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Report of the Working Group on Crangon Fisheries and Life History (WGCRAN)

18–20 May 2010

Sylt, Germany

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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Executive summary

Landings

The Working Group on Crangon Fisheries and Life History (WGCRAN) 2010 meeting was successfully held at AWI, Sylt, Germany in May 2010. Members from Germany, the Netherlands, Belgium and Portugal were in attendance. Unfortunately Danmark could not be represented due to budget cuts at DTU Aqua. The effort and landings statistics for the Crangon directed fleets were updated for 2009. We note that Germany and the Netherlands continue to dominate the fisheries, with each of these nations landing around 12 000–16 000 tonnes in 2009 which is similar to the period from 1996 onwards. Denmark, the UK, Belgium and France together caught and landed the remaining 4800 tonnes, thus totalling around 33 000 tonnes landed from the North Sea.

Distribution of effort

International maps of the distribution of the effort were produced based on the German, Dutch and Danish VMS data for 2005 to 2008. In winter and spring the fisheries is concentrated off the Danish coast, while later, in summer, fishermen from all nations stay closer to the coast and inside the Wadden Sea.

Bycatch programs

The DCR regulation requires the collection of bycatch data. In the Netherlands this program started in 2008 and yielded the first Dutch bycatch data ever. So far only non spring data have been collected yielding a fish bycatch percentage of 5–12%. Forty to fifty % of the catch consisted of undersized shrimp.

Electric beam trawl

Due to lack of finances only little progress has been made in testing and the application of the electric beam trawl designed by ILVO.

Pollution load

Analyses of shrimp samples collected last year by WGCRAN members from the distribution range of brown shrimp were presented. These analyses indicate high concentrations of organotins persist on the Elbe and Scheldt towards the major ports of Hamburg and Antwerp.

Swept area estimate

A first try was made at combining the German and Dutch demersal fish survey to arrive at a combined swept area estimate for the autumn season. Taking catchability of the gear into account the total stock in autumn was estimated at 40 000 tonnes in the area covered by the survey.

Stock estimate

The MSC process still raises many questions. A formal question was directed at the group by the German government just two weeks before the meeting requiring answers to the questions: 1) whether it is possible to determine the size of the brown shrimp stock, 2) whether it is possible to introduce a standard stock management system with reference points and if not 3) if there would be alternative approaches to ensure that the stock is managed sustainably. Tessa van der Hammen (IMARES) presented the application of a biomass model to investigate if that would be a suitable way to assess the Crangon stock. This approach was discussed and it was concluded that the model could not be applied due to the fact that most of the model assumptions were not met. Alternative approaches were formulated.

Other issues

With a long list of Terms of Reference, and little work carried out interseasonally, not all Terms of Reference were addressed at the meeting.

Marc Hufnagl and Axel Temming (Hamburg university) presented results on three different topics. The first part dealt with an update on total mortality estimates, the second with potential food limitation of *Crangon Crangon* during the winter season and in the third part first results derived from the Helgoland Roads Zooplankton Series on *Crangon Crangon* were presented. Georg Respondek (Hamburg University) analysed the logbook data to investigate the behaviour of the German shrimp fishing fleet. Stefan Reiser (Hamburg University) explained the experimental work he is going to do on thermal preference of *Crangon*. Joana Campos (CIMAR) presented an overview of her PhD work on *Crangon*. Josien Steenbergen (IMARES) gave an overview on co-management projects between the Dutch shrimp fishers and researchers from IMARES to arrive at discard reduction through a net adaptation called "the mailbox". Volker Siegel and Thomas Neudecker (Johann Heinrich von Thünen Institute) presented seasonal biomass estimates for the German Bight in 2009/2010.

Altogether the WGCRAN continues in its tradition as a small but highly active and innovative working group.

1 List of participants to the WGCRAN 2010 meeting

A complete list of participants to the WGCRAN meeting is listed in Annex 1 of this report.

2 ToR a) Update landings and effort

2.1 Description of the national data sets

Because of confusion during the meeting on differences in methods of calculation of landings and effort between the countries we thought it would be a sensible idea to shortly repeat details on this as was done in the 2005 report for the last time.

2.1.1 Germany

Since 2000, the EU log sheet system is mandatory for the shrimp fishing fleet. The data are collected and stored by the BLE ("Bundesanstalt für Landwirtschaft und Ernährung"). Data are available on the trip, the effort and the catch per species.

Data on the trip include the registration sign of the vessel and time and place of departure and arrival, respectively.

Recordings of fishing activities can appear several times per calendar day, once per day or once per two days, in the case of an overnight trip. Available data include the catch by species and product category, the fishing date and time (begin, end, duration), the number of hauls, the hours fishing the gear and mesh size, the statistical rectangle and relevant vessel characteristics. The catch weight estimated at sea is corrected at landing by means of the quantity registered in the sale. As for other species, a conversion factor is applied to convert from landing weight to fresh weight (=1.19), in this case to compensate for weight loss due to cooking at sea. The figures given in this report, however, are in terms of landing weight. According to the relational character of the data base, the whole set of information is repeated when a boat changes the rectangle, which adds complication to the analysis.

Only the weight of shrimps sold for human consumption is considered, disregarding the shrimps sieved out and degenerated after landing ("Siebkrabben", "Quetschkrabben"), and those landed for industrial processing to pet food ("Futterkrabben"). Also, the landings and effort of part-time fishermen are not included in the German data as used here.

The number of days at sea includes all days with at least part of the day spent out of port as integer number rounded up to full days.

2.1.2 Netherlands

The Dutch data from landings and effort are derived from the VIRIS (Visserij Registratie en Informatie Systeem) database which contains logbook data from all Dutch vessels landing both in Dutch and foreign harbours. Catches are registered by the fisherman in logbooks. These data are send to the national inspection service (AID) and stored into the VIRIS data-base. Landings only include commercial sizes.

Because the registration of ICES rectangles is not mandatory for crangon fisheries, no trip specific information on rectangle is available.

Days at sea for the Dutch data were calculated as the number of days at sea, minus one day (because this day is assumed to be used for sailing home). One day trips were included as one day. In the earlier series produced by LEI, the last day was counted, which explains the difference between the two series. For the LEI one day at sea can be a single tidal trip of approximately 4 to 6 hours or a full day at open sea of 24 hours. Therefore the apparent stagnation of Dutch effort data is most likely misleading and the increasing LPUE figures in recent years are likewise biased.

2.1.3 United Kingdom

Fisheries data for the brown shrimp fisheries in the UK are collected by fisheries officers and input into a central database. Fishery activity by the fleet is comprehensively reported for the main fishery in The Wash operating primarily from the ports of King's Lynn and Grimsby. Landings from the fisheries on the West coast (Irish Sea) have been less extensively reported in recent times.

Vessels over 10 metres make statutory landing declarations but this is not a legal requirement for vessels under 10 metres. Although some of the fleet in The Wash fishery are vessels below 10 metres the fleet primarily land through only a few main merchants where landings information is available. Fishing activity is reported from landings declarations from the over 10 metre vessels, and typically as summary records for the below 10 metre LOA boats. Landed weights are obtained at the merchants/processors and are cooked weights of commercial sized shrimps. Summary records will generally have accurate information on landed weights but the fisheries officers will estimate effort information and fishing area. In most cases these estimates should be reasonable given the small size of these vessels often limiting the operational range of these boats to day trips in local ICES rectangles. Occasionally larger UK vessels may land and fish from foreign harbours but their fishing activity will be acquired from the statutory landing declarations.

In the past working groups have used hours fished as a measurement of effort for UK fishing effort data and subsequently LPUE. More recently, to aid comparison with international statistics, effort in terms of HP days has been computed. HP data is available for nearly all registered fishing vessels from 1988 but a meaningful index of effort in terms of HP days is not available for summary records. In 1988 only 75% of recorded landed weight had associated effort information in HP days, but from 1989 this proportion varied between 80% and 100%. Records with no effort information were excluded for the purpose of LPUE estimation and total effort has been estimated from the ratio of total landings to observed LPUE. Days fished is a relatively course measure of fishing time as it is recorded as whole days. This effort measure takes no account of time steaming between grounds but should be accurately recorded.

2.1.4 Belgium

Belgian logbook and landing data are managed by the federal 'Dienst Zeevisserij' in an Oracle database. While the EU electronic logbook is still not in service in Belgium, fishermen arbitrary fill in fishing hours and catch weight (cooked weight before sieving) daily for each ICES square visited. These data are then put manually into the electronic database by 'Dienst Zeevisserij' on a regular basis. The data gathering on the landings in Nieuwpoort, Oostende and Zeebrugge are also done by 'Dienst Zeevisserij'. Only in Zeebrugge the landed shrimp are sieved, in Nieuwpoort there isn't even an operational sieving installation. The cooked weight data are converted to fresh weight using a correction factor of 1.25. The biology section of ILVO receives and stores these data on a monthly basis in an Access database called BelSamp. This database however is rather limited (detailed data are lost) and error prone. In pursuit of 'Dienst Zeevisserij', ILVO is planning to switch to a more advanced database in cooperation with VLIZ (The Flanders Marine Institute). As the weight measurement of the daily landings in the harbor are more accurate, the daily arbitrary catch weight for each square is corrected in Belsamp:

$$Corrected\ catch\ weight_{square\ x} = Catch\ weight_{square\ x} \times \frac{Landing\ weight}{\sum_{all\ squares} catch\ weight}$$

The Belsamp database thus contains following data: Auction year; Auction month; Auction day; Dutch port name; Vessel ID; Vessel number; Vessel name; Vessel length [m]; Vessel GRT [t]; Vessel NRT [t]; Vessel engine power [kW]; Rectangle group code; Scientific species name; DZ species ID; ICES species abbreviation; Sum(Fresh weight (kg)); Fishing hours.

While both databases contain all domestic and foreign activities of Belgian trawlers, the Belgian data used for the WGCRAN working group are currently related to the landings in Belgian harbors only. For example, in 2009 the total landing of Belgian shrimp trawlers in Belgian ports was 444 tons of cooked shrimp, while 824 tons were landed abroad.

The Landings per Unit Effort (LPUE, in tons per horsepower fishing hours) used is calculated as follows:

$$LPUE = \frac{Cooked\ weight\ (in\ tonnes)}{\frac{Engine\ power\ (in\ kW)}{736} \times fishing\ hours}$$

Finally it should be noted that especially in Belgium a large but yet inestimable quantity of cooked commercially sized shrimp never reaches the official statistics. These shrimp are directly distributed to the local restaurants or sold in outdoor fishmarkets (such as the 'Vistrap' in Oostende). Moreover, it is likely that more and more shrimp trawlers will associate with the cooperative "Vlaamse Visserij Vereniging CVBA" (VVV) which was founded in 2007. In that case the caught shrimp are not landed at the fish market but are immediately processed by VVV for being marketed as 'Purus' shrimp.

As such, one could question to whether LPUEs have any scientific significance, especially in the Belgian case.

2.1.5 France

French vessels are small (8–14 m), those more than 10 meters fill logbook, the others monthly fishing declarations. All the declarations are computed by the French fishing administration and Ifremer has access to the database. The French crangon fishery is only composed by French vessels landing in French harbours. The landings concern only commercial size.

2.2 Update Landings and effort

2.2.1 Overview – Germany

German landings of consumption shrimp have slightly decreased from 12 956 tonnes in 2008 to 12 567 in 2009 according to official data on the active shrimpers. The seasonal distribution of the landings followed the standard pattern in principle, i.e.: very low landings in winter, increasing in spring, with a light depression in May/June and the main autumn fishery. The decrease was mainly due to lower landings in autumn (7976 t July to December 2009 compared to 8945 same period in 2008) partly compensated by slightly higher landings in the first half of the year. That was also an effect of a slight difference in effort: an increase of hp-days (KW-days) in spring and a decrease in October compared to 2008.

Comparing landings from different regions a 10% decrease in landings for the Schleswig-Holstein was reported, i.e. northern region compared to a 14% increase in the south-western part (Weser-Ems) and a stable situation in the central, i.e. Elbe-Weser part (+1%). This reflects a shift of the fishable stocks towards the south-west.

There have been 228 vessels actively contributing to the landings. Several further vessels contributing only to about 1 percent of the total landings are considered part time fishermen and were not included in this number.

As there was uncertainty on the source of data and allocation to fractions of the catch it was confirmed by a fisherman that the logbook data in combination with sales protocols produced by the processing companies clearly state consumption shrimps in kilograms separate from undersized and industrial shrimps and the actual prices. All data presented to WGCRAN refer presently to shrimps for human consumption only.

The previously described correlation of autumn and following spring landings was confirmed by comparatively good landings in the 2009 spring season.

2.2.2 Overview – The Netherlands

Total effort in the Netherlands in 2009 could not be calculated because the data have been transferred to a new database by the AID and the results did not look reliable. For landings data the reports by the producers organisations were used for 2009. For the effort the average over the period 2006–2008 has been used. Since there are no indications for a reduction in fishing effort the real value will likely not be very different.

Landings by Dutch vessels of *Crangon crangon* have slightly increased to 15 512 tonnes in 2009, which is an increase of 7% in comparison with 2008. The seasonal distribution of the landings and effort show peaks in March to May and September to November. Generally that pattern is consistent over the years, but in 2009 only the autumn peak showed up. Compared to previous years landings in October have been very high. The winter landings were as low as in 2008.

LPUE shows a constant level in the last years. The LPUE values are generally much higher in autumn than in spring, probably due to the fact that the Dutch vessels fish near Sylt in that period, where they fish on large shrimp. The number of vessels landing brown shrimp is fairly constant in the period 1995 to present with ± 210–230 vessels landing into Dutch harbours (that includes only vessels that land > 1 tons per year).

2.2.3 Overview – Denmark

The annual and monthly Danish landings of *C. crangon* and by other EU-vessels are reported by the industry. The data on landings from Danish waters are given for 2009 and the Danish landings amounts to 3096 tonnes and the landings by other EU-countries were 1709 tones. These landings are included in the respective national figures. The Danish landings decreased in 2009 compared to 2008 by 8.6%.

Based on logbook information the reported catch, effort and LPUE for the Danish fleet is given. In 2009, 27 Danish vessels fished and landed *C. crangon*. Total fleet effort increased from around average 1 166 101 (hp-days) in 2008 to 1 199 797 in 2009. The LPUE the previous 12 years was on average 3.35 Kg/hp-day. The LPUE peaked in

2006 at a value of 5.78 Kg/hp-day. In 2007 the Danish LPUE decreased to 2.58. The highest landings took place in March and April. The lowest landings were in January, February and November. The Danish effort is high in spring and in autumn.

Similar to the previous years, a large number of German vessels (however fewer compared to the previous years, 32) and Dutch vessels (64) too fished shrimps in Danish waters and landed the catches in Danish harbours. There has been a decrease in the number of vessels from other EU-countries fishing and landing *C. crangon* in 2009 compared to 2008 of around 33%. The Belgians have decreased their activity in the Danish economical zone in the North Sea. Only 2 Belgian vessels have fished and landed *C. crangon* in Danish waters compared to 4 vessels the year before. Although their landings represent only 0.1% of the total landings caught in Danish waters. The effort and LPUE data for the other EU countries are based on logbook information from the respective EU-Countries.

2.2.4 Overview – United Kingdom

The majority of fishing record data for vessels landing shrimps into the UK is stored on official databases held by English and Scottish authorities. Historically these data have been combined but since 1997 Scottish landings have been zero or negligible and for some records implausible capture methods have led to doubts about their validity. As such UK landings presented in recent working group reports and for recent years (post 1997) have consisted exclusively of those by English and Welsh vessels. With improvements in reporting procedures from 1988 landings data are considered to provide a reasonably comprehensive account of fishing activity by UK vessels and data prior to this year are considered less reliable.

Improvements in reporting have also led to most landings since 1988 being accompanied by corresponding effort information in the form of the engine power of the vessels and the days fished (rounded to the nearest whole day). Indeed since 2007 all landings have appropriate engine power and days fished information enabling computation of hp-days for each landing and corresponding summation to month and year.

The Wash fishery in the North Sea is the source of typically around 90% of the recorded landings for the UK with ICES squares F034 and F035 the most important areas for the UK *Crangon* fishery. Annual landings of *Crangon* have been variable over time with the highest recorded landings (2154 t) in 2001 and the lowest in 1984 (132 t). UK landings from 2004 to 2006 were below 500 t in each year with the annual landing for 2006 (~430 t) being the lowest value since 1992. However, 2007 saw high landings of brown shrimps at 1384 tonnes, the fourth largest landings since (accurate) records began in 1988. Moreover, the landings-per-unit-of-effort was the highest for this period. The good recruitment that provided the high landings in the autumn of 2007 also contributed to a good fishery in the winter and early spring of 2008. Landings in 2009 show that catches were initially moderate in the first half of the year but were good in the peak of the fishery.

Since 1990, effort information in terms of hp-days is available for most of the reported landed shrimps (from 63% in the early years increasing to 100% in 2007 to 2009). Total effort was estimated from the ratio of total landings to observed LPUE. Estimated total effort for 2004 and 2005 was lower than in previous years in line with landings at just over 500 000 hp-days. Estimated effort for 2006 was only ~250 000 hp-days because effort was redirected into the local cockle fishery. Estimated annual effort levels since 2006 have increased to more typical values. However, in the autumn of 2007 and winter of 2008 effort was very high and this corresponds to the period of good landings and high prices. Fishing effort in 2009 was in the order of ~660 000 hp-days, the highest value in the last seven years.

Since 1989 the number of UK vessels reported as fishing for brown shrimps has varied between 44 and 91, depending on market forces and other fishing opportunities. Although this value is likely to be an underestimate of the true numbers of vessels operating in England and Wales it is considered a reasonable estimate of the size of the fleet. The recent high prices and landings of the main UK fishery have led to moderately high numbers of vessels (74 in 2009) prosecuting the fishery.

