

Missing 50,000 – 100,000 t of North Sea cod in 2017

Based on the IBTS (International Bottom Trawl Survey) in the 1st quarter and the 3rd quarter of the year the indications are that 50,000–100,000 t of cod in addition to the reported catch disappeared from the North Sea between February 2017 and September 2017.

The IBTS 1q index fall substantially in 2018 (Figure 1). Based on the catchability coefficient from the assessment the fall in the stock biomass was 50,000-100,000 t. Also, the IBTS 3q index fall substantially. This happened already in 2017. This fall was also corresponding to a fall in stock biomass of 50,000-100,000 t. Therefore, the indications are that the fall happened between 1q 2017 and 3q 2017.

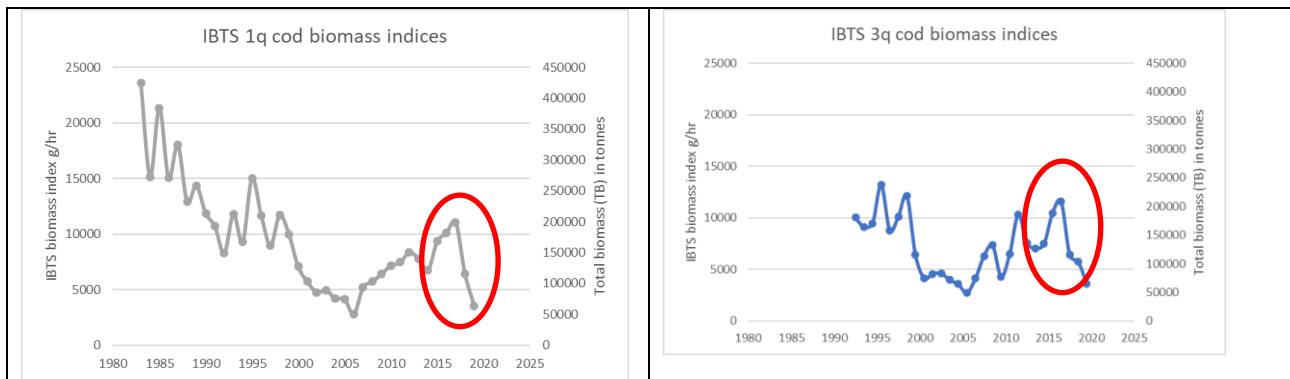


Figure 1. *NSea cod. IBTS indices (From WGNSSK 2020) of biomass (Sumproduct of indices by numbers and age and WEST, multiplied by q catchability).*

The total mortality, Z (age 2-4), calculated based on the IBTS, shows a drastic increase in the same period for both the IBTS 1q and the IBTS 3q survey (Figure 2). The pattern is most clear for the IBTS 1q survey data. The IBTS 1q is based on more trawl hauls and therefore probably more precise than the IBTS 3q index.

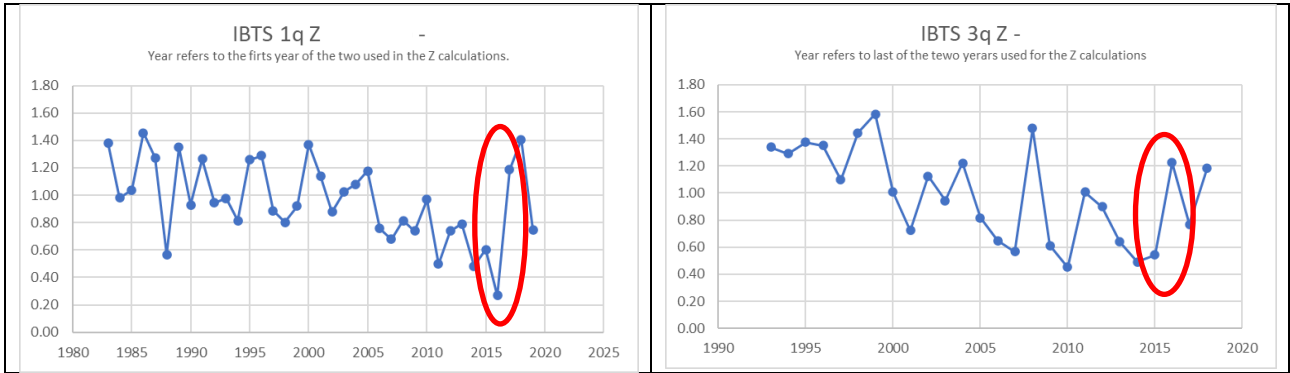


Figure 2. *NSea cod. Total mortality Z (age 2-4) calculated from IBTS data (WGNSSK 2020). The x-axis gives the first year of the Z calculation, for instance Z for 2017 is Z from 1q 2017 to 1q 2018 for the 1q plot.*

The IBTS 1q and 3q biomass indices track the stock time trend from the assessment quite well, as indicated in Figure 3. Both the IBTS 1q and the IBTS 3q are however, deviating more than ever seen from the assessment in 2016 and 2017.

