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

by

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**Abstract**

This paper presents the Danish, Swedish, and Norwegian fisheries data used in the annual assessment of the shrimp stock in Skagerrak and the Norwegian Deep. Long term fluctuations/trends in landings and trends in national LPUE's are presented and described. Increasing gear efficiency has been taken into account in analyses of the Danish, Swedish and Norwegian LPUE. During a benchmark meeting in 2013 it was decided to use two analytical models to assess the status of the *Pandalus* stock in Skagerrak and the Norwegian Deep. Log book data on Swedish, Danish and Norwegian bycatches are presented. Estimated age compositions of the annual landings since 1985 are presented.

**1 The *Pandalus borealis* stock in Skagerrak and the Norwegian Deep**

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**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, 1990): 1) the Norwegian Deep-Skagerrak stock which is confined to ICES Divs. 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, Norway and UK exploit these resources. The Fladen ground stock was earlier exploited by Danish and UK (Scottish) vessels. In the recent 9 years no *Pandalus* fishery has taken place on the Fladen Ground and only the stock in the Norwegian Deep and Skagerrak has been exploited.

Since 1<sup>st</sup> February 2013 it was agreed between EU and Norway to implement new technical measures in the *Pandalus* trawl fishery in the Union and Norway's waters of Skagerrak. A sorting grid with maximum bar spacing of 19mm is now mandatory in all shrimp trawls in Skagerrak, except within the Norwegian 4 nm border. Provided that there are adequate fishing opportunities, it is allowed to use a fish retention device of 120mm square mesh tunnel at the grid's fish outlet. It has also been discussed to introduce a discard ban in Skagerrak but the agreement has been postponed. The European Union and Norway have agreed that, for those species (stocks) where a discard ban will be implemented, all catches should be accounted against the quotas concerned. This means that the quota set for the stocks concerned should reflect the total catch and not only the landings.

### 1.1.1 The Danish *Pandalus* fishery.

Historically, the Danish *Pandalus* fishery has targeted both the shrimp stock in Divs. IVa east and 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 came to a stop during 2004. Virtually no shrimp landings have been recorded from Fladen since 2004 (Sect. 4). At present, all Danish shrimp landings come from IVa east and IIIa. Since 'at sea' boiled shrimps fetch better prices, an increasing number of Danish vessels now land boiled shrimp. Fig. 2 shows that an increasing fraction of the Danish shrimp catches since 2000 has been landed as 'sea boiled shrimp' with maximums of approx. 44% in 2010 and 28% in 2012. The majority of sea boiled shrimp are landed in Swedish ports, where the demand is high. Minor amounts have also been landed in Norwegian ports. New analyses for the period 1987 to 2012 of the Danish logbook 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 138 vessels in 1987 to only 10 vessels in 2013 (Fig. 3). Following a large decline from 1987 to 2006, fleet size seems to have stabilized at around 10-14 larger vessels.

#### Gear development in the Danish shrimp fishery and its influence on effort.

The technological improvements of the fishing fleet and their implication for the effective effort have been described in SCR Doc. 08/75 (2009). The effective effort by vessels has increased considerably. Following this development the nominal LPUE is standardized accordingly (Fig. 10). Since 2005, an increasing number of vessels have started using twin trawl, which today is the most common gear deployed. A Nordmøre grid has also voluntarily been used in the fishery. When the vessels quota situation allows it, the grid trawl is equipped with a large square mesh tunnel in order to retain large fish,

### 1.1.2 The Norwegian *Pandalus* fishery (SCR Doc. 13/066)

### 1.1.3 The Swedish *Pandalus* fishery

In 2012, a total of 64 trawlers reported landings of *Pandalus* ( $\geq 100$ kg) in the Swedish logbooks. Of these, 39 landed more than 10 t *Pandalus* and can be considered specialised in this fishery. The trend in number of *Pandalus* trawlers from 1995 to 2012 is shown in Fig. 4.

The size of the vessels ranges between 12-34 m with an average of 22 m. GRT varies from 19 to 343, with an average of 119 GRT. The average engine effect is around 411 kW (92-738 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 (about 98% *Pandalus*). The Nordmøre grid is since 1<sup>st</sup> February 2013 legislated in the Skagerrak. If the fish quotas allows, it is legal to use a fish retention device (a 120mm square mesh tunnel) in order to retain large fish. Since 2011 this "grid and tunnel" trawl can be distinguished in the Swedish logbooks. Table 7 shows the fish bycatch in the different Swedish *Pandalus* trawls.

