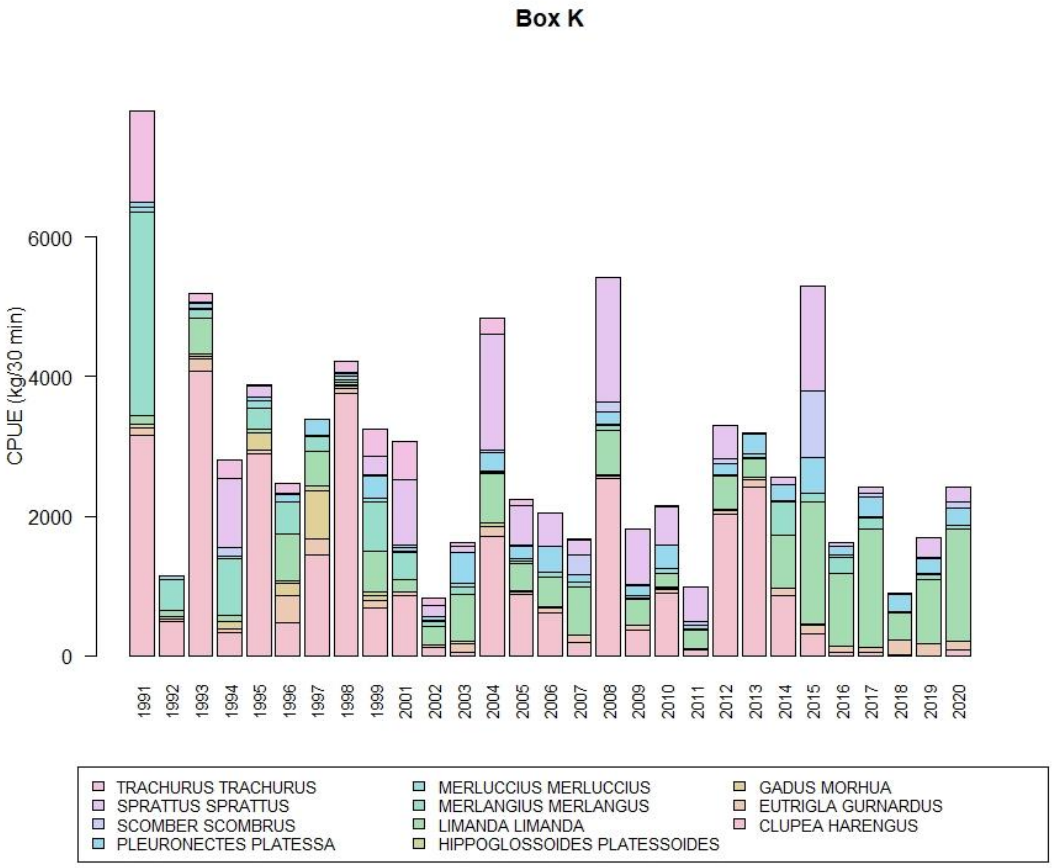


Figure 4: Top: Summed CPUE (kg 30 min^{-1}) of the species contributing to least 99.5% to the cumulative biomass in Box N. Bottom: Long-term trends in mean CPUE per haul (kg 30 min^{-1}) of the selected species in Box N, with indicated median CPUE per haul value over all sampling years (dashed line).