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2.2.5 Overview – Belgium

Total annual landings from Belgian shrimp trawlers into Belgian harbors increased in 2009 with 68% to 444 tons (60% in Oostende, 36% in Nieuwpoort and 4% in Zeebrugge) compared to 2008, which is higher than the average of 375 tons landed during the last decade, where landings seemed to stabilize after a 20-year drop. Landings of Belgian trawlers into foreign ports also increased drastically with 50% to 824 tons (98.4% in the Netherlands, 1% in Germany and 0,5% in Denmark). Notably, one shrimper was back into use and landed 62 tons, while another trawler which landed 56 tons during the preceding year was sold to a Dutch ship-owner. The Belgian shrimp trawling fleet consists of 32 vessels, of which 13 vessels exclusively landed in Belgian harbours, which is the same number of Belgian trawlers landing exclusively in foreign harbours. The Annual LPUE (kg/hp-fishing hours) related to the landings in Belgian harbours increased dramatically from 0.074 to 0.125, the highest domestic LPUE observed since 1983, while the LPUE of the landings into foreign harbours was 0.183 kg/hp-fishing hours.

From now on we will further focus on the landings of Belgian shrimp trawlers into Belgian harbours. On average, the yearly Belgian effort during the last decade is characterized by a low level of 200 000 hp-fishing hours from January till may, gradually increasing and reaching a peak of 900 000 hp-fishing hours in October. In contrast with other national shrimp fleets, an intensive fishery during the first semester is thus missing. The large annual effort reduction from more than 6 million to less than 4 million hp – fishing hours observed in 2007 seems to stabilize at 3.5 million hp – fishing hours. The monthly effort during January–March was low (~6000 hp-fishing hours), while the monthly effort during August–December fluctuated around 50 000 hp-fishing hours, lacking the usual peak in October. Compared to previous years, monthly LPUEs during August–November were exceptional with a maximum of 0.222 kg/hp-fishing hours in September, compared to an average monthly maximum of less than 0.100 during the previous decade. As a consequence annual LPUE peaked to 0.125 kg/hp-fishing hours, as stated earlier the highest annual LPUE observed since 1983.

2.2.6 Overview – France

In France, the brown shrimp fishing occurs in the Eastern English Channel and the Southern North Sea (Bay of Somme, Seine estuary, Dunkerque and Boulogne areas), along the Atlantic coast (pertuis charentais) and also for a very small part on the Mediterranean coast.

The landings concern only French vessels working in national coastal waters. Total landings in 2008 were estimated to 309 tonnes with 170 coming from the Northern part. For this same year, the total number of boats involved was respectively 145 and 48; these include a majority of boats fishing part time on brown shrimp. 2009 preliminary statistics seems to show a slight increase of the landings.

The boats are small (8–14m) and they used otter bottom trawl with selectivity device as Devismes or Asselin, the brown shrimp are landed alive and the main fishing seasons are spring and autumn.

Landings are estimated from administrative data, logbook and, for the smaller boats, fishing declaration. Ifremer also carries out a census of the activity (metiers) of all the French boats every year; the effort is estimated in boats-months. The quality of the statistical data has improved a lot in the last years but some uncertainty still remains due to the small size of the boats, the present high value of the brown shrimp and a local market (tourism).

Even if the landings are not well known, a general decreasing trend is observed for the landings and the current level is only 10% of which it was in the 1970s. This seems linked with a decrease of the local stocks.

2.3 Total EU landings of C. Crangon

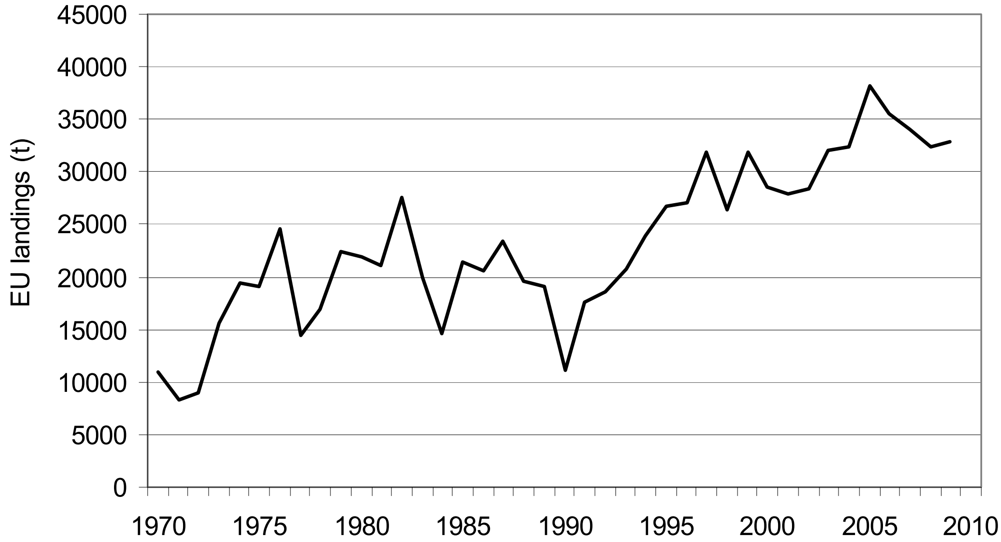

Figure 2.1. Landings of C.*Crangon* from the North Sea [t].

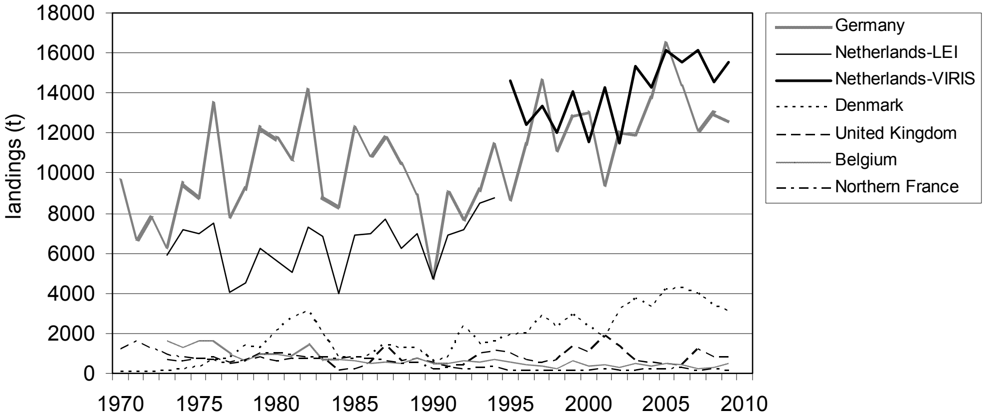

Figure 2.2. Landings of C.*Crangon* from the North Sea [t] by country.

2.4 Seasonal EU landings of C. Crangon

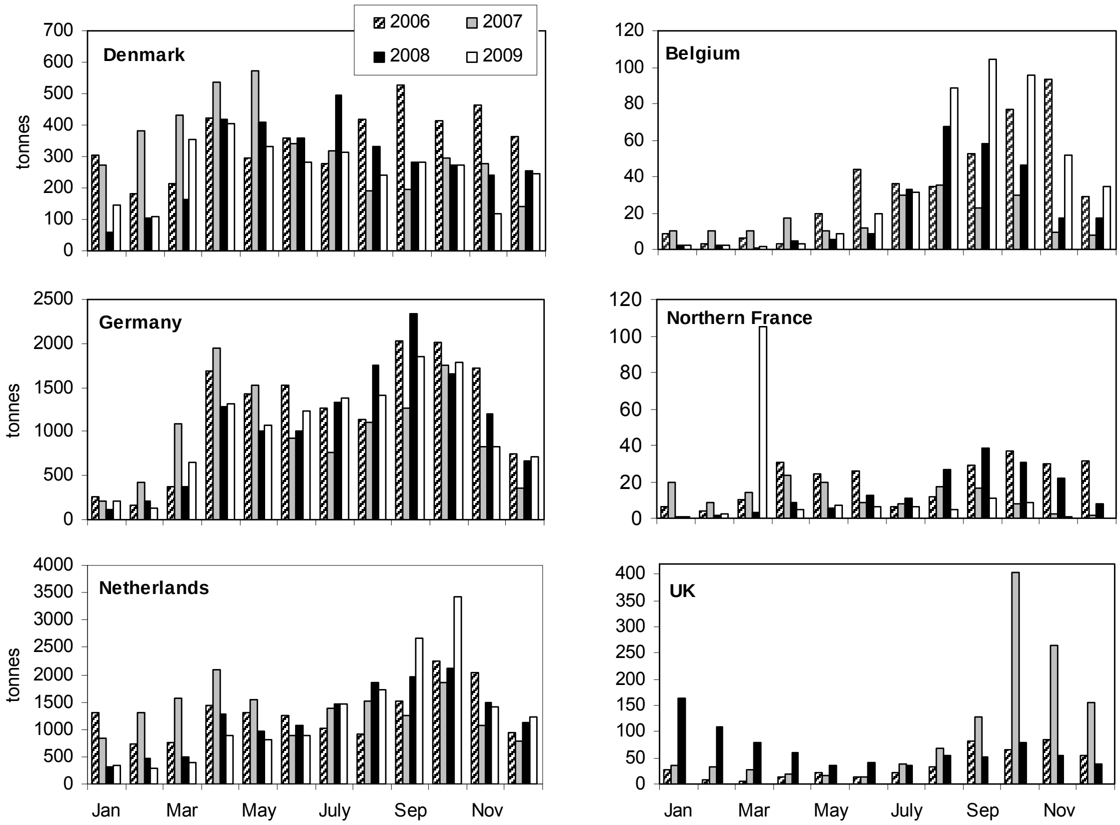

Figure 2.3. Landings of C.*Crangon* from the North Sea [t] by country and month.

2.5 Total fleet effort in the EU C. Crangon fishing fleets

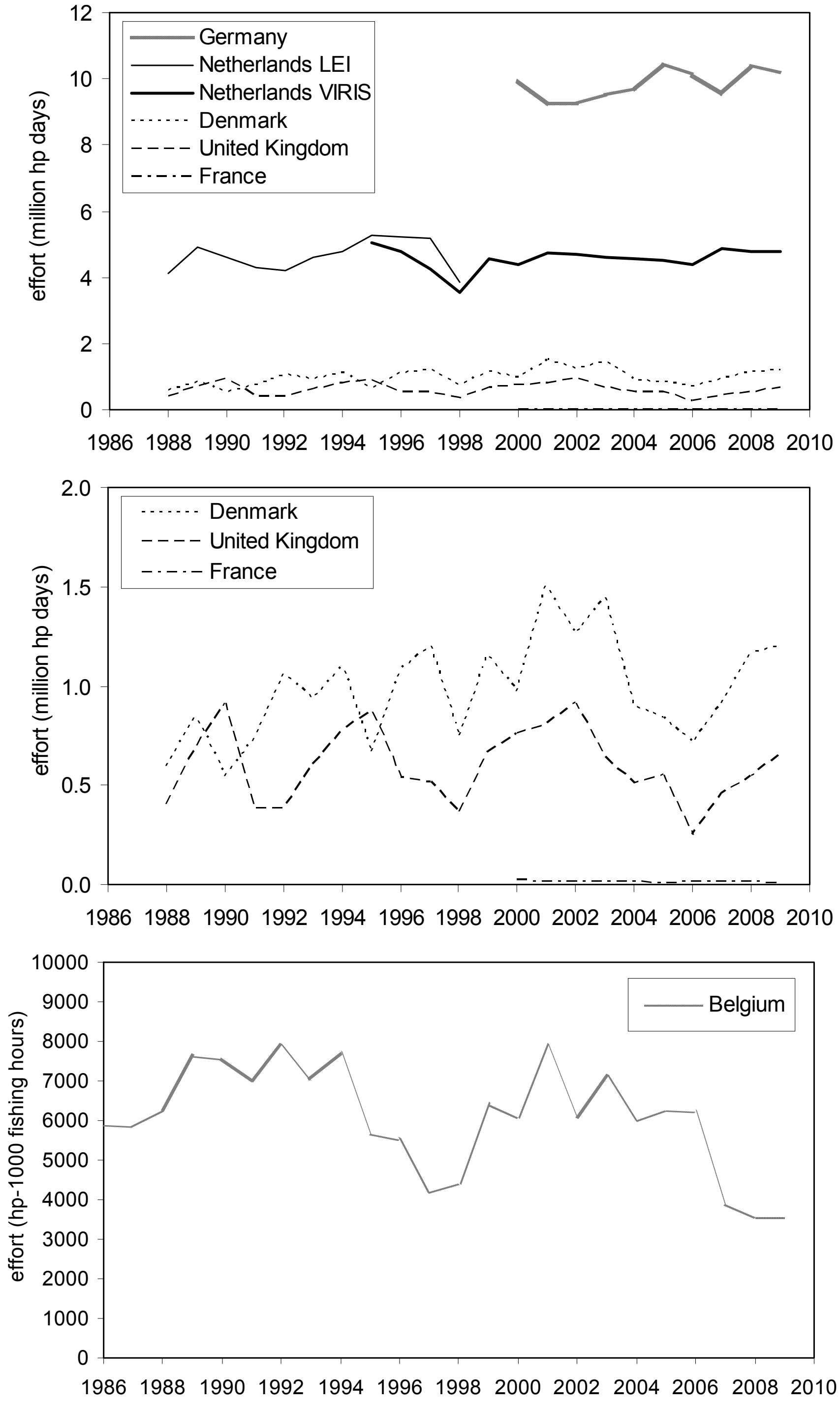

Figure 2.4. Effort in the EU fishing fleets. Netherlands LEI based on data collated by LEI institute; Netherlands VIRIS based on VIRIS data. The middle graph represents the data for Denmark, UK and France again separate, but on a different y-axis, allowing to see the year to year fluctuations better. The lower graph presents the Belgian data in a different unit.

2.6 Seasonal fleet effort in the EU C. Crangon fishing fleets

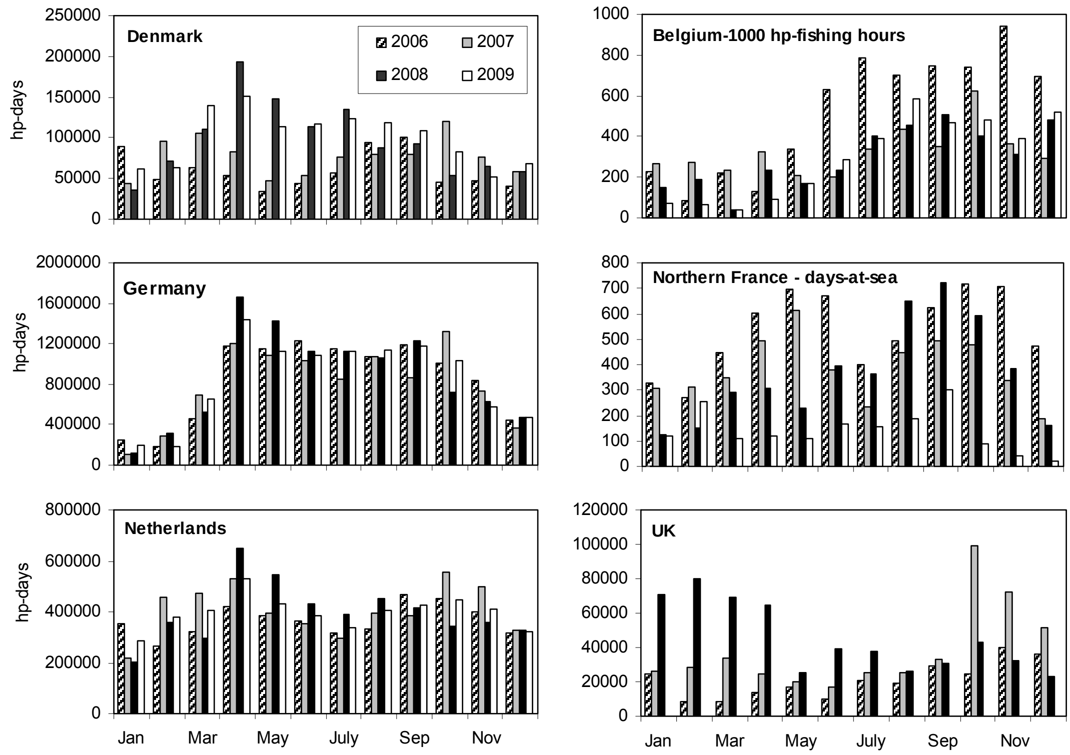

Figure 2.5. Effort by country and month (Dutch effort 2009 is average of past 3 years).

2.7 Landings per unit effort in the EU *C. Crangon* fishing fleets

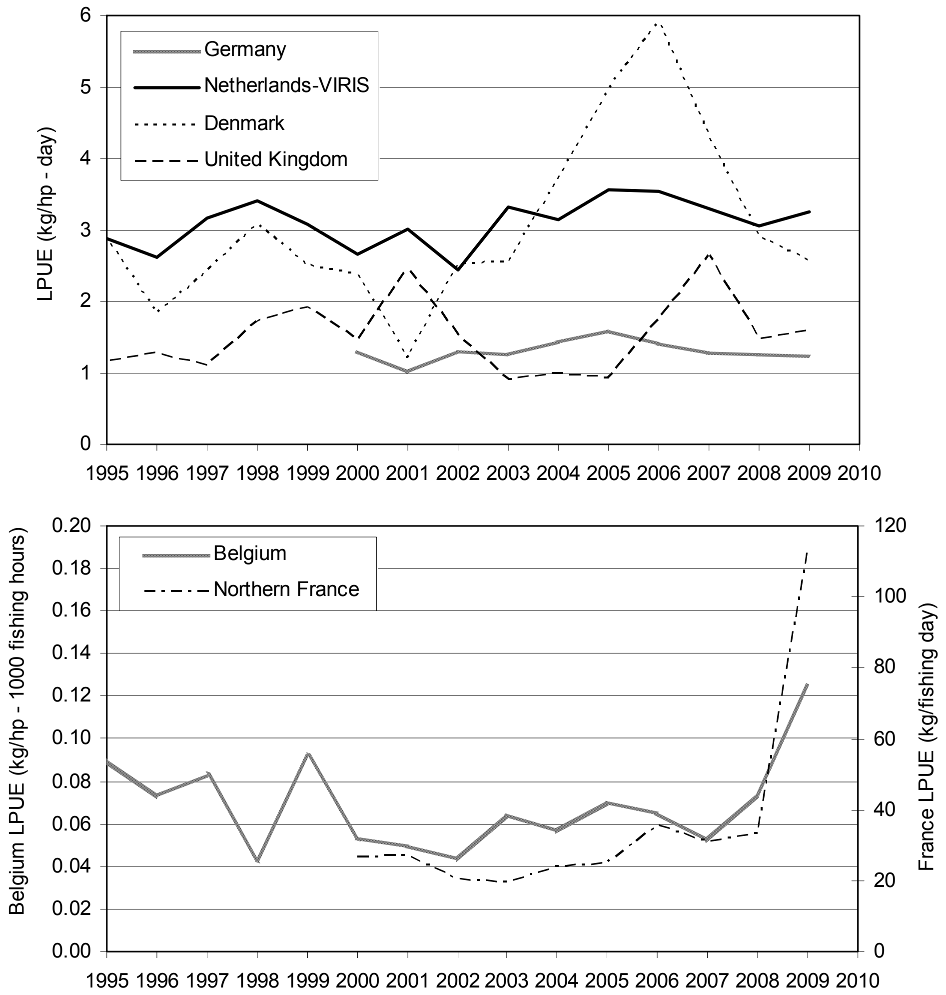

Figure 2.6. Landings per unit of effort in the EU fishing fleets. Units are different for the different countries: (DK) kg/hp-day; (NL) kg/hp-day;(DE) 1973–1994 effort LEI, catch PO, 1995–2003 catch + effort VIRIS; (BE) kg/10 hp-fishing hours.

