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Cod bycatches in the Barents Sea shrimp fishery during 1983-2005

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Abstract

This document provides estimated numbers of Northeast Arctic cod taken as bycatch in the Norewegian shrimp fishery during the period 1983-2005. Estimates raised to total international shrimp catch in the Barents Sea are also presented. The results show high estimated bycatch of cod in 1985, 1992 and 1998. The highest recorded numbers of cod in length from 5cm to 25cm was in 1985. The cod bycatch in 1989 was the lowest across the whole series. Both cod bycatches and the shrimp landing have declined during the last two years.

Materials & Methods

The IMR computer programs for by-catches estimation consists of a series of SAS routines for combining several data sources; official shrimp landing statistics, logbook from shrimp trawlers, shrimp surveys, other IMR surveys using shrimp trawl, and finally fishery surveillances data. The final output is annual estimates of the number of cod (or any bycatch species) by 1cm interval caught in the shrimp fishery.

The method is based on Hylen & Jacobsen (1987). Preliminary results of the program were presented as a WD to the 2004 AFWG meeting (Ajiad et. al., 2004), where the method is described. The general outline of the estimation procedure is as follows; Bycatch rates observed in research surveys and surveillance surveys are used as estimates of bycatch rates in the commercial fishery by taking account of the difference in selection properties of the gears used. Commercial shrimp catch by quarter and locality (the small rectangles in the Norwegian catch reporting system, figure 1) are combined with the survey observations in the same quarter and locality. The observation "cells" are thus defined as the localities with commercial catch within a quarter. For cells with missing survey observations the bycatch rates are estimated by using all the observations within the whole Main Area (figure 1). This document shows the latest and updated results of years 2003-2005 of cod by-catch after we have tried to improve our estimation of bycach with the following changes:

a) Replaced the median by mean in the extrapolation process for filling a missing cell in the input data set.
b) Excluded all observations from the data set in which shrimp catch is below 2 kg. (Figure 2 displays a reference line at 2 kg in the 2005 data).
c) Converted positions in the survey data to the Directorate of Fisheries area and locality system, in order to correct for errors in the original locality coding.
d) Specified the amount of shrimp catch not covered by survey data (quarters with missing survey data in a whole main area). The annual bycacth estimates were then scaled according to the amount of catch not covered by survey data.

e) Explored the possibilities for estimating bycatch for the total international shrimp fishery in the Barents Sea.

Results & Discussion

Cod bycatch in the Norwegian shrimp fishery:

Text table below shows the total Norwegian landing of shrimp north of 69 degrees and the covered commercial catch from main areas and quarter where there exist data for estimating by-catch, while the uncovered is the commercial catch from main area and quarters where there do not exist data for estimating by-catch. The poorest coverage was in 1991. After 1999 the coverage has been good. The ratio total/covered is used to raise the bycatch estimate in the covered catches to bycacth estimate for total catch. This procedure could be improved by looking at each individual Main Area/quarter with missing samples and decide which of the covered Main Areas that could by used.

Table 2 shows the estimated bycatch number by length groups and total bycatch wight of cod. Cod above 25 cm disappears after the introduction of the sorting grid in 1992. The estimated bycatch weight was much higher before 1992 compared to later.

Year	Total tonnes	Covered tonnes	Uncovered tonnes	tot/cov
1983	63690	43217	20473	1.474
1984	72215	63610	8606	1.135
1985	81956	67429	14527	1.215
1986	48738	47385	1353	1.029
1987	28712	20051	8661	1.432
1988	30100	20297	9803	1.483
1989	46559	34874	11685	1.335
1990	54330	44256	10074	1.228
1991	38889	19339	19550	2.011
1992	42085	41639	446	1.011
1993	33094	30823	2272	1.074
1994	20822	19547	1275	1.065
1995	18862	13068	5795	1.443
1996	21341	17648	3693	1.209
1997	31931	26737	5194	1.194
1998	49207	41199	8008	1.194
1999	54748	46583	8164	1.175
2000	57861	55178	2683	1.049
2001	46699	45872	827	1.018
2002	44442	42576	1866	1.044
2003	37851	37764	86	1.002
2004	25124	24987	137	1.005
2005	29573	27163	2409	1.089

Total cod bycatch estimation (all nations):

Table 1 shows the total shrimp landings from the Barents Sea. This is the sum of Norwegian landings north of 69 and the landings from Russia and other nations in ICES area I and II (ICES, 2006). Under the assumption that these fleets have similar selection properties to the Norwegian fleets and that they fish in the same seasons and areas, a total bycatch of cod may be estimated by raising the Norwegian bycatch to total international shrimp catch in the Barents Sea. Table 1 show the raising factors and the raised number of cod less than 26 cm.

