# ICES Survey Protocols – Manual for Inshore Beam Trawl Surveys, Coordinated by Working Group on Beam Trawl Surveys (WGBEAM)

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# I Background

Three countries – Belgium, Germany, and the Netherlands – currently participate in the inshore beam-trawl surveys in ICES Area. Two inshore beam-trawl research surveys are conducted by the participating countries in the North Sea: (i) the international Demersal Young Fish survey (DYFS), conducted since 1969/1970 by Belgium, Germany, and the Netherlands; and (ii) the Sole Net survey (SNS), conducted by the Netherlands. The latter is formally a nearshore rather than an inshore survey, but it is included in this manual for practical reasons. Table I.2 lists major changes in DYFS and SNS inshore beam-trawl surveys over time, their origin, and their presumed effect.

In general, the national surveys in an area can be regarded as a time-series that can be used for stock assessments. When the spatial coverage by the different countries and gears is stable, data can be combined. Despite the similarity in objectives and sampling protocols, the survey designs and sampling gears remain sufficiently diverse that the production of indices across several surveys or survey areas remains complex and usually requires a model-based approach. Generally, such approaches are objective-dependent and are difficult to generalize across species.

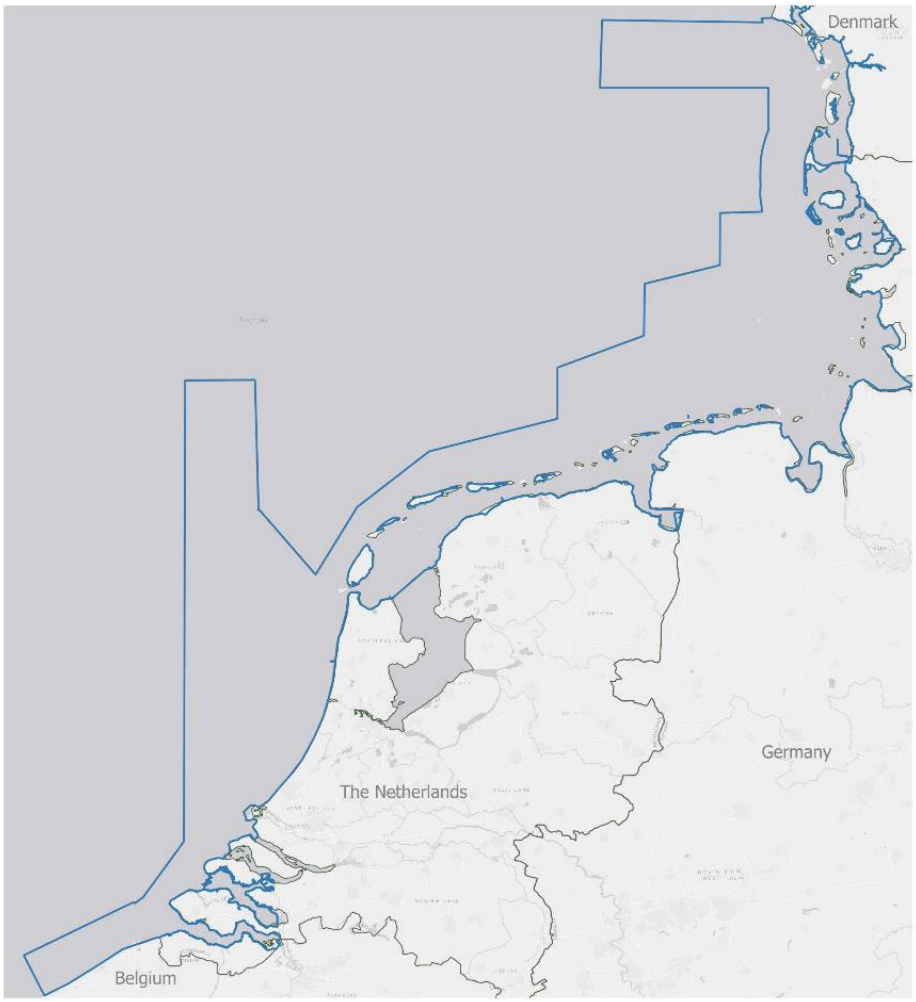


**Figure I.1. Outline of the combined Demersal Young Fish survey (DYFS) and Sole Net survey (SNS) sampling area (map base from https://data.ices.dk/view-map). Detailed maps in Annex 5.**

DYFS was established as a single survey carried out by three countries. However, the gears used have evolved somewhat independently among countries. The effect of the changes on catchability is unknown. Therefore, any comparisons of time-series between survey areas must include analyses that account for these divergences.

DYFS ranges from the Belgian coast in the south to the Danish North Sea coast in the north. It also covers the Dutch eastern and western Scheldt and the Dutch, German, and Danish Wadden Sea (Figure I.1; Annex 5). SNS covers the coastal areas from Scheveningen (the Netherlands) to Esbjerg (Denmark). DYFS is conducted annually from the end of August to the end of October, and SNS is conducted in the first half of September (Table I.1; Annex 3).

Beam trawls are towed over the sea floor. They consist of a tubular steel beam supported by steel beam heads at each end, with shoes at the bottom that slide over the seabed. As a result of the rigid construction, the gears have a fixed width. The inshore beam-trawl surveys described in this manual deploy either a 3 m or a 6 m beam trawl (see an example in Figure I.2 and details in Table A4.1 and Annex 4). The beam width is mainly determined by practical considerations: specifically, the size of the vessel and the fishing method (over the side vs. over the stern). The rigging of the beam trawls is strongly related to the sampling area (bottom structure) and target species. DYFS uses a bobbin to additionally catch *Crangon crangon* (brown shrimp) and, in the Dutch DYFS survey, one tickler chain is generally added to the gears. SNS is rigged with tickler chains, but without a bobbin, as shrimp is not a target species in this survey. Mesh size in the codend ranges from 20 to 22 mm in DYFS and is 40 mm in SNS. Towing speed over ground is variable (Table A3.2; Annex 3) and, in inshore areas (DYFS), also depends on the tidal current. Belgium generally fishes against the tide, while Germany and the Netherlands fish with the tide.

DYFS was originally established as a single survey and can still be considered as such, although harmonization among countries has not always been a key priority. SNS is conducted only by the Netherlands and differs from DYFS in gear and protocols, mainly as a reflection of the differences in target species and ages as well as in areas fished.

The main goals of the inshore surveys are:

- Data collection (individual length, weight, sex, maturity, and age) for a number of flatfish species (plaice, sole, dab, flounder, turbot, and brill) to create fisheries-independent abundance indices by age group (0-year-olds, 1-year-olds, and older);
- collection of abundance and length-frequency data for fish species, including elasmobranch species, for ecosystem analysis purposes;
- collection of abundance and length-frequency data for brown shrimp;
- collection of data on at least a selection of epibenthos species for ecosystem analysis purposes;
- collection of environmental data (temperature and salinity); and
- collection of marine litter data (for the Belgian DYFS only).

The abundance indices for flatfish and brown shrimp as well as the information on elasmobranch species distribution and on marine litter are supplied to the relevant ICES (stock assessment) working groups.

The surveys are coordinated by ICES Working Group on Beam Trawl Surveys (WGBEAM) in order to fulfill the EU obligation to coordinate surveys under the EU Data Collection Framework. WGBEAM also coordinates offshore beam-trawl surveys (de Boois *et al.*, 2023) and industry beam-trawl surveys.

**Table I.1. Summary of North Sea inshore beam-trawl survey and gear characteristics. A detailed overview of the surveys can be found in Annex 3 and of the gears, in Annex 4. DYFS: Demersal Young Fish survey; SNS: Sole Net survey.**

| Country | Belgium DYFS | Germany DYFS | The Netherlands DYFS | The Netherlands SNS |
|---|---|---|---|---|
| Survey start | 1970 | 1972[1] | 1970 | 1969 |
| Survey period | Sep–Oct | End Aug–Oct | End Aug–Oct | Sep |
| Survey days | 8 | 20 | 62 | 10 |
| Stations per year | 33 | 235 | 300 | 50 |
| Standard tow duration (min) | 30 | 15 | 15 | 15 |
| Fishing speed (knots) | 3.5 | 3 | 2.5–3 | 3.5–4 |
| Beam width (m) | 6 | 3 | 3 (Wadden Sea and Scheldt basins)<br>6 (coastal zone) | 6 |
| Gear attachments [2] | B | b | bt | t |
| Environmental sampling instrument[3] | CTD | CTD | CTD | CTD |

[1] Geographic expansions in 1974 and 2012.
[2] b: bobbins; t: tickler chains.
[3] See Section 5.1.

**Table I.2. List of major and notable changes over the past 20 years in the Demersal Young Fish survey (DYFS) and Sole Net survey (SNS) inshore beam-trawl surveys (details and full overview can be found in Section 8). The year should be interpreted as the year the change started – unless marked with an asterisk (*), in which case, the change only applied to the year stated.**

| Year | Geographic region | Type of change | Description of change | Effect of change on data-use |
|---|---|---|---|---|
| 2021 | German DYFS areas | Data collection | RV Clupea was not available. Sampling was conducted by a number of chartered vessels (area 405), and RV Mya2 (four stations in area 406). One of the vessels sunk, and the German DYFS 2021 was ceased after this incident. For this reason, some stations were not realized in 2021. | Notable. No stations at all were realized in the area 412 (River Elbe) other than areas sampled with different vessels and/or incompletely |
| 2020 | Belgian coast | Data collection | Start of registration of non-commercial fish and epibenthos | Large. Dataset enhanced, making it suitable for ecosystem studies |
| 2019 | Belgian coast | Data collection | Start of marine litter recording | Large. Dataset enhanced, |
| 2018 | Belgian coast | Ddata collection | Start of otolith data collection for plaice and sole | Large. Dataset enhanced, i.e. age information in the survey area |

| Year | Geographic region | Type of change | Description of change | Effect of change on data-use |
|---|---|---|---|---|
| 2012* | Scheveningen (NL) to Esbjerg (DK) | Vessel | NL: SNS sampling conducted with different vessel (RV Tridens II) due to RV Isis being damaged | Probably large. Survey outcomes differed significantly from surrounding years. Recommended to treat SNS 2012 data with care. |
| 2012 | German coast | Vessel | RV Clupea new in service for the sampling in the German North Sea coastal areas outside the island chain | Large. Dataset enhanced. |
| 2003* | Scheveningen (NL) to Esbjerg (DK) | Temporal coverage | NL: SNS conducted in spring (only 2003) | Large. Data should not be used in the time-series |

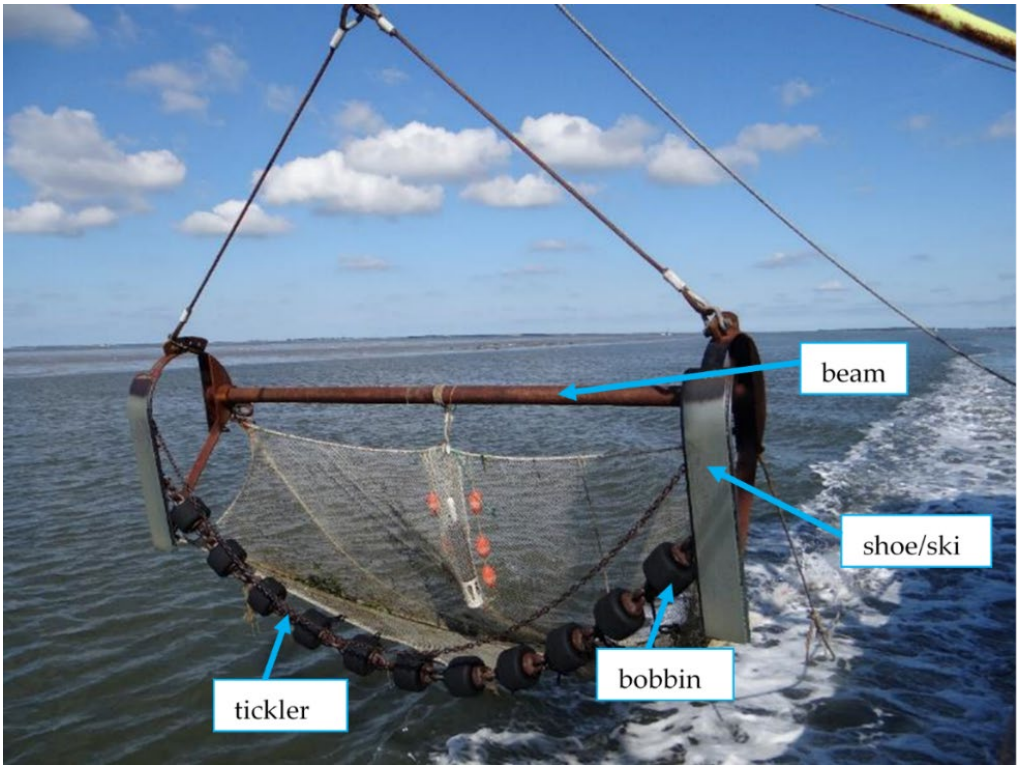


**Figure I.2. Example of a beam trawl used in the Demersal Young Fish survey (DYFS). Image credit: I.Y. Tulp.**

In addition to the surveys described in this manual, a few other inshore beam-trawl surveys take place in ICES Area. These are listed below. The documentation for these additional surveys is not currently available in a format that could be incorporated into this manual but may be included in future versions.

- Since 2019, the Netherlands has conducted a monthly sampling programme in the western Dutch Wadden Sea. Sampling with a 2.5 m beam trawl is conducted one day per month on six DYFS stations. The initial trial has been continued as a yearly monitoring programme (*Krukelsurvey*) from 2022 (Vrooman and Tulp, 2021).

- From 1973 to 2010, England (UK) conducted the annual young fish survey (YFS) on the eastern/southeastern English coast in September/October, using chartered vessels. The survey ceased in 2011. In 2022, England started a similar survey in the Thames estuary. However, it is unclear whether and how this campaign will continue (ICES, 2023).
- The French commercially funded inshore beam trawl survey data used in the assessment of sole in Subarea 7d is called NOURSOM[1]. NOURSOM data were initially sent directly to the Subarea 7d sole stock coordinator and are now sent directly to ICES in response to data call requests.
- Other French commercially funded inshore beam trawl surveys are carried out in several Channel estuaries (Seine, Canche, and Authie), but their time-series are shorter.

When starting a new beam-trawl survey, it is advised to follow the guidance in Annex 10 and to contact the chair of the WGBEAM[2].

[1] NOURSOM. 2023. Institut Français de Recherche pour l'Exploitation de la Mer (Ifremer), Brest, France. https://wwz.ifremer.fr/manchemerdunord/Unite-Halieutique/Campagnes-a-la-mer/Suivi-des-nourriceries/NOURSOM

[2] ICES Working Group on Beam Trawl Surveys. 2023. ICES, Copenhagen, Denmark. https://www.ices.dk/community/groups/Pages/WGBEAM.aspx

# II Version history

This is the first version of the manual on inshore beam-trawl surveys. WGBEAM is responsible for authoring and updating the manual at the end of every three-year terms-of-reference cycle, or as needed. Prior to 2024, survey details can be found in the annual WGBEAM reports[3].

| Date | Version | Changes |
|---|---|---|
| March 2024 | 01 | First full version of the manual published |
| Prior to 2024 | n/a | Survey details described in annual WGBEAM reports |

[3] WGBEAM annual reports. 2023. ICES Library. https://ices-library.figshare.com/search?q=%3Atitle%3A%20WGBEAM&sortBy=publication_date&sortType=desc&groups=37164

# 1 Survey objectives

The surveys included in this manual were originally developed to address the need for fisheries-independent information on commercial flatfish species. Flatfish species occurring in the North Sea have life cycles that include young fish nursing in areas close to the shore. Newly hatched flatfish drift with currents towards the shore and eventually settle, adopting a demersal lifestyle close to, or half buried in, soft or sandy seafloor substrates. Small flatfish live in shallow habitats and eventually move to deeper waters and further out from the coast. For stock assessments, young-flatfish indices from coastal surveys complement indices based on older ages by providing information on yearly recruitment.

The prime target species and type of beam trawl are set depending on the survey area and/or the relevance of the species for the national or EU fisheries. The EU Data Collection Framework (DCF) and the data requirements therein are one of the driving forces for the EU countries involved in the surveys. Over time, the data collection within surveys has expanded as the general focus has become more ecosystem-related, and new requests from data end users have been incorporated. This has led to the expansion of epibenthos data collection and to the collection of age data for more species.