2.8 Seasonal landings per unit effort in the EU C. Crangon fishing fleets

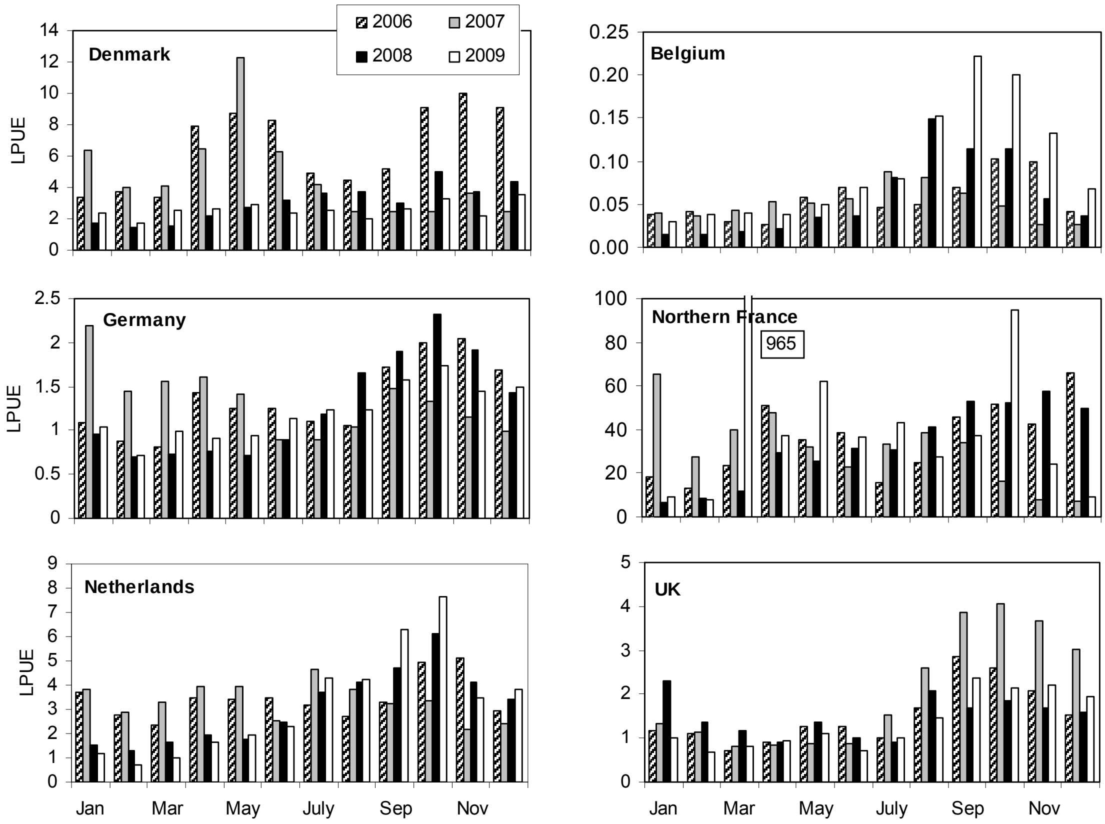

Figure 2.7. Landings per unit of effort in the EU fishing fleets. Units are different for the different countries: (DK) kg/hp-day; (NL) kg/hp-day;(DE) 1973–1994 effort LEI, catch PO, 1995–2003 catch + effort VIRIS; (BE) kg/10 hp-fishing hours.

2.9 Numbers of vessels

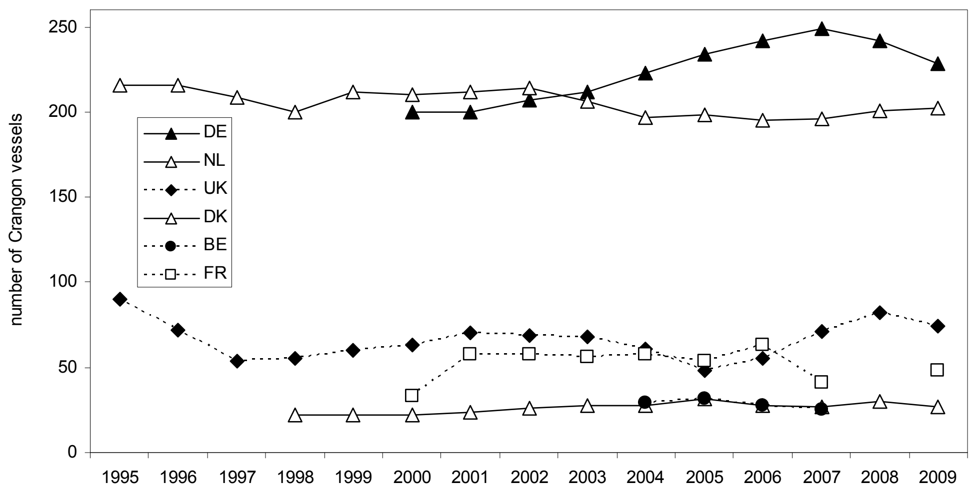

Figure 2.7. Number of active Crangon vessels per country.

3 ToR b) update on bycatch data collected under the DCR in German and Dutch shrimp fisheries

Ingrid Tulp

In 2008 the bycatch program in Dutch shrimp fisheries under the DCR started. Circa eight daytrips per year are made in the Dutch coastal waters. Up to now the focus has been on the Wadden Sea (Figure 3.1). Given the large variation caused by season, vessel, gear, rotary sieve and way of fishing this is very limited to provide a reliable estimate of the bycatch. The protocol as discussed and decided upon in ICES (2008) was used. In the majority of hauls the largest proportion of the catch consisted of undersized shrimp. Young flatfish and roundfish made up 5–12% of the catch on weight basis. Forty to 50% of the catch consisted of undersized shrimp. The spring which is the period with the expected highest bycatch rates has not been sampled yet.

Table 3.1. Overview of samples taken in the Dutch bycatch program.

year	date start	date end	quarter	n days	n hauls	sievenet	data incl. in analysis
2008	29-Jul	29-Jul	3	1	4	y	y
2008	29-Sep	30-Sep	3	2	6	y	y
2008	24-Nov	24-Nov	4	1	6	y	y
2009	1-Jul	2-Jul	3	2	6	y	y
2009	28-Sep	2-Oct	3	5	12	y	n
2009	7-Oct	7-Oct	4	1	7	y	y
2009	12-Oct	13-Oct	4	2	11	y	y
2009	11-Nov	11-Nov	4	1	5	n	n
total				15	57		

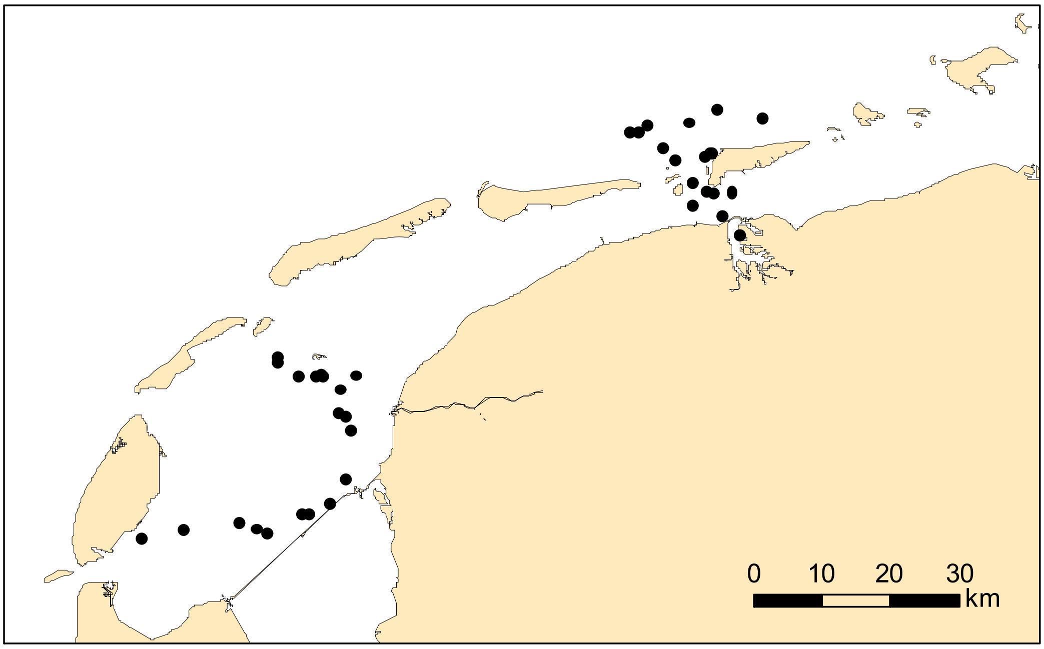

Figure 3.1. Distribution of sampling sites.

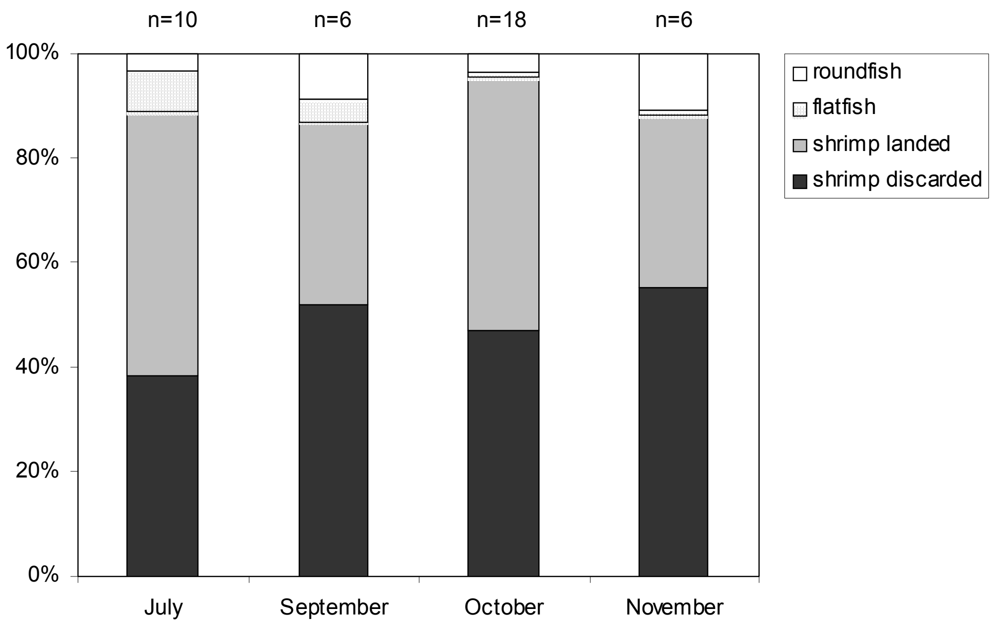

Figure 3.2. Catch composition (on the basis of weight) during the bycatch program in the Dutch shrimp fisheries.

References

ICES (2008). Report of the Working Group on Crangon Fisheries and Life History (WGCRAN).

4 ToR c) make progress in updating the paper by Welleman & Daan (2001)

No progress was made on this ToR.

5 ToR d) explore available data on number of egg-bearing females and correlations with stock size

No progress has been made on this subject.

6 ToR e) Distribution of fishing effort of the Danish, German and Dutch shrimp fisheries in the North Sea

Torsten Schulze, Heino Fock

6.1 Methods

During the project "Study for the Revision of the plaice box" (see Beare *et al.* 2010 for further details), funded by the European Commission, partners submitted EU VMS (vessel monitoring system) data for Denmark, Germany and The Netherlands. The same data set was used for the present analyses. Original VMS data consist of the vessel identification number, position, speed over ground and heading. For each position a flag indicating "fishing" or "not fishing" was computed from the speed of each vessel, i.e., a certain range of low speed was labelled "fishing" whereas higher speed and standing still were labelled "not fishing". The position of the boat was then allocated to a 3 times 3 nm miles rectangle (i.e. 100 fine rectangles per ICES rectangle) and the time interval between two positions was summed up to the amount of fishing effort spent in a specific 3 by 3 nm rectangle (hours fishing, Figure 6.1). Since the time interval between each position can be up to two hours there is a considerable portion of 'unseen' activity by each vessel (Figure 6.2). The method applied, here, for VMS data analysis takes account of this uncertainty by substituting each registration with a discrete set of positions with high probability of vessel presence (Fock 2008). This assumption, however, leads to inaccuracies when specific borders are met which may not be passed so that the probability assumption does not hold. For the PB, this may lead to indications of fishing inside the box when actually no fishing inside has taken place, e.g. for vessels > 221 kW. Further, positions with low steaming speed over ground indicating "fishing" action are generated while slowly moving through tidal gullies or against the current etc. which is a further inaccuracy of the method. Error for this method to analyze VMS was assessed to be ca. 5 % (Fock 2008).

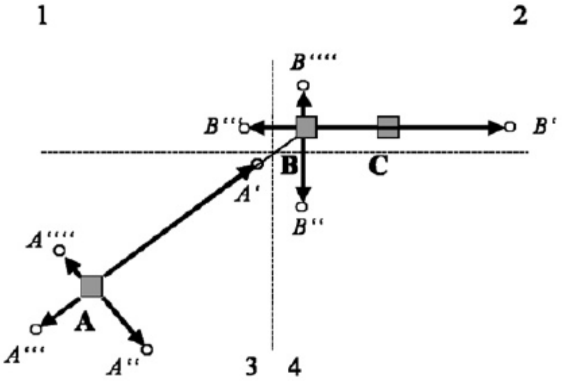

Figure 6.1. The VMS data model. The distances between three subsequent VMS fishing positions A, B and C, i.e. AB and BC are shorter than would have been expected from the product of fishing speed times time interval, indicating that unaccounted movements have occurred. Thus, the VMS data model replaces A and B by four new positions each, A0–A0000 and B0–B0000. The lengths AA0 etc. are calculated from vessel specific mean fishing speed (v) and vessel specific portions of movement in respective directions A0 (p) and the time interval (t), respectively. The effort allocated to A0 is calculated from vessel specific portion of movements in direction A0 times the preceding time interval, respectively. In this example, the raw data interpretation would mean that fishing activities only took place in sectors 3 and 2. The VMS data model indicates that fishing activities also take place in sectors 1 and 4, indicated by B000 and B00. Note that due to model implications B0 lies beyond C (from Fock 2008).

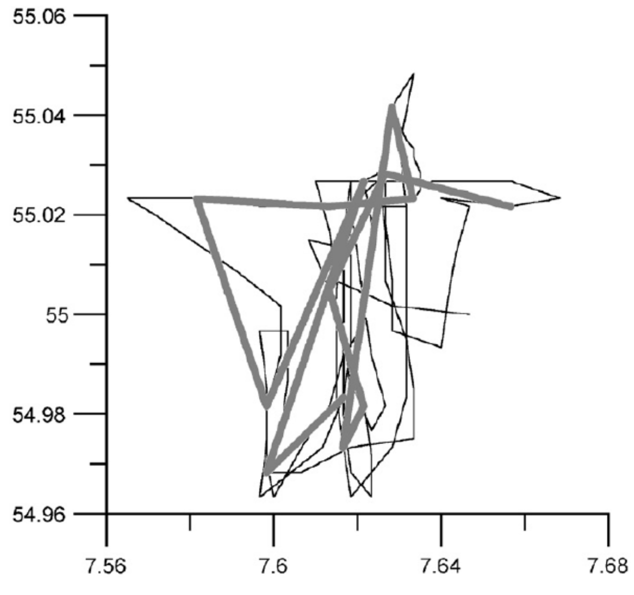

Figure 6.2. Effect of temporal resolution of VMS data on spatial coverage of fishing activities based on a 24-h sequence for a single vessel in the North Sea. Original VMS recordings at 12-min. intervals compared to 2-h interval resolution (bold grey line) (from Fock 2008).

To identify the métier of the vessels (shrimper or other) log-book information on the used gear, mesh size and power category for each vessel and trip was used. However, misclassification due to wrong logbook data might occur (e.g. see effort in the second and the third quarters of 2007 of Dutch shrimpers in off shore areas). The data were aggregated by all four years or quarter for total national shrimp fleets (i.e. vessels with less than 300 hp, fishing with beams and mesh sizes of 16–31 mm in the cod end) so that no individual boat or fisherman may be identified.

Since only part of the VMS data of the Dutch fleet were available for the study, the Dutch effort per métier and power class data were corrected by the proportion of effort in terms of kWhours covered in the VMS data with the kWhours-effort covered by logbook data (Table 6.1).

Table 6.1. Proportion of kWhours covered in the dutch VMS data of the kWhours covered by logbook data.

year	ratio vms-logbook
2005	0.16
2006	0.20
2007	0.22
2008	0.25

6.2 Results

The distribution of fishing effort (hours) per 3 x 3 nm rectangles of the Danish (DEN), German (GER) and Dutch (NLD) shrimp fisheries in 2005 to 2008 are presented for the whole period in Figure 3 and quarterly in Figure 4.

