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Manual for the Offshore Beam Trawl Surveys

Version 3.4

Working Group on Beam Trawl Surveys
(WGBEAM)

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Contents

1 Introduction

Seven countries are participating in the Working Group on Beam Trawl Surveys (WGBEAM). In total, data are collected during 9 offshore surveys. An overview of the main characteristics of the different offshore beam trawl surveys is given in Annex 1, the geographic distribution of the surveys is in Annex 2.

The surveys coordinated by WGBEAM have independent origins and have not been harmonized into a single survey design like the International Bottom Trawl Survey (IBTS). No standardization of gears across surveys exists. Comparison across survey areas is not possible without thorough scientific investigation. Combining information from different gears is possible as long as the spatial coverage of the respective gears has remained constant over time. Comparative tows have been conducted over time, although not systematically. Especially in areas with rough bottoms (e.g. English southeast coast) not all set-ups of a beam trawl are suitable.

WGBEAM works on increasing standardized sampling by conducting comparative tows in overlapping areas, exchanging staff during surveys and publishing this manual.

The purpose of this manual is threefold:

1. Describe the current methodologies, stratification and sample processing used in the beam trawl surveys of Belgium, France, Germany, Iceland, Italy/Slovenia, the Netherlands and UK (Cefas) (chapters 2 to 6)
2. Describe the main points of attention when combining the data of the respective beam trawl surveys (chapter 7)
3. Describe the major historical changes in survey methodology and/or data collection (chapters 8 and 9)

2 Survey objectives

Although the history and background of the surveys varies, the current objectives are similar for all areas:

- Create fisheries-independent abundance indices by age group (1 year olds and older) for a number of fish species (i.a. plaice, sole, dab, lemon sole, flounder, turbot, brill, monk fish) for the sampled area
- Collection of biological data on all fish species including elasmobranch species for ecosystem analysis purposes, including length measurements
- Collection of data on at least a selection of epibenthos species for ecosystem analysis purposes
- Collection of marine litter data

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

3 Current survey designs

3.1 Sampling areas and periods

Although originally started in the North Sea area including the English Channel, the beam trawl survey sampling area currently ranges from the Bay of Biscay to Icelandic waters in the North-East Atlantic and Adriatic Sea in the Mediterranean Sea. Maps of the sampling areas are in Annex 2.

The surveys in the North Sea, Eastern Channel, Western Channel, Irish Sea & Bristol Channel and Icelandic sea occur between July and October. The surveys in Bay of Biscay and Adriatic Sea are conducted in November-December. The survey in the Western Channel & Celtic sea occurs between February and April. A full overview is available in Annex 1.

3.2 Survey stratification

3.2.1 Fixed station design

The **Belgian** 62 fixed stations in the **North Sea** (11 in ICES area 4b, 51 in 4c) were historically choosen to adequately (a) spatially cover the ICES rectangles, (b) the target species population and (c) fishing characteristics. During the span of the time-series, some stations have moved slightly, for various reasons. The rationale for the new locations has been: within 5 nautical miles from the original station, and on similar grounds and depth. The attempt is generally to sample habitat as similar to the habitat of the previous fixed station rather than a random sample within the area. There is no fixed order in which the stations are fished but a similar yearly pattern is attempted. The order in which stations are fished in a certain year can be retrieved from the succession of haul numbers, whereras stations are unique.

Germany (**North Sea**) fishes about 63 stations in a grid of ICES statistical rectangles which is tried to be kept fixed. The origin of the locations is not known. Generally, the same stations are fished every year. Four stations are placed in the most inshore rectangles, three in the next seaward ones, and two otherwise.

The **UK (Cefas) North Sea** beam trawl survey (BTS) operates annually in the Eastern Channel and southern North Sea following fixed station design survey using RV Cefas Endeavour. The positions of stations are set historically, originally from areas deemed of high importance for plaice and sole catches by commercial fishermen and areas known to harbour juveniles. The haul number identifies the annual order of each gear deployment (including invalid tows) of any gear that goes over the side of the vessel during the survey (i.e. the first deployment is station 1, and subsequent stations are incremental). Prime stations (station numbers) are unique numbers that do not change, irrespective of the survey station number, and provide a fixed numbering system for sampling sites with minor variation (see below). There is no particular order in which the stations should be worked.

The current survey targets a total of 79 sampling locations with 34 located in 7d UK; 30 located in 7d France and a further 15 located in 4c. Additionally, if time permits, there are 5 tows currently fished in Belgian waters to provide comparison to the tows conducted on the Belgica survey and these have been completed in most years since 2004. If static gear or other restrictions prevent the execution of a primary station there are alternative tows in the same area. The chief scientist has positions of alternative tows

that have been used before, when the primary station was not accessible. All tow positions are stored on board in the ships navigation system and backed up on Cefas's own systems in spreadsheets and on the FSS.

The **UK (Cefas) Irish Sea and Bristol Channel** beam trawl survey (ISBCBTS) operates in the Irish Sea (7a) and Bristol Channel (7fg) and targets a total of 108 tows. The survey has run annually since 1988 each September using RV Corystes (1988-2008) and RV Cefas Endeavour (2009-present). Of the 108 primary stations, 66 are in ICES Division VIIa and 43 in ICES Divisions 7f and 7g. All primary station positions are fixed and can be identified by a unique prime station number (Station number in datras). The positions of stations are set historically, originally from areas deemed of high importance for plaice and sole catches by commercial fishermen. The stations are distributed over sectors and depth-bands (for the purposes of otolith sampling). The number of primary survey stations within each sector amount to: Irish Sea South (ISS, 18 stations), Irish Sea North (ISN, 16 stations), Irish Sea West (ISW, 15 stations), Saint Georges Channel (SCG, 16 stations), Bristol Channel Inner (BCI, 32 stations), Bristol Channel Outer (BCO, 11 stations). The 11 BCO stations are considered the lowest priority as the data currently do not contribute to the VPA tuning and recruitment indices at the respective working groups.

In the **Bay of Biscay**, **France** sampling design consists of a set of 49 stations, on fixed positions replicated each year in November-December. The fixed station survey was defined according to information on sole fishing areas. Hauls were provided by fishers. Station positions were selected to have a uniform coverage of the sole fishing area by one or two hauls in two-thirds (48 out of 72) of the 10′ latitude by 10′ longitude rectangles of the fishing area. Four strata are defined. Their weights are the surface of the sole habitat estimated by the fishing area (in number of 10′ latitude by 10′ longitude rectangles). In each stratum, the sampling effort is planned in proportion to the surface area of the sole fishing ground in the Bay of Biscay.

The **Adriatic Sea** survey (**Italy/Slovenia**) consists of 67 fixed positions chosen in a random depth stratified design (0-30 m: 39 stations; 30-50 m: 17 stations; 50-100 m: 11 stations) in the conception and the same stations are now sampled every year. Effort was allocated to the strata to cover the area (GSA17) and stocks adequately.There is no fixed order in which the stations are fished but a similar yearly pattern is executed as far as possible. During the span of the time-series, stations may have been moved slightly. The rationale for the new locations has been: within 5 nautical miles, similar ground and depth.

Stations in the **Icelandic** survey are fixed. In total 80 stations were selected based on four criteria and were therefore not selected randomly (figure 2). The first three criteria were that the tow depth had to be less than 50 m, that it had to be close to the shore (within 5 nm) and the bottom had to be sandy according to the ship's sonar. The fourth and final criteria was that the stations had to be close (within 10 nm) to areas marked by demersal seine fishermen as areas were juvenile flatfish were found.

3.2.2 Stratified random design

The **UK (Cefas)** south-west Ecosystem survey (**Q1SWECOS)** is set-up as a stratfied random survey covering the shelf area from roughly 9°W to the 200m isobath on the shelf break. The approx. 27 stations are divided in strata (min. 5 stations per stratum) of the stratified random design are based on a large number of species distributions, community analysis and environmental covariates. Budget and time-dependent efforts

have been made to collect additional ecosystem information to develop a full ecosystem monitoring programme without degrading the fisheries time-series information. The additional sampling provides information on many additional ecosystem components such as hydrography, epifauna, zooplankton, phytoplankton, sediment, infauna, geochemistry.

To make the design effective the area is subjectively –based on large number of species and/or indicators- parceled out into relatively homogenous sub-regions or strata so that the majority of the variance is explained between strata and minimized within stratum. As much physical and biological information as possible is used to make the stratification consistent with the spatial scale of the habitats that make up the ecosystem. This is essential in order to provide useful information on as many species and ecosystem processes as possible.

As the physical conditions of habitats may vary, the stratification is based on the post-facto identified biological communities, using the long-term experience and knowledge of fishermen in the area as a starting point. The focus is on the variables of interest, rather than the variables (environment) that affect the variables of interest. The major advantage of this approach is that it ensures almost 100% coverage of the area and the expertise covers a larger period than the quantitative information available for the area. More detailed information on the history of the design is available in paragraph 8.4.

3.2.3 Systematic design

The Netherlands plans to fish about 72 stations in the central and western North Sea. One haul is carried out in the centre of an ICES rectangle, unless fishing is not possible in that area. In that case, the best position in the neighbourhood of the centre of the rectangle is chosen. The monitoring in the central and western North Sea started as part of the North Sea IBTS, but was changed into a beam trawl survey in 1998. In the south-eastern North Sea 82 first priority stations and 12 additional stations are planned, distributed over the ICES rectangles based on flatfish catch expectations (historical information). Two to four hauls are carried out in a rectangle, depending on the distance to the coast. The ICES rectangles to be fished are standard. The minimum distance between two hauls is set to 10 nautical miles. The priority stations are taken into account for the independent survey indices.

3.3 Survey gears

3.3.1 Variety of beam trawls

All surveys coordinated by WGBEAM are carried out with a beam trawl. However, depending on the local circumstances and the ship's capacity, the width and rigging of the beam trawls varies. Most countries, however, have used the same gear for the full time period and did not change the geographical area over time. Operation of the gear might occur from the aft or from the side, depending on the ship's design.

The setup of the gear is mostly related to seafloor conditions. For example, in the Dutch beam trawl survey the gear is rigged with a flip-up rope in the central and western North Sea to keep boulders out of the net. In the south-eastern North Sea no flip-up rope is used as there are no boulders in that area. Gears with chain mats have to be used in areas with rough seafloor, to prevent net damage.

Detailed information on the gears and rigging is listed in Annex 4.

3.3.2 Overview by country

Belgium uses a commercially rigged 4 m beam trawl equipped with a chain mat (since 1993) and 40 mm mesh size in the cod-end. The gear is trawled from the stern. Detailed schematics and information on the net and the beam will be available and maintained at the institute from summer 2019 onwards.

Germany uses a 7.2 m beam trawl, similar to those employed by the shrimping fleet. Five tickler chains are attached. Cod-end mesh size is 40 mm. Detailed schematics and information on the net and the beam are available and maintained at the institute .

Netherlands uses an 8 m beam trawl, especially designed for the survey (in 1985). The beam trawl is fitted with 8 chains, of which 4 are connected to the beam and 4 to the net. As mentioned, the gear is rigged with a flip-up rope in the central and western North Sea to keep boulders out of the net. In the south-eastern North Sea no flip-up rope is used as there are no boulders in that area. Cod-end mesh size is 40 mm. Detailed schematics and information on the net and the beam are available and maintained in the national manual.

The Quarter 1 south-west Ecosystem survey (**Q1SWECOS, UK Cefas** and **Ireland**), uses a more modern version of the traditional commercial gear used on other surveys. The main differences are the use of polypropelene as the netting and an extension to the codend (3-m) for easier catch retrieval on the RV. Two gears are deployed per haul and recorded seperately. One gear is fitted with a 40 mm liner, the other uses only the commercial 80 mm cod-end. Detailed schematics and information on the net and the beam are available and maintained in the national manual.

The other **UK (Cefas)** beam trawl surveys use a commercially rigged (1989 style) 4 m beam trawl (measured between inside edges of shoes) fitted with a chain mat and flip-up ropes in all areas and with a 40 mm liner. The liner needs to be sufficiently long, that when attached to the forward end of the codend it extends to about 1 metre below the cod-line. Detailed schematics and information on the net and the beam are available and maintained in the national manual.

Iceland uses, like UK (Cefas), a commercially rigged (1989 style) 4 m beam trawl (measured between inside edges of shoes) fitted with a chain mat and flip-up ropes. The liner needs to be sufficiently long, that when attached to the forward end of the cod-end it extends to about 1 metre below the cod-line. Detailed schematics and information on the net and the beam are available and maintained at the institute.

France uses a 4 m beam trawl gear with 10 ticklers, derived from commercially beam trawl used by the Belgian fleet in the Bay of Biscay on soft grounds. 4 chains are connected to the beam and 6 to the net. Because the lack of skill for this kind of gear in France, it was ordered in Netherlands. From the survey beginning in 2007 to 2013 on board Gwen Drez, the beam trawl was towed on two warps, each of them being connected to each shoe. From 2014 onwards, because of change of vessel, the beam trawl is towed on one warp. Cod-end mesh size is 40 mm. Detailed schematics and information on the net and the beam are available and maintained in the national manual.

The **Italian/Slovenian** survey is carried out with two or four modified 3.5 m beam trawls, named as *rapido* trawl by the Italian fishermen. The gear was specifically designed to work on different types of bottom and consists of a modified beam trawl with a rigid mouth. The frame is rigged with iron teeth along the lower leading edge. Joined to the iron frame there are 4 skids and a reinforced rubber diamond-mesh net

in the lower part to protect the polyamide net bag tied to the iron frame. Cod-end mesh size is 40 mm. Detailed schematics and information on the net and the beam are available and maintained in the national manual.