Table1 and Fig 3 display our latest estimation of the total number of cod taken as by catch in the Norwegian shrimp fishery, Russian and others during 1983-2006. Estimated bycatch exceeded 20 millions cod in six years, with a peak during 1985 and 1998 while 1989 is the lowest value of cod bycatch in the whole series. Applying (T/n) value to our estimation led to a considerable increased in numbers of cod. The lowest raising factor was 1.14 in 2003 and the highest 1.92 in 1991.

References

Ajiad A., Aglen, A. and Nedrreaas K. 2004. Cod bycatch mortality from the Barents Sea shrimp fishery 1983-2002. WD: 24, Arctic Fisheries Working Group, Copenhagen.

Hylen, A and Jakobsen J. E. 1987. Estimation of cod taken as by-catch in the Norwegian fishery for shrimp north of 69^{o} N. ICES C.M. 1987/G:34

ICES, 2006. *Pandalus* assessment working group report, 26 October-3 November 2005, Halifax, Canada. ICES CM 2006/ACFM:10.

Table 1. Norwegian and all nations landing of shrimp and estimates of total cod by-catches (mil).

Year	Norwegian Landing N 69	Total Landing (t)	Total/ Norwegian	Bycatch(mil) Norway	Total Bycach (mil)
1983	63690	97698	1,53	9.52	14.57
1984	72215	123641	1,71	7.37	12.60
1985	81956	124322	1,52	60.80	92.41
1986	48738	65492	1,34	8.14	10.91
1987	28712	40726	1,42	6.95	9.87
1988	30100	46768	1,55	3.35	5.19
1989	46559	62243	1,34	1.12	1.50
1990	54330	81312	1,50	6.02	9.02
1991	38889	74479	1,92	11.73	22.52
1992	42085	71050	1,69	15.05	25.43
1993	33094	56297	1,70	11.31	19.23
1994	20822	28993	1,39	3.28	4.56
1995	18862	24745	1,31	4.52	5.92
1996	21341	30408	1,42	12.04	17.10
1997	31931	38588	1,21	23.71	28.69
1998	49207	60205	1,22	55.01	67.11
1999	54748	77805	1,42	9.46	13.43
2000	57861	85698	1,48	5.25	7.77
2001	46699	60710	1,30	9.90	12.87
2002	44442	56349	1,27	1.94	2.46
2003	37851	42967	1,14	13.18	15.03
2004	25124	32526	1,29	2.06	2.66
2005	29573			1.32	

