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The *Pandalus* Stock in Skagerrak and the Norwegian Deep (Divisions IIIa and IVa East)

by

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Abstract

This paper presents the Danish and Swedish fisheries data used in the Annual assessment of the stock in Skagerrak and Norwegian Deep. Long term fluctuations/trends in landings are described. Trends in national LPUE are presented. Increasing gear efficiency has been taken into account in analyses of Danish LPUE. Quantification of Swedish discards due to high grading indicates the significance of this in catches. Age compositions of the annual landings since 1984 are presented.

1.1 The *Pandalus* fisheries in the North Sea and Skagerrak

In the North Sea and Skagerrak three geographically separated aggregations of the northern shrimp (*Pandalus borealis)* are recognised and assessed as three separate stocks (ICES 2006): 1) the Norwegian Deep-Skagerrak stock which is confined to ICES Div. IVa east and IIIa, 2) the Fladen Ground stock in ICES Div. IVa west, and 3) the Farn Deep stock in ICES Div. IVb west (Fig. 1). Vessels from Denmark, Sweden, UK and Norway exploit these resources. The Fladen ground stock has been exploited by Danish and UK (Scottish) vessels. In recent years only the stock in the Norwegian Deep and Skagerrak has been exploited.

1.1.1 The Danish *Pandalus* fishery.

Historically, the Danish *Pandalus* fishery has targeted both the shrimp stock in the Div. IVa east and Div. IIIa and the stock on Fladen Ground. In the period 1994 to 1999 the fisheries in the two areas were of about the same size, but since 2000 the Fladen fishery has declined and this fishery came to a stop during 2004. Virtually no shrimp landings have been recorded from Fladen since 2004, see further in Sect. 3. At present, all Danish shrimp landings come from IVa east and IIIa. During recent years an increasing amount of Danish shrimp catches have been landed in Swedish west coast fishing ports. Minor amounts have also been landed in Norwegian ports. In 2006 appr. 28% of total Danish shrimp landings were landed in Swedish ports. Of these around 40% were landed processed (boiled). Boiled shrimps fetch better prices and in recent years an increasing number of Danish fishers have begun to boil the shrimp onboard before landing them in Sweden thus obtaining a better price. The majority of the Danish catches are, however, still landed in Danish fishing ports unprocessed. Most of these shrimp are landed directly to a few large factories processing almost all sizes of shrimp.

New analyses for the period 1987 to 2006 of the Danish log book data on catch and corresponding effort, vessel size from the vessel register and economical data of landings on single trip basis have been made. Results show that the

number of vessels participating in the *Pandalus* Fishery has decreased from 191 vessel in 1987 to only 24 vessels in 2006. It is mainly the smaller vessels which have left the *Pandalus* fishery, and the average vessel length has increased from 20 to 26 m in the period and average horsepower from 415 to 670. More detailed trends in the development of the Danish *Pandalus* fleet are shown in Fig. 2.

Gear development and its influence on effort.

The technological improvements of the fishing gear ('technological creep') and its implication for the effective effort is further described in SCR Doc. 07/84.

1.1.2 The Norwegian *Pandalus* fishery (SCR Doc. 07/82)

1.1.3 The Swedish *Pandalus* fishery

In 2006, a total of about 70 trawlers reported landings of *Pandalus* in the Swedish log books. Of these app. 50 landed more than 10 t *Pandalus* and can be considered specialised in this fishery.

The size of the vessels ranges between 8-34 m with an average of 20 m. GRT varies from 3 to 222, with an average of 96 GRT. The average engine effect is around 367kW (44 kW-736 kW). The larger trawlers are normally fishing in the eastern and central part of Skagerrak. The smaller trawlers are mostly fishing in the Swedish coastal zone inside a 'trawling border' where special regulations apply for the use of trawls: Trawling is in these areas restricted to waters deeper than 60 m and there are special limits in the length of ground rope and in the size of the trawl and trawl doors. Furthermore, the trawls to be used inside this border must be equipped with a species selective Nordmøre grid of 19 mm bar space and an unblocked fish opening in the trawl roof. This has resulted in very clean landings from these trawls (99% *Pandalus*). The Nordmøre grid may also be used outside the trawling border as an alternative to the EU legislated 70 mm square mesh panel in shrimp trawls.

This particular *Pandalus* trawl with grid can be distinguished from other shrimp trawls in the log books since 1997. The effort of this gear has shown an increasing trend and, in 2006, constituted 28% (18 khrs) of total Swedish *Pandalus* effort (65 khrs). In Sweden the use of twin trawls in the *Pandalus* fishery is not yet common. In 2006, for instance, twin trawls accounted for only 2% of the Swedish *Pandalus* landings. Swedish *Pandalus* landings (1990-2006) by trawl gear are given in Fig. 3.

There are two different Swedish markets for *Pandalus*, resulting in two different kinds of landings: a) higher value, larger sized shrimp sorted by a 10.5 mm sieve and boiled onboard before landed, and b) lower value smaller sized shrimp, sorted by 8.5 mm sieve, landed fresh and sold to the industry for further processing. Since the shrimp lose weight when boiled, these landings must be raised by a factor of 1.13 to obtain fresh weight for the landings statistics, see Sect. 1.2.1. Landings consist of app. equal proportions of boiled and fresh shrimp.

The TACs are limiting the Swedish *Pandalus* fishery and in order to distribute landings over the year the fishers have voluntarily introduced rations per fisher per week. This has resulted in high-grading of the catch, i.e. discarding less valuable smaller *Pandalus* to increase the proportion of the more valuable boiled shrimp in the individual landings ration. The discard due to high grading of small *Pandalus* was in 2006 estimated to around 1200 t based on comparison of the length compositions in the Swedish and Danish landings (c.f. Table 2).

1.2 Landings, catch and effort data (IVa East and IIIa)

1.2.1 Landings

Landings, as officially reported to ICES, are shown in Table 1 by area (Division IIIa and Sub-area IV). In Skagerrak the landings for 2006 increased with app. 15% compared to 2005 and are now at the highest level since 1998. Landings increased in all three countries. In Sub-area IV, in recent years only from the Norwegian Deep, total landings decreased with 38% compared to 2005. Since 2004 there have been virtually no catches from the Fladen Ground. Table 2 presents the landings and estimated Swedish high-grading for the assessment unit 'Skagerrak and

the Norwegian Deep, i.e. Div. IIIa and the eastern part of Div. IVa. The landings in 2006 were around 14168 t, similar to landings in 2005.

Landings from Norway and Sweden (and to a lesser extent from Denmark, see Sect. 1.1.1) consist of a fraction of larger shrimp that are boiled on board and a remaining portion of smaller shrimp landed fresh. Official landings and log book data from Norway and Sweden give landed weight as a mixture of raw and boiled shrimp, but these can be separated in Swedish sale slip data. The Swedish landings figures (Table 2) have been adjusted with the conversion factor of 1.13 to obtain fresh weight for the years where sufficient information is available. The amount added for the last eight years has ranged between 100 and 200 t. The Working Group has now corrected the Norwegian landings in recent years considering the proportion of raw and boiled shrimp landed. The Danish landings figures have not yet been corrected corresponding to boiled shrimps landed in Swedish ports.