3.4 Haul procedures

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

In general, the offshore beam trawl survey is a day-time survey, which means that fishing occurs between 15 minutes prior to sunrise and 15 minutes after sunset. Beginning and ending of the daylight period hauls 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 attempted where practicable. Only in the Bay of Biscay a day and a night haul are conducted at every station.

In most countries one beam trawl is operated. Only **Netherlands** applies two beam trawls simultaneously in the **North Sea**.

For **Q1SWECOS** (**UK Cefas** and **Ireland**), there are no formal day light sampling restrictions, but time of day is recorded and 24 hour sampling has been carried out at times to facilitate efficient vessel usage. Tows consist of a two simultaneously deployed 4 m beam trawls with aimed to be standardised over two nautical miles, one fitted with a 40 mm liner the other without liner.

Hauls can be marked invalid by the scientist in charge, e.g. if net damage occurs, or if the tension on the wires is higher than the maximum allowed value (depends on ship and . Depending on the situation, the station is re-sampled (preferred option), re-sampled at a shorter tow duration, slightly moved (in case of bad quality fishing ground) or skipped.

3.4.1 Haul duration

Start of the haul is considered as the moment the full length of line has been set according to the standard warp-depth ratio (paragraph 3.4.2). In addition, some countries use systems to view depth, warp length and tension on the wires during trawling. For **Belgium**, the **Netherlands** and **UK (Cefas)**, Marelec trawl control system shows the line length and the tension during towing, indicating if the net is set to the ground and/or is blocked in any way. **Italy** uses a minilog (Star Oddi) attached in each gear giving the real time depth and temp. **Iceland** has a Scanmar trawl depth sensor attached to the net in all hauls. **Germany** uses a system to view the tension on the wires during trawling.

Haul duration is set to 30 minutes for all surveys, except Q1SWECOS, which is standardised to 2 Nmiles. The duration for a valid tow should at least be 15 minutes. The start of the trawl should be given as the time that the gear has settled on the bottom, and the end of the trawl should be given as the time that hauling commenced. If for any reason a tow is less than 15 minutes or more than 40 minutes, then the catch should still be fully processed, though the tow should be classified as an additional tow, and a valid tow attempted where practicable. In case of increased risk to net damage and/or known difficult substrata (sand, stones, shells) or large benthic by-catches, fishing duration is reduced to the minimum of 15 minutes a priori. Those stations can be marked as valid tows.

In the Adriatic (**Italy/Slovenia**), depending on the circumstances a shorter period is allowed not dropping below 10 minutes. In such case the haul is repeated and the catches are pooled together.

The Quarter 1 south-west Ecosystem survey (**Q1SWECOS**, **UK Cefas** and **Ireland**) differs in setup as tow duration is distance(area)-standardised; attempting to cover 2 nautical miles over the ground, in order to be able to deal with strong variation in tide and conditions that require some flexibility in towing speed. Tow length can be shortened if the ground dictates but are only considered valid if fished for a minimum of 1 nmi.

3.4.2 Fishing speed and warp length

Fishing speed is 4 knots over ground (Q1SWECOS: against tide), except for the **Bay of Biscay** (**France**) survey (5 knots) and the **Adriatic** (**Italy/Slovenia**) survey (5.5 knots). Tidal direction is not taken into account for the offshore beam trawl surveys, except for Belgium, where the standard fishing procedure is to fish against the tide, but is due to lack of time has not always been the done. Also, there is no record in which hauls fishing was done in are against tide.

Warp length is generally 3-4 times water depth for all surveys, when using it as a single line, and 6 to 7 times the water depth as the warp is used double (**North Sea**: **Belgium**, **Germany**) the exact value depending on the water depth and the local circumstances. In the **Adriatic** (**Italy/Slovenia**), warp length is 7 times water depth. Warp length can be adjusted to less if on hard rocky ground or more if fishing into a strong tidal current or other circumstances.

3.4.3 Documentation of trawl information

All information of the beam trawl surveys is stored in the ICES database DATRAS.

In the **North Sea**, **Belgium**, haul time and positions (shoot and haul) and abiotic data such as depth, wind speed, wind direction, surface temperature and surface salinity are retrieved from the ship's system. Bottom temperature and bottom salinity are acquired from the CTD that is attached to the beam. The haul metadata is stored in a standard format that is read into Smartfish afterwards by import software.

The **Netherlands** retrieves data on hauling position, depth, time, etc. directly from the ship's system. The information is stored in a standard format that can be read by the input software of the institute's database. CTD data is added from downcasts.

During the other surveys the haul information is not automatically collected from various sources and entered in the database.

4 Catch handling

4.1 Pooling catches

In most surveys, only one gear is deployed and so, only the catch of one net is sorted.

In the **North Sea Dutch** beam trawl survey of the two simultaneously operated beam trawls only one net is sorted for the length distribution and species composition. The catch of the other net is used to collect additional fish for biological information (age, sex-ratio, etc.).

In the **Adriatic** (**Italy/Slovenia**), the catches of the two gears towed are pooled together.

In **Q1SWECOS** (**UK Cefas** and **Ireland**) survey, the gears have different selectivities (mainly for small individuals due to the use of a 40mm blinder in one gear). Samples should be either pooled in analysis or only a single gear used, as the catches are likely strongly auto-correlated because of the common deployment. Both gears are reported seperately in the ICES database DATRAS.

UK (Cefas) Western Channel commercial beam trawl survey (WCBTS): *to be described*.

4.2 Catch processing

Although the detailed process of catch sorting might vary per survey series (see section 4.4), as it is largely dependent on the size of the vessel and the sorting tools available, 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 (e.g. by counting the number of fishing baskets).

4.2.1 Subsampling

In the case of larger catches a selection of species/size categories of species may be identified as being sufficiently abundant that they can be subsampled, appropriately. Subsampling can be based on weight, volume or numbers. If the entire catch cannot be sorted through then the data should be flagged accordingly when submitted to the DATRAS database.

When representative subsampling is not directly feasible, the species is further sorted into two or more size grades or categories. As the catches vary, the decision on prpoer subsampling has to be taken on a case by case basis. The following two examples are used to describe incidences when grading or categorization may be required but are by no means exhaustive.

Example 1 - A catch element consists of 999 fish in the length range 18 - 26cm and one fish at 40cm. It is evident that a single subsample of 100 fish when raised up will give either 10 or zero fish at 40cm. The correct approach is to remove the one large fish and measure it separately, treating that sample as category 1, and 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 18–26cm, 3 fish in the length range 10–12cm and 3 fish in the length range 38–40cm. It is evident that a single raised subsample of 100 fish could give anything between zero and 10 fish in the length ranges 10–12cm and 38–40cm. The correct approach is to remove the small and large fish and measure them as category 1, and 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.

4.2.2 Species sorting and identification

Finfish species

All finfish species are identified to the lowest taxonomic level using established quality control methods (see Section 5.4). Only if this proves impossible can some be grouped by genus or larger taxonomic group (e.g. *Pomatoschistus* species, Ammodytidae).

In most surveys subsampling by species is allowed, as long as a specified minimum of specimens per species is measured. The (sub-)sample of the species is weighed (only exception: Netherlands in southeatsern North Sea). 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, but in general 50-100 specimens should be measured to the cm below for a proper length frequency distribution.

A representative (mixed) subsample of the epibenthos is generally sorted and identified to the lowest taxonomic level. Free-living species are at least counted, and often weighed. For attached species presence is recorded.

Viable (undamaged and not empty) elasmobranch eggs are identified to the lowest taxonomic level and counted. Advice on identification of egg capsules is given in http://home.planet.nl/~bor00213/

4.2.3 Exceptions

In the **Belgian** survey, a closed species list (all finfish species and commercial shellfish) was used for species recordings until 2009 and in 2015 and 2016 (Annex 6 for species and registration types).

For **Netherlands**, catch processing slightly differs between the south-eastern North Sea and the central/western North Sea, due to the density of the station grid as well as catch composition in the areas and consequently, the amount of catch processing time available and needed between hauls. In the southeastern part (dense sampling grid, lots of young fish and few species), larger and rare fish and larger or rare epifauna species are sorted. Small fish and other epifauna, is collected in baskets of which a mixed sample (from different baskets) of one basket is created. This sample is sorted and, if necessary, subsampled. In the other areas, where the sample grid is less dense, the average fish size bigger, and the species diversity higher, all fish is sorted as well as larger or rare epifauna species. The remainder of the epifauna is collected in baskets. If the quantities of epifauna are more than one fishing basket, a mixed sample (from different baskets) of one basket is created. This sample is sorted and, if necessary, sub-sampled.

UK (Cefas) surveys, North Sea beam trawl survey (BTS) and the Irish Sea and Bristol Channel beam trawl survey (ISBCBTS) quantifies benthic by-catch at selected prime stations – generally one per ICES rectangle. However at the all other prime stations, the following species are always picked out and quantified (*Eunicella verrucosa, Sabellaria spinulosa, Pentapora foliacea, Funiculina quadrangularis, Meiosquilla desmaresti, Dromia personata, Arctica islandica, Atrina fragilis, Solaster Endeca, Virgularia mirabilis, Pennatula phosporea, Glossus humanus, Crepidula fornicate, Styela clava*).

On the Quarter 1 south-west Ecosystem survey (**Q1SWECOS),** the benthic by-catch is fully identified to species level where possible and recorded as presence absence at a minimum. Over time there has been an effort to fully enumarate the benthic bycatch from the sample with the liner (adding unseen observations from the sample with out the liner). Therefore time series can only be used consistently at the observation level.

A full protocol is available at Cefas.

In the **Icelandic** survey, all fish, crabs, *Nephrops*, and seacucumbers are separated from other catch on a conveyor belt. Benthos, debris, seaweed, kelp, rocks, shell hash is left on the conveyor belt. The conveyor belt has a tray beneath it which is checked after each station in case anything fell off. Flow scale is not used. Since 2018 the protocol has slightly been changed, so that the weight of all benthos species is recorded for day-time hauls (approx. half of the hauls).

4.3 Length measurements

4.3.1 Finfish species

All fish species are measured 'to the cm below' (10.0-10.9 --> 10 cm), and counted. Herring and sprat are measured 'to the half cm below' (10.0-10.4--> 10.5-10.9 --> 10.5), or 'to the cm below'. Length is defined as total length, measured from tip of snout to tip of caudal fin. In most surveys subsampling by species is allowed, as long as a specified minimum of specimens per species is measured. The (sub)sample of the species is weighed (only exception: Netherlands in southeatsern North Sea till 2016).

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, but in general 50-100 specimens should be measured to the cm below for a proper length frequency distribution.

4.3.2 Other species

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

The shellfish species *Nephrops novegicus* and *Cancer pagurus* and other commercially important shellfish species are measured to the mm below by sex, as indicated in Figure 4.2.2.1, and treated as the finfish species. The UK (Cefas) sorts and measures as three sexes – being male, female and berried (bearing eggs).

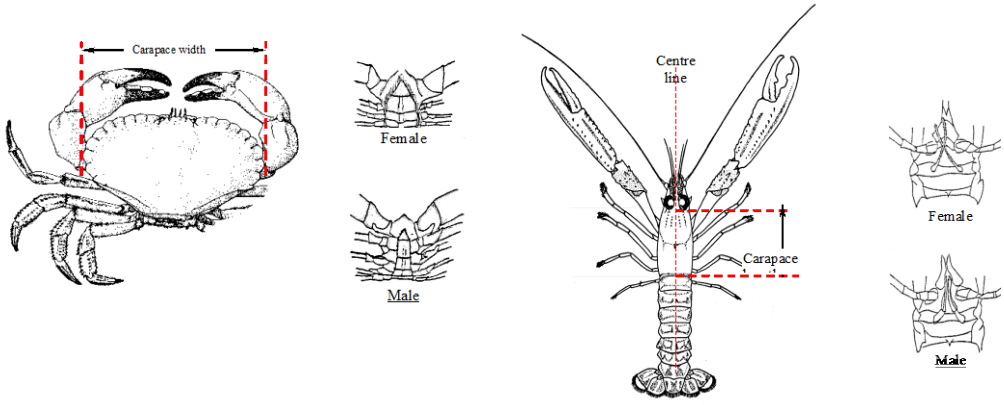

Figure 4.2.2.1 Measurement of *Cancer pagurus* (left, carapax width) and *Nephrops norvegicus* (right, carapax length)

For Cephalopod species, mantle length is generally recorded to the mm below. The UK (Cefas) and France (Ifremer) measures cephalopod to the cm below. Belgium only measures the commercialy important species such as *Loligo vulgaris, L. forbesii* and *Sepia officinalis*. *Alloteuthis* and *Sepiola* species are counted as part of the epibenthos subsample. Germany measures Cephalopods to the ½ cm below.

4.3.3 Exceptions

Belgium does not measure all cephalopod species, but only the commercially important ones (*e.g. Loligo vulgaris, L. forbesii* and *Sepia officinalis*). *Alloteuthis* and *Sepiola* species are counted and weighted. In some years also width (wing to wing) was measured of rays and skates, but since 2017 it was decided to only collect total length (tip of nose till tip of tail, in line with other countries) for those species. A closed species list was used until 2009 and in 2015 and 2016 (Annex 6 for species and registration types).

Netherlands records minimum and maximum length (to mm below) per species per sample for epifauna in the central and western North Sea.

