WORKING GROUP ON CRANGON FISHERIES AND LIFE HISTORY (WGCRAN; OUTPUTS FROM 2022 MEETING)

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Contents

i Executive summary

The Working Group on *Crangon* Fisheries and Life History (WGCRAN) works on studying the population dynamics of the brown shrimp *Crangon crangon* and factors influencing the stock as well the individual species. A central goal of the group is to provide a biological basis for advice and to identify ways for sustainable management.

A main outcome of the 2022 meeting was the standardization of the compilation of commercial data, i.e. the creation of a common workflow for uniform (inter-) national data retrieval. On this basis, total brown shrimp landings, fishing effort and landings per unit effort were discussed.

For the first time, biological stock status indicators, i.e. brown shrimp swept area biomass, annual mortality, and fraction of large shrimp were calculated both with and without incorporating Belgian scientific survey data. For the swept-area biomass, the addition of Belgian data had limited influence.

The meeting finally discussed the status of the international bycatch sampling programmes under the *de minimis* exemption from the landing obligation. For future common analysis supporting policy decisions, a data format was established for compiling the data collected by each country.

ii Expert group information

Expert group name	Working Group on *Crangon* Fisheries and Life History (WGCRAN)
Expert group cycle	Multiannual (3 years)
Year cycle started	2022
Reporting year in cycle	1/3
Chair(s)	Hünerlage, Lara Kim, Germany
	Pedersen, Eva Maria Fenger, Denmark
Meeting venue(s) and dates	21–23 June 2022, Bremerhaven, Germany, hybrid meeting 16 participants
	13–15 June 2023 in Oostende, Belgium
	8–12 June 2024 in DTU, Lyngby, Denmark

iii Terms of References a) – g)

a) Stock status indicators

Report and evaluate population status indicators like recent landings and effort trends in the brown shrimp fisheries. Generate a standardized LPUE time-series and provide a detailed description of the process of collecting the data series effort, landings and LPUE for WGCRAN.

b) Logbook information and VMS analysis

Combine VMS, landings and effort data to gain a population distribution indicator and to monitor regional distribution and regional shifts in fishing effort.

c) Decision support tools

Develop and evaluate brown shrimp-specific management decision-support tools to evaluate strategies on how to sustainably and efficiently harvest the brown shrimp stock.

d) Research on bycatch

Review the status and results of research on bycatch time-series and consider the implications for management. Evaluate methods and procedures used on board for collecting data on bycatch. Gather, compile and evaluate information on the on board and ashore sieving fractions and processes and new national bycatch/discards data from e.g. DCF.

e) International survey data

Analysis of spatio-temporal trends of survey-based stock indicators (e.g. biomass, length distribution, mortality); Ground-truthing of VMS derived LPUE estimates.

f) Legislation, law and management

Information on national legislation, laws and management concerning the brown shrimp fisheries in the whole North Sea will be synthesized (e.g. Natura 2000, MSC process, landing obligation, ...).

g) Ongoing research and projects

Present and review ongoing brown shrimp research in the ICES Area (impact studies, development of fishing gears, life cycle studies...) aiming at supporting international collaboration as well as evaluating management implications.

1 Stock status indicators (ToR a)

1.1 General development and overview

Since the 1960s total yearly landings of brown shrimp have generally increased and annual landings were steadily above 30 000 tonnes from 2003 to 2015 (Figure 1.1). In 2016 the landings dropped to 25 255 tonnes and in 2017 they dropped to 22 249 tonnes which was the lowest registered amount landed in more than 20 years. In 2018, exceptionally high quantities were landed (45 475 tonnes), accounting to the highest landings of the time-series. The last three years the landings have dropped again to around 25 000 tonnes. With 25 189 tonnes in 2019, 26 858 tonnes in 2020 and 24 213 tonnes in 2021, which is the second lowest registered total landings since 1994.

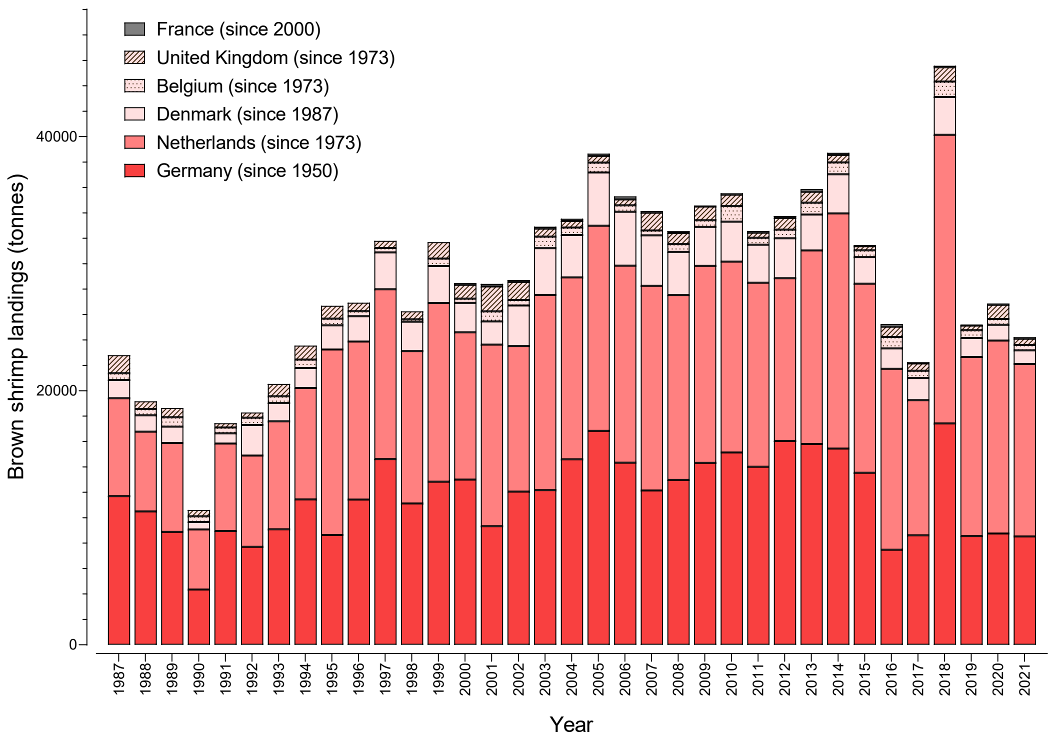

Figure 1.1. Total brown shrimp landed for human consumption (in tonnes) from the North Sea by country. The numbers in brackets give the year since data collection of the respective country started. For detailed countries' time-series, see Figure 1.5.

In 2021, the largest share of the total landings belonged to the Netherlands (56.0%), followed by Germany (35.4 %), Denmark (4.4 %), UK (2.0 %), Belgium (1.7%). and then France (0.5%).

The effort of the brown shrimp fishery can be counted both as days at sea (DAS) and as horsepower days at sea (hpDAS). Since 2016, the annual effort in the North Sea Brown shrimp fishery decreased slightly in both terms, from 13.3 million horsepower days at sea (hpDAS), over 11.8 million hpDAS in 2018 and 8.4 million hpDAS in 2019 due to storage bottlenecks in the processing industry and to 10.3 million hpDAS in 2020 (beginning of the COVID-19 pandemic). In 2021, the effort slightly increased to 10.9 million hpDAS (Figure 1.2).

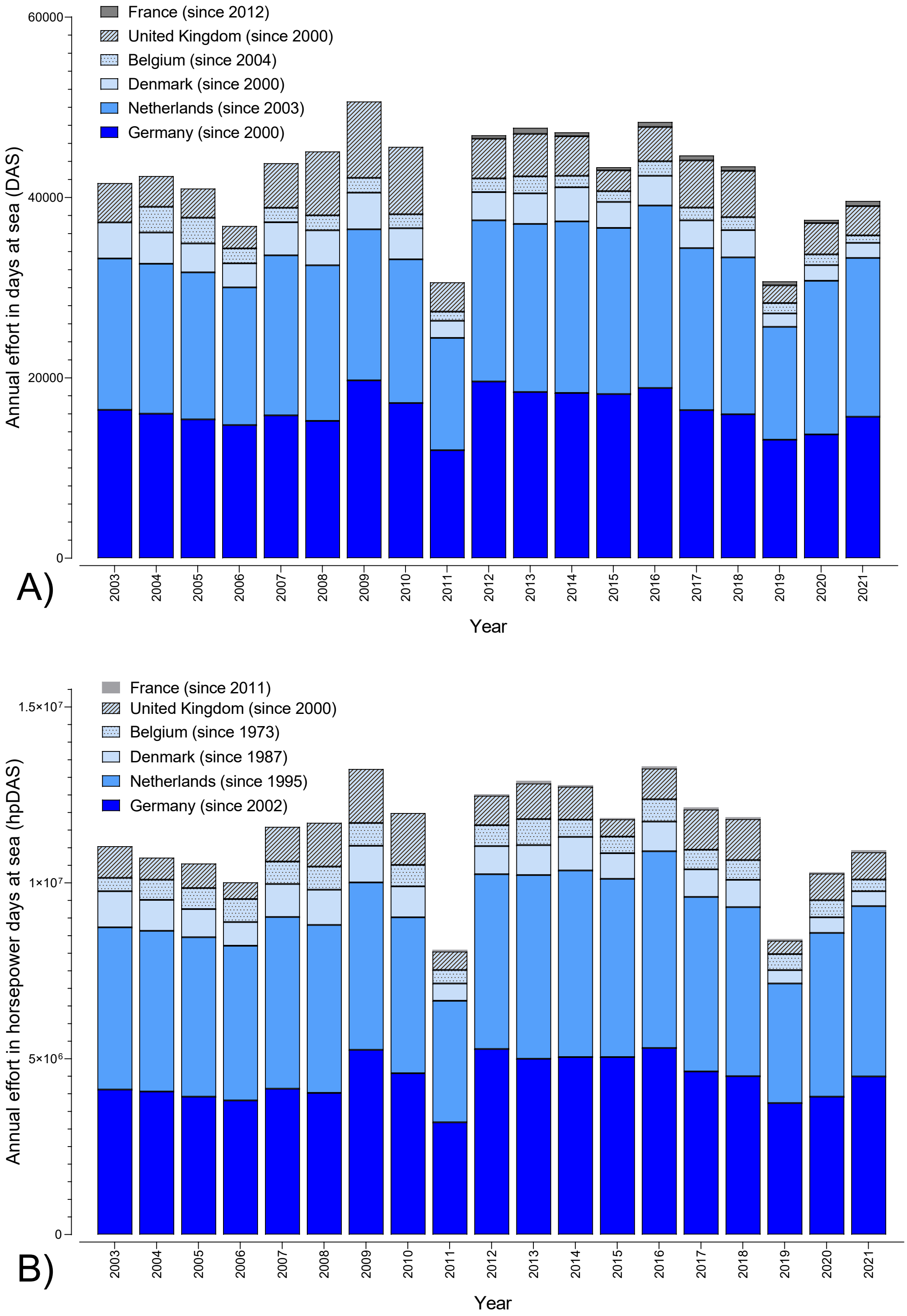

Figure 1.2. Total annual effort in A) days at sea (DAS) and B) horsepower days at sea (hpDAS) of the brown shrimp fishery by country. The numbers in brackets indicate the year since the data became available for WGCRAN.

