SERIES OF ICES SURVEY PROTOCOLS

SISP 2-MIK 2

# Manual for the Midwater Ring Net sampling during IBTS Q1

Revision 2

The International Bottom Trawl Survey Working Group

ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

**International Council for the Exploration of the Sea**
**Conseil International pour l'Exploration de la Mer**

H. C. Andersens Boulevard 44–46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

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# Contents

# 1 Introduction

The Midwater Ringnet is the present standard gear for the sampling of fish larvae during the North Sea International Bottom Trawl Survey in the first quarter. The sampling for fish larvae during the IBTS Q1 was initiated in 1977, and during the period 1977–1991 an Issacs Kidd Midwater Trawl was used as the standard gear. When changing to the present ringnet (which use a long two-legged bridle attachment as for the frame trawl described by R. D. Methot) the used abbreviation for the new gear – MIK- was erroneously interpreted as an abbreviation of the names Methot, Isaacs and Kidd. This is not the case, and the present gear has only a passing resemblance to the gears described by R. D. Methot or Isaacs and Kidd. Hence the names to be used for the gear are either "MIK" or "Midwater Ringnet".

The construction of the MIK is strong and robust because of the often harsh conditions in the first quarter period in the North Sea. Hence compared to the smaller conical nets traditionally utilized for plankton sampling, the gear is made more robust by using a very strong (and heavy) ring frame, and a net strengthened with nylon or canvas reinforcing straps. The main target of the MIK-sampling is larval herring between 2 and 3 cm length, which at that size are of quite low densities. Therefore, the gear has a relatively large opening of 2 metre in diameter. Furthermore, because of the fast escape behaviour of the large herring larvae, sampling is carried out at night (with a black net) at a towing speed of 3 knots. The speed constraints the mesh size and a relatively coarse mesh of 1.6 mm is standard.

The standard rigging and procedures for undertaking MIK sampling during IBTS Q1 is described in the sections below. Minor differences in MIK design may occur among participants, however, these differences are all believed to be insignificant with respect to catchability of the gear. Nevertheless, the comparability among participants is verified for each survey. This is done by comparing the results of participants that sample the same ICES rectangles.

# 2 Gear construction and sampling procedures

## 2.1 The Midwater Ringnet

The MIK net consists of a rigid ring frame to which the net is attached, a conical net made of nylon gauze, a codend bucket, a pair of bridles for towing, a depressor with bridles, a flowmeter for filtered volume determination and a depth gauge for monitoring net depth. In particular, the parts of the gear, as shown in Annexes 1 and 2 are:

a ) Ring of 2 metre diameter. This should be reasonably strong, preferably made of two connected steel tubes (picture in Annex 1). When the ring is heavy (~100kg) there is no need for a depressor, but only a weight to stabilize the ring (see "d" below).

b ) Black net of 1.6 mm pore, 13 metre long, strengthened by nylon or canvas straps. In the last metre of the net a 500 μm net is inserted (Figure b1 in Annex 1).

c ) Straps (with nuts, bolts and plates) or a strong line for mounting the net on the ring.

d ) Saddle shaped weight or depressor of approximately 25kg or more where necessary dependent on weight of the 2m ring.

e ) Pair of 10 metre long bridles to the gear. This length in order to keep the bridles away from the path into the net.

f ) Pair of 3.0 metre long bridles to the weight or depressor. This length is needed in order to keep bridles away from touching the net.

g ) Codend bucket (Ø 11 cm) for collection of the plankton sample. Use a netting of 500 μm or less for the codend (see examples).

h ) Flowmeter mounted on a string crossing the ring, positioned in the centre of the ring. Keep string slack so that flowmeter is approximately 0.5 m inside the net. Suggested flowmeter types are General Oceanic 2030R or the newer types of Hydrobios 438 110.

i ) In order to monitor the depth of the gear (and thereby calculate the distance to bottom) a depth sounder with acoustic transmission should be mounted in the ring.