For length frequencies, **UK (Cefas)** requires doubling of the minimum sampling size (75 specimens) in case of large catches (n > 1000) of any species.

Additional to the measurement by sex, UK-Cefas, Netherlands and Germany distinguish female egg bearing shellfish.

France has sorted non-commercial epibenthos in three groups from 2007 to 2013: starfish, crabs and shrimps, which are weighed (total weight) and counted (eventually by subsample). From 2014 onwards, all the non-commercial epibenthos is sorted by lower taxon to which they can be attributed on board, counted and weighted (total weight).

In the Adriatic survey (**Italy/Slovenia**) all finfish species, rays, sharks, cephalopods and commercially important shellfish and crustaceans are measured to the mm below except for *Bolinus brandaris*, *Hexaplex trunculus* and *Squilla mantis*. All the specimens of sole, spottail mantis shrimp, caramote prawn, Norwegian lobsters, cuttlefish, skates, sharks are sexed.

In the Icelandic survey all crabs, lobsters, sea cucumbers, scallops, cyprines, and shrimps are counted. If more than 50 individuals are measured of a fish species, the remaining individuals are counted to speed up processing.

4.4 Collection of biological information (age, sex, maturity)

4.4.1 Biological information collected

All countries collect biological information for a number of species, at least sole and/or plaice. The stratification is described in paragraph 4.3.2.

During all surveys otoliths are collected to provide age information. Generally, the fish is measured to the mm below, sex is defined and if possible, and the fish is weighed. From 2010 onwards, for spring spawning fish no maturity information is collected, following the WKMSSPDF2010 recommendation (ICES, 2010). WGBEAM 2018 decided that, due to a presumed change in spawning season, from 2019 onwards for the biologically sampled individuals the macroscopic maturity stage will be recorded. Macroscopic maturity classification follows internationally agreed criteria as reported by WKASMSF 2018 (ICES, 2018a).

In general, otoliths are returned to the lab for appropriate processing by a dedicated otolith processing team and skilled age readers.

The UK (Cefas) and France (Ifremer) measure biologically sampled individuals to the usual measuring interval for the species, i.e demersal species to the cm below, herring/sprat to the ½ cm below.

The species of which biological information is collected, vary. Table 4.3.1.1 shows the data collection for biological information. The maturity stage keys used for skates and rays are in Annex 3, the maturity scales for finfish follow the WKASMSF 2018 (ICES, 2018a) guidelines.

Table 4.3.1.1 Biological information currently collected on a routine basis by country and area in the offshore beam trawl surveys (L=individual length, W=individual weight, O=otolith, I=illicium, S=scale, M=maturity, X=biological information collected, but unclear which parameters)

	North Sea and Eastern Channel (Belgium, Germany, Netherlands and UK-Cefas – North Sea beam trawl survey (BTS))				West. Channel	West. Channel and Celtic Sea	Irish Sea and Bristol Channel	Bay of Biscay	Adriatic	Iceland
Species	Bel	Ger	Ned	UK-Cefas (BTS)	UK-Cefas (Commercial)	UK-Cefas (Q1SWECOS)	UK-Cefas (ISBCBTS)	Fra	It/Slo	Iceland
Arnoglossus laterna			LWO					L		
Aspitrigla cuculus				LWOM		LWOM	LWOM	LO		
Aspitrigla obscura										
Buglossidium luteum			LWO					L		
Conger conger				LWM		LWM	LWM	L		
Dicentrarchus labrax				LWOM		LWOM	LWOM	LSM		
Dipturus batis						LWM		L		
Eutrigla gurnardus				LWOM		LWOM	LWOM	LO		
Gadus morhua	LWO		LWO	LWOM		LWOM	LWOM			
Galeus melastomus										
Glyptocephalus cynoglossus						LWOM				X
Hippoglossoides platessoides			LWO							X
Hippoglossus hippoglossus			LWO							X
Lepidorhombus whiffiagonis				LWOM		LWOM		LOM		X
Leucoraja naevus				LWM		LWM	LWM	L		
Limanda limanda	LWO	LWO	LWO	LWOM			LWOM	L		X
Lophius piscatorious				LWOM		LWOM	LWOM	LIM		
Lophius budegassa						LWOM		LIM		

Melanogrammus aeglefinus				LWOM		LWOM	LWOM			
Merlangius merlangus				LWOM		LWOM	LWOM	LOM		
Merluccuius merluccius				LWOM		LWOM	LWOM	LOM		
Microstomus kitt	LWOM		LWOM	LWOM	LWOM	LWOM	LWOM	L		X
Molva molva						LWM	LWM	L		
Mullus surmuletus				LWOM		LWOM	LWOM	LOM		
Mustelus asterias				LWM		LWM	LWM	L		
Platichthys flesus			LWO	LWOM				L		X
Phrynorhombus norvegicus			LWO					L		
Pleuronectes platessa	LWO	LWO	LWO	LWOM	LWOM	LWOM	LWOM	L		X
Raja brachyura				LWM		LWM	LWM	L		
Raja clavata				LWM		LWM	LWM	L		
Raja fullonica						LWM				
Raja microcellata				LWM		LWM	LWM	L		
Raja montagui				LWM		LWM	LWM	L		
Raja undulata						LWM		L		
Scophthalmus maximus	LWO		LWO	LWOM		LWOM	LWOM	L	LWOM	X
Scophthalmus rhombus	LWO		LWO	LWOM		LWOM	LWOM	L	LWOM	
Scyliorhinus stellaris						LWM	LWOM			
Solea solea	LWO	LWO	LWO	LWOM	LWOM	LWOM	LWOM	LOM	LWOM	
Squalus acanthias						LWM				
Torpedo marmorata						LWM		L		
Trigla lucerna				LWOM		LWOM	LWOM	L		
Trigloporus lastoviza				LWOM		LWOM	LWOM	L		
Zeus faber				LWOM		LWOM	LWOM	L		
Sepia officinalis									LWM	

* illiciums collected, no otoliths

4.4.2 Stratification of biological samples

The stratification of the biological sampling varies over the surveys. In paragraph 4.3 a full overview of types of biological data collection is given. Below the stratification of the biological information is described. Maps for biological stratification are provided in Annex 5.

By area and length class

The biological data collection for **Belgium, Germany and Netherlands** in the **North Sea, France in the Bay of Biscay** 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 4.3.2.1). Areas can be ICES rectangle, flatfish area (Netherlands, south-eastern North Sea, Annex 5) or roundfish area (Netherlands, central and western North Sea, Annex 5). The collection of otoliths is spread over the flatfish/roundfish areas as much as possible. Registration of biological data is always done on a haul basis. Due to optimization excercises over the years the numbers of otoliths that were collected may have changed.

Table 4.3.2.1. Stratification of biological data collection for Belgium, Germany and Netherlands, Italy, France, UK (Cefas) and Iceland

AREA	COUNTRY	SPECIES	NUMBER	AREA DEFINITION	PERIOD	COMMENT
North Sea	Belgium	Plaice, Sole	2 per cm class	ICES rectangle	From 2018	
			3 per cm class	ICES rectangle	2017	
			5 per cm class	ICES rectangle	1992-2016	only ≥ 15 cm
		Turbot, Brill, Cod	3 per cm class	ICES rectangle	From 2017	
			5 per cm class	ICES rectangle	1992-2016	only ≥ 15 cm
		Lemon sole, Dab	3 per cm class	ICES rectangle	From 2018	
	Germany	Plaice, Dab	1 per cm class per sex	ICES rectangle	From 2014	
			3 per cm class per sex	ICES rectangle	1997-2013	
		Sole	No stratification, all sampled			
	Netherlands	Plaice	1 per cm class	ICES rectangle	From 2001	< 40 cm
		Plaice	2 per cm class	ICES rectangle	From 2001	≥ 40 cm
		Sole	2 per cm class	ICES rectangle	From 2001	
		Turbot, Brill, Dab, Flounder, Lemon sole, Cod	4-5 per cm class	Flatfish area or roundfish area		Haul-based registration since 2001; collection in all survey years
		Other species listed in Table 4.3.1.1	3-5 per cm class	Roundfish area		Only central and western North Sea

Area	Country	Species	number	area definition	period	comment
		Plaice, Sole	5 per cm class	Flatfish area or round-fish area	1985-2000	
	UK (Cefas)	Plaice	2 per cm class per sex	Station		
		Sole	10 per cm class	Stratum	From 2010	
			11 per cm class per sex		Up to 2009	
		Dab	5 per cm class	Survey	From 2012	
			n per cm class per sex n=4 < 13cm, n=8 13-49cm, n=50 > 50cm	4c, 7d	Up to 2013	
		Lemon sole, Turbot, Brill, ...	Lemon: 5 per cm class Turbot,Brill 50 per cm	4c, 7d Survey		
Bay of Biscay	France	Sole	min. 5 per cm class per sex	North of 46°30′		
			Minimal 5 per cm class per sex	South of 46°30′		
Adriatic Sea	Italy	Sole, Turbot, Brill	10 per cm class	Survey area		For all sole caught maturity stage is identified
Icelandic Sea	Iceland	Plaice, Dab, Lemon sole, Long rough dab, Flounder, Halibut, Turbot, Witch flounder	10	Station		No length stratification
Irish Sea and Bristol Channel	UK (Cefas)	Plaice	n per cm class n=1 <5cm, n=4 5-19cm, n=8 20-59cm, n=1 >59 cm	Stratum and depth band: 0–20m, 20+m.	From 2001	

Area	Country	Species	number	area definition	period	comment
		Sole	n per cm class n=2 <5cm, n=6 5-19cm, n=12 20-59cm, n=1 >59 cm	Stratum and depth band: 0–20m, 20+m.	From 2010	
			n per cm class per sex n=1 <5cm, n=4 5-19cm, n=8 20-59cm, n=1 >59 cm	depth band: 0–20m, 20+m.	Up to 2009	
		Dab	n per cm class n=1 <7cm, n=4 7-14 cm, n=8 15-29cm, n=4 > 29 cm	7a, 7fg	From 2014	
			n per cm class per sex n=1 <7cm, n=4 7-14 cm, n=8 15-29cm, n=4 >29 cm	depth band: 0–20m, 20+m.	Up to 2013	
		Lemon sole, Turbot, Brill, ...	n per cm class Lemon sole n=2 <10cm, n=5 10-34cm, n=2 >34cm Turbot Brill n=50	depth band: 0–20m, 20+m.		
Western Channel	UK (Cefas)					
South-west Ecosystem survey, Q1SWECOS	UK (Cefas)	Plaice	n per cm class per sex n=1 <11 cm n=10 11-35 cm F, 11-26cm M; n=20 36-51cm F, 26-41cm M;	stratum: UK-inshore, offshore and French-inshore		Historically virtually all individuals are sampled for age, but due to in-crease of plaice stock this is not

Area	Country	Species	number	area definition	period	comment
			n=10 >51cm F, >41cm M			the case anymore
		Sole	100 per cm class per sex	Stratum	From 2014	virtually all individuals are sampled for age
		Sole	20 per cm class	stratum: UK-inshore, offshore and French-inshore	2006-2013	virtually all individuals are sampled for age
		Megrim	20 per cm class per sex	Stratum		
		Turbot, Brill, ...	All			

4.5 Documentation of catch and biological 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 per ship, but is available in national manuals.

North Sea, Belgium uses digital measuring boards for length measurements and the electronic registration of biological fish and shellfish data. For individual fish weights the balance is directly synchronised with the measuring board. During the survey at sea data that are recorded with the measuring boards are automatically saved in Smartfish, the ILVO database.

The **Netherlands** reads the haul information and adds catch information by means of a home-developed data entry programme, using a a fixed species list to prevent typing errors, and defined length ranges for most species based on database recordings. Data on length measurements is entered directly into the computer. After the haul, the SIC checks the information in the file for completeness and obvious mistakes. Data from biological samples are written down and entered later in the same file. Otoliths are returned to the institute for appropriate processing by a dedicated otolith processing team and after reading the ages, the information is added to the file.

The **UK (Cefas)** uses the Electronic Data Capture (EDC) system to collect data that has inbuilt QC for min/max lengths along with length-weight checks on every length sample collected and every biologically sampled individual.

Iceland uses an electronic system (Hafvog) to collect length data.

France enters data into the computer on board.

Italy registers the catch and haul information on paper while on board and enters the information into the database when ashore.

5 Additional data

5.1 Environmental data

No definitions for the accuracy of CTD measurements have been set, as this is additional data collection. It is assumed that all countries use instruments that fit their needs and that descriptions are available at the institutes.

5.1.1 Data collection

Temperature and salinity data are collected during all surveys, mostly by using a CTD. Only in the Bay of Biscay a SCANMAR temperature unit is being used.

- Vertical downcast profiles are collected by Germany, Netherlands, UK-Cefas and in the Adriatic (Italy/Slovenia). Detailed information on the instruments used is available at the national institutes.
- Continuous CTD data collection during the tow is collected by Belgium, France, Iceland UK-Cefas and Italy/Slovenia.

Germany and UK (Cefas) collect water samples.

5.1.2 Data storage and availability

The **Netherlands** and **Germany** store the CTD data in the institute's database –after checking for outliers- together with the other survey data and vertical CTD profile information is supplied to ICES hydrographical database (ocean.ices.dk). **Belgium** stores the continuous CTD data in Smartfish, the ILVO database. Average bottom temperature and salinity are supplied with the other data in the datras HH file.

