Stock Annex: Flounder (*Platichthys flesus*) in subdivisions 22 and 23 (Belt Seas and the Sound)

Stock specific documentation of standard assessment procedures used by ICES.

Stock:	Flounder
Working Group:	Baltic Fisheries Assessment Working Group **(**WGBFAS)
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A. General

A.1. Stock definition

There are two sympatric flounder populations in the Baltic Sea, which differ in their spawning habitat and egg characteristics (Nissling *et al*., 2002, Nissling and Dahlman, 2010). Demersal spawners produce small and heavy eggs which develop at the bottom of shallow banks and coastal areas in the northern part of the Baltic Proper. Pelagic spawners spawn at 70–130 m depth, and their eggs are neutrally buoyant at 10.6–12.0 psu salinity and require oxygen concentrations of 1–2 ml/l for development (Nissling *et al*., 2002). There is also strong genetic evidence for separating these ecotypes into separate stocks (Florin and Höglund, 2008; Hemmer Hansen *et al*., 2007) with the pelagic spawners distributed in the southern and the deeper eastern part of the Baltic Sea and the demersal spawners in the northern area. The pelagic spawners are considered to inhabit SDs 22 to 28, with a spatial overlap between the demersal and pelagic ecotypes, especially in SD 28 but the proportions of mixing are unknown. The pelagic spawners were further separated into three stocks: SD 22–23; SD 24–25 and SD 26 and 28 (ICES, 2012a; ICES, 2014).

There is evidence of a differentiation between SD 22-23 from SD 24-25 stocks based on egg buoyancy (Nissling *et al*., 2002, Table 1), length at maturity (Nissling *et al*., 2002, Table 2, Figure 1) and to some extent genetics (Hemmer Hansen *et al*., 2007). Even though there is no physical connection between SD 22 and SD 23, flounder populations in these areas are assumed to be connected through the western part of SD 24. Dividing the SD 24 for setting stock boundaries was not considered practical due to most of the data being recorded at SD level. Therefore, the entire SD 24 was merged with the SD 24–25 stock, even though the western part of SD 24 is considered to belong together with SD 22–23 stock.

Table 1. Reproductive characteristics from flounder sampled in different SD's. Data from Nissling et al 2002.

Variable	SD23	SD24	SD25	SD28
Salinity of Neutral Egg Buoyancy (psu)	26.1±0.8	15.2±1.9	13.9±1.5	20.3±1.1
Egg size	1.12±0.07	1.34±0.04	1.43±0.06	0.99±0.05
Lowest salinity of spermatozoa activation	11.6±1.0	11.8±0.6	10.3±1.3	3.4±0.3

Table 2. Range of length at 50% maturity for flounder in different ICES SD based on BITS Q1 2008–2011 (data from WKFLABA, ICES, 2012a). Flounder in SD 22 mature at a much greater size than flounders in other areas. No data from SD 23 and 27.

