22 Whiting (*Merlangius merlangus*) in Division 3.a (Skagerrak and Kattegat)

This section was last updated in 2020, as WGNSSK was not requested to provide updated advice on this stock in 2021.

22.1 General

22.1.1 Stock definition

There is a paucity of information on the population structure of whiting in Division 3.a (the Skagerrak-Kattegat area). No genetic or otolith-based surveys have been conducted. Tagging of whiting has previously been undertaken, but these data need to be re-examined. Results from previously modelled survey data (SURBAR) were inconclusive regarding independent population dynamics in Division 3.a in comparison with the North Sea (ICES, 2016), presumably due to the need of age readings in 3.a (age information used in SURBAR was borrowed from Subarea 4). The drop in landings in the beginning of the 1990s gives, however, an indication of local stock structure as this reduction was not paralleled by any similar event in the North Sea. There are also findings of locally spawned whiting eggs in Kattegat 3.aS (Börjesson *et al*., 2013).

22.1.2 Ecosystem aspect

No new information was presented at the Working Group. A summary of available information on ecosystem aspects is presented in the Stock Annex last updated at ICES WKDEM (ICES, 2020).

22.1.3 Fisheries

Whiting landings in Division 3.a have declined in recent decades from over 20 000 tonnes in the 1980s to 179 tonnes in 2019. Denmark is catching most of the whiting in the area; Sweden and Norway follow with considerably less amounts. The Danish industrial fleet (main target species: sprat) is landing 40–80% of whiting in the area. Information was uploaded to InterCatch by Sweden, Denmark, Norway, Germany and the Netherlands. Discard estimates are available since 2002. A summary of available information on fisheries and information on derivation of discards is presented in the Stock Annex (last updated during the WKDEM 2020 benchmark (ICES, 2020).

22.2 Data available

22.2.1 Catch

The estimation of discards is done using InterCatch data. In 2019, ICES estimated catch was equal to 806 tonnes and are split to landings and discards (imported or raised) as follows:

Catch category	Imported or Raised	Catch (tonnes)	Percent
Landings	Imported	179	100%
Discards	Imported	596	95%
Discards	Raised	31	5%
Logbook registered discard	Imported	0	
BMS landing	Imported	0	

The raising of discards for unsampled strata was done assuming a discard rate equal to a weighted mean of reported discard rates, with weights equal to the total landings in tonnes. The raising is done by grouping all fleets by area. The industrial fleet, responsible for a substantial part of the landings (42% in 2019), does not have any discards. The landings and estimated discards are shown in Table 22.1.

22.2.2 Survey index

A combined survey index was derived using four bottom trawl surveys that operate in the area, namely the two international bottom trawl surveys (NS-IBTS (Q1 and Q3) and BITS (Q1 and Q4)) and two Danish national bottom trawl surveys targeting cod and sole both conducted in Q4.

The survey index calculation is described in the stock annex, here a short description is given. Predictions of a Tweedie Generalised Additive model on a fine grid are used to estimate the biomass index. The model is described by the following equation

$$\log(\mu i) = \text{Gear}(i) + f_1(\text{lon}_i, \text{lat}_i) + f_2(\text{timeOfYear}_i, \text{lon}_i, \text{lat}_i) + f_3(\text{time}_i, \text{lon}_i, \text{lat}_i) + f_4(\text{depth}_i) + U(i)_{\text{ship:gear}} + \log(\text{HaulDur}_i)$$

that includes a time-invariant spatial effect (f_1), a seasonal repeating pattern (f_2), a space-time interaction effect (f_3) that can capture smooth changes over longer time scales, a smooth function of depth (f_4), a fixed gear effect and random effects for the interaction between ship and gear. Finally, the model includes an offset term of the logarithm of haul duration that corresponds to the assumption that catch is proportional to haul duration.

The prediction of the biomass index in Q1 is used for giving advice and is shown in Figure 22.1.

22.3 Data analyses

22.3.1 Exploratory survey-based analysis

Previously, an exploratory SURBAR analysis has been performed and showed that internal consistency was virtually absent, impeding cohort analysis for the stock (ICES, 2016). The main conclusion from the SURBAR analysis was that the lack of internal consistency in the available survey indices (Figure 12.1.6 in ICES 2016) prevents an analytical assessment. This internal inconsistency could be related to a) age reading problems, and/or b) a mixture of several stock components leading to unaccounted migrations.