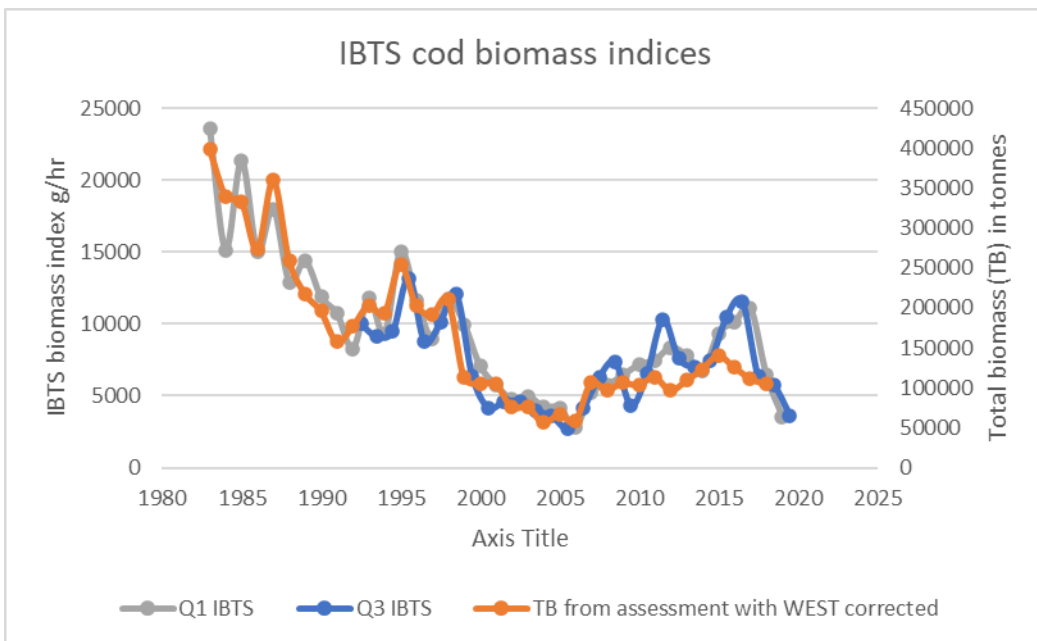


Figure 3. *NSea cod. Trend over time from the assessment (WGNSSK 2020) and the IBTS 1q and IBTS 3q surveys.*

This large change in the IBTS series are not just uncertainties in the IBTS indices, because:

- 1) The changes are larger than the likely uncertainties.

- 2) They are consistent in both the 1q and the 3 q IBTS surveys in timing.
- 3) The years before was quite stable and after as well.
- 4) The fact that the two IBTS indices follow each other well over time indicate that they are quite precise.
- 5) The drop is not mainly due to drop in recruitment but, as shown below, to increases in total mortality (Z age 2-5) and thus in a disappearance of age 2-5 cod.

This has given ICES large problems in the annual assessment as there is a disturbingly large “retrospective pattern” (Figure 4, left panel). The ICES Advice text in 2019 states: “The reason for this discrepancy is not fully understood and might include a number of possible ecological and anthropogenic drivers”.

For the present note a trial SAM run was performed, adding 50000 t to the 2017 catch - everything else being equal to the ICES 2020 assessment. This SAM run got rid of the bias in the retrospective pattern (Figure 4, right panel), which probably confirms the notion of the “missing” cod.

Possible reasons for the disappearance (“missing”) of cod:

1. Misreporting.
2. Migration of cod out of the North Sea.
3. Extra predation by seals or maybe whales visiting the North Sea in the first half of 2017.
4. Diseases.
5. Unknown unknowns.

There are indications that some cod migrated to Division VIa, but it can only be a small fraction of the missing cod because a massive invasion of cod is not seen in the catches, in the survey in Division VIa or in the assessment of this rather small cod stock in Division VIa.