5.2 Marine litter

5.2.1 Data collection

During all offshore surveys litter from the catch is collected. Since 2009, UK-Cefas records information on litter caught during the surveys. Belgium, Germany and the Netherlands (only RV Tridens II) collect litter information since 2011 and France since 2014 and Iceland since the start of the survey in 2016. The data collection procedure followed is and has been in line with the at that time actual guidelines described by the ICES working group on Marine Litter (WGML; current version ICES, 2018b Annex 9c and https://vocab.ices.dk/?CodeID=149933).

5.2.2 Data storage and availability

Germany, Iceland, France, UK (Cefas) and Italy store the data in a litter database in the institute. Belgium and the Netherlands store the Excel sheets with litter information on an internal server (automated backup). All countries deliver the information to ICES Litter database related to DATRAS. The litter reference coding used follows https://vocab.ices.dk/?ref=1381.

6 Quality assurance

6.1 National manuals

Table 6.1.1. Overview of national offshore beam trawl survey manuals

COUNTRY	AREA	MANUAL (Y/N)	UPDATE FREQ	COMMENTS
Belgium	North Sea	N	N	No manual currently available for the Belgian BTS nor DYFS, only draft versions.
France	Bay of Biscay	Y	annual	
Germany	North Sea	N		
Iceland	Icelandic Sea	Y	annual	
Italy/Slovenia	Adriatic	Y		The manual also contains: • Detailed gear descriptions
Netherlands	North Sea	Y	Reviewed annually, updated when relevant	The manual also contains: • a quality assurance table, describing the risk, the potential measure, critical moment, limit values and actions to be taken. • Detailed gear descriptions
UK (Cefas)	All areas	Y	Reviewed annually, updated when relevant	For Q1SWECOS available only in draft.

6.2 Gear

In general, standard gear descriptions are used to maintain the gear. A check is done (by the fishing skipper, other crew and/or institutes' gear technicians) before each survey, and the gear is repaired when necessary. If the gear does not match the description, the gear technicians overhaul the gear. If the gear is damaged during the survey, the net is replaced, it is repaired by crew based on the net drawings, using pre-made net pieces or repaired by hand and a check will be performed immediately after the survey as it is not possible to properly hang out the net on board while at sea.

In the Adriatic beam trawl survey, a check is done before or after each sampling day.

Germany does not have a standard gear description to which the gear is checked, because the crew carries out the maintenance.

6.3 Sub-sampling

The **Netherlands** (**North Sea**) has defined quality assurance for the fraction and numbers subsampled is defined. At least three times during a survey is checked if the last two fractions in the sub-sample are equal.

For the **Adriatic** (**Italy/Slovenia**) rapido trawl survey quality assurance for the fraction subsampled is defined.

6.4 Species identification

WGBEAM uses the outcome of the Workshop on Taxonomic Quality (ICES, 2007b) 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. Species that cannot be identified at sea are conserved (mostly frozen) and returned to the lab for identification by experts.

In the **North Sea**, quality assurance of species identification is done in **Netherlands** and **Belgium** by annual internal identification tests+workshops (demersal fish and epifauna; pelagic fish species; fresh water fish species; marine shellfish species) for the institute's personnel. For employees having responsibilities in the offshore beam trawl surveys (e.g. SIC's) there is a minimum score defined for the demersal fish and epifauna identification test.

In **UK (Cefas)**, species identification for fish is to species level and ID guides have been compiled with the help fo taxonomic experts. Fish ID's that are uncertain at sea. To ensure quality control, staff are specifically trained for different surveys and fish identification tests are randomly carried out on surveys.

In the **Adriatic** (**Italy/Slovenia**), in 2011 an identification workshop has been carried out for the personnel involved in the survey, and a list of species, checked for synonyms and mistakes, has been finalised.

6.5 Data quality

Quality checks of the **Belgian** BTS data occur on three levels: 1) data quality checks on the software and database level, 2) data exploration quality checks in Power-bi and 3) additional quality checks in R studio (on the converted DATRAS HH, HL and CA datasets). A series of checks are done on trip level (*e.g.* dates), haul level (*e.g.* timing, positions, haul duration, distance), sample level (*e.g.* number of lengths, CPUE per ICES division) and individual fish level (*e.g.* number of otoliths). Lengths and weights are checked if recordings are between realistic ranges. Moreover, LWKs and ALKs are checked for outliers.

After the survey, the **Netherlands** performs standard checks for the parameters (outliers and/or missing values) are performed using a standard SAS script before the data is uploaded to the institute's database.

During the **UK (Cefas)** survey and again at the survey's end, a suite of data quality checks are performed on the collected data to ensure accuracy and quality. Other checks are carried out on the data before the data is uploaded to the database. Maturity identification is supervised for staff inexperienced with the particular survey until agreement and confidence are attained by staff to ensure consistency both within and between surveys in the series.

The electronic system (Hafvog) **Iceland** uses has a built-in QC for min/max lengths and length/weight distributions. Further checks are also carried out when the data is uploaded to the national database.

For **France** during the survey or at the survey's end, a check is performed on the collected data for typing errors and obvious mistakes. A suite of checks is carried out on the data before the data is uploaded to the national database.

Italy performs data quality procedures before entering data in the database.

The offshore beam trawl survey data for all countries are uploaded to DATRAS. Before uploading in DATRAS, files are screened. The allowable ranges, mandatory fields and checks carried out have been updated in 2013 (WKDATR2013) have been approved by WGBEAM 2013 and are available at http://www.ices.dk/datacentre/datsu/selrep.asp. Each country is responsible for the quality assurance of the data in DATRAS.

7 Guidance for data use

Below, for a number of data use scenarios the main points of attention are given. However, when it is unclear if signals in a time-series are caused by a change in sampling strategy, by erroneous data submission or something else, contact the datasubmitter for the country (available via ICES), or the country's WGBEAM representative (in latest WGBEAM report).

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 remain complex and usually require a model based approach. Generally such approaches are objective dependent and are difficult to generalise across species.

7.1 Treatment of biological information

Due to the stratification of the biological sampling, it is not possible to treat age samples as random for the purposes of growth studies or ALK development.

7.2 Use for 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.

For the **North Sea** surveys (**Belgium**, **Germany**, the **Netherlands**) data may be combined from 1998 onwards, as the international area coverage has remained constant since then, and the national (and so: different gears) coverage as well. The difference in gear efficiency can therefore be assumed of no importance in the light of the time-series that is used as a relative measure in the assessment.

Points of attention are a shift in the stratification of biological data collection. In general, it can be assumed that data currently are collected and registered on a more detailed (registered by haul) level than in historical years (e.g. registration by flatfish area). That is a matter of fact that cannot be changed.

Specific points of attention:

- **North Sea** and **Eastern Channel** (**UK Cefas**): otolith collections are based on stratified otolith targets at length, rather than targets by station which needs to be considered in the calculation of age-based indices. Age-based indices calculation is particularly difficult in the North Sea area where targets were regularly reached after completing only a small number of stations. Finally, additional / experimental survey stations not used in the index calculations are available on the FSS and in some years these had been included in the otoliths targets requiring detailed analysis as to how to best deal with ALK calculations for age-based indices. If in doubt more detailed information is available from Cefas or an information request to WGBEAM.
- **Western Channel** (**UK Cefas**): For the years 1985 to 1997 the number of stations used for the assessment was between 47 and 49 and was called the 'Grid'. By 1998 the 2 new inshore stations had been fished for four years so it was decided to recalculate sole and plaice indices to include all stations that were fished each year. For the record the Grid stations (49) are all stations (58) minus 9 prime stations (F (4), G (1), L (2), D0o, D0i).
- **Bay of Biscay** (**France**) survey: Data have been used for the Bay of Biscay sole assessment since 2013. A list of 50 reference stations have been established for the

abundance index calculation. However, in some years, it has not been possible to fish all the 50 reference stations, particularly in 2007 and 2010. In those years, the stratification affects the abundance index calculation as the planned number of hauls in each stratum could not be fully completed.

- Since 2017 the ICES North Sea demersal working group (WGNSSK) creates a combined (Belgium, Germany and the Netherlands) survey index for plaice in the North Sea. The Netherlands also still delivers separate indices to WGNSSK for the two BTS areas (southeastern North Sea and central&western North Sea respectively).
- In the North Sea, sole indices from Netherlands (southeastern North Sea, since 1985) are used as a tuning index for the assessment. Belgian data are being taken into consideration to be used as a separate tuning index for the assessment of sole in the North Sea. The addition of the Belgian BTS index could potentially improve the perception of the North Sea sole stock, because the Belgian BTS is the only beam trawl survey that covers a large part of the important spawning area for sole in the Thames estuary. This may be even more important as since the implementation of the electric (pulse) trawl, the commercial fishery for sole has shifted more towards the south-west of the North Sea (Belgian survey area).

7.3 Use for biodiversity and/or length distributions

For finfish and elasmobranch species all surveys can be used for their respective time-series. When geographical area coverage for different gears has remained constant over the time-series, data of the different gears can be combined, preferably using numbers per swept area (towed distance*beam width) as the CPUE.

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

a. The potential use of a closed benthos list (see 4.2.3, 4.3.3, Annex 6)
b. The increased and still increasing attention for species identification, that may lead to 'more' species in a survey, but is not necessarily true. Whenever possible, countries try to provide correct information, but it is difficult and simply not always possible to correct information back in time as it is not always clear if a new species occurred because it had never been recognized, or that it simply never had occurred before.

Specific points of attention:

- Until 2009, Belgium only measured all specimens of species of commercial interest and collected length for a closed fish species list (Annex 6).
- From 2010 onwards, Belgium collects length information for all fish species, as well as numbers for the epibenthos species (see chapter 4 of this manual).
- In 2015 and 2016 the Belgian survey was carried out by a commercial vessel and only the absolute minimum sampling could be carried out, resulting in sampling according to the period before 2010.

So, for length frequencies for fish species of commercial interest and of the closed fish list the data can be used, but for biodiversity analyses the Belgian data prior to 2010 and from 2015 and 2016 are not suitable.

8 History of the surveys by area

8.1 North Sea and Eastern Channel (Belgium, Germany, Netherlands, UK-Cefas)

8.1.1 Belgium

The Belgian offshore beam trawl survey, collecting fisheries-independent data primarily for plaice and sole in the south-western North Sea, started in 1992. The survey is always planned at the end of August, beginning of September. For the entire period from 1992 uptill 2018, the survey has been carried out on board of RV Belgica, except for the years 2015 and 2016 when the RV Belgica broke down and the commercial fishing vessel "the Ramblers" (Z.279) had to be used instead. The continuous time-series using a 4 m beam trawl with chain mats and 40 mm mesh in the codend as the standard gear started in 1993. The area covered is IVb,c (southern and central North sea). 62 fixed stations are fished for 30 min at 4 knots. Although target species are plaice and sole, all fish species (in addition commercial crustaceans and cephalopod species) are measured since 2010 (until then, there were some exceptions for which only numbers were recorded) and otoliths have been collected from plaice and sole, but also from other species such as cod, brill, turbot, dab and lemon sole. All (epi)benthic species are recorded (numbers and/or weights) since 2009. Litter has been collected since 2011.

8.1.2 Germany

The German survey started in 1991, covering areas off the Jutland (40F4-43F7) coast which were not sampled by the then existing international surveys. From 2009, the area was extended to the rectangles 39F4-7. In 2013, the rectangles 43F8 + 9 were added. The gear is a 7m beam trawl, since 1992 with 40mm liner in the codend, and 80mm mesh in the first year. Some years (1996, 2006) are missing in the series as a result of technical failures. The survey started with RV "Solea" (A) which was replaced in 2004 with the newly built "Solea" (B).

8.1.3 The Netherlands

The Dutch offshore beam trawl survey started in 1985 by RV "Isis". Target species were plaice and sole because those species were (and are) commercially exploited by the Dutch fisheries. The main goal of the survey was to create fisheries independent indices for plaice and sole in the South-eastern North Sea to be used in the ICES North Sea demersal working group (WGNSSK). Although the first focus was on the target species, since the beginning all fish species were measured and for epifauna species numbers were recorded. Otoliths are collected for plaice, sole, dab, brill, turbot and cod since 1985.

In 1996, Netherlands started a beam trawl survey in the Central North Sea using RV "Tridens II". Originally, this was the Q3 IBTS but because Dutch fisheries more and more concentrated on flatfish species, it seemed to be more appropriate to get more information on those species in the Central North Sea and to change the gear from the IBTS standard gear (Grand Ouverture Verticale, GOV) to a beam trawl. In 1996 and 1997 part of the IBTS Q3 was replaced by a beam trawl survey. Since 1998, the complete survey has been carried out as a beam trawl survey.

Since 2017, the complete survey ('Isis' and 'Tridens II' area) has been covered by RV "Tridens II". Originally the target species were plaice and sole, but catches have always been completely sorted and otoliths have been collected for more species than plaice and sole throughout the years.

8.1.4 UK (Cefas)

UK (Cefas) has carried out an annual July/August beam trawl survey by since 1988 using a commercial 4m beam trawl, and has provided the commercially independent dataset used in the North Sea demersal working group (WGNSSK). The survey has run annually since 1988 using FV Susanna (1988 only), RV Corystes (1989-2007) and RV Cefas Endeavour (2008-present). The primary aim was to assess the relative abundance of pre-recruit plaice and sole in ICES Division VIId. Consequently, most of the sampling was carried out in areas are nursery grounds for these species. In 1995 the survey was extended to include the southern North Sea in order to sample the whole population of plaice and sole. Since 2008 additional stations have been fished off the Belgium coast in order to start a time-series of stations for comparison purposes. These have been completed in most years since 2008.