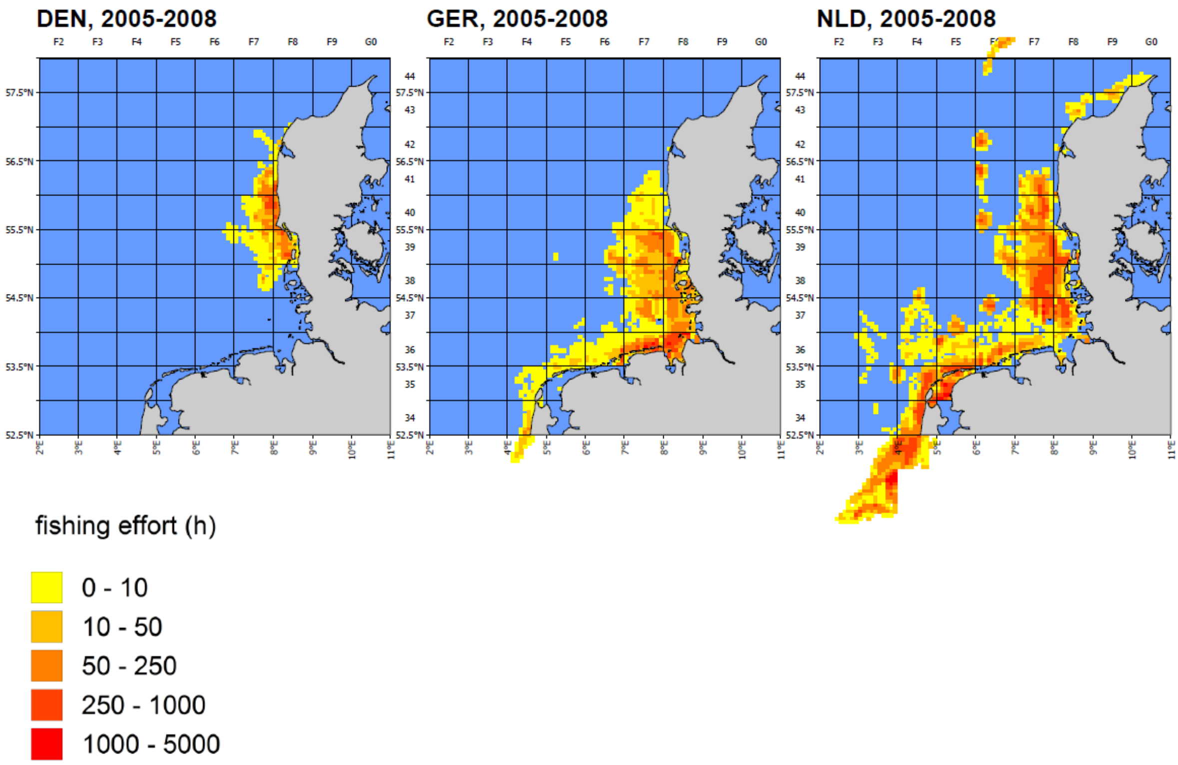

Figure 6.3. Distribution of fishing effort (hours) of the Danish (DEN), German (GER) and Dutch (NLD) shrimp fisheries in 2005 to 2008.

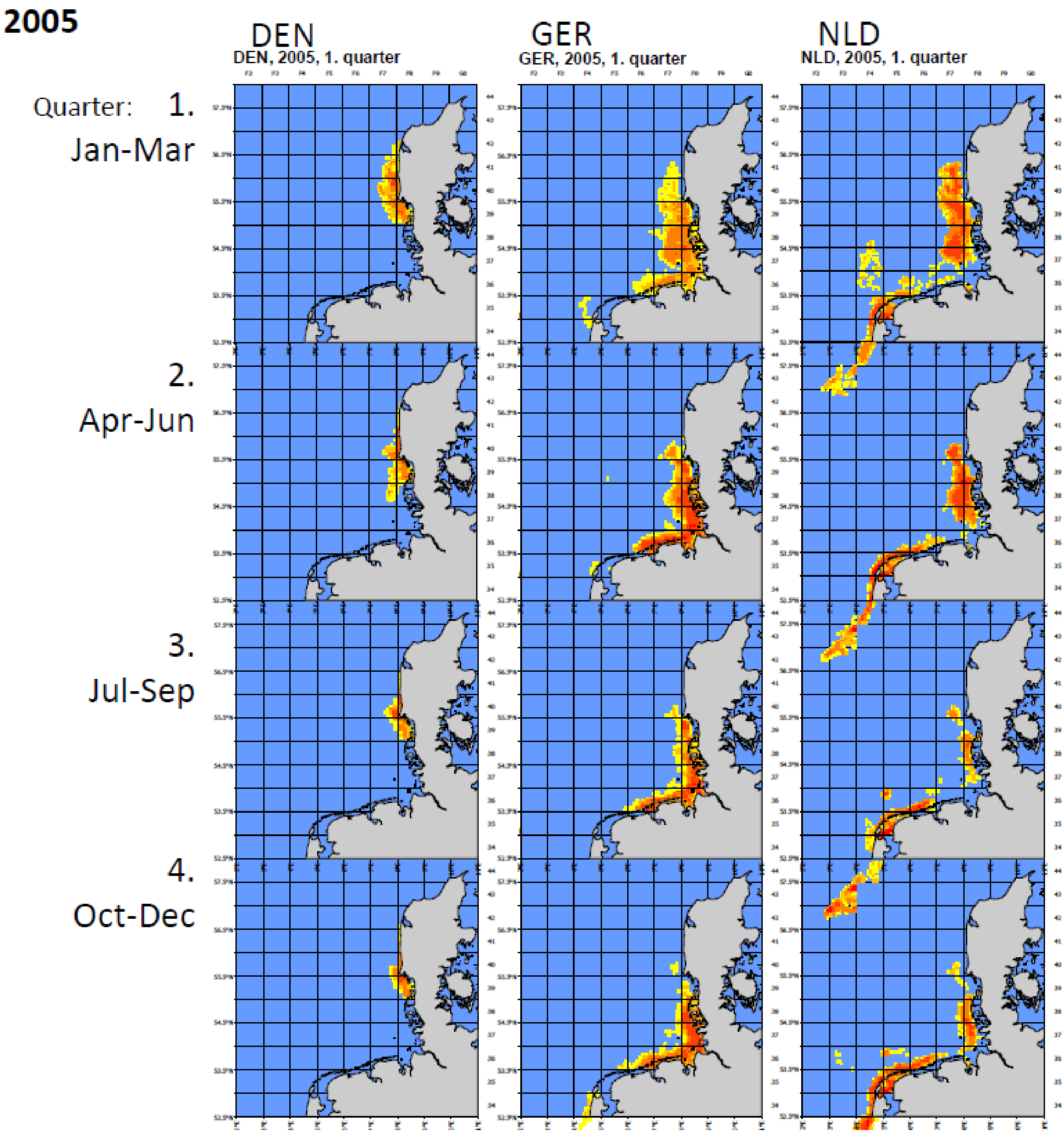

Figure 6.4. Distribution of fishing effort of the Danish (DEN), German (GER) and Dutch (NLD) shrimp fisheries in 2005 to 2008 for the first to fourth quarter. See Figure 6.3 for legend.

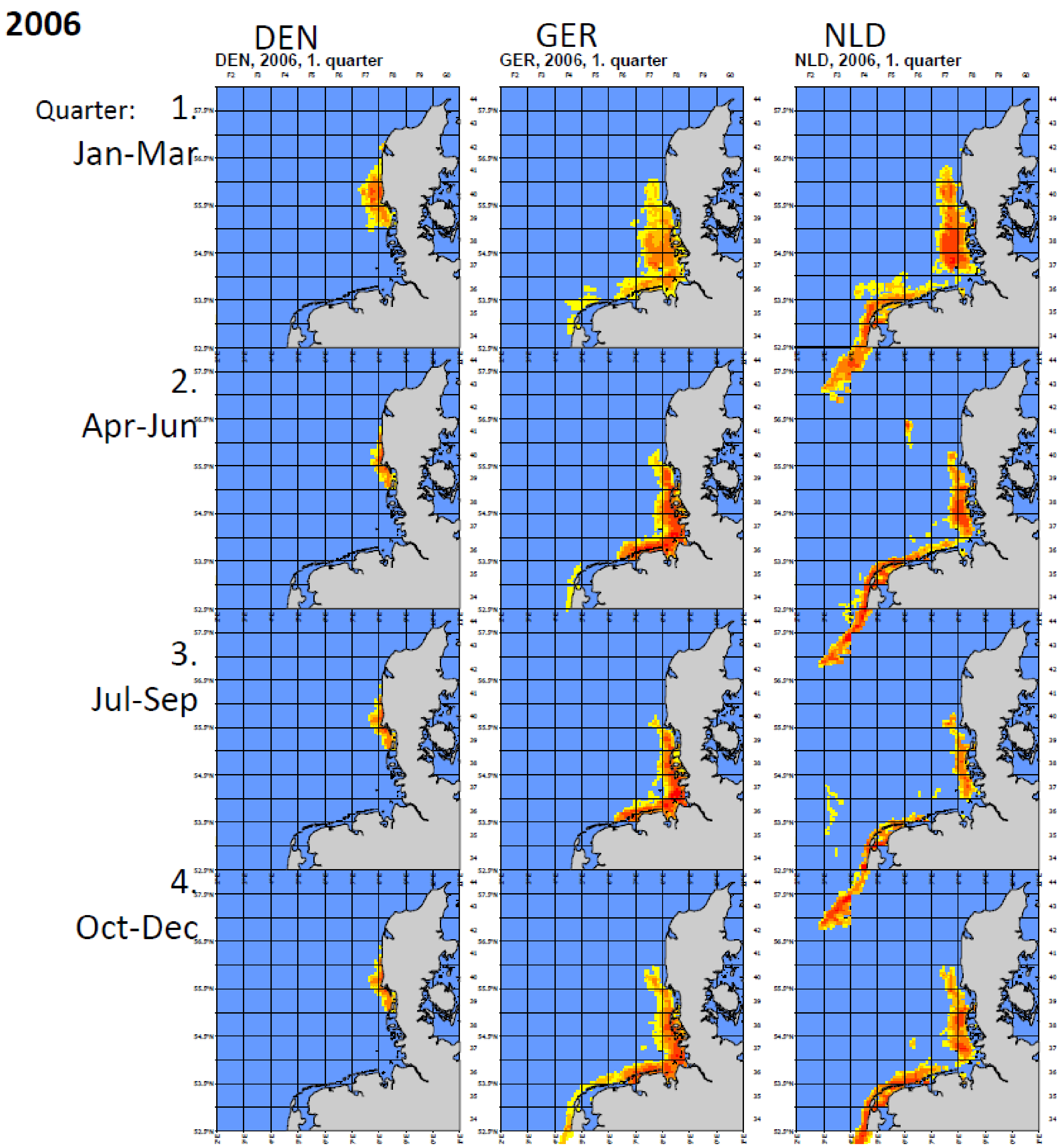

Figure 6.4. Continued.

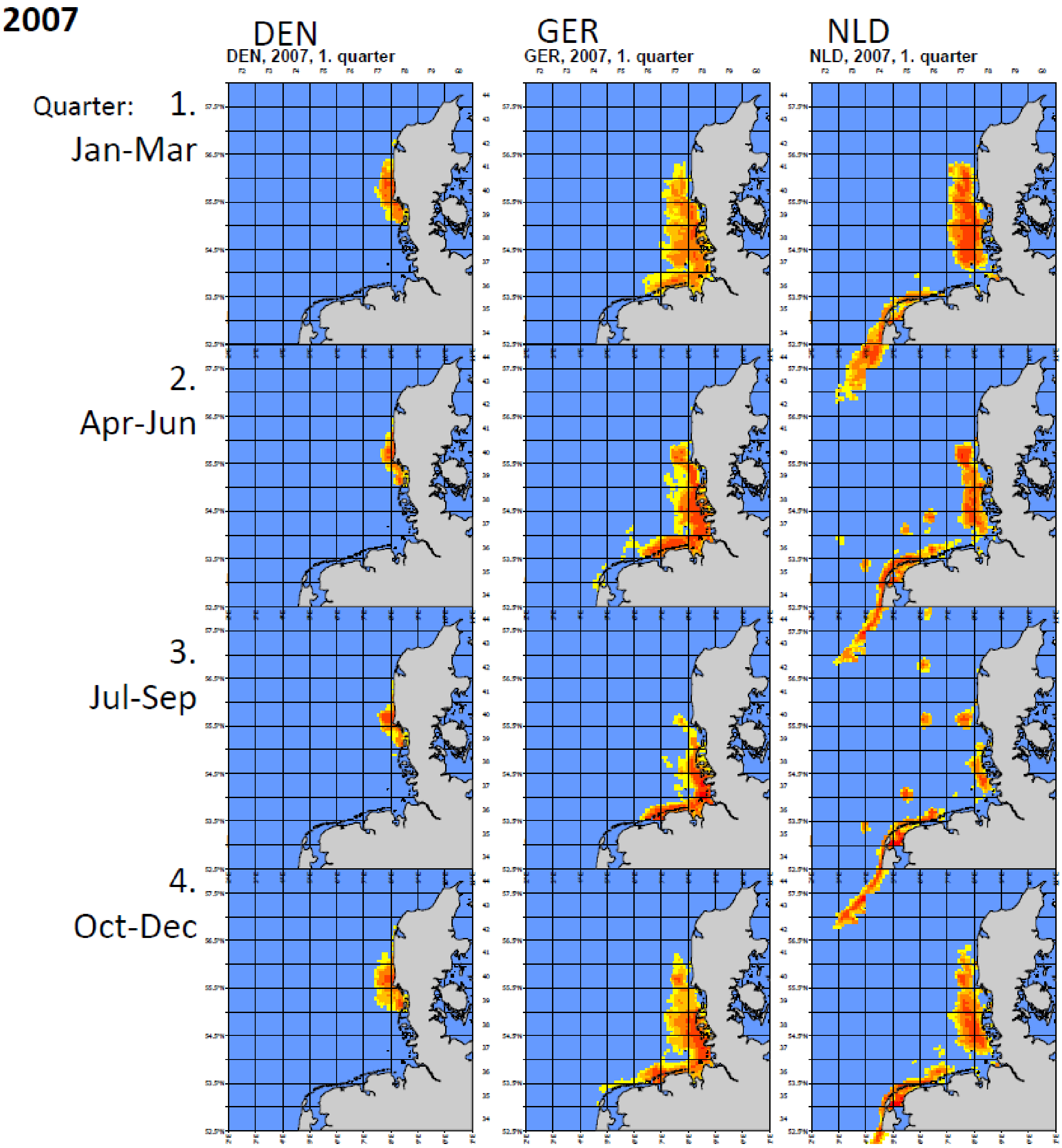

Figure 6.4. Continued.

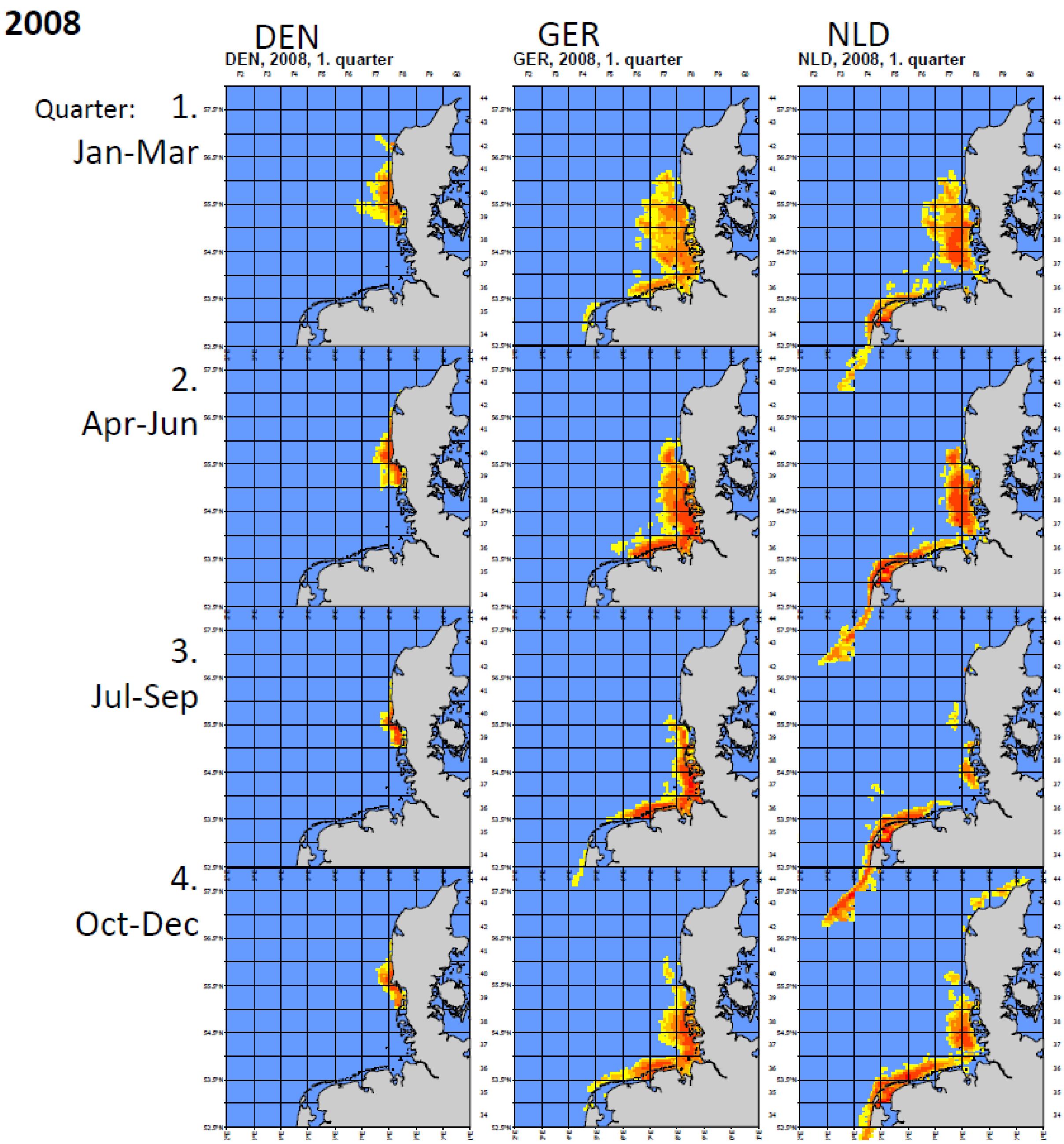

Figure 6.4. Continued.