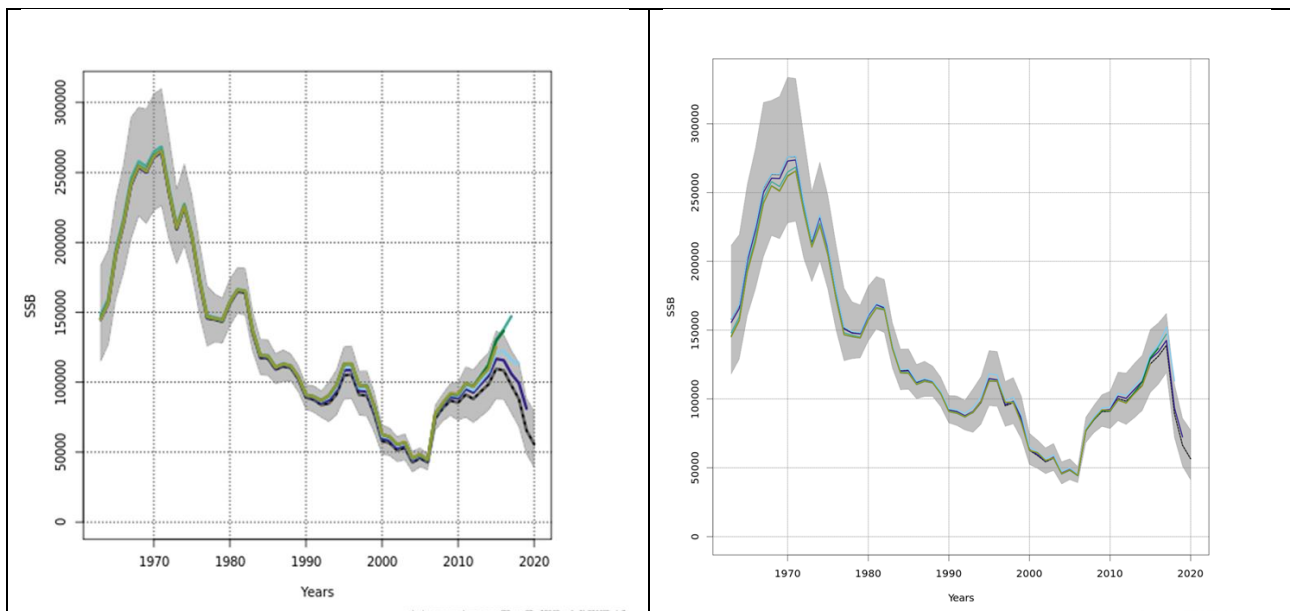


Figure 4. *NSea cod. Retrospective plots of SSB. From WGNSSK 2020 (left panel) and from an assessment where the catch in 2017 is raised by 50000 t (split into number-at-age using WECA and CANUM for 2017) (right panel). The point to note is the disappearance of the retrospective pattern.*

The amount of “missing” cod is so large that it should be possible to find where they went. ICES or others should look into this.

Conclusion:

The hypothesis and approach presented here and justified by the IBTS data, represents an alternative to the “increase in M since 2011” (as a way of dealing with migration out of the North Sea), as discussed in February in WKNSEA 2021,.

References:

ICES. 2020. Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK). ICES Scientific Reports. 2:61. 1140 pp. <http://doi.org/10.17895/ices.pub.6092>.

Annex 1. Various material from ICES Advice 2020.

Quality of the assessment

In recent years (since 2017), assessments resulted in a downscaling of SSB and an upward revision of F. This is caused by lower catch rates of older fish in the IBTS surveys compared to the commercial catches. The reason for this discrepancy is not fully understood and might include a number of possible ecological and anthropogenic drivers. If the recent observed retrospective pattern continues, the current forecast may be too optimistic.

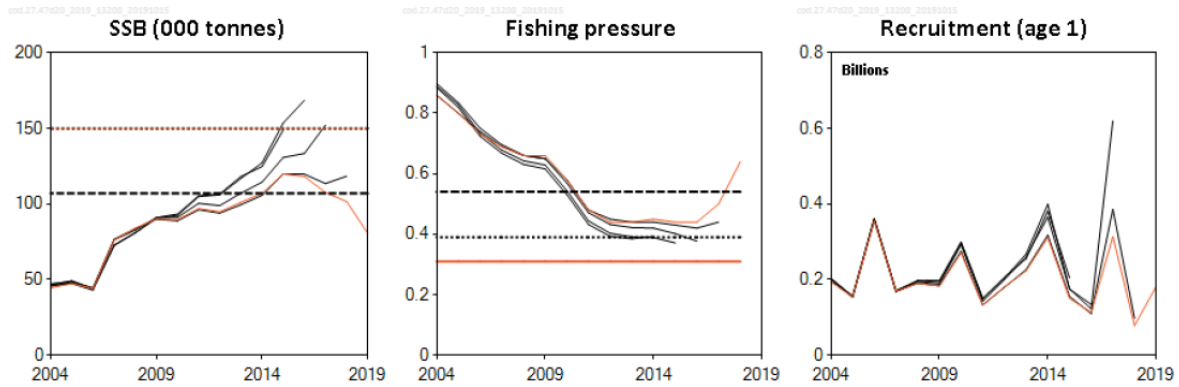


Figure 2 Cod in Subarea 4, Division 7.d, and Subdivision 20. Historical assessment results (final-year recruitment estimates included). Maturity-at-age was re-estimated in 2017, which caused the observed downward revision in SSB in the 2017 assessment.

