

NS-IBTS indices calculation procedure

In IBTS North Sea, the indices are calculated per index area, which are specific for each species.

For most species, the indices are calculated as mean No/hour at age per statistical rectangle and then as a mean of the statistical rectangles over the index area. For herring, sprat and saithe, the indices at age (no/hour) are calculated using mean over rectangles, weighted for the percentage of area with water depths between 10m-200m and for area 8 and 9 water depths between 10m-250m.

The following rules apply:

- Only valid hauls are taken into account
- When only a few ALK observations are available, additional data of the ALK from neighbouring area is used (see [Annex 2](#))
- There is a weighting factor applied for each statistical rectangle (see [Annex 1](#), [Annex 3](#))
- For herring and sprat only day hauls (based on daynight code) are taken into account (see [Annex 1](#))
- As age group 2 and older herring in area 8 and 9 are assumed to be spring spawners, CPUE for these are set to zero
- For herring two extra indices are calculated to reflect the Downs's herring spawning component juveniles, based on herring up to and including length of 12.5 cm. The first (NS Her1to9) is calculated as described above whereas the second (NS her1to7) assumes that the CPUE in RF8 and 9 are zero because the small herring here could be mainly spring spawners

The following steps are applied to the raw DATRAS data:

1. CPUE per length (l) and age (a) (1 cm group and 0.5 cm for herring and sprat) per haul: sum by year, quarter, statistical rectangle (ST) and divide by total number of hauls (H) in the statistical rectangle in that year and quarter.

$$mCPUE_{ST,a,l} = \frac{\sum_{ST} CPUE_{H,a,l}}{\sum_{ST} H}$$

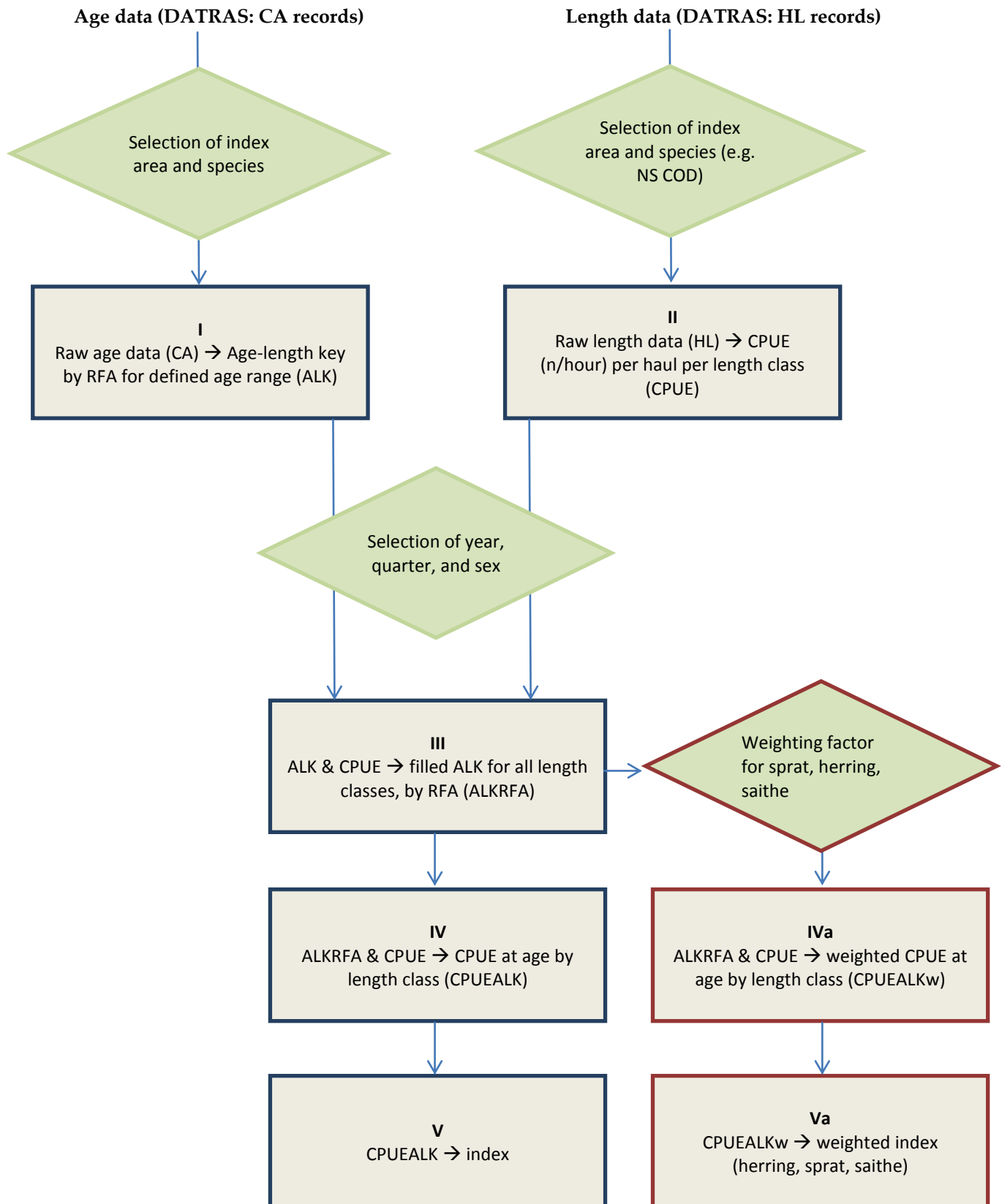
2. Mean CPUE by index area: sum of mean CPUE per length per age in all fished rectangles in index area (IA) divided by number of fished rectangles in index area:

$$mCPUE_{IA,a,l} = \frac{\sum_{IA} CPUE_{ST,a,l}}{\sum_{IA} ST}$$

3. Indices by age: sum of the CPUE by length for a specific age within the index area:

$$mCPUE_{IA,a} = \sum_l mCPUE_{IA,a,l}$$

Flow diagram from DATRAS Exchange data to year class index, NS-IBTS.



I Raw age data (CA) → Age-length key by RFA for defined age range (ALK)

- a. Extraction of raw age at length data from DATRAS for species and index area
- b. Calculate age-length key by roundfish area (RFA) by centimeter classes and for herring and sprat by 0.5 cm classes
- c. If there is no ALK for a roundfish area, ALK's from neighbouring RFA's are used to fill gaps (see [Annex 2](#))
- d. Numbers per length class are summed for age groups < plus group. Numbers per length class for ages ≥ plus group are added to the plus group

II Raw length data (HL) → CPUE (n/hour) per haul per length class (CPUE)

- a. Extraction of raw length data from DATRAS for species and index area:
 - Species recording code is taken into account: , Bycatch species recording codes exist for a species then only hauls with all species reported or the selected species record is selected. NO Bycatch species recording codes exist for a species then all hauls are selected. If there is standard species then take only haul which has data of that standard species Only valid haul data are selected
 - Check for day/night code (see [Annex 1](#)); for herring/sprat only day hauls are selected, for the other species all hauls are selected
- b. Calculation of number of valid hauls per statistical rectangle
- c. Addition of 'zero hauls', i.e. add 0 values for all omitting length classes
- d. Raise data from sub sampling to total number per haul by multiplying the number at length with the sub sampling factor
- e. Sum number at haul by length class over category and sex
- g. If data type is not CPUE (C) then $NoA\text{thaul} = \text{number} * (60 / \text{HaulDuration})$
- h. Sum the CPUE per haul per length for each statistical rectangle per roundfish area

III ALK & CPUE → filled ALK for all length classes, by RFA (ALKRFA)

- a. If there is no ALK for a length in the CPUE file, age information is obtained as follows:
 1. If length class (CPUE) < minimum length class (ALK), then age=1 for the first quarter and age=0 for all other quarters (see [Annex 1](#))
 2. If minimum length class (ALK) < length class (CPUE) < maximum length (ALK) then age is set to the nearest ALK. If the ALK file contains values at equal distance, a mean is taken from both values
- b. If length class (CPUE > maximum length (ALK) age is set to the plus group
- c. Merge ALK file with CPUE file by year, quarter, length class (see [Annex 4](#))

IV ALKRFA & CPUE → CPUE at age by length class (CPUEALK)

- a. Merge ALKRFA and CPUE by year, quarter, RFA, length class
- b. Sum numbers at length per age per statistical rectangle
- c. Sum number of hauls per statistical rectangle
- d. Calculate mean CPUE at length per age per by statistical rectangle (=result(b)/result(c))

IVa ALKRFA & CPUE → Weighted CPUE at age by length class (CPUEALKw) –herring, sprat, saithe

For North Sea IBTS herring, saithe and sprat, data are weighted by depth strata in the statistical rectangle (see [Annex 1](#) and [Annex 3](#)). As herring in RFA 8 and 9 are autumn spawners, ages > 1 are set to age=0 for North Sea IBTS herring in quarter 1 in RFA 8 and 9.