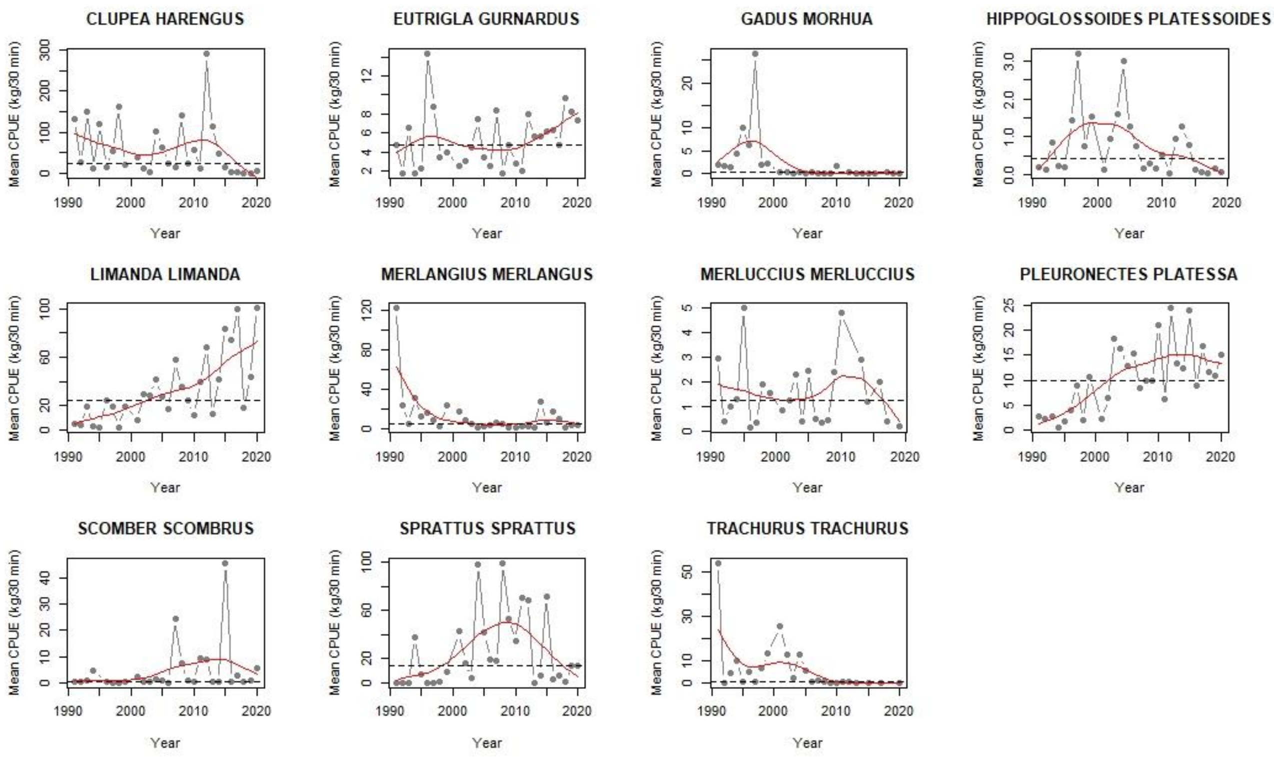
