HERRING ASSESSMENT WORKING GROUP FOR THE AREA SOUTH OF 62° N (HAWG)

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Annex 4: List of Working Documents

Working documents HAWG 2021	
WD 01	Pastoors, M and Rolf, N. Utilizing the full time series of herring catch by rectangle.
WD 02	Polte, P and Gröhsler, T. 2020 Western Baltic spring spawning herring recruitment monitored by the Rügen Herring Larvae Survey
WD 03	Gröhsler, T. German herring Fisheries and stock assessment data in the Western Baltic in 2020.
WD 04	HAWG 2021. IBPNSAS2021 – Interbenchmark Protocol on North Sea Autumn Spawning Herring 2021
WD 05	Pastoors, M. and Quirijns, F.A. PFA Self sampling report for North Sea herring Fisheries, 2015-2020

Working Document 02 **Herring Assessment WG for the area South of 62° North (HAWG)/WBSSH 16 – 24 March 2021**

2020 Western Baltic spring spawning herring recruitment monitored by the Rügen Herring Larvae Survey

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The waters of Greifswald Bay (ICES area 24) are considered a major spawning area of Western Baltic spring spawning (WBSS) herring. The German Thünen Institute of Baltic Sea Fisheries (TI-OF), Rostock, and its predecessor monitors the density of herring larvae as a vector of recruitment success since 1977 within the framework of the Rügen Herring Larvae Survey (RHLS). It delivers a unique high-resolution dataset on the herring larvae ecology in the Western Baltic, both temporally and spatially. Onboard the research vessel FFS CLUPEA a sampling grid including 35 stations is sampled weekly using ichthyoplankton gear (Bongo-net, mesh size 335 µm) during the main reproduction period from March to June. The weekly assessment of the entire sampling area is conducted within two days (detailed description of the survey design can be found in Polte 2013, ICES WD08). The collected data provide an important baseline for detailed investigations of spawning and recruitment ecology of WBSS herring spawning components. As a fishery-independent indicator of stock development, the recruitment index is incorporated into the assessment of the ICES Herring Assessment Working Group (HAWG).
The rationale for the *N20* recruitment index is based on strong correlations between the amount of larvae reaching a length of 20 mm (TL) in Greifswald Bay and abundance data of juveniles (1-wr and 2-wr fish) as determined by acoustic surveys in the Arkona and Belt Seas (GERAS).
This correlation supports the underlying hypotheses that i) major variability of natural mortality occurs at early life stages before larvae reach a total length of 20 mm and ii) larval herring production in Greifswald Bay is an adequate proxy for annual recruitment strength of the WBSS herring stock.
The *N20* recruitment index is calculated every year based on data obtained from the RHLS. This is done by estimating weekly growth of larvae for seasonal temperature change and taking the sum of larvae reaching 20 mm by every survey week until the end of the investigation period. On the spatial scale, the 35 sampling stations are assigned to 5 strata and mean values of stations for each stratum are extrapolated to the strata area (for details see Oeberst et. al 2009).
Calculation procedures have been reviewed and re-established in 2007 and the recalculated index for the time series from 1992 onwards is used by HAWG since 2008 as 0-group recruitment index for the assessment of Western Baltic Spring Spawning herring.

2020 N20 index results:

The regular Rügen-herring larvae Survey started on February 26th and was conducted until June 26th, over a 16-week period.
With an estimated product of **239 million** larvae, the 2020 *N20* recruitment index is the lowest of the time series and about 50% of the former record low of 2016 (Table 1, Figure 1).

2020 additional survey observations:

According to former observations on the impact of winter SST on spawning phenology and herring early life stage survival (Gröger et al. 2014, Polte et al. 2021), the conditions in spring 2020 were special as it was the warmest winter during the past decade (https://www.bsh.de/DE/DATEN/Meerestemperaturen/Meeresoberflaechentemperaturen/Fernerkundungsdaten/_Module/Frames/oseemw_emonat_textbaustein.html). Field observations revealed that distinct spawning cohorts as they were regularly occurring in the system in former years were entirely missing in 2020. Instead larval size composition was rather diverse throughout the entire season, pointing on a blurred spawn timing and/or larval survival dynamics without pointed peal hatching events.

Instead of an additional control cruise for winter spawners usually conducted mid-February, the regular RHLS started early (Feb 26th). In November (start Nov 5th) a control survey were conducted

testing for abundance of autumn larvae which were absent in significant numbers during the survey duration.

Table 1: *N20* larval herring index for spring spawning herring of the Western Baltic Sea (WBSS), generated by RHLS data.