6.3 Future aspects

The fleets of other countries (e.g. Belgium, Great Britain, France) should be analyzed the same way to provide a complete picture of the distribution patterns of European shrimper fleets.

To correct misclassifications (shrimpers which target other species) the landings of each trip could be checked for main species landed.

The complete VMS data set for the Dutch vessels should be used since the proportions used are equal for the whole investigated area but the actual coverage of Dutch VMS data on the Dutch fleet is not (H. Fock, unpublished results).

According to the information in the logbook data the analyses could be done also for other métiers or categories (e.g. vessel length, harbour of landing, home port, nationality). The used method is suitable to identify principle areas of fishing on a relatively fine scale (see Fock 2008 and Berkenhagen *et al.* 2010).

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7 ToR f) review the report on electric beam trawl research by Bart Verschueren

Due to a delay in the project (because of financial reasons) there was no final report at the time of the meeting to be reviewed.

8 ToR g) Pollution loads of *Crangon*

Yves Verhaegen

Within the framework of the PhD study on ecotoxicology of organic pollutants in brown shrimp, the pollution load of a wide variety of pollutants (PCBs, PAHs, organochlorine pesticides, flame retardants, organotins and perfluorinated organic compounds) will be analyzed. Thanks to the partner institutes of the WGCRAN working group, 52 stations were sampled between 1/09/09 and 10/11/09, covering the commercially exploited fishing grounds of *Crangon crangon*:

- Dr. Ingrid Tulp, IMARES, IJmuiden: 5 samples from the Scheldt estuary (RV Schollevaar), 7 from the Dutch coast (RV Isis) and 14 samples from the Dutch Wadden Sea (RV Stern) through the DFS program;
- Thomas Neudecker, Institut für Seefischerei, Hamburg: 15 samples from the German Wadden Sea (chartered commercial shrimpers) through the DYFS program;
- Per Sand Kristensen, National Institute of Aquatic Resources, Charlottenlund: 7 samples from the Danish Wadden Sea using a chartered commercial shrimper;
- Yves Verhaegen, Insitute for Agricultural and Fisheries Research (ILVO), Oostende: 4 samples from the Belgian Continental Shelf through monitoring campaigns aboard the RV Belgica.

All analyses will be performed at the Management Unit of North Sea Mathematical Models (MUMM), Oostende, except the perfluorinated organic compounds, which will be analyzed at the Biology Department at Antwerp University. For the moment, the organotin content of these samples are analyzed. The sampling station location and some preliminary organotin data are represented in Figure 8.1.

Shrimp caught at the Oostdyck sandbank, the most western and offshore sampling station, exhibited the lowest organotin concentration (19 µg Sn ion/kg dry weight). Highest concentrations were measured near Vlissingen-Oost harbor (167 ng/g), while organotin concentrations sharply decreased within the Scheldt estuary 10 km east towards the sea (85 µg/kg). Concentrations were high in the Elbe estuary near Wehldorf (133 µg/kg). All other nearshore and intertidal sampling stations exhibited organotin concentrations around 20–50 µg/kg.

Organotins are composed of Sn ions chemically bound to one or more hydrocarbon substituents (most often butyl or phenyl). Triorganotins are extremely toxic and were used as industrial, agricultural and pharmaceutical biocides and in marine antifouling paints. Diorganotins (except diphenyltins) exhibit a low toxicity and were used in polymer manufacturing. Monoorganotins exhibit very low toxicities and were used as PVC heat stabilizers. Organotins are believed to be well degradable (triorganotins -> diorganotins -> monoorganotins -> inorganic tins).

While the use of organotin in antifouling paints on ship hulls and other submerged surfaces has been banned globally since September 2008, our preliminary results indicate high concentrations persist on the Elbe and Scheldt towards the major ports of Hamburg and Antwerp. These loads are considered, however, of being of no harm to human consumption purposes as they are well below accepted dangerous thresholds.

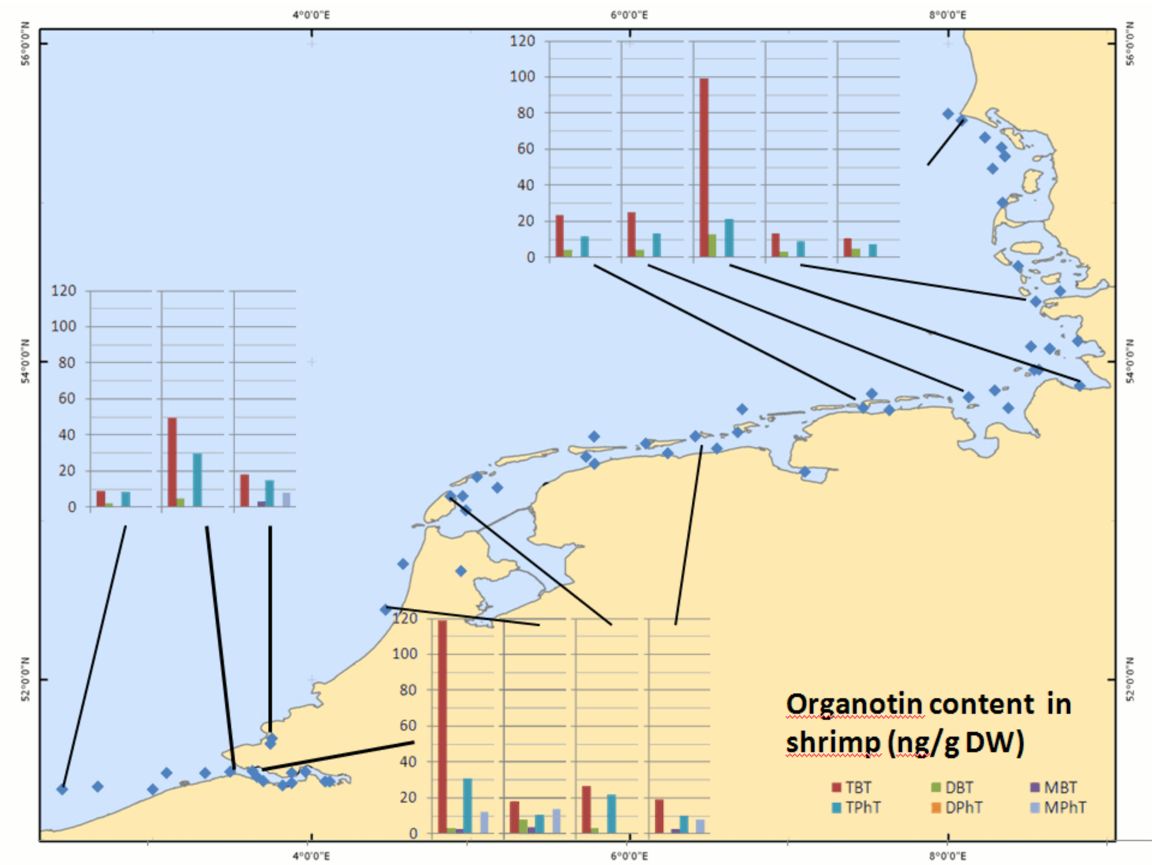

Figure 8.1. Map showing sampling stations and organotin concentration.

9 ToR i) review recent *Crangon* related Research & Development activity

9.1 Update of mortality estimates, winter food limitation and larval abundance

Marc Hufnagl, Axel Temming (Hamburg University)

Results on three different topics were presented. The first part dealt with an update on total mortality estimates, the second with potential food limitation of *Crangon Crangon* during the winter season and in the third part first results derived from the Helgoland Roads Zooplankton Series on *Crangon Crangon* were presented.

Hufnagl *et al.* (2010) estimated total mortality of the brown shrimp with different length based methods for the period 1955 to 2006. Beforehand the bias of the length based methods was evaluated under seasonal recruitment, growth and mortality conditions by applying the methods to simulated, artificially created length frequency distributions with known mortality. From this exercise correction functions for the systemic bias of the methods were developed.

The mortality time series was now updated and extended to the years 2007, 2008 and 2009 using the German Demersal Young fish survey (DYFS) and the Dutch Demersal Fish Survey (DFS). Estimates based on the DFS data slightly decreased in comparison to the years before 2007 and now leveled between 4.5 and 5.5 comparable to the updated DYFS estimates (Table 9.1)

Table 9.1.Total mortality estimate for the years 2007, 2008 and 2009 based on the German Demersal Young Fish Survey and the Dutch Demersal Fish Survey. Used methods: Beverton & Holt, Ssentongo & Larkin, Jones & Zalinge and nonseasonal Length Converted Catch Curve.

	DYFS			DFS		
	2007	2008	2009	2007	2008	2009
L∞ Wetherall	84.0	86.4	81.1	83.0	78.0	76.6
L∞ Powell	83.8	88.9	82.5	87.1	79.9	81.0
Z Beverton Holt	4.0	5.0	4.1	4.6	3.6	3.9
Z Jones&Zalinge	4.7	5.7	4.6	4.8	3.9	4.5
Z Ssentongo&Larkin	4.0	5.0	4.1	4.5	3.6	3.9
Z LCCC	4.7	6.0	4.4	5.1	3.7	4.3
mean Z	4.4	5.4	4.3	4.8	3.7	4.1

In the second part of the presentation data on dry weight condition (DWCI, dry weight at length) and RNA/DNA ratio of brown shrimps caught off Büsum and Wilhelmshaven between 2005 and 2007 were shown. At both sampling sites a distinct seasonal pattern was obvious with high values for both proxies during summer and low values during winter. In starvation experiments performed at different temperatures the decline of the same parameters with time was determined. Using the ratio of the decrease of the DWCI and the RNA/DNA ratio the time that animals starved in the field could be estimated. Between January and March the median of the *Crangon Crangon* population starved about 30 days and a fraction of the population even showed starvation indications during summer. The results will soon be published in the Netherlands Journal of Sea Research by Hufnagl and Temming.

The Helgoland Roads Zooplankton data (Greve *et al.* 2003) on *Crangon Crangon* and Crangonidae were used to determine the timing of the earliest appearance of *Crangon Crangon* larvae in the North Sea. The results obtained were compared to model predictions of the timing of larvae using the model approach of Temming & Damm (2002). The predictions were made applying HAMSOM (Hamburg Shelf and Ocean Model, e.g. Pohlmann 2006) temperatures, egg development rates determined by Redant (1978) and larval development rates observed by Criales & Anger (1986). A good fit ($r^2 = 0.7$) between the observed and calculated (mean C. *Crangon* day for the period January–July) increase in brown shrimp larvae for the period 1990 to 1999 was determined. For the earlier time period (1975 to 1999) *Crangon Crangon* larval abundance was estimated from total Crangonidae observations and still interannual trends were covered by the model ($r^2 = 0.52$) what is in line with previous assumptions on the development. Further it shows that winter temperature is an important driver for timing of the invasion. It was furthermore tested whether the abundance of larvae observed during the first half of the year is suitable to estimate biomass in autumn. For this purpose the Helgoland roads data were correlated with the biomass estimates from the DFS survey but only a weak negative correlation was determined. It was concluded that the larval abundance from this one sampling site cannot be used to predict autumn biomass.

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9.2 Thermal preference of *Crangon Crangon*, L.

Stefan Reiser & Axel Temming (Hamburg University)

Landings for the brown shrimp (*Crangon Crangon*, L.) across European harbours exhibit a clear pattern from higher to lower latitudes. In Belgium harbours, landings of *Crangon* are decreasing and whereas landings in Denmark are increasing (ICES, 2007). This observed trend is accompanied by increasing sea surface temperature (SST) in the North Sea, which might alter the distributional range of *Crangon*, forcing the population to more northern latitudes.

In this section of the meeting, the concept and first steps of a PhD thesis were presented, aiming to determine thermal preference in brown shrimp of different size classes, sex, nutritional state and geographical origin. An experimental setup, using an annular chamber design following Myrick *et al.* (2004) was introduced and critically reviewed compared to alternative setups for temperature preference evaluation in aquatic organisms. The results of the technical evaluation and the conducted modifications on the setup, evaluating tank bias were shown and discussed.

The data derived from this experimental setup shall give first information on thermal preference of *C. Crangon* throughout its life cycle. If temperature is one of the main drivers influencing brown shrimp behaviour an updated version of the life-cycle model will be coupled to a three dimensional hydrodynamic model to examine shifts in the brown shrimps' dispersal towards higher latitudes in the North Sea.

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Myrick, C.A., Folgner, D.K. and Cech, J.J. (2004): An Annular Chamber for Aquatic Animal Preference Studies. Transactions of the American Fisheries Society, 133: 427-433.

9.3 Investigations of a stock assessment in brown shrimp

Tessa van der Hammen & Jan Jaap Poos

The Ministry of Agriculture, Conservation and Food quality, Producer organisations of the Dutch shrimp fisheries and NGO's (Stichting de Noordzee and Waddenvereniging) have underlined the importance of sustainable harvesting of brown shrimp in the North Sea and Wadden Sea. Also they would like the brown shrimp fishery to meet the conditions of an MSC (Marine Stewardship Council) certificate. The first principle that the shrimp fishery needs to fulfil in order to acquire an MSC-label states that the stock should not be overfished. A previous report ("Stock assessment in brown shrimp (Crangon crangon) part 1: investigation of possible methods") investigated the possibilities to assess the stock of the brown shrimp (Crangon crangon) and it was concluded that a stock assessment with a biomass dynamic model should be investigated. This model does not need demographic data and was used successfully in Northern shrimp (Pandalus borealis). The model only needs the total amount of shrimp landings and an index of catches per unit of effort (CPUE) to assess the stock. The main assumptions of the model are (1) the stock under study is a single stock and (2) the available index (CPUE, catch per unit of effort series) describes the trends in the population well.

The total amount of shrimp landings were calculated as the sum of the landings from The Netherlands, Germany, Denmark and the UK. A number of CPUE indices are available. CPUE indices were calculated from the Dutch Demersal fish Survey (DFS) and from logbook data in five countries (The Netherlands, Germany, Denmark, The UK and Belgium). The DFS takes place annually in September and October. Ideally, these indices should show more or less similar trends. However, the indices differ substantially. Reasons for this may be that (1) none of the fleets of the countries involved fish in the whole area and (2) each country calculates the index in a different manner. Likewise, a disadvantage of the DFS data is that the DFS does not sample the whole fisheries area. In addition analysis of the DFS data suggests that the stock may be driven by local population dynamics and there is no positive autocorrelation between two successive years. This means that the shrimp abundance in one year does not give us any information of the stock size in the next year, which is necessary for a reliable stock assessment. The lack of autocorrelation is most likely caused by the occurrence of more than one generation per year. To cover for this, sampling should happen more frequently, at least twice a year.

We used the DFS data to explore the model. This index was valued as the best CPUE series by the ICES Crangon working group (WGCRAN, ICES Working Group on crangon fisheries and life history). In addition, it was the only index that resulted in realistic parameter values. The median MSY value (maximum sustainable yield) was estimated at 31 500t shrimp (95% confidence interval: 27 000t – 39 000t). These values are close to the weight landed annually for the last 10 years. However, because of the lack of a good index, these data have to be interpreted carefully.

The main conclusion from the study is that the applicability of the biomass model for a reliable stock assessment of brown shrimp needs considerably more study and data collection. In addition, because of the complexity of the data and the biology of shrimp, cooperation and approval by (international) stock assessment and shrimp ecology experts as well as approval from the ICES advisory committee (ACOM) is desirable. In addition, a better survey with more frequent sampling would increase the reliability of the model substantially.

The use of reference points in the management of any resource is the responsibility of the management bodies involved. Given the uncertainty of the estimates derived from the biomass model, caution should be taken when using these in management. One could envisage a system where the lower confidence limit of MSY are used as a landings target, while the biomass is monitored through the index, and the landings and/or fishing effort are adjusted downward if the index indicates that the stock falls below the biomass at the maximum sustainable yield (Bmsy).

During the WGCRAN meeting the work on the biomass model was discussed by international colleagues. In general, it was viewed as a good initiative and should remain on the agenda. However, because of the complicated life history, spatial distribution and the lack of a good CPUE index, there was also much doubt about whether reliable reference points could be estimated in future.

9.4 Behaviour of the German shrimp fishing fleet

Georg Respondek (Hamburg University)

Part of my Diploma Work was to determine factors influencing the behavior of the German shrimp fishing fleet. This Work was based on the logbook data of the German fleet, received from the Bundesanstalt für Landwirtschaft und Ernährung (BLE). Five ports situated along the German North Sea coast were chosen to analyze regional differences in behavior (from north to south: Husum, Büsum, Cuxhaven, Norddeich, Greetsiel). The Analysis was restricted to trips with the same start- and landing site.

Every one of these ports showed a characteristic pattern of trip duration choice by the fishermen, with longer trips in Husum and Büsum and most trips around 12 hours in the other ports. The mean trip-hours per boat showed a typical seasonal development for every port.

The influence of different factors on the behavior of the fleet in terms of mean trip-hours per boat was analyzed in two ways. First, correlation analysis was carried out, then a GAM (Generalized Additive Model) was fitted in S-plus to analyse the multivariate interactions. There was no direct influence of the CPUE, the monthly price of gasoline nor the market price of *C.crangon* on behavior in terms of monthly trip-hours per boat. The analysis of the monthly trip-hours per boat with a Generalized Additive

Model (GAM) gave 77% explanation of variance only with the factors „Month“ and „Harbor“. There was very little change in behavior between years, the shrimp fishing fleet seems behaviour seems conservative.