Discards

Discard of shrimp may take place in two ways: 1) as discard of small (<15 mm CL), not marketable shrimp since the processing plants do not accept them, and 2) as a result of high-grading, i.e. discard of medium sized, less valuable shrimp to improve the economic return of quotas.

In Sweden, quota restrictions and the substantial price difference between large, boiled shrimp and medium sized fresh ones together with a voluntary system of weekly rations (different for medium and large shrimp) have resulted in high grading at sea by discarding the medium sized ones (only 14% of kg price for boiled shrimp).

The amount of discards in this category in the Swedish fisheries was estimated to around 1200 t in 2006 based on comparison of length distributions in Swedish and Danish landings. The estimation is shown in Figs. 4a and 4b. The annual Danish length distribution is scaled to fit the yearly Swedish length distribution (Fig. 4a) for the larger *Pandalus* sizes based on the assumption that there is no discarding of the most valuable larger size groups (right hand side of the curve, ≥21 mm CL), and that the Swedish and Danish fisheries are conducted on the same *Pandalus* grounds. The higher numbers in the Danish smaller size groups, compared to the Swedish numbers, are then multiplied with the mean weight of each size group, and the sum is considered as the weight of the Swedish discarding due to high grading (Fig. 4b). Estimations based on such Swedish high grading are shown for the last six years in Table 2.

A Swedish at-sea discard sampling project has been carried out for a few *Pandalus* trips during 2004 and 2005 and shows even higher estimates of total discards (> 2500 t) but these are considered to be based on too few samples to be included in assessments.

The difference between the Swedish trend in LPUE in recent years compared to the Danish and Norwegian trends (Fig. 5) might be explained by the Swedish high grading, which does not occur in the Danish and Norwegian fisheries. In figure 5, also the Swedish LPUE (adjusted to the estimated high grading) is shown for the last six years.

1.2.2 Effort and LPUE

Annual national figures for effort and landings per unit of effort (LPUE) are shown in Table 3 and Fig. 5. The Danish and Norwegian LPUE have shown an increasing trend from 2001 to 2004, but decreased in 2005. The Swedish LPUE remained at the same level from 2002 to 2004, possibly due to the discarding practices described above, but similar to the other two LPUE indices also shows a slight decrease in 2005. In 2006 all indices show an increase.

The effect of technological creeping in the Danish *Pandalus* fishery on Danish effort and LPUE figures has been taken into account in the standardised LPUE indices (SCR Doc. 07/84) (Fig. 5). The Swedish shrimp trawls are still mainly single trawls. The quantitative information in log books on the development of the Norwegian trawl gear in Divs. IIIa and IVa east is incomplete. In order to include gear type (single and twin trawl) as a variable in the standardisation of the Norwegian LPUE, the incorrect recordings of gear type in the log books were corrected based

on interviews with ship owners (SCR Doc. 07/82). The Norwegian LPUE indices have thus been standardised according to area, month and vessel for the years 2000-2006.

As Norwegian vessels <11 m are not required to deliver log books, the Norwegian logbook data cover only around 20-30% of total landings. Thus, total Norwegian effort has been estimated from total official landings and LPUE data from log book records. In order to obtain the same effort unit for all three countries, i.e. 'fishing hours', the Danish unit 'fishing days' was converted to 'hours' on basis of functional regressions between Danish-Norwegian and Danish-Swedish LPUE. These two regression coefficients were averaged to get Danish kg/hr as well as the total Danish effort in hours (unit=1000 hours), see Table 3. The time series of standardised total international effort (harvest rate (HR)) and standardised Danish LPUE (Kg/hr) are shown in Fig. 6.

1.3 Biological sampling of landings

1.3.1 Sampling frequency, intensity

Information on the size and subsequently age distribution of the landings are obtained by sampling the landings. The biological samples also provide information on sex distribution and maturity.

National sampling effort is presented in Table 4. The overall sampling level 2006 was around 12 kg per 1000 t landed or 2200 specimens.

1.3.2 Landings in numbers at age

The length data have been pooled by quarter, and these national quarterly length distributions have then been partitioned into age compositions by the Bhattacharya method (software: FISAT). Due to lack of Norwegian length data for 2003 and 2004, the Norwegian total landings for those years were age distributed according to the combined Danish and Swedish age data.

Table 5 gives the "catch-at-age" data. Catches are dominated by shrimp of ages 1 and 2. Separation of age group 3 from older groups is often uncertain due to lack of distinct modes in the length distributions. For this *Pandalus* stock the number of distinguishable size groups rarely exceeds 4, and the WG doubts the reliability of separation of the age groups older than age 3.

1.3.3 Mean weights at age

Weights-at-age for the Danish and Swedish catches were derived from the length samples of the catches, where the weights of the measured shrimp in each sample are recorded by length group. The corresponding Norwegian weights-at-age figures for 2006 are based on the quarterly Swedish length samples. The mean weights-at-age in the catch are given in Table 6. In some years there were no recorded 0-group shrimp in the catches, then averages for the other years were used..

1.4 Trawl survey data (SCR Doc. 07/83)

1.5 Assessment of the *Pandalus* stock in Divisons IIIa and IVa East.

1.5.1 State of Stock in 2007 and 2008

This year's assessment of the current state of stock is based on evaluation of Danish standardised LPUE from the fishery 1987-2006 and can be found in the 2007 NIPAG report.

1.5.2 Biological Reference Points

The view of the NIPAG is that, the data on the stock-recruitment relationship, from previous assessments, did not support establishment of a SSB reference value for this *Pandalus* stock based on this relationship (ICES, 2003). In

1998 ICES (ACFM, 1998) pointed out that there was not basis for establishment of a B_{lim} on basis of the available S-R data. Considering the major impact from predation, such a poor relationship is likely.

According to previous assessments, predation accounts for at least twice as much removal from the *Pandalus* stock compared to fishery removals from1985-2002. Such dynamics also render it problematic to establish a reference value for F (or Y/B), at least if the relative magnitudes of *F* and *M* (predation) are independent of stock size.

Following the current NAFO definition (SCS Doc. 04/12), 30% B_{msy} could be used as a limit reference point (B_{lim}).

2 The by-catch in the *Pandalus* fisheries in the Subarea IV and Division IIIa

In recent years there has been increasing focus on (mixed) fisheries with by-catches of species from stocks subject to recovery plans or under special surveillance. The fisheries for *Pandalus* in the North Sea area cannot be classified as mixed fisheries as for instance some of the fisheries for *Nephrops*. The current by-catch regulations in force for the gears used in the fisheries for *Pandalus* restrict the amounts of by-catch. Nevertheless several valuable fish species, e.g. cod, witch flounder and anglerfish, are landed as by-catch. The WGPAND has since the 1980s regularly compiled and presented relevant information on by-catch in the WG reports.

Tables 7 A - F give for the recent 3 years the available Danish, Norwegian and Swedish data on by-catch of the main species in the *Pandalus* fisheries landed for h.c. In some years quantities of Norway pout and Blue whiting have also been recorded. For Denmark and Sweden the data are from log book records, and are only recorded landings, i.e. not the discarded by-catch. Both the Danish and Swedish log book records cover nearly all the recorded *Pandalus* landings. The Norwegian data come from the landings statistics.