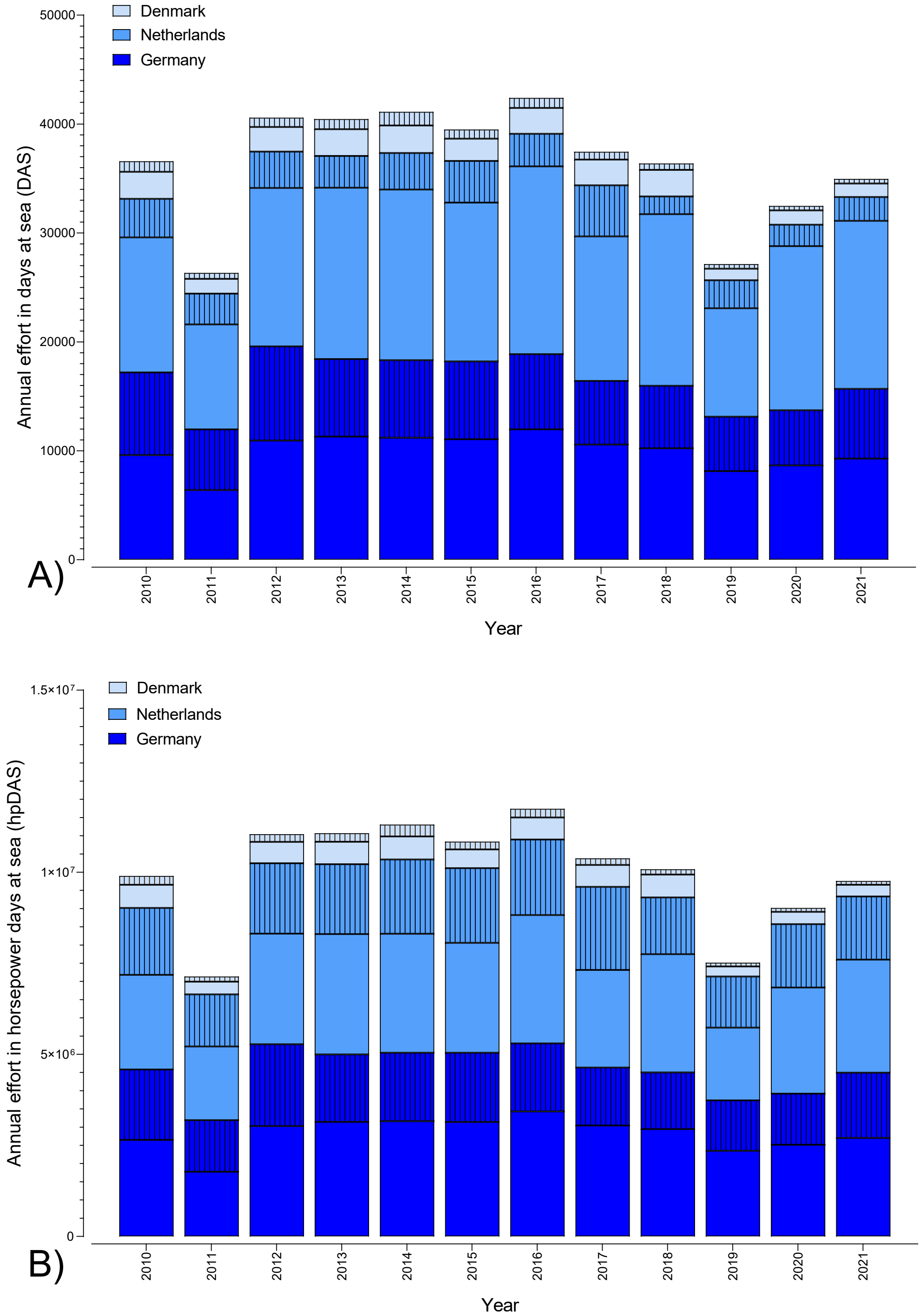

Figure 1.3. Total effort in A) days at sea (DAS) and B) horsepower days at sea (hpDAS) per country. Effort is split into fishing time (=without pattern) and steam time (= striped pattern).

For main fleet; the Netherlands, Germany and Denmark, the effort (both DAS and hpDAS) is split into fishing time and steam time (Figure 1.3), thereby giving a more precise estimate of the active fishing effort. The relation between steam time and fishing time is relatively stable at around 30-40% steam time for all countries and all years.

The general patterns of landings per unit effort of the main fleets (NL, GER, DK) are comparable and all show a peak in the LPUE in 2011, however the Danish LPUE this year show an even higher peak than the other nations (Figure 1.4). In the following years, a general decreasing trend in LPUE (kg/DAS) can be observed for Germany, Denmark and the Netherlands until 2017 (Figure 1.4.A). In 2018, which had a strong recruitment of brown shrimp, the highest LPUEs of the time-series are observed. In later years, a decreasing trend is again observed.

When LPUE (kg/hpDAS) is considered (Figure 1.4B), the North Sea fleet can be split into two different groups where the Dutch, German, French and Danish fleet all have LPUE values above 2 (kg/hpDAS) and the fleet from Belgium and United Kingdom have LPUE values below 2 (kg/hpDAS). The reasons for this difference may be multiple (e.g. longer distances to the fishing location, lower shrimp density in the Belgian fishing area, different effort calculations) and have not yet been investigated.

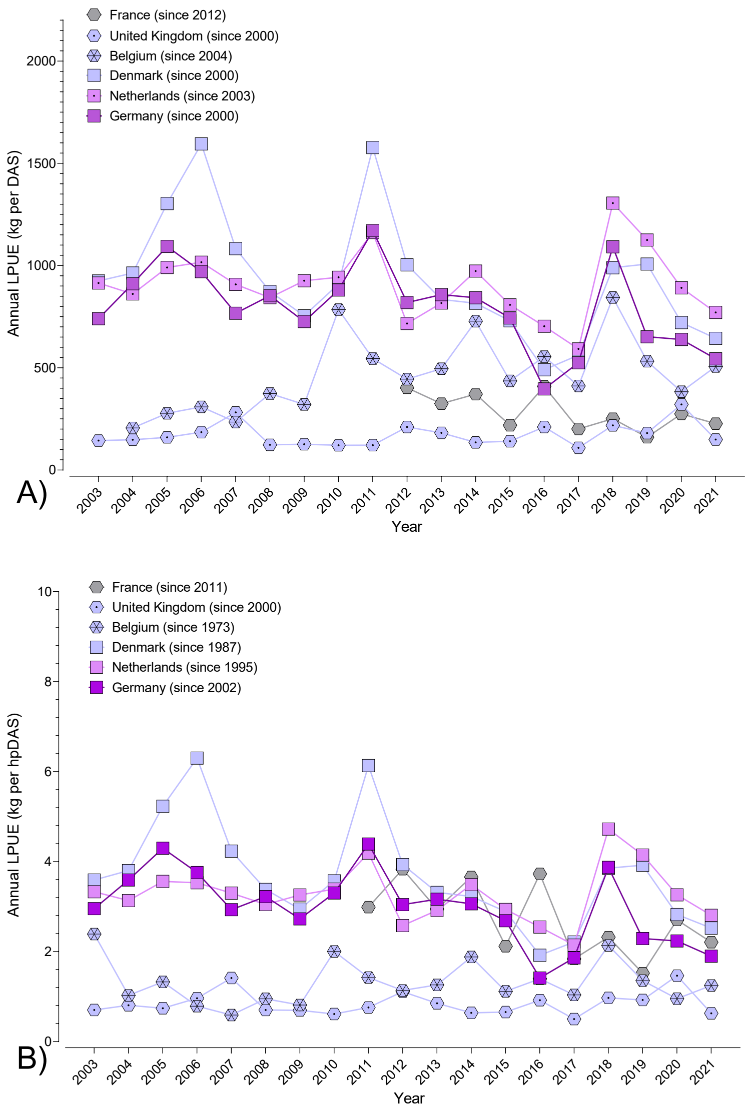

Figure 1.4. Annual landings per unit effort (LPUE) in kg per A) days at sea (DAS) and B) horsepower days at sea (hpDAS) of the brown shrimp fishery by country. The numbers in brackets indicate the year since the data became available for WGCRAN.

1.2 Landings and effort statistics 2021

1.2.1 National annual landings

In 2021, German landings were slightly lower than the previous year, now three years in a row with low landings has been observed (Figure 1.5). In 2018, landings were nearly double this level. Considering the last 50 years data, these last three years is the lowest consecutive landings and is only slightly higher than the landings in 2016, which is the year with the lowest landings in the last ten years. The German share of total landings has been above 30% for the last three years, continuing a declining trend that started with 50% in the early 1980s (Figure 1.5).

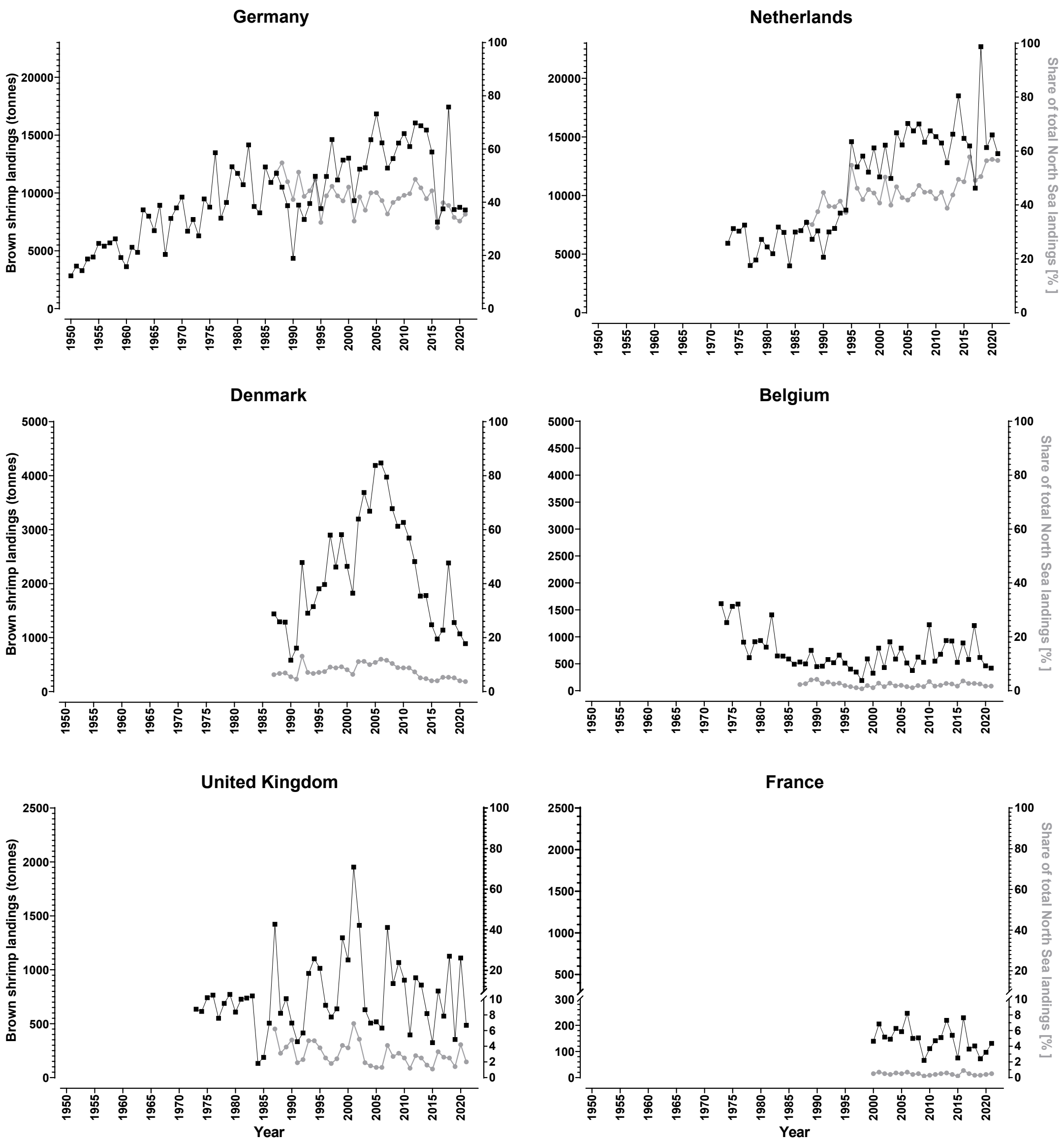

Figure 1.5. Country specific time-series of brown shrimp landed for human consumption (in tonnes). Data in grey give the percentage of landings in relation to total (whole North Sea, all nations).

The Dutch landings in 2021 were slightly lower than the previous years but higher than in 2017, the year with the lowest landings of the last decade (2017). The share of Dutch shrimp landings in total landings has increased from about 30% in the 1980s to almost 60% (2021). In parallel, landings increased over time, but in recent years (starting with 2014), this trend is only sustained by the exceptionally strong year 2018 and average landings seem to have reached a plateau (Figure 1.5).

In Denmark, landings in the exceptional year 2018 were about 3 000 tonnes, equivalent to the annual landings between 2009 and 2014. However, landings in the subsequent years 2019 to 2021 were the lowest in the last 25 years. After peaking in 2006, Danish landings and Denmark's share of total North Sea landings began to decline. Both landings and share have more than halved since then (to less than 1500 t and 5%, respectively). The actual 2021 value is the third-lowest value in this time-series (Figure 1.5).

Belgian landings decreased from 2018 to 2021 and the share of total landings decreased from 3% to 2% during this period. However, there is no strong trend in landings or in the share of total landings over the last 20 years (Figure 1.5).

Landings from the UK exceeded 1000 tonnes in 2018 and 2020, while they were close to 500 tonnes in 2021. The share of total landings has been below 4% for the last three years. Landings from the UK have fluctuated widely in recent decades, with no discernible trend (Figure 1.5).