9.5 Working together for lower discards ('project mailbox')

Josien Steenbergen (IMARES)

In the process towards getting an MSC certificate, the Dutch brown shrimp fisheries set up a management plan. One of the objectives described in this management plan is to reduce plaice discards. Sievenets were introduced for reducing the bycatch. An evaluation of the sievenet, carried out by Catchpole *et al.* (2008), showed however that with the sievenet still substantial numbers of 0-group fish retained in the nets. Also, some fishers complain about the sieve net, as it clogs in periods with high abundance of seaweed. Therefore, these fishers wanted to develop another gear adjustment for reduction of plaice discards. In close cooperation between scientists and fishers from the Dutch Fishery Study Group "Sustainable Shrimp Fishery", a new gear adjustment is being developed and tested. Shrimp fishers and net makers initiated this project and take an active role in the process of both development of the gear and data collection. The challenge is to create an adjustment that is as effective as a sieve net in reducing plaice discards, but does not congest seaweed. The adjustment, 'mailbox', basically consists of a cut transversely over the net. The idea is that the shrimps go over the cut in the net, whereas the flatfish can escape through the net. First tests of the 'mailbox' in 2008 were promising (Quirijns *et al.*, 2008). Next step is carried out in 2010, with a project funded by the Dutch Fisheries Innovation Platform. The gear needed to be optimized and tested scientifically. First, fishers and net makers optimized the gear adjustment while using under water observations. When the optimal adjustment is chosen, scientists will join the fishers onboard for a comparative study in May, June and autumn 2010. For these tests the standard discards protocol, that was agreed upon by the WG CRANGON is used (ICES, 2008). If the new adjustment shows as effective as the traditional sieve net in reducing plaice discards, it will probably be accepted in the management plan as an alternative.

References

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9.6 Update of combined German and Dutch swept area autumn estimate

Ingrid Tulp & Volker Siegel

The update of the Dutch biomass estimate based on data from the Dutch Demersal Fish Survey (DFS) was presented to the working group. The total stock abundance was estimated by the sum of the stratified arithmetic means of the catch weights (by 5 m depth strata) multiplied by the surface of each depth stratum. The catchability of the gear is assumed to equal 1. Missing values were estimated based using extrapolation using the program TRIM (TRends and Indices for Monitoring data). The estimates show strong year-to-year variations.

The DFS and DYFS overlap in two areas 405 and 406 (Figure 9.1). Densities in these areas are however consistently higher in the DFS compared to the DYFS (Figure 9.2). For the total estimate the DFS data were used for these areas. Total estimates arrive at ca. 40 000 tonnes for recent years (Figure 9.3).

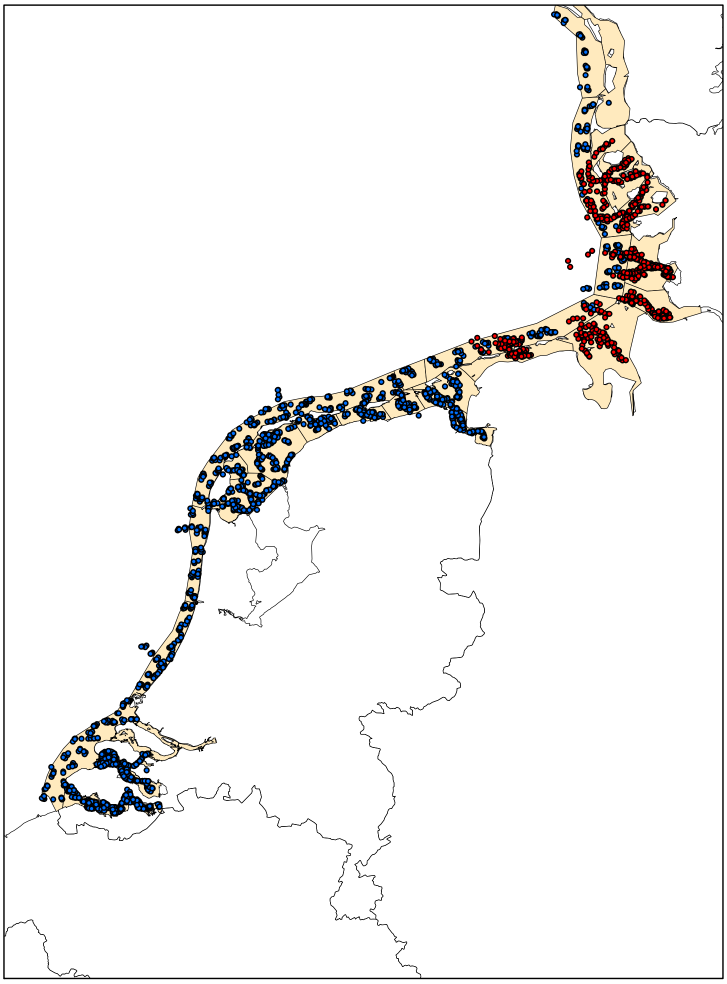

Figure 9.1. Area coverage by the DFS (blue) and the DYFS (red).

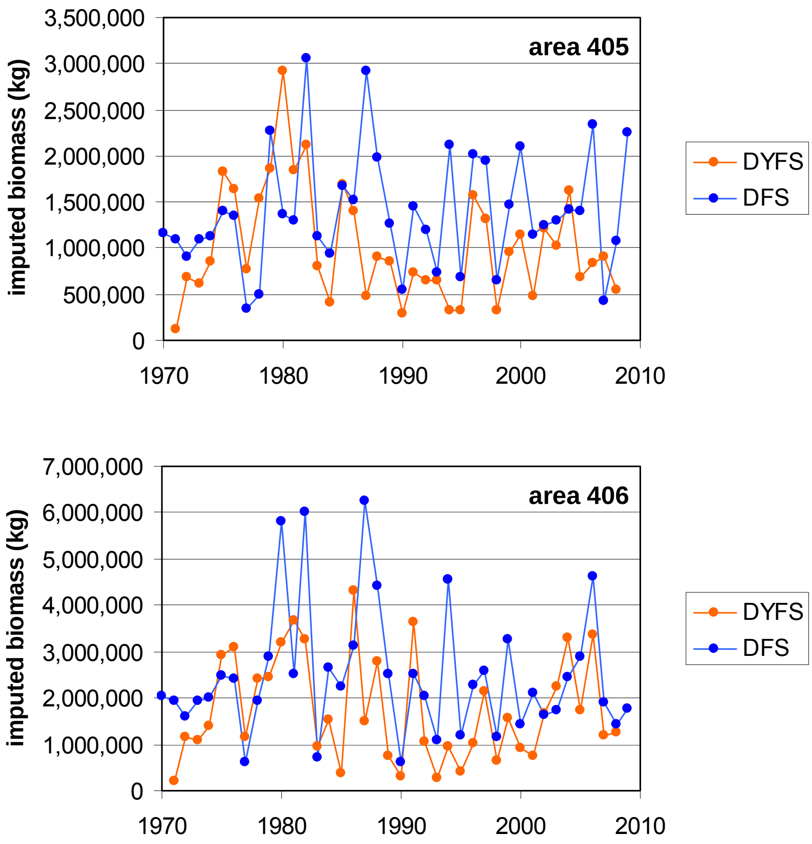

Figure 9.2. Biomass in the overlap areas in the two surveys.

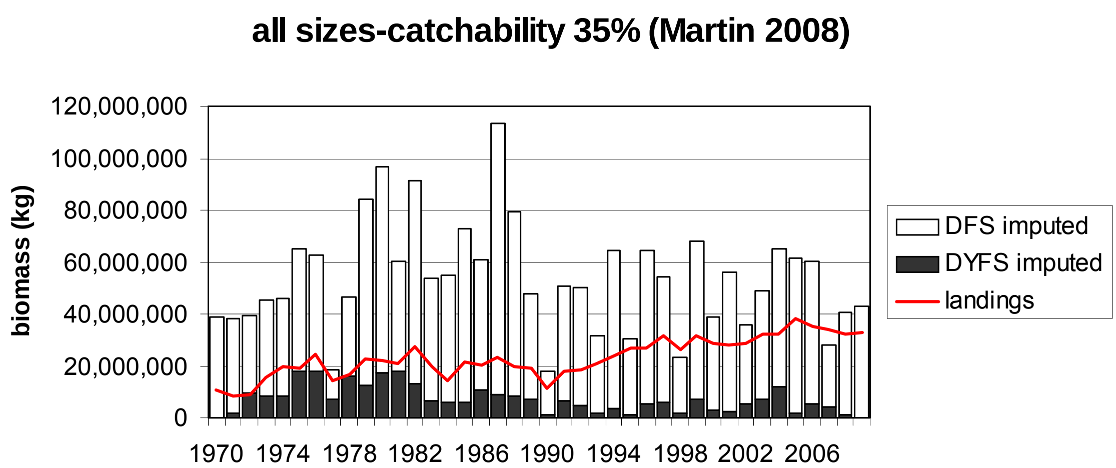

Figure 9.2. Total biomass estimate using the DFS data for the overlap areas and a catchability of 35% (Martin 2008 in ICES 2008).

9.7 Verification of *Crangon crangon* in deeper waters of the northern North Sea

Volker Siegel and Thomas Neudecker (Johann Heinrich von Thünen Institute)

In 2008 data were presented to WGCRAN on the distribution and abundance of *Crangon crangon* in deeper waters of the northern North Sea (Callaway *et al.* 2002) These samples were collected during an international benthos study and data are currently stored in the ICES data base. Members of WG CRAN expressed some concern that this information may be biased, because it would contradict current knowledge about the species depth distribution range recorded so far. In 2009 first preliminary results were presented which indicated that the species data presented in 2008 may have been *Crangon allmanni*.

In the thirrd quarter of 2009 approximately 50 ancillary beamtrawl samples were collected on board the German RV „Walther Herwig" during the annual IBTS survey to the southern and northern North Sea. The data obtained from the ICES data base had also been collected during the same time of the year. After the recent samples were taken on board, samples were identified to the species level and *Crangon* specimens were stored in formalin. These samples were double checked later in the lab for correct species identification. Final results showed that *Crangon crangon* was only recorded in three samples from the inner German Bight at water depths ranging between 23 and 37 m. No shallower stations had been sampled during the survey. All other stations in water depths down to almost 150 m yielded only specimens of the species *Crangon allmanni* (Figure 9.4). This is in conformity with common knowledge about the species.

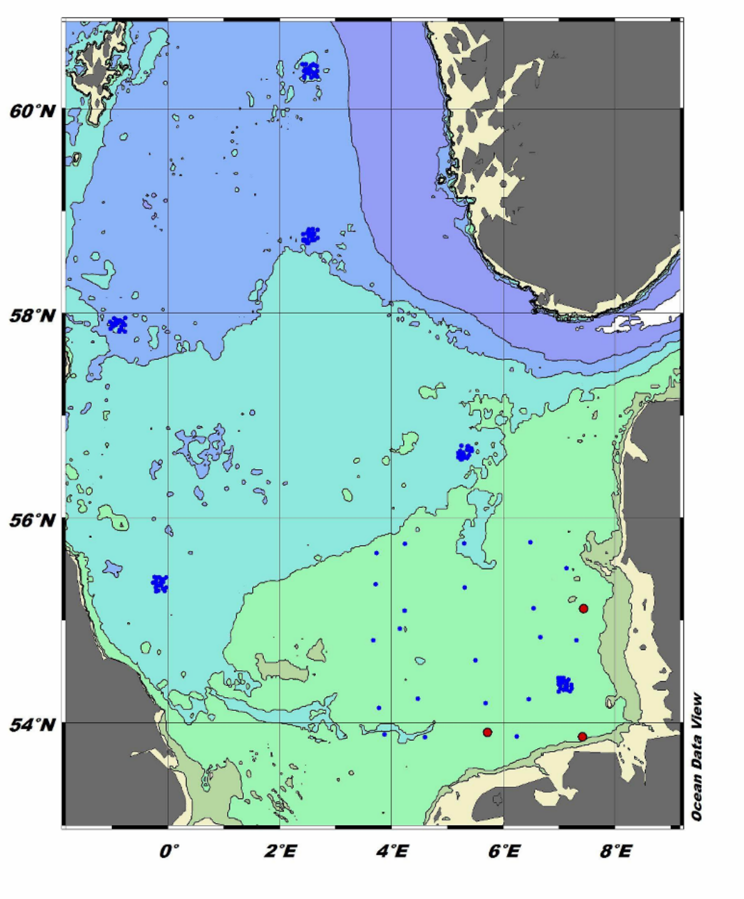

Figure 9.4. Beamtrawl samples collected during the German North Sea IBTS survey In the 3rd quarter 2009 sorted to species level; ***Crangon crangon*** **(red circles) and** ***C. allmanni*** **(blue).**

9.8 Seasonal biomass estimates for *Crangon crangon* in the German Bight from the 2009/2010 season

Volker Siegel and Thomas Neudecker (Johann Heinrich von Thünen Institute)

Results on Crangon biomass estimates were presented from several German surveys carried out during the season 2009/2010. The surveys considered were the DYFS in September, the beamtrawl-flatfish survey in December and the Crangon-Winter-Survey in January. Biomass estimates were done on the basis of depth strata 0–5, 5–10, 10–20, 20–30 m as shown in the figure below. The map reflects the exact area to which the biomass estimates were extrapolated.

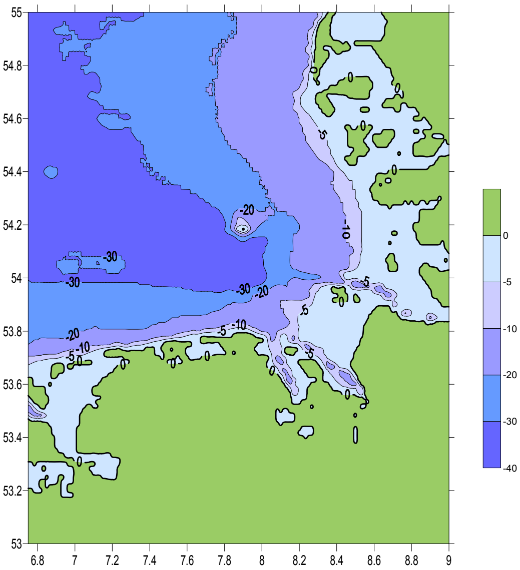

Figure 9.5. Survey area for which the various seasonal biomass estimates in 2009/10 have been carried out.

Results on *Crangon* biomass estimates were presented from several German surveys carried out during the season 2009/2010. The regular DYFS was carried out in September 2009 on board chartered commercial shrimp trawler using a scientific beam-trawl of 3 m width. More than 65% of the estimated *Crangon crangon* trawlable biomass was found in the shallower part of less than 10 m water depth (Figure 9.6). The total instantaneous stock biomass was estimated around 13200 tonnes for the German Bight. The stock of *Crangon allmanni* yielded only 48 tonnes for the survey area and the species was mostly found in water depths deeper than 20 m.

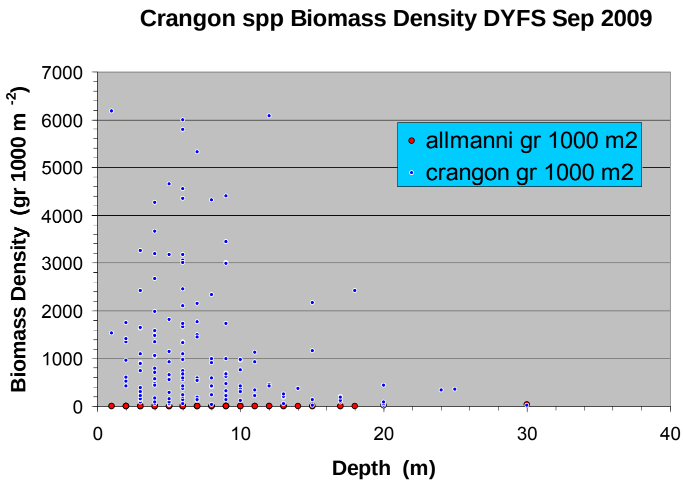

Figure 9.6. Depth distribution of *Crangon* species during September 2009 DYFS.

In December 2009 a flatfish survey was carried out on board RV Solea using a 7-m beam-trawl with a mesh size of 20 mm. The survey covered the entire German EEZ, but did not sample water depth shallower than 15 m. The biomass estimate for the entire EEZ yielded 870 tonnes for *Crangon crangon*. No information was available for the areas shallower than 15 m (Figure 9.7). From the same survey more than 400 tonnes were estimated for the *C. allmanni* stock with a maximum occurrence of the species in water depths between 30 and 40 m.

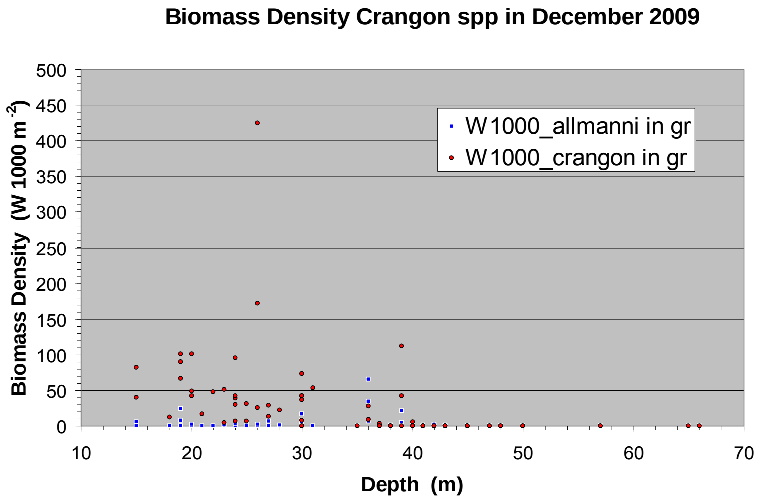

Figure 9.7. Depth distribution of *Crangon* species during December 2009 beamtrawl survey (note that no samples were taken shallower than 15 m).

Since the early 1990s Germany has carried out a regular winter survey (January) on brown shrimp in the German Bight. This survey uses the 7-m beamtrawl (20 mm meshes) on board RV Solea. Since the vessel can only operate in water depths deeper than 10 m, a commercial shrimp vessel has been chartered since 2003 to cover the depth layers between 2 and 10 m during the survey period. This cutter uses the scientific 3-m beamtrawl and operates in the area off East Frisia. If we assume that the results of the shallow water sampling off East Frisia is roughly representative for other shallow areas in the German Bight, then we could estimate a biomass of 4700 tonnes for the winter stock of *Crangon crangon* in the German Bight. 75% of that biomass was found in the depth stratum 0 to 10 m. Results from the 2009 survey clearly indicated that length composition was also different for the shallow and deeper parts of the survey area with size classes around 40 mm dominating in shallow water while the peak in the length frequency distribution shifted to larger shrimp (50 mm) in water depth below 10 m (Figure 9.8). About 188 tonnes were estimated for the stock of C. allmanni with a maximum below 30 m water depth.