In the Eastern English Channel, tows are done in two sub-areas: originally 79 in 107d and 29 in 104c. Initially, all tows in 107d had equal priority and the tows in 104c are worked time permitting. Since 1999 the number of tows worked has been reduced to 75 in 107d and 16 in 104c, as a result of a reduction of cruise time and all these tows now have equal priority. Further reductions in the numbers of tows were made in 2011 to cater for less survey days and to remove locations where unmanageable benthic and substrate by-catches were observed. Current numbers of survey locations are detailed in section 3.2.1 of this report.

8.2 Western Channel

The **UK (Cefas) Western Channel** commercial beam trawl survey (WCBTS) operated from 1989 to 2013 (series now terminated) using the FV Carhelmar in all years except 2002 and 2004 where the RV Coyrstes was used. The survey remained relatively unchanged apart from small adjustments to the position of individual hauls to provide an improved grid spacing. Station positions were fixed and each station had a unique prime number (station number in datras). The prime station number consisted of a letter and number. The survey was originally divided into 16 blocks all identified by a letter (A- P) and within a block there may a number of stations from 1 up to 6. A full block of 6 stations equates to 15'of Longitude and 30'of Latitude. The full survey of 58 tows was completed annually in October each year.

The biological data collection was stratified by bands based on distance from the coast. This is in contrast to the VIIa, f and g survey where otolith strata are based on depth bands. The reason for this is that the coastal shelf with a depth of water less than 40 m is relatively narrow and in addition is often fished with fixed gear. The survey bands (in miles) were 0–3; 3–6; 6–12; 12+ inshore; and 12+ offshore.

This survey operated using two Cefas 4m beam trawls towed for 30 minutes at 4 knots over the ground using a warp/water depth ratio of 3.5:1. When completed by the FV Carhelmar, two beam trawls were deployed, but otoliths were sampled from both gears combined. In many cases age information, (CA records in datras) were retrospectively assigned to the two different gears to match the length distributions. In 2002 and 2004 when the survey was carried out on the RV Corystes only one gear was deployed,

and the abundance information was doubled to equal the survey effort from other surveys, but variance estimates for these surveys must be treated as more uncertain due to the reduced effective sample size.

8.3 Irish Sea and Bristol Channel (UK -Cefas)

Complaints from the fishing industry in the southwest about the lack of scientific investigation and knowledge of the local sole stock provided the catalyst for the survey in VIIe. Following enquiries of the local fishery officers and normal tendering procedures, a skipper-owned 300-hp beam trawler the Bogey 1 was selected. The first year (1984) the survey consisted of a collection of tows on the main sole grounds. For the years 1984–1988 the vessel was unchanged. In 1989 the Bogey 1 was replaced by the latest design 24m 300hp (220kw) beam trawler FV "Carhelmar". Between 1989 and 2001, the survey continued to be fished from the FV "Carhelmar". In 2002 the survey moved onto the RV "Corystes", until it was reinstated on the FV "Carhelmar" in 2005.

An Autumn Irish Sea groundfish survey has been carried out annually by MAFF/DEFRA since 1979. A Granton otter trawl was used until 1987, and then in 1988 the commercial 4m beam trawl that is currently used was introduced. At the same time, a limited beam trawl survey was carried out in the Bristol Channel. From 1988 to 1992 the main survey effort was concentrated in the northeast Irish Sea and the Bristol Channel and since 1993 a standard survey covering the whole of ICES Divisions VIIa, f, and g, has been undertaken. In 2002, the survey was extended to cover the survey area in ICES Division VIIe, previously undertaken by the charter vessel FV "Carhelmar" that had been used since 1988. In 2005 the VIIe survey was moved back to the "Carhelmar" and this area is no long covered by the research vessel.

In the early years of the survey series (1988-1991), tow duration was largely 15 minutes, with a growing number of 30 minute tows over this period. Since 1992, the default tow duration became 30 minutes.

The number of primary survey stations within each sector amount to: ISS (18 stations), ISN (16 stations), ISW (15 stations), SGC (16 stations), BCI (32 stations), (BCO 11 stations). Historically, there was another sector SEI (11 stations) but this sector was dropped ~20 years ago with only opportunistic visits made to these locations more recently. The 11 BCO stations are considered the lowest priority as the data currently do not contribute to the VPA tuning and recruitment indices at the respective working groups. Three depth bands were used until 2000: 0–20m, 20–40m and 40+m; in 2001 these were reduced to two depth bands: 0–20m and 20+m.

8.4 Celtic Sea and South-west of Ireland (UK Cefas and Ireland)

UK (Cefas) initiated and conducted the Quarter 1 south-west beam trawl survey (Q1SWBeam) in the Western channel annually mid-February to mid-April in early March/late February for two weeks. Since 2013 the area has been extended to include the wider Celtic Sea and has been renamed the Quarter 1 south-west Ecosystem survey (**Q1SWECOS)** after obtaining DCF (EU Data Collection Framework) status (4 weeks total time). The major deliverable for the survey has always focused on the production of age based indices for sole and plaice in the area, but also provides information on a much wider range of demersal species such as lemon sole, monkfish and cuttlefish. Since 2016 **Ireland** has made the Q1SWECOS survey an internationally coordinated effort joining up with the existing survey to cover the shelf area from roughly 9°W to the 200m isobath on the shelf break.

A stratified random survey design was chosen as the best possible survey design for the area, because the strong environmental gradients associated with the biogeographic transition would require a systematic design to be performed at very high resolution or be subject to biases cause by annual variation in the environmental conditions as also the case for a fixed station design. When environmental conditions vary and these changes can be quantitatively accounted for, this design commonly outperforms systematic and fixed station designs in terms of bias with only a small penalty in increased variance for species with a broad distribution. Moreover, the area is a biogeographic transition zone so that traditional survey methods such as fixed station designs or rectangle based systematic designs were not considered to be suitable to provide unbiased estimates of the state of the principal stocks. Furthermore, the understanding of the stock dynamics in terms of distribution and recruitment variability is comparatively poor and thought to be more heavily influenced by the temporally variable environmental and ecological conditions. To address these gaps in the understanding of the principal commercial fish stocks, provide information on a wider range of commercial species and to address the ever increasing need for ecosystem information the major focus has been to design this survey as an ecosystem survey able to deliver holistic ecosystem information though be it at different levels of precision for the various reporting requirements.

As the physical conditions of habitats are variable, the areas are defined based on the communities to which biological conditions were post-facto assigned. Given the relative paucity of large scale consistently collected ecological information, the starting point was the long-term experience and knowledge of fishermen in the area. Based on discussions with local fishermen and ex-fishermen we identified not only the areas that were fished at specific times of year for specific target communities in the largely multispecies fisheries, but also identified areas which had been traditionally fished under different environmental conditions or using other methods. The major ad-vantage of this approach is that it ensured almost 100% coverage of the area and covered a significant time frame what one might consider 'normal variability'. Spatial commonality in the information provided by individual fishermen was identified and aggregated to rough areas based on the available information and the subjective weighting based on the information requirements of the policy customer.

Although the information provided by the industry covered virtually the entire area of the original survey the level of detail varied considerable. The general commonalities in the information were highly consistent with respect to the centre of community distribution. In contrast fishermen found it much harder to agree on the most appropriate boundary between these communities, suggesting that these are naturally gradients rather than hard boundaries as considered in the stratified design. Presumably the environmental conditions had been variable over time and or individuals had unique drivers and gears in terms of their targeting of specific species which meant they would exploit the same species over largely common areas but with different spatial extents.

8.4.1 Sampling design 2006–2012

The Western Channel is stratified into 13 strata numbered 1 to 13 (Figure 10.1). Five of these are located along the English coast (numbers 1-5) with 3 slightly larger strata covering the French coastal zone (numbers 10-12). The remaining five (numbers 6-9 and 13) are considered offshore on the basis of the oceanographic conditions with the Hurd deep (stratum 9) containing the deepest part of the survey area of around 200m

although this depth is limited to a very small part of the stratum. Each stratum is subdivided into roughly 10-15 hand-drawn polygons from which samples are picked randomly without replacement proportional to the area of each polygon. Polygons are designed to be perpendicular to the expected environmental gradients, i.e. for most of the channel strata the inshore-offshore gradient is steeper than the east-west gradient therefore polygons are generally wider than tall.

Sampling locations are randomly selected each year within each stratum with a variable number selected in order to minimise the variance of estimates of abundance. Each sampling location is given a priority number, with the appropriate number being selected plus several priority spares. The priority locations must be targeted for fishing, but if one proves unworkable, the next priority ' spare' location in numerical order comes into play instead. In order to maintain the survey integrity and validity, it is important that the numerical sequence is maintained, with any gaps in this sequence being locations that could not be fished, not just chosen to avoid for logistical and operational reasons. A total of 81 sampling locations are targeted. Operationally, these survey protocols have remained valid in every survey year.

8.4.2 Sampling design 2013–2015

The western channel remains stratified into 13 numerically identified strata. All strata remain the same, except stratum 1 which was extended northwards into the Celtic Sea based on the ecological information available as this would otherwise have required an additional stratum for the Celtic Sea area. New polygons (grids) were developed based on a systematic hexagon design (grid) with the hexagon area = 1/15th of the respective stratum area. This change has no statistical implications since the probability of site selection is and has always been inversely related to the size of the polygon (grid). The change to a hexagon grid design was largely done for consistency with the Celtic Sea strata where it was difficult to determine the major axis of the environmental gradients, but also because the inshore-offshore assumed gradient was found to be less influential than originally thought.

Initially the intent was to follow the same design principles that had been used to identify the original Western Channel strata when extending the survey into the Celtic Sea. However, it became apparent that the density of fishermen knowledge was poorer. As an example, individual gill netters have very specific areas which they target repeatedly but these areas differ between netters so it is difficult to combine their knowledge. Mobile gear fishermen are spatially more coherent, but there are large areas of the Celtic Seas where little fishing effort is exerted by the available knowledge base. However, the area is richer in scientific information such as historic surveys and the more recent availability to international fishing activity information in terms of landing, onboard observer programs and VMS data meant that these sources provided an acceptable alternative to more general fishermen's knowledge. However, it does tend to limit the temporal element of the ecological view to the recent past, where this had included elements stretching over decades in the Western Channel. The Celtic Sea strata were given letter codes rather than number in order to be able to distinguish the original strata when calculating the original indices. The survey extension included a large part of the Celtic Sea (VIIf-j) with initially 11 additional strata (strata A-K) with five locations targetted within each of these meaning that a total of 136 locations were targeted including the 81 in the Western Channel.

8.4.3 Sampling design 2016-

Ireland started the beam trawl survey in the Irish/Celtic Sea in March 2016, in line with the English survey in the western Channel and Celtic Sea.

Following work done at WGISUR and WGMSFDemo there was an international interest to move towards more ecosystem based monitoring and to develop a more coherent monitoring effort in the Celtic Sea. A DEFRA (UK government) funded project, 'Its TIME for Truly Integrated Monitoring for Ecosystems' (MF 1231) provided the funds to the Marine Institute, IFREMER and cefas to develop a scientific basis for this effort. Subsequently the Irish joined the effort extending the survey further westwards using a modified set of strata for the Celtic Sea agreed at WGMSFDemo. The design principles of these strata remained the same, but the newly collected Q1SWECOS data and additional information which had become available through the cooperation in the project suggesting some change were deemed appropriate. Stratum A was most heavily modified as it had been found to be largely impractical to sample for technical reasons (very hard ground and was now excluded from the survey) and far more variable than originally expected covering communities that were similar to those in the Bristol Channel and those on the west coast of Ireland. The changes to the southern boundary of Strata A meant that the northern extent of stratas B, F and G were also changed. Removing strata A reduced the total numbers of targeted locations to 131. Other major changes were largely confined to altering the straight line that formed the western extend of the 2013-2015 design into something more ecological meaningful and to ensure the coherence with the ecological strata of the French EVHOE survey design on the transition to the Bay of Biscay. As in the previous design the new strata were subdivided into hexagons 1/15th the size of the strata.

8.5 Bay of Biscay (France)

The Bay of Biscay offshore beam trawl survey started in 2007 by France. It is carried out by IFREMER in November-December. From 2007 to 2013, the "Gwen Drez", a 24 m trawler, has been used. In 2014, because the withdrawal of the Gwen Drez from the French research fleet, the survey was carried out on the Antea, a 35 m trawler which is usually based overseas. Since 2015, the survey is carried out with the Cotes de la Manche, a 25 m research vessel, largely similar to the Gwen Drez, but which can fish only with one warp.

The main goal of the survey is to get a fisheries independent index for sole in the Bay of Biscay. Consequently the survey spread over the whole Bay of Biscay sole habitat, form the coast to 100m. Although the target species is sole, all fish species area measured, weighed and counted and benthos species are sorted (by group from 2007 to 2013 and by lower taxon to which they can be attributed on board from 2014 onwards), weighed and counted.

8.6 Adriatic (Italy/Slovenia)

The Adriatic beam trawl survey started in 2005 in the framework of the SoleMon project, funded by the Italian Ministry of Agriculture (MIPAF). Initially, it involved two Italian Units, ISMAR – CNR of Ancona and the Istituto Centrale per la Ricerca scientifica e tecnologica Applicata al Mare (ICRAM), Chioggia and one Croatian Unit, IOF of Split. Two yearly surveys at sea (years 2005 and 2006) were carried out with the chartered fishing vessels in the North Adriatic Sea (Italian and Croatian waters).