Tables 7 A - F also give cod percentage of *Pandalus* landings. It is believed that this is a better estimator than % of total catch, since log-book recordings probably not always are consistent in recordings of e.g. Norway pout and/or Blue whiting. Note that for Skagerrak the percentages of landed total h.c. by-catch are similar for all 3 countries (excluding trawls with selective grids). Rough estimates give magnitudes of around 500 t of cod landed annually from the *Pandalus* fisheries in this area. Notice that trawls equipped with a selective grid, judging from the logbook records of landings by this gear type, seem to be very efficient in reducing by-catch (Table 7 C).

3 A short note on the *Pandalus* Stocks on Fladen Ground (Division IVa) and Farn Deep (Division IVb)

3.1 The development in the fishery for *Pandalus* on Fladen Ground.

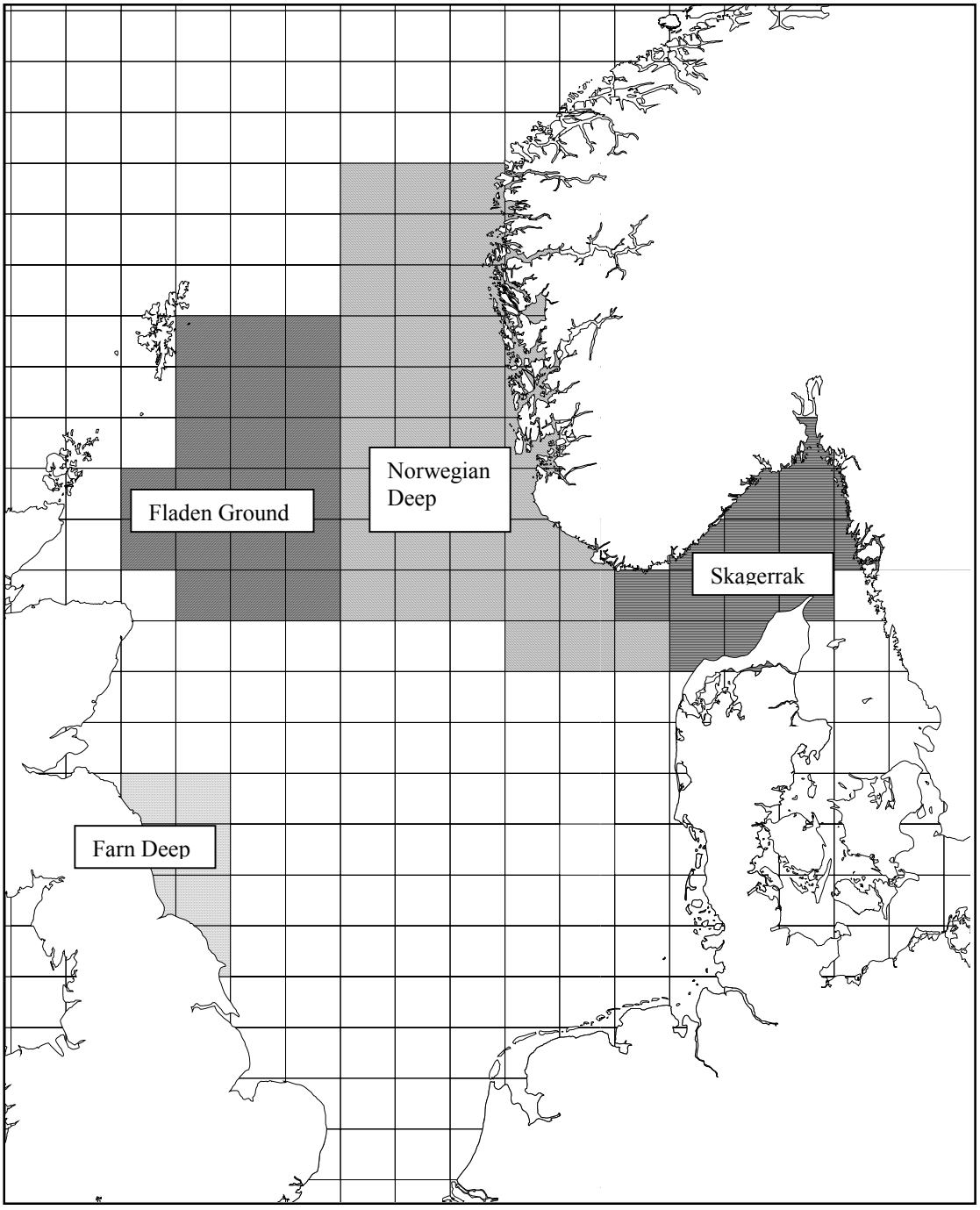
This stock was not included in the terms of reference received by the working group from ICES. However, a short description of the fishery is given, as a shrimp fishery may be conducted in this area in the future. The landings from the Fladen Ground are recorded since 1972. Since 1991 total landings have fluctuated between none in 2006 to more than 5000 t (Table 8). The Danish fleet has accounted for the majority of landings while the Scottish fleet stands for a minor part. The fishery has taken place mainly during the first half of the year, with the highest activity in the second quarter. Table 9 shows the effort and LPUE.

Since 1999 total Fladen landings have declined continuously, and since 2004 the Fladen Ground fishery was practically non-existing with total recorded landings of less than 25 t. Interview information from the fishing industry obtained in 2004 gives the explanation that this decline is caused by low shrimp abundance, low prices on small shrimp characteristic for the Fladen Ground and high fuel prices. This stock has not been surveyed for several years, and the decline in this fishery may reflect a decline in the stock.

3.2 The *Pandalus* Stock in the Farn Deep (Division IVb)

The WG has not provided advice on this small stock because no catches have been recorded since 1998. Since 1991, only UK vessels have fished *Pandalus* in the Farn Deeps. Total landings fell from 500 t in 1988 to none in 1993. In 1995 and 1996 again about 100 t were reported. In the past 10 years the *Pandalus* fishery in Farn Deeps has been negligible (ICES, 2005).

Fig.1. The distribution of the *Pandalus* stocks in the North Sea area as defined by the ICES squares.



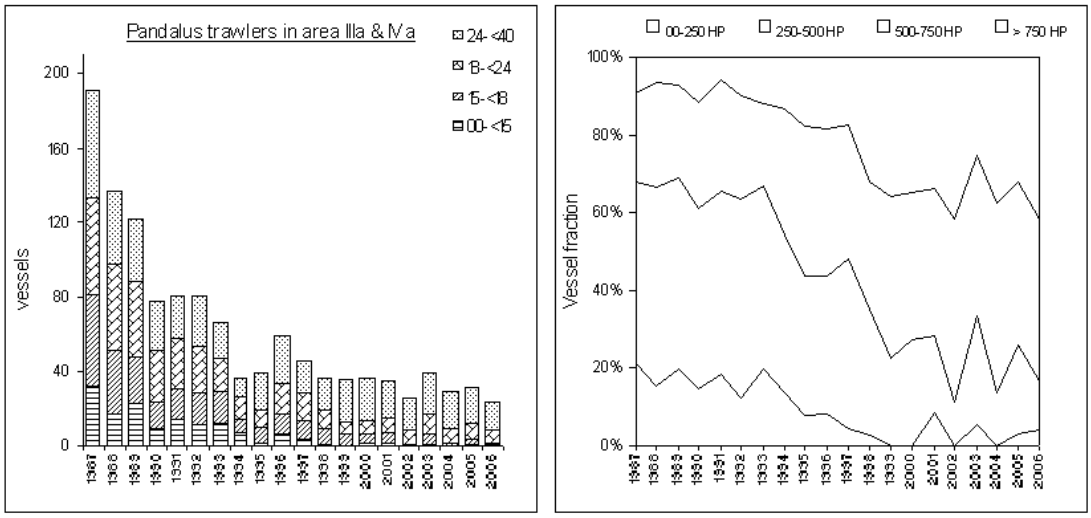


Figure 2. Trend in numbers (left) and engine power (right) by size groups of Danish Pandalus trawlers from 1987 to 2006.