## 2.2 Fishing method

Hauls should only be made at night during the period between 30 minutes past sunset to 30 minutes before. If there is no cloud cover, i.e. the daylight period has been extended; fishing should not begin until 60 minutes after sunset and cease 60 minutes before sunrise.

The haul profile is oblique. Maximum tow depth is 100 meter, measured at the lower part of the ring. At shallower depths the tow should be to 5 metre above the bottom measured from the lower part of the ring. If the haul duration of a single haul is less than 10 minutes (usually only at very shallow depths < 30 – 40 m) a double haul must be made, i.e. to above the bottom again without the net breaking the surface.

The shooting position is defined as the sampling position.

Haul duration and distance towed must be recorded. Both values are measured between the points of the flowmeter getting in and out of water.

## 2.3 Haul procedures

Because of the length of the bridles they will have to be hauled partly through the block, and a wide-opening block is necessary (see pictures in Annex 3). The connection between bridle and hauling wire should be flexible.

When the gear is put out the net should float freely, and the weight should be underwater before the ring is lowered underwater.

Fishing speed is 3 knots through the water.

The wire is paid out at a speed of 25 metre per minute (= 0.4 $ms^{-1}$) and retrieved at 15 $mmin^{-1}$ (= 0.25 $ms^{-1}$). These speeds are chosen to get reasonable haul duration, and to some extent take ship's speed into consideration.

The flowmeter is read before and after each haul.

On deck the hindmost part of the net and the 500 μm netting is washed from outside into the codend bucket.

## 2.4 Calibration of the flowmeter

The flowmeter used in the survey should be calibrated to revolutions per metre. One method is to tow the MIK (without the bucket) at a depth of about 10 metre for a known distance and to make at least two measurements in opposite directions.

If changing the flowmeter, a new calibration is necessary.

# 3 Sample and Data Treatment

The samples should be preserved in either buffered (e.g. Sodium Acetate Trihydrate or Sodium Tetraborate) 4% formaldehyde-freshwater solution or in 96% ethanol. If samples are preserved in formaldehyde or the herring larvae are sorted fresh, it is recommended that the herring larvae are transferred to 96% ethanol as soon as possible.

All fish larvae should be sorted and herring and sprat larvae should be identified, sorting of fresh material should be carried out while keeping the sample cold on ice and sorting time should be kept as short as possible. Care should be taken for the correct identification of clupeoid larvae, in particular differentiating between herring (*Clupea harengus*) and sprat (*Sprattus sprattus*) and the other North Sea clupeids sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*). Descriptions of those larvae are given in Annex 7.

Larval standard lengths (see Annex 4) should be measured to the "millimetre below". Ethanol preserved larvae might appear quite rigid; soaking for approximately 30 minutes in freshwater will soften them, making measurement easier. The condition of larvae at length measurement (i.e. fresh or from formaldehyde or ethanol) should be indicated on the standard form.

Catches of eel (*Anguilla anguilla*) should also be indicated in the standard form. If possible, other larval species (fish < 6 cm) should be reported, in particular pearlside, *Maurolicus muelleri*, lemon sole, *Microstomus kitt*, crystal *Crystallogobius linearis* and transparent *Aphia minuta* goby as well as sand *Pomatoschistus minutus* and Norwegian *P. norvegicus* goby should be measured and recorded. A rough description and pictures of those species are given in Annex 5.

Preferably samples are processed and reported within one month after termination of the survey. The immediate reporting of herring and sprat catches (for the use of the Herring Assessment Working Group meeting) should be made using the standard spreadsheet and e-mailed to Dr Matthias Kloppmann (matthias.kloppmann@vti.bund.de). Subsequently the standard forms (Annex 6) should be mailed to ICES, H. C. Andersens Boulevard 44–46, DK-1553 Copenhagen V, Denmark.

The data will be included in the fish egg and larvae database at ICES.

# 4 Allocation of Rectangles

At least 2 hauls per ship per rectangle should be carried out within each standard rectangle and the distance between hauls within and between rectangles should be at least 10 nm. Hauls should also be carried out at least 5 nm distances from the border of a standard rectangle. Only where rectangle areas intersecting with land prohibit 10 nm distances between 2 hauls within 24 hours the distance to the border can be < 5 nm.