SD	22	23	24+25	26	27	28
LM50 (cm)	25-26		15-21	14-21		18-19

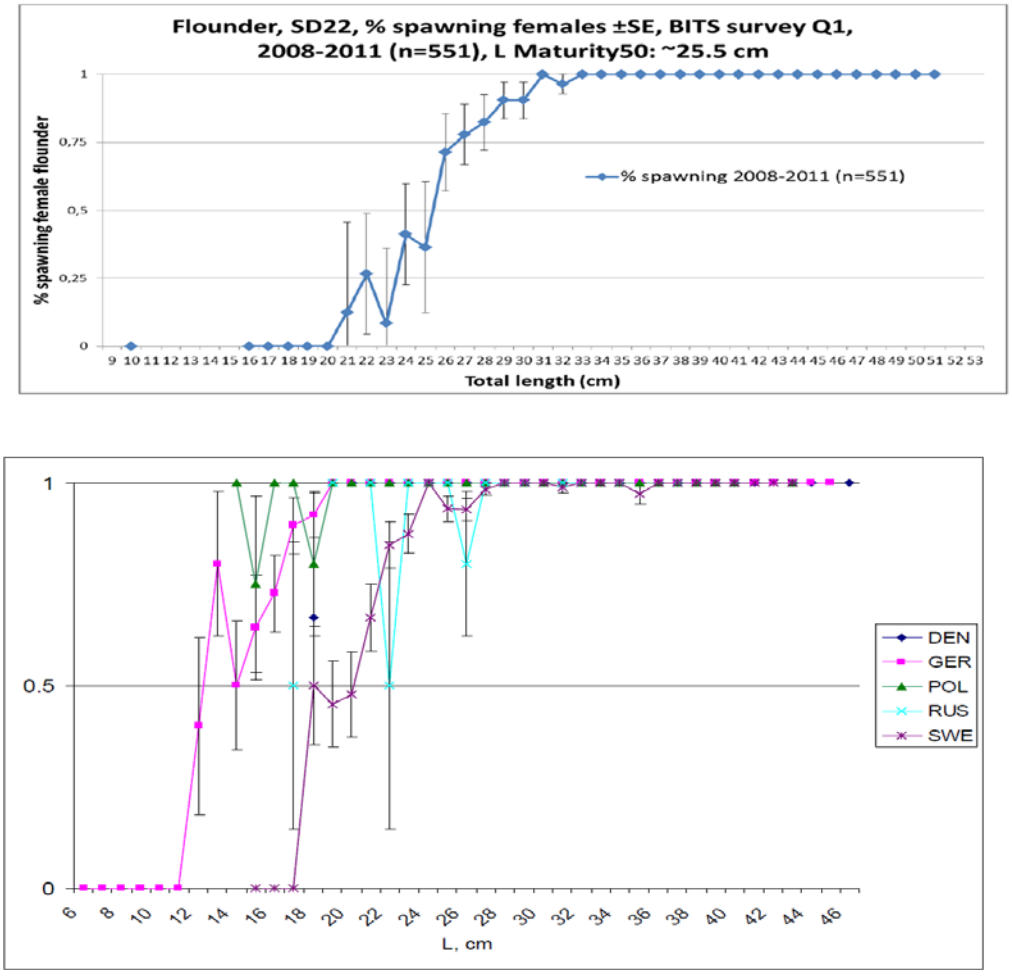

Figure 1. Length at 50% maturity from BITS Q1 2008–2011 in SD 22 (upper panel; German data only) and SD 24+25 (lower panel).

A.2. Fishery

ICES Subdivision 22 is the main fishing area for this stock with Denmark and Germany being the main fishing countries. Subdivision 23, where the main part of the landings is taken by Sweden, is only of minor importance as a fishing area.

Annual landings in SD22 in the period since 2000 vary between 3000 and 1500 tonnes. Landings in SD23 were below 350 tonnes/year in the entire time series since 2000 and declined to 150 tonnes after 2008. The highest total landings of flounder in SD22 were observed in 2000 (>3000 tonnes) and the lowest in 2006 (<1000 tonnes). Since 2007 the landings are around 1400 tonnes. Landings increased slightly in 2013, where 50% of total landings are from the Danish fleet, whereas 49% of landings were made by Germany and around 1% from the Swedish fleet.

Flounder are caught mostly by trawlers and gillnetters. The minimum landing size is 25 cm. Active gears provide most of the landings in SD 22 (ca. 70%). However, in SD 23, passive gears provide around 85% of total flounder landings (for Swedish fleet 98–100%). Flounder is caught as a bycatch-species in fisheries targeting cod (i.e. mostly trawlers) and in a mixed flatfish fishery (i.e. mostly gillnetters).

B. Data

B.1. Commercial catch

The Catch from commercial fisheries includes a landed and a discarded fraction.

Landing weights back to 2000 are available from Germany, Denmark and Sweden. Landings are submitted to the ICES database InterCatch. Landings are provided by Subdivision, quarter and fishing gear.

In WKBALFLAT (ICES, 2014), an attempt was made to set up a time series of flounder discards in SD 22–23. The calculation of discard weights for the period back to 2000 was done by national data-submitters, based on the national sampling programmes. The quality of the national estimations cannot be assured or revised since calculation methods were not available for the stock coordinator. Missing discard weights were estimated by the stock coordinator, using the Landing/Discard ratio from similar strata. The discard ratio was calculated as:

Catch (C) = Landing (L) + Discard (D) → Discard ratio: D/C×100=%D

However, no discard was estimated for strata not having a landing of flounder assigned, either due to zero landings (and a 100% discard) or no catches occurring in this quarter (for a given gear type). These "zero landings" strata are, however, of minor importance for the stock in SDs 22–23. In SD22, which corresponds to 80–90% of flounder landings, landings took place in every stratum (gear type per quarter). In SD23, there are non-reported landings for the active gear fraction which usually lands about 100–300 kg per quarter.

Given that the flounder is a bycatch species, it could be more appropriate to raise flounder discards with for example cod, instead of flounder landings, but this option is not available in InterCatch and was not possible to do it during the benchmark (ICES, 2014) due to time constraints and data availability.

Discards of flounder are highly variable, depending on e.g. local and national markets (which is driven not only by flounder, but also by cod and plaice), vessel capacity and quota limitations (e.g. cod). Discards also differ between areas and gear.

In general, discards are higher in active (e.g. trawls) than in passive fishing gears (e.g. setnets and traps). All fishing gears show some discards, with active gears having average discard ratio of 30–50% of the catch, whereas passive gears have an average discard-ratio of 10–20%.