During the WKDEM 2020 benchmark (ICES, 2020) there was an attempt to do an assessment using the surplus production model in continuous time (SPiCT). The estimated uncertainty was very high, therefore none of the scenarios deemed adequate to be used to provide advice for the stock.

22.3.2 Advice

In the last benchmark of whiting in Division 3.a. in 2020 (ICES WKDEM, 2020) the stock was raised from category 5 to category 3 (ICES, 2018). The advice, starting from 2020, will be based on the trends of new combined survey index, which was first introduced in the benchmark, using the "2-over-3 rule". According to the rule, the advice for the next 2 years will be equal to the last given advice multiplied by the ratio of the average index in the last 2 years to the average index during the 3 years prior. An uncertainty cap should be used; this means that the next advice cannot be more than 20% increase or decrease compared to the last advice. Finally, a precautionary buffer of 20% should be applied if it was not applied in the last 2 years and there is no indication of the stock status.

For the first advice using the new approach in 2020, the average catch during the last 10 years ($C_{2010–2019}$ =1203 tonnes) is used instead of the last advice. Additionally, the precautionary buffer is applied in 2020 as it was last applied in 2017. The "2-over-3" ratio was equal to 0.97 (Figure 22.1). The advice is then equal to the average catch multiplied by the ratio multiplied by the precautionary buffer (0.8).

For whiting in Division 3.a, ICES advises that when the precautionary approach is applied, catches in each of the years 2021 and 2022 should be no more than 929 tonnes. This corresponds to projected landings corresponding to the advice equal to 242 tonnes.

22.3.3 Issues for future benchmarks

During the last benchmark of whiting in Division 3.a (ICES, 2020) there was an attempt to assess the stock using the surplus production model in continuous time (SPiCT) and several scenarios of data input were considered. The conclusion was that there was no model that could be used to provide advice. Future research is needed to improve the assessment model. More specifically, SPiCT cannot deal at the moment with biomass indices that combine multiple surveys from different quarters of the year and an extension to the model is needed to allow for such autocorrelated time series.

In the routine surveys, IBTS quarter 1 and quarter 3 in Division 3.a, biological data are collected for this species, in particular otoliths for aging and maturation information. These can be used in a future benchmark to understand growth and maturity patterns of the population in this area.

22.4 References

ICES. 2018. Advice basis. *In* Report of the ICES Advisory Committee, 2018. ICES Advice 2018, Book 1, Section 1.2. https://doi.org/10.17895/ices.pub.4503.

ICES. 2020. Benchmark Workshop for Demersal Species (WKDEM). ICES Scientific Reports. 2:31. 136 pp. http://doi.org/10.17895/ices.pub.5548

Table 22.1. Whiting in Division 3.a (Skagerrak and Kattegat): Nominal landings (t) as supplied by the Study Group on Division 3.a Demersal Stocks (ICES, 1992b) and updated by the WGNSSK in 2007. The estimates of discards for 2002–2018 were updated in WKDEM2020 (ICES, 2020).