In the Southern Bight abundances of herring larvae are very variable. Intensified sampling should therefore be carried out in this area. If possible, more than 2 hauls per ship per rectangle should be made in the following rectangles: 30F1, 32F2, 32F3, 33F2, and 33F3.

An example of a typical distribution of samples per rectangle within one survey is given for the years 2009 and 2010 in Annex 7.

During the survey the status of MIK-sampling and, if available, the numbers of herring larvae caught should be reported to the coordinating vessel. If there is any risk that rectangles will be left unsampled then initiatives should be taken to reallocate sampling between participants.

# 5 Calculation of herring larvae index

The standard areas for which the abundance of herring larvae is calculated, and used in the calculation of the Herring Assessment Working Group indices, are shown in Annex 7.

The procedure for herring larvae index (IBTS0) has been to calculate the total abundance of larvae in the sampled area. Hence basically a calculated mean density of larvae (in no per m²) is multiplied by the total standard area.

In order to consider "skewness" in sampling intensity due to less intense or no sampling in some areas, the averaging of densities is first done for each statistical rectangle and subsequently for defined, larger sections. Finally abundances are obtained for these sections and are summed for the total area.

In order to exclude the Downs larvae, which are too patchily distributed and too young (might reach extreme abundances); the abundances of larvae south of 54°N for which the mean size at station is below 20 mm are excluded before calculating the standard IBTS0 index.

The procedure is the following:

1 ) Averages of no-per-m2 is calculated for each rectangle

2 ) Averages of no-per-m2 for rectangles are averaged for sections defined by:

If stat1 is the first two digits of "statistical rectangle" and stat4 is the two last then:

if stat4<F2 and stat1>39 and stat1<46 then section='cw';

if stat4>F1 and stat1>39 and stat1<46 then section='ce';

if stat4<F2 and stat1<40 and stat1>34 then section='sw';

if stat4>F1 and stat1<40 and stat1>34 then section='se';

if stat4<F2 and stat1>45 then section='nw';

if stat4>F1 and stat1>45 then section='ne';

if stat4>F8 then section='ka';

if stat1<35 then section='ch';

The sections cw, ce, nw, ne, sw, se, ka and ch denote the following subsections of the North Sea (see also Figure in Annex 7): Central West (cw), Central East (ce), Northwest (nw), Northeast (ne), Southwest (sw), Southeast (se), Kattegat (ka) and Channel (ch).

3 ) Averages of no-per-m² for subareas are multiplied by section-area factors defined by:

if section='cw' then af=28;

if section='ce' then af=33;

if section='sw' then af=12;

if section='se' then af=30;

if section='nw' then af=27;

if section='ne' then af=11;

if section='ka' then af=10;

if section='ch' then af=10;