A survival-rate (i.e. 50% survival in Q1 and Q4 and 10% survival in Q2 and Q3) was applied to the discarded fraction of the catch. These numbers represent the lower limits among the relatively wide range of survival rates obtained from several studies conducted in the Baltic Sea (see e.g. Revil, 2012; Herrmann *et al*., 2013; Broadhurst *et al*., 2006; and the WKBALFLAT Working document 2.1)

Given the uncertainties with the current estimates of discards, it was decided at WKBALFLAT that only a landing advice should be provided for the flounder stock in SD 22–23, until further work is done on a more appropriate calculation of the discards raising procedure (see below) (ICES, 2014).

To enable a catch advice, the following improvements are needed;

- More detailed documentation of discards is needed, such as where did the samples come from, and what the countries already have extrapolated themselves. In general, only data from sampled strata should be provided, with extra information/advice on how to fill the gaps of unsampled srata (e.g if zero landings of flounder, should the discards be estimated based on cod landing, etc.).
- A common approach to calculating and raising discards for bycatch species, in particular when there are zero landings, should be established
- To be able to use InterCatch for discard compilation, discards ratios should be available to borrow across years
- To be able to use InterCatch for discard compilation, it needs to be possible to use other discard raising factors than presently available, for example cod landings. Another option would be to add an additional column for total landings on a trip.

B.3. Surveys

The Baltic International Trawl Survey (BITS) is covering the area of the flounder stock in SDs 22-23. The survey is conducted twice a year (1st and 4th quarter) by the member-states having a fishery in this area. Survey-design and gear is standardized. Due to a change in survey gear in 2000, only the indices recorded during the period 2001 to present are used.

Fishing Stations are assigned each year by a randomized list, the average number of stations covering Subdivisions 22 and 23 is given in Table 1. Effort and cpue are calculated from the catches. The BITS-Index is calculated as:

Average number of flounder >= 20 cm weighted by the area of each depth stratum which all together covers the area covered by the stock.

Table 1: average numbers of BITS-stations in SD22 and SD23

AREA AND QUARTER		AVERAGE NO. OF STATIONS	STANDARD DEVIATION
SD 22	Q1	24	4.62
Q4		26	5.28
SD 23	Q1	3	0.62
	Q4	3	0.66

B.5. Other relevant data

During WKBALFLAT 2014, possibilities for age/length based analytical assessment were explored.

Length-distributions are available from Germany, Denmark and Sweden from 2000 onwards.

Age-data are considered to be applicable only when the ageing was conducted using new methods (breaking and burning of otoliths technique) as recommended by WKARFLO (ICES, 2007, 2008) and WKFLABA (ICES 2010).

From commercial fisheries samples, age information for CANUM and WECA are available from Germany (2009 onwards) and Denmark (2012 onwards).

In years where only numbers-at-length are available (but no age-data), preliminary analyses applying statistical slicing method using the von-Bertalanffy growth-equation have been conducted (ICES, 2014). Further development and validation of this approach, for example comparison with real age reading data for later years, is encouraged. Further, sex-ratios should be available at least in a pilot study to determine whether it has an influence on the assessment or both sexes can be combined in future assessments.

C. Assessment: data and method

Model used: Stock trend model based on scientific surveys

Model Options chosen:

Input data types and characteristics:

Stock trends are estimated using the Biomass Index from BITS-Q1 and BITS-Q4 surveys. The index is calculated by length-classes, and covers the period from 2001 onwards.

The Biomass-Index is a product of the calculated cpue by length and average-weight per length-class. The catch per unit of effort (number/hour) uses only fishes ≥ 20 cm from both surveys and data is extracted from the ICES DATRAS database. The values are averaged from all (incl. 0 catch) daytime hauls weighted by depth stratum area. The average weight per length-class is calculated from a length-weight relationship based on BITS-data to cover all length-classes. The weight is calculated using the average weight-length relation from the period 2001 to 2013.

Weight-length relation was calculated using $W = a \times L^b$

where a and b are growth-parameters, calculated from BITS data (pooled data from 2001 to 2013, both quarter combined).

$$a = 0.0168$$

$$b = 2.910$$

Both BITS-Q1 and BITS-Q4 surveys are aggregated into one annual index value for a given year (using geometric mean between quarters). The Biomass-Index is calculated for each year. For advice, the relative change in the average biomass index in the last two years is compared to the average of the three years before.

H. Other Issues

To provide landings-advice, the flounder stock in the SD 22–23 should be assessed with a Survey-based trend model (as suggested for data limited stock following the DLS Guidance Report; ICES, 2012c). However, an additional exploratory analytical assessment (e.g. SAM) should be carried out. The data quality currently doesn't allow the results of the analytical assessment to be used for advice, and different issues, such as discards and deriving age structure based on length measurements need to be improved (as described above). Further development in these calculation procedures and analyses is strongly encouraged to be carried out in parallel with survey based trend analyses, to allow for a possible transition to analytical methods in future.

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