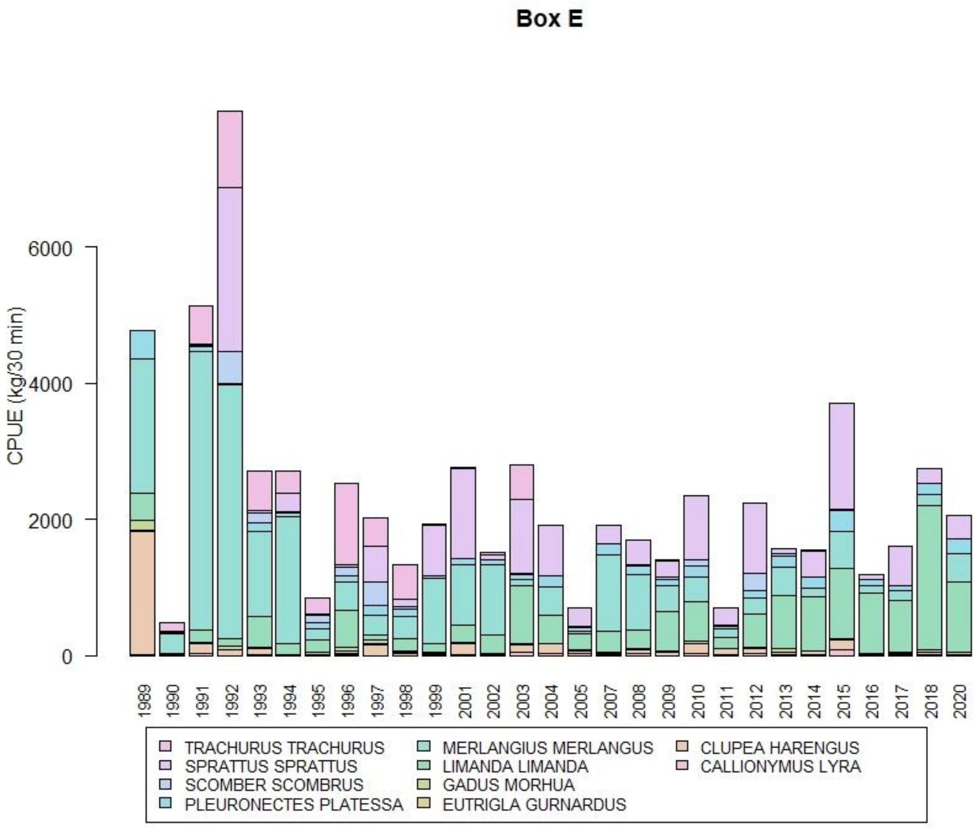