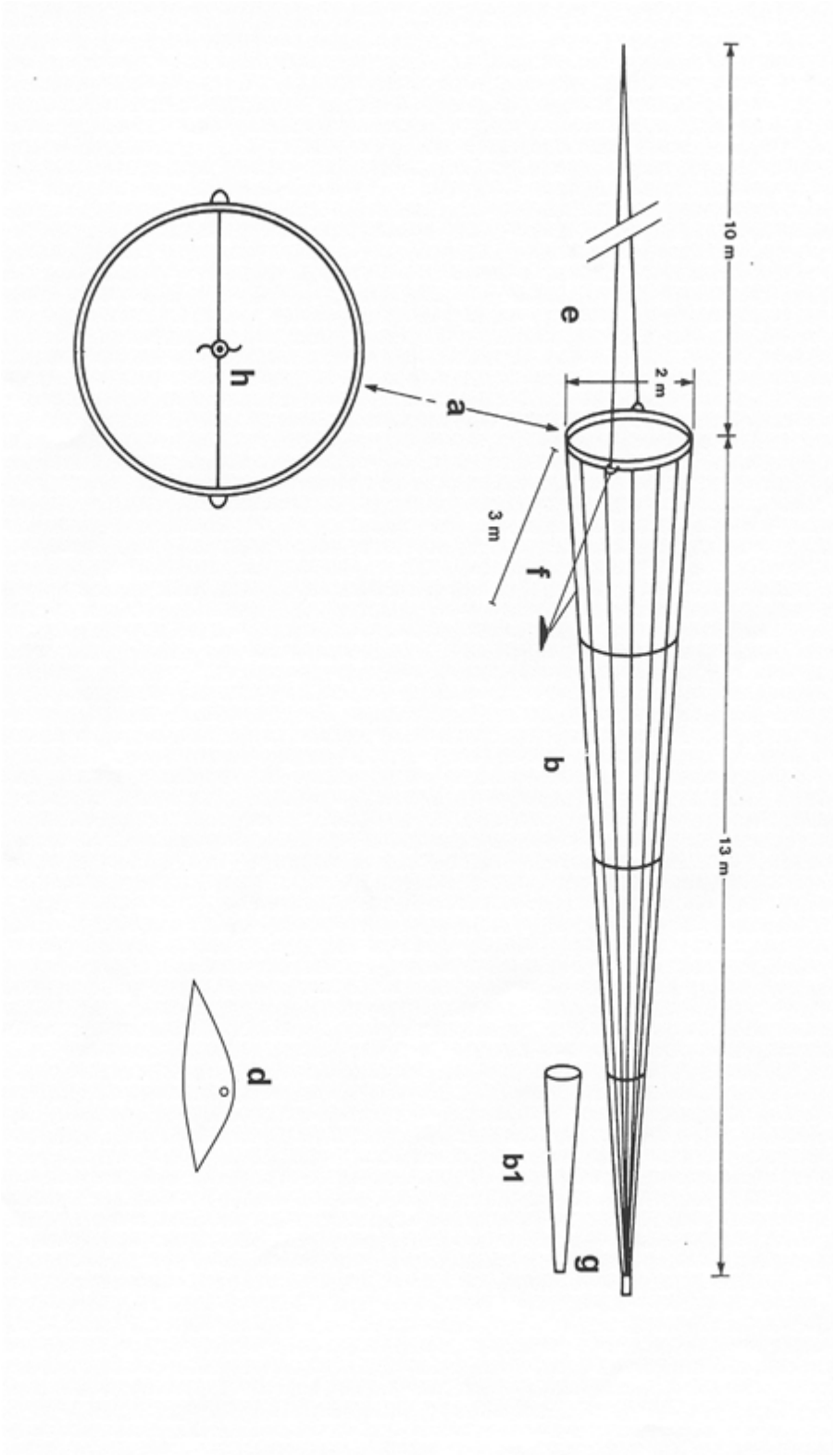
miksec =section average in no-per-$m^2$ *af * 3086913600;

4 ) The index is then the sum of all abundances in sections (which amount to an estimate of the total number of larvae):.

IBTS0 = sum of miksec.