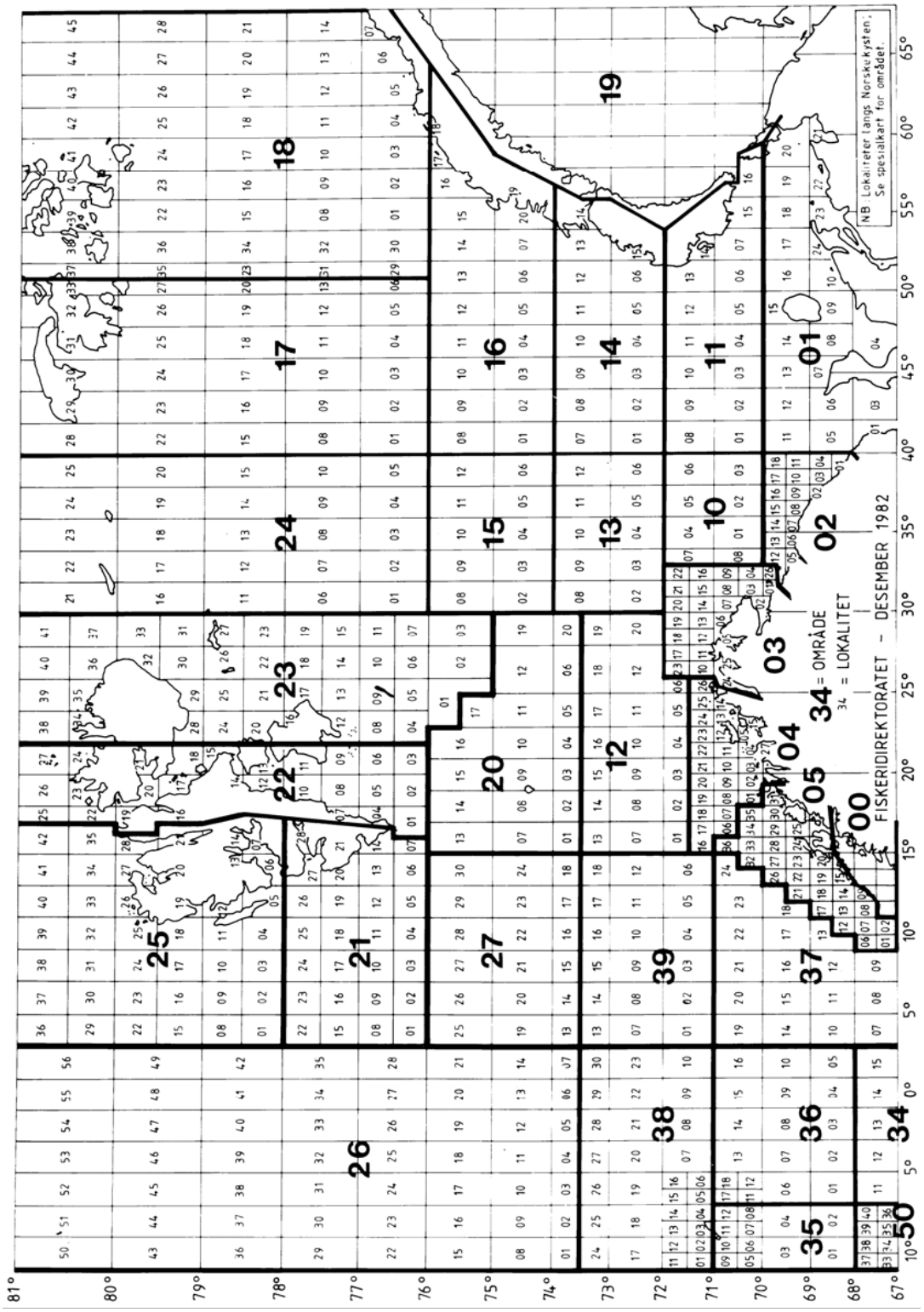

Figure 1. Main Areas (Bold lines and bold numbers) and Localities (small rectangles) in the Norwegian Directorate of Fisheries catch reporting system.

Table 2. Numbers (‘000) of NEA cod by length groups and total weight (tonnes) taken as bycatch in the Norwegian Barents sea shrimp fishery during 1983-2005.

Fish length	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
4	0	0	0	0	0	0	0	0	0	1	0	0
5	0	0	1	0	0	0	0	63	0	52	0	4
6	0	0	17	0	0	2	19	316	0	184	149	32
7	0	1	457	7	7	0	42	626	0	1066	101	187
8	863	2	744	36	6	8	111	546	4	644	134	201
9	20	2	1298	61	4	56	49	264	23	1687	934	375
10	293	45	1593	264	8	67	202	306	201	2401	1074	327
11	317	150	1260	161	15	74	2	142	438	2483	2148	278
12	598	191	1311	200	36	88	27	339	866	1762	1074	239
13	250	350	1984	235	80	76	17	421	859	1191	889	182
14	287	382	1776	178	99	92	11	405	903	886	472	148
15	709	460	3193	291	398	94	10	523	597	416	534	182
16	674	493	3476	453	619	54	66	184	707	403	335	265
17	1008	617	3670	441	451	39	95	253	1059	456	308	201
18	1196	596	4548	414	448	110	49	224	636	451	289	214
19	974	699	4044	437	195	188	36	294	689	333	338	158
20	673	754	3960	544	432	251	80	302	1163	248	555	99
21	555	598	4421	635	416	365	44	312	1067	140	450	54
22	384	577	3535	679	466	444	34	234	600	81	469	29
23	376	659	4163	910	935	610	48	152	641	106	504	34
24	88	479	6667	979	923	260	96	72	576	30	252	50
25	259	314	8678	1215	1415	468	82	38	698	28	307	24
>25	3589	4621	53581	9327	9627	9307	6014	2264	1547	0	0	0
Total	13112	11991	114376	17469	16577	12653	7135	8280	13276	15050	11314	3281
Tonnes	5335	4036	49261	8375	7607	10164	11592	5382	2197	287	405	92