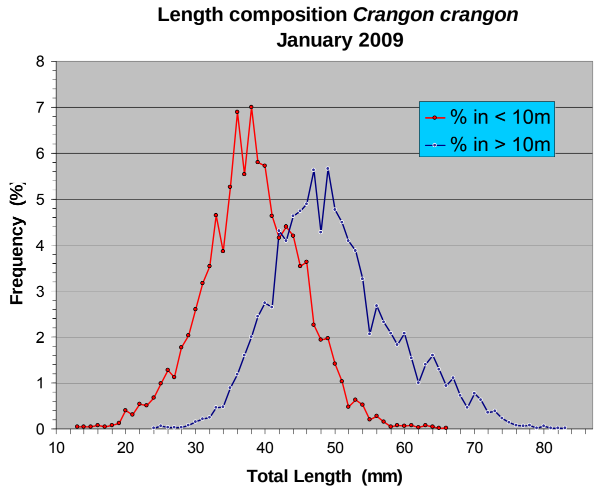

Figure 9.8. LF distribution of *Crangon* species during January 2009 beamtrawl survey in two different depth zones.

Several conclusions can be drawn from the various surveys. During late summer/autumn more than 65% of the *Crangon crangon* stock are found in shallow waters of less than 10 m depth. The same biomass distribution pattern can be observed in winter. Obviously *Crangon crangon* are not leaving the shallow parts of the southern North Sea in winter, but remain there in high quantity. This is shown by two consecutive surveys with the December survey showing extremely low biomass for the depth range deeper than 15 m and the January survey with the great dominance of shrimp in less than 10 m depth. On the other hand differences seem to occur in the distribution/migration pattern of smaller and larger shrimp during winter. During winter shrimp in shallow waters mostly belonged to smaller size fractions. This observation should be verified with additional data from more survey years.

Furthermore, the instantaneous shrimp biomass is relatively low (13 000 tonnes) in autumn compared to the actual annual landings of the commercial fishery from that area. However, recent results on the high mortality/production rate (Z= 4.5 to 5, Hufnagl *et al.* 2010) may explain the discrepancy. Even more surprising is the very low stock size in winter with just below 5000 tonnes and the observation that the shrimp stock has not migrated to deeper water. This migration hypothesis was sometimes used in the past to explain the low biomass of shrimp near the coast in winter. The seasonal distribution migration patterns of shrimp will certainly need further attention in future research activities.

References

Callaway *et al*. (2002) Diversity and community structure of epibenthic invertebrates and fish in the North Sea. ICES Journal of Marine Science 59:1199-1214.

9.9 Distribution and abundance of brown shrimp along the German Coast in autumn 2009 and in winter 2009–2010

Thomas Neudecker

9.9.1 Autumn 2009 DYFS

Along the German coast the Demersal Young Fish and Brown Shrimp Survey (DYFS) is conducted annually in September. In 2009 a total of 152 stations were fished. The northern most tidal gully system south of Sylt and the deeper and more off shore regions west of Amrum could not be fished due to unfavourable weather conditions. "Amrum Bank" is a traditional winter fishing ground for brown shrimp. It was planned to survey that area as well because the standard survey area of DYFS does not cover that part of the shrimp fishing grounds which are frequented by the German as well as Dutch fleets indicating shrimp stocks in deeper water outside the survey area.

However, deeper parts were fished between Büsum and Helgoland again as in 2008 showing a very similar situation: very few shrimp present in depths below 10 metres of water and hardly any at water depths of more than 20 metres.

A similar situation may be concluded from the low catch rates observed off the East Frisian Islands. In front of the islands and at depths of more than 10 metres the amount of *C. crangon* in the catch was considerably lower than within the island chain.

Values from the regional catches per gully system show a gradient: lower values are observed in the northern part while the higher ones are found more southerly and to the west in East Frisian waters (Figure 9.9). That distribution matches the observed fishery results, which have also been communicated by fishermen corresponding to landing statistics. It also shows that the observed shift of shrimp distribution towards the northern parts of the German Bight and into Danish waters, as presented in previous contributions, has changed back to conditions of years before.

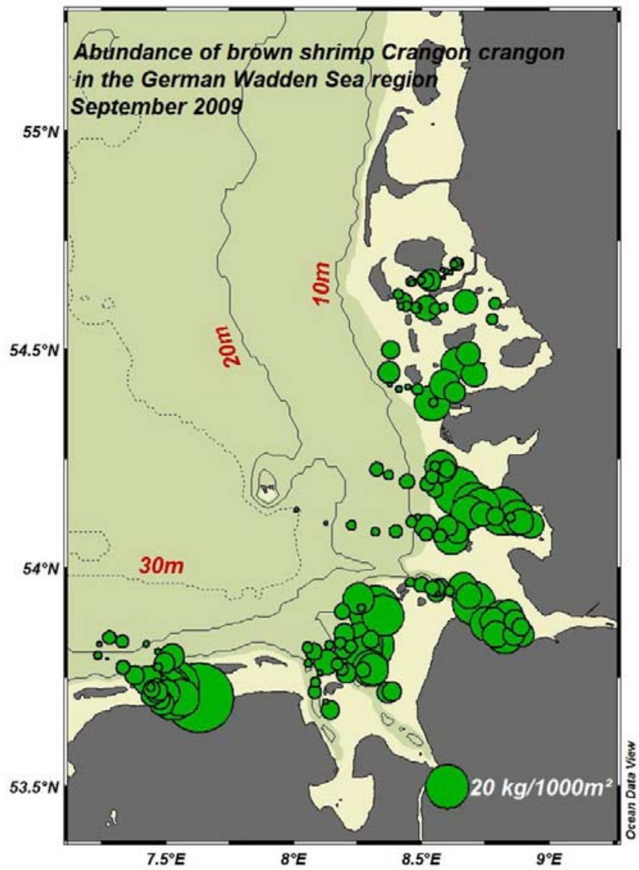

Figure 9.9. Abundance and distribution of *C. crangon* along the German coast in autumn 2009.

9.9.2 January 2010 WCS

Germany conducts a nationally coordinated and financed survey on the distribution and abundance of *C. crangon* annually in January and February named the Winter Shrimp Survey (WCS). That survey uses FRV "SOLEA", principally able to fish at all depths and regions of the North Sea with one or two 7.2m beam trawls. As previous surveys showed that *C. crangon* is predominantly distributed along the coasts and not within the central North Sea the survey area was limited in January and February 2010 to a depth range between 8 to 43 metres. A total of 120 stations were fished between 4.1. and 3.2.2010 giving probably the best coverage of the area since the start of the series in 1991.

The catch consisted of *C. crangon* mainly. Only in rare cases some C. allmanni were present in the more northern and deeper stations, hardly influencing the results (Figure 9.10).

Contrary to previous years no commercially fishable densities were found in the Danish area west of Jutland. Correspondingly no shrimpers were seen there. That observation is attributed to the much lower water temperatures as in other years. Furthermore the mean catch was lower than in previous years despite the fact that more hauls were made in shallower waters which should have increased mean catch rates. Nevertheless, the traditional over wintering and fishing areas as "Amrum Bank" and a smaller region northwest of Helgoland showed slightly higher catches than the remaining parts. The East Frisian region showed much better catches than the more northern parts. That also reflects the 2009 autumn situation.

Some uncertainty of the winter distribution of *C. crangon* is due to the lack of survey coverage towards the main Dutch coast where higher amounts of the population might have been over-wintering.

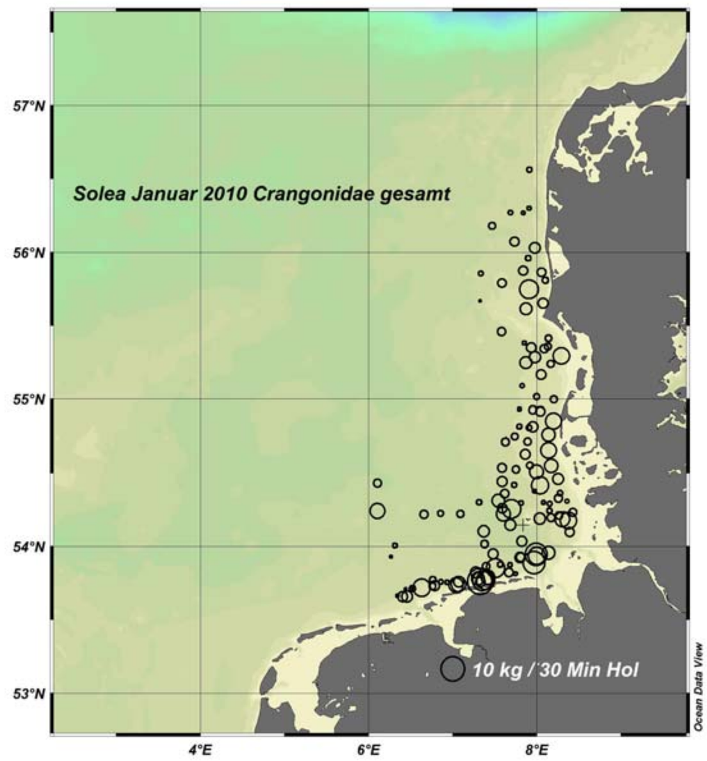

Figure 9.10. Abundance and distribution of *C. crangon* along the German coast in winter 2009/2010.

9.10 An estimation of North Sea brown shrimp (*C. crangon*) winter biomass

Thomas Neudecker (Johann Heinrich von Thünen Institute)

Germany started a nationally coordinated and financed survey on the distribution and abundance of *C. crangon* in January 1991. A biomass estimate was carried out, using depth strata for the entire North Sea provided by Zeiler (BSH, pers. comm.) and the available data sets from the WCS time series. Catches in kg/1000m² were pooled per stratum and raised to the total depth area.

The same procedure was applied to data resulting from catches made in January by chartered shrimp cutters. The first "winter cutter" was chartered in 2003 following an observation, that highest catches were achieved in the shallowest hauls of FRV "SOLEA" at depths of approx. 8 metres indicating that – contrary to "standard knowledge" - a considerable part of the over-wintering brown shrimp stocks must be found in shallow coastal waters outside the operational range of "SOLEA".

That chartered shrimper fished in the "Husum area", i.e. east of the "Amrum Bank" fishing ground, the winter fishing area of many of the Dutch and German shrimpers. As catch rates were very low there compared to the observations of "SOLEA" all further chartered trips were made in the East Frisian area, in the same tidal gully system as for DYFS.

The survey was not consistent over time as weather conditions varied considerably and the survey duration was also limited from 9 days at the beginning of the time series to 33 days given in recent years.

Due to prevailing winter and especially wind conditions the operational area of the Winter Shrimp Survey (WCS) was also inconsistent in regional coverage. While severe winds were blowing from the south-west, only stations sheltered by the East-Frisian Islands could be fished leaving out vast areas along the North-Frisian coast. At strong easterly winds only stations along the North-Frisian coast could be fished making comparisons critical as brown shrimp are not distributed evenly. On top of that mean values for single survey catches are not comparable. Due to the regional inconsistencies caused by the weather, different numbers of hauls were achieved at different depths with different *C.crangon* densities leading to bias.

Variability is high between years (Table 9.2).

These biomass estimates are difficult to interpret:

- Catchability is unknown and may very well be dependent on ambient water temperatures: higher temperatures allowing for better catches because of higher activity and better response of the shrimp to the gear.
- WCS data may not be valid for the entire North Sea especially when only few hauls were achieved in a limited survey area
- Shrimpers data are even more limited as one must assume that densities of the Accumer Ee region are not to apply equally for all of the shallow parts of the North Sea

If there is a need for a more reliable estimate of the biomass of the winter stock of *C. crangon* is desired then the winter surveys should be continued and more time should be made available to cover more of the distribution area.

Table 9.2. Abundance of *C. crangon* along the German coast in winter as recorded by Solea (upper table) and Solea and shrimper combined (lower table).

Results from Winter Crangon Surveys (WCS=WiFi, Biomass of C.crangon by depth stratum)

Depth Strata [m]	Areas in North Sea [km²]	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Mean values	Percent from total
≤10	21000	2.569				15.875					11.509	7.385	3.092	12.418	4.944	2.605	8.732	6.111	1.893		6.049	**6.932**	21,77
≤20	24000	3.862	6.895			16.235				1.984	11.039	5.149	3.801	6.402	7.762	4.065	7.497	7.145	2.876	4.838	2.131	**6.112**	19,19
≤30	61000	9.056	5.203			31.651				4.501	17.945	7.081	3.466	9.284	18.867	11.225	8.122	20.504	6.757	5.447	2.045	**10.744**	33,74
≤40	65000	12.927	2.906							2.624	12.622	1.053	2.001	6.965	11.506	15.126	5.922	15.947	3.702	2.596	6.435	**7.309**	22,95
≤50	58000		7.068							1.530	428		375	13.999	6.824		1.787	5.210		9	2.099	**3.933**	12,35
≤60																							
Sum North Sea	229000	**28.414**	**22.072**			**63.761**				**10.640**	**53.545**	**20.668**	**12.734**	**49.068**	**49.903**	**33.021**	**32.060**	**54.916**	**15.229**	**12.890**	**18.759**	**31.845**	100

Results from Winter Crangon Surveys (WCS=WiFi and WiKu=shrimper, Biomass of C.crangon by depth stratum)

Depth Strata [m]	Areas in North Sea [km²]	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Mean values	Percent from total
≤10	21000	2.569				15.875					11.509	7.385	3.092	**3.751**	**6.799**	**9.955**	**18.746**	**14.747**	**3.637**	**32.072**	**26.292**	**12.033**	**30,66**
≤20	24000	3.862	6.895			16.235				1.984	11.039	5.149	3.801	**3.365**	**11.939**	**9.999**	**4.675**	**10.480**	**2.161**	**25.539**	**12.350**	**8.631**	**21,99**
≤30	61000	9.056	5.203			31.651				4.501	17.945	7.081	3.466	9.284	18.867	11.225	8.122	20.504	6.757	5.447	2.045	**10.744**	27,37
≤40	65000	12.927	2.906							2.624	12.622	1.053	2.001	6.965	11.506	15.126	5.922	15.947	3.702	2.596	6.435	**7.309**	18,62
≤50	58000		7.068							1.530	428		375	13.999	6.824		1.787	5.210		9	2.099	**3.933**	10,02
≤60																							
Sum North Sea	229000	**28.414**	**22.072**			**63.761**				**10.640**	**53.545**	**20.668**	**12.734**	**37.365**	**55.935**	**46.306**	**39.252**	**66.887**	**16.257**	**65.664**	**49.220**	**39.248**	100

10 In response to ToR j)

Additional ToR (requested by the Regional Coordination Meeting for the North Sea and East-Atlantic (RCM – NSEA, Sept 2009)): make a detailed overview of the temporal and spatial scale and technical details of the *Crangon* fisheries in order to evaluate whether the sampling scheme within the DCR carried out by the different nations could be combined.

The currently available VMS maps (see section 6) give a detailed temporal and spatial overview of the shrimp fisheries of the main fishing countries (DK, GE and NL combined). The VMS maps (NL) however could be substantial biased by flatfish fishing. For the Dutch data only a part of the actual effort data was available. As from 2010 onwards it will be possible to have a 100% coverage of the data.

From the long-term German discard data we know that the discard percentage is highly variable with area, depth, season and vessel. In order to get a good overview you need a good coverage of the effort. Our view is that the current program is already insufficient, so combining the effort in order to reduce the effort is not a good option. It would however be a good idea to improve the coordination of the program between the countries. In practise the current DCR program consists of 8 daytrips, with roughly 4 hauls per day in the NL, 11 trips (75 hauls) in Germany, and 4 trips in Denmark.

11 ToR m) Stock management

Additional ToR (requested by ICES May 2010):

1) Is it possible at the moment to determine the size of the brown shrimp stock?
2) Is it possible to introduce a standard stock management system with reference points for brown shrimps?
3) What are possible alternative approaches for ensuring that the stock is managed sustainably?

11.1 Is it possible at the moment to determine the size of the brown shrimp stock?

Currently two approaches have been followed to answer this question:

Swept area estimate (densities from surveys have been raised to biomass estimates at one point in time using depth stratified surface areas)

- Variation is very large (high biological variability, gear effects and variable gear efficiency)
- It represents only one point in time (high P/B ratio)
- Different areas show different (sometimes even opposing) time trends
- If we look at overlapping areas in the two surveys the correlation between the two series is low
- Stock estimate is highly dependent on presumed catchability of the gear

Biomass model used for MSY (van der Hammen & Poos 2010, section 9.3):

- Recent examinations show that a biomass model does not provide a reliable biomass estimate nor reference points, even if the most reliable series (DFS survey series) is used
- The assumptions on which the biomass model is based (one shrimp stock and the LPUE series describes the trend in the stock) are not met
- The equilibrium assumption is not met, carrying capacity (K in the model) is not constant
- The surveys do not cover the distribution area of shrimp (distribution area is larger than survey area)
- The different CPUE series only cover part of the fishing area
- Use of catch statistics (and therefore of CPUE or LPUE): The size of sieving grids on board and on land have changed and influenced the landings. The sieving size has likely not been constant over the years: what we call "commercial size" has decreased over the years. Undersized (discarded) shrimps are not included in the landings statistics.
- The outcome highly depends on what input series to use and LPUE series from the shrimp fishing countries are very different.
- Catch and LPUE is not merely a reflection of the stock, but may also be highly influenced by economic factors (shrimp price)
- There are many uncertainties in the effort series: creep in engine power, size of boats, way to calculate effort has changed over time (Germany) and are still not standardised between the countries. Standardisation (preferably to hours at sea or fishing hours instead of hpdays) will need additional effort by the group.
- There are regional different population trends. Probably there is one population in the genetic sense but because of the regionally different reactions to the hydrographic circumstances regional trends differ.

So are uncertainties in shrimp stock assessment higher than other stocks that have a formal assessment?

Yes, because:

- In shrimp fisheries changes in the sieving procedure of mm's could already make a big difference, the minimum commercial size is not constant (unlike minimum landing size in many fish species)
- There is no stock recruitment relationship
- Short-lived species, with no year to year correlation

11.2 Is it possible to introduce a standard stock management system with reference points for brown shrimps?

At this point we conclude that the biomass model (section 9.3) cannot be applied for a reliable stock assessment of brown shrimp because of the reasons given in section 9.3. The alternative swept area estimate estimate does not provide an absolute value and is highly dependent on assumptions on catchability. Also an attempt in the past to apply the Yield per Recruit model for this aim has not been successful (Temming unpublished).