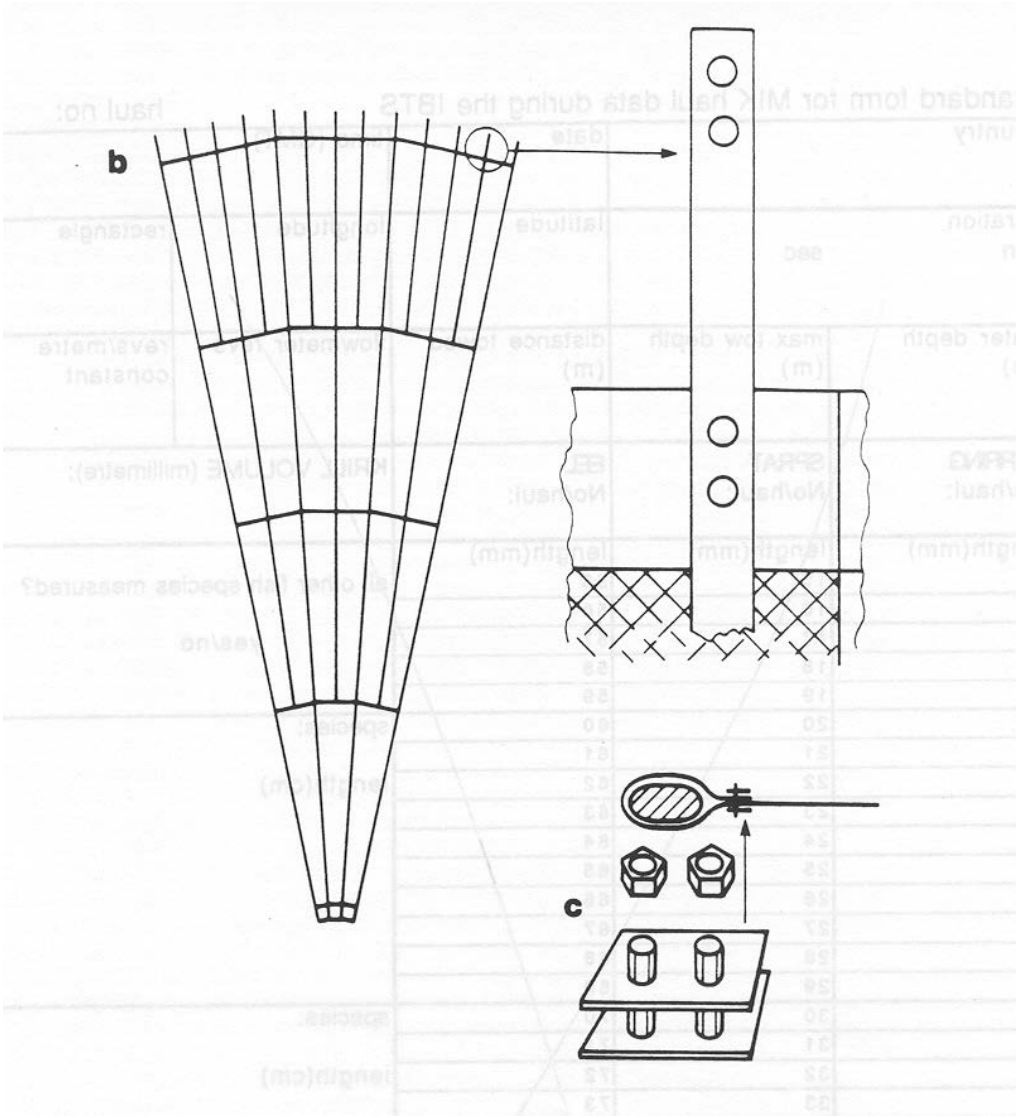
## Annex 1: Rigging

Construction and rigging of the Midwater Ring Net. Letters refer to description in the text of Section 2.1