Following the appraisal of the work carried out and the results obtained, the possibility to extend to the whole East Adriatic Sea the SoleMon Project was discussed during the 8th AdriaMed Coordination Committee (Tirana, December 2006) and agreed by the participating countries. The execution of surveys for the appraisal of *Solea solea* in both GSA 17 and 18 (Albania, Croatia, Montenegro and Slovenia) supported by the AdriaMed Project was included in the Project workplan for 2007. In addition, as follow up of the work carried out, the results of the two year surveys 2005-2006 were presented during the GFCM-SAC Sub Committees meetings held in Kavala, Greece (September 2007).

In autumn 2007 the survey was carried out with R/V Dallaporta in both GSA 17 and GSA 18. In May 2008 an ad-hoc meeting on data evaluation on the spatial distribution and abundance of sole (*Solea solea*) in the Adriatic Sea" (on the basis of the surveys carried out in 2007) was organized by the Project to jointly analyse the data coming from the survey carried out from spring 2005 to autumn 2007.

From 2007 the surveys are regularly performed with R/V Dallaporta in GSA 17 and the resulting data are processed for the evaluation assessment of *S. solea* and presented to the relevant meeting of the STECF and GFCM SAC.

Eight beam trawl fishing surveys were carried out: two systematic "pre-surveys" (spring and fall 2005) and six random surveys (spring and fall 2006, fall 2007 and fall 2008) stratified on the basis of depth (0-30m, 30-50m e >50m). Hauls were carried out by day using 2 or 4 gears simultaneously for 30 min (when possible) at 5.5 knots. A total of 68 fixed stations were sampled in spring 2005, 62 in fall 2005, 42 in spring 2006, and 67 in fall 2006-2010.

8.7 Iceland sea (Iceland)

The Icelandic beam trawl survey was started in 2016, after both fishermen and scientists had requested a dedicated flatfish survey for over a decade. It is organized by the Marine and Freshwater Research Institute in Reykjavik. In the first year, a pilot study was conducted on the former research vessel current shrimp trawler Dröfn RE-35, and only 31 stations on the west coast were sampled. In 2017, the survey was expanded to include the south and north coasts, and 81 stations were taken in total with the research vessel Bjarni Sæmundsson RE-30. The survey targets plaice, dab and lemon sole, but also collects biological information on other flatfish species.

9 History and developments of the survey gear

Most surveys have been carried out using the same gear over a reasonable time period, but most surveys had major gear changes at the start of the survey. The data into account for index calculation are derived from the standardized survey, so there are no major gear changes in the time-series unless comparative fishing took place before the modification. The description of the currently used gears can be found in section 4.1. and in Annex 4.

The **Belgian** BTS survey runs since 1992, but the continuous time-series using a 4 m beam trawl with 40 mm mesh in the codend as the standard gear started in 1993.

The **German** survey started in 1991 using a 80mm mesh in the codend, which was changed to 40mm in 1992. The series taken into account starts in 1992.

For the **Netherlands**, In 2010 (RV "Tridens II") and 2011 (RV "Isis") respectively, the nets were slightly modified. 15 hangers of 2 1T2B were replaced by 10 1T2B and 5 AB. Therefore, the number of meshes decreased from 55 to 45 (originally 37) and from 45 to 36 (originally 26). The effect of this modification was tested before the survey was carried out with the new net. The results of the comparison were reported to WGBEAM 2011 (ICES, 2011). As there was no significant effect, it is assumed that this modification does not have any effect on the results.

In the Western English Channel surveys (**UK-Cefas**), for the years 1984–1988 the vessel was equipped with two 6m chain mat beam trawls with 75mm codends. For the survey hauls one of the codends was fitted with a 60mm liner. In 1989 when the Bogey 1 was replaced two commercial chain mat 4m-beam trawls (measured inside the shoe plates) were purchased by MAFF as dedicated survey gear. Both beams were fitted with the standard flip-up ropes and 75mm codend. For years 1989 and 1990 only 1 codend was fished with a 40mm liner but from 1991 with the introduction of 80mm codends both were fitted with 40mm liners. The gear has remained unchanged since 1991. The skipper initiated the bridle length extension when the Cefas beams where first used to improve the towing stability of the beams when used on "Carhelmar".

France carried out a first survey in the Bay of Biscay in 2006 using a twin otter trawl and it was presented at the ICES International Bottom Trawl Survey Working Group (IBTSWG) at its 2007 meeting. Because the survey aims to get a flatfish index, the IBTSWG advised that this survey should be presented to the WGBEAM. This latter recommended the use of a beam trawl which is considered to be more adapted when aiming at flatfish abundance index. Consequently, the gear was changed to a 4 meter beam trawl in 2007. The gear has remained unchanged since then, but it was towed on two warps from 2007 to 2013 and on one warp later, due to a change of vessel.

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Annex 1 Overview of WGBEAM offshore surveys

	North Sea and Eastern English Channel					Western Channel	Western Channel and Celtic Sea	Irish Sea and Bristol Channel	Bay of Biscay	Adriatic	Iceland
	Belgium	Germany	Netherlands	Netherlands	UK–Cefas (BTS)	UK–Cefas (WCBTS)	UK–Cefas (Q1SWECOS)	UK–Cefas (ISBCBTS)	France	Italy/Slovenia	Iceland
Survey area	IVb and c west	IVb east	IVb and c east	Central N Sea	VIId and IVc	VIIe	VIIe, f,g,h,j	VIIa, f and g	VIIIa,b	GSA17	Va
Survey start	1992	1991	1985	1996	1988	1988 (ended 2013)	2006 (VIIe) 2013 VIIf-j)	1988	2007	2005	2016
Survey period	August - September	August	August- September	August- September	July	September-October	Feb-April	September	November-December	November-December	August-September
Usual start date	week 35	week 32	week 32	week 34	week 30	week 39/40	Weeks 11-14	week 36/37	week 45	week 45	Week 34
Nº survey days	10	11	20	16	14	8	30	21	22-27	15-20	16
Station positions	fixed	pseudo-random	pseudo-random	pseudo-random	Fixed	fixed	random	fixed	fixed	fixed	Fixed
Stations per year	62	63	88	63–73	79	57	131	108	45-55	67	81
Ship	RV Belgica	RV Solea	RV Isis	RV Tridens	RV Endeavour	MFV Carhelmar	RV Endeavour	RV Endeavour	RV Cotes de la Manche	RV G. Dallaporta	RV Bjarni Sæmundsson
Ship length	50.9 m	42 m#	28 m	74	72 m##	22 m	72 m	72 m @	25 m	35.7 m	56 m
Trawl duration (min)	30	30	30	30	30	30	2nm (~30 minutes)	30	30	30	30
Tow speed (knots, SOG)	4	4	4	4	4	4	4	4	5	5.5	4

Beam trawl length (m)	4	7	8	8	4	4	4	4	4	3.5	4
Nº beams fished	1	2	2	2	1	2	2	1	1	2	1
Nº beams sorted	1	1	1	1	1	2	2	1	1	2	1
Gear code	BT4A	BT7	BT8	BT8F	BT4FM	BT4FM	N/A***	BT4FM	BT4A	Rapido	BT4FM
Gear attachment	*	(none)	(none)	**	*	*	*	*	(none)	(none)	*
Start benthos sampling	2009	1992	1985	1996	1991	1992	2006	1992	2014 (partly from 2007)	2005	2018

 # new vessel since 2004; previously 35m

new vessel since 2008; previously RV "Corystes" 54m

@ new vessel since 2009; previously RV "Corystes" 54m

*** chain mat**

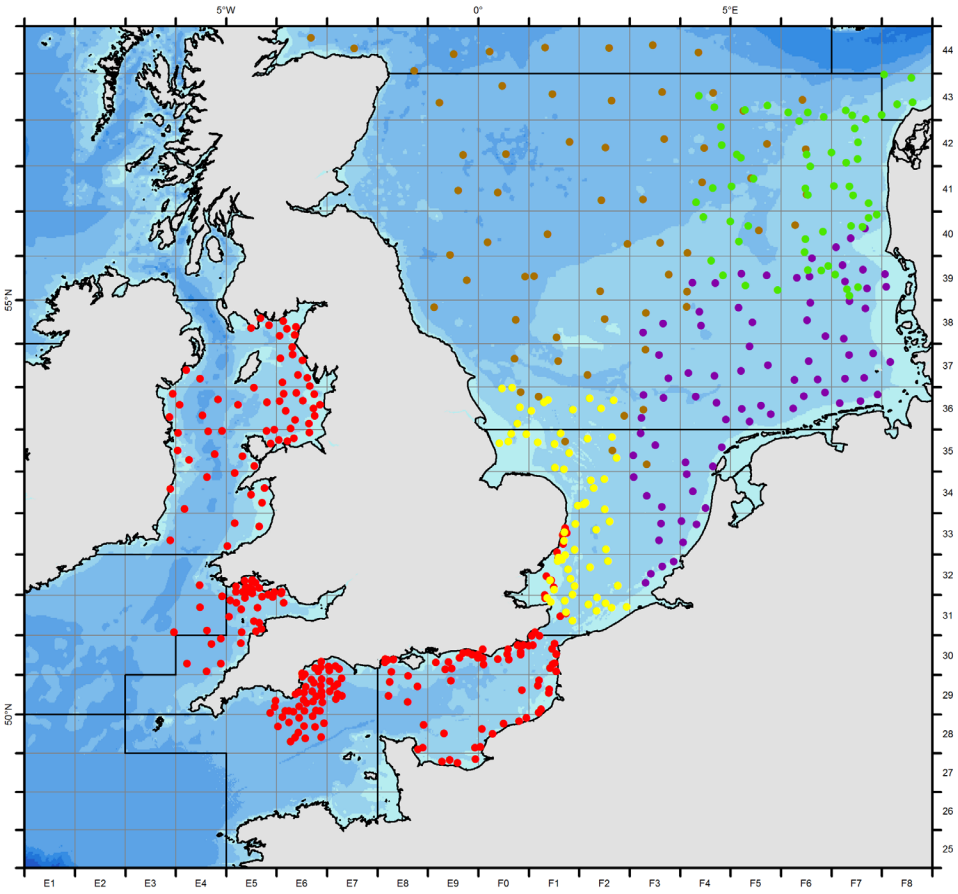
**** flip-up rope only**

***** Work progressing to get these survey data onto Datras**

Annex 2 Geographic distribution of the surveys

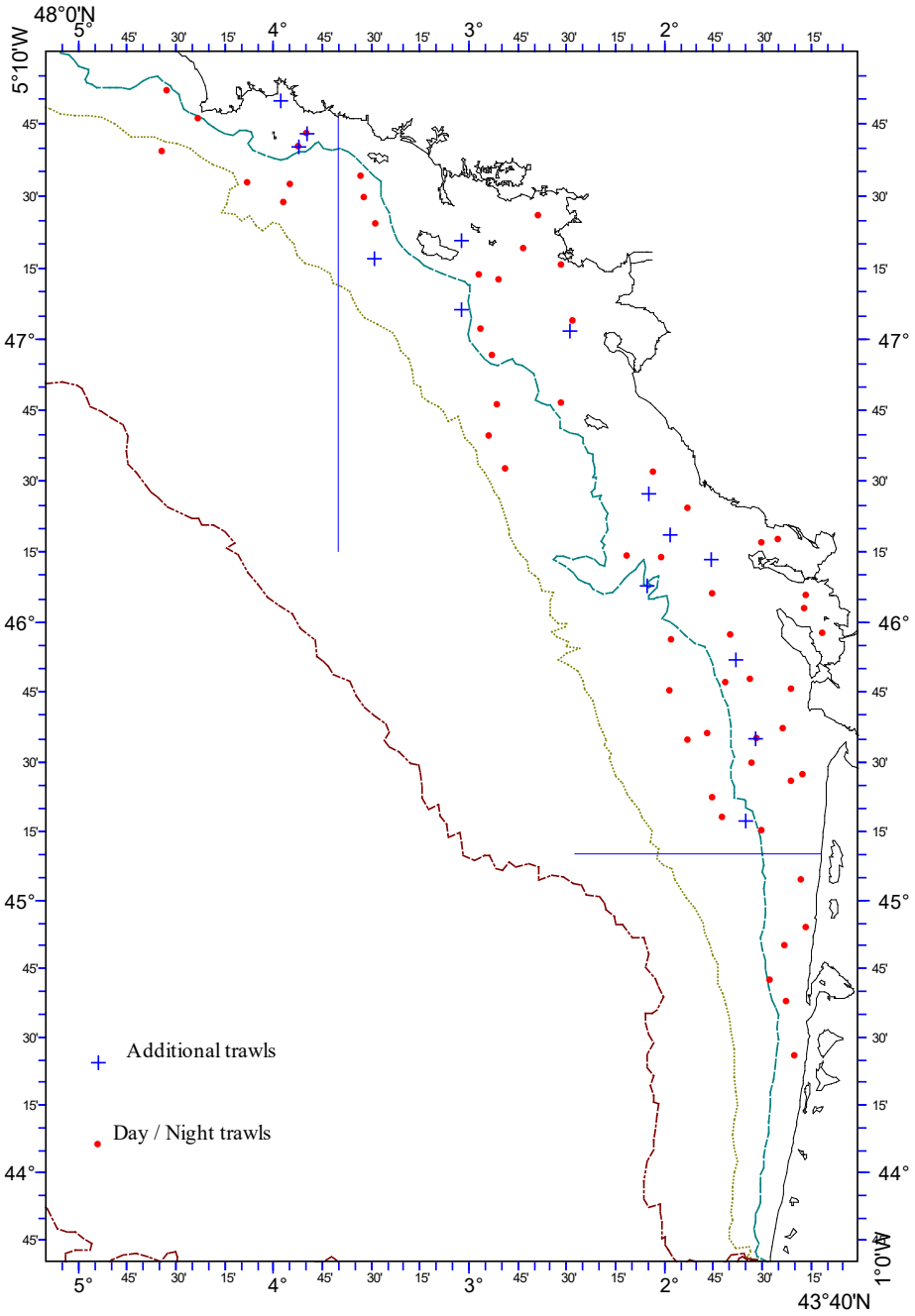
UK-Cefas and Irish survey in western Channel and Celtic Sea has randomly located survey locations so is not shown here. Stratification schemes will be published when available.