From ICES WGNSSK 2020.

Registered catches of cod in

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Sub-area IV										
Country										
Belgium	666	653	862	1,075	1,258	1,223	1,103	696	818	727
Denmark	5,686	4,863	4,803	4,536	5,457	6,026	6,713	6,119	5,489	4,964
Faroe Islands	32	-	-	-	-	-	-	-	-	0
France	782	619	369	287	637	517	391	401	583	450
Germany	2,844	2,211	2,385	1,921	2,257	2,133	2,083	2,300	1,506	822
Greenland	-	-	-	-	-	-	2	1	-	-
Netherlands	2,657	1,928	1,955	1,344	1,242	1,403	1,365	653	513	716
Norway	4,495	4,898	4,601	4,060	4,600	5,404	5,627	5,521	5,553	4,518
Poland	-	2	-	-	-	-	-	-	-	-
Sweden	362	316	471	332	401	415	373	387	274	344
UK (E/W/NI)	2,553	2,169	1,629	2,129	2,962	-	-	-	-	-
UK (Scotland)	11,567	10,141	10,565	10,619	10,517	-	-	-	-	-
UK (combined)	n/a	n/a	n/a	n/a	n/a	14,889	16,603	18,523	21,054	15,589
Others	-	-	-	-	-	-	-	0	-	-
Danish industrial by-catch	12	0	0	2	24	0	5	147	0	2
Norwegian industrial by-catch *	201	1	-	-	-	-	-	-	-	-
Total Nominal Catch	31,657	27,799	27,840	26,324	29,355	32,011	34,265	34,746	35,789	28,130
Unallocated landings	-677	-1,124	-1,013	-1,009	-805	-767	-1,230	-1,637	-1,345	428
BMS landings	-	-	-	-	-	-	-	1	8	41

Annex 2. Catch data by year including the raised 2017 catch by 50000 t split into human consumption and discards in the same proportions as the original data.

Year	Landings	Discards	Catch	Total Removal
1963	106100	10562	116668	116668
1964	134179	9519	143692	143692
1965	181517	17250	198753	198753
1966	213386	26156	239492	239492
1967	260288	26893	287213	287213
1968	277983	17187	295194	295194
1969	214060	9168	223207	223207
1970	230199	19532	249717	249717
1971	294205	60025	354216	354216
1972	333572	35676	369282	369282
1973	234936	25214	260159	260159
1974	207936	26002	233914	233914
1975	210206	37618	247865	247865
1976	205669	46331	251957	251957
1977	182372	79841	262115	262115
1978	313287	49491	362816	362816
1979	273274	60189	333423	333423
1980	292946	100206	392966	392966
1981	340490	52481	393031	393031
1982	325103	63704	388813	388813
1983	289771	37115	326837	326837
1984	210164	67464	277704	277704
1985	214781	27976	242752	242752
1986	170604	59616	230156	230156
1987	226385	32817	259306	259306
1988	191710	14732	206512	206512
1989	140548	41416	181924	181924
1990	115529	23318	138857	138857
1991	103039	15890	118963	118963
1992	108714	31476	140236	140236
1993	129977	28342	158343	147340
1994	106479	42467	148960	152282
1995	130769	31585	162308	194774
1996	131194	20967	152189	160249
1997	132439	44525	176932	148832
1998	145100	41008	186177	134949
1999	94766	12917	107665	96926
2000	73299	16418	89712	82762
2001	44772	11552	56345	66415
2002	53454	11221	64673	52846
2003	30809	4607	35425	51808
2004	27255	7459	34715	37330
2005	29767	11334	41096	38358
2006	22576	8989	31567	31567
2007	23643	28380	52017	52017
2008	26905	24988	51888	51888
2009	33259	21599	54863	54863
2010	36071	12373	48440	48440
2011	33793	10002	43788	43788
2012	32506	7373	39878	39878
2013	30686	10429	41107	41107
2014	34518	10590	45108	45108
2015	37945	12952	50894	50894
2016	39809	12936	52748	52748
2017	73719	16806	90513	90513
2018	42023	9073	51103	51103
2019	33713	4532	38244	38244