The French Channel fishery has landed less than 150 tonnes since 2002 and accounted for less than 0.5% of total landings between 2018 and 2021 (Figure 1.5).

1.2.2 National monthly landings, effort and LPUE

The national monthly patterns of landings, fishing effort and LPUE in 2019, 2020 and 2021 are discussed below and compared with the average pattern over the last ten years (2012–2021) (Figure 1.6–1.8).

The monthly average patterns (2012–2021) of the two main fleets, the German and the Dutch, are very similar to the same magnitude of landings, effort and LPUE from March to July (Figures 1.6–1.8). However, the peak in Dutch landings in autumn is around 30% higher than the German, and landings and effort in winter were both about 50% higher.

The German landing in 2021 was like the two previous years generally below the 10-year running mean, especially in the autumn (Figure 1.6.). The effort was only slightly lower than the running mean, which results in an around 25% lower LPUE in the autumn 2021 compared to the running mean (2012–2021) (Figure 1.7 and 1.8).

The Dutch landings in 2021 (Figure 1.6) were following the trend of the 10-year running mean relatively close with the highest catches in October and the lowest in February, however all months except august had a slightly lower catch than the running mean (2012-2021). With the exception of May and August, fishing effort was slightly below average (Figure 1.7), resulting in a Dutch LPUE slightly below the 10-year running mean the entire season, except from in August which had a LPUE just above the mean (Figure 1.8).

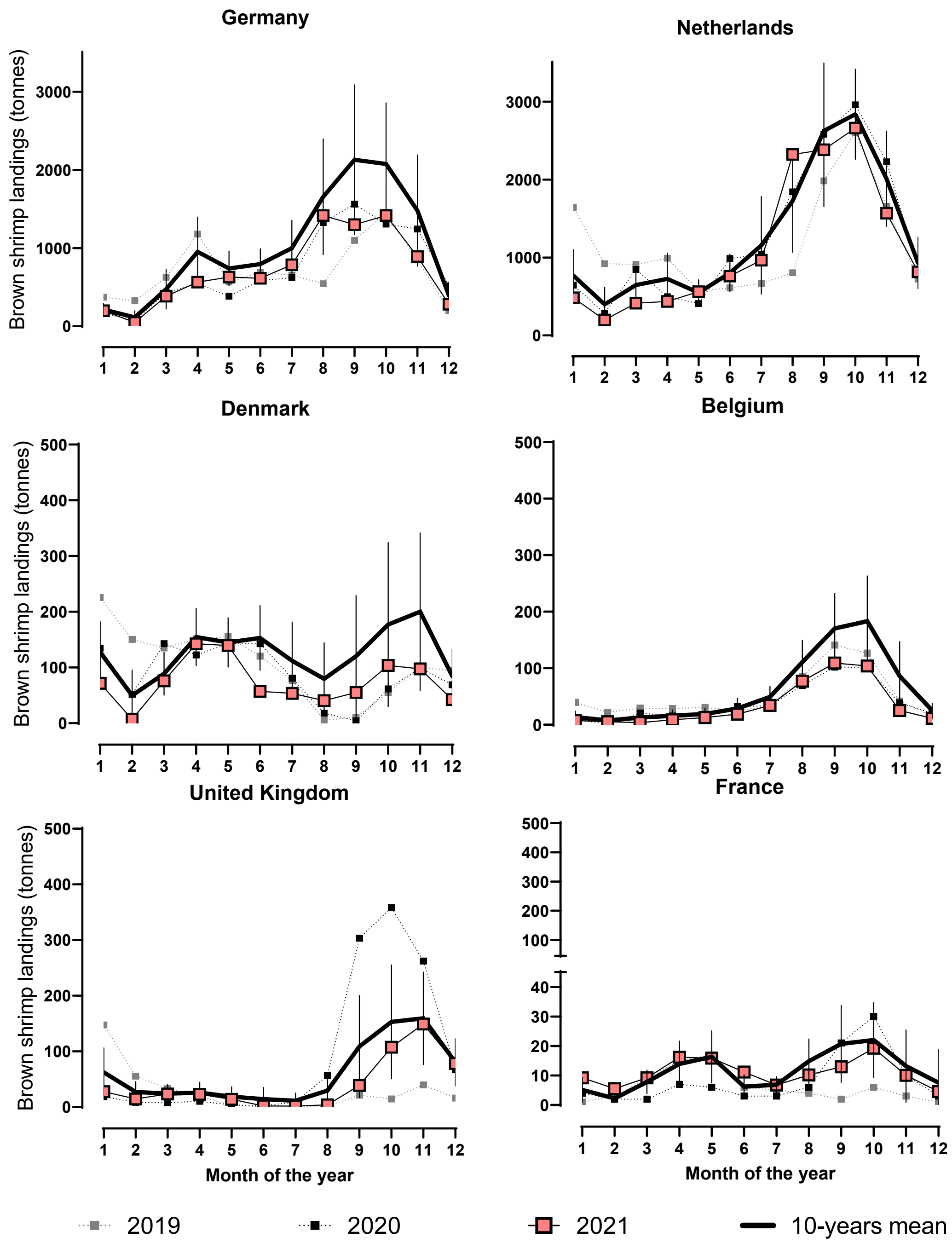

Figure 1.6. Monthly landings of commercial sized brown shrimp (in tonnes) per country in 2019, 2020, 2021 and the last 10 years 2012-2021 (10-years running mean +/- SD).

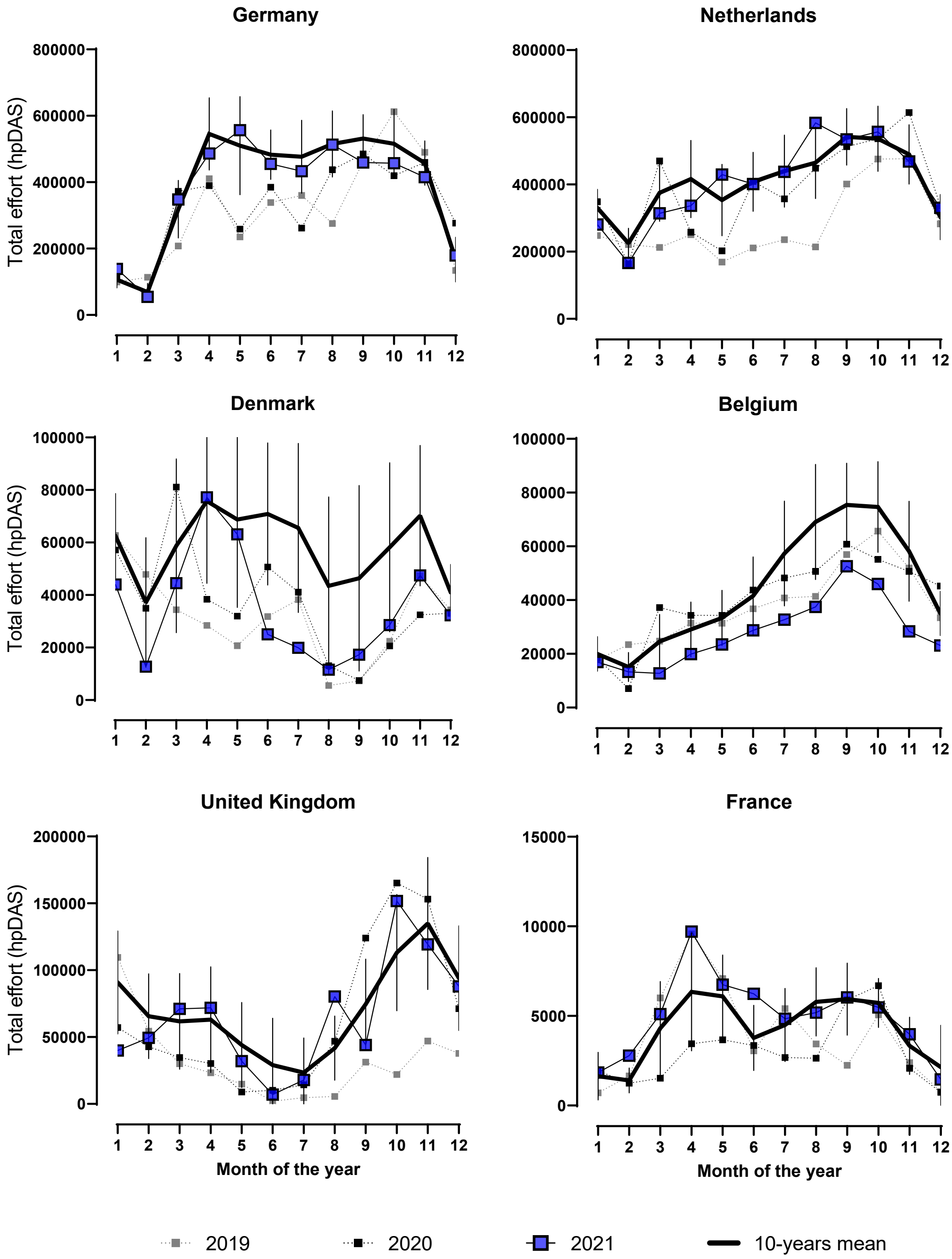

Figure 1.7. Monthly total fishing effort on commercial sized brown shrimp per country in 2019, 2020, 2021 and the last 10 years 2012-2021 (10-years running mean +/- SD). Effort is given as horsepower days at sea (hpDAS).

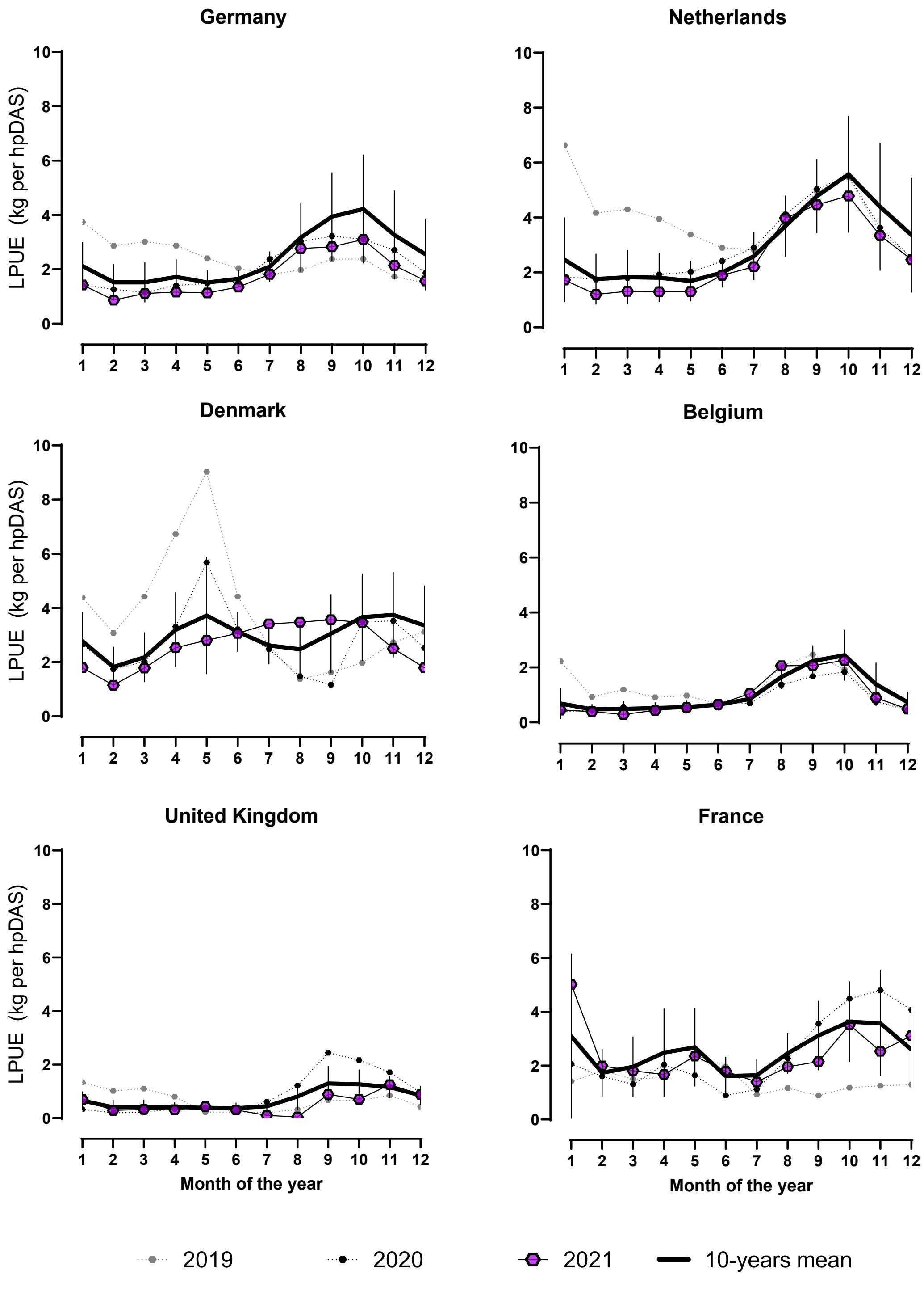

Figure 1.8. Monthly commercial sized brown shrimp landings per unit effort (LPUE) per country in 2019, 2020, 2021 and the last 10 years 2012-2021 (10-years running mean +/- SD). LPUE is given as in kg per horsepower days at sea (hpDAS).