11.3 What are possible alternative approaches for ensuring that the stock is managed sustainably?

The group discussed a few alternatives:

a. A co-management approach to monitoring and management of shrimp fisheries

The approach is based on a number of pre-conditions which are assumed to apply to the North Sea brown shrimp fishery:

1) The combination of high mortality, short life span, lack of age determination and high variability in local catch rates makes most analytical assessment approaches impossible to apply to this population.
2) Due to high spatial variability in catch rates, any scientific survey with a limited number of tows will most likely yield highly uncertain stock estimates.

An alternative strategy for stock monitoring and management could therefore be based on large number of simultaneous standardised catches taken from commercial vessels. This survey should be carried out during early summer to sample the pre-recruits to the main autumn fishery as undersized shrimp. According to our current understanding of the life cycle the dominant recruitment wave can be observed as 10–20 mm sized juveniles in May/June on the tidal flats. These individuals originate most likely from the previous winter spawning and grow to commercial size in autumn and spawn during the next winter.

In a (within one week, the actual sampling needing not more than 1 day) summer survey carried out in July/August with commercial vessels (as many ships as possible) using a small meshed (standardised) gear (or small meshed inlet) this cohort will occur as undersized shrimp of approximately 30–45 mm. Trawl information (positions, duration etc) should be collected for every haul. The size of this cohort could be determined from standardized catches with commercial vessels with no sieving and discarding being performed on board of the vessels. Some extra investigation is needed to optimise the conservation method of the catch (cooked or fresh on ice). If the catch is landed the relative share of the two cohorts can be established from sieving procedures with appropriate grid dimensions and subsequent weighting of the different sieve fractions. The processing of the samples should be carried out as a transparent procedure and scientists should be involved taking subsamples for more detailed investigations into the stock structure.

By catch rates of undersized plaice could be recorded simultaneously and areas with high by catch rates could be identified. Such areas could be closed on a real time basis and be monitored further over time with experimental catches by selected fishermen.

The system could be refined over years with regard to the standardisation of gear and catch procedures, selection of catch locations, sample number and analysis. Theoretically a simplified procedure could also be carried out completely on the vessels, if the sieving is done in a standardised procedure on the vessel and volume instead of weight is used to quantify the size fractions. Subsamples for scientific analysis could be preserved frozen (–20°C) or in alcohol.

In the initial years the monitoring would not yield a reference point, but it would lead to a reference data set of pre-recruit estimates and subsequent autumn catches. Progressively the data will allow the detection of unusual situations which will induce action in terms of catch and effort reductions. With increasing experience reference biomass, and cohort size indices will be refined. In case of decisions on substantial effort reductions a second control survey could be initiated close to the main season. The system could be complemented with a real time monitoring of log book and VMS information selected to represent a wide spatial coverage.

Pro's: co-management, synoptic (real-time) overview on stock distribution and size, additional info on discards, can be repeated if needed (in a smaller dimension), better information on the effort. Extra information on egg-bearing females and predator densities.

Cons: standardisation of process, requires assistance on that one day (at several ports people have to take care of samples) and data have to be processed quickly. If smaller mesh size is used than legally allowed a permit is needed. The timing of the pulse of recruitment is highly dependent on water temperature and spatially variable. Therefore any such survey in the main North Sea fisheries would need to be carefully timed and extensive in distribution so as not to miss the pulse.

b. Ad hoc shrimp fishery regulation

To maintain a certain level of the shrimp stocks as well as a viable shrimp fishery, fisheries could themselves develop a system giving extremely short notice (within two weeks e.g. or less) on changes in shrimp stock developments. Basis for such a system would be the already established EU reporting system by log-books and landing protocols:

A subset of shrimpers (e.g. 5, better more, ideally all) from every region (e.g. landing site, harbour, fishing ground) report directly to a bureau (agency, could be the processing company) their catch and effort data by the end of each week (Friday). It will be the same data as reported to the "EU state office" which is not entitled to manage the fishery. The data of these shrimpers from every region are processed (in a transparent way) and within a short time (e.g. following Wednesday) mean LPUE information by region could be distributed to the fleet. The time span will be shortened and data basis possibly widened with the application of electronic log books.

Reference points (minimum monthly LPUE) can be drawn and developed from experience and old LPUE-data (e.g. not below 75% of the average, rule of thumb which then lead to reactions by the fleet similar to the traffic light system:

Green = LPUE is high and no danger can be seen for shrimp stocks => free fishing

Yellow = LPUE is moderate. No danger can be seen for immediate decline of shrimp stocks => fishing limited on "higher" effort level (e.g. four or five fishing days per week)

Red = LPUE is low. Danger can be seen for shrimp stocks => fishing is restricted to only a very limited effort level (e.g. two or three days per week) to reduce fishery mortality.

This "ad hoc" short time LPUE is a possible management tool contrary to an annual LPUE system which is not applicable to the short lived crangon species.

As man tends to escape from regulations and limits, it will be essential to define effort precisely i.e. actual fishing time (hours fishing), not time at sea, and possibly gear parameters. Further research is necessary for the latter ones as mesh sizes and new net designs will influence catch efficiency and shrimp size in the catch.

To keep control and the system effective it might become necessary to develop a quota system which gives quota in fishing hours per week or month to each shrimping vessel. That would leave room for individual decisions, vessels size and luck whereas landing limitations effect individual economy in a different manner, possibly being more beneficial to smaller vessels.

Precautional fishing by this system self sustainable.

Natural effects caused by high predation rates cannot be predicted and could still lead to a preliminary collapse of shrimp stocks. Nevertheless, by the proposed system additional mortality due to fishing will be reduced for the benefit of shrimp stocks (and predators).

Pro's: constant monitoring and management, can be done at any time of the year even with large subsets, ten years of (German) reference data available already.

Cons: if fisherman know that the management depends on their observations they might sample areas with high CPUE. If a stock shrinks, the remaining individual animals tend to concentrate on a few hotspots. If sampling takes place on these spots no decline is noticed. Logistics: data processing may be quite labour intensive.

c. A combination of indicators of stock status

Moving away from a more formal assessment a combination of (perhaps softer) stock parameters could be used to assess the stock status:

- Number of egg-bearing females as an indication of the reproductive potential
- Size composition
- Maximum length
- Size of distribution area
- Predator biomass
- Environmental conditions

Pro's: real insight into drivers of population.

Cons: has to be carried out by scientists. At the moment we do not exactly know how to interpret or base actions on these parameters. Additional data are needed (possibly from the fishers survey).

11.4 Environmental impact

The first MSC principle can in our view not be seen separate from the bycatch and ecosystem effects. Sustainability implies more than that the stock does not collapse. It is the fishery with the smallest mesh size and bycatch is a real problem at least in some parts of the year.

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Annex 1: List of participants

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Annex 2: Agenda

Monday 17 May		arrival of participants	
Tuesday 18 May	9:30	Ingrid Tulp/Thomas Neudecker	opening, agenda and Terms of reference
		landings and effort	
	10:00	Ingrid Tulp	update landings and effort data
	10:30	Per Sand Kristensen	development in Danish foreign landings and EU discard investigation of the Danish *Crangon* fishery
	11:00	*coffee break*	
	11:30	Volker Siegel	*Crangon* biomass estimate and depth distribution 2009/2010
	12:00	Thomas Neudecker	Winter *Crangon* Survey (WCS) 2010 and various other subjects
	12:30-13:30	*lunch*	
		MSC related subjects	
	13:30	Torsten Schulze	international VMS data
	14:00	Josien Steenbergen	cooperation between scientists and brown shrimp fishers to reduce discards
	14:30	Ingrid Tulp and Volker Siegel	update combined swept area estimate
	15:00	*tea break*	
	15:15	Stephan Reiser	climate impacts on *Crangon*
	16:15	Ingrid Tulp	preliminary analysis of Dutch discard sampling
	16:30	Bart Verschueren	progress on electric beam trawl studies
Wednesday 19 May		**Research and development**	
	9:00	Marc Hufnagl and Axel Temming	update of mortality estimates
	9:30	Tessa van der Hammen	possibilities for stock management
	10:15	*coffee break*	
	10:45	Zaki Sharawy	food conversion and growth
	11:30	Georg Respondek	logbook data: results of Msc project
	12:30-13:30	*lunch*	
	13:30	Joana Campos	overview of thesis work
	14:30	Yves Verhagen	progress in studies of pollution in brown shrimp
	15:30-17:00	all: further discussion	extra ToR m) stock assessment in brown shrimp

Thursday 20 May	9:00	tour AWI	
	9:30	all: discussion	ToR j) make a detailed overview of the temporal and spatial scale and technical details of the *Crangon* fisheries
	10:30	all: discussion	read and discuss formulation answers to ToR on stock management
	11:00	all	write report
	14:00	all	Terms of Reference 2011, recommendations decision on date and location
	17:00	closure	

Annex 3: WGCRAN Terms of Reference 2009

2009/2/SSGEF17 The **Working Group on Crangon Fisheries and Life History** (WGCRAN), chaired by I. Tulp, The Netherlands, will meet in AWI, Sylt, Germany, 18–20 May 2010 to:

a) Collate and update landings and effort data, including numbers of active vessels;

b) Give an update on bycatch data collected under the DCR in German and Dutch shrimp fisheries;

c) Make progress in updating the paper by Welleman and Daan;

d) Explore available data on number of egg-bearing females and the correlation with stock size;

e) Collate annual VMS data (by quarter) from Member States into one map to illustrate regions of fishing activity by *Crangon* vessels in the North Sea;

f) Review the report on electric beam trawl research by Bart Verschueren;

g) Give an update on the spatial distribution in pollution loads of *Crangon* (work by Yves Verhaegen);

h) Review progress of MSC certification process and evaluate use of data collected within MSC for use by WGCRAN;

i) Review recent *Crangon* related Research and Development activity;

j) Make a detailed overview of the temporal and spatial scale and technical details of the crangon fisheries in order to evaluate whether the sampling scheme within the DCR carried out by the different nations could be combined (requested by the Regional Coordination Meeting for the North Sea and East-Atlantic (RCM - NSEA);

k) Report by 15 March on potential contributions to the high priority topics of ICES Science Plan by completing the document named "SSGEF_workplan.doc" on the SharePoint site. Consider your current expertise and rank the contributions by High, Low or Medium importance;

l) Prepare contributions for the 2010 SSGEF session during the ASC on the topic areas of the Science Plan which cover: Individual, population and community level growth, feeding and reproduction; The quality of habitats and the threats to them; Indicators of ecosystem health.

m) Inform ACOM whether the answers to the following questions raised by the government of Germany are positive or negative and provide justifications:

1. Is it possible at the moment to determine the size of the brown shrimp stock?
2. Is it possible to introduce a standard stock management system with reference points for brown shrimps?
3. What are possible alternative approaches for ensuring that the stock is managed sustainably?

WGCRAN will report by 1 August 2010 (via SSGEF) for the attention of SCICOM and ACOM (on ToR m).

Supporting information

Priority	C. crangon fisheries are economically important with landings value that rank this species in the top three species caught from te North Sea.
Scientific justification	Justification for the ToRs is as follows: Despite the economic importance and regional dependencies of this species, we still have much to learn and understand on the natural history of this species, particularly in respect of its ecology, stock dynamics, distribution etc. We (WGCRAN) know much more about the fishery itself, how much is caught, who catches it, where and when etc. Such information, has limited utility however, and ICES will continue to have a retarded capacity to produce soundeffective management advice in relation to these fisheries, if we use such information in isolation. For the production of more robust and flexible managerial advice, we need to combine our current knowledge of fisheries landings, effort and fishing activity with a good supportive biological understanding of the Crangon stocks and their ecological interacions. To this end, we make this our priority for the WGCRAN. Substantial progress has been made in the development of a Crangon biomass estimate. The goals to arrive at a combined estimate for all surveys this year was not met and will be dealt with next year. Following a pre-assessment by the Marine Stewardship Council on the sustainability of the *C. crangon* fishery, attention has been drawn to its discarding practises, the sustainability of *C. crangon* stocks, and impacts upon benthic communities. Following a full assessment of the technical measures introduced to reduce discards in *C. crangon* fishery (see WGCRAN07), it was recognized that although discards had been significantly reduced the problem had not been completely resolved. Further modifications to the trawl design and catching process may offer one way to reduce discarding, in particular through the development of the electric shrimp beam trawl design. A comprehensive series of sea trials using this method has determined its usefulness in reducing discards. By next year the report of this new technique will be published. Fishing mortality in turbid areas may increase because fishing operations are no longer restricted to night-time. To investigate these side effects the group will need to evaluate this report. The biology and behaviour of *C. crangon* does not lend itself to conventional stock assessment techniques therefore other methods are required. Further to a biomass estimate, data are available to investigate the ability to assess the stock size within each year through its correlation with the numbe of egg bearing females. A thorough analysis of these data are required before its usefulness in assessing the stock can be established. Further research has commenced as a response the MSC process. It is therefore considered important to keep fully informed on the MSC certification process. It was also agreed that in addition to the landings, effort and number of active vessels, each Member State would provide VMS data from *C. crangon* vessels in order to identify areas affected by the fishery and spatial patterns in fishing activity. The combined map of all memebr states will give the needed seasonal overview picture of fishing effort. ToR j) This is in response to a request made by the Regional Coordination Meeting for the North Sea and East-Atlantic (RCM - NSEA), which is an EU meeting coordinating sampling programmes under the Data Collection Regulation (DCF). ToRs k) and l) This is in response to a request from SSGEF. ToR m) This is in response to a request from the German gouvernement.
Resource requirements	The research programmes which 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 12 members and guests. Next year we will invite students of Crangon bIology that have recently finished their PhD and might contribute valuable insight to the group
Secretariat facilities	None
Financial	No financial implications.
Linkages to advisory committees	There are no obvious direct linkages with the advisory committees.
Linkages to other committees or groups	There is linkage to the WGBEAM and WGECO
Linkages to other organizations	CWSS = Common Wadden Sea Secretariat; TMAP = Trilateral Monitoring and Assessment Programme.; RCM –NSEA

Annex 4: WGCRAN draft resolution for the meeting in 2011

The **Working Group on Crangon fisheries and life history** (WGCRAN), chaired by Ingrid Tulp, The Netherlands, will meet in IJmuiden, The Netherlands, 17–19 May 2011 to:

a) Update landing and effort. Make an effort to improve the data (from hp-days to hours at sea or fishing hours). Standardise the data (every country should report landings from their nation vessels into own harbours but also into foreign harbours).

b) Update VMS maps and quantify patterns and differences between seasons years and countries (include BE and UK, FR)

c) Proceed on issue of best models for biomass analyses (including swept area estimate). Contrast models: biomass vs Y/R models or other suitable models

d) Update on mortality (Marc)

e) Review the report on electric beam trawl research by Bart Verschueren;

f) Review management plans suggested by fisheries with regard to the MSC process

g) Review the assessments made by MSC certifiers

h) Review recent *Crangon* related Research & Development activity

WGCRAN will report by 1 August 2011 (via SSGEF) for the attention of SCICOM.

Supporting information

Priority	C. crangon fisheries are economically important with landings value that rank this species in the top three species caught from te North Sea. The Crangon fisheries is currently in the MSC process and requires infromation from the working group
Scientific justification	Justification for the ToRs is as follows: Despite the economic importance and regional dependencies of this species, we still have much to learn and understand on the natural history of this species, particularly in respect of its ecology, stock dynamics, distribution etc. We (WGCRAN) know much more about the fishery itself, how much is caught, who catches it, where and when etc. Such information, has limited utility however, and ICES will continue to have a retarded capacity to produce soundeffective management advice in relation to these fisheries, if we use such information in isolation. For the production of more robust and flexible managerial advice, we need to combine our current knowledge of fisheries landings, effort and fishing activity with a good supportive biological understanding of the Crangon stocks and their ecological interacions. To this end, we make this our priority for the WGCRAN. Substantial progress has been made in the development of an integrated Crangon biomass estimate. Following a pre-assessment by the Marine Stewardship Council on the sustainability of the *C. crangon* fishery, attention has been drawn to its discarding practises, the sustainability of *C. crangon* stocks, and impacts upon benthic communities. Following a full assessment of the technical measures introduced to reduce discards in *C. crangon* fishery (see WGCRAN07), it was recognized that although discards had been significantly reduced the problem had not been completely resolved. Further modifications to the trawl design and catching process may offer one way to reduce discarding, in particular

	through the development of the electric shrimp beam trawl design. A comprehensive series of sea trials using this method has determined its usefulness in reducing discards. Testing the device has been hampered by financial problems in 2009 but has continued in 2010. The biology and behaviour of *C. crangon* does not lend itself to conventional stock assessment techniques therefore other methods are required. Ongoing effort to investigate the application of models to arrive at a proper stock management is needed. An update on the mortality of Crangon is useful in this respect. The MSC process is still ongoing and the group thought it would be useful that the assessments made by MSC certifiers are reviewed by WGCRAN. It was also agreed that in addition to the landings, effort and number of active vessels, each Member State would provide VMS data from *C. crangon* vessels in order to identify areas affected by the fishery and spatial patterns in fishing activity. Such maps have been compiled for NL, GE and DK, but need to be updated and complemented with other member states.
Resource requirements	The research programmes which 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 12 members and guests.
Secretariat facilities	None
Financial	No financial implications.
Linkages to advisory committees	In August 2010 WGCRAN will report to ACOM on the ToR m) from 2009
Linkages to other committees or groups	There is linkage to the WGBEAM and WGECO
Linkages to other organizations	CWSS = Common Wadden Sea Secretariat; TMAP = Trilateral Monitoring and Assessment Programme.; RCM –NSEA

Annex 5: Recommendations

Recommendation	For follow up by:
1. Revise or reconsider or comment on the distribution data from brown shrimp in the epibenthic survey (2001/2002). Data refer to >100 m depth in northern North Sea.	Benthos Ecology working group (BEWG)
2. Dutch logbook data should be specified so proper catch and effort data can be calculated	Dutch government: ministry of LNV P.O.Box 20401 2500 EK Den Haag The Netherlands
3. Increase and standardise sampling effort for bycatch program: improve seasonal and spatial coverage	EU: DCR program
4. Carry out basic quality checks and analyses on available brown shrimp data from DFS and DYFS	Working Group on Beam Trawl Surveys (WGBEAM)