

Appendix 9– Stock Annex

Quality Handbook

ANNEX: Herring SD 30

Stock specific documentation of standard assessment procedures used by ICES.

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| Stock: | Herring in Subdivision 30 (Bothnian Sea) |
| Working Group: | Baltic Fisheries Assessment Working Group |
| Date: | 22 April 2004 |

A. General

A.1. Stock definition

In the Bothnian Sea (Sub-division 30) there are two spring-spawning coastal herring populations (Hannerz, 1955, 1956; Otterlind, 1957, 1962b, 1976; Sjöblom, 1961; Parmanne and Sjöblom, 1982, 1986), one along the west coast and one on the east coast. The autumn spawning stock is very sparse (Sjöblom, 1978). The separation into the coastal and open sea components are not applied to these populations, although different spawning groups have been presented (Ehnholm, 1951). The migration pattern on both sides of the Bothnian Sea is the same and a mirror image of each other. The spring-spawning coastal herring on the Swedish coast spawn in May-July in the coastal areas starting in the most shallow areas and shifting with a rising water temperature to deeper waters (Neuman, 1982). The spawning occurs along the whole coastline. The migration of the adult population near to the spawning grounds takes place in late autumn and early winter mainly from the open sea areas (Aro 1989). The new spawners, as well as immatures, winter inside the Archipelagoes and near to the coast and new spawners join the spawning stock later during the spawning time. The feeding migration starts soon after spawning. The main feeding areas are the slopes of the Bothnian Sea Basin and the outer Archipelago. The herring in the western side of the Bothnian Sea seem to be more bound to the coast than the southern Baltic stocks (Otterlind, 1976).

The feeding migration of the specimens occurs mainly along the coast to the south and north and there seem to be some connections to the Åland Sea and to the Quark (Otterlind, 1957, 1962b), which are transition areas for the southern and northern stocks. The proportion of the eastward migration to the Finnish coast is very low. The spring-spawning coastal herring on the Finnish coast spawn also in May-July along the whole coastline from the northern side of the Archipelago Sea up to the Quark. The migration of the adult population to the spawning grounds from the feeding and wintering areas, which are in the open sea and partly in the Archipelago Sea and in the Quark Archipelago, occur during the winter and in late winter, when the first spawning shoals are quite near to the coast. Some of the younger mature age groups winter nearer to the coastline and in the Archipelago Sea (Sjöblom, 1961). After spawning the feeding migration is quite rapid to the open sea near to the slopes of the Bothnian Sea Basin and in the outer archipelago. They are in the feeding grounds usually July-December. The feeding migration extends to southern parts of the Bothnian Sea and inside the Archipelago Sea, in the Quark and sometimes inside the Bothnian Bay, too. There is also some exchange between the Finnish and Swedish coasts (Parmanne and Sjöblom, 1982, 1986). The spring-spawning coastal herring in the east coast of the Bothnian Sea has a clear homing behaviour and about 95 % of recaptures have been obtained inside 150 km from the tagging place (Parmanne and Sjöblom, 1986).

The stock boundary is set between Sub-divisions 30 (Bothnian Sea) and Sub-division 31(Bothnian Bay) at 63° 30' N in the north and southern border at 60° 30' N in the south. These borders seem to be useful both for management purposes and biological basis for stock separation.

A.2. Fishery

Since mid-1970s the fishery has been dominated by pelagic and demersal trawl fisheries and trapnet fisheries. In 2003 trawl fisheries accounted for over 95 % of the catches in 2003. A traditional gill net fishery for spawning herring has disappeared and does not have any significance. The remaining catches are taken by trapnet fishing targeting spawning component of the stock in May-June. Catches have increased in late 1990s because of intensified fishery. In recent years TAC regulation has decreased fishing possibilities in the Bothnian Sea and some fishing effort have moved

outside the stock distribution area. The fishery has been regulated by TACs and Bothnian Sea belongs to Management Unit 3 of International Baltic Sea Fishery Commission (IBSFC).

In the herring fishery pelagic trawl and demersal trawl fleets and fishing vessels overlap. Many of the vessels use both pelagic trawl and demersal trawl or the same gear is used in both fisheries. In herring fishery pelagic trawl fleet exploit younger part of the Baltic herring stock and bottom trawling is directed to more adult part of the stock. Usually Baltic herring fishing is conducted as a single trawling. At certain times of the year vessels may switch to bottom trawling. In autumn and early winter before ice is covering Bothnian Sea pelagic pair trawling is used for industrial purposes. In common with pelagic trawlers, many vessels transfer between the Bothnian Sea (SD 30) and the Åland Sea and northern Baltic proper (SD 29), depending on fishing possibilities and ice cover during the winter.

Bottom trawls are used exclusively for Baltic herring. As pelagic trawlers, the bottom trawlers transfer between fishing grounds depending on fishing possibilities and ice cover.

Trap-net fishery includes a variety of trap-net types for Baltic herring. Fishery is conducted near the coast and inside the archipelagos. Trap-net fishery for Baltic herring is conducted mainly during the spawning season in spring/ early summer (May-June) targeting spawning component of Baltic herring stock.