The Danish landing and effort correspond to a maximum of 1/10 of what is seen in the Dutch or German fishery (Figure 1.6 and 1.7). The seasonal pattern of the landings is also quite different as the autumn peak is only slightly higher than the spring peak (Figure 1.6). The Danish landings in 2021 were for June, October and November reduced by close to 50% compared to the running 10-year mean, in general the landing for all months was below the mean. The effort was also generally below the mean with the highest decrease in June, July and August where the effort only corresponded to around 50% of the running mean (2012–2021), exceptions were April and

May where the highest efforts of the year in the Danish fishery were registered. The small changes in effort and landings compared to the general means, result in a different LPUE pattern than normally observed in the brown shrimp fishery, with only one late summer peak occurring around August with similar LPUE values to those found in the two peaks, normally observed in spring and autumn (Figure 1.8).

The Belgian landings in 2021 followed the general pattern of the 10-year running mean, with very few tonnes landed within the first half of the year, and a peak in September and October (Figure 1.6). However, the autumn peak, was around 40% lower than the running 10-year mean, but similar to the amounts landed in 2019 and 2020 and it can be assumed that the high mean value is affected by the very high landings in 2018 (around 350 tonnes in October 2018). The effort in 2021 was low, compared both to the years 2019 and 2020 and to the 10-year running mean (2012–2021), but all years followed the same trend with a peak in effort in September/October (Figure 1.7). The patterns of effort and landings combined in 2021 meant the LPUE values ended up very similar to the two previous years and to the 10-year running mean (Figure 1.8).

The landing pattern and magnitude in the UK fishery was similar to the Belgian fishery, with a pronounced peak in autumn. However, the landings in UK show a slightly lower peak and with a one-month delay compared to Belgium (Figure 1.6). The UK effort in 2021 have two peaks, a spring peak in March/April and an autumn peak in October/November which is neither found in previous years, nor in the 10-year running mean, however the effort the entire year fluctuating above and below the 10-year running mean (Figure 1.7). The UK LPUE values for 2021 were overall close to or slightly below the 10-year running mean, with the larges difference observed in the months July–October (Figure 1.8).

French average landings, effort and LPUE (2012–2021) (Figure 1.6–1.8) exhibited two peaks, one in the first and one in the second half of the year. The French landings were in 2021 below 20 tonnes per month and followed roughly the level of the 10-year average except from in September where the landings were only around half of the 10-year average (Figure 1.6). The effort was higher in the first half of the year compared to the average (Figure 1.7). Whereas the French LPUE values for 2021 generally was below the average but above the level of 2019 (Figure 1.8).

1.3 Biological stock status indicators

The calculation of biological stock status indicators relies on international inshore survey data. Until recently, only data from the Dutch and German survey were used for this purpose. As Belgium uploaded shrimp lengths from 2014–2021 to DATRAS in 2022, it was decided to include Belgian data in the calculation of these indicators.

All calculations for Belgium were done in one R-script (available on the ICES SharePoint). The output of the script was merged with the results for the Dutch and German surveys. Below, the influence of adding the Belgian data to the other survey data on the biological stock status indicators is discussed.

1.3.1 Fraction of large shrimps

The fraction of shrimps > 60 mm during 1955–2021 caught in the different surveys conducted during autumn showed a decreasing trend over time until about 1990. However, the decreasing overall trend may partly be explained by different dataseries, where bycatch data (Büsum and Ost-Friesland) were used from 1955–1996, and survey (DFS and DYFS) data were used later within the included time period. The proportion of large shrimp decreases in both bycatch times-series, with the proportion of shrimp >70 mm stabilizing in the 1990s. The share of shrimps >60 mm of scientific surveys (DFS and DYFS) showed a moderately increasing trend from 1990 until about 2010, during which period it varied from 10 to 25%.

Compared to the German and Dutch survey, a higher proportion of >60 mm and >70 mm shrimp are caught in the Belgian DYFS survey. This can partly be explained by the survey area: the Belgian DYFS is carried out at greater depths. This is preferred by larger shrimp. Moreover, the Belgian DYFS uses slightly larger mesh sizes in the cod-end (BE: 22 mm, NL/DE: 20 mm). Instead of a stable or downward smoother without addition of Belgian survey data, this results in an upward or stable Loess smoother in the years 2014–2021 (Figure 1.13 and 1.14). Since 2016, survey data of the Netherlands and Germany indicate that the fraction of large shrimp is decreasing, which is supported by the Belgian DYFS data. In 2019 and 2020, the fraction of large shrimp was comparatively low in both the Dutch and German surveys. This was different for the Belgian DYFS survey, where the fraction of large shrimp was comparatively high in 2020. In 2021, the fraction of large shrimp increased slightly for the Dutch and German survey, but decreased slightly for the Belgian survey.

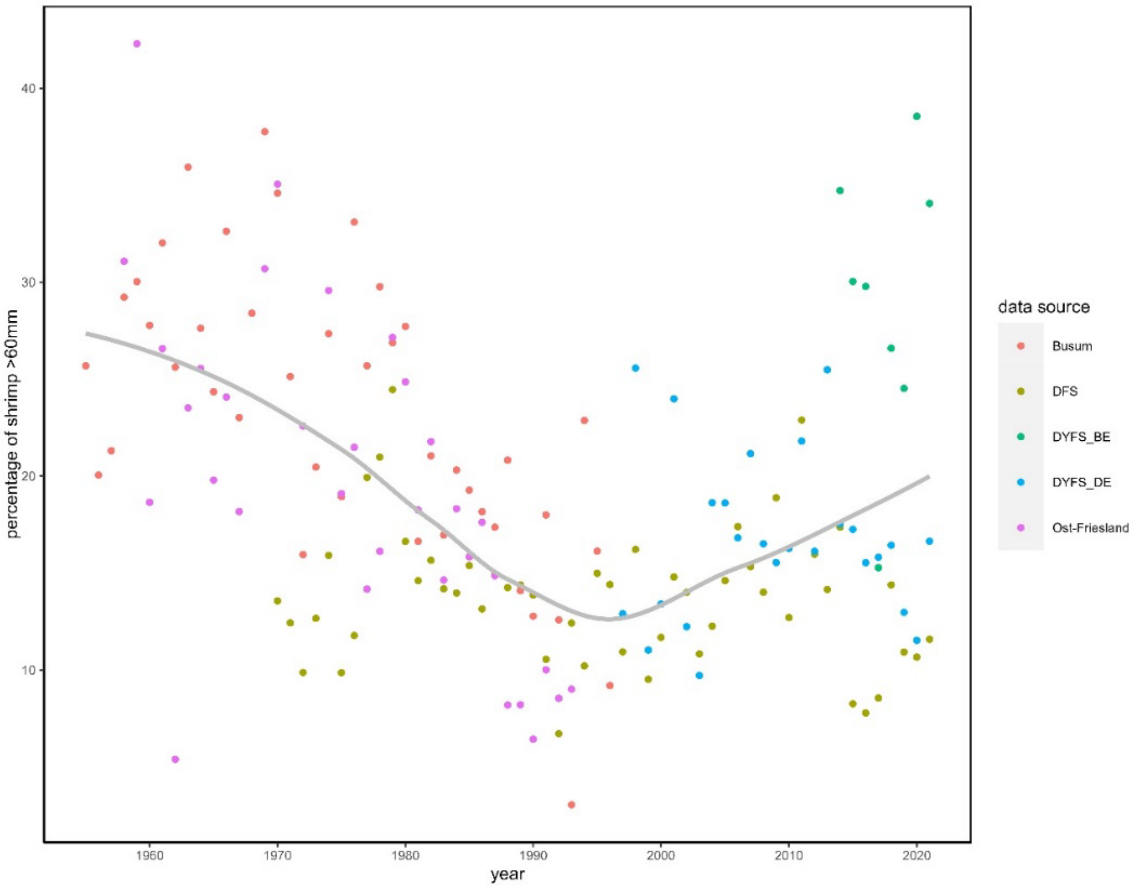

Figure 1.13. Time-series of proportion of large brown shrimp (>60 mm) in five different survey programs. DFS and DYFS are fishery-independent surveys; Busum and Ostfriesland are German bycatch series. Percentage is expressed as the fraction of shrimp >45 mm. The grey line is a Loess smoother.

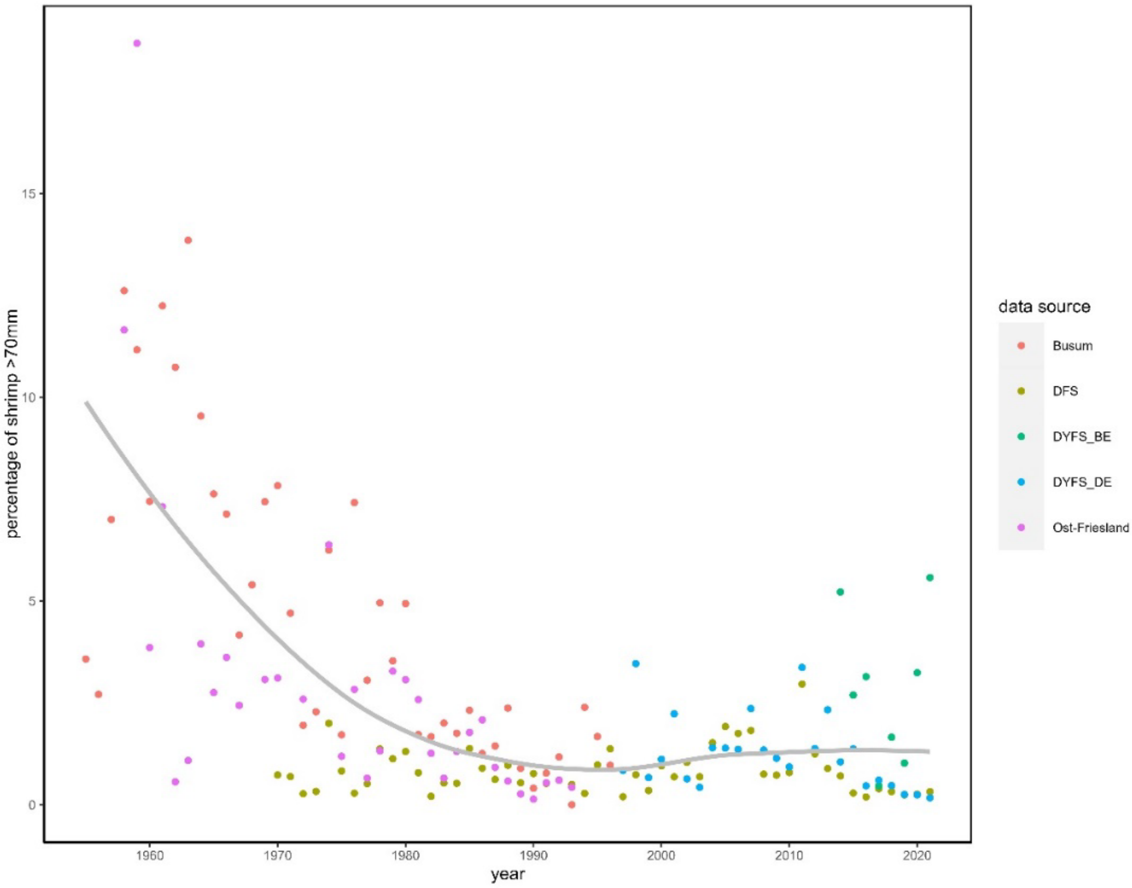

Figure 1.14. Time-series of proportion of large brown shrimp (>70 mm) in five different survey programs. DFS and DYFS are fishery-independent surveys; Busum and Ostfriesland are German bycatch series. Percentage is expressed as the fraction of shrimp >45 mm. The grey line is a Loess smoother.