Figure 5: Top: Summed CPUE (kg 30 min^{-1}) of the species contributing to least 99.5% to the cumulative biomass in Box K. Bottom: Long-term trends in mean CPUE per haul (kg 30 min^{-1}) of the selected species in Box K, with indicated median CPUE per haul value over all sampling years (dashed line).



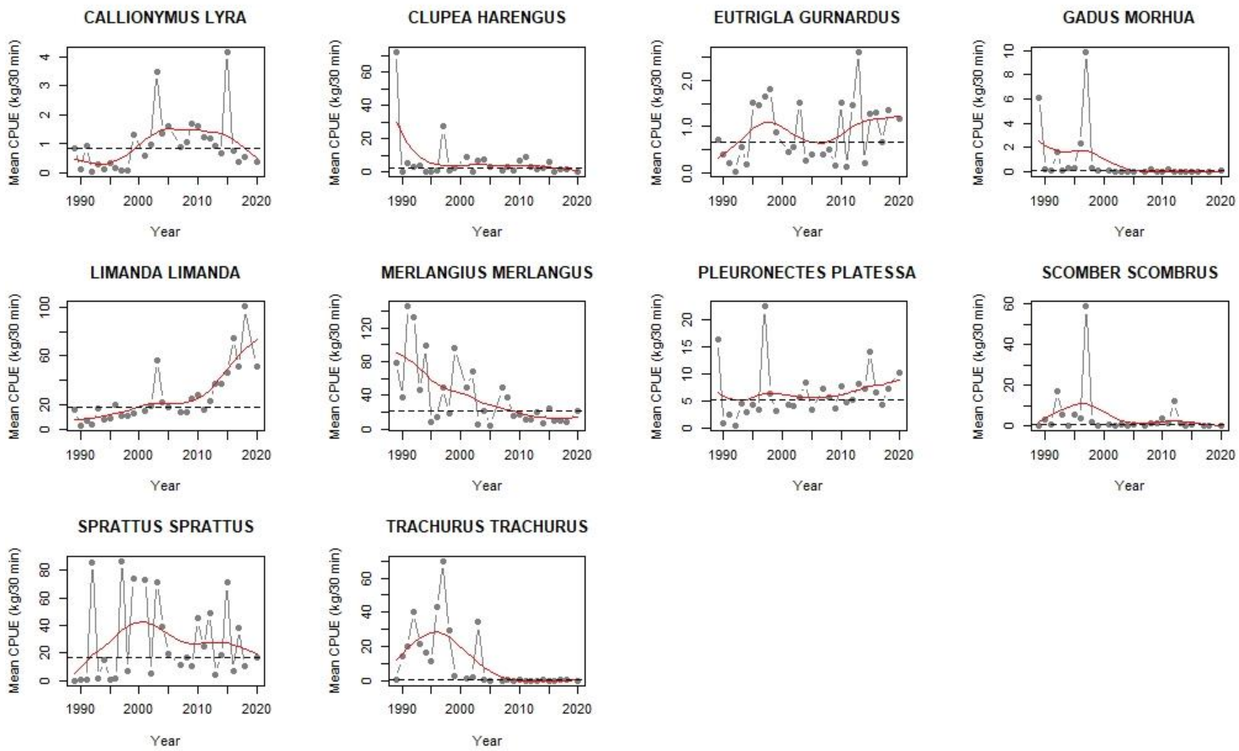


Figure 6: Top: Summed CPUE (kg 30 min^{-1}) of the species contributing to least 99.5% to the cumulative biomass in Box K. Bottom: Long-term trends in mean CPUE per haul (kg 30 min^{-1}) of the selected species in Box K, with indicated median CPUE per haul value over all sampling years (dashed line).

2.2. Long-term trends in elasmobranch catches

An overview of the total elasmobranch catches in 2020 as kg per 30 min and numbers per 30 min for each box are given in Table 4. Overall, most elasmobranches were caught in box E. In Figure 6 the decreasing trend of catches of thorny skate is shown for box H while in boxes K and E the catches of lesser spotted dogfish (*Scyliorhinus canicula*) seem to slightly increase over the last decade.

Table 4. Overview of elasmobranch catches in the 2020 GSBTS.

Box	Species	Total catch (kg)	Total catch (n)
BOX E	MUSTELUS ASTERIAS	0.21	2
BOX E	RAJA CLAVATA	0.53	6
BOX E	RAJA MONTAGUI	0.04	1
BOX E	SCYLIORHINUS CANICULA	0.22	8
BOX K	RAJA MONTAGUI	0.22	1
BOX K	SCYLIORHINUS CANICULA	0.22	4
BOX H	RAJA RADIATA	0.07	3
BOX P	SCYLIORHINUS CANICULA	0.103	1