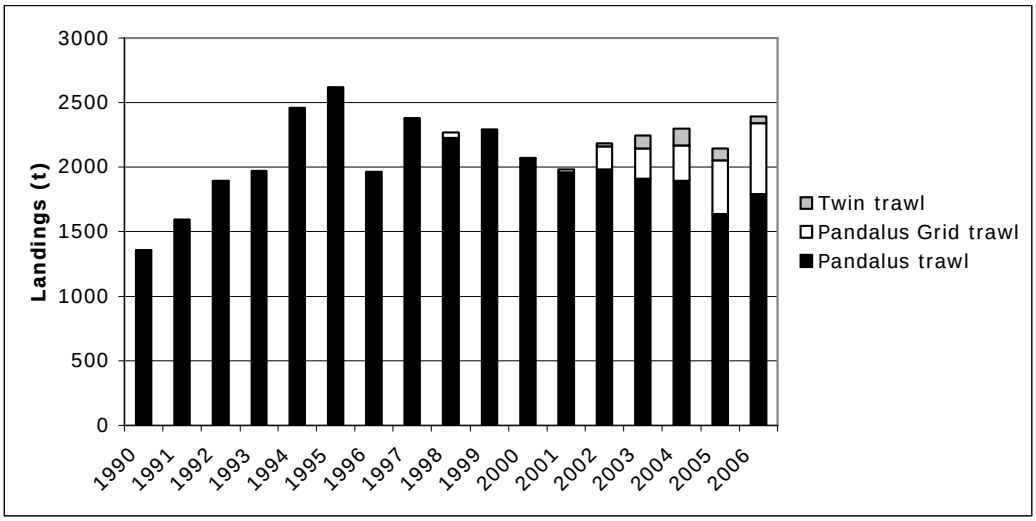


Figure 3. Swedish *Pandalus* logbook landings per trawl type 1990-2005.

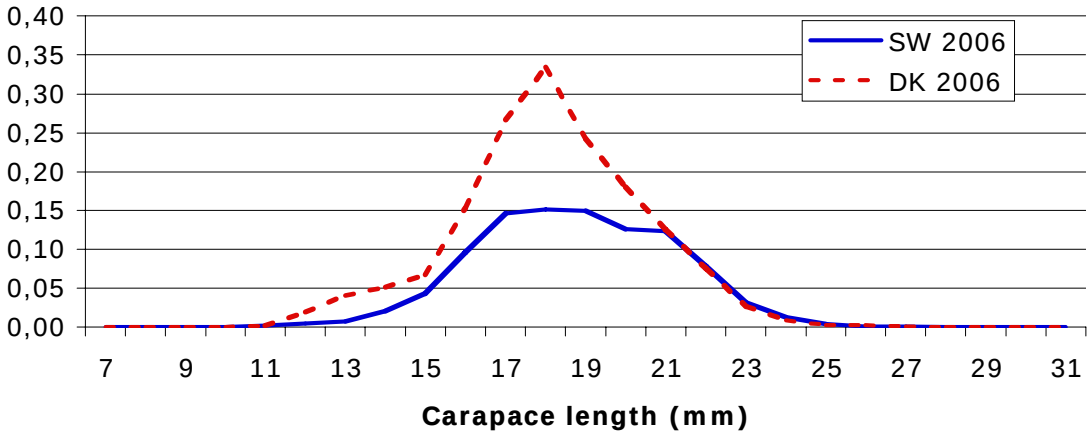


Figure 4a. Swedish length frequency distribution for 2006 and corresponding Danish length frequency distribution (dotted line) adjusted to Swedish CL > 21 mm.

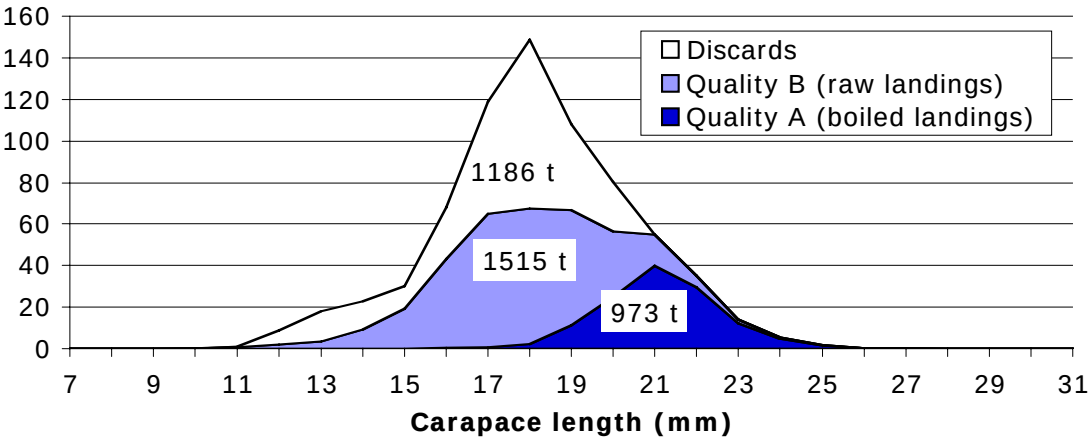


Figure 4b. Size distribution of Swedish landings, separated into boiled and raw shrimps, and estimated discards due to high-grading.