The current survey objectives are similar for all areas:

- Data collection (individual length, weight, sex, maturity, and age) to create fisheries-independent abundance indices by age group (0-year-olds, 1-year-olds, and older) for a number of flatfish species for the sampled area (Section 4.6);
- collection of abundance and length-frequency data of fish species, including elasmobranch species, for ecosystem analysis purposes (Section 4.5.1);
- collection of abundance and length-frequency data for brown shrimp (Section 4.5.2);
- collection of data on at least a selection of epibenthos species for ecosystem analysis purposes (Section 4.5.3);
- collection of environmental (temperature and salinity) data (Section 5.1); and
- collection of marine litter data (Section 5.2).

Specific information that can be derived from the inshore surveys is:

- Abundance information for fish, brown shrimp, and macrozoobenthos;
- Age structure of fish species of commercial interest in the coastal zone.

The end users of the inshore beam-trawl survey data have traditionally been stock assessment groups working within the North Sea. These groups use the data from inshore research surveys as fisheries-independent sources of information, often as recruit or tuning series for the stock assessment models.

Over the past decades, data collection and use has broadened to meet ecosystem assessment as well as fisheries requirements. They are used by OSPAR and ICES ecosystem-focused working groups and by the EU Marine Strategy Framework Directive (MSFD) for the EU Member States. As an example, ICES Working Group on Marine Litter (WGML) requested data collection on marine litter from the trawl survey catches. All survey data are publicly available via the ICES data portal[4] and ICES Database of Trawl Surveys (DATRAS)[5] and are broadly used.

[4] ICES data portal. 2023. ICES, Copenhagen, Denmark. https://data.ices.dk/view-map

[5] DATRAS. 2023. ICES, Copenhagen, Denmark. https://www.ices.dk/data/data-portals/Pages/DATRAS.aspx

# 2 Data and reporting

## 2.1 Data availability and data products

The data from all inshore beam-trawl surveys are uploaded to DATRAS[6] and can be downloaded as a data product[7] (survey = DYFS or = SNS) or by using the existing webservices[8]. This applies to biological and to the marine litter information (ICES, 2022). Data submission deadlines[9] are set by WGBEAM based on the completion of age reading and data checks. Submission of historic data is still in progress. The years available can be checked at the DATRAS submission status[10].

Calculated data products are available for DYFS and SNS: catch per unit effort (CPUE) per length, per hour, and per swept area (SA). These products can be used for determining length-frequency distributions and for calculating CPUE over a larger area. Counts of individuals are available for all countable species, but weight information is not consistently available for all species/surveys.

Requests for new data products can be sent to datrasadministration@ices.dk or, if the request comes from an ICES Working Group, can be handed in via the ICES recommendations database directed to DATRAS team, WGBEAM, and ICES Working Group on DATRAS Governance (WGDG).

## 2.2 Reporting on survey performance and results

Reporting on the surveys is done annually in the WGBEAM report[11]. A tabular survey summary (see Table 2.1) is provided for all beam trawl surveys in the report.

If possible, a presentation session on the previous year's surveys is organized for WGBEAM and end users during the group's annual meeting. Upon request, the WGBEAM chair presents the surveys to end-user groups during their annual meetings.

WGBEAM also evaluates the survey results by geographic area and species and presents the outcomes in the annual working group report[11]. As a minimum, the data underlying the abundance indices for plaice and sole are evaluated, and species identification consistency is checked by region[12].

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[6] DATRAS. 2023. ICES, Copenhagen, Denmark. https://www.ices.dk/data/data-portals/Pages/DATRAS.aspx

[7] DATRAS data product download. 2023. ICES, Copenhagen, Denmark. https://datras.ices.dk/Data_products/Download/Download_Data_public.aspx

[8] DATRAS webservices. 2023. ICES, Copenhagen, Denmark. https://datras.ices.dk/WebServices/Webservices.aspx

[9] DATRAS deadlines. 2023. ICES, Copenhagen, Denmark. https://www.ices.dk/data/data-portals/Pages/DATRAS-deadlines.aspx

[10] DATRAS submission status. 2023. ICES, Copenhagen, Denmark. https://datras.ices.dk/Data_products/Submission_Status.aspx

[11] WGBEAM annual reports. 2023. ICES, Copenhagen, Denmark. https://ices-library.figshare.com/search?q=%3Atitle%3A%20WGBEAM&sortBy=publication_date&sortType=desc&groups=37164

[12] WGBEAM webpage. 2023. ICES, Copenhagen, Denmark. https://www.ices.dk/community/groups/Pages/WGBEAM.aspx

**Table 2.1. Headers of the WGBEAM survey summary sheet**

| **Survey, country** |
|---|
| Area coverage |
| Running since |
| Methodology described in |
| Information to assessment WG |
| Data availability |
| Comments on 2021 survey |
| Data collected |

## 2.3 Guidance for data use (analysis, caveats)

This section provides guidance on how to best interpret the data from beam trawl surveys for a number of data use scenarios and summarizes the main sampling differences among surveys. Section 8 provides information on the changes in the surveys over time.

Questions regarding the data (e.g. detection of presumed errors) can be directed to datrasadministration@ices.dk (WGBEAM Chair should be on cc'd on the e-mail). The question will then be forwarded to the national data submitter. In all cases, the question, urgency, and relevance should be clearly specified. Offensive language must not be used, even when there is an urgent need for an answer.

Despite the similarity in objectives and sampling protocols, the survey designs and sampling gears remain sufficiently diverse that the production of indices across several surveys or survey areas remains complex and usually requires a model-based approach. Generally, such approaches are objective-dependent and are difficult to generalize across species.

Because of the nature of surveys (fieldwork at sea within a relatively fixed time-frame), sampling intensity can vary due to unforeseen circumstances, e.g. meteorological conditions or invalid tows due to the sudden appearance of blooms of species (e.g. the blooms of *Electra pilosa* that affected the Dutch surveys in 2021 and 2022) and/or spatial limitations that prevent fishing (e.g. wind farms and marine protected areas). To account for these differences as well as for the differences in survey setup, a modelling approach can be used for data analyses.

Most data variables in DATRAS are self-explanatory, or their meaning can be looked up in the DATRAS documentation[13].

### 2.3.1 Swept area calculation

For beam-trawl surveys in general, and thus for DYFS and SNS, the calculation of the SA is quite straightforward, since the width of the beam does not change and the gear more or less follows the surface of the seabed. The recommended formula will vary depending on which data are available. Three options are suggested by WGBEAM (shown below for two different conditions). It is advised to always use option (1), based on beam width and distance, except when the distance is missing from DATRAS, in which case option (2) is the best alternative. When both the fishing speed and distance are missing in DATRAS, the standard values reported in the manual can be taken as the average fishing speed; alternatively, option (3) can be used

[13] DATRAS reporting format. 2023. ICES, Copenhagen, Denmark. https://datras.ices.dk/Data_products/ReportingFormat.aspx

(depending on the availability of information). Please note that italics denote DATRAS product terminology.

For conditions where *GearExp*=SB (single beam; catch of one net sorted):

a) Option 1:

$$\text{Swept area (km}^2\text{)} = \text{beam width} \times \text{distance} / 10^6 \quad (1)$$

b) Option 2:

$$\text{Swept area (km}^2\text{)} = \text{beam width} \times (\text{haul duration} / 60) \times \text{fishing speed} \times 1852 / 10^6 \quad (2)$$

c) Option 3: Calculate distance based on shooting and hauling position (formula available at ICES Data Centre, datrasadministration@ices.dk) and apply calculated distance in Equation (1)

For conditions where *GearExp*=DB (double beam; catches of two nets put together):

a) Option 1:

$$\text{Swept area (km}^2\text{)} = 2 \times \text{beam width} \times \text{distance} / 10^6 \quad (3)$$

b) Option 2:

$$\text{Swept area (km}^2\text{)} = 2 \times \text{beam width} \times (\text{haul duration} / 60) \times \text{fishing speed} \times 1852 / 10^6 \quad (4)$$

c) Option 3: Calculate distance based on shooting and hauling position (formula available at ICES Data Centre), and apply calculated distance in Equation (3)

Where:

- beam width: numerical value in *Gear* (in metres)
- distance: *Distance* (in metres)
- haul duration: *HaulDur* (in minutes)
- fishing speed: *GroundSpeed* (in knots)
- shooting position: *ShootLat*, *ShootLong*
- hauling position: *HaulLat*, *HaulLong*

In the cases were information on haul duration and on fishing speed are not available in DATRAS, the standard haul duration and the fishing speed by survey may be used (Section 4.1.2 and Table A3.2 in Annex 3).

### 2.3.2 Treatment of biological information

Because of the spatial and length stratification of the biological sampling, it is not possible to treat age samples as random for the purposes of growth studies or age–length key (ALK) development, as the proportion of specimens with age data may not be consistent for all strata or datasets.

### 2.3.3 Data use for flatfish stock assessments

In general, the surveys in an area by country can be regarded as a time-series that can be used for stock assessments. When the spatial coverage by the different countries and gears is stable, data can be combined.

For DYFS (Belgium, Germany, and the Netherlands), data can be combined from 1974 onwards because the national (thus the different gears) and international area coverage has remained constant since then. The differences in efficiency among the gears used on the different surveys can be assumed to be constant over time by species and size class and are of limited to no importance for the use of the time-series as a relative measure in stock assessments. The only potential cause for a change in catchability would be a change in the behaviour of a certain species and size class.

SNS is only conducted by the Netherlands and can be considered as a constant time-series from the start.

For all surveys, there can be shifts in the accuracy of the stratification for biological data collection, e.g. current registration by haul compared to earlier registration by flatfish area. In general, it can be assumed that current data collection and registration is more detailed (by haul) than in earlier years (by flatfish area).

Specific points for attention:

- DYFS: otolith collection for Belgium and Germany is not available for the full time-series.
- DYFS: ALKs seem to change between northern and southern areas, at least for plaice. As a consequence, when using ALK information from Dutch data, only data from the areas close by (i.e. neighbouring areas) should be used.
- Changes in biological data collection can be found in Section 4.6.2 and Table 4.2.

### 2.3.4 Data use for elasmobranch stock assessments

For elasmobranch stock assessments, it is recommended that the unaggregated data are used directly from DATRAS. For elasmobranch species, the following aspects are important:

a) There can be potential differences in data collection (sections 4.4.1 and 4.5.1).

b) Elasmobranch species are in general measured by sex. This provides the opportunity to calculate CPUE by sex, but it also means that, for generic length-frequency calculations, numbers have to be added up for the different length classes.

c) Data on elasmobranch viable eggs is also available (Section 4.4.2) at DATRAS, development stage code "E": see ICES vocabularies[14].

### 2.3.5 Data use for brown shrimp stock assessments

Shrimp can be measured fresh on board (the Netherlands), stored in the refrigerator and processed the day after the samples were taken (Belgium), or processed onshore after freezing (Germany). These differences are not assumed to affect length measurements (ICES, 2023a).

### 2.3.6 Data use for biodiversity and/or length distributions

For finfish and elasmobranch species, the time-series from all surveys can be used. Where the geographical area coverage for different gears is constant over the time-series, data from the different gears can be combined, preferably using numbers per SA (towed distance × beam width) as the CPUE.

[14] ICES vocabularies – Development stage. 2023. ICES, Copenhagen, Denmark. http://vocab.ices.dk/?ref=1397

For crustaceans, cephalopod species, and other epifauna species, the following aspects are important:

a) The potential use of a closed benthos list (see sections 4.4.3 and 4.5.4, and Annex 7).

b) The increasing attention to species identification may have resulted in species appearing in the survey in recent years that had previously been present in the catch, but were unrecognized. This can give the false impression of an increase in species diversity in a survey. Countries try to provide correct information whenever possible. However, it is not always possible to correct historical information, because it is not always clear whether a new species is recorded because it had not been recognized previously (i.e. it had been identified as a different species) or because it had not previously occurred in the surveyed area.

c) The crustaceans *Nephrops norvegicus* (Norway lobster), *Homarus gammarus* (European lobster), and *Cancer pagurus* (brown crab) are generally measured by sex. This provides the opportunity to calculate CPUE by sex, but it also means that, for generic length-frequency calculations, the numbers have to be added up for the different length classes (details in Section 4.5.3).

d) As the unified DATRAS format applies, data users should be aware that it is possible to upload different maturity stages for crustaceans (most often used for Norway lobster and European lobster), development stage code "B": see ICES vocabularies[15].

[15] ICES vocabularies – Development stage. 2023. ICES, Copenhagen, Denmark. http://vocab.ices.dk/?ref=1397

# 3 Current survey sampling designs

## 3.1 Sampling areas and periods

The area sampled by DYFS and SNS currently ranges from the coastal zone of Belgium, the Netherlands, and Germany all the way to Esbjerg in Denmark. The surveys include the Dutch Scheldt basins (Eastern and Western Scheldt) and the Dutch and German Wadden Sea. The inshore surveys are conducted between the end of August and October (Annex 3, Table A3.1). Maps of the sampling areas are included in Annex 5.

## 3.2 Survey stratification

All surveys have a fixed or semi-fixed station setup, with the locations mainly selected so that the depth range of the survey areas is represented. The division in sampling areas (Annex 5) defined in DYFS and SNS are historically chosen; the further background is unknown.

The Belgian DYFS covers 33 fixed stations in ICES Division 4.c. One station is located in Dutch waters. The positions of the stations were historically chosen to adequately cover the main nursery grounds of flatfish and brown shrimp along the Belgian coast. There is no fixed order in which the stations are fished, and the choice depends on weather, tides, and the occurrence of seaward military shooting exercises at the military base of Lombardsijde, Belgium. The order in which stations are fished in a certain year can be retrieved from the succession of haul numbers.

The component of the German DYFS covered by chartered shrimp vessels uses semi-fixed stations. In general, the same stations are fished each year, with the aim to reach a sufficient spatial coverage of the area and of the different depth strata. However, because of weather conditions and the dynamic nature of the inshore Wadden Sea area, this is not always possible, and slight changes are made between years. The component of the German DYFS covered by RV Clupea (since 2012) uses a fixed station grid along the German North Sea coastal areas outside the island chain. For both components of the German DYFS, there is no fixed order of the stations. Rather, the order is determined by prevailing weather conditions.

The Dutch DYFS is conducted by three vessels: RV Luctor in the Dutch Scheldt basins, RV Stern in the Dutch Wadden Sea, and RV Isis in the coastal zone. In general, the same stations are fished each year, with the aim to reach a sufficient spatial coverage of the area and of the different depth strata. Because of weather conditions and the dynamic nature of the Wadden Sea area, however, this is not always possible, and slight changes are made between years. The order of the stations depends on the progress of the survey as well as tidal and meteorological conditions.

SNS is conducted using RV Isis. Ten standard transects parallel or perpendicular to the shoreline, including the coastal area from South Holland (Scheveningen) to Denmark (Esbjerg), are sampled. Over the 10 transects, hauls are collected at predefined fixed locations, ranging from four to eight per transect, summing to about 50 in total. The placement of transects and stations is chosen such that the survey represents all depth strata. While generally the same stations are fished each year, the exact locations of the stations may vary depending on weather conditions.

## 3.3 Survey gears

### 3.3.1 Variety of beam trawls

All surveys coordinated by WGBEAM are carried out with a beam trawl. The width and rigging of the beam trawls vary depending on the local circumstances and the ship's capacity. However, most countries use the same gear for the full time period and have not changed the geographical area over time. Depending on the ship's design, operation of the gear might occur from the aft or from the side.

All DYFS gears are rigged with bobbins to rouse shrimp from the sediment into the net. Mesh size for DYFS in the codend is around 20 mm, owing both to the shrimp and the target flatfish age groups. For the SNS, older flatfish are targeted (one to four years old), resulting in a gear with tickler chains and a larger mesh in the codend.

An overview of the surveys and gear is given in Table A3.2 (Annex 3), and the full dimensions of the gears and rigging are listed in Table A4.1 and figures A4.1–A4.5 (Annex 4).

### 3.3.2 Overview by country

In the Belgian DYFS, a commercially rigged 6 m shrimp beam trawl is used with a 22 mm mesh size in the codend and no tickler chain. The gear is trawled from the stern.

The German DYFS uses a 3 m shrimp beam trawl with a 20 mm mesh size in the codend and no tickler chain. The gear is trawled from the side.

For the Dutch DYFS along the Dutch and German coast up to Esbjerg, a 6 m beam trawl (RV Isis) is used; in the Wadden Sea, Eastern Scheldt, and Western Scheldt, a 3 m beam trawl is used (RV Stern, RV Luctor). In all setups, the beam carries one tickler chain, the mesh size is 20 mm in the codend, and the gear is trawled from the side. On board Luctor, on specific stations, the tickler is removed from the gear.