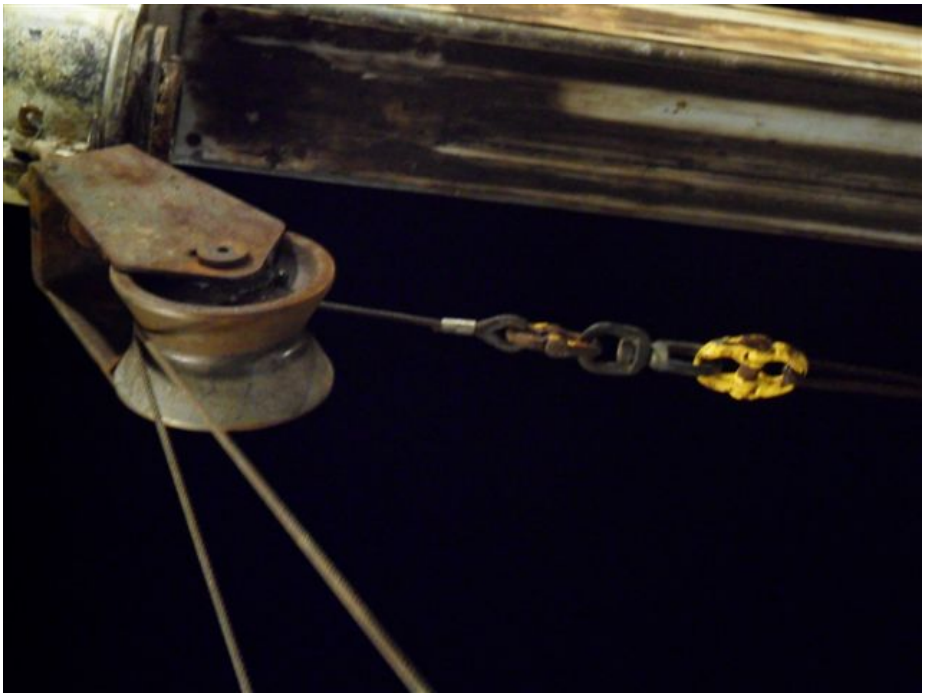


## Annex 2: Net construction

Unfolded net of the MIK midwater trawl and illustration of possible net attachment.



## Annex 3:Misc. pictures of rigging and net construction

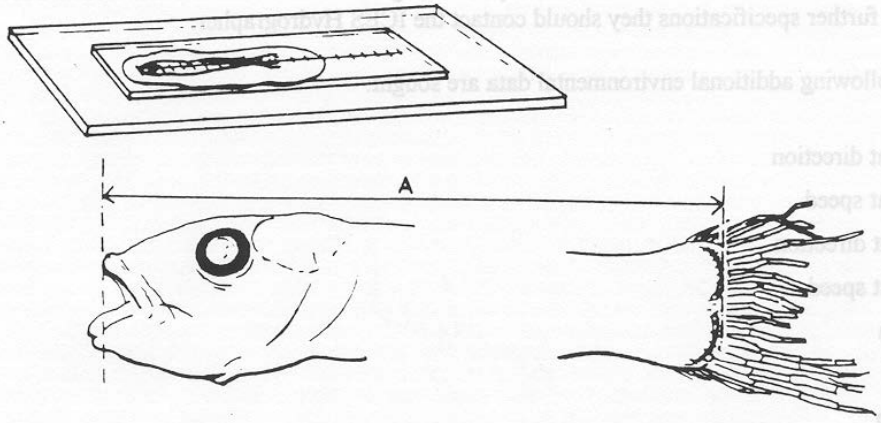


**Block and bridle attachment.**

**Flowmeter and SCANMAR attachment.**

**Examples of codend buckets.**

## Annex 4: Measuring standard length of herring larvae



# Annex 5: Description of clupeoid and other larval fish species commonly found during the MIK survey

A compilation of the distinctive features of clupeoid larvae was done during the recent ICES Workshop on the identification of clupeoid, flatfish, gadoids and other fish larvae (WKIDFL). The results are given in the following paragraphs and are copied from the respective workshop report (ICES, 2011).

## Clupeoids

General characteristics:

- Tubular, slender shape of body
- Long gut with anus near the tail end
- Number of myotomes in the trunk
- The body proportion changes during development thus the anus moves forward and the myotome count decreases with age
- The difference between clupeiods and sandeel is the position of the anus. In sandeel the anus is halfway the body, in clupeoids the guts is much longer and the anus is positioned close to the tail. Argentinids which also have a long gut tend to have a deeper body and different pigmentation than clupeids.