Table 2 continued

Fish length	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
4	0	7	0	0	0	0	0	0	0	0	0
5	0	33	0	0	0	0	0	0	0	0	0
6	29	25	0	0	0	1	4	0	295	0	0
7	69	209	58	42	54	1	25	21	2697	598	0
8	26	225	209	404	24	4	129	61	1088	105	1
9	194	84	412	4224	115	21	346	182	117	31	5
10	531	62	651	11713	436	116	398	180	214	155	52
11	760	478	5711	13854	292	108	757	115	741	229	130
12	855	1238	4730	7008	332	222	1156	121	1523	234	198
13	709	2084	4443	5908	1243	1423	1302	108	2006	175	265
14	625	2374	2864	3906	1165	892	1289	168	1946	123	194
15	313	1687	2202	1827	1779	820	1117	146	1260	84	177
16	173	1162	982	1574	1372	741	889	139	647	67	139
17	94	934	460	1740	1148	249	851	180	333	62	82
18	88	690	190	915	634	219	672	176	131	68	39
19	19	450	247	1345	408	172	360	126	81	56	20
20	22	263	318	423	258	125	329	105	32	42	9
21	11	24	173	93	152	82	181	65	20	20	4
22	3	10	61	28	48	41	43	22	35	7	0
23	0	4	0	1	0	8	50	13	7	1	0
24	0	4	0	0	0	7	0	5	3	1	0
25	0	0	0	0	0	1	0	3	3	1	0
>25	0	0	0	0	0	0	0	0	0	0	0
Total	4521	12045	23711	55005	9461	5252	9898	1936	13180	2061	1317
Tonnes	86	343	497	980	309	159	294	63	233	37	33