SNS is conducted using a 6 m beam trawl with four tickler chains and 40 mm mesh size in the codend of the trawl (sole net). The gear is trawled from the side.

It is unclear why the Dutch DYFS gears are rigged with a tickler and the other gears are not. With tickler, the catchability for burying fish (e.g. sole) is probably better. Comparative tows (with and without tickler) have been conducted by Germany in the past, but the results have never been published. It is assumed that it was decided for practical reasons not to use a tickler, perhaps because too many unwanted elements, like shells and mud, ended up in the net.

# 4 Observation methodologies

## 4.1 Haul procedures

The fishing methodology is similar for most of the inshore beam-trawl surveys.

In general, the inshore beam-trawl survey is a daylight survey, which means that fishing occurs between 15 min prior to sunrise and 15 min after sunset. The start and end of the daylight period is set according to astronomic sunset and sunrise. If a tow is conducted outside these hours, it must be reported as an additional tow, and a valid tow should be attempted where practicable.

Belgium and Germany operate one beam trawl in DYFS. One exception is the German DYFS on the River Elbe, where two beam trawls are deployed to ensure sufficient manoeuvrability of the vessel in this area, which has very strong currents. The Dutch DYFS on RV Isis and RV Luctor is conducted with two beam trawls (one on either side of the vessel), whereas RV Stern operates only one net. The catch of one of the nets (usually starboard) is sampled when two gears are operated. SNS also operates one trawl on each side to obtain balance, and only the catch in one trawl (usually starboard) is sampled.

Hauls can be marked invalid by the scientist in charge (SIC) if, for instance, net damage occurs; the tension on the wires is higher than the maximum allowed value (dependant on ship and gear); or the net is blocked by seaweed, hydrozoa, or bryozoa, thereby affecting catchability. Depending on the situation, the station is either resampled (the preferred option); resampled at a shorter tow duration; slightly moved, e.g. in the event of poor-quality fishing ground; or skipped.

### 4.1.1 Haul duration

The start of the haul is considered as the moment the full length of line has been set according to the standard warp/depth ratio (Section 4.1.3). In addition, some countries use systems to view depth, warp length, and tension on the wires during trawling. Belgium uses a Marelec trawl control system, which shows the line length and the tension during towing, indicating whether the net is set to the ground and/or is blocked in any way.

Standard haul duration is 15 minutes. One exception is the Belgian DYFS, where haul duration is set at approximately 30 minutes. Occasionally, in the event of known difficult substrata (sand, stones, shells, bryozoa) or large benthic bycatches, fishing duration can be shortened. Haul duration of less than five minutes might be considered as an invalid haul.

### 4.1.2 Fishing speed

Germany and the Netherlands generally fish with the tide, Belgium generally against the tide. The speed over ground varies among countries and surveys (details in Table A3.1, Annex 3) and ranges from 2.0 to 3.5 knots for DYFS and from 3.5 to 4.0 knots for SNS.

### 4.1.3 Warp length

The skipper is responsible for the correct warp length and the exact haul procedure. For Belgium, Germany, and the Netherlands, the warp length is generally 3–4 times the water depth, with the exact value depending on the water depth, bottom substrate, and other local circumstances. Warp length can be adjusted depending on these circumstances. The water depth at setting is maintained as much as possible during the haul; however, this is not always possible, especially in the Wadden Sea. As a result, the minimum and maximum depth in a haul can vary.

## 4.2 Catch processing

The detailed process of catch sorting varies by survey, as it is largely dependent on the size of the vessel and the sorting tools available. Standard procedure is that, wherever possible, the entire catch is sorted, in some cases using representative subsamples. The catch is weighed, or an estimate of the weight of the catch is made by e.g. counting the number of fishing baskets.

In most surveys, only one gear is deployed, so only the catch of one net is sorted. In the Dutch surveys, only one of the two simultaneously operated beam trawls is sorted for the length distribution and species composition. The catch of the other net is sometimes used to collect additional fish for biological information (age, sex-ratio, etc.).

## 4.3 Subsampling

In the case of larger catches, a selection of species/size categories of species may be identified as being sufficiently abundant to be subsampled appropriately. Subsampling can be based on weight, volume, or numbers. If the entire catch cannot be sorted, the data should be flagged accordingly when submitted to DATRAS. The (sub)sample of the species is weighed – except for in the Netherlands, where subsampling is generally done based on volume.

Belgium uses a rotating shrimp sieve to divide the complete catch into three size fractions (small, medium, and large). The sieve has been introduced primarily to have a good representation of all size classes of brown shrimp and to mimic the situation on a commercial shrimp vessel as closely as possible. Each fraction is sorted to species level. The fractions undergo subsampling if needed, where both the total weight and subsample weight per fraction are measured. The subsample excludes the rarer species and a specific selection of fish species (listed in Annex 7). Instead of subsampling, these species are counted/measured and weighed to account for their presence in the entire catch (subfactor 1).

Where possible, Germany sorts the whole catch to species level. However, in most cases, a mix of *Crangon* and e.g. shell, algae, ctenophora, and gravel is subsampled to estimate the total *Crangon* catch by weight. In some cases, the mix is extended to other, dominant fish and/or epibenthos species in the haul (e.g. brittle stars, gobiids, swimming crabs). Whenever possible, plaice are removed from the sample before subsampling.

The Netherlands estimates total catch in the haul by volume. The sample is scanned and the SIC decides which species should be counted or measured for the whole sample (subfactor 1) and which should be subsampled and to which subfactor (2, 4, 8, 16, 32, or 64). Subsampling is done by mixing the total catch and dividing subsamples by volume. The subfactor is normally chosen such that a subsample consists of at least 50 specimens of specific species. As a result, different species may be recorded in different subfactor fractions.

Where representative subsampling is not feasible, the species is further sorted into two or more size grades or categories. Because the catches vary, the decision on proper subsampling has to be taken on a case-by-case basis. The following two examples describe incidences when grading or categorization may be required:

**Example 1:** A catch element consists of 999 fish in the length range 18–26 cm and one fish at 40 cm. It is evident that a single subsample of 100 fish, when raised up, will give either 10 or zero fish at 40 cm. The correct approach is to remove the one large fish and measure it separately – treating that sample as category 1 – then take a subsample from the remaining 999 fish (category 2). When measured and raised, this provides an accurate assessment of the numbers caught at each length for this element of the catch.

**Example 2:** A catch element of one species consists of 994 fish in the length range 18–26 cm, three fish in the length range 10–12 cm, and three fish in the length range 38–40 cm. It is evident that a single raised subsample of 100 fish could give anything between zero and 10 fish in the length ranges 10–12 cm and 38–40 cm. The correct approach is to remove the small and large fish and measure them as category 1, then take a subsample from the remaining 994 fish (category 2) by splitting based on weight, fraction, volume, or numbers. When measured and raised, this provides an accurate assessment of the numbers caught in each length group for this element of the catch.

## 4.4 Species sorting and identification

### 4.4.1 Finfish and elasmobranch species

All finfish species and elasmobranchs are identified to the lowest taxonomic level using established quality control methods (see Section 7.4). If this proves impossible, some species can be grouped by genus or larger taxonomic groups (e.g. *Pomatoschistus*, Ammodytidae).

In most surveys, subsampling by species is allowed as long as a specified minimum of specimens per species is measured. Subsampling of the catch for length frequencies is allowed as long as a proper length distribution is collected. The minimum number for a proper length frequency distribution for fish may vary because of the heterogeneity of the length distribution of the species in a haul. In general, approximately 50 individual fish should be measured to the centimetre below for a proper length frequency distribution. However, where a limited number of length classes is present in the catch, measuring fewer individuals could be allowed.

### 4.4.2 Other species

A representative (mixed) subsample of the epibenthos is generally sorted and identified to the lowest taxonomic level. Free-living species are counted and, often, weighed. For attached organisms, species presence is recorded. Brown shrimp are measured to the millimetre below. A minimum of 75 to 100 measured individuals is currently considered necessary for a proper length frequency distribution, but this is under review by ICES Working Group on *Crangon* Fisheries (ICES, 2023b).

Belgium identifies and counts viable (i.e. not damaged and not empty) elasmobranch eggs to the lowest taxonomic level.

### 4.4.3 Exceptions

In the Belgian DYFS, a closed list of 19 finfish species is measured (Table A7.1 in Annex 7). The finfish species not included in this list are counted and weighed as part of the epibenthos catch processing.

For the Dutch DYFS, seaweed is also identified to the taxonomic group level. Weight per haul is estimated based on volume or weight of subsamples.

## 4.5 Length measurements

### 4.5.1 Finfish and elasmobranch species

All fish species are measured to the cm below (10.0–10.9 rounds to 10 cm) and counted. Herring and sprat are measured to the half cm below (10.0–10.4 rounds to 10; 10.5–10.9 rounds to 10.5) or to the cm below. Length is defined as total length, measured from tip of snout to tip of caudal fin. Subsampling by species is allowed in most surveys, as long as a specified minimum of specimens per species is measured.

Subsampling of the catch for length frequencies is allowed as long as a proper length distribution is collected. The minimum number for a proper length frequency distribution may vary due to the heterogeneity of the length distribution of the species in a haul; in general, 50–100 specimens should be measured to the cm below for a proper length frequency distribution.

Elasmobranch species are measured by sex to the cm below, tip of nose to tip of tail, and are treated as the finfish species.

### 4.5.2 *Crangon crangon* (brown shrimp)

Shrimp can either be measured fresh on board (the Netherlands), stored in the refrigerator and processed the day after the samples were taken (Belgium), or processed ashore after freezing (Germany). This last option is assumed not to affect the length measurements (Section 2.3.5). Subsampling for length measurements can be based on weight, volume, or numbers. All countries have a different protocol for subsampling.

Belgium uses a rotating shrimp riddle to sort the catch into three fractions (small, medium, and large) in order to get a good representation of all size classes of brown shrimp. From each fraction, ~ 250 shrimps are randomly sampled and taken to the lab on shore for length measurement (to the mm below) using the Smartshrimp hardware and software developed in-house (Figure 4.1). The sample weight and length of the shrimps are aggregated to represent total catch.

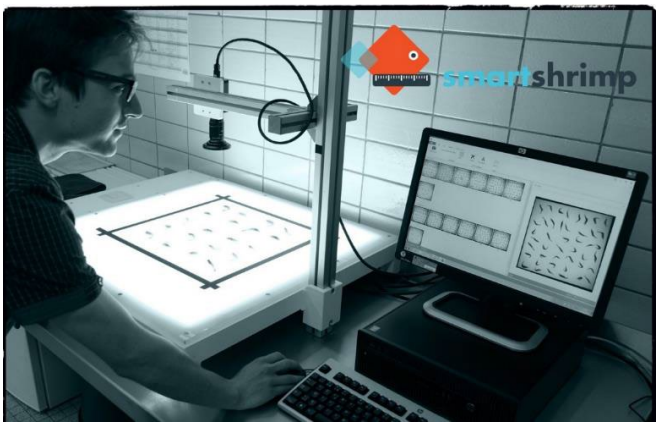


**Figure 4.1 Automated length measurement of *Crangon crangon* (brown shrimp) in Belgium with the Smartshrimp software. Image credit: Wim Allegaert.**

Germany takes *Crangon sp*. subsamples (~ 250 g) from each haul. The frozen subsample is analysed subsequently in the lab. Specimens are measured, and some of the samples are further analysed for sex ratio and the number of egg-carrying females. If *Crangon allmanni* (are found in the subsample, length measurements are also done for this species. Length measurements are done manually with an electronic pen on a digital tablet (to the mm below) (Figure 4.2).

**Figure 4.2 *Crangon* measurements for Demersal Young Fish survey (DYFS), Germany. Image credit: Jana Bäger.**

The Dutch DYFS use subsampling based on volume of each haul to obtain a representative sample of *Crangon sp*. (normally brown shrimp) so that 50–100 specimens per haul are length-measured fresh. Measurement is done to the nearest mm of total length (including scaphocerite to telson, excluding the flagellum antennae) using an mm-lineal, and lengths are digitally recorded using the in-data software on board. SNS catches small amounts of shrimp, and these are not recorded.

### 4.5.3 Other species

The shellfish species Norway lobster, brown crab, and other commercially important shellfish species are measured to the mm below by sex (Figure 4.3) and treated as the finfish species. If cephalopod species are measured, mantle length is generally recorded to the mm below.

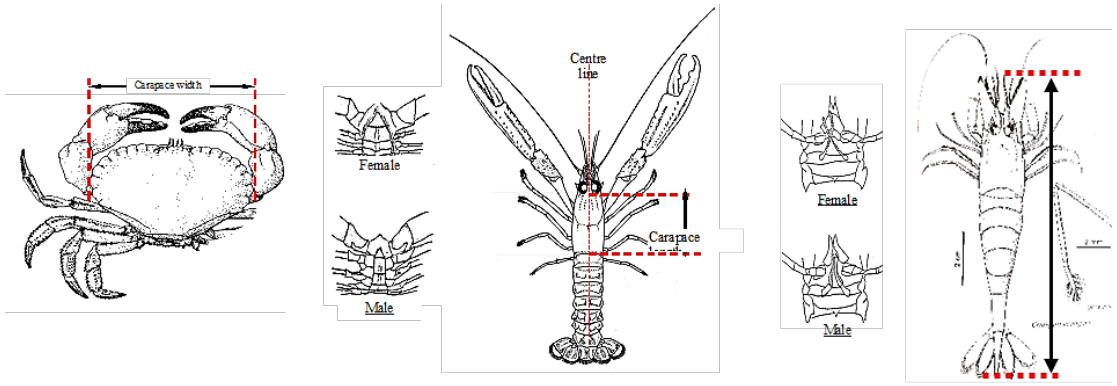


**Figure 4.3 Measurement of *Cancer pagurus* (left, carapax width), *Nephrops norvegicus* (middle, carapax length), and *Crangon sp*. (right, body length). Drawings reproduced with permission from Hayward and Ryland (1994).**

### 4.5.4 Exceptions

Belgium measures a closed list of finfish species (to the half cm below). In 2009, this species list was extended to cover a total of 19 species (Table A7.1 in Annex 7). The finfish species not included in this list are counted and weighed as part of the epibenthos catch processing.

Belgium and the Netherlands do not measure the commercially important cephalopod species (nor crustaceans, in the case of Belgium) but count them as part of the epibenthos catch processing.

## 4.6 Biological information (age, sex, maturity)

### 4.6.1 Biological information collected

All countries collect biological information for a number of species, at least sole and plaice. The stratification is described in Section 4.6.2.

During all surveys, otoliths are collected to provide age information. Generally, the fish is measured to the mm below, sex is defined if possible, and the fish is weighed. From 2010 onwards and following the Workshop on maturity staging of sole, plaice, dab and flounder (WKMSSPDF) recommendation (ICES, 2010), macroscopic maturity information was only collected from two months prior to the spawning season to the end of the spawning season – meaning that maturity information was no longer collected systematically in the autumn surveys for plaice, sole, turbot, and brill. However, because of a presumed change in spawning season, WGBEAM 2018 decided that the macroscopic maturity stages would again be recorded for the biologically sampled individuals from 2019 onwards. Macroscopic maturity classification follows internationally agreed criteria as reported by the Workshop for advancing sexual maturity staging in fish (WKASMSF) (ICES, 2018).

The species for which biological information is collected vary. Table 4.1 shows the biological information collected for the various species and countries. The maturity stage keys used for skates and rays are in Annex 9; the maturity scales for finfish follow the WKASMSF 2018 guidelines (ICES, 2018).

### 4.6.2 Stratification of biological samples

The stratification of the biological sampling varies among countries. Maps for biological stratification are provided in Annex 6. The biological data collection for Germany and the Netherlands follows a fixed stratification by area and length class: a fixed number of otoliths by cm class and area is collected for different species (Table 4.2). The numbers of otoliths that were collected may have changed over the years because of optimization exercises. Belgium follows a fixed stratification by haul and length class.

Belgium has collected biological information for plaice and sole since 2018 (one fish per species per cm class per haul). Previously, only length measurements and catch weights were collected. Currently, the selected fish are gutted, stored in the fridge on board, and taken to the laboratory on land at the end of the day, where they are processed the day after collection. Individual length and weight, sex, and age are determined.

Germany has does age readings for plaice on a routine basis since 2013. For this purpose, five specimens ≥ 8 cm are sampled per DYFS area. The samples are frozen on board and, subsequently, otoliths and individual fish data are sampled in the laboratory on land.