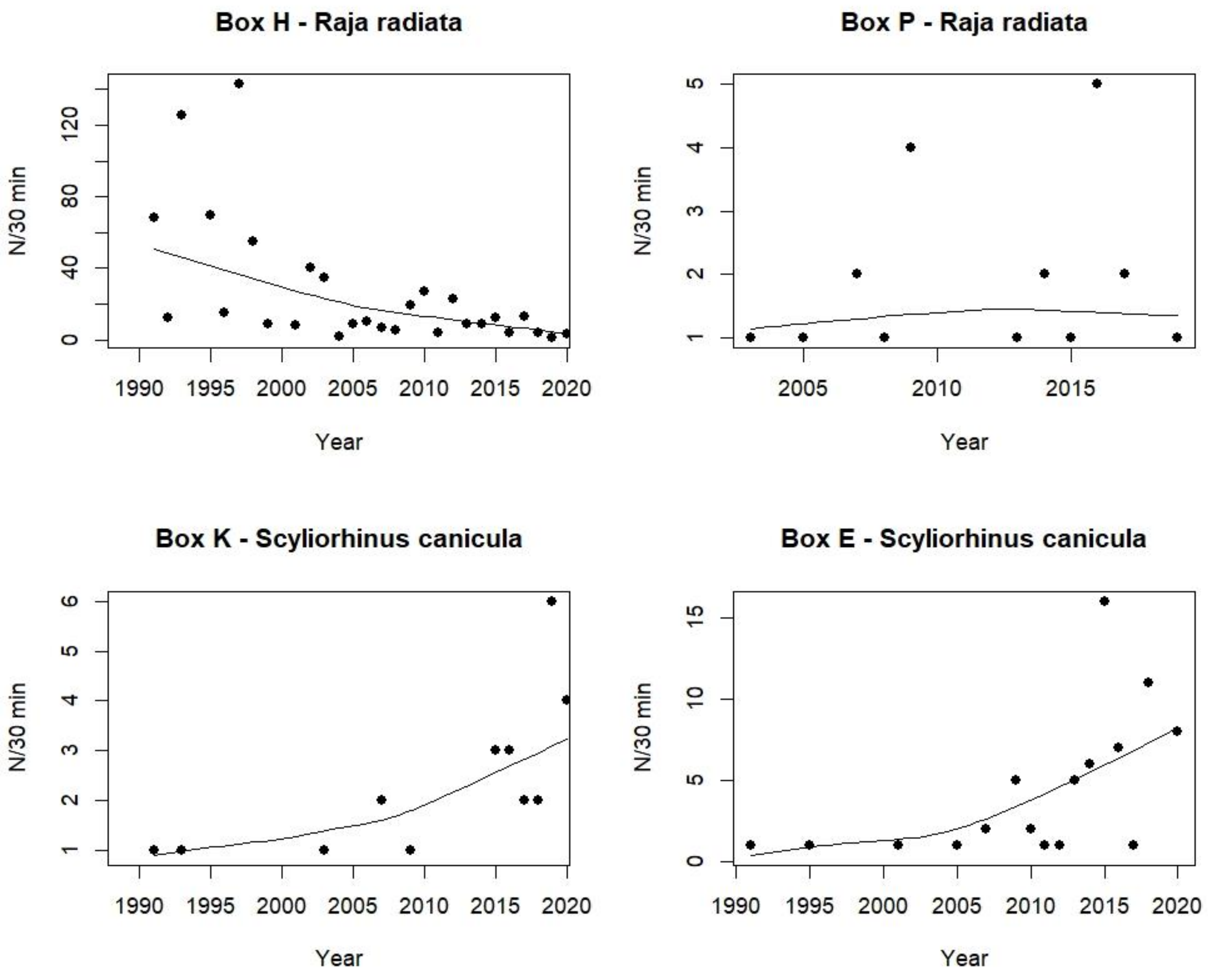


Figure 7: Long-term trends of the two more frequently caught elasmobranchs thorny skate (*Raja radiata*) and lesser spotted dogfish (*Scyliorhinus canicula*) as total numbers 30 min^{-1}.

2.3. Experimental fisheries in the vicinity of two offshore windparks

A total of 9 stations have been sampled with the standard GSBTS cod hopper and a trawl duration of 30 min around the offshore windparks (OWPs) Borkum Riffgrund (6) and Riffgat (3) on fine and muddy sand (Figure 8). Riffgat is located within coastal waters and close proximity to shore. The catch composition as mean kg per 30 min is shown in Table 5 and a relative comparison of mean cpues per species is shown in Figure 9. The main aim of the experimental trawls was to assess the proportion of brown crab (*Cancer pagurus*) catches since this species is expected to benefit from the artificial hard substrate within in OWPs. We only sampled brown crab around Borkum Riffgrund. Although the two OWPs are only located 30 km apart we found clear differences in catch composition between those two areas. For instance, lesser weever (*Echiichthys vipera*) a species associated to sandy bottoms were only caught in relatively high numbers (36) around Borkum Riffgrund. Only for a few species such as small sandeel (*Ammodytes tobianus*), dragonet (*Callinoymus lyra*) or European flounder (*Platichthys flesus*) mean catches were comparable.