*Primary characteristics of clupeoids (from Russell 1976).*

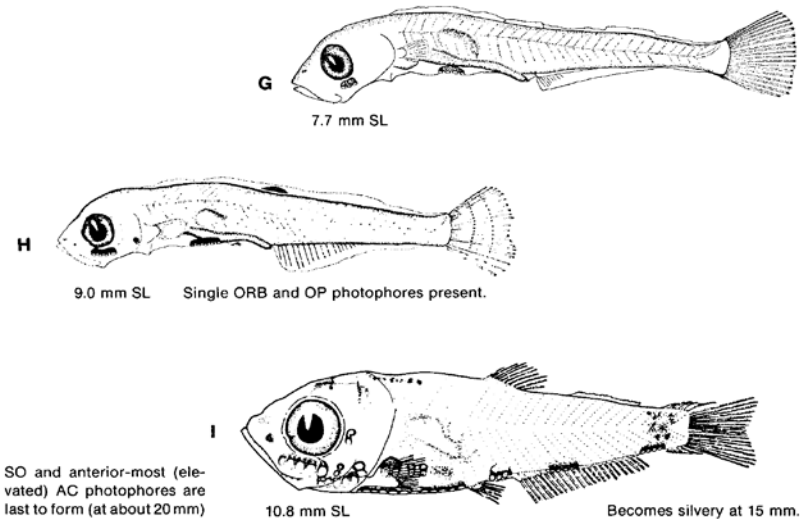
| Developement stage | Herring | Sprat | Pilchard/Sardine | Anchovy |
|---|---|---|---|---|
| **Yolk sac** | Yolk not segmented | Yolk segmented | Yolk segmented | Yolk segmented, oblong shape |
| **10 mm** | | | | |
| No. myotomes in trunk | 47 | 37 | 41-42 | |
| **10-20 mm** | | | | |
| No. myotomes in trunk | 46-47 | 35-37 | 41-42 | |
| Position pelvic fin | Not appaered yet | Appaers at 17.5-20 mm, 4-5 myotomes behind the pylorus | Appaer at 18-20 mm, level with the pylorus | |
| Dorsal fin | | | | Rear edge of dorsal fin overlaps with the anal fin |
| **20-40 mm** | | | | |
| No. myotomes in trunk | 41-46 | 31-35 | 36-41 | |
| Position pelvic fin | 7-8 myotomes behind the pylorus | 4-5 myotomes behind the pylorus | Level with the pylorus | |
| Length of tail from anus to base of caudal fin | Greater than 6 times in total length | Less than 6 times in total length | | |

Secondary characteristics:

Herring is always bigger at any developmental stage compared to the other species. Herring have pigmented eyes at hatching while other species do not gain pigment until later (5 mm). Herring attain flexion stage later (17 mm) than other species so a larvae at 11–13 mm with flexion will not be herring (Munk and Nielsen, 2005). The head of anchovy is bigger compared to the other species (not very useful).

*Maurolicus muelleri*

Larvae and juveniles of pearlside (*M. muelleri*) that typically occur in MIK samples from the northern part of the North Sea during the 1Q IBTS are characterized by the presence of photophores below the eyes and on the belly. The gut stretches to about half the body length. Typical sizes of pearlside larvae and juveniles are between 15 and > 25 mm SL.

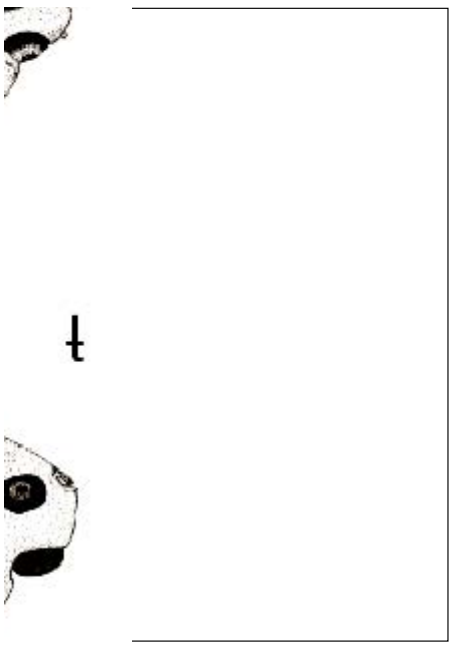



Figures copied from Fahay 1983.

*Microstomus kitt*

Larvae of the lemon sole (*M. kitt*) that occur in MIK samples from the 1Q IBTS typically have reached a developmental stage where the left eye has at least started to migrate to the right body side. The larvae are deep bodied. The pigmentation shows a characteristic regular banded pattern along the dorsal and ventral margins of the body. Typical sizes of lemon sole larvae and juveniles are between 20 and > 35 mm SL.