Year	Denmark (1)			Norway	Sweden	Others	Total	WG estimate of Discards
1975	19,018			57	611	4	19,690	
1976	17,870			48	1,002	48	18,968	
1977	18,116			46	975	41	19,178	
1978	48,102			58	899	32	49,091	
1979	16,971			63	1,033	16	18,083	
1980	21,070			65	1,516	3	22,654	
	Total consumption	Total industrial	Total					
1981	1,027	23,915	24,942	70	1,054	7	26,073	
1982	1,183	39,758	40,941	40	670	13	41,664	
1983	1,311	23,505	24,816	48	1,061	8	25,933	
1984	1,036	12,102	13,138	51	1,168	60	14,417	
1985	557	11,967	12,524	45	654	2	13,225	
1986	484	11,979	12,463	64	477	1	13,005	
1987	443	15,880	16,323	29	262	43	16,657	
1988	391	10,872	11,263	42	435	24	11,764	
1989	917	11,662	12,579	29	675	-	13,283	
1990	1,016	17,829	18,845	49	456	73	19,423	
1991	871	12,463	13,334	56	527	97	14,041	
1992	555	3,340	3,895	66	959	1	4,921	
1993	261	1,987	2,248	42	756	1	3,047	
1994	174	1,900	2,074	21	440	1	2,536	
1995	85	2,549	2,634	24	431	1	3,090	
1996	55	1,235	1,290	21	182	-	1,493	
1997	38	264	302	18	94	-	414	
1998	35	354	389	16	81	-	486	
1999	37	695	732	15	111	-	858	
2000	59	777	836	17	138	1	992	
2001	61	970	1,031	27	126	+	1,184	
2002	164	1347	1510	23	134	1	1669	2373
2003	104	641	745	20	72	2	839	1837
2004	252	954	1206	17	74	1	1298	2782
2005	110	853	962	13	73	0	1048	1625
2006	71	410	481	11	86	0	578	1497
2007	57	275	332	14	82	1	429	1524
2008	54	286	340	14	52	0	407	795
2009	73	172	245	10	34	0	289	778
2010	49	158	207	10	30	1	248	803

Year	Denmark (1)			Norway	Sweden	Others	Total	WG estimate of Discards
2011	40	44	85	8	20	0	114	937
2012	30	7	37	16	10	1	63	377
2013	29	130	159	8	15	1	183	687
2014	49	346	395	5	37	2	439	649
2015	75	570	645	6	56	5	712	820
2016	129	334	463	13	62	5	543	1307
2017	189	193	382	8	33	7	431	1185
2018	175	156	332	5	34	2	372	1357
2019	78	75	153	5	20	1	179	627

[1] **Values from 1992 updated by WGNSSK (2007), WGNSSK (2011).**

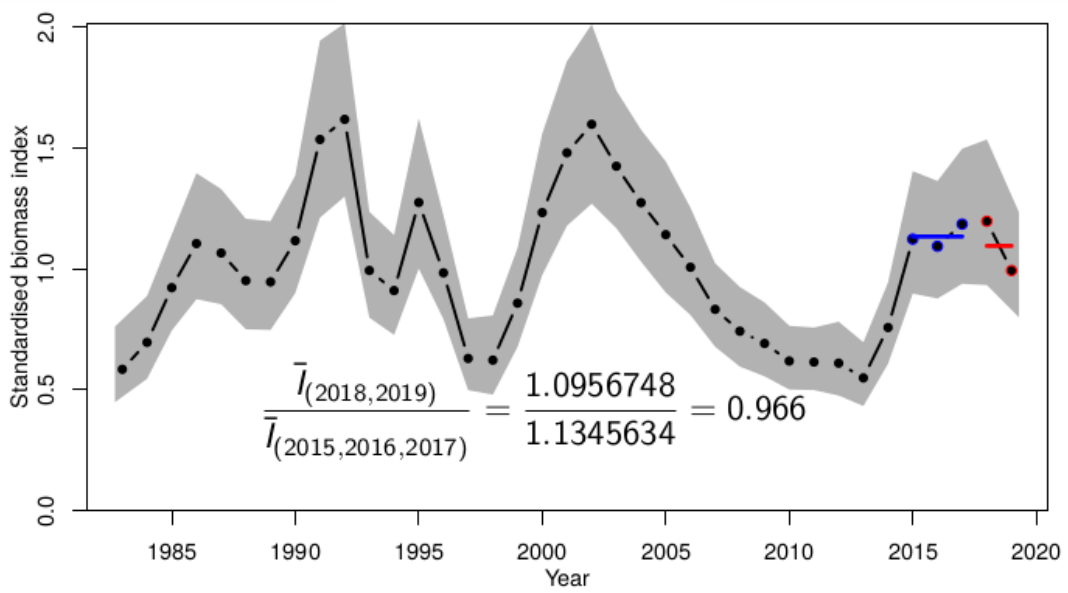

Figure 22.1. Whiting in Division 3.a (Skagerrak and Kattegat): Combined biomass index (Q1) using survey data from the two international bottom trawl surveys and two Danish national surveys. The average of the last two years (red line) and the average of the three years before that (blue line) are used to calculate the "2-over-3" ratio shown inside the figure.