1.3.2 Mortality

After a continuous increase in total annual mortality (Z) during 1955–1995, there has been strong annual variation (methods see Hufnagl *et al.* (2010)). From 1994, there was a decreasing trend until 2008, thereafter there was no clear trend until 2019, when the estimated total mortality was similar to the previous maximum level in the early 1990s.

Adding Belgian survey data to calculate mortality indices only slightly lowered the mean mortality index of the whole period (5.53 y^{-1} without Belgian data vs 5.46 y^{-1} with Belgian data). This is because Belgian data is only available since 2014 and therefore does not affect the mean of the whole period (1955-2021). Figure 1.15 indicates that Belgium has lower mortality indices than the Dutch and German surveys. In 2021, the mean estimated annual total mortality (Z) was 5.74 y^{-1} without Belgian data, i.e., close to the mean during the whole period without inclusion of Belgian data (5.53 y^{-1}).

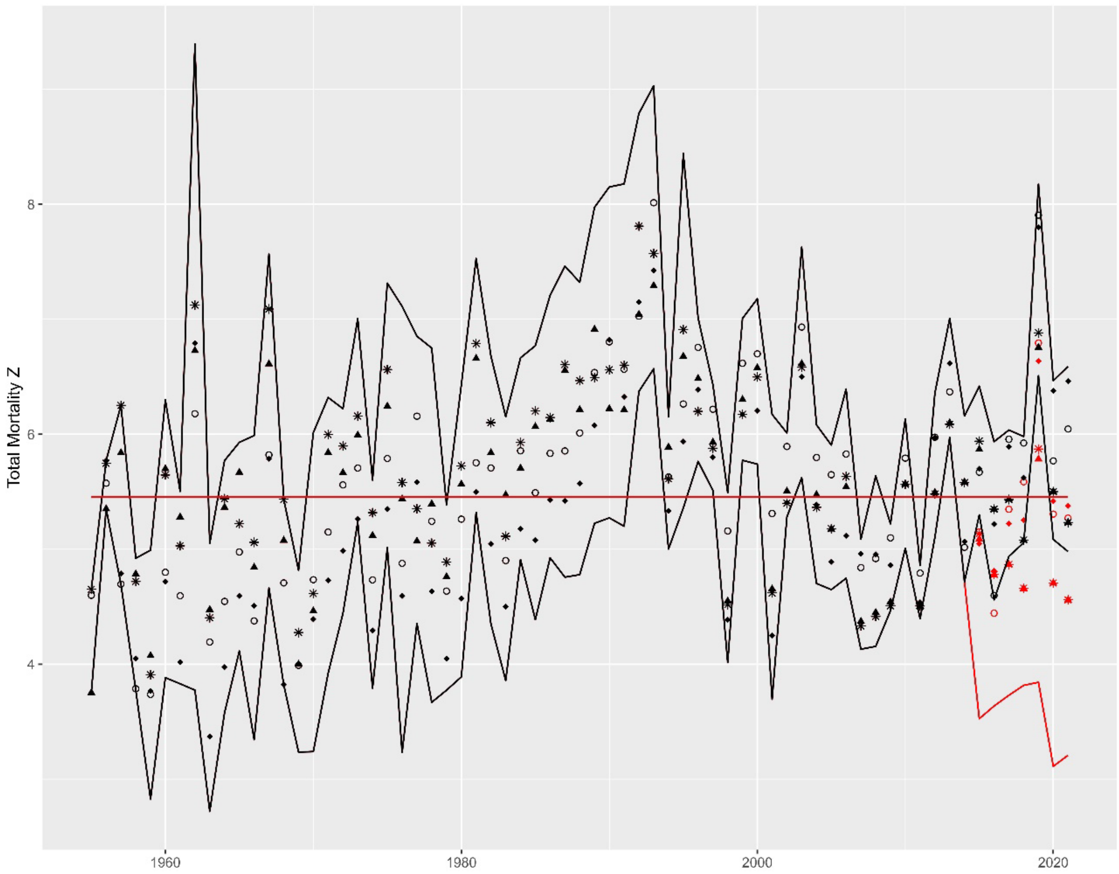

Figure 1.15. Total annual exponential mortality rate Z [y^{-1}] estimated for 1955–2021 using length-based methods. Four different methods were used (with the mean of all surveys of the different methods represented by different symbols): Beverton and Holt (▲), Jones and van Zalinge (◦), Ssentongo and Larkin (*) and Length Converted Catch Curve (♦). Red horizontal line=mean during the whole period. Black symbols and curves are the mortality indices based on the Dutch and German data, with the curves representing the lowest and highest mortality indices per year. Red symbols and curves are the mortality indices based on the Dutch, German and Belgian data with the curves representing the lowest and highest mortality index per year; methods and validations are presented in Hufnagl *et al.* (2010).

1.3.3 Swept-area biomass estimate

A swept-area biomass index of *Crangon crangon* was used in order to compare stock indices with annual landings data (Tulp *et al.* 2016). In Tulp *et al.* (2016) total biomass production was also calculated based on the swept-area estimate of brown shrimp biomass. In this report we include the swept-area estimate (Figure 1.16), not the full biomass production estimate (taking mortality estimates as well as various assumptions into account). The swept-area biomass index has since 2010 varied from approximately 7 to 14 thousand tonnes.

Adding Belgian data to the calculation of the swept-area biomass has limited influence (Figure 1.17). All swept-area biomass indices have increased with around 2.5 tonnes but the trend remains similar.

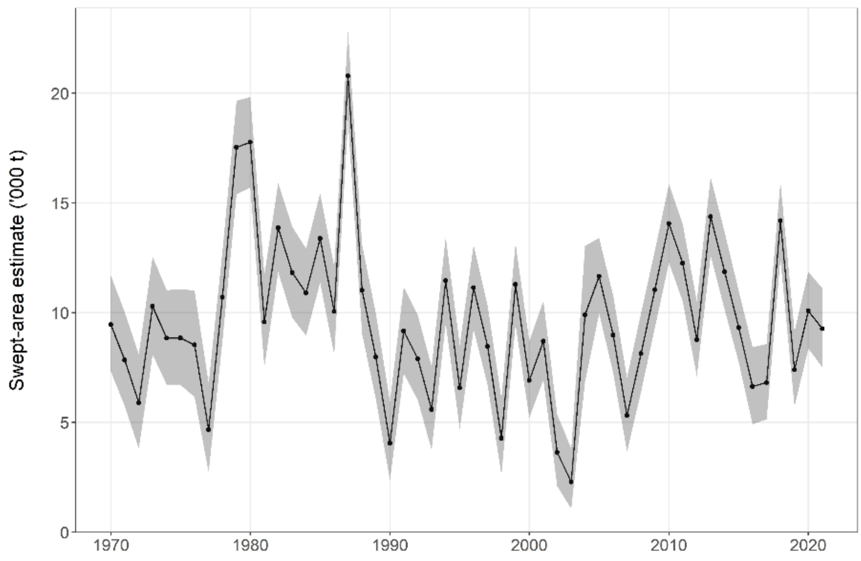

Figure 1.16. Time-series 1970–2021 and 95% confidence limits (grey area) of the swept area biomass estimate calculated according to Tulp *et al.* (2016) - only inclusion of Dutch and German survey data.

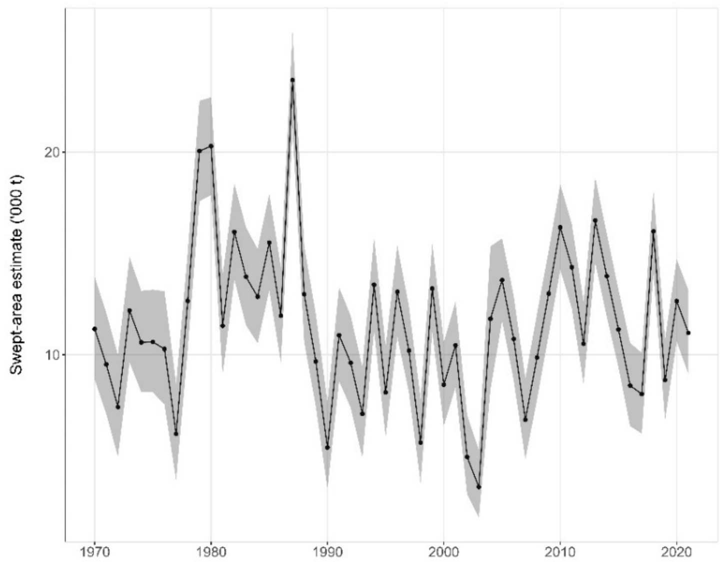

Figure 1.17. Time-series 1970–2021 and 95% confidence limits (grey area) of the swept area biomass estimate calculated according to Tulp *et al.* (2016) - inclusion of Belgian, Dutch and German survey data.

1.3.4 Way forward

In the next WGCRAN meeting, some more progression can be made with regard to the unified script:

- The German and Dutch data could be directly sourced from DATRAS as well, instead of making use of the custom excel sheet.
- The consistency between the calculations of the mortality indices could be improved. The German calculation method includes 45–83 mm, while the Dutch calculation method includes 45–73 mm. For the calculation of the Belgian mortality indices, it was decided to include 45–83 mm, following the German example.

- Swept-area estimates are calculated in the script, but not yet the full biomass production estimate (taking mortality estimates as well as various assumptions into account). This is another improvement that could be made to the script.

1.3.5 References

Temming A., Günther C., Rückert C., Hufnagl M., 2017. Understanding the life cycle of North Sea brown shrimp *Crangon crangon*: a simulation model approach. Marine Ecology Progress Series 584: 119–143.

Tulp I, Chen C, Haslob H, Schulte K, Siegel V, Steenbergen J, Temming A, Hufnagl M (2016) Annual brown shrimp (*Crangon crangon*) biomass production in Northwestern Europe contrasted to annual landings. ICES J Mar Sci 73(10):2539–2551.

2 Logbook information and VMS analysis (ToR b)

2.1 Progress in 2022

During the meeting it was discussed how to analyse spatial data of the international fleet in the future. Previously, to address the second part of the ToR b (i.e. "[…] to monitor regional distribution and regional shifts in fishing effort."), maps were produced in gridded form for the total international fleet per year and per month. However, having high number of gridded maps without developing research question or further statistical testing were not found to be useful for including in the report. In addition, anonymity of the individual vessels seemed to be problematic for some nations. Therefore, experts suggested using bigger areas for aggregating international fishing effort. In 2019, Respondek et al. (2021) developed an analysis for a specific research question that served the first part of ToR b (i.e. "To combine VMS, landings and effort data to develop a spatial indicator of shrimp distribution based on LPUE […] "). Figure 2.1 shows the shapes that were used to aggregate the spatial fishing effort data per areas.

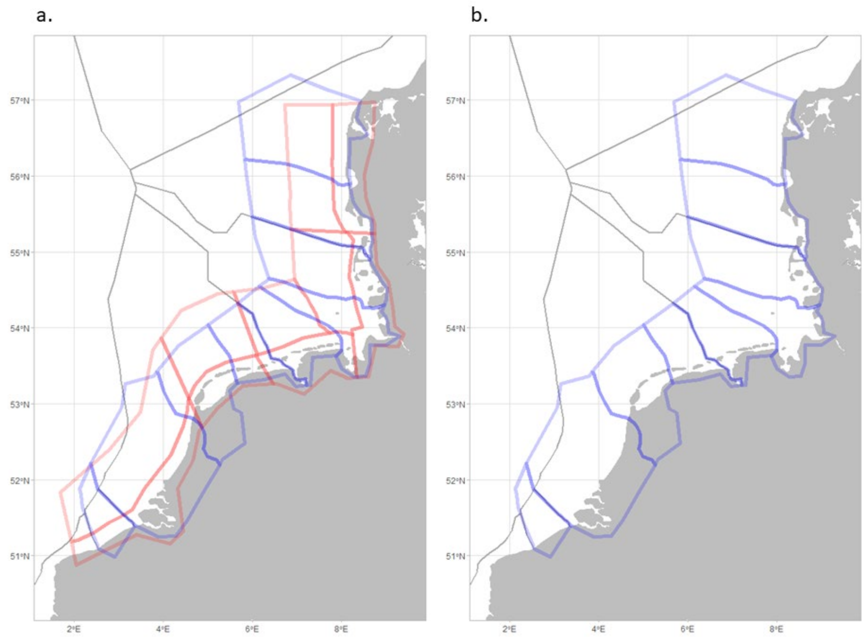

Figure 2.1. Comparison of two versions of areas that are used in aggregation of international fishing effort. a. Two versions that were used in different data calls do not overlap. Red polygon show the shape used by Respondek et al. 2021. It was used in analysis done on WGCRAN 2019. b. Blue polygon (WGCRAN-2020; same in both panels) is used in WGCRAN ICES VMS calls on 2020 and 2021. Final version of areas follow national EEZ borders (in dark gray).