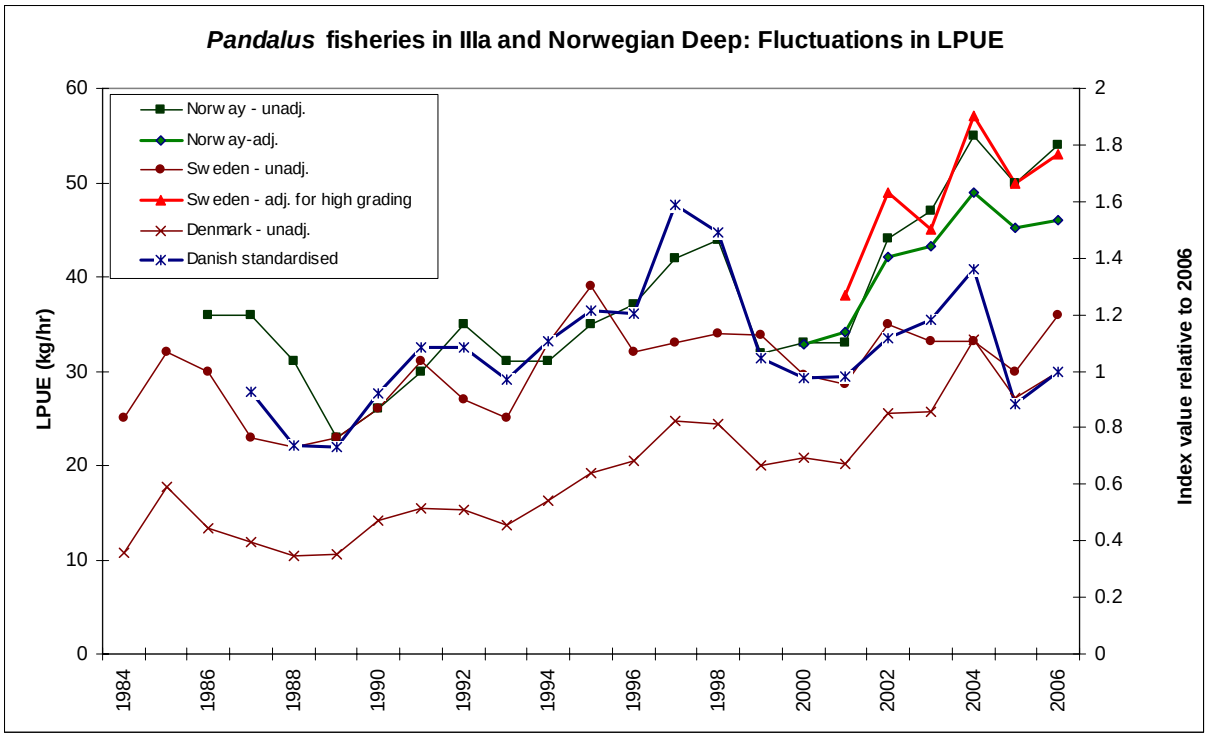


Figure 5. Comparison of Danish, Norwegian and Swedish trends in LPUEs, see text.

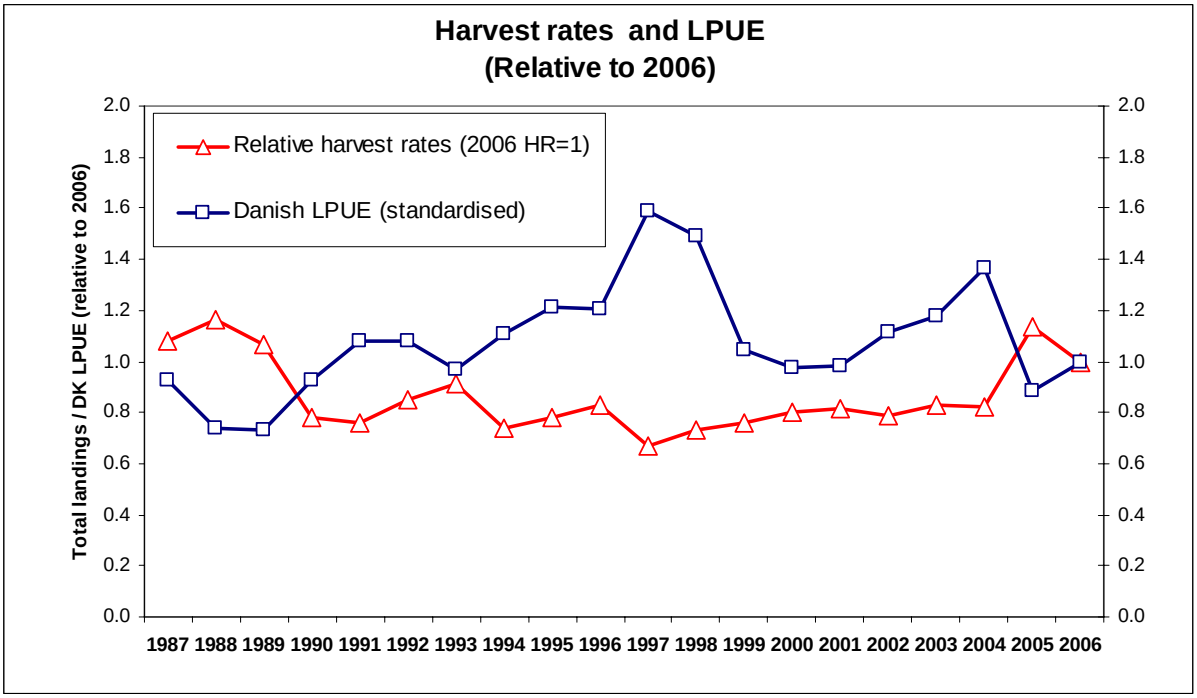


Figure 6. Standardised Danish LPUE (indices) and estimated total effort (HR) for 1987 to 2006.

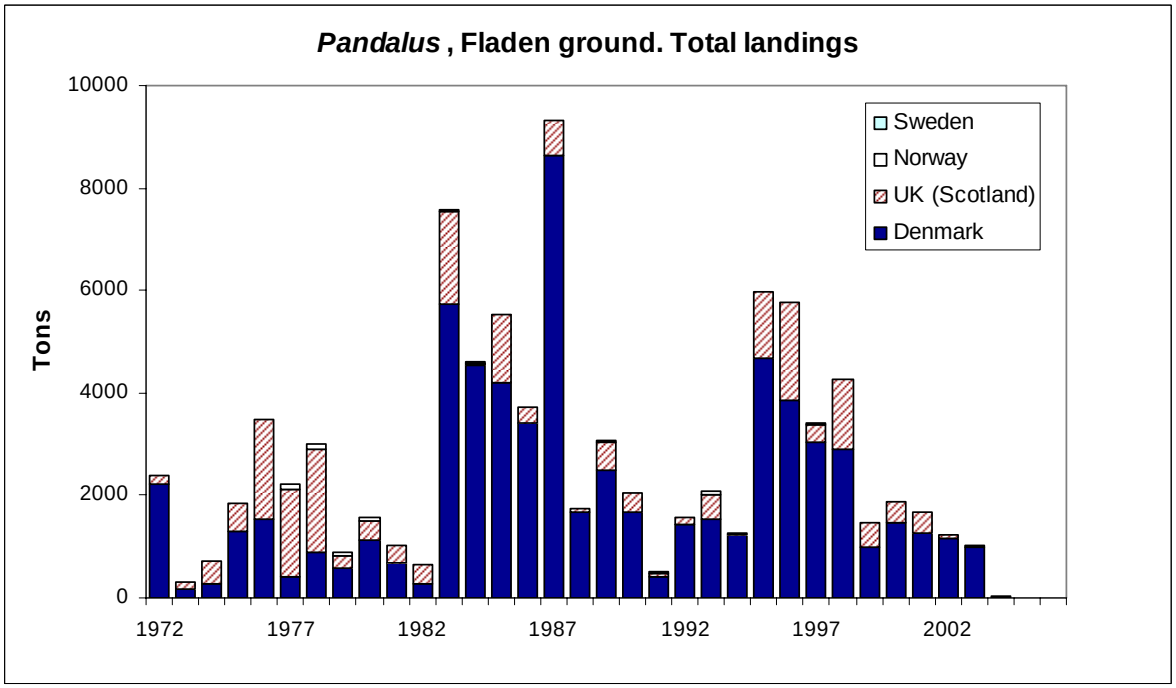


Fig. 7. Total shrimp landings from the Fladen Ground., 1972 – 2006.