A.3. Ecosystem aspects

The recruitment of herring is dependent on environmental events, but stock-recruitment relationship has been established. Growth rate of herring has decreased and this is partly caused by density dependent effects of high population size.

B. Data

B.1. Commercial catch

Commercial herring catch statistics is based on catch notifications submitted by fishermen at set intervals. The application of the Act (1139/94) on implementing the Common Fisheries Policy of the European Community obliges all professional fishermen to submit a catch notification.

The fishing data of vessels at least 10 metres long are entered in the EU fishing logbook. The data entered are the dates of fishing by fishing trip, the size of the catch by species, the fishing (statistical) rectangle, the gear and number of gears used in fishing, and the trawling time in hours. A fishermen is obliged to keep an up to date logbook onboard his vessel. The logbook must be returned to the regional authorities within 48 hours of the catch being landed.

With the exception of salmon catches, the Finnish fishing data of vessels under 10 metres long are entered in a monthly coastal fishery form. The data entered are the size of the catch by species by the statistical rectangle, the type and number of gears used in fishing, and the number of fishing days. The forms must be returned to the regional authorities by the fifth day of the following month. All logbooks and most of the other catch notification forms are checked by national authorities.

The proportion of the Baltic herring catch landed in Finland for the food and processing industry in relation to the total catch of that species was estimated with the aid of the fish purchasing register maintained by the Ministry of Agriculture and Forestry.

Because all the main fisheries (pelagic trawls, demersal trawls and trap-nets) have different exploitation patterns and are used as separate fleets in stock evaluations, they also need to be sampled separately. Instead of following European Council Regulation sampling scheme, the primary requirement in Bothnian Sea herring sampling is to properly cover all the 12 strata (3 fleets and 4 year-quarters) to meet the assessment-criteria.

Since the study projects funded by DG XIV (International Baltic Sea Sampling Programs I & II) in 1998-2001, a length stratified sub-sampling scheme has been applied to estimate age compositions of Baltic herring. This sampling scheme is designed to support the development of international databases and standardized methodologies in data processing. Baltic herring samples are collected mainly in fishing harbours and, if necessary, also onboard commercial fishing vessels. In sampling scheme the annual life cycle of Baltic herring has been taken into account and the presence of the ice coverage during the winter in the Bothnian Sea. Because of these conditions, all three fishing gears are not in use in all year quarters, e.g. trap net fishery is usually conducted only in spawning time, in quarters 2 and 3. The sampling is roughly based on the proportions of regional catches in different fisheries. Moreover, the sampling intensity in general

is locally adjusted during the year according to temporal and regional changes in fisheries. The seasonal herring fishing intensity in each area is predominantly dependent on the TAC, which causes fishing restrictions in certain fisheries and/or seasons and may therefore influence the sampling intensity from the planned.

According to assumed catches by ICES Sub-divisions, gears in use, fishing intensity and taking into account, regardless of the amount of catches, a minimum coverage requirement of one sample by fishery per month.

The sampling strategy is to have age-length samples from all major gears in each quarter.

| Country | Kind of data | | | | |
|---------|-------------------------|---------------------------------|-----------------------------------|------------------------------------|-----------------------------|
| | Caton (catch in weight) | Canum (catch at age in numbers) | Weca (weight at age in the catch) | Matprop (proportion mature by age) | Length composition in catch |
| Finland | x | x | x | x | x |
| Sweden | x | x | x | | x |

The Finnish and Swedish input files are Excel spreadsheet files. The data should be found in the national laboratories and with the stock co-ordinator. The national data have been aggregated to international data on Excel spreadsheet files. Weight at age data is mainly obtained from the Finnish landings, and Swedish catches were assumed to have the same age composition and weight at age as the Finnish landings. In some years the final combined data on numbers at age have been adjusted to remove SOP discrepancies.

B.2. Biological

Weight at age in the stock is assumed to be the same as weight at age in the catch.

A fixed natural mortality of 0.2 is used both in the assessment and the forecast.

The proportion of natural mortality before spawning (M_{prop}) was set to 0.33 and the proportion of fishing mortality before spawning (F_{prop}) to 0.15.

The maturity ogives are based on the proportions of mature individuals of each age class in Finnish sampling data, and are updated every year.

B.3. Surveys

No surveys

B.4. Commercial CPUE

The three main fleets operating in Baltic herring fisheries in the Bothnian Sea are:

- Pelagic trawling (single- and pair-trawling)
- Demersal trawling
- Trapnet fisheries (spawning fishery)

In Finnish trawl fishery same trawls are often used as pelagic- and demersal trawl. There has been an increase in trawl gear size and changes in gear properties since early 1980s in Finnish Baltic herring fishery. In the past reported fishing effort data (trawling hours) may have not indicated correctly fishing mortalities generated by reported total fishing effort. Thus a correction coefficient for trawl fishing effort data in 1980-2003 has been applied to remedy this bias in calibrating XSA. This method estimates the increase in average trawl size to quantify the relative change in fishing power of herring trawl fleet. The annual correction coefficient for is derived using a model which estimates the average size of fishing circle of trawl (Rahikainen and Kuikka 2002). The model uses yearly data of trawls sold, their size and an estimated annual abolition rate. The total reported fishing effort in trawling hours by year has then been multiplied by estimated coefficient. As the same gear is used both in demersal trawling and pelagic trawling, the same coefficient has been used for both fleets. In assessments, correction factors of CPUE data has been used since 1997 assessment.