However, the areas presented in the paper are not following the national exclusive economic zone (EEZ) or the 12-nm coastline. For future data requests from ICES, starting from 2020, a new shape file was produced that had borders following the EEZ borders. This shape file and area design version is named WGCRAN-2020. Furthermore, it was decided to aggregate the data per depth layer additionally to the polygon. Figure 2.2 gives the bathymetry profile in relation to regional shapes designed by WGCRAN.

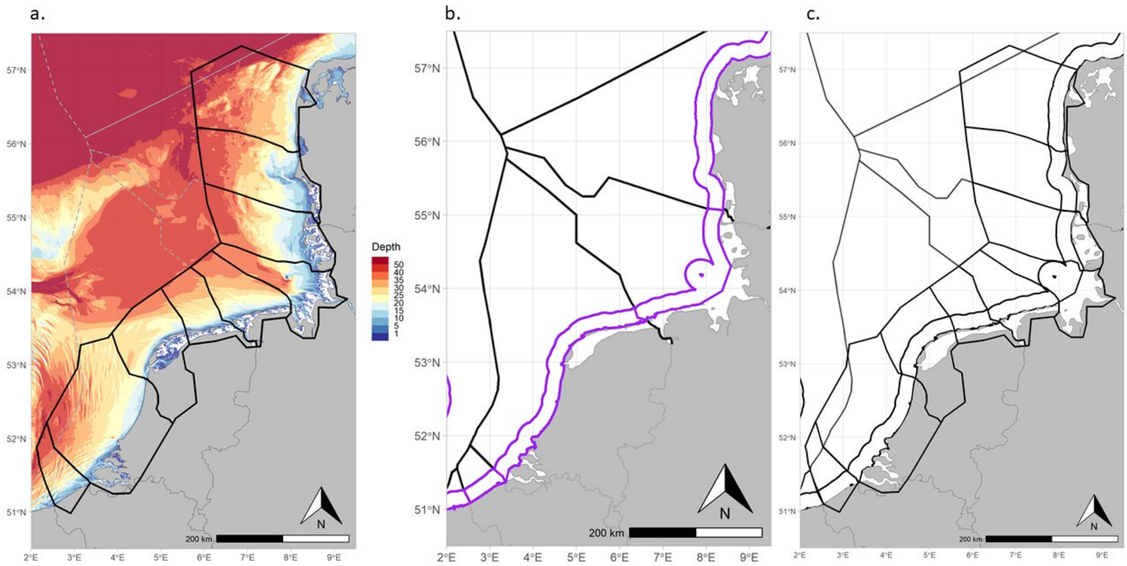

Figure 2.2. Aggregation areas mapped with bathymetry, 12nm zone and national EEZ borders. All borders have management implications on the fishery thus considered to be included for the new aggregation shape in the next data call. a.) Final aggregation area shape (WGCRAN-2020) with bathymetry (GEBCO - 1m resolution) and national EEZ borders in dashed light grey; b.) National EEZ borders in black and 12-nm zone in purple; c.) National EEZ borders, 12 nm zone and "WGCRAN-2020" polygon is shown all together.

For the next ICES data call, it is suggested to include further aggregation layers, i.e. the coastline and the 12-nm zone, additional to the bathymetry profile. Adding the 12-nm zone has implications such as restrictions on fishing for the German vessels behind the coastline in Dutch coast and vice versa. Figure 2.2b shows the 12-nm zone in relationship to national EEZ borders of the WGCRAN countries. Figure 2.2c shows the designed area shapes, the EEZ and the 12-nm zone shapes look all together.

For future data requests and aggregation, R-script and shape files are deposited at the ICES WGCRAN SharePoint. Details of public shape files retrieved is listed below.

- Bathymetry, downloaded from GEBCO database in 2022-09-13 with 1m resolution: GEBCO Compilation Group (2021) GEBCO 2021 Grid (doi:10.5285/c6612cbe-50b3-0cffe053-6c86abc09
- 12 nm zone: Flanders Marine Institute (2019). Maritime Boundaries Geodatabase: Territorial Seas (12NM), version 3.
  Available online at https://www.marineregions.org/. https://doi.org/10.14284/387
- National Exclusive Economic Zones: Flanders Marine Institute (2020). The intersect of the Exclusive Economic Zones and IHO sea areas, version 4.
  Available online at https://www.marineregions.org/. https://doi.org/10.14284/402

2.2 References

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3 Research on bycatch (ToR d)

3.1 Progress in 2022

The status and results of the co-sampling programmes in the Netherlands, Germany and Denmark were discussed (i.e., bycatch sampling of TAC species under the *de minimis* exemption from the landing obligation). Special attention was paid to the sampling details of the different countries. It was noted that there are variations between countries with regard to some specifications in the sampling strategy (see also previous report ICES (2022)) as well as in the methodology in the raising (see below). These variations were taken into consideration and an attempt was made to find a common method of combining the data (Figure 3.1). As a result, a common data collection sheet was developed (see Annex 4: Tables 1 and 2).

3.1.1 Raising procedure Germany

Unlike the other countries, Germany does not have data on the volume of the individual hoppers of the co-sampling shrimpers, nor are the catches of individual hauls officially documented in the logbooks or landing statistics. Accordingly, there are no data that allow an accurate projection to the individual haul.

For the German sampling, following data are so far available and used for raising procedure:

a) Sample delivered: weight percentage of commercial sized shrimp (=consumption shrimp assumed to be ≥ 50 mm length), weight percentage of single TAC species;
b) German landing statistics: total weight of consumption shrimp landed from the trip, which delivered the sample;
c) German landing statistics: total weight of consumption shrimp landed by the German fleet (monthly, seasonally, annually).

Accordingly, the raising procedure is done with the assumption that the sampled catch was of the same composition as the fishing trip. The total mass of the respective TAC species per trip is set in relation to the consumption shrimp landed per trip and raised based on the consumption shrimps landed by the German fleet.

3.1.2 Raising procedure the Netherlands

Volume measures of the Dutch shrimp hoppers was available from previous sampling programs and have been complemented during the co-sampling program. Measurements of the individual hoppers make it possible to allocate a volume (litres) to the measured total catch height (centimetres). With this method, the fishers can measure with relatively low effort, the catch volume themselves by holding a measuring stick into the filled hopper. This way, the total catch volume for every haul of the sampled trip is provided and can be used for the raising procedure.

For the Dutch co-sampling, following available data is used for raising procedure:

A) Per sample delivered (2 each per trip): sample volume, volume of total uncooked shrimp in the sample (unsorted, not differentiated between undersized and landed), weight and length measurement of each species within the sample other than shrimp; position, time and duration of the sampled haul; measured height (converted to weight) of total catch, volume of landed (cooked) shrimp.

B) Per sampled trip: for each (also non-sampled) haul, position, time and duration of each haul, measured height (converted to weight) of total catch, volume of landed (cooked) shrimp. The information is delivered by the fisher on an excel sheet and is used for the estimated of fishing effort and catch per entire trip.

C) Dutch landing statistics or VMS data: total weight of landed shrimp and total fishing effort by the entire Dutch Brown shrimp fleet (per area and time).

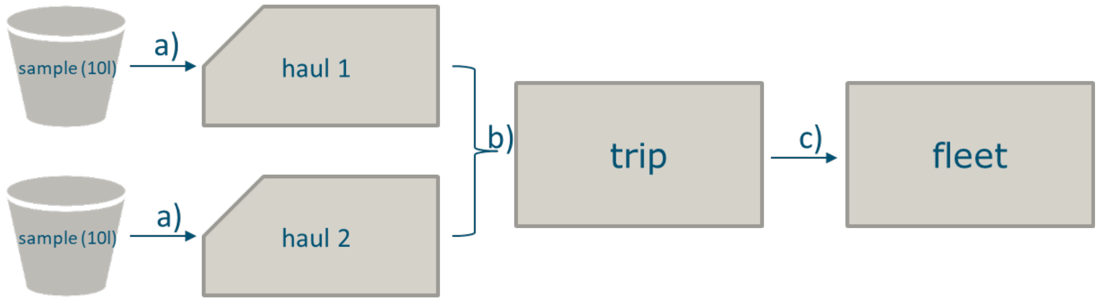

Figure 3.1. Schematic figure of the raising process of the different countries. Despite close collaboration and coordination between countries, differences in the haul information available causes the initial raising procedure to trip level (a, b) to be different per country. The raising procedure to fleet level (c), however, will be done in a similar manner.

The raising procedure (from sample to fleet level) is based on the assumption of constant ratios and representativeness of the samples taken:

Step a) From sample to haul's total volume catch: The weight (percentage) of shrimps and by-catch TAC species in the total catch is estimated considering the ratio between the weight of the sample taken and the total catch measured in the hopper (Figure 3.1).

Step b) From haul to trip level: The duration of all hauls (registered by the fishers) is taken as the fishing effort of the sampled trip. Considering the ratio between the duration of the two sampled hauls and the total fishing effort, the weight (percentage) of shrimps and bycatch TAC species is extrapolated to trip level (Figure 3.1).

Step c) From trip to fleet level: Considering the ratio between the trip's and the entire fleet's effort (fishing time if using VMS data) or catch (landings if using landing statistics), the weight (percentage) of shrimps and bycatch TAC species is extrapolated to the fleet level. Area and time resolution differences are considered (Figure 3.1).

3.1.3 Raising procedure Denmark

For the Danish co-sampling programme, the volume of all hoppers have been measured so the fishers, like in the Dutch programme can measure the catch volume themselves by holding a measuring stick into the filled hopper in addition the skipper estimates the total weight of the catch (kg).

Following data are so far available and used for raising procedure:

a) Sample delivered: weight percentage shrimp (not split between undersized and landed), weight percentage of single fish species including, weight percentage of others; info on data sheet. Estimated weight of total catch, measured catch on hopper, kg landed shrimp

b) Danish landing statistics: total weight of consumption shrimp registered per haul.

c) Danish landing statistics: total weight of consumption shrimp landed by the Danish fleet (monthly, seasonally, annually).

Accordingly, the raising procedure is done with the assumption that the (one or two) sampled hauls were representative for all the hauls during the fishing trip. The total mass of the respective TAC species per trip can therefore be calculated based on the relation of consumption shrimp landed per trip. It can further be raised to fleet level per month or year based on the consumption shrimps landed in the period by the Danish fleet.

Example:	In haul:	Raised to trip
	Total catch 60 kg.	720 (calculated)
	Landed shrimps 25 kg.	300 kg (logbook data)
Sample size 2 kg.		
Percent distribution in sample:		All below calculated
Shrimps 70%	42 kg (25/42 = 59.5% landing size shrimps)	204 kg undersized
Non-TAC species 10%	6 kg	72 kg
Other 15%	9 kg	108 kg
Plaice 3%	1.8 kg	21.6 kg
Whiting 2%	1.2 kg	14.4 kg

3.2 References

ICES (2022): Working Group on Crangon Fisheries and Life History (WGCRAN; outputs from 2021 meeting). ICES Scientific Reports. Report. https://doi.org/10.17895/ices.pub.10056

4 International Survey data

4.1 Size relationship frozen (thawed) vs. fresh brown shrimp (WGBEAM request)

WGBEAM asked whether shrimp size measurements differ between those measured immediately fresh on board during the surveys and those that were transported frozen to the lab and measured there after thawing.

During the sampling campaigns in 2021 of the CRANMAN project, 293 brown shrimp of the discard fraction of commercial fishing trips were measured fresh on-board and were afterwards put individually in numbered Eppendorf tubes and frozen. Later in the lab, each individual shrimp was thawed and measured again. Both manual measurements of total lengths were accurate to 1 mm (below). As only the discard fraction was sampled, the majority of measured shrimp were smaller than 50 mm.

The size measurements of fresh and thawed shrimp did not differ (slope: 0.99; R^2: 0.97; Figure 4.1). We conclude that length frequency distributions of brown shrimp are probably not affected by freezing and that the different measurement methods (concerning freezing) between countries are of minor concern. However, we recommend repeating these measurements with shrimp larger than 50 mm.