Figures copied from Nichols 1971.



*Aphia minuta* and *Crystallogobius linearis*

Both, transparent (*A. minuta*) and crystal (*C. linearis*) goby are translucent when alive or freshly dead. When preserved in formalin they appear all white. Both are characterized by a prominent swimbladder. While transparent goby has scales, crystal goby has none. The first dorsal fin of transparent goby has 5 rays while in crystal goby there are 2 rays only in male while in female specimens there are no rays in the first dorsal.

*Pomatoschistus minutus* and *P. norvegicus*

Sand (*P. minutus*) and Norwegian (*P. norvegicus*) gobies are probably the most abundant goby species in the North Sea. Both are characterized by a distinctive black spot on the hind margin of the first dorsal. The species can only be separated by counts of the pectoral fin rays. While the Norwegian goby has 16–18 pectoral rays, sand goby has 18–20 rays in its pectoral fin.

## References

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Russell, F. S. 1976. The eggs and planktonic stages of British marine fishes. Academic Press, London. 524 pp.

## Annex 6: Standard form

Haul no

Standard form for MIK haul data during the IBTS

| country | | date | time (GMT) | |
|---|---|---|---|---|
| duration<br>min sec | | latitude | longitude | rectangle |
| water depth<br>(m) | max tow depth<br>(m) | distance towed<br>(m) | flowmeter revs | revs/metre<br>constant |
| HERRING<br>No/haul: | SPRAT<br>No/haul: | EEL<br>No/haul: | **Larval length measured from**<br>Fresh material ☐<br>Formaldehyde preserved ☐<br>Ethanol preserved ☐ | |
| length (mm) | length (mm) | length (mm) | | |
| 15 | 25 | 55 | | |
| 16 | 26 | 56 | | |
| 17 | 27 | 57 | | |
| 18 | 28 | 58 | | |
| 19 | 29 | 59 | | |
| 20 | 30 | 60 | species: | |
| 21 | 31 | 61 | | |
| 22 | 32 | 62 | length (cm) | |
| 23 | 33 | 63 | | |
| 24 | 34 | 64 | | |
| 25 | 35 | 65 | | |
| 26 | 36 | 66 | | |
| 27 | 37 | 67 | | |
| 28 | 38 | 68 | | |
| 29 | 39 | 69 | | |
| 30 | 40 | 70 | species: | |
| 31 | 41 | 71 | | |
| 32 | 42 | 72 | length (cm) | |
| 33 | 43 | 73 | | |
| 34 | 44 | 74 | | |
| 35 | 45 | 75 | | |
| 36 | 46 | 76 | | |
| 37 | 47 | 77 | | |
| 38 | 48 | 78 | | |
| 39 | 49 | 79 | | |
| 40 | 50 | 80 | species: | |
| 41 | 51 | 81 | | |
| 42 | 52 | 82 | length (cm) | |
| 43 | 53 | 83 | | |
| 44 | 54 | 84 | | |
| 45 | 55 | 85 | | |
| 46 | 56 | 86 | | |
| 47 | 57 | 87 | | |
| 48 | 58 | 88 | | |
| 49 | 59 | 89 | | |
| 50 | 60 | 90 | species: | |
| 51 | 61 | 91 | | |
| 52 | 62 | 92 | length (cm) | |
| 53 | 63 | 93 | | |
| 54 | 64 | 94 | | |
| 55 | 65 | 95 | | |
| 56 | 66 | 96 | | |
| 57 | 67 | 97 | | |
| 58 | 68 | 98 | | |
| 59 | 69 | 99 | | |
| 60 | 70 | 100 | | |

all measurements to the mm or cm below
see IBTS Manual for guidelines

sample analysed by:

## Annex 7: Distribution of MIK hauls

Chart showing usual number of MIK hauls in each statistical rectangle (illustrated by maximal number of hauls in rectangles during 2009 and 2010). The areas used for calculation of the herring larvae abundance indices are indicated.