Beam trawl surveys in the North Sea, Eastern and Western Channel and the Irish Sea (Belgium, Germany, Netherlands and UK-Cefas)

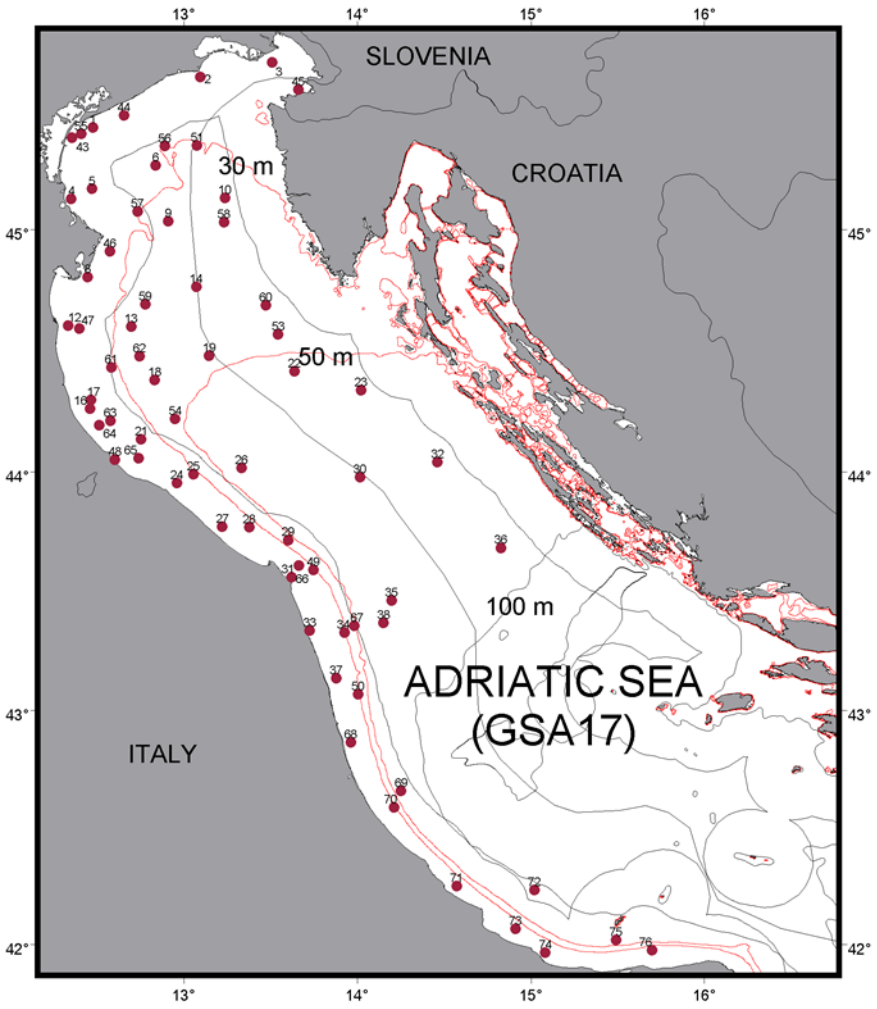


Imagery reproduced from the GEBCO_08 Grid, version 20100927, www.gebco.net

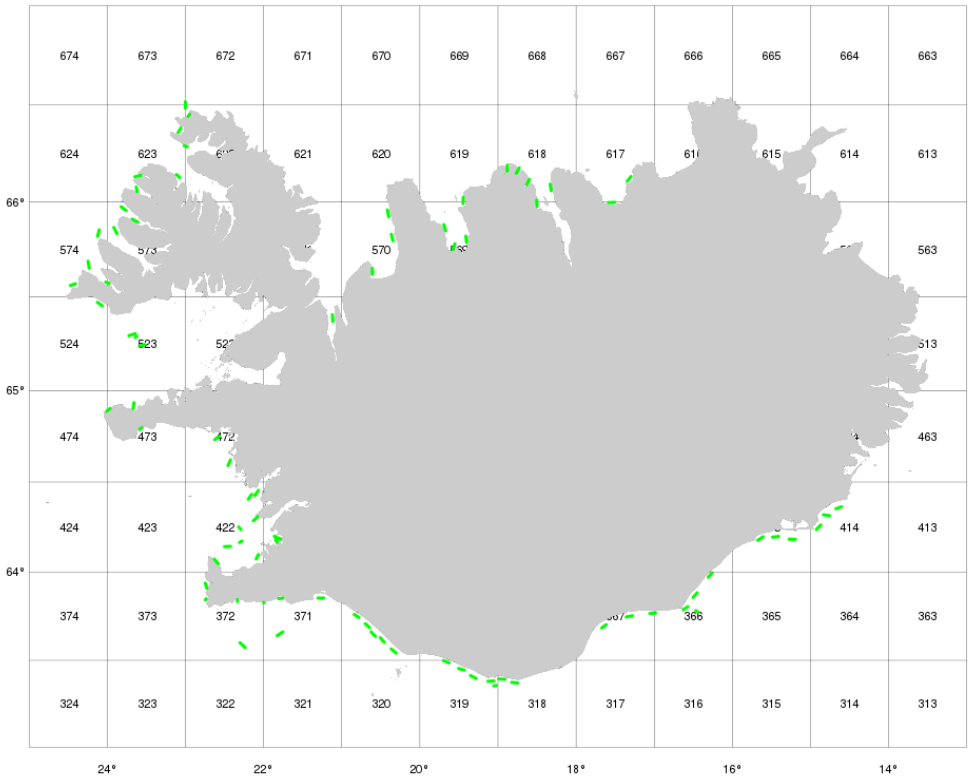
Beam trawl survey in the Bay of Biscay (France)



Beam trawl survey in the Adriatic (Italy/Slovenia)



Beam trawl survey in the Iceland sea (Iceland)



Annex 3 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 Testes small and thread-shaped	Ovaries small, their internal structure gelatinous or granulated and with no differentiated oocytes visible 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. Testes enlarged, sperm ducts beginning to meander	Ovaries enlarged and with more transparent walls. Oocytes differentiated in various small sizes (<5mm). 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. Testes enlarged, sperm ducts meandering and tightly filled with sperm	Ovary/ovaries large and tight. Oocytes enlarged, with some very large, yolk-filled oocytes (>5mm). 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. 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 4 Beam trawl dimensions

		North Sea and Eastern English Channel					Western Channel	Western Channel and Celtic Sea	Irish Sea and Bristol Channel beam trawl survey (ISBCBTS)	Bay of Biscay	Adriatic	Iceland sea
		Belgium	Germany	Netherlands	Netherlands	UK–Cefas (North Sea beam trawl survey (BTS)	UK–Cefas	UK–Cefas	UK–Cefas	France	Italy/Slovenia	Iceland
Full gear	Weight (kg):			2200 (net incl.) 1800 (net excl.)	2200 (net incl.) 1800 (net excl.)	2500	2500		2500		225	2500
Beam	Width in-side shoes (m):	4	7	8	8	4	4	4	4	4	3.5	4
	Nº com-ponents (pipes)			3 (2 small, 1 large)	3 (2 small, 1 large)							
	Pipe length (m)			Small: 3 Large: 5	Small: 3 Large: 5							
	Pipe di-ameter (mm)			Small: 150 Large: 200	Small: 150 Large: 200							
	Pipe thickness (mm)			Small: 15 Large: 20	Small: 15 Large: 20							
Skids	Nº of skids	2	2	2	2	2	2	2	2	2	4	2
	Height (cm)			80	80							
	Width (cm)			40	40						12	
	Length (cm)			100	100							

	Weight (kg), per shoe			500	500							
Chains	Nº Tick-lers	0	5	4	4	0	0	0	0	10	0	0
	Tickler length (mm)	-		1520,1420, 1320,1220	1520,1420, 1320,1220	-	-		-		-	
	Tickler diameter (mm)	-		24	24	-	-		-		-	
	Chain mat	+	-	-	-	+	+		+	-	-	+
	Bridle length (mm)					2900	2900		2900			2900
	Bridle material					5/8" Grade 40 drag alloy chain	5/8" Grade 40 drag alloy chain		5/8" Grade 40 drag alloy chain			5/8" Grade 40 drag alloy chain
Net	Flip-up rope	-	-	+	+	+	+	+	+	-	-	+
	Length flip-up rope (mm)					1040	1040	1120	1040			1040
	Material flip-up rope			Braided nylon	Braided nylon	Rubber on 22 mm corlene rope	Rubber on 22 mm corlene rope	Rubber on 16mm wire	Rubber on 22 mm corlene rope			Rubber on 22 mm corlene rope
	Nº Tick-lers at-tached			4	4							

	Length headline (mm)			780	780	400	400	1146	400			400
	Material headline			28mm braided nylon	28mm braided nylon	22mm combination wire rope	22mm combination wire rope	32mm Atlas rope	22mm combination wire rope			22mm combination wire rope
	Length ground rope (mm)			1900	1900	1080	1080	1100	1080			1080
	Material ground rope			16″ chain	16″ chain	22mm 6/19 construction wire rope	22mm 6/19 construction wire rope	26mm PIR wire	22mm 6/19 construction wire rope			22mm 6/19 construction wire rope
	Netting material			Braided nylon	Braided nylon			Nylon, with euroline belly/cod-end				
	Cod-end meshsize (mm), stretched	40	44	40	40	40	40	40	40	40	40	40
	Mesh sizes net			See figure A5.1	See figure A5.1							