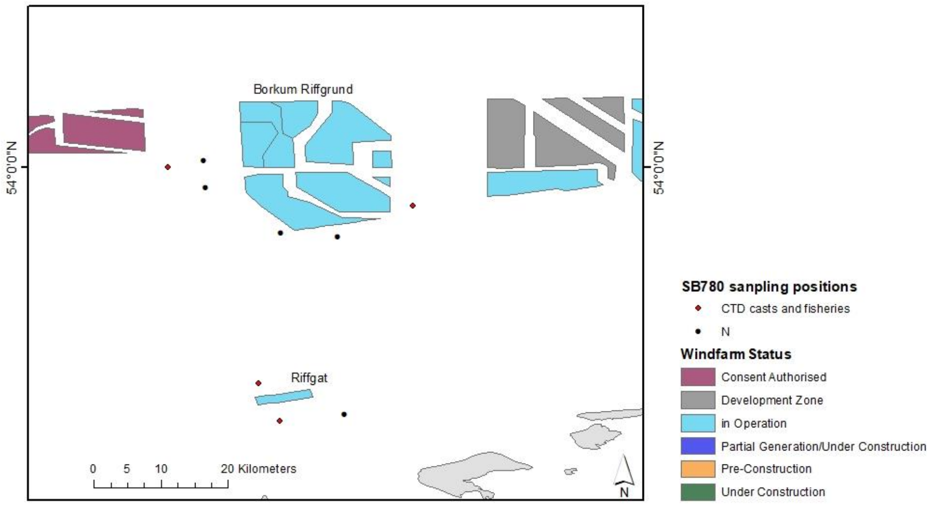


Figure 8: Mid trawl positions of the experimental fisheries in the close proximity of two offshore windparks.

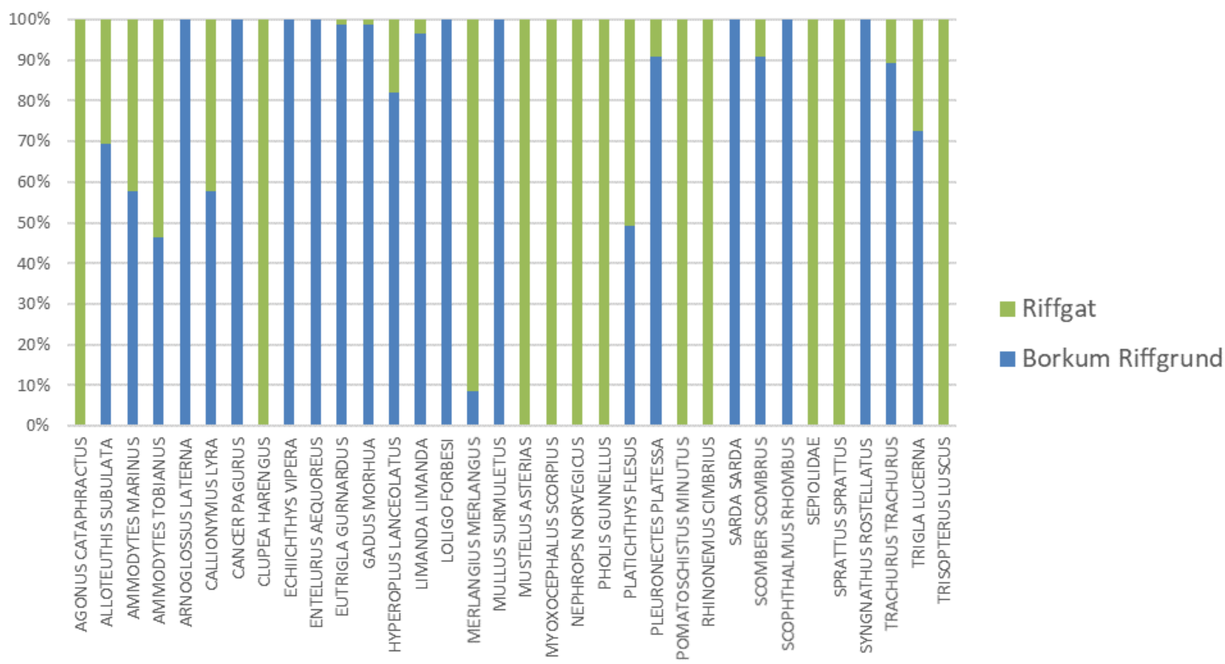


Figure 9: Relative comparison of the catches (mean kg per 30 min) per species. Note that the number of stations varied for the two distinct OWPs

Table 5. Catch composition (kg per 30 min averaged by OWP) of the nine stations sampled around the two OWPs Borkum Riffgrund (6 stations) and Riffgat (3 stations) during the course of SB780.