- a. Merge ALKRFA and CPUE by year, quarter, RFA, length class
- b. Sum numbers at length per age per statistical rectangle
- c. Sum weights of all valid hauls by statistical rectangle, following [Annex 3](#)
- d. Calculate weighted mean CPUE (=result(b)/result(c))

V CPUEALK → index

Va CPUEALKw → indexw

- a. Sum CPUE per age by indexarea
- b. Sum number of fished statistical rectangles in indexarea
Calculate mean CPUE for the indexarea (=result(a)/result(b))

Annex 1

Day-night haul, min-max length and aggregation of ALK and CPUE lookup table for individual index areas

Index area and species	Quarter	Maximum age	Minimum length (mm)	Maximum length (mm)	ALK area level	CPUE area level	Length class aggregation level	Length Class (mm)	Area weighting taken into account	Day/night
NS_Cod	1	6	150	900	RFarea	Statistical rectangle	1 cm	1500	no	no
NS_Cod	2	6	70	1100						
NS_Cod	3	6	70	1100						
NS_Cod	4	6	70	1100						
NS_CodCat	1	6	150	900	RFarea	Statistical rectangle	1 cm	1500	no	no
NS_CodCat	3	6	70	1100						
NS_Haddock	1	6	150	600	RFarea	Statistical rectangle	1 cm	800	no	no
NS_Haddock	2	6	100	700						
NS_Haddock	3	6	100	700						
NS_Haddock	4	6	100	700						
NS_Herring	1	5	150	320	RFarea	Statistical rectangle	0.5 cm	500	yes	yes
NS_Herring	2	5	60	340						
NS_Herring	3	5	60	340						
NS_Herring	4	5	60	340						
NS_Her1to9	1	5	60	125	RFarea	Statistical rectangle	0.5 cm	500	1	1
NS_Her1to7	1	5	60	125	RFarea	Statistical rectangle	0.5 cm	500	1	1
NS_Mackerel	1	6	200	450	RFarea	Statistical rectangle	1 cm	600	no	no
NS_Mackerel	2	6	50	450						
NS_Mackerel	3	6	50	450						
NS_Mackerel	4	6	50	450						
NS_Norway Pout	1	6	100	250	RFarea	Statistical rectangle	1 cm	500	no	no
NS_Norway Pout	2	6	50	250						
NS_Norway Pout	3	6	50	250						
NS_Norway Pout	4	6	50	250						
NS_Plaice IIIa	1	10	40	600	RFarea	Statistical rectangle	1 cm	800	No	no
NS_Plaice IIIa	3	10	40	600						
NS_Saithe	1	6	250	900	RFarea	Statistical rectangle	1 cm	1200	yes	no
NS_Saithe	2	6	70	1100						
NS_Saithe	3	6	70	1100						
NS_Saithe	4	6	70	1100						
NS_Sprat IIIa	1	6	70	160	RFarea	Statistical rectangle	0.5 cm	300	yes	yes
NS_Sprat IIIa	3	6	70	160						
NS_Sprat IV	1	6	70	160	RFarea	Statistical rectangle	0.5 cm	300	yes	yes
NS_Sprat IV	2	6	45	160						
NS_Sprat IV	3	6	45	160						
NS_Sprat IV	4	6	45	160						
NS_Whiting	1	6	150	450	RFarea	Statistical rectangle	1 cm	650	no	no
NS_Whiting	2	6	80	500						
NS_Whiting	3	6	80	500						
NS_Whiting	4	6	80	500						

Annex 2

The IBTS ALK supplement procedure

The procedure is as given below: The ALK table by species and Roundfisharea (RFA) is checked for empty cells and for age classes containing less than 25 otoliths. If no otoliths were collected then data from neighbouring RFA's are added to the ALK. All ALKs are inspected manually, which is also a quality control procedure where peculiarities are spotted. Often individual outliers or bulks of data not consistent with the rest of data are spotted. These data are then looked into and send back to the country of origin for checking. Manual inspection of the ALK data is also used to identify omitting data from a country, discovered when there is no or an incomplete ALK for a RFA .

The procedure for supplementary data is described below.

The ALK table is compared with with the CPUE (n/hr) by species and RF. Special attention is required for situations where the number of otoliths is low, but the CPUE is high. If the ALK data are not sufficient, i.e. spread out over length and ages, additional data are derived from neighbouring ALK's.

If there are only a few age groups represented in the ALK or the length range of the ALK is limited a supplement is made from neighbouring RFA's.

For some species the number of otoliths is too low to create an ALK by RFA. For saithe and mackerel the age data by quarter are merged and applied to all RFA's.