Year	N20 (Millions)
1992	660
1993	4542
1994	15158
1995	9327
1996	24540
1997	5290
1998	18782
1999	22342
2000	3404
2001	5670
2002	12452
2003	4775
2004	6818
2005	5118
2006	4173
2007	1986
2008	1903
2009	7989
2010	8004
2011	4493
2012	1340
2013	3588
2014	681
2015	3001
2016	482
2017	1247
2018	1563
2019	1317
2020	**239**

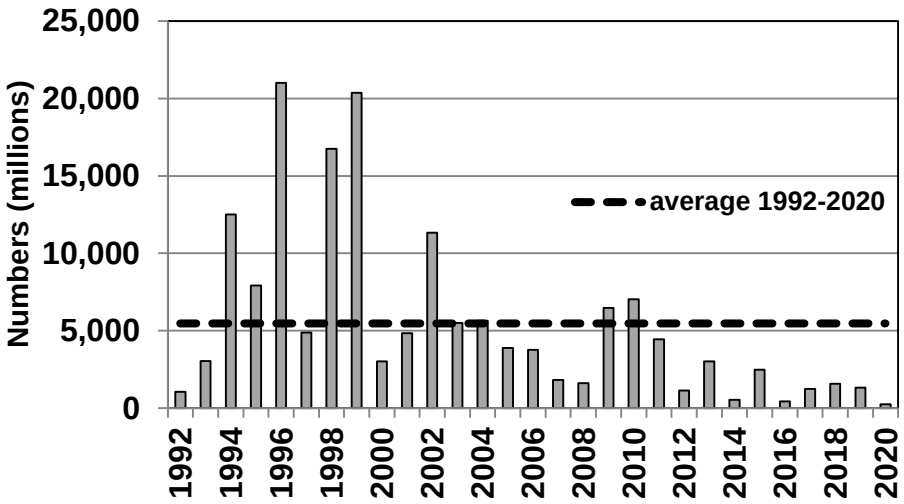

Figure 1 Time series of the N20 index (1992-2020)

Revision of the relation between N20 and GERAS 1-wr herring after years with low larvae production

After multiple years with the record low N20 (2014,2016), the relation with the 1-group juveniles as monitored by the German hydroacoustic survey (GERAS) was re-evaluated to see if recent years with extremely low larvae production are reflected in the abundance of 1-wr juveniles on the scale of the western Baltic Sea. The results reveal an unchanged and strong correlation between N20 and GERAS 1-wr juveniles. The low N20 years resulted in correspondingly low GERAS indices for the 1-wr juveniles (Fig. 2).

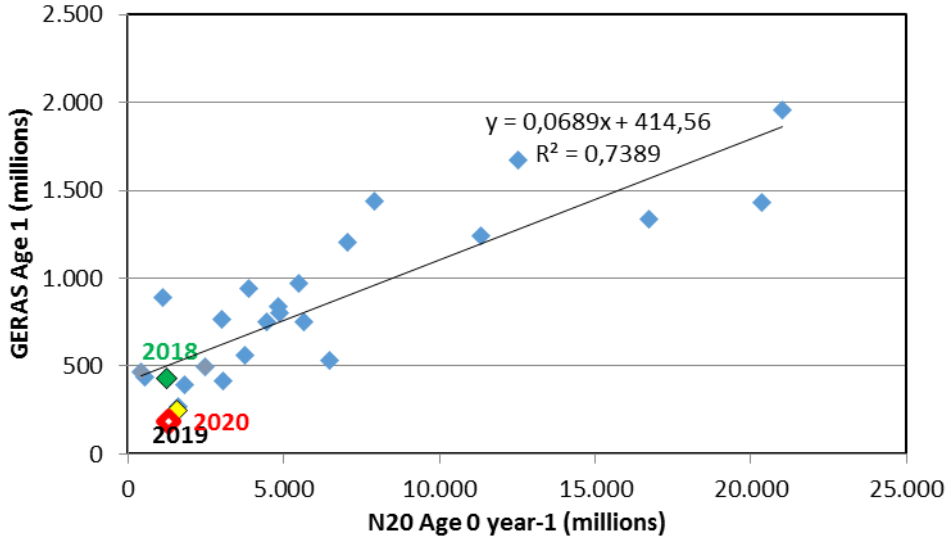

Figure 2 Correlation of N20 larvae index (1993-2019) with the 1-wr herring from GERAS (1994-2020). Note: The one-year lag phase between indices. E.g. the exceptionally low N20 year 2016 is represented by the GERAS 1-wr index 2017.

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