The Netherlands collects otoliths for age reading from the flatfish species plaice, sole, brill, dab, flounder, and turbot. From each subarea (i.e. 17 subareas in the [Dutch] DYFS and 10 subareas in SNS) and per cm class or length groups, a predefined number of otoliths is collected (Table 4.2, DYFS; Table 4.3, SNS). Fish smaller than 8 cm are not sampled for age in DYFS but are assumed to be age 0. Fish smaller than 10 cm are not sampled for age in SNS, as the target age groups starts from age 1. Because smaller size classes represent fewer age classes, the number of samples per cm class and subarea was reduced in 2021 for the cm classes < 20 cm, following statistical evaluation of sample size with respect to variation (de Boois & Bleeker, 2021).

**Table 4.1 Biological information currently collected on a routine basis by species and country in the inshore beam-trawl surveys. Abbreviations: Netherlands (NL), Belgium (BE), Germany (DE).**

| Species | Individual length | Individual weight | Age structure | Sexual maturity | Comment |
|---|---|---|---|---|---|
| Limanda limanda | NL | NL | NL | NL | NL: < 8 cm no age samples |
| *Platichthys flesus* | NL | NL | NL | NL | NL: < 8 cm no age samples |
| *Pleuronectes platessa* | BE, DE, NL | BE, DE, NL | BE, DE, NL | NL | NL: < 8 cm no age samples |
| *Scophthalmus maximus* | NL | NL | NL | NL | NL: < 8 cm no age samples |
| *Scophthalmus rhombus* | NL | NL | NL | NL | NL: < 8 cm no age samples |
| *Solea solea* | BE, DE, NL | BE, NL | BE, NL | NL | DE: Almost exclusively age 0 caught; NL: < 8 cm no age samples |
| *Crangon crangon* | | | | DE | DE: Proportion of berried females for selected stations |

### 4.6.3 Stratification of biological samples

The stratification of the biological sampling varies among countries. Maps for biological stratification are provided in Annex 6. The biological data collection for Germany and the Netherlands follows a fixed stratification by area and length class: a fixed number of otoliths by cm class and area is collected for different species (Table 4.2). The numbers of otoliths that were collected may have changed over the years because of optimization exercises. Belgium follows a fixed stratification by haul and length class.

Belgium has collected biological information for plaice and sole since 2018 (one fish per species per cm class per haul). Previously, only length measurements and catch weights were collected. Currently, the selected fish are gutted, stored in the fridge on board, and taken to the laboratory on land at the end of the day, where they are processed the day after collection. Individual length and weight, sex, and age are determined.

Germany has does age readings for plaice on a routine basis since 2013. For this purpose, five specimens ≥ 8 cm are sampled per DYFS area. The samples are frozen on board and, subsequently, otoliths and individual fish data are sampled in the laboratory on land.

The Netherlands collects otoliths for age reading from the flatfish species plaice, sole, brill, dab, flounder, and turbot. From each subarea (i.e. 17 subareas in the [Dutch] DYFS and 10 subareas in SNS) and per cm class or length groups, a predefined number of otoliths is collected (Table 4.2, DYFS; Table 4.3, SNS). Fish smaller than 8 cm are not sampled for age in DYFS but are assumed to be age 0. Fish smaller than 10 cm are not sampled for age in SNS, as the target age groups starts from age 1. Because smaller size classes represent fewer age classes, the number of samples per cm class and subarea was reduced in 2021 for the cm classes < 20 cm, following statistical evaluation of sample size with respect to variation (de Boois & Bleeker, 2021).

### 4.6.4 Processing of age material

Otoliths are generally returned to the lab for appropriate processing by a dedicated otolith processing team and skilled age readers who are participating in ICES age reading exchanges and/or workshops initiated by ICES Working Group on Biological Parameters (WGBIOP). The actual form in which year class information is identified from otoliths varies by institute and/or species. The information on the age structure used, as well as the otolith preparation method of the age structure, can be found in the data file at DATRAS (CA record, columns *AgeSource* and *AgePrepMet*).

Age reading can take place from the otolith itself, using a microscope. It is also possible to identify the ages from pictures.

Until 2018, otoliths collected in the German DYFS were embedded in resin. From 2019, otoliths were no longer processed; instead, whole otoliths are read. Otoliths are archived in the institute.

Since 2020, the Dutch DYFS has used the SmartDots software for age reading[16]. The Belgian DYFS has used SmartDots since 2016. Alongside year class information, these readings provide a value for otolith growth per year. This information is not submitted to DATRAS but can be made available for specific purposes.

[16] ICES SmartDots. 2023. ICES, Copenhagen, Denmark. https://smartdots.ices.dk

**Table 4.2. Current stratification of Demersal Young Fish survey (DYFS) biological data collection (overview of changes over time in Section 8).**

| Country | Species | Number of fish | Spatial stratification unit(s) | Stratification applied from (-to) | Comment |
|---|---|---|---|---|---|
| Belgium | Plaice, sole | 1 per cm class | Haul | 2018 | Age, sex, individual length and weight. Before 2018, only individual length and catch weight. |
| Germany | Plaice | 1 per length group | DYFS area | 2021 | Length group ≥ 8 cm; haul-based registration |
| | Plaice | 5 per length group | DYFS area | 2013 | Length group ≥ 8 cm; haul-based registration |
| The Netherlands | Plaice | 1 per length group | DYFS area | 2021 | Length group (5-)8–12 cm; haul-based registration |
| | Plaice | 3 per length group | DYFS area | 2021 | Length group 13–19 cm; haul-based registration |
| | Plaice, sole | 5 per cm class | DYFS area | 1972 | Length group ≥ 20 cm; haul-based registration |
| | Sole | 1 per length group | DYFS area | 2021 | Length group 8–14 cm; haul-based registration |
| | Sole | 3 per length group | DYFS area | 2021 | Length group 15–19 cm; haul-based registration |
| | Dab | 4 per cm class | DYFS area | 1977 | ≥ 8 cm; haul-based registration since 2002 |
| | Turbot, brill, flounder | all | Survey | 1994 (flounder), 2003 (turbot, brill) | ≥ 8 cm; haul-based registration since 2002 |
| | Plaice, sole | 5 per cm class | DYFS area | 1969–2020 | ≥ 8 cm |

**Table 4.3. Stratification of Sole Net survey (SNS) biological data collection**

| Species | Number of fish | Spatial stratification unit(s) | Stratification applied from (-to) | Comment |
|---|---|---|---|---|
| Plaice | 1 per length group | SNS area | 2021 | Length group 10–12 cm; haul-based registration |
| Plaice | 3 per length group | SNS area | 2021 | Length group 13–19 cm; haul-based registration |
| Plaice, sole | 5 per cm class | SNS area | 1969 | Length group ≥ 20 cm; haul-based registration |
| Sole | 1 per cm class | SNS area | 2021 | Length group 10–14 cm; haul-based registration |
| Sole | 3 per cm class | SNS area | 2021 | Length group 15–19 cm; haul-based registration |
| Dab | 4 per cm class | SNS area | 1976 | ≥ 10 cm; haul-based registration since 2002 |
| Turbot, brill, flounder | all | Survey | 1989 (flounder), 2004 (turbot, brill) | ≥ 10 cm; haul-based registration since 2002 |
| Plaice, sole | 5 per cm class | SNS area | 1969–2020 | ≥ 10 cm |

# 5 Additional data

## 5.1 Environmental data

No definitions for the accuracy of environmental (i.e. CTD) measurements have been set. It is assumed that all countries use instruments suited to their needs and that descriptions are available at the institutes.

Gear depth (pressure), water temperature, and salinity are recorded in all surveys with a CTD sensor attached to the beam. Additionally, the Netherlands sometimes collects turbidity using these CTDs (Hydrolab or Valeport). The Netherlands and Germany collect Secchi depth information (water visibility). Germany takes water samples to calibrate the CTD instruments.

A detailed overview of environmental data collection by country can be found in Annex 8.

## 5.2 Marine litter

Belgium has collected macrolitter from the catch since 2018 as part of the EU Marine strategy framework directive (MSFD). The data collection procedure followed is consistent with the guidelines described by ICES Working Group on Marine Litter (WGML; ICES, 2022).

# 6 Data recording and storage

## 6.1 Recording trawl information

All information of the inshore beam-trawl survey hauls is stored in ICES database DATRAS. Information about invalid hauls is also recorded.

For the Belgian DYFS, haul time and positions (shoot and haul) and abiotic data such as depth, wind speed, and wind direction are retrieved from the ship's system. Bottom/surface temperature and bottom/surface salinity are acquired from the CTD attached to the beam. The haul metadata is stored in a standard format that is subsequently read into Smartfish, the ILVO database, via import software.

For the German DYFS, haul information and CTD data are gathered from different sources, depending on the ship and which sensors were in use. R-scripts were developed to automate processing of these data and to facilitate combination with the catch database.

SNS and the Dutch DYFS retrieve data on hauling position, depth, time, etc. directly from the ship's system and/or from an external GPS instrument. The information is stored in a standard format that can be read by the input software of the institute's database. Water temperature and salinity are acquired from the CTD, which is attached to the beam, and measured continuously during the haul.

## 6.2 Recording catch information

For measuring, calibrated measuring boards are used. Measurement accuracy is registered with the length information. For weighing, motion-compensated marine scales are used. The measuring accuracy and precision varies by ship but is available in national manuals. The SIC on board at the survey is responsible for entering correct data collected from the surveys. Each country has its own system and national database.

Belgium uses digital measuring boards for length measurements and electronic registration of biological fish data. Data recorded with the measuring boards during the survey at sea are automatically saved in Smartfish. Since 2021, data on epibenthic species (count and catch weight) have been added directly to Smartfish via tablets.

Germany records data on catch and length measurements on paper on board the vessel. When ashore, these data are entered into a database using the institute's data entry software. This software is able to detect obvious errors in the data; however, the SIC checks all entered information in the files for completeness and errors.

The Netherlands reads the haul information and adds catch information by means of a data entry programme developed in-house (Billie), which uses a predefined species list to prevent typing errors and defined length ranges for most species based on database recordings. Data on length measurements is directly digitized. After the haul, the SIC checks the information in the file for completeness and obvious mistakes.

## 6.3 Recording biological information

In Belgium, otoliths are returned to the institute for appropriate processing by a dedicated otolith processing team. Ages are determined using the age reading software SmartDots, which is linked to the Smartfish database.

In Germany, frozen samples of fish are returned to the institute, whereupon otoliths are taken to the laboratory for appropriate processing by a dedicated otolith processing team. After reading the otoliths, the age information is added to the file.

In the Netherlands, data from biological samples are written down and entered later in the appropriate Billie file (Section 6.2). Otoliths are returned to the institute for processing by the otolith processing team. After reading the ages (using the SmartDots system with an API developed at Wageningen Marine Research), the age information is added to the file.

## 6.4 Data storage

### 6.4.1 Trawl, catch, and biological information

National inshore beam trawl survey data are stored in institutional databases. Data are transmitted to ICES data portal DATRAS.

### 6.4.2 Environmental data

All countries store CTD data in institutional databases after checking for outliers. Average surface and bottom temperature and salinity are supplied with the other data in the DATRAS file (haul records).

### 6.4.3 Litter data

Belgium stores Excel sheets with litter information on an internal server (with automated backup) and uploads the data to DATRAS[17]. The litter reference coding follows ICES vocabulary[18].

[17] DATRAS. 2024. ICES, Copenhagen, Denmark. https://www.ices.dk/data/data-portals/Pages/DATRAS.aspx

[18] ICES vocabularies. 2023. ICES, Copenhagen, Denmark. https://vocab.ices.dk/?ref=1381.

# 7 Quality assurance

## 7.1 National manuals

Table 7.1 contains information on the status of national inshore beam-trawl manuals as of February 2024.

## 7.2 Gear

In general, standard gear descriptions are used to maintain the gear (Annex 4). A check is performed before each survey by the fishing skipper, other crew, and/or the institutes' gear technicians, and the gear is repaired when necessary. If the gear does not match the description, it is overhauled by gear technicians. If the gear is damaged during the survey, the net is replaced; repaired using premade net pieces, based on the net drawings, by crew members; or repaired by hand. A gear check is also performed immediately after the survey, as it is not possible to properly hang out the net while at sea.

In the Netherlands, for both DYFS and SNS, a selection of gear and net parameters (i.e. specific rigging parameters, as well as those parts most subject to wear and tear) is checked annually. Every five years or when a net or gear is replaced by a new one, all characteristics are checked.

## 7.3 Subsampling

No specific quality assurance protocols for subsampling are in place.

## 7.4 Species identification

WGBEAM uses the outcome of the Workshop on Taxonomic Quality (ICES, 2007) concerning problem taxa. Generally, literature is used on board to identify species. All countries' sampling procedures allow for continuous feedback on species identification on board (e.g. by having identification keys and multiple experts on board or contact experts ashore). Species that cannot be identified at sea are conserved (mostly frozen) and returned to the lab for identification by experts.

The Netherlands and Belgium assure quality of species identification by annual internal identification tests and workshops for the institutes' personnel on demersal fish and epifauna, pelagic fish species, brackish and fresh water fish species, and marine shellfish species. For the employees responsible for the inshore beam-trawl surveys (e.g. SICs), there is a minimum score defined for the demersal fish and epifauna identification test.

**Table 7.1. Overview of national inshore beam-trawl survey manuals.**

| Country | Area | Available? | Update frequency | Reference | Comment |
|---|---|---|---|---|---|
| Belgium | North Sea | Yes | Reviewed annually, updated when relevant | Raat (2022) | After internal review, manual will be published on smartfisheries.be |
| Germany | North Sea | No | Not applicable | Not applicable | Only a draft version in German language is available, which has to be checked, updated, and finalized |
| The Netherlands | North Sea | Yes | Reviewed annually, updated when relevant | Van Damme *et al*. (2023) | Internal institute's document. Next to technical information, the manual also contains a quality assurance table describing the risk, the potential measure, critical moment, limit values, and actions to be taken. |

## 7.5 Data quality

Quality checks on Belgian data occur on three levels:

1) data quality checks on the software and database level,
2) data exploration quality checks in Power-bi and R, and
3) additional quality checks in R studio on the converted DATRAS datasets.

A series of checks is performed on trip level (e.g. dates), haul level (e.g. timing, positions, haul duration, distance), sample level (e.g. number of length measurements), and individual fish level (e.g. number of otoliths). Lengths and weights are checked to ensure that recordings are between realistic ranges. Individual length–weight relations and ALKs are checked for outliers.

Germany performs standard checks (outliers and/or missing values) for the parameters, which are already partly incorporated in the used data entry software. After the survey, the Netherlands performs standard checks for the parameters (outliers and/or missing values) using a standard SAS script before the data is uploaded to the institute's database.

The inshore beam-trawl survey data for all countries are uploaded to DATRAS. Before uploading in DATRAS, files are screened. The allowed ranges, mandatory fields, and checks that need to be carried out were updated in 2013 by ICES Workshop on DATRAS Data Review Priorities and Checking Procedures (WKDATR; ICES, 2013b) with approval from WGBEAM (ICES, 2013a) and are available at ICES data submission checking portal[19]. Each country is responsible for the quality assurance of their respective data in DATRAS.

[19] DATSU. 2023. ICES, Copenhagen, Denmark. datsu.ices.dk/web/selRep.aspx

# 8 History of the surveys by country

Over time, surveys slightly change for different reasons. The impact on data collection differs. This also applies to the DYFS and SNS inshore beam-trawl surveys. In sections 8.1, 8.2, and 8.3, the changes by country are described. Table 8.1 provides an overview of the changes and the presumed impact.

## 8.1 Belgium

The Belgian inshore DYFS began in 1970, collecting fisheries-independent data primarily for plaice, sole, and brown shrimp in the Belgian coastal zone. Initially, the survey was conducted twice annually, in September and May. Since 1992, the survey has been conducted annually, in September. From 1970 to 1982, the research vessel Hinders was used. From 1983 onwards, the survey was carried out using the training and research vessel O29 Broodwinner. From 2012 onwards, the research vessel Simon Stevin was used. The number of stations was extended from 27 in the beginning of the time-series to the 33 current fixed stations. From 1970 to 1990, the stations were fished for approximately 15 minutes. Since 1991, the stations have been fished for 30 minutes at 3.5 knots against tide. Although target species are plaice, sole, and brown shrimp, a list of closed species have been measured as well since 1970. This list is included in Annex 7. Remaining (non-commercial) fish species and (epi)benthic species have been recorded since 2020 (numbers and/or catch weights).

Otoliths have been collected from plaice and sole since 2018. Marine litter has been collected since 2018.