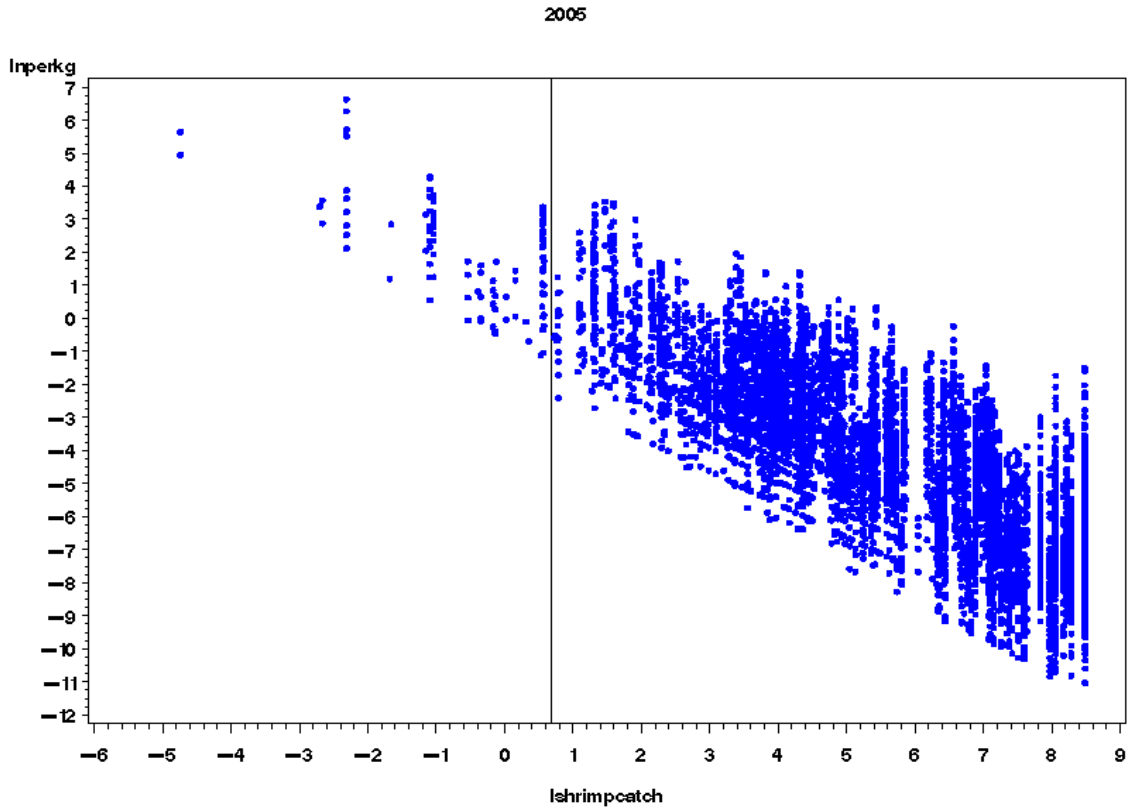

Fig 2. log of numbers of cod per kg of shrimp against log shrimp catch in kg and the reference line for 2 kg shrimp in the 2005 data.

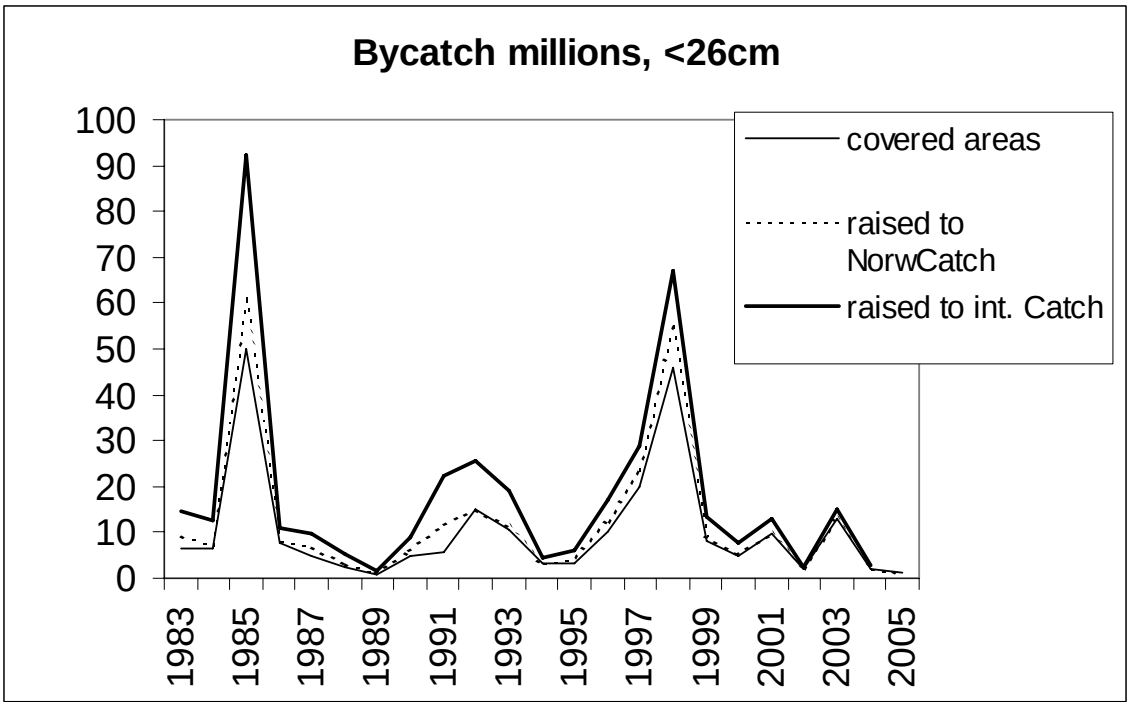

Figure 3. Esimated bycatch of cod <26 cm (millions) in the Norwegian shrimp catches covered by survey data, raised to total Norwegian catch north of 69, and raised to total international shrimp catch in the Barents Sea.