Figure A5.1 Dimensions Dutch beam trawl net

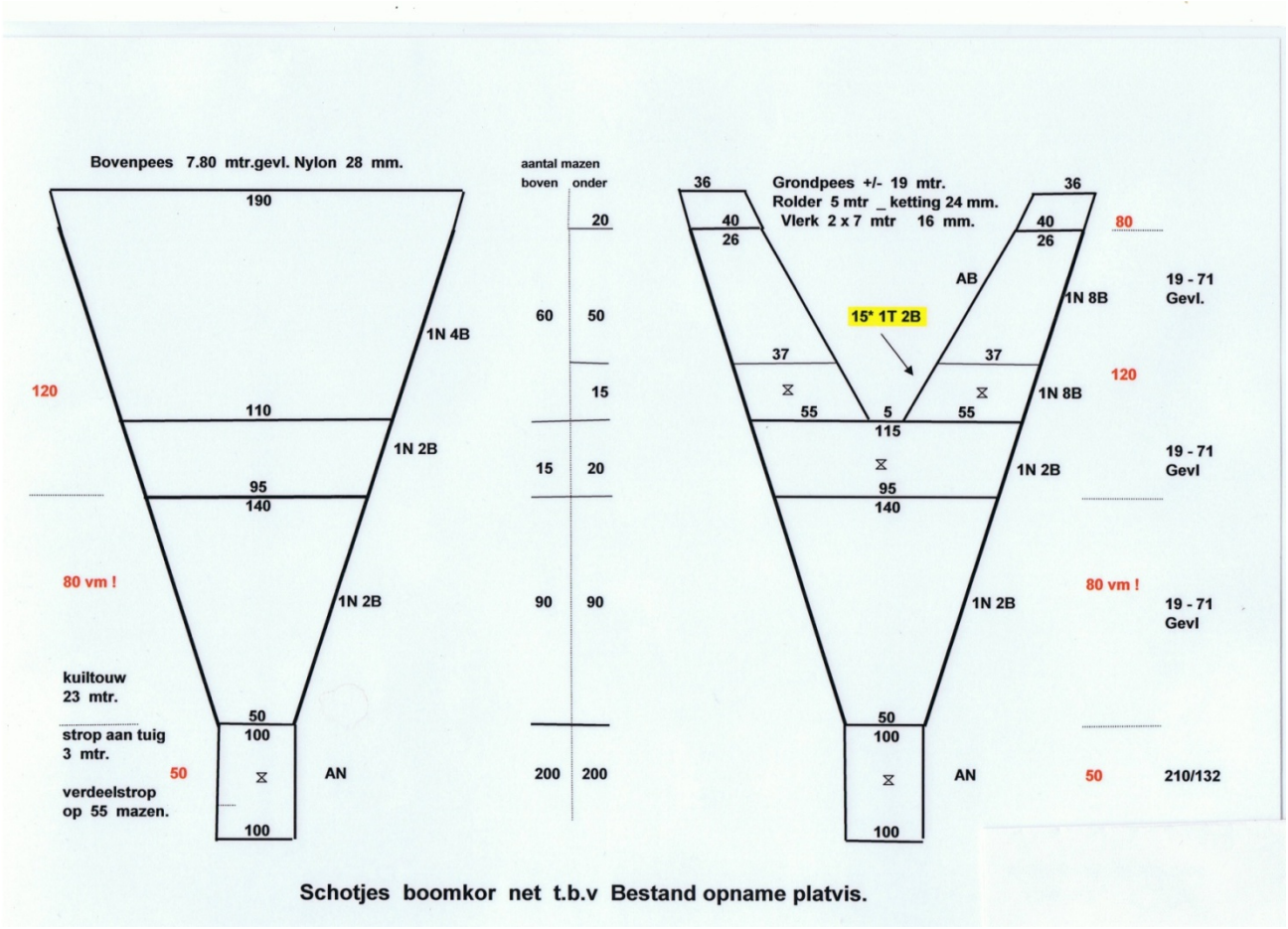


Figure A5.2 Dimensions Belgian beam trawl net

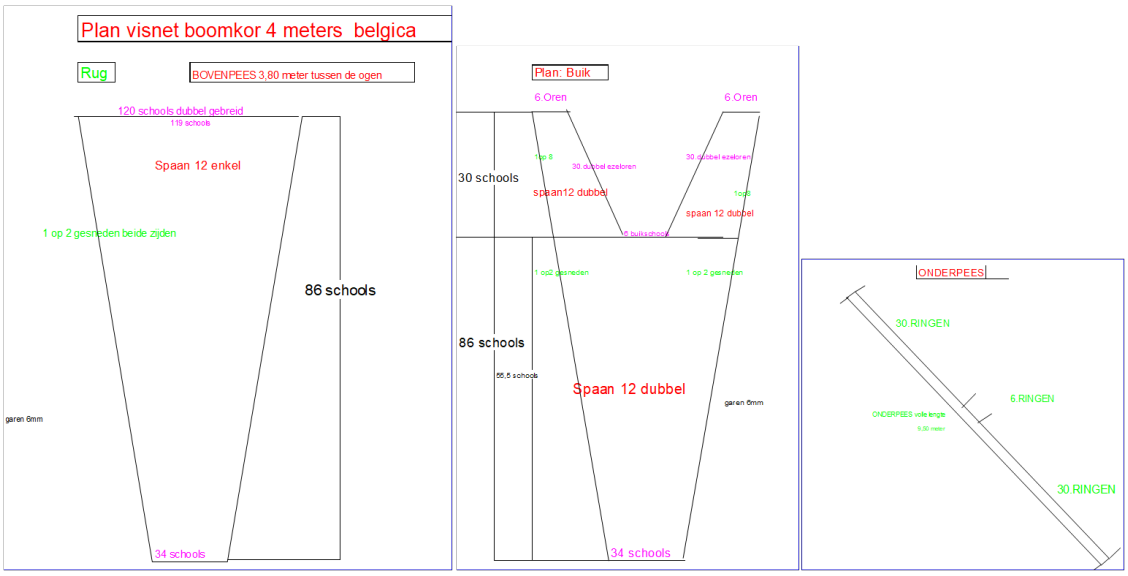
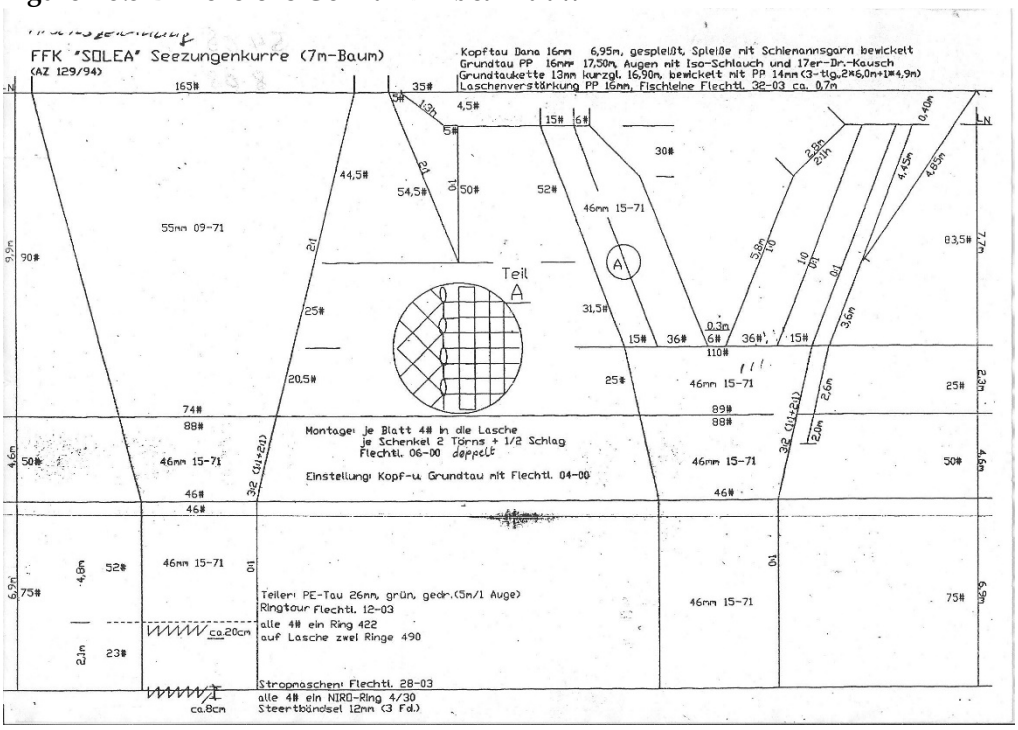
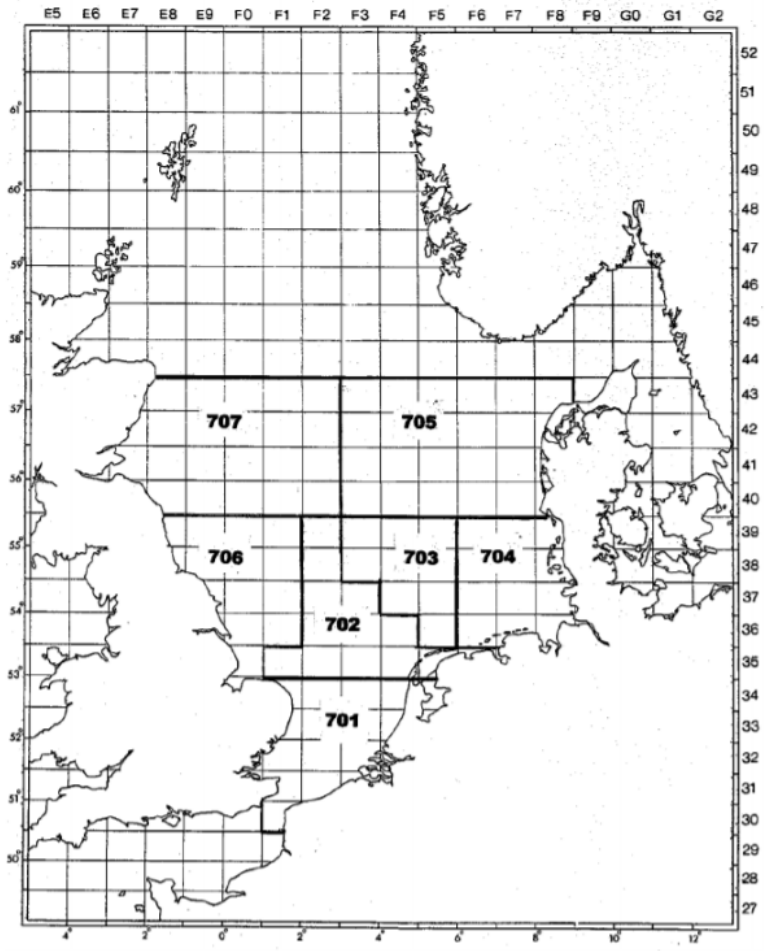


Figure A5.3 Dimensions German 7m beam trawl

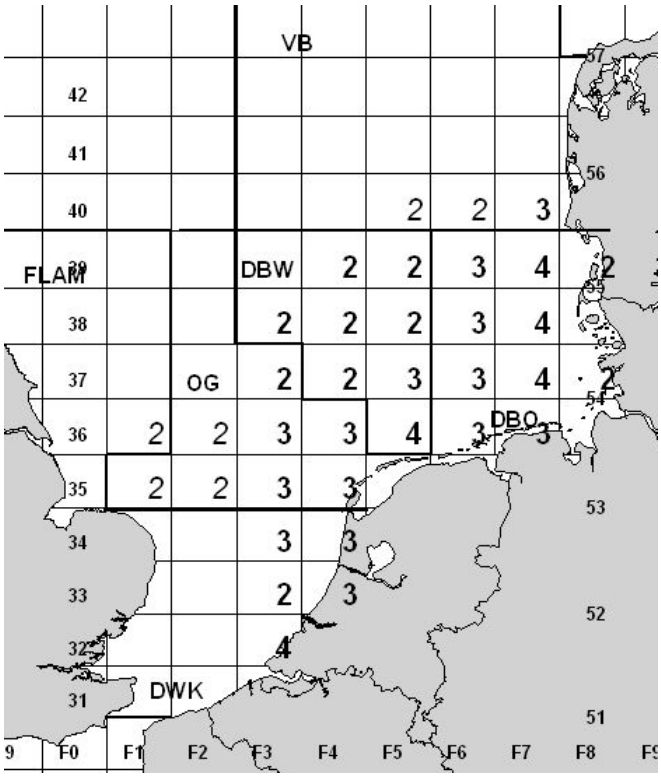


Annex 5 Biological sampling stratification areas

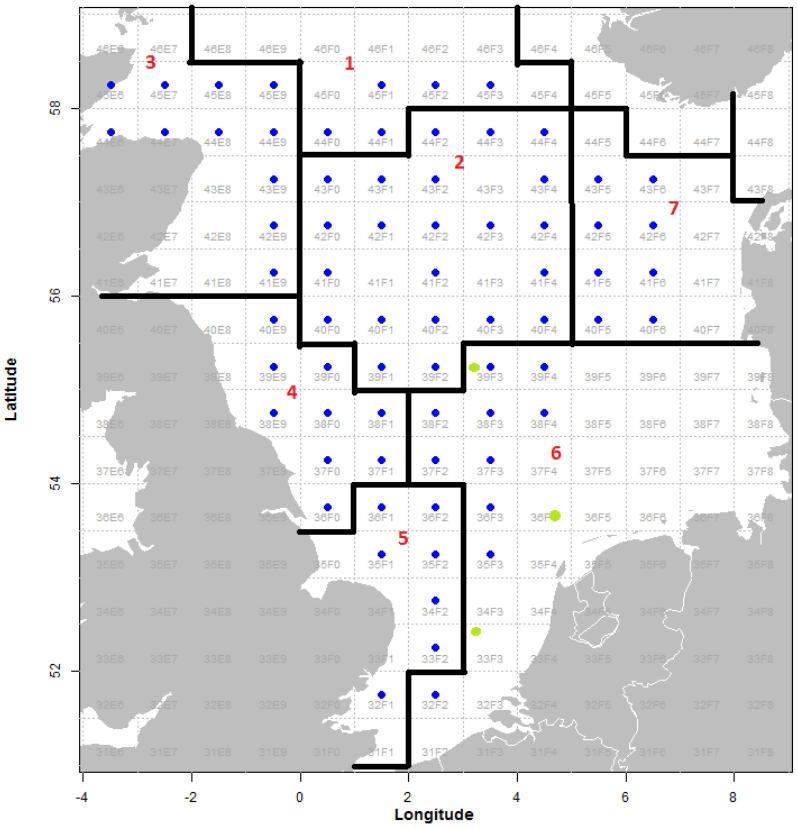
North Sea - Belgium: Flatfish areas



North Sea – Netherlands: Flatfish areas



North Sea– Netherlands: Roundfish areas



Annex 6 Closed species lists offshore beam trawl surveys

Belgium 1992-2009, 2015, 2016

SCIENTIFIC NAME	SAMPLE WEIGHT	LENGTH MEASUREMENT
Amblyraja radiata	Y	Y
Anguilla anguilla	Y	Y
Aspitrigla cuculus	Y	Y
Cancer pagurus	Y	N
Chelidonichthys lucerna	Y	Y
Dicentrarchus labrax	Y	Y
Eutrigla gurnardus	Y	Y
Hippoglossoides platessoides	Y	Y
Gadus morhua	Y	Y
Glyptocephalus cynoglossus	Y	Y
Homarus gammarus	Y	N
Lepidorhombus whiffiagonis	Y	Y
Leucoraja circularis	Y	Y
Leucoraja naevus	Y	Y
Limanda limanda	Y	Y
Loligo vulgaris	Y	N
Lophius piscatorius	Y	Y
Melanogrammus aeglefinus	Y	Y
Merlangius merlangus	Y	Y
Merluccius merluccius	Y	Y
Microstomus kitt	Y	Y
Molva molva	Y	Y
Mullus surmuletus	Y	Y
Mustelus asterias	Y	Y
Nephrops norvegicus	Y	N
Phrynorhombus norvegicus	Y	Y
Platichthys flesus	Y	Y
Pleuronectes platessa	Y	Y
Raja brachyura	Y	Y
Raja clavata	Y	Y
Raja microocellata	Y	Y
Raja montagui	Y	Y
Raja undulata	Y	Y
Scomber scombrus	Y	Y
Scophthalmus maximus	Y	Y
Scophthalmus rhombus	Y	Y
Scylliorhinus canicula	Y	Y
Sepia officinalis	Y	N
Solea lascaris	Y	Y

Solea solea	Y	Y
Trachinus draco	Y	Y
Trachurus trachurus	Y	Y
Trisopterus luscus	Y	Y
Zeus faber	Y	Y

Annex 7 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 first steps along the correct path to 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 listed above and one should take advantage of this, to help ensure the success of any new beam trawl survey.