Catch weights of measured fish (Annex 7) have been recorded since 2016. (Sub)samples of shrimp were estimated by volume until 2016 and have been weighed since 2017.

Belgium has used a digital measuring board for length measurements of fish since 2010 and Smartshrimp for length measurements of brown shrimp since 2011.

## 8.2 Germany

In the past, Germany conducted an inshore beam-trawl survey during the second quarter of the year. This part of the DYFS was terminated in 2005. In 2012, a German research vessel (RV Clupea) was made available to provide comprehensive coverage of the coastal areas within the 12 nm zone along the German North Sea coast; this vessel has been part of the German DYFS ever since. A full overview is available in Table A3.1 (Annex 3).

In the past, the German DYFS covering Area 412 (Elbe river) conducted fishing during night-time. These hauls were flagged accordingly in the DATRAS data format.

In former times, DECCA was used and before that, positions were recorded according to a nautical chart and fixed navigation marks. Before 2018, TD sensors were used to collect abiotic data, recording gear depth and water temperature. Salinity was measured via bottle samples from the surface.

Before 1996, no scales were used on board; the subsample fractions were estimated by volume.

**Table 8.1 Overview of changes in inshore beam-trawl surveys. When a change is marked as "ongoing", the year mentioned should be considered the starting year of the change. Note that some changes may be overruled by new changes, e.g. vessel changes, but those will be visible in the data. Abbreviations: Demersal Young Fish survey (DFDS), Sole Net survey (SNS), The Netherlands (NL), Germany (DE), Belgium (BE), Denmark (DK).**

| Year | Ongoing / incidental change | Geographic region | Element of change | Description of change | Effect of change on data-use |
|---|---|---|---|---|---|
| 2021 | Ongoing | Scheveningen (NL) to Esbjerg (DK) | Data collection | SNS: stratification of biological data collection for plaice and sole (i.e. individual length and weight, and otoliths) changed | Limited; the effect of a potential reduction on the indices has been tested before implementation |
| 2021 | Ongoing | Dutch to Danish coast, Dutch Wadden Sea, Dutch Scheldt basins | Data collection | NL: DYFS stratification of biological data collection for plaice and sole (i.e. individual length and weight, and otoliths) changed | Limited; the effect of a potential reduction on the indices has been tested before implementation |
| 2021 | Ongoing | German DYFS areas | Data collection | DE: collection of plaice otoliths changed to 1 per cm length class per area. | Limited; potential effect on indices |
| 2021 | Incidental (2021 only) | German DYFS areas | Data collection | DE: research vessel Clupea not available, sampling conducted by a number of chartered vessels (area 405), and RV Mya2 (four stations in area 406). One of the vessels sank, and the German DYFS 2021 ceased after this incident. Therefore, some stations were not realized in 2021. | Medium; no stations at all were realized in the area 412, River Elbe. Other areas sampled with different vessels and/or incompletely. |
| 2020 | Ongoing | Scheveningen (NL) to Esbjerg (DK) | Data collection | SNS: age reading via SmartDots | Limited, more information becomes available (annual growth), but not uploaded to DATRAS |

**Table 8.1 (continued)**

| Year | Ongoing / incidental change | Geographic region | Element of change | Description of change | Effect of change on data-use |
|---|---|---|---|---|---|
| 2020 | Ongoing | Dutch to Danish coast, Dutch Wadden Sea, Dutch Scheldt basins | Data collection | NL: DYFS age reading via SmartDots | Limited, more information becomes available (annual growth), but not uploaded to DATRAS |
| 2020 | Ongoing | Belgian coast | Data collection | BE: non-commercial fish and epibenthos sorted from catch and recorded | Large; additional information available, making the dataset suitable for ecosystem studies as well |
| 2019 | Ongoing | Belgian coast | Data collection | BE: marine litter sorted from catch and recorded | Additional information available |
| 2018 | Ongoing | Belgian coast | Data collection | BE: otolith data collection plaice and sole | Large; additional information available, i.e. age information in the survey area |
| 2018 | Ongoing | Belgian coast | Data collection | BE: weight recorded of subsample fractions | Limited; subsampling fraction based on weight instead of volumetric |
| 2017 | Ongoing | Dutch Wadden Sea, Scheldt basins | Data collection | NL: individual weights recorded for fish of which otoliths are collected | Moderate; more detailed information available on the individual fish |
| 2016 | Ongoing | Belgian coast | Data collection | BE: more fish species added to closed list | Additional information available: length data for more fish species |
| 2016 | Ongoing | Belgian coast | Data collection | BE: weight recorded of measured fish | Additional information available: weight data available from the field |

**Table 8.1 (continued)**

| Year | Ongoing / incidental change | Geographic region | Element of change | Description of change | Effect of change on data-use |
|---|---|---|---|---|---|
| 2016 | Ongoing | Dutch Scheldt basins | Vessel | NL: DYFS sampling conducted with new vessel | Limited, as gear and sampling protocol remained constant (comparative fishing has been conducted) |
| 2013 | Incidental (only 2013) | Scheveningen (NL) to Esbjerg (DK) | Vessel | NL: SNS sampling partly conducted with different vessel (Jakoriwi) because of damaged vessel RV Isis during (2013 only) | Limited for commercial species, as gear and sampling protocol remained the same; data to be treated with care for other use |
| 2013 | Ongoing | German DYFS area | Data collection | DE: otolith collection for plaice (5 per cm length class per area) | Additional information on plaice ALKs available for German DYFS areas |
| 2012 | Incidental (only 2012) | Scheveningen (NL) to Esbjerg (DK) | Vessel | NL: SNS sampling conducted with different vessel (Tridens II) due to damaged vessel RV Isis | Probably large; outcomes significantly differed from surrounding years. Recommended to treat SNS 2012 data with care. |
| 2012 | Ongoing | German coast | Spatial coverage; new vessel | DE: DYFS (Sep/Oct) additional sampling along the coast with new research vessel Clupea | Expansion of spatial coverage with RV Clupea along the North Sea German coast outside the island chain. |
| 2012 | Ongoing | Belgian coast | Vessel | BE: vessel change (Broodwinner --> Simon Stevin) | Limited, as gear and sampling protocol remained constant |
| 2011 | Ongoing | Belgian coast | Data collection | BE: electronic measurement for shrimp measurements | Limited, as gear and sampling protocol remained constant |
| 2010 | Ongoing | Belgian coast | Data collection | BE: electronic measurement boards for fish measurements | Limited, as gear and sampling protocol remained constant |

**Table 8.1 (continued)**

| Year | Ongoing / incidental change | Geographic region | Element of change | Description of change | Effect of change on data-use |
|---|---|---|---|---|---|
| 2010 | Incidental (only 2010) | Scheveningen (NL) to Esbjerg (DK) | Vessel | NL: SNS sampling partly conducted with different vessel (Jakoriwi) due to damaged vessel RV Isis during survey (2010 only) | Limited for commercial species, as gear and sampling protocol remained the same; data to be treated with care for other use |
| 2005 | Ongoing | Niedersachsen Wadden Sea + Elbe estuary, Schleswig-Holstein | Temporal coverage | DE: DYFS sampling in Apr/May ceased | Reduction of temporal coverage |
| 2003 | Ongoing | Scheveningen (NL) to Esbjerg (DK) | Data collection | NL: age data collection for Turbot (*Scopthalmus maximus*) and Brill (*Scopthalmus rhombus*) in SNS | Expansion of species list for age information |
| 2003 | Ongoing | Dutch to Danish coast, Dutch Wadden Sea, Dutch Scheldt basins | Data collection | NL: age data collection for Turbot (*Scopthalmus maximus*) and Brill (*Scopthalmus rhombus*) in DYFS | Expansion of species list for age information |
| 2003 | Incidental (only 2003) | Scheveningen (NL) to Esbjerg (DK) | Temporal coverage | NL: SNS conducted in spring (only 2003) | Large; data not to be used in the time-series |
| 1996 | Ongoing | Niedersachsen Wadden Sea + Elbe estuary, Schleswig-Holstein | Data collection | DE: weight recorded of subsample fractions | Limited; subsampling fraction based on weight instead of volumetric |
| 1996 | Ongoing | Scheveningen (NL) to Esbjerg (DK) | Vessel | NL: SNS sampling conducted with new vessel (Tridens II --> Isis) | Limited, as gear and sampling protocol remained constant (comparative fishing has been conducted) |

**Table 8.1 (continued)**

| Year | Ongoing / incidental change | Geographic region | Element of change | Description of change | Effect of change on data-use |
|---|---|---|---|---|---|
| 1992 | Ongoing | Belgian coast | Temporal coverage | BE: DYFS sampling in Apr/May ceased | Reduction of temporal coverage |
| 1992 | Ongoing | Scheveningen (NL) to Esbjerg (DK) | Spatial coverage | NL: SNS sampling areas north of Esbjerg (transects 671-673) finished | Reduction of spatial coverage |
| 1991 | Ongoing | Belgian coast | Sampling protocol | BE: haul duration changed from 15 to 30 mins | Unclear; probably limited for frequently caught species, larger for rare species (as distance fished is doubled) |
| 1990 | Ongoing | Scheveningen (NL) to Esbjerg (DK) | Vessel | NL: SNS sampling conducted with new vessel (Tridens --> Tridens II) | Limited, as gear and sampling protocol remained constant (comparative fishing has been conducted) |
| 1990 | Ongoing | Scheveningen (NL) to Esbjerg (DK) | Temporal coverage | NL: SNS sampling in Apr/May ceased | Reduction of temporal coverage |
| 1989 | Ongoing | Scheveningen (NL) to Esbjerg (DK) | Data collection | NL: age data collection for Flounder (*Platichthys flesus*) in SNS | Expansion of species list for age information |
| 1989 | Ongoing | Dutch to Danish coast, Dutch Wadden Sea, Dutch Scheldt basins | Data collection | NL: age data collection for Flounder (*Platichthys flesus*) in DYFS | Expansion of species list for age information |
| 1987 | Ongoing | Dutch Scheldt basins | Water body specifications | NL: finalization of Delta works, affecting the freshwater inlet in DYFS area Easter Scheldt | Unclear, but good to consider when using the data for that area as a separate series |
| 1987 | Ongoing | Dutch Scheldt basins | Spatial coverage | NL: DYFS sampling in lake Grevelingen ceased | Reduction of spatial coverage |

**Table 8.1 (continued)**

| Year | Ongoing / incidental change | Geographic region | Element of change | Description of change | Effect of change on data-use |
|---|---|---|---|---|---|
| 1986 | Ongoing | Dutch to Danish coast, Dutch Scheldt estuaries | Temporal coverage | NL: DYFS sampling in Apr/May ceased | Reduction of temporal coverage |
| 1985 | Ongoing | Dutch Wadden Sea | Temporal coverage | NL: DYFS sampling in Apr/May ceased | Reduction of temporal coverage |
| 1984 | Ongoing | Dutch to Danish coast | Vessel | NL: DYFS sampling conducted with new vessel (RV Isis), in addition to vessel already conducting the survey | Expansion of depth ranges within the spatial area |
| 1982 | Ongoing | Belgian coast | Vessel | BE: vessel change (Hinders --> Broodwinner) | Limited, as gear and sampling protocol remained constant |
| 1979 | Incidental (only 1979 spring) | Dutch to Danish coast | Vessel | NL: additional sampling with another vessel (Bona Spes) (1979 spring only) | Limited; total area coverage remained constant, sampling areas divided between the two vessels |
| 1977 | Ongoing | Dutch to Danish coast, Dutch Wadden Sea, Dutch Scheldt estuaries | Data collection | NL: age data collection for Dab (*Limanda limanda*) in DYFS | Expansion of species list for age information |
| 1976 | Ongoing | Scheveningen (NL) to Hirtshals (DK) | Data collection | NL: age data collection for Dab (*Limanda limanda*) in SNS | Expansion of species list for age information |
| 1974 | Ongoing | Scheveningen (NL) to Esbjerg (DK) | Spatial coverage | NL: SNS areas north of Esbjerg (transects 671–673) sampled | Expansion of spatial coverage |

**Table 8.1 (continued)**

| Year | Ongoing / incidental change | Geographic region | Element of change | Description of change | Effect of change on data-use |
|---|---|---|---|---|---|
| 1974 | Ongoing | Schleswig-Holstein | Spatial coverage | DE: start DYFS (Apr/May & Sep/Oct) | Expansion of spatial coverage |
| 1972 | Ongoing | Niedersachsen Wadden Sea + Elbe estuary | Spatial coverage | DE: start DYFS (Apr/May & Sep/Oct) | Expansion of spatial coverage |
| 1972 | Ongoing | Dutch to Danish coast | Vessel | NL: additional sampling with another vessel (Willem Beukelsz) ceased | Limited; total area coverage remained constant; sampling areas divided between the two vessels |
| 1972 | Ongoing | Dutch Wadden Sea | Vessel | NL: vessel change (Waddenzee -> Stern) | Limited, as gear and sampling protocol remained constant |
| 1970 | Ongoing | Belgian coast | Spatial coverage | BE: start DYFS (Apr/May & Sep/Oct) | Expansion of spatial coverage |
| 1970 | Ongoing | Dutch to Danish coast, Dutch Wadden Sea, Dutch Scheldt estuaries | Spatial coverage | NL: start DYFS (Apr/May & Sep/Oct), including area 631 (Grevelingen) | Expansion of spatial coverage |
| 1969 | Ongoing | Scheveningen (NL) to Esbjerg (DK) | Spatial coverage | NL: start SNS (Apr/May & Sep/Oct) | |

## 8.3 The Netherlands

### 8.3.1 DYFS

The Dutch DYFS commenced in 1970. From 1970–1986, it covered one additional area compared to later years: saltwater lake Grevelingen in the southwestern Dutch delta. Vessel changes took place in the Dutch Wadden Sea (1972), coastal zone (1972, 1979 [spring], 1984), and Scheldt basins (2016) (see Table 8.1). Until 1985, sampling occurred in spring and autumn; from 1986 onwards, only the autumn sampling programme remained. Catches have been fully sorted and recorded from the start, although the level of detail for identification of benthic species has improved over time.

The coastal zone survey was conducted by different vessels between 1970 and 1983. The DYFS has been conducted with RV Isis since 1984. In addition to the standard DYFS programme in the coastal zone, RV Tridens I operated DYFS and SNS nets simultaneously from 1970 to 1986 in spring and until 1989 in autumn, following the SNS station stratification.

In the coastal zone, individual fish weights for fish of which otoliths were collected are available for the full time-series. In the Dutch Wadden Sea and Scheldt basins, these data are available only from 2017 onwards.

Otolith collection has expanded from plaice and sole in 1972 to dab (from 1977), flounder (from 1989), and turbot and brill (from 2003). In 2021, the number of otoliths collected was evaluated and reduced for sole and plaice < 20 cm, based on a study simulating the effect of a reduction on the age-length keys and, thus, on the fishery-independent indices.

### 8.3.2 SNS

The SNS was established by the Netherlands in 1969 and followed up on a previous programme aimed at flatfish, the so-called 'transect programme' (*raaienprogramma*), which was active in the 1950s. From 1969 to 1995, SNS was performed using the RV Tridens I (IMO no. 6812833); since 1996, SNS has been performed with RV Isis (IMO no. 8318180). From 1969–1989, SNS was carried out in both spring (in April/May) and autumn (in September). Since 1990, SNS has been performed in the autumn only – except in 2003, when SNS was performed only in spring.

The Danish coastal area north of Esbjerg (areas 671–673) was also sampled from 1974 to 1991 and in 1994. In response to the sediment conditions (i.e. greater clay fraction), the beam trawl in this area was made heavier to ensure good fishing. The specifications agreed at the time were not properly recorded and can no longer be traced.

In 2012, the SNS was conducted with RV Tridens II due to technical issues with RV Isis. The survey was carried out a few weeks later than in other years. The survey results in 2012 were different from other years and should be treated with care, as a vessel effect and/or temporal effect may have influenced the results that year. In 2010 and 2013, the SNS was partly carried out by the commercial vessel Jakoriwi using the original survey gears. The vessel size and power are comparable to that of RV Isis (the principal survey vessel), so a minor effect on the catches is expected. Sample processing differed slightly from the original protocol for non-commercial species, so the data should be treated with care, especially for biodiversity studies.

Otolith collection has expanded from plaice and sole (1972) to dab (1977), flounder (1989), and turbot and brill (2003). In 2021, the number of otoliths collected was evaluated and reduced for sole and plaice < 20 cm, based on a study simulating the effect of a reduction on the age-length keys and, thus, the fishery-independent indices.