Species	Borkum Riffgrund	Riffgat
AGONUS CATAPHRACTUS	0.00	0.34
ALLOTEUTHIS SUBULATA	1.64	0.73
AMMODYTES MARINUS	0.65	0.47
AMMODYTES TOBIANUS	0.60	0.70
ARNOGLOSSUS LATERNA	0.03	0.00
CALLIONYMUS LYRA	0.08	0.06
CANCER PAGURUS	0.07	0.00
CLUPEA HARENGUS	0.00	9.31
ECHIICHTHYS VIPERA	1.12	0.00
ENTELURUS AEQUOREUS	0.02	0.00
EUTRIGLA GURNARDUS	0.15	0.00
GADUS MORHUA	0.69	0.01
HYPEROPLUS LANCEOLATUS	3.56	0.78
LIMANDA LIMANDA	3.83	0.14
LOLIGO FORBESI	1.13	0.00
MERLANGIUS MERLANGUS	0.94	9.99
MULLUS SURMULETUS	0.13	0.00
MUSTELUS ASTERIAS	0.00	3.38
MYOXOCEPHALUS SCORPIUS	0.00	0.06
NEPHROPS NORVEGICUS	0.00	0.03
PHOLIS GUNNELLUS	0.00	0.01
PLATICHTHYS FLESUS	0.25	0.26
PLEURONECTES PLATESSA	0.77	0.08
POMATOSCHISTUS MINUTUS	0.00	0.02
RHINONEMUS CIMBRIUS	0.00	0.00
SARDA SARDA	3.38	0.00
SCOMBER SCOMBRUS	6.27	0.63
SCOPHTHALMUS RHOMBUS	0.27	0.00
SEPIOLIDAE	0.00	0.00
SPRATTUS SPRATTUS	0.00	70.66
SYNGNATHUS ROSTELLATUS	0.00	0.00
TRACHURUS TRACHURUS	8.20	0.99
TRIGLA LUCERNA	0.45	0.17
TRISOPTERUS LUSCUS	0.00	0.04

We further deployed at 20 stations around the two OWPs a string of five baited pots with a total soaking time of 24 h (Figure 10). The total catches as number of female (N_F) and male (N_M) brown crab per station are also shown in Figure 10. Catches were standardised to a soaking time of 24 and were highest at the western boarder of Borkum Riffgrund (Figure 11). Overall more male brown crabs were sampled than female (Figure 12). The mean carapace width varied between females and males (F:142 mm; M:130 mm).

The observed differences in catches around Borkum Riffgrund could either indicate some degree of spatial preferences of brown crab or the effect of local depletion due to pot fishery that might have occurred around the days of sampling. We have observed UK pots being deployed at the western boarder at the dates of our experimental pot fisheries.

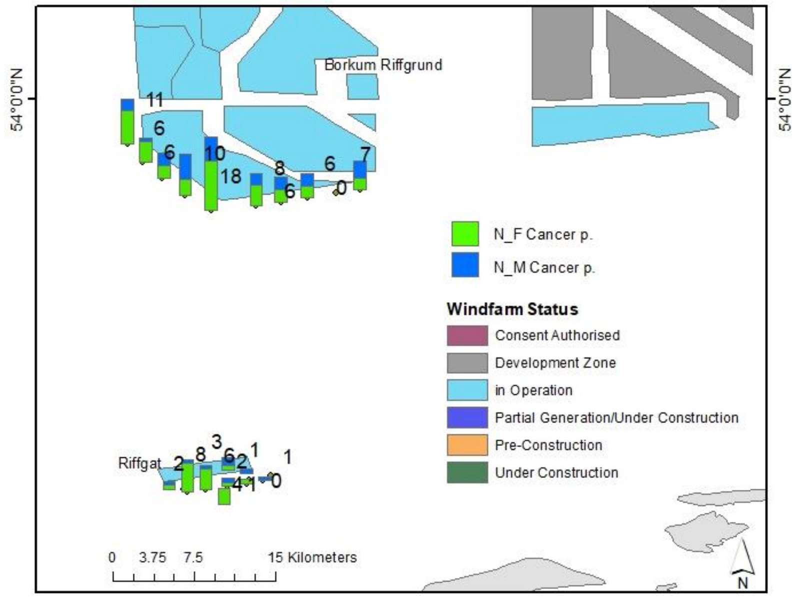


Figure 10: Relative position of pot strings with total number of female and male brown crab catches.