Table 1 Nominal landings (tonnes) of *Pandalus borealis* in ICES Division IIIa and subarea IV as officially reported to ICES.

	Division IIIa				Sub-area IV					
Year	Denmark	Norway	Sweden †	Total	Denmark	Norway	Sweden	UK (Engl.)*	UK (Scotl.)*	Total
1970	757	982	2740	4479	3460	1107		14	100	4681
1971	834	1392	2906	5132	3572	1265			438	5275
1972	773	1123	2524	4420	2448	1216		692	187	4543
1973	716	1415	2130	4261	196	931		1021	163	2311
1974	475	1186	2003	3664	337	767		50	432	1586
1975	743	1463	1740	3946	1392	604	261		525	2782
1976	865	2541	2212	5618	1861	1051	136	186	2006	5240
1977	763	2167	1895	4825	782	960	124	265	1723	3854
1978	757	1841	1529	4127	1592	692	78	98	2044	4504
1979	973	2489	1752	5214	962	594	34	238	309	2137
1980	1679	3498	2121	7298	1273	1140	38	203	406	3060
1981	2593	3753	2210	8556	719	1435	31	1	341	2527
1982	2985	3877	1421	8283	1069	1545	92		354	3060
1983	1571	3722	988	6281	5724	1657	112	65	1836	9394
1984	1717	3509	933	6159	4638	1274	120	277	25	6334
1985	4105	4772	1474	10351	4582	1785	128	415	1347	8257
1986	4102	4811	1357	10270	4288	1681	157	458	358	6942
1987	3466	5198	1085	9749	9642	3145	252	526	774	14339
1988	2246	3047	1075	6368	2656	4614	220	489	109	8107
1989	2527	3156	1304	6987	3298	3418	122	364	579	7802
1990	2277	3006	1471	6754	2080	3146	137	305	365	6084
1991	3258	3441	1747	8446	747	2715	161	130	54	3807
1992	3293	4257	2057	9607	1880	2945	147	69	116	5157
1993	2451	4089	2133	8673	1985	3449	167	29	516	6146
1994	2001	4388	2553	8942	1362	2426	176	41	35	4040
1995	2421	5181	2512	10114	4698	2879	166	217	1324	9284
1996	3664	5143	1985	10792	4063	2772	82	97	1899	8913
1997	3617	5460	2281	11358	3314	3112	316	52	365	7159
1998	2933	6519	2086	11538	3297	3092	187	55	1364	7995
1999	1398	3987	2114	7499	1679	2761	182	46	479	5147
2000	1898	3556	1890	7344	1956	2562	184	0	378	5080
2001	1186	2959	1958	6103	2030	3955	154	0	465	6604
2002	1967	3709	2044	7720	1647	3622	143	0	70	5482
2003	2612	3736	2098	8446	1631	3994	144	0	0	5769
2004	3044	4638	2152	9834	884	4364	147	0	0	5391
2005	2485	4419	1996	8900	477	4087	148	0	0	4712
2006	2837	5177	2235	10249	224	3037	141	0	0	3402

* Includes small amounts of other Pandalid shrimp

† 1970 to 1974 includes subarea IV.

Total for 1988 - 1990 includes 19, 21 and 51 t. by the Netherlands

2006 figures are preliminary.

Table 2.

Pandalus borealis landings from divisions IIIa (Skagerrak) and IVa (eastern part) as estimated by the Working Group.*)

Year	Denmark	Norway	Sweden	Total land.	Estimated discards	Agreed TAC	Est. catch
1970	1102	1729	2742	5573			
1971	1190	2486	2906	6582			
1972	1017	2477	2524	6018			
1973	755	2333	2130	5218			
1974	530	1809	2003	4342			
1975	817	2339	2003	5159			
1976	1204	3348	2529	7081			
1977	1120	3004	2019	6143			
1978	1459	2440	1609	5508			
1979	1062	3040	1787	5889			
1980	1678	4562	2159	8399			
1981	2593	5183	2241	10017			
1982	3766	5042	1450	10258			
1983	1567	5361	1136	8064			
1984	1800	4783	1022	7605			
1985	4498	6646	1571	12715			
1986	4866	6490	1463	12819			
1987	4488	8343	1322	14153			
1988	3240	7661	1278	12179			
1989	3242	6411	1433	11086			
1990	2479	6108	1608	10195			
1991	3583	6119	1908	11610			
1992	3725	7136	2154	13015		15000	
1993	2915	7371	2300	12586		15000	
1994	2134	6813	2601	11548		18000	
1995	2460	8095	2882	13437		16000	
1996	3868	7878	2371	14117		15000	
1997	3909	8565	2597	15071		15000	
1998	3330	9606	2469	15406		18800	
1999	2072	6739	2445	11256		18800	
2000	2371	6444	2225	11040		13000	
2001	1953	7266	2108	11327	375	14500	11702
2002	2466	7703	2301	12470	908	14500	13378
2003	3244	8178	2389	13811	868	14500	14679
2004	3905	9544	2464	15913	1797	15690	17710
2005	2952	8959	2257	14168	1483	15600	15651
2006	3061	8613	2488	14162	1186	16200	15348

*) Swedish landings have been corrected for loss in weight due to boiling.

Table 3 National LPUE and total effort. *Pandalus* division IIIa and IVa east.

	Denmark		Denmark		Norway		Sweden	
Year	LPUE stand. kg/day	effort days	LPUE kg/hr	effort Khrs	LPUE kg/hr	effort Khrs	LPUE kg/hr	effort Khrs
1987	1163	9706	13	350	36	230	23	57
1988	925	10171	9	367	31	251	22	57
1989	921	10011	9	361	23	273	23	63
1990	1159	4540	15	164	26	232	26	58
1991	1359	5129	19	185	30	206	31	61
1992	1358	5367	19	194	35	204	27	80
1993	1217	5261	15	190	31	243	25	91
1994	1390	2845	21	103	31	218	33	82
1995	1522	2531	27	91	35	255	39	76
1996	1512	3731	29	135	37	214	32	74
1997	1994	2379	46	86	42	212	33	78
1998	1872	2181	42	79	44	219	34	73
1999	1310	2383	24	86	32	219	34	72
2000	1224	2793	24	101	33	195	30	75
2001	1231	2369	23	85	33	206	29	74
2002	1403	2062	33	74	44	168	35	65
2003	1479	2564	35	93	47	163	33	72
2004	1710	2057	53	74	55	164	33	74
2005	1108	2944	28	106	50	171	31	68
2006	1255	2440	35	88	54	154	36	65

Table 4 Sampling of Pandalus in IVaE and IIIa 2006

Denmark Quarter	Landings (tons)	samples	Weight (kg)	Numbers measured-sexed
1	942	6	6.4	1577
2	751	6	7.2	1774
3	683	3	1.6	391
4	686	6	7.1	1647
Total	3061	21	22.3	5389

Norway Quarter	Landings (tons)	samples	Weight (kg)	Numbers measured-sexed
1	2132	9	20.4	2864
2	2161	12	18.2	3182
3	2245	13	14.2	3062
4	1677	12	17.6	3911
Total	8214	46	70.0	13019

Sweden Quarter	Landings (tons)	samples	Weight (kg)	Numbers measured-sexed
1	621	7	22	3458
2	695	7	24	3878
3	539	3	10	1596
4	633	6	21	3232
Total	2488	23	76.6	12164

Total					Sampling per 1000 ton landed	
Quarter	Landings (tons)	samples	Weight (kg)	Numbers measured-sexed	Weight	Numbers
1	3695	22	48.6	7899	13.1	2137.7
2	3607	25	49.3	8834	13.7	2449.2
3	3467	19	26.1	5049	7.5	1456.5
4	2996	24	45.3	8790	15.1	2934.4
Total	13763	90.0	168.9	30572	12.3	2221.3

Table 5. Catch in numbers at age. *Pandalus* in division IIIa and IVa east.