## 8.4 History and developments of the survey gears

The DYFS was established as an internationally coordinated and standardized survey. The SNS has always been solely conducted by the Netherlands. Despite the ambition to keep the time-series as coherent as possible, vessel changes or modification of station grids do happen. This section has provided a detailed overview of the history of the different surveys and a summary of the changes over time in tabular form (Table 8.1). The table also highlights the presumed effect of the change on the data use.

Belgium uses a 6 m beam trawl with 22 mm mesh in the codend. The time-series is available in the institute (complete) and in DATRAS (since 1985).

For the Netherlands, the DYFS 3 m beam trawls used in the Dutch Scheldt basins and the Dutch Wadden Sea originally were identical. From 2006 to 2012, parameters of all gears were checked annually to the gear and net schemes. Since 2013, selected parameters have been checked annually prior to or directly following the survey. At evaluation of the gear measurements, it appeared, based on local circumstances and insights of the skippers, that the layout of both 3 m gears had slightly diverged. In 2015, the gears were modified back to one setup. In the Scheldt areas, where the changes to the gear were largest, comparative fishing of the gear prior to 2015 and from 2015 onwards was conducted; this yielded no differences in catchability.

Germany used a 3 m beam trawl for the whole survey time-series without any major modifications. However, the technical drawing of the net and the beam trawl dates to 1993 and has been used ever since to build replacements. Whether or to what extent net or gears differed slightly from these prior to 1993 is unknown.

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# Annex 1: Author contact information

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# Annex 2: List of abbreviations

| Acronym | Meaning |
|---|---|
| ALK | Age–length key, a relationship that can be derived from individual length and age recordings |
| API | Application programming interface |
| BE | Belgium |
| CPUE | Catch per unit of effort, a standardised catch. Standardisation may occur by swept area (mostly: numbers per $km^2$), or by duration (mostlyL numbers per hour) |
| CTD | Instrument to measure conductivity and temperature at different water depths |
| DATRAS | ICES online database of trawl surveys with access to standard data products |
| DCF | EU Data collection framework |
| DE | Germany |
| DK | Denmark |
| DYFS | Demersal Young Fish Survey |
| EU | European Union |
| GPS | Global positioning system |
| ICES | International Council for Exploration of the Sea |
| MSFD | EU Marine strategy framework directive |
| NL | The Netherlands |
| OSPAR | The Convention for the Protection of the Marine Environment of the North-East Atlantic |
| RV | Research vessel |
| SIC | Scientist in charge (chief scientist) |
| SNS | Sole Net Survey |
| TIMES | ICES Techniques in Marine Environmental Sciences |
| WGBEAM | ICES Working group on beam trawl surveys |
| WGBIOP | ICES Working group on biological parameters |
| WGCRAN | ICES Working group on *Crangon* fisheries |
| WGDG | ICES Working group on DATRAS governance |
| WGML | ICES Working group on marine litter |
| WKASMSF | ICES Workshop for advancing sexual maturity staging in fish |
| WKMSSPDF | ICES Workshop on maturity staging of sole, plaice, dab and flounder |
| WKTQD | Workshop on Taxonomic Quality Issues in the DATRAS Database |

# Annex 3: Overview of WGBEAM inshore surveys (current situation)

**Table A3.1. Survey area, time-series, sampling period, sampling design, vessel**

| | **DYFS** | | | | | | | **SNS** |
|---|---|---|---|---|---|---|---|---|
| | **Belgium** | **Germany** | | | **The Netherlands** | | | **The Netherlands** |
| **Survey area** | **Belgian Coast** | **Niedersachsen Wadden Sea and Elbe Estuary** | **Schleswig-Holstein** | **North Sea coastal Area outside the island chain** | **Dutch Wadden Sea** | **Scheldt Estuary** | **Dutch to Danish coast** | **Scheveningen (NL) to Esbjerg (DK)** |
| Survey start | 1970 | 1972 | 1974 | 2012 | 1970 | 1970 | 1970 | 1969 |
| Start benthos sampling | 2020 | 1972 | 1974 | 2012 | 1970 | 1970 | 1970 | 1969 |
| Survey period | Apr/May (1970–1991) Sept/Oct | Apr/May (1974–2004) Sept/Oct | Apr/May (1974–2004) Sept/Oct | Sept/Oct | Apr/May (1970–1986) Aug/Oct | Apr/May (1970–1986) Sept/Oct | Apr/May (1970–1986) Sept/Oct | Apr/May (1969–1989) Sept/Oct |
| Start (week no.) | 35 | 37 | 36 | 37 | 35 | 36 | 38 | 36 |
| No. survey days | 8 | 5 | 5–7 | 14 | 25 (within 5 weeks) | 12 (within 3 weeks) | 25 (within 5 weeks) | 10 (within 2 weeks) |
| Station positions | Fixed | Semi-fixed | Semi-fixed | Fixed | Semi-fixed | Fixed | Fixed | Fixed |
| No. stations | 33 | 75 | 75 | 85 | 120 | 80 | 100 | 50 |

| Table A3.1 (continued) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Ship | RV Simon Stevin | Chartered vessels | Chartered vessels | RV Clupea | Stern | Luctor | Isis | Isis |
| Ship length (m) | 36 | 12–16 | 12–18 | 28 | 21 | 34 | 28 | 28 |

**Table A3.2. Sampling characteristics**

| | **DYFS** | | | | | | | **SNS** |
|---|---|---|---|---|---|---|---|---|
| | **Belgium** | **Germany** | | | **The Netherlands** | | | **The Netherlands** |
| **Survey area** | **Belgian Coast** | **Niedersachsen Wadden Sea and Elbe Estuary** | **Schleswig-Holstein** | **North Sea coastal Area outside the island chain** | **Dutch Wadden Sea** | **Scheldt Estuary** | **Dutch coast to Danish coast** | **Scheveningen (NL) to Esbjerg (DK)** |
| Trawl duration (min) | 30 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Day/night sampling | Day | Day | Day | Day | Day | Day | Day | Day |
| Fishing direction | Against tide | With tide | With tide | With tide | With tide | With tide | With tide | With tide |
| Speed over ground (knots) | 3.5 | 3 | 3 | 3 | 2–3 | 2–3 | 2–3 | 3.5–4 |
| Beam width | 6 | 3 | 3 | 3 | 3 | 3 | 6 | 6 |
| No. beams fished | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |

**Table A3.2 (continued)**

| | **DYFS** | | | | | | | **SNS** |
|---|---|---|---|---|---|---|---|---|
| | **Belgium** | **Germany** | | | **The Netherlands** | | | **The Netherlands** |
| **Survey area** | **Belgian Coast** | **Niedersachsen Wadden Sea and Elbe Estuary** | **Schleswig-Holstein** | **North Sea coastal Area outside the island chain** | **Dutch Wadden Sea** | **Scheldt Estuary** | **Dutch coast to Danish coast** | **Scheveningen (NL) to Esbjerg (DK)** |
| No. beams sorted | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Operation from | Aft | Side | Side | Side | Side | Side | Side | Side |
| Length data | Commercial fish and elas-mobranch species, brown shrimp | All fish and elasmobranch species, brown shrimp | All fish and elasmobranch species, brown shrimp | All fish and elasmobranch species, brown shrimp | All fish and elasmobranch species, brown shrimp | All fish and elasmobranch species, brown shrimp | All fish and elasmobranch species, brown shrimp | All fish and elasmobranch species, brown shrimp |
| Catch weight per species | Yes | Yes | Yes | Yes | No | No | No | No |
| Epibenthos data | All species | All species | All species | All species | All species | All species | All species | All species |
| Biological data | Table 4.1 | Table 4.1 | Table 4.1 | Table 4.1 | Table 4.1 | Table 4.1 | Table 4.1 | Table 4.1 |
| Environmental data | Continuous | Continuous | Continuous | Continuous | Continuous | Continuous | Continuous | Continuous |
| Litter data since | 2018 | No litter data | No litter data | No litter data | No litter data | No litter data | No litter data | No litter data |

# Annex 4: Beam trawl dimensions

**Table A4.1. Dimensions of gear components**

| | | DYFS | | | | | | | SNS |
|---|---|---|---|---|---|---|---|---|---|
| | | Belgium | Germany | | | The Netherlands | | | The Netherlands |
| **Survey area** | | **Belgian Coast** | **Niedersachsen Wadden Sea and Elbe Estuary** | **Schleswig-Holstein** | **North Sea coastal Area outside the island chain** | **Dutch Wadden Sea** | **Scheldt Estuary** | **Dutch coast to Danish coast** | **Scheveningen (NL) to Esbjerg (DK)** |
| Beam | Width inside shoes (m): | 6 | 3 | 3 | 3 | 3 | 3 | 6 | 6 |
| | No. of components (pipes) | 1 | 3 | 3 | 3 | 1 | 1 | 1 | 3 (2 small, 1 large) |
| | Pipe length total (m) | 6 | 3 | 3 | 3 | 3 | 3 | 6 | 6 |
| | Pipe circumference (mm) | | 298 | 298 | 298 | 290 | 290 | 370 | Small: 500<br>Large: 640 |
| | Pipe thickness (mm) | | 15 | 15 | 15 | 8 | 8 | 18 | Small: 10<br>Large: 12 |
| Skids | No. skids | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | Height (cm) | | 56.5 | 56.5 | 56.5 | 64 | 64 | 71 | 80 |
| | Width (cm) | | 7 | 7 | 11 | 20 | 20 | 15 | 13 |
| | Length (cm) | | | | | 77 | 77 | 85 | 80 |

**Table A4.1 (continued)**

| | | **DYFS** | | | | | | | **SNS** |
|---|---|---|---|---|---|---|---|---|---|
| | | **Belgium** | **Germany** | | | **The Netherlands** | | | **The Netherlands** |
| **Survey area** | | **Belgian Coast** | **Niedersachsen Wadden Sea and Elbe Estuary** | **Schleswig-Holstein** | **North Sea coastal Area outside the island chain** | **Dutch Wadden Sea** | **Scheldt Estuary** | **Dutch coast to Danish coast** | **Scheveningen (NL) to Esbjerg (DK)** |
| Chains | No. ticklers | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 4 |
| | Tickler length (mm) | - | - | - | - | 370 | 370 | 720 | 1 235, 1 335, 1 435, 1 535 |
| | Tickler diameter (mm) | - | - | - | - | 10 | 10 | 13 | 13 |
| | Chain mat | No | No | No | No | No | No | No | No |
| | Bridle length (mm) | - | | | | 2 000 | 2 000 | 4 750 | 4 000 |
| | Bridle material | - | | | | 18 mm steel rope | 18 mm steel rope | 16 mm chain | 19 mm chain |
| Net | Flip-up rope | No | No | No | No | No | No | No | No |
| | Length headline (mm) | 5 800 | 2 900 | 2 900 | 2 900 | 2 900 | 2 900 | 5 770 | 5 800 |
| | Material headline | | 10 mm braided polyester | 10 mm braided polyester | 10 mm braided polyester | 10 mm braided nylon | 10 mm braided nylon | 14 mm braided nylon | 16 mm braided nylon |
| | Length ground rope (mm) | 7 400 | 3 450 | 3 450 | 3 450 | 3 700 | 3 700 | 7 500 | 15 700 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Material ground rope | | 10 mm braided polyester | 10 mm braided polyester | 10 mm braided polyester | 10 mm braided nylon | 10 mm braided nylon | 16 mm braided nylon, 10 mm chain | 16 mm braided nylon, 13 mm chain |
| Bobbin rope (mm) | | | | | 3 600 | 3 600 | 7 280 | - |
| Bobbin diameter (mm) | 200 | 200 | 200 | 200 | 170 | 170 | 210 | - |
| Netting material | Knotted nylon | Knotted polyester | Knotted polyester | Knotted polyester | Knotted nylon | Knotted nylon | Knotted nylon | Knotted nylon |
| Codend mesh size (mm), stretched | 22 | 20 | 20 | 20 | 20 | 20 | 20 | 40 |
| Mesh sizes net | See Figure A4.1 | See Figure A4.2 | See Figure A4.2 | See Figure A4.2 | See Figure A4.3 | See Figure A4.3 | See Figure A4.3 | See Figure A4.4 |