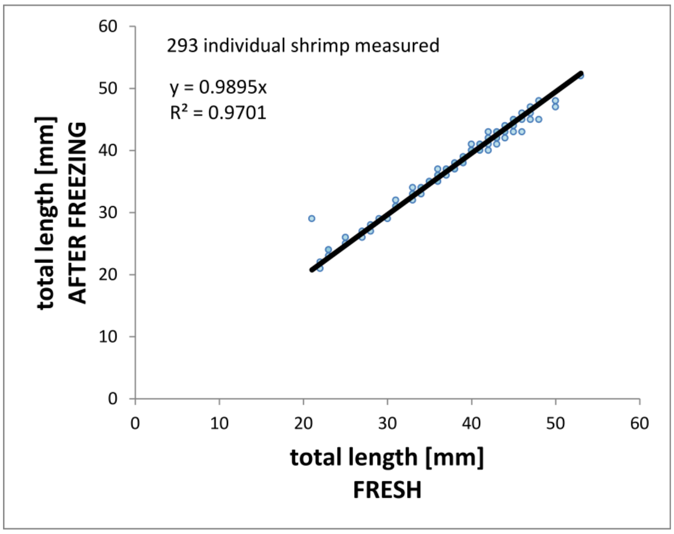

Figure 4.1. Comparison of total length of individual brown shrimps measured firstly fresh, i.e. immediately after catch, and then secondly after freezing.

4.2 Sampling size (WGBEAM request)

Another WGBEAM question was "What is the minimum number of shrimp measured per stratum (i.e. subarea)?" which raised a general discussion on how to determine a sample size. No exact number was decided but the overall conclusion was that depends on the aim of the sampling and the number of stations per strata. An overview of the general statistics of the already sampled data was made and can be found as a WGCRAN working document (Mosegaard 2022 Descriptive statistics of *Crangon crangon* length distributions from the DYFS survey).

5 Legislation, law and management (ToR f)

5.1 *De minimis* exemption

There was an International meeting on the *de minimis* exemption in Bremerhaven on 24 to 25 May 2022.

On 24 May, where industry, researchers and the member states were present, the status on the existing *de minimis* exemption for North Sea brown shrimp fisheries and requirements for the 2023 joint recommendation (JR) were presented. It was emphasized that the European Commission had clarified that in May 2023 a new JR was required and that a mere overhaul of the 2018-JR would be insufficient.

On 25 May only the member states were present, the subjects from the previous day were further discussed, and the roadmap listed below, created:

- summer 2022: coordination of co-sampling programme in ICES WGCRAN (WUR, Thünen Institute, and others)
    - the 2023-JR should cover data from whole 2022 from the sampling programme
- until September 2022: circulation of templates to the Scheveningen Group by DE/Thünen for the 2023-JR; NL will if necessary, complement the template regarding de minimis aspects (disproportionate costs of sorting on board)
    - template will contain inter alia headings on fleet descriptions, national legislation, selectivity and other projects; MSC certification; economic situation of shrimp fisheries
- October 2022: stocktaking of further development regarding shrimp fisheries (selectivity projects, sampling results, etc.) in Scheveningen Group meeting
- January 2023: dedicated shrimp meeting on evidence for development of JR (especially, what are results of the co-sampling programme across MS; discussion on phrasing of the exemption)
- March 2023: finalization of shrimp chapter of 2023-JR
- May 2023: submission of full JR to COM

6 Ongoing research and projects (ToR g)

The ongoing *Crangon* project are listed in Table 1 and details on the projects CRANIMPACT, CLICCS and CRANMAN can be found in the sections below.

Table 1 Overview of current projects related to Crangon crangon (fishery) research

Project name	**Country**	**Time**	**Description**
Structural Change Coastal Fisheries	GER	2021–2027	https://www.thuenen.de/en/cross-institutional-projects/structural-change-in-coastal-fisheries
Co-sampling shrimp fishery	NL	2021–2023	Estimating discard percentages of quota species in the Dutch shrimp fishery for a de minimis exemption
SHRIMPBREED	BE	2020–2023	Study on the technical and economic feasibility of brown shrimp *Crangon crangon* farming for product diversification.
Co-sampling shrimp fishery	DE	2019–2023	Estimating discard percentages of TAC species in the German shrimp fishery for a *de minimis* exemption
Bycatch reduction in the North Sea brown shrimp beam trawl fish-ery	DK	2019–2023	Document and reduce bycatch of fish with special emphasis on juve-nile TAC species. This include the development of a BRD and a co-sampling programme for the Danish *de minimis* exemption
IRC	NL	2019–2022	Research on bycatch in shrimp fishery in support of a MSC certifica-tion
CRANMAN	GER	2018–2022	Research on population and fisheries dynamics of the *Crangon* stock and evaluation of the self-management of the fishery
CRANIMPACT	GER	2018–2022	Impact of shrimp fishery on the seabed
SepCran	BE	2018–2022	Selectivity studies to minimize bycatch in shrimp fishery

6.1 Project: CRANIMPACT

Fisheries for brown shrimp (*Crangon crangon*) is a major fishery in the entire Wadden Sea region spanning the western coastal regions of the Netherlands, Germany and Denmark. In order to facilitate ecosystem-based management, during the CRANIMPACT campaigns 2019 and 2020, 328 grab samples and 62 2 m-beam trawl were taken from subtidal channels in the Danish (unfished stations) and the German Wadden Sea (all stations with fisheries) to reveal both short-term effects by means of Before-After-Control-Impact (BACI) experiments and large scale effects by means of gradient analysis. The first experiment in 2019 investigated two replicate neighbouring areas in the Lister Ley tidal channel directly before and up to 14 days after a multiple fishing event conducted by a commercial shrimper. The samples after experimental disturbance were taken at equal intervals in a control area and inside the disturbed area. In 2021 the BACI design was adopted to be able to detect a possible scavenger effect also for epifauna and to improve precision for epifauna samples while taking replicates. Endofauna was sampled using a 0.1 m^2 van Veen grab. Epifauna samples were collected using a 2 m beam trawl (Jennings *et al*., 1999).

With regard to endofauna, 197 taxa were analysed. 44 species occurring with a frequency of more than 4 % were taken for gradient analyses. Three main clusters of assemblages were identified, i.e. a sand mason (*Lanice conchilega*) structured assemblage, an assemblage characterized by amphipods *Bathyporeia* spp. and polychaetes *Nephtys* spp., *Scoloplos armiger* agg. and *Spio martinensis*, and an impoverished *Bathyporeia*-assemblage. Towards the heads of the tidal channels small spionids, i.e. *Streblospio benedicti* and *Pygospio elegans*, increased in abundance. In order to improve management, a distinction between natural and anthropogenic disturbances is required. Within a regional gradient analysis, distance-based redundancy analysis revealed 3 significant that 3 environmental factors accounted for 26.3 % of community variability, i.e. percentage clay composition, bed shear stress and fishing effort, the latter based on VMS analysis. Fishing effort was related to the shift between the states of the two *Bathyporeia*-assemblages and differences within the *Lanice*-assemblage, while sediment composition and bed shear stress accounted for the differentiation between *Lanice*-assemblage and *Bathyporeia*-assemblages.

Before-After-Control-Impact (BACI) experiments carried out on *Bathyporeia*-habitats off the island of Sylt revealed that out of 19 tested endofauna variables/populations, 5 incidents showed a significant response to fisheries within a 14 days-period after a fourfold multiple fisheries event, indicating recovery in a time range of 13-21 days. The effect sizes in these 5 cases were estimated at 10.8–48.9% of respective population sizes. The role of small-scale spatial variability in the analysis of Wadden Sea experimental designs is highlighted, significant in 22% of investigated variables after Bonferroni-correction, while only in 19% of all cases a temporarily limited impact could be detected.

The epifauna was significantly dominated by brown shrimp (*Crangon crangon*) in both BACI experiments and both treatments, experimentally undisturbed and disturbed. The second most abundant species was the shore crab (*Carcinus maenas*), followed by the hermit crab (*Pagurus bernhardus*). This dominance was evident in the 2019 as well as 2021 experiment, noticing that more starfish (*Asteria rubens*) were found in the samples in 2019. In the 2019 BACI experiment, the distribution and number of species belonging to the mobile epifauna was not significantly different in both areas. There were also no significant differences in species distribution and abundance over time. Sessile fauna was only represented by a few representatives of the sea squirts. The results of the BACI in 2021 show no significant fishing effect on the epifauna, both in the spatial and temporal distribution of the species found. The numbers of sessile species in the catches in 2021 were very low in terms of abundance.

6.2 Project: CLICCS

The project "Sustainable Adaptation Scenarios for Coastal Systems" (as part of C3 in the excellence cluster CLICCS - Climate, Climatic Change, and Society) aims at developing possible and plausible adaptation scenarios for German Brown Shrimp Fisheries under current and future climate change conditions. It is an interdisciplinary project by the Department of Integrative Geography and the Department of Marine Ecosystem Dynamics and Fishery Science at the University of Hamburg and focuses on developing bottom-up governance and management adaptations with various stakeholder groups such as fishers, local politicians, representatives of producer organizations, administrative staff.

6.2.1 Project Rationale and Goal

The project follows a qualitative, participative and transdisciplinary rational. The goal is to understand local perspectives on and practices directed towards climate change. In a co-constructive process, various knowledge systems and participative modelling approaches will be used to initiate cooperative scenario-building for Brown Shrimp Fisheries.

Conceptually, the project addresses the current lack of qualitative research in understanding climate change within the context of ocean change. It focuses on regional perceptions of ocean change as these perceptions shape adaptation options – what could and should be done. The research is done against the backdrop of a prevailing quantitative rationale characterizing the field, in which little research has been focusing on continental European Social-Ecological Ocean Knowledge(s).

6.2.2 Research

To gain a bottom-up understanding of German Brown Shrimp Fisheries, we have conducted and analysed more than 40 guided interviews with various actors directly or indirectly involved in coastal fisheries. Our preliminary analysis has shown that perceptions and practices of fishing reveal a detailed and 'ocean-based' climate change awareness of fishers. This, we think, provides entry-points to and additional perspectives for assessing and enhancing scientific models – and therefore directly influencing adaptation options. Not recognizing, or even neglecting, these perceptions and divers 'knowledges' will lead to conflict when trying to construct plausible climate change adaptations options for Brown Shrimp Fisheries in Germany and beyond.

6.3 Project: CRANMAN

During the project CRANMAN the biology and the fishery of *Crangon crangon* was analysed in order to support an efficient self-management system. It was conducted from 2018 to 2022 by the University of Hamburg (Institute for Marine Ecosystem and Fishery Science) and the Thünen-Institute of Sea Fisheries. Since August 2022 the final report is available in German language (Temming *et al.*, 2022) and the main results are summarized hereafter.

A combined analysis of VMS data from the Netherlands, Germany and Denmark showed an increase in effort of 12% (2009–2018) with decreasing landings (Respondek *et al*., 2022). Especially in the first quarter and particularly in northern areas, shrimp abundance (CPUE) decreased continuously for ten years. The data indicate a negative effect of winter fishing in southern areas on stock densities in the following summer/autumn in northern areas indicating potential recruitment overfishing and previously unknown spatial relationships of sub-populations (Respondek *et al.*, 2022). Regional differences and possible dependencies of fishing effort and stock development are not considered in the current harvest control rules (HCR). Furthermore, the calculation of the HCR reference values is based on the German fleet only, while the calculation of the monthly LPUE, which are used to check whether the HCR needs to be applied, is based on all fleets. Therefore, an improved calculation method and a regionalization of the HCR is recommended.

No evidence of density-dependent growth was found (Saathoff, 2023). Instead, a cohort effect was documented, according to which the recruits hatched from the winter eggs showed consistently higher growth rates compared to recruits hatched from the subsequent summer eggs (Saathoff, 2023). Similar to previous studies, variability in the growth trials, conducted under the same conditions was high (Saathoff, 2023). Contrary to expectations, this was partly due to a high variability in the moulting interval (Saathoff, 2023), which was previously believed to mainly be a function of temperature. The new insight into the importance of the moulting interval stimulated further research. Thus, a new quantitative measurement method was developed to determine moult intervals from carapace hardness of frozen *Crangon* samples (Saathoff, 2023). Based on a laboratory calibration, recently occurred moults could be determined via carapace properties and individual dry weight at length. These in turn can be used to calculate moulting intervals for groups of individuals based on frozen field samples.

An analysis of discard mortality on commercial fishing trips revealed significantly higher mortality rates than previously reported in the literature. In particular, long haul times - and thus higher catch volumes and longer processing times, as well as the passage through the drum sieve increased mortality severely.

Modelling results of Günther *et al.* (2021) showed that increased mesh size (20–26 mm) in the codend could efficiently reduce the fraction of undersized shrimp while simultaneously increasing catches of commercial shrimp as a result of the subsequent growth of the escaped shrimp.