Numbers*10**-6											
YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGE											
0	17.7	7.4	2.7	14.1	31.3	0.0	3.9	25.5	27.2	0.7	2.7
1	1200.8	1146.4	1260.5	1086.6	2083.6	2250.1	1231.8	1071.4	1889.6	671.9	646.0
2	1305.4	1029.7	1205.6	923.9	385.5	910.8	1035.8	1289.2	803.8	1380.4	970.5
3	187.9	482.7	390.2	300.2	173.8	121.1	326.7	569.1	262.7	143.0	851.5
+gp	52.3	25.1	203.2	146.7	13.6	31.3	25.6	57.5	15.5	30.5	42.0
TOTALNUM	2764.1	2691.3	3062.1	2471.5	2687.9	3313.3	2623.8	3012.7	2998.7	2226.4	2512.5
TONSLAND	**13273**	**13233**	**14876**	**12929**	**12193**	**11421**	**12107**	**13556**	**13475**	**11761**	**13713**

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE											
0	61.1	19.7	12.7	4.6	88.1	0.1	3.9	2.4	5.7	13.6	4.8
1	1211.6	2175.6	903.4	1436.1	1270.7	904.7	922.3	668.7	1062.9	795.0	1018.0
2	991.4	1181.9	1597.9	720.1	836.3	824.5	858.4	1466.5	1251.4	1148.7	1146.9
3	454.6	295.6	468.1	318.3	199.3	390.0	581.8	283.8	477.6	416.3	381.9
+gp	69.5	29.8	48.2	43.3	39.2	68.3	101.8	0.0	50.4	0.0	28.5
TOTALNUM	2788.2	3702.6	3030.2	2522.4	2433.5	2187.6	2468.3	2421.4	2847.9	2373.7	2580.0
TONSLAND	**14436**	**16110**	**15753**	**11895**	**11401**	**11657**	**12339**	**13338**	**15815**	**13715**	**13763**

Table 6. Mean weight at age in catches. *Pandalus* in division IIIa and IVa east.

Catch weights at age (kg)											
YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGE											
0	0.0009	0.0012	0.0009	0.0009	0.0011	0.0009	0.0015	0.0010	0.0009	0.0009	0.0009
1	0.0032	0.0032	0.0024	0.0030	0.0034	0.0030	0.0033	0.0035	0.0035	0.0034	0.0033
2	0.0064	0.0054	0.0048	0.0054	0.0065	0.0053	0.0053	0.0052	0.0067	0.0060	0.0057
3	0.0104	0.0083	0.0077	0.0090	0.0099	0.0083	0.0079	0.0078	0.0088	0.0093	0.0089
+gp	0.0134	0.0140	0.0114	0.0117	0.0133	0.0106	0.0122	0.0095	0.0109	0.0117	0.0116

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE											
0	0.0007	0.0009	0.0007	0.0007	0.0007	0.0006	0.0008	0.0014	0.0017	0.0014	0.0014
1	0.0037	0.0031	0.0033	0.0033	0.0032	0.0031	0.0036	0.0035	0.0037	0.0038	0.0035
2	0.0067	0.0061	0.0055	0.0063	0.0063	0.0056	0.0054	0.0060	0.0061	0.0059	0.0061
3	0.0094	0.0094	0.0087	0.0088	0.0103	0.0085	0.0083	0.0082	0.0077	0.0092	0.0075
+gp	0.0138	0.0119	0.0133	0.0112	0.0139	0.0118	0.0113	0.0121	0.0107	0.0113	0.0123

Table 7. By-catch, 2004-2006 in the *Pandalus* fisheries in the Norwegian Deep & Skagerrak

A:
Skagerrak, Sub-div. IIIA. Danish log book records

Species:	2004 Total	2004 % of total catch	2005 Total	2005 % of total catch	2006 Total	2006 % of total catch
Blue Whiting	0.0	0.0	50.0	1.6	0.0	0.0
Norway lobster	13.9	0.4	13.4	0.4	9.4	0.3
Pandalus	3044.3	84.7	2516.8	80.8	2842.0	82.1
Angler fish	7.3	0.2	7.3	0.2	3.3	0.1
Whiting	0.2	0.0	0.2	0.0	0.2	0.0
Haddock	36.7	1.0	13.2	0.4	9.8	0.3
Hake	4.0	0.1	5.9	0.2	2.8	0.1
Ling	1.2	0.0	1.0	0.0	0.7	0.0
Saithe	263.2	7.3	278.6	8.9	428.9	12.4
Witch flounder	50.1	1.4	56.9	1.8	23.7	0.7
Norway pout	0.0	0.0	0.0	0.0	0.0	0.0
Cod	113.2	3.1	118.7	3.8	103.4	3.0
Other market fish	61.3	1.7	52.2	1.7	39.2	1.1
Cod as % of shrimp:		3.7		4.7		3.6

B:
Skagerrak, Sub-div. IIIA. Swedish log book records

Species:	2004 Total	2004 % of total catch	2005 Total	2005 % of total catch	2006 Total	2006 % of total catch
Blue Whiting	14.6	0.7	0.1	0.0	0.0	0.0
Norway lobster	5.9	0.3	7.7	0.4	6.7	0.3
Pandalus	1754.4	80.0	1478.8	81.2	1789.3	81.1
Angler fish	2.6	0.1	5.4	0.3	6.2	0.3
Whiting	2.8	0.1	3.7	0.2	4.8	0.2
Haddock	13.8	0.6	10.3	0.6	6.0	0.3
Hake	4.8	0.2	4.9	0.3	9.1	0.4
Ling	1.9	0.1	3.2	0.2	4.6	0.2
Saithe	270.5	12.3	167.4	9.2	246.1	11.2
Witch flounder	51.1	2.3	44.4	2.4	22.2	1.0
Norway pout	0.0	0.0	0.0	0.0	0.0	0.0
Cod	44.7	2.0	83.0	4.6	72.5	3.3
Other market fish	25.4	1.2	11.4	0.6	37.8	1.7
Cod as % of shrimp:		2.5		5.6		4.1

C:
Skagerrak, Sub-div. IIIA. Swedish log book records (sorting grid)