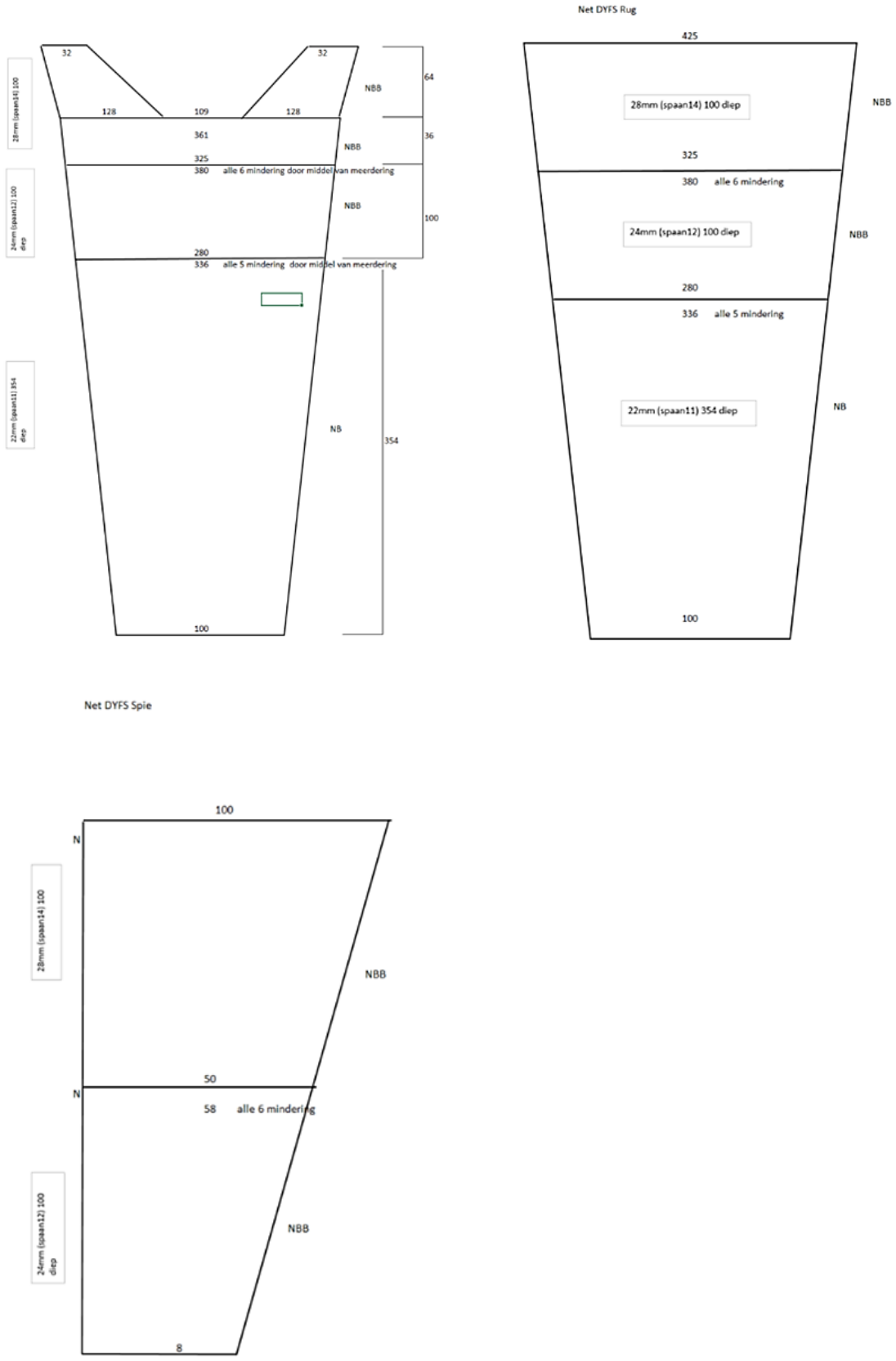


**Figure A4.1 Dimensions of the Belgian Demersal Young Fish survey (DYFS) trawl net**

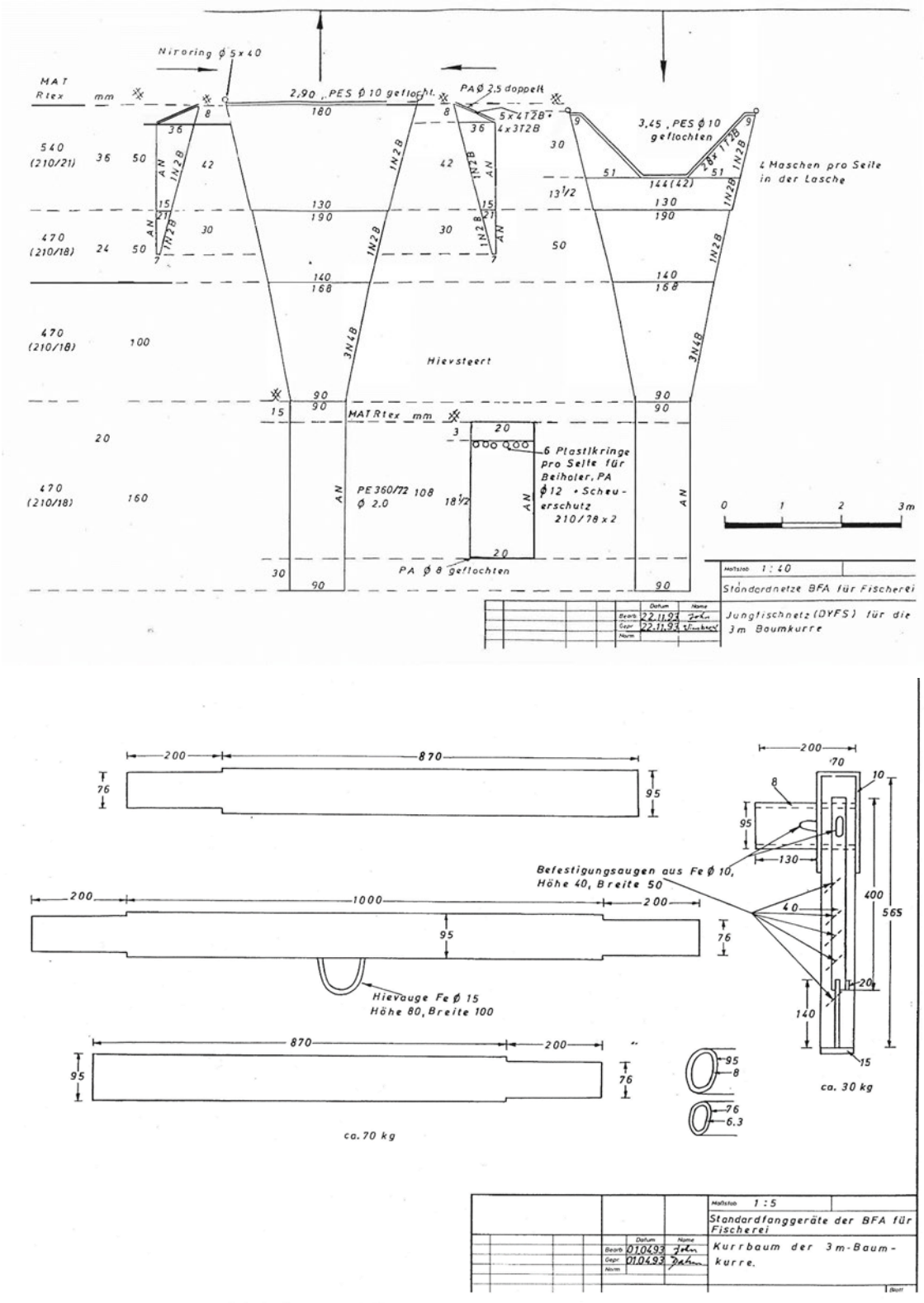


**Figure A4.2 Dimensions of the German Demersal Young Fish survey (DYFS) trawl net**

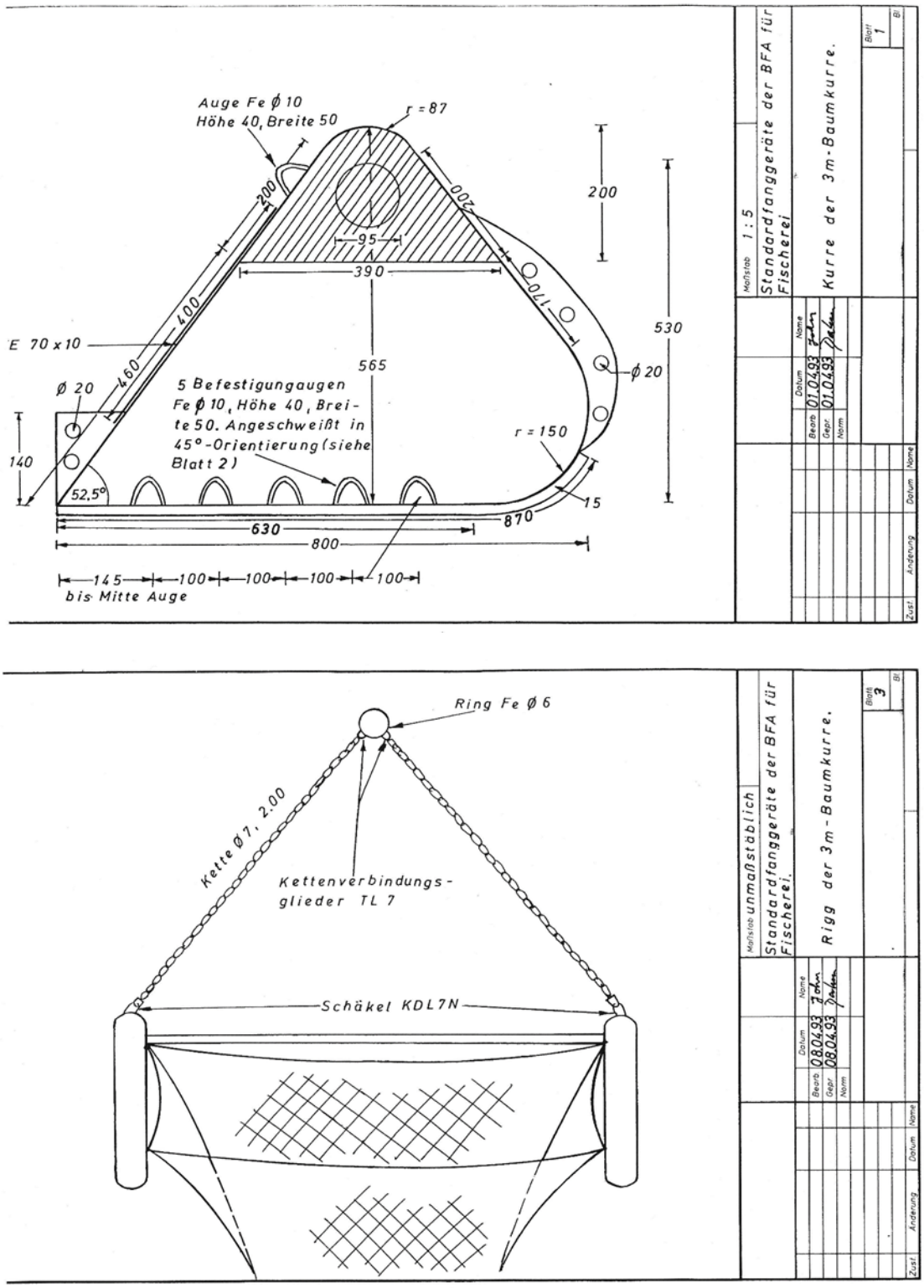


**Figure A4.2 (continued) Dimensions of the German Demersal Young Fish survey (DYFS) trawl net**

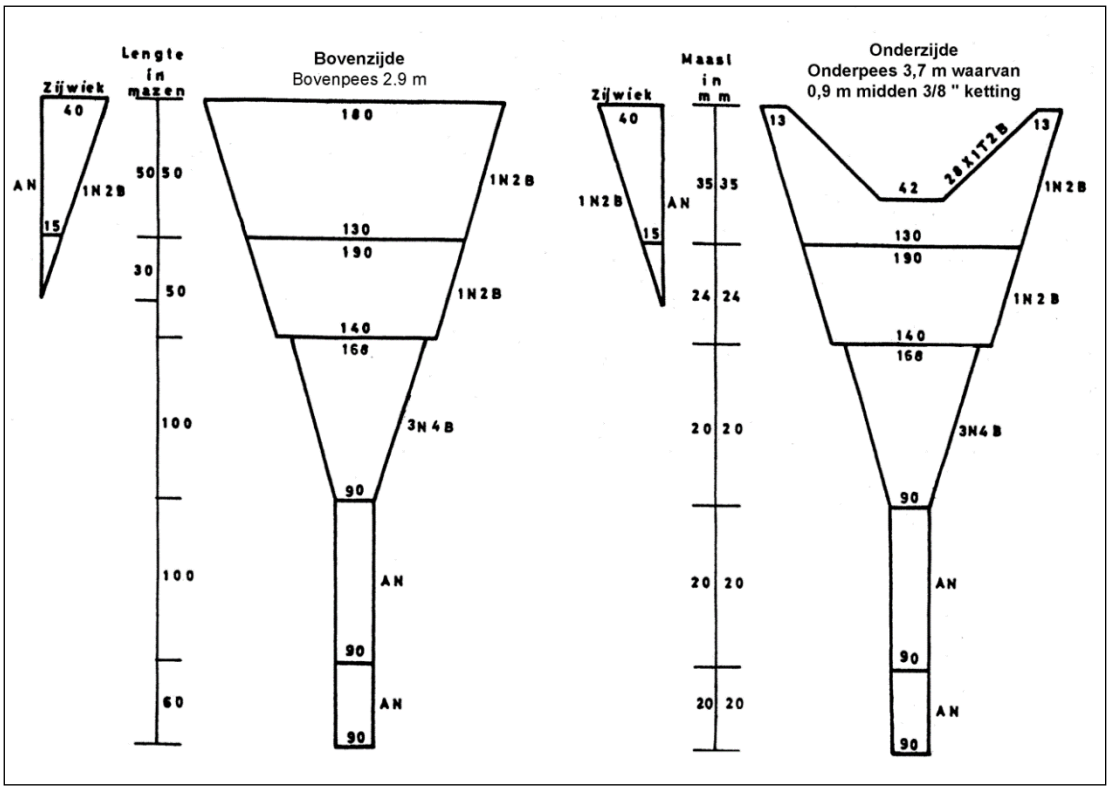


**Figure A4.3 Dimensions of the Dutch Demersal Young Fish survey (DYFS) 3 m trawl net (from Damme *et al.*, 2023)**

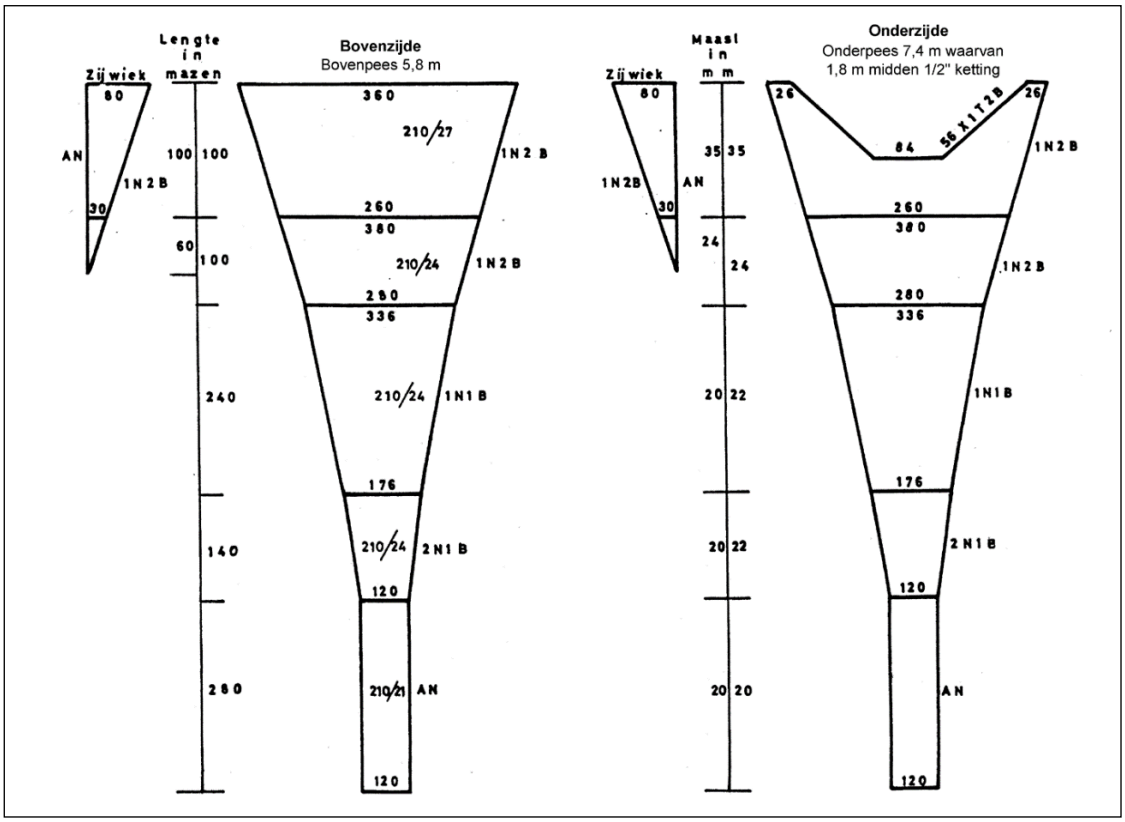


**Figure A4.4 Dimensions of the Dutch Demersal Young Fish survey (DYFS) 6 m trawl net (from Damme *et al.*, 2023)**

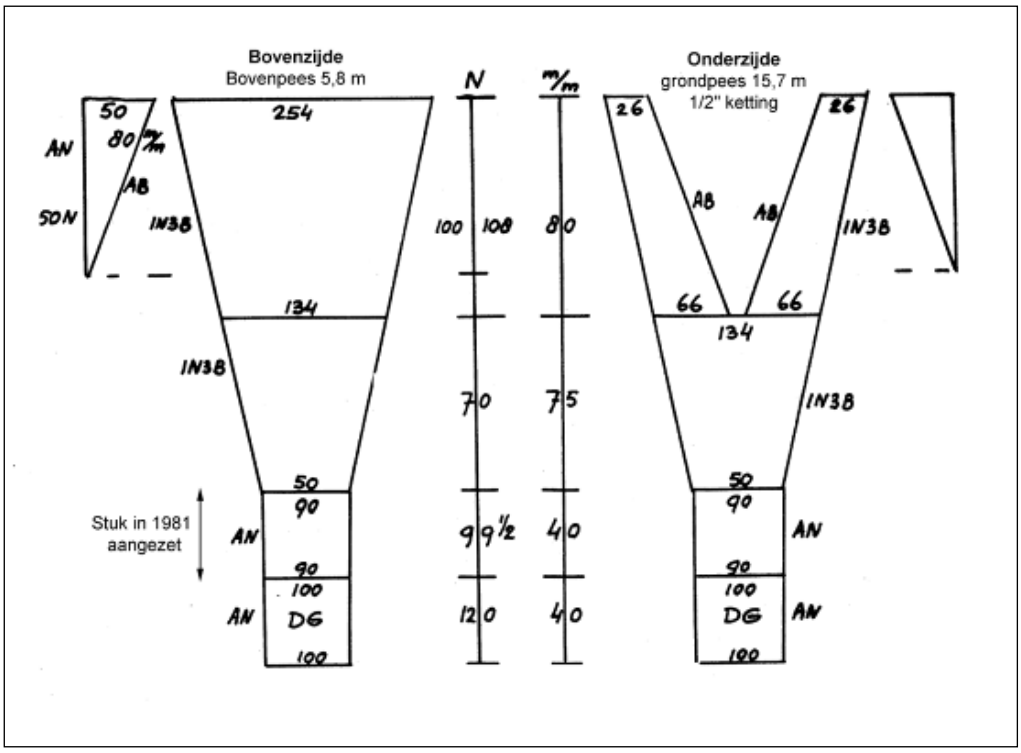


**Figure A4.5 Dimensions of the Dutch Sole Net survey (SNS) trawl net (from Damme *et al.*, 2023)**

# Annex 5: Geographic distribution of the surveys

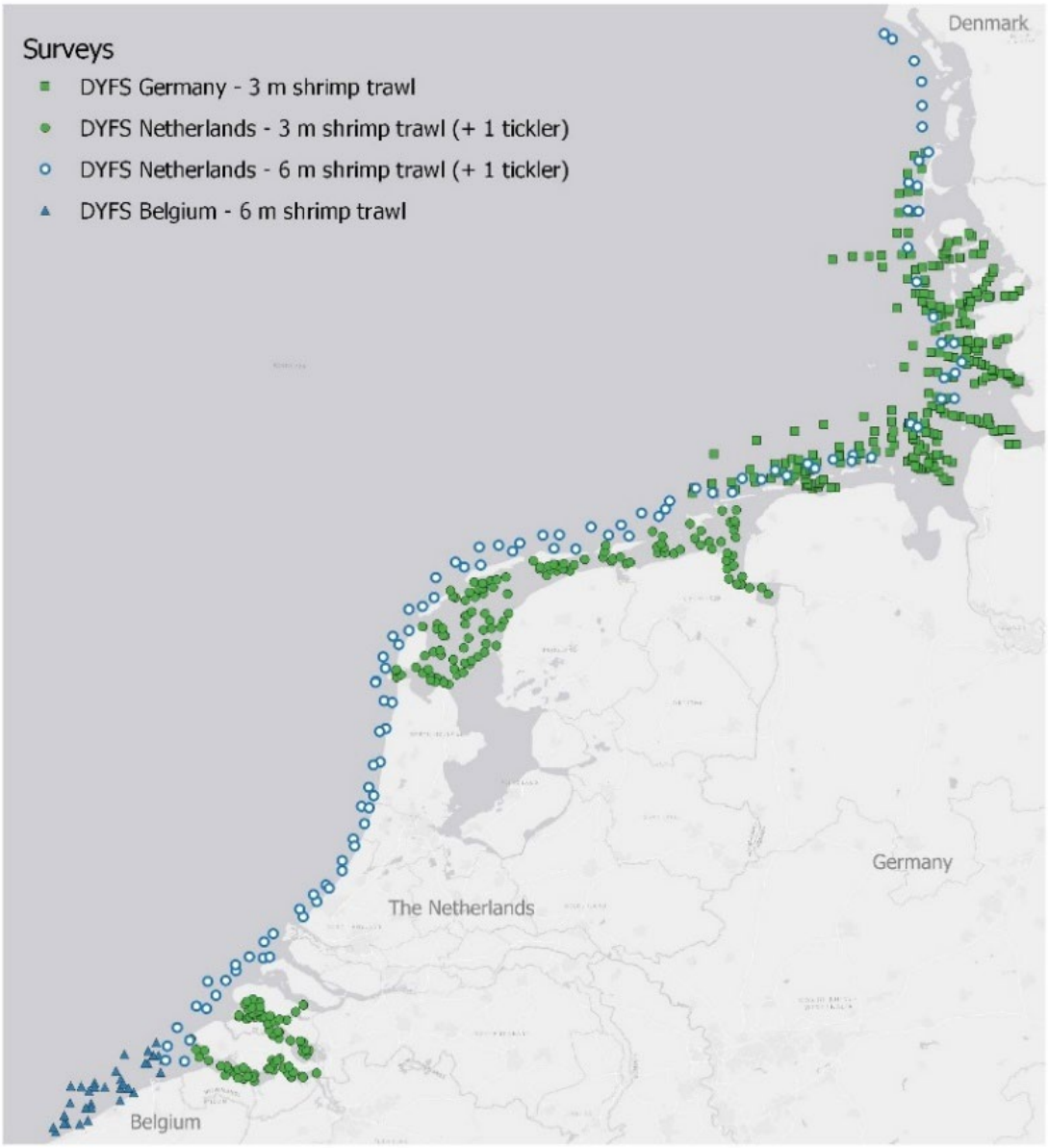


**Figure A5.1 Demersal Young Fish survey (DYFS), all countries**


**Figure A5.2 Sole Net survey (SNS). Lines: transects. Dots: stations on the transects.**

# Annex 6: Biological sampling stratification areas

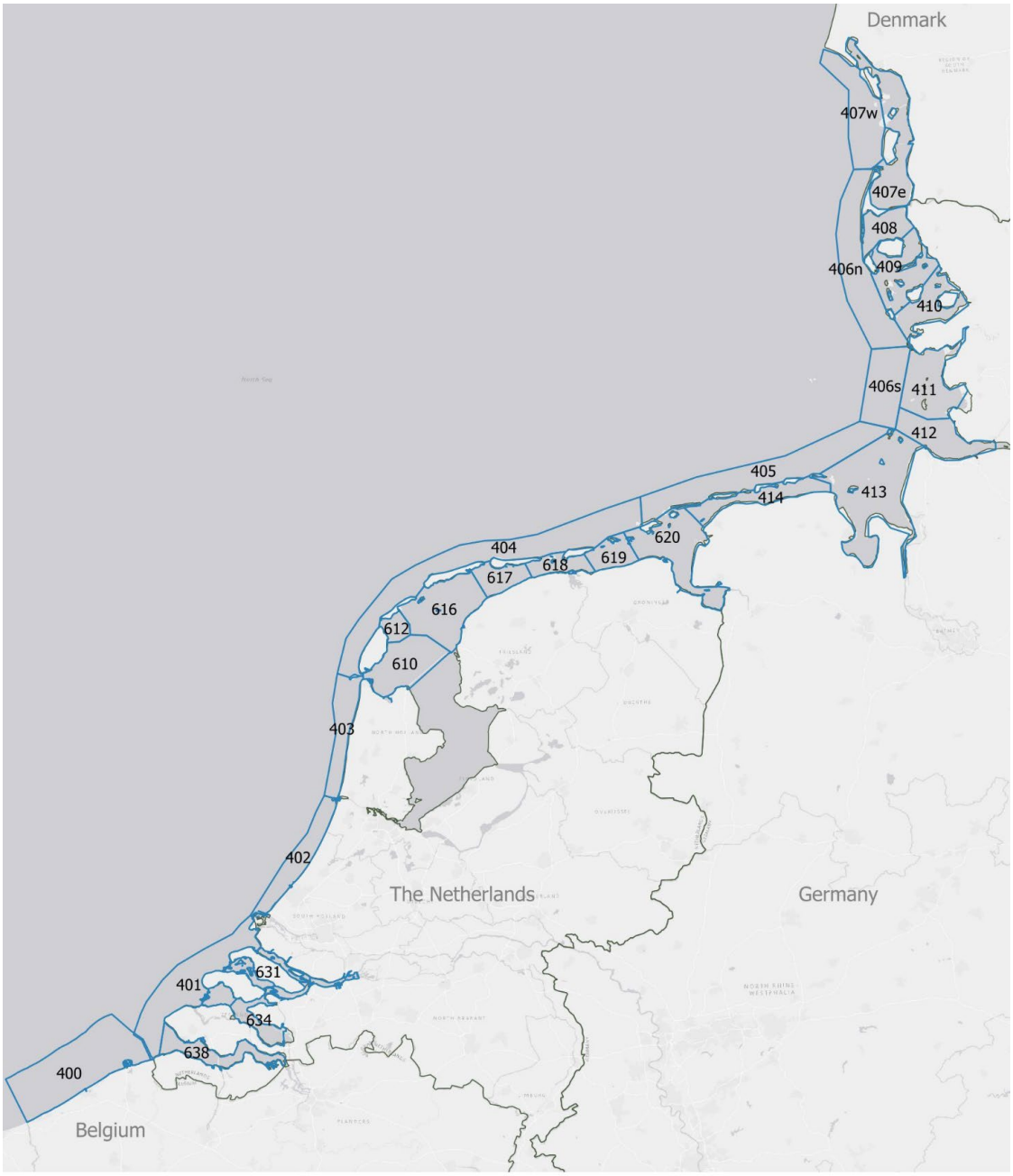


**Figure A6.1 Demersal Young Fish survey (DYFS) subareas. The numbers in the blue shapes represent the subareas for biological data collection stratification.**

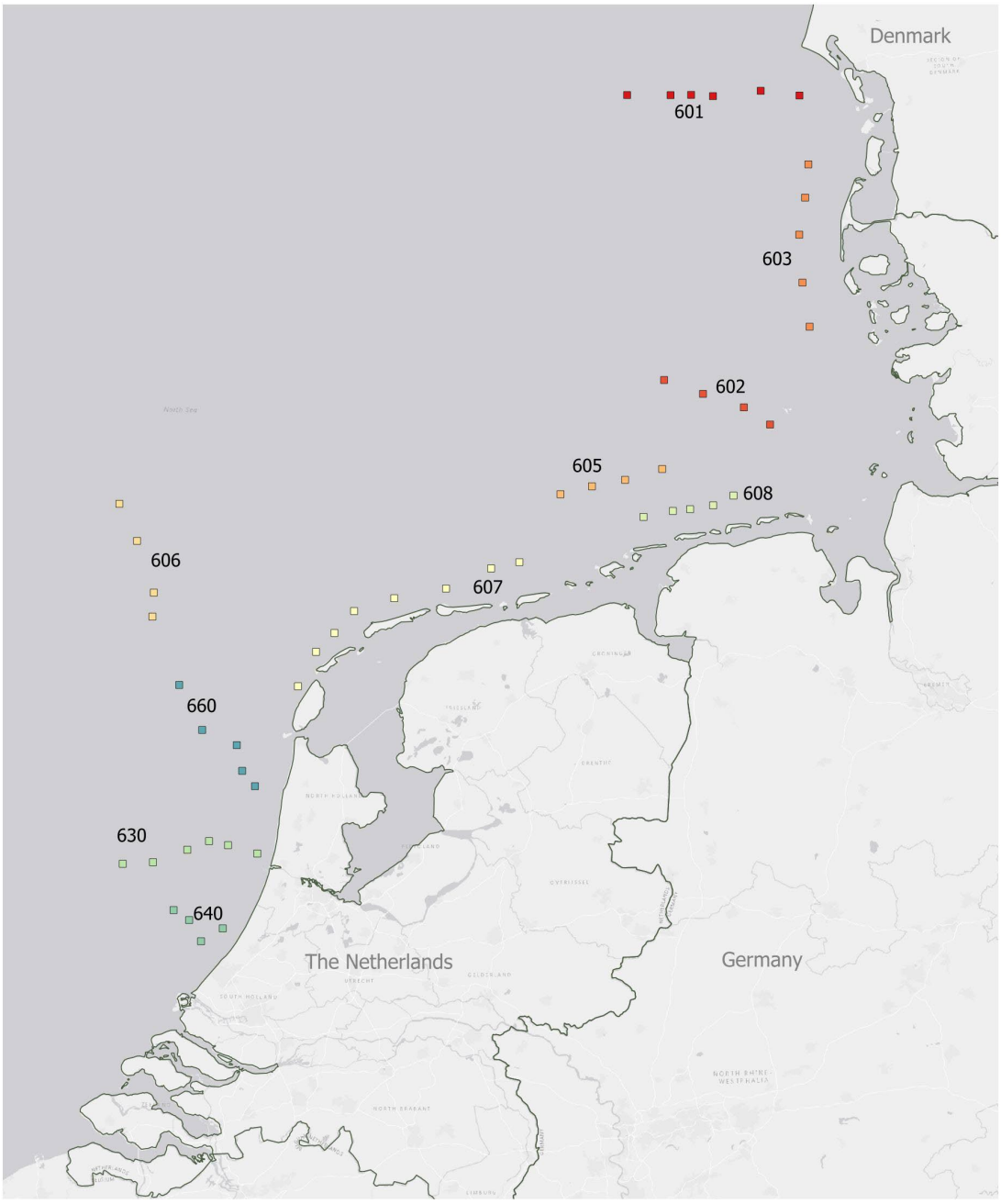


**Figure A6.2 Sole Net survey (SNS) areas. The numbers next to the transects (similar coloured dots in one line) represent the subareas for biological data collection stratification.**

# Annex 7: Closed species lists for inshore beam-trawl surveys DYFS Belgium

**Table A7.1. Belgian Demersal Young Fish survey (DYFS)**

| Data collection since | Scientific name | Sample weight |
|---|---|---|
| 1970 | *Solea solea* | Yes |
| 1970 | *Pleuronectes platessa* | Yes |
| 1970 | *Limanda limanda* | Yes |
| 1970 | *Scophthalmus maxima* | Yes |
| 1970 | *Scophthalmus rhombus* | Yes |
| 1970 | *Gadus morhua* | Yes |
| 1970 | *Merlangius merlangus* | Yes |
| 2008 | *Platichthys flesus* | Yes |
| 2009 | *Eutrigla gurnardus* | Yes |
| 2009 | *Trachurus trachurus* | Yes |
| 2009 | *Microstomus kitt* | Yes |
| 2009 | *Scomber scombrus* | Yes |
| 2009 | *Mullus surmuletus* | Yes |
| 2009 | *Chelidonichthys lucerna* | Yes |
| 2009 | *Raja clavata* | Yes |
| 2009 | *Scylliorhinus canicula* | Yes |
| 2009 | *Dicentrarchus labrax* | Yes |
| 2009 | *Chelidonichthys cuculus* | Yes |
| 2018 | *Mustelus sp.* | Yes |

# Annex 8: Trawl information and environmental parameters

| | DYFS | | | SNS |
|---|---|---|---|---|
| | **Belgium** | **Germany** | **The Netherlands** | **The Netherlands** |
| Surface current direction | | | | |
| Surface current speed | | | | |
| Bottom current direction | | | | |
| Bottom current speed | | | | |
| Tidal phase | | x | x | x |
| Tide direction | | | x | x |
| Tide speed | | | x[a,b] | x |
| Swell direction | | | x | x |
| Swell height | | | x | x |
| Swell speed | | | | |
| Wind direction | x | x | x | x |
| Wind speed | x | x | x | x |
| Towing direction | | x | x | x |
| Surface temperature | x | x | x | x |
| Bottom temperature | Since 2020 | Since 2018 | x | x |
| Surface salinity | x | x | | |
| Bottom salinity | Since 2020 | Since 2018 | | |