In a direct comparison, however, with parallel fishing of codends with 22 and 24 mm only a minor effect on the reduction of undersized shrimp in commercial catches was observed. Still, time-series of DCF data indicated a long-term reduction in the proportion of undersized shrimp in the German shrimp fishery since the start of MSC certification and the gradual mesh size increases.

The *Crangon* population model (Temming *et al.*, 2017) was further improved. Data on the shares of size classes of shrimps from German landing declarations over the course of the season were used in the simulation model to validate an adult shrimp growth submodel. The amount of eggs per female was re-determined from measured data while laboratory experiments demonstrated that re-fertilisation is possible directly after egg laying. The population model was re-parameterised with recent temperature and effort data for the period 2013 to 2020. In the new version, it can model cohort-specific growth. The recruitment in the model is no longer externally specified, but is generated by the simulated parent animals. The closed life cycle allows for the first time to study possible recruitment effects of fishing. The model was successfully used to simulate the effects of combined measures on mesh size and effort reduction.

Bycatch amounts, according to historical bycatch data of the shrimp fishery (TIEWS series, 1990), varied severely both spatially and temporally with clearly decreasing trends for the period from 1955 to 1993. The mean proportion of endangered species was 0.001% of the total bycatch, however, this might be an underestimation due to small subsample volumes. The required 6% bycatch limit (de minimis rule) was exceeded in some years for plaice, sole and whiting, but was always below 6% of the quota for cod and herring.

An assessment of the framework conditions for a self-management showed that the biology of the North Sea shrimp and the fleet structure clearly favour the success of a sustainable self-management. However, there is a lack of awareness among fishers of the need for regulation of the target species. According to the fishers themselves, compliance with the rules is generally high and there is a strong interest in greater participation. The weaknesses of the management system, according to the fishers, are the control and implementation by the producer organizations.

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Annex 1: List of participants

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Annex 2: Resolutions

2021/FT/EPDSG05 The **Working Group on *Crangon* fisheries and life history** (WGCRAN), chaired by Kim Hünerlage, Germany, and Eva Maria Pedersen, Denmark will work on ToRs and generate deliverables as listed in the table below.

	Meeting dates	Venue	Reporting details	Comments (change in Chair, etc.)
Year 2022	21–23 June	Bremerhaven	Interim e-evaluation	
Year 2023	13–16 June	Belgium	Interim e-evaluation	
Year 2024	18–20 June	DTU, Danmark	Final report by Date to SCICOM	

ToR descriptors

ToR	Description	Background	Science Plan Codes	Duration	Expected Deliverables
a	Data collection of the status of the *Crangon* stock.	Report and evaluate population status indicators like recent landings and effort trends in the brown shrimp fisheries. Generate a standardized lpue time-series and provide a detailed description of the process of collecting the dataseries effort, landings and lpue for WGCRAN.	1.1; 2.1	year 1,2,3	A time-series analysis of the standardized stock indicators will be delivered by all WGCRAN members within the annual report(s)
b	Compilation of Logbook information and VMS analysis	To combine VMS, landings and effort data to develop a spatial indicator of shrimp distribution based on LPUE and to monitor regional distribution and regional shifts in fishing effort.	2.1; 2.4; 3.5; 5.4	year 1,2,3	Results will be presented in the annual report(s)
c	Development of decision-support tools for brown shrimp harvesting	To develop and evaluate brown shrimp-specific management decision-support tools to evaluate strategies on how to sustainably and efficiently harvest the brown shrimp stock.	2.1; 2.2; 5.1; 5.4 6.1	year 1,2,3	Results will be presented in technical reports, summarized in a peer-reviewed paper and included in the annual report(s)

d	Assessment of brown shrimp bycatch	Review the status and results of research on bycatch time-series and consider the implications for management. Evaluate methods and procedures used on board for collecting data on bycatch. Gather, compile and evaluate information on the on-board and ashore sieving fractions and processes and new national bycatch/discards data from e.g. DCF.	3.1; 3.2	year 1,2,3	Results as well as updates on the development of sampling procedures will be presented in the annual report(s)
e	Analysis of spatio-temporal trends of survey based stock indicators	Analysis of German, Belgian and Dutch scientific survey data to assess spatio-temporal trends of survey based stock indicators (e.g. biomass, length distribution, mortality); Ground-truthing of VMS derived lpue estimates.	3.1; 3.2	year 1,2,3	Results will be presented in the annual report(s)
f	Overview of Legislation, Law and Management	Information on national legislation, laws and management concerning the brown shrimp fisheries in the whole North Sea will be synthesized (e.g. Natura 2000, MSC process, landing obligation,...).	7.1	year 1,2,3	An overview and update of relevant information on legislation, law and management will be included in the annual report(s)
g	Overview of ongoing research	Present and review ongoing brown shrimp research in the ICES Area (impact studies, development of fishing gears, life cycle studies...) aiming at supporting international collaboration as well as evaluating management implications.	6.1	year 1,2,3	The summaries of updates on ongoing research will be included in the annual report(s)

Summary of the Work Plan

Year 1	Stock status indicators will be updated and harmonized between countries (ToR a). German and Dutch survey data will be analysed and reported, Belgian data will be included in the analyses (ToR e). Data used for the compilation of manuscripts in support of ToR b and c will be made available. Information and updates on national legislation, laws and management concerning the brown shrimp fisheries will be summarized (ToR d and f). New information generated from ToR g will be reported.
Year 2	Stock status indicators will be updated and harmonized between countries (ToR a). German, Belgian and Dutch survey data will be analysed and reported (ToR e). Data used for the compilation of manuscripts in support of ToR b and c will be made available. Information and updates on national legislation, laws and management concerning the brown shrimp fisheries will be summarized (ToR d and f). New information generated from ToR g will be reported.
Year 3	Stock status indicators will be udated and harmonized between countries (ToR a) as well as German, Belgian and Dutch survey data will be analysed and reported (ToR e). Data used for the compilation of manuscripts in support of ToR b and c will be made available. Information and updates on national legislation, laws and management concerning the brown shrimp fisheries will be summarized (ToR d and f). New information generated from ToR g will be reported.

Supporting information

Priority	*Crangon* fisheries are economically important with landings value ranking this species among the top three species caught from the North Sea. The priority of WGCRAN is to understand the interactions between the brown shrimp population (structure and abundance) and human behaviour (mainly fishing effort), the environment, and the ecosystem. One important aspect is and will be the monitoring, investigation and development of population status indices. WGCRAN is the only expert group to evaluate the Brown Shrimp Fisheries Management Plan which was developed by the industry in the course of the MSC certification.
Resource requirements	The research programmes that provide the main input to this group are already underway, and resources are already committed. The additional resource required to undertake additional activities in the framework of this group is negligible.
Participants	The group is normally attended by some 10 members and guests.
Secretariat facilities	Standard EG support.
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	WGCRAN aims at a permanent linkage with ACOM after year 2 when sound and proven stock indicators and tools to evaluate management strategies have been developed (ToR a, b, c).
Linkages to other committees or groups	There is a linkage to WGBEAM through the international scientific surveys (DFS and DYFS). WGINOSE by providing data for the integrated assessment. WGSAM as the SMS key runs will be used to estimate natural mortality of brown shrimp. Members of WGCRAN are also members in these groups.
Linkages to other organizations	CWSS = Common Wadden Sea Secretariat; TMAP = Trilateral Monitoring and Assessment Programme; RCM – NSEA

Annex 3: Way forward

In the next WGCRAN meeting, some more progression can be made with regard to the unified script:

- The German and Dutch data could be directly sourced from DATRAS as well, instead of making use of the custom excel sheet.
- The consistency between the calculations of the mortality indices could be improved. The German calculation method includes 45-83 mm, while the Dutch calculation method includes 45-73 mm.
- Swept-area estimates are calculated in the script, but not yet the full biomass production estimate (taking mortality estimates as well as various assumptions into account). This is another improvement that could be made to the script
- Develop a script that combine EFLALO and VMS data

Plans for additional meetings

- Extra meeting on bycatch was scheduled for October 2022.
- Extra VMS meeting was originally planned for the fall 2022 but was further postponed the WGCRAN meeting in 2023.

Topics to be included on next WGCRAN meeting (2023)

- Dynamic shrimp population models (Stock assessment + modelling session)
- GOALS: have new common scripts ready for Stock status indicators (biological and Landings and effort).

Annex 4: Recommendations

- **WGBEAM question:** What conservation does your institute prefer before length measurement?
  Answer from WGCRAN: According to single measurements by the University of Hamburg, the length of Crangon crangon does not change after freezing, i.e. there is no difference between thawed and fresh animals (see 4.1). Measurements should therefore be made on the type of samples best suited for the workflow on board the vessel.

- **WGBEAM question:** "What is the minimum number of shrimp measured per stratum (i.e. subarea)?"
  Answer from WGCRAN: No exact number was decided. The overall conclusion was that the number depends on the aim of the sampling and the number of stations per strata. However, a minor statistical study on shrimp length variation within and between strata, using data from DATRAS, could help to indicate a desired number of shrimp to measure.

Annex 5: Tables

Table 1 Proposed common data sheet to compile internationally collected data: Overview of data collected and raised <u>per fishing trip</u>. Please note: The data are exemplary only and show no results! TAC-species are gives by ICES abbreviations: PLE = plaice; HER = herring; WHG = whiting; SOL = sole; TUR = turbot; SPR = sprat; BLL = brill; SAN = sandeel; LEM = lemon sole; COD = cod.

Month	Quarter	Country	active fishing hours	hol duration(h)	# hols sampled	KW	Mesh	Beam length	ICES Area	ICES Rectangle	LandKgTrip Shrimp(boiled)	LandedkgTrip (fresh(*1.07))	PLE Tripkg	HER Tripkg	WHG Tripkg	SOL Tripkg	TUR Tripkg	SPR Tripkg	BLL Tripkg	SAN Tripkg	LEM Tripkg	COD Tripkg	NonTACfish Tripkg
3	1	DE	20	1	1	220	24	8	4b	35F6	500	535	10	0	26	26	26	26	26	26	26	26	5
4	2	DK	25	0.5	2	210	24	8	4b	36F8	700	749	0	200	10	10	10	10	10	10	10	10	10
5	3	NL	36	5	2	220	24	8	4b	37F8	800	856	12	3	20	20	20	20	20	20	20	20	20
6	4	NL	25	4	2	140	24	8	4b	35F8	1000	1070	120	20	10	10	10	10	10	10	10	10	10
7	1	DK	25	3	2	220	24	8	4b	36F7	300	321	100	10	0	0	0	0	0	0	0	0	0
8	2	DE	24	1	1	220	24	4	4b	35F6	200	214	0	0	0	0	0	0	0	0	0	0	6
12	3	DE	26	2	1	220	24	8	4b	35F6	1500	1605	5	0	3	3	3	3	3	3	3	3	8

Table 2 Proposed common data sheet to compile internationally collected data: Overview of data collected and raised <u>per haul sampled</u>. Please note: The data are exemplary only and show no results! NA for Germany as German catch information is only reported per fishing trip, not per haul fished. TAC-species are gives by ICES abbreviations: PLE = plaice; HER = herring; WHG = whiting; SOL = sole; TUR = turbot; SPR = sprat; BLL = brill; SAN = sandeel; LEM = lemon sole; COD = cod.

Trip ID	HolID	Date	Country	HolStart	HolEnd	Duration	Fishing Depth	ICES Rectangle	HAUL LandKgShrimp	PLE Haulkg	HER Haulkg	WHG Haulkg	SOL Haulkg	TUR Haulkg	SPR Haulkg	BLL Haulkg	SAN Haulkg	LEM Haulkg	COD Haulkg	Shrimps Haulkg	NonTACfish Haulkg	TotalSample Weight
DE1235	GER34	27.09.2020	DE	3:00	4:00	1	5	35F6	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	5
DK1234	DK35	27.09.2020	DK	14:00	14:30	0.5	10	36F8	50	0	200	10	10	10	10	10	10	10	10	10	10	2
NL1233	NL36	27.09.2020	NL	17:00	17:45	0.75	25	37F8	20	12	3	20	20	20	20	20	20	20	20	20	20	6
NL1234	NL37	27.09.2020	NL	2:00	4:00	2	65	35F8	50	120	20	10	10	10	10	10	10	10	10	10	10	5
DK1234	DK38	27.09.2020	DK	1:00	1:30	0.5	98	36F7	10	100	10	0	0	0	0	0	0	0	0	0	0	2
DE1236	DE39	27.09.2020	DE	18:00	18:50	0.8	4	35F6	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	4
DE1240	DE40	27.09.2020	DE	3:00	4:00	1	5	35F6	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	8