Species:	2004 Total	2004 % of total catch	2005 Total	2005 % of total catch	2006 Total	2006 % of total catch
Blue Whiting	0.0	0.0	0.0	0.0		
Norway lobster	0.9	0.3	1.4	0.3	2.6	0.5
Pandalus	274.3	98.3	417.5	98.9	552.7	98.8
Angler fish	0.0	0.0	0.0	0.0	0.1	0.0
Whiting	0.0	0.0	0.0	0.0		
Haddock	0.2	0.1	0.1	0.0	0.2	0.0
Hake	0.0	0.0	0.0	0.0		
Ling	0.0	0.0	0.0	0.0		
Saithe	2.5	0.9	1.3	0.3	1.5	0.3
Witch flounder	0.3	0.1	0.2	0.0	0.2	0.0
Norway pout	0.0	0.0	0.0	0.0		
Cod	0.8	0.3	1.7	0.4	2.0	0.3
Other market fish	0.0	0.0	0.0	0.0	0.4	0.1
Cod as % of shrimp:		0.3		0.4		0.4

D:
Norwegian Deeps, Sub-div. IVA East Danish log book records

Species:	2004 Total	2004 % of total catch	2005 Total	2005 % of total catch	2006 Total	2006 % of total catch
Blue Whiting	0.1	0.0	45.0	6.3	0.0	0.0
Norway lobster	28.7	2.5	5.7	0.8	3.2	0.9
Pandalus	860.4	75.1	455.9	64.0	239.3	63.6
Angler fish	42.2	3.7	16.4	2.3	8.4	2.2
Whiting	2.2	0.2	0.6	0.1	3.2	0.9
Haddock	6.4	0.6	2.8	0.4	0.9	0.2
Hake	2.6	0.2	5.2	0.7	1.9	0.5
Ling	7.7	0.7	7.1	1.0	3.1	0.8
Saithe	137.7	12.0	133.5	18.7	85.4	22.7
Witch flounder	5.3	0.5	2.0	0.3	0.8	0.2
Norway pout	0.2	0.0	0.0	0.0	0.2	0.1
Cod	42.3	3.7	28.6	4.0	22.1	5.9
Other market fish	10.1	0.9	9.4	1.3	7.8	2.1
Cod as % of shrimp:		4.9		6.3		9.2

E:
Skagerrak, Sub-div. IIIA. Norwegian logbook records

Species:	2004 Total	2004 % of total catch	2005 Total	2005 % of total catch	2006 Total	2006 % of total catch
Blue Whiting	0.0	0.0	0.0	0.0	0.0	0.0
Norway lobster	20.6	0.4	23.9	0.5	23.6	0.4
Pandalus	4638.0	87.8	4419.1	88.7	5177.1	89.6
Angler fish	22.1	0.4	26.0	0.5	30.4	0.5
Whiting	11.2	0.2	6.6	0.1	5.6	0.1
Haddock	66.6	1.3	39.7	0.8	45.7	0.8
Hake	9.2	0.2	9.6	0.2	9.7	0.2
Ling	28.9	0.5	29.2	0.6	34.8	0.6
Saithe	64.8	1.2	74.5	1.5	110.9	1.9
Witch flounder	33.0	0.6	25.8	0.5	25.8	0.5
Norway pout	0.0	0.0	0.0	0.0	0.0	0.0
Cod	260.9	4.9	238.2	4.8	194.4	3.4
Other market fish	128.1	2.4	88.2	1.8	119.2	2.1
Cod as % of shrimp:		5.6		5.4		3.8

F:
Norwegian Deeps, Sub-div. IVA East Norwegian logbook records

Species:	2004 Total	2004 % of total catch	2005 Total	2005 % of total catch	2006 Total	2006 % of total catch
Blue Whiting	0.0	0.0	0.0	0.0	0.0	0.0
Norway lobster	12.8	0.3	12.0	0.3	16.7	0.4
Pandalus	4360.5	85.6	4087.5	87.1	3037.1	80.9
Angler fish	152.5	3.0	117.7	2.5	112.1	3.0
Whiting	4.4	0.1	2.3	0.0	3.2	0.1
Haddock	47.6	0.9	42.2	0.9	28.5	0.8
Hake	24.9	0.5	19.5	0.4	27.5	0.7
Ling	40.7	0.8	35.6	0.8	39.3	1.0
Saithe	237.9	4.7	193.6	4.1	295.7	7.9
Witch flounder	4.3	0.1	2.8	0.1	5.0	0.1
Norway pout	0.0	0.0	0.0	0.0	0.0	0.0
Cod	144.3	2.8	126.5	2.7	127.7	3.4
Other market fish	63.5	1.2	52.7	1.1	61.8	1.6
Cod as % of shrimp:		3.3		3.1		4.2

Table 8 Landings in tonnes of Pandalus borealis from the Fladen Ground (Division IVa) as estimated by the Working Group

Year	Denmark	Norway	Sweden	UK (Scotland)	Total
1972	2204			187	2391
1973	157			163	320
1974	282			434	716
1975	1308			525	1833
1976	1552			1937	3489
1977	425	112		1692	2229
1978	890	81		2027	2998
1979	565	44		268	877
1980	1122	76		377	1575
1981	685	1		347	1033
1982	283			352	635
1983	5729	8		1827	7564
1984	4553	13		25	4591
1985	4188			1341	5529
1986	3416			301	3717
1987	8620			686	9306
1988	1662	2		84	1748
1989	2495	25		547	3067
1990	1681	3	4	365	2053
1991	422	31		53	506
1992	1448			116	1564
1993	1521	38		509	2068
1994	1229	0		35	1264
1995	4659	15		1298	5972
1996	3858	32		1893	5783
1997	3022	9		365	3396
1998	2900	3		1365	4268
1999	1005	9		456	1470
2000	1482			378	1860
2001	1263	18		397	1678
2002	1147	9		70	1226
2003	999	8	1		1008
2004	23	0	0	0	23
2005	10	0	0	0	10
2006	0	0	0	0	0

Table 9. *Pandalus borealis*, Fladen Ground. Reported LPUE (shrimp trawlers), and estimated total effort.

Year	Denmark Recorded LPUE (ton./day)	Denmark Total effort (Days)	Denmark effort Index	UK (Scotland) LPUE (kg/hour)	UK (Scotland) Total effort (hours)	UK (Scotland) effort Index
1982	0.96	295	0.10	74	4757	0.31
1983	1.18	4855	1.61	89	20528	1.32
1984	0.97	4694	1.56	37	676	0.04
1985	1.21	3016	**1.00**	86	15593	**1.00**
1986	0.96	3558	1.18	71	4239	0.27
1987	1.24	5908	1.96	81	8469	0.54
1988	0.83	1298	0.43	44	1909	0.12
1989	0.99	2463	0.82	65	8415	0.54
1990	1.28	1313	0.44	106	3493	0.22
1991	1.50	281	0.09	124	429	0.03
1992	1.44	1006	0.33	69	1685	0.11
1993	1.83	831	0.28	90	5656	0.36
1994	1.93	637	0.21	91	386	0.02
1995	2.00	2331	0.77	130	9949	0.64
1996	1.79	2155	0.71	62	30532	1.96
1997	2.86	1078	0.36	202	1807	0.12
1998	2.20	1405	0.47	97	14145	0.91
1999	1.62	606	0.20	107	4263	0.27
2000	1.79	830	0.28	121	3128	0.20
2001	2.20	577	0.19	*)	-	-
2002	1.62	711	0.24	*)	-	-
2003	1.70	598	0.20	*)	-	-
2004	0.92	27	0.01	*)	-	0.01
2005	*)	-	-	*)	-	-
2006	*)	-	-	*)	-	-

*) No directed shrimp fishery