The total fishing effort for stock assessment is reported as trawling hours (multiplied by fishing power index) in trawl fisheries and number of trap nets set annually in trap net fishery. According to 2003 effort data, there has been an decrease of 3 121 trawling hours in demersal trawling and an increase of about 477 trawling hours in pelagic trawling compared with the effort in 2002. The number of trapnets increased from 203 in 2002 to 253 in 2003.

B.5. Other relevant data

None.

C. Historical Stock Development

Model used: XSA

Software used: IFAP / Lowestoft VPA suite

Model Options chosen:

Tapered time weighting applied, power = 3 over 20 years

Catchability independent of stock size for all ages

Catchability independent of age for ages ≥ 8

Survivor estimates shrunk towards the mean F of the final 5 years or the 5 oldest ages

S.E. of the mean to which the estimate are shrunk = 0.500

Minimum standard error for population estimates derived from each fleet = 0.300

Prior weighting not applied

Input data types and characteristics:

| Type | Name | Year range | Age range | Variable from year to year Yes/No |
|---------|---|-----------------------|-----------|--|
| Caton | Catch in tonnes | 1973 – last data year | | Yes |
| Canum | Catch at age in numbers | 1973 – last data year | 1 – 9+ | Yes |
| Weca | Weight at age in the commercial catch | 1973 – last data year | 1 – 9+ | Yes |
| West | Weight at age of the spawning stock at spawning time. | 1973 – last data year | 1 – 9+ | Yes - assumed to be the same as weight at age in the catch |
| Mprop | Proportion of natural mortality before spawning | 1973 – last data year | 1 – 9+ | No – set to 0.33 for all ages in all years |
| Fprop | Proportion of fishing mortality before spawning | 1973 – last data year | 1 – 9+ | No – set to 0.15 for all ages in all years |
| Matprop | Proportion mature at age | 1973 – last data year | 1 – 9+ | Yes |
| Natmor | Natural mortality | 1973 – last data year | 1 – 9+ | No – set to 0.2 for all ages in all years |

Tuning data:

| Type | Name | Year range | Age range |
|----------------|-----------------------------|-----------------------|-----------|
| Tuning fleet 1 | Finnish trap net fleet | 1980 – last data year | 2-9 |
| Tuning fleet 2 | Finnish bottom trawl fleet | 1980 – last data year | 2-9 |
| Tuning fleet 3 | Finnish pelagic trawl fleet | 1980 – last data year | 2-9 |

D. Short-Term Projection

Model used: Age structured

Software used: ICES Standard Assessment Tools (MFDP, MFYPR)

Initial stock size. Taken from the XSA for age 2 and older. The geometric mean recruitment of years 1990 - 2002 is used for age 1 in all projection years.

Natural mortality: Set to 0.2 for all ages in all years

Maturity: Average of last 3 years

F and M before spawning: Set to 0.15 and 0.33 respectively

Weight at age in the stock: Assumed to be the same as weight at age in the catch

Weight at age in the catch: Average weight of the three last years

Exploitation pattern: Average of the three last years, scaled by the Fbar (3-7) to the level of the last year

Intermediate year assumptions: Status quo F

Stock recruitment model used: None, the geometric mean recruitment of years 1990-2002 is used for age 1

Procedures used for splitting projected catches: Not relevant

E. Medium-Term Projections

Model used: Age structured. Calculated for a 10 year period by Monte Carlo simulation

Software used: Excel spreadsheet

Initial stock size: Taken from the XSA for age 2 and older. The geometric mean recruitment of years 1990 - 2002 is used for age 1 in all projection years.

Natural mortality: Set to 0.2 for all ages in all years

Maturity: Average of last 3 years

F and M before spawning: Set to 0.15 and 0.33 respectively

Weight at age in the stock: Assumed to be the same as weight at age in the catch

Weight at age in the catch: Average weight of the three last years

Exploitation pattern: Average of the three last years, scaled by the Fbar (3-7) to the level of the last year

Intermediate year assumptions: Status quo F

Stock recruitment model used: Beverton-Holt stock-recruitment relationship

- Uncertainty models used: None

F. Long-Term Projections

Not done

G. Biological Reference Points

The following precautionary approach reference points have been proposed in 2000 to Baltic herring in SD 30:

| ICES considers that: | ICES proposes that: |
|------------------------|------------------------------|
| B_{lim} is 145 000 t | B_{pa} be set at 200 000 t |
| F_{lim} is 0.30 | F_{pa} be set at 0.21 |

Technical basis:

| | |
|--|--|
| B_{lim} : spawning stock biomass, where probability of lower recruitment increases | B_{pa} : $B_{lim} * \exp(1.645 * 0.2)$ |
| F_{lim} : F_{loss} | F_{pa} : F_{med} |

There is no new biological nor fishery data available for the basis of revision of present reference points.

H. Other Issues

None.

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