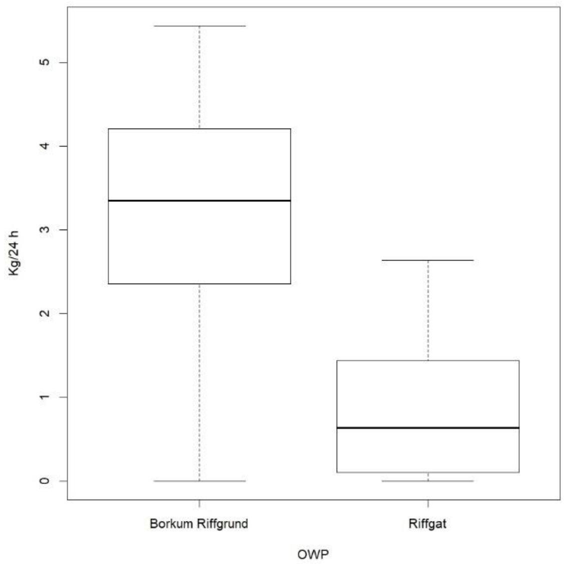


Figure 11: Standardised brown crab catches around the two OWPs Borkum Riffgrund and Riffgat.

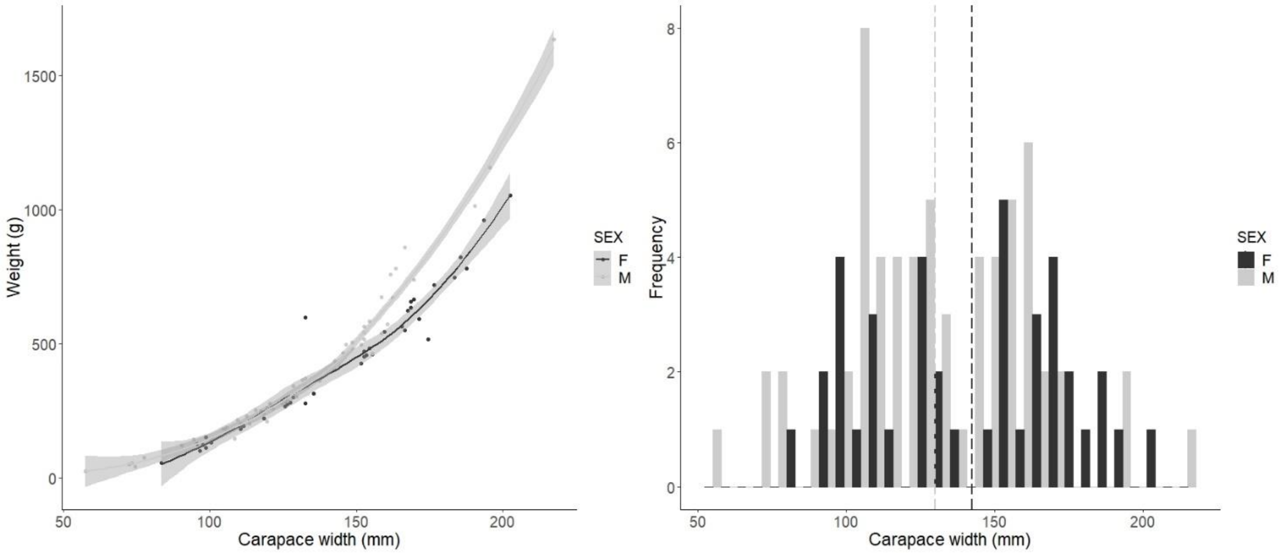


Figure 12: Carapace width – weight relationships of brown crab sampled by the experimental pot fishery (left); frequency distribution of carapace width for female and male brown crab with the mean width (F:142 mm; M:130 mm) (right).

Personnel

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