| Surface conductivity | x | | x | x |
| Bottom conductivity | Since 2020 | | x | x |
| Secchi depth | | x | x | |
| Turbidity | | x | | |
| Marine litter | Since 2018 | | | |

[a] DYFS Scheldt area (Luctor) and Dutch to Danish coast (Isis)
[b] DYFS Scheldt area (Lector) and Dutch Wadden Sea (Stern)

# Annex 9: Four stage maturity key for skates and rays (Rajidae)

| Stage | State | Male | Female |
|---|---|---|---|
| A | Immature | Claspers undeveloped, shorter than extreme tips of posterior margin of pelvic fin<br>Testes small and thread-shaped | Ovaries small, internal structure gelatinous or granulated and with no differentiated oocytes visible<br>Oviducts small and thread-shaped, width of shell gland not much greater than the width of the oviduct |
| B | Maturing | Claspers longer than posterior margin of pelvic fin, their tips more structured, but cartilaginous elements are not hardened, and the claspers are soft and flexible.<br>Testes enlarged, sperm ducts beginning to meander | Ovaries enlarged and with more transparent walls. Oocytes differentiated in various small sizes (< 5 mm).<br>Oviducts) small and thread-shaped, width of the shell gland much greater than the width of the oviduct but not hardened |
| C | Fully mature | Claspers longer than posterior margin of pelvic fin, cartilaginous elements hardened and claspers stiff<br>Testes enlarged, sperm ducts meandering and tightly filled with sperm | Ovary/ovaries large and tight. Oocytes enlarged, with some very large, yolk-filled oocytes (> 5 mm).<br>Uteri enlarged and widening, shell gland fully formed |
| D | Active | Claspers reddish and swollen, sperm present in clasper groove, or flows if pressure exerted on cloaca | Viviparous species (e.g. spurdog, tope and smoothhounds, sting/electric rays): distinct yolk-filled eggs with developing embryos present in the oviducts<br>Oviparous species (e.g. lesser-spotted dogfish and skates [Rajidae]): egg capsules beginning to form in shell gland and partially visible in uteri, or egg capsules fully formed and hardened in oviducts/uteri |

# Annex 10: Guidelines for starting a new beam-trawl survey

This manual should be the starting point for any institute or body that wishes to start a beam-trawl survey that will be used for indices purposes.

Whenever a new survey is commissioned, the suitability of the gear is paramount, and liaison with the industry and ICES WGBEAM would be the correct first step towards an inaugural survey. Fundamentally, the following steps should be carried out before any survey is started.

1) Identify the species that are to be targeted.
2) Identify the area to be fished.
3) Identify the most appropriate gear to use.
4) Ensure the gear can be deployed efficiently from your research platform.
5) Ensure that you have competent and expert knowledge to deal with the gear and the sampling.
6) Design the survey to deliver robust data that is representative of your needs.
7) Document the process and ensure that there is repeatability to all of the processes that you carry out.
8) Liaise with experts (such as those at WGBEAM) when designing and carrying out your survey.

One of the remits of WGBEAM to provide expert advice on such issues as those listed above, and one should take advantage of this to help ensure the success of any new beam-trawl survey.