The procedure can probably be simplified by deciding that supplements for a given RF are derived from all neighbouring RFs. This will mean that:

RFA1	will be supplemented by data from	RFA2, 3
RFA2	"	RFA1, 3, 4, 6, 7
RFA3	"	RFA1, 2, 4
RFA4	"	RFA2, 3, 5, 6
RFA5	"	RFA4, 6
RFA6	"	RFA2, 4, 5, 7
RFA7	"	RFA2, 6
RFA8	"	RFA7, 9
RFA9	"	RFA8

Annex 4

Filling ALK procedure

MinL		10
MaxL		23

	Age	Age	Age	Age	Age
cm	1	2	3	4	5+
5		0	0	0	0
6		0	0	0	0
7		0	0	0	0
8		0	0	0	0
9		0	0	0	0
10	5	2	1	0	0
11	3	7	2	0	0
12					
13	2	8	1	0	0
14	9	2	7	1	8
15					
16					
17					
18					
19					
20					
21					
22	1	2	4	5	2
23	2	4	5	6	1
24+	0	0	0	0	1



	Age	Age	Age	Age	Age
cm	1	2	3	4	5+
5	1	0	0	0	0
6	1	0	0	0	0
7	1	0	0	0	0
8	1	0	0	0	0
9	1	0	0	0	0
10	5	2	1	0	0
11	3	7	2	0	0
12	2.5	7.5	1.5	0	0
13	2	8	1	0	0
14	9	2	7	1	8
15	9	2	7	1	8
16	9	2	7	1	8
17	9	2	7	1	8
18	5	2	5.5	3	5
19	1	2	4	5	2
20	1	2	4	5	2
21	1	2	4	5	2
22	1	2	4	5	2
23	2	4	5	6	1
24+	0	0	0	0	1

Annex 5

Calculations in the IBTS database are only referring to the standard species.

Basic concepts and variables

Variable	Significance
A	Index for sampling area
R	Index for statistical rectangle
I	Index for length class
J	Index for age group
H(r)	Number of valid hauls in statistical rectangle [r]
C(r)	Number per hour per haul in statistical rectangle [r]
C(r,i)	Length distribution in rectangle [r]: Number per hour per haul in length class [i] and statistical rectangle [r]
C(r,j)	Age distribution in rectangle [r]: Number per hour per haul in age group [j] and statistical rectangle [r]
C(r,i,j)	Age/length distribution in rectangle [r]: Number per hour per haul in length class [i], age group [j] and statistical rectangle [r]
f(a,i,j)	Age/length key for length class [I] in sampling area [a]: The proportions of fish in length class [i] falling in age group [j]
O(a,i,j)	Number of otoliths sampled in sampling area [a], length class [i] and age group [j]
A	Index for sampling area
H(a)	Number of valid hauls in sampling area [a]
C(a)	Number per hour per haul in sampling area [a] (total of all rectangles in the area)
R(a)	Number of rectangles sampled in sampling area [a]
Cr(a)	Mean number per hour per haul in sampling area [a] (mean of rectangles in the area)
C(a,i)	Length distribution in sampling area [a]: Number per hour per haul in length class [i] and sampling area [a] (total of all rectangles in the area)
C(a,j)	Age distribution in sampling area [a]: Number per hour per haul in age group [j] and sampling area [a] (total of all rectangles in the area)
Cr(a,j)	Mean distribution in sampling area [a]: Mean number per hour per haul in age group [j] and sampling area [a] (mean of all rectangles in the area)
C(a,i,j)	Age/length distribution in sampling area [a]: Number per hour per haul in length class [i], age group [j] and sampling area [a] (total of all rectangles in the area)

Aggregation of data

Aggregation by area takes place on two levels:

- Sampling area are groupings of stat. rec. into wider areas. At present only roundfish area is allowed.
- The standard area for a particular species is a selection of the statistical rectangle used for computation of abundance index for the species in question. It species depended.

The following formulas describe how to aggregate data on sampling area level. The variables and relationships for aggregation by standard area are entirely parallel to aggregation by sampling area and will therefore not be described.

Number of valid hauls in sampling area:

$$H(a) = \sum_{r \in a} H(r)$$

Number per hour per haul in sampling area:

$$C(a) = \sum_{r \in a} C(r)$$

Number of rectangles sampled in sampling area:

$$R(a) = \sum_{r \in a} 1$$

Mean number per hour per haul in sampling area:

$$Cr(a) = \frac{C(a)}{R(a)}$$

Length distribution in sampling area:

$$C(a, i) = \sum_{r \in a} C(r, i)$$

Age distribution in sampling area:

$$C(a, j) = \sum_{r \in a} C(r, j)$$

Mean distribution in sampling area:

$$Cr(a, j) = \frac{C(a, j)}{R(a)}$$

Age/length distribution in sampling area:

$$C(a, i, j) = \sum_{r \in a} C(r, i, j)$$