The *Pandalus* trawl with grid can be distinguished from other shrimp trawls in the logbooks back to 1997. The landings from this gear have shown an increasing trend from 9% of total landings in 2002 to 51 % in 2012 (Figure 6).

The Swedish specialized shrimp fleet ( $\geq 10$  t/yr) shows a slightly decreasing trend and has been of around 40-50 vessels during the last decade according to logbooks (see fig. 4) and there has not been any major change in single trawl size or trawl design until recent years according to the Swedish net manufacturer, but during the last 7 years the twin trawlers have increased their landings from 7 to around 50% of total Swedish *Pandalus* landings. These

twin trawls have 40- 80% higher catch rate compared to vessels using single rigged trawls (Fig. 5). Swedish *Pandalus* landings (1990-2012) by trawl gear are given in Fig. 6.

The Swedish quota has earlier been limiting the Swedish *Pandalus* fishery and in order to distribute landings over the year the fishers have voluntarily introduced rations per fisher per week, but in recent years the quota has not been restricting the fishery. The rations have sometimes resulted in high grading of the catch, i.e. discarding less valuable smaller *Pandalus* (16% of the price of boiled shrimp) to increase the proportion of the more valuable boiled shrimp in the individual landings ration. The total Swedish landings separated into fresh and boiled, and proportion of boiled *Pandalus* are presented in Fig. 7. The estimates of discarding in Denmark, Norway and Sweden are presented in SCR Doc. 13/68.

During the years 1963 to 1983 the Swedish National Board of Fisheries conducted an inquiry investigation to on average of 190 shrimp trawling trips per year. The inquiry gives information of kg landed and discarded shrimps, trawling duration, location, trawl size, etc. This information on yearly lpue has then been used to estimate the total Swedish un-standardized effort given the total landings (Fig. 8). Corresponding information on effort and lpue for 1984 to 2011 comes from the logbooks (Figs. 9 and 10).

There are two different Swedish markets for *Pandalus*, resulting in two different kinds of landings: high value large shrimps boiled onboard and smaller low value shrimps landed raw to the industry for further processing. The shrimps are sorted twice, firstly by a sieve of 10 mm bar space meaning an L50 of approximately 20 mm carapace length and secondly by a 7.5-8 mm sieve to get the low quality part. Shrimps going through the 7.5 mm sieve are discarded. The high quality sizes are thus 3+ age group (females) and the low quality sizes < 20 mm CL are mainly males less than 3 years old. The long term trends with un-standardised lpue for these categories are shown in Fig. 10.

Swedish log book data started to have available information on vessel level since 1995 and standardization of lpue was this year carried out from 1996 to 2012 when vessel data was more completely reported.

$$\log(\text{LPUE}) = \text{YEAR} * \text{MONTH} + \text{GEAR\_CODE} + \text{NUMBER\_OF\_GEARS} + a * \text{kW} + \text{error}$$

where  $a$  is the linear coefficient of the relationship between LPUE and kW. Gear code is trawl 1) without grid, 2) with grid (unblocked fish opening) or 3) with grid and large square mesh fish tunnel in order to retain marketable fish. Number of gears is either single or twin trawl. The Swedish standardized lpue is presented together with the Norwegian and Danish in Fig 11.

## 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 2012 landings increased compared with the 2011 landings, but are still on a low level. In Sub-area IV landings have decreased since 1995 and the 2012 landings are the lowest in the whole time series back to 1970. Table 2 presents the landings and estimated catch for the assessment unit 'Skagerrak and the Norwegian Deep' (ICES Div. IIIa and Div. IVa East). Total landings in 2012 were 7 771 t, which is about 400 t less than in 2011.

Landings from Norway, Denmark and Sweden consist of a fraction of larger shrimp that are boiled on board and a remaining portion of smaller shrimp landed fresh. Official landings and logbook data give landed weight as a mixture of raw and boiled shrimp, but these can be separated in sale slip data. The shrimp lose weight when boiled, therefore the boiled landings figures have been corrected with a conversion factor of 1.13 to obtain fresh weight for the years where sufficient information is available (Table 2). The amount added to the Swedish landings (all years) has ranged between 100 and 200 t, while the amount added to the Norwegian landings for the last thirteen years has ranged between 230 and 550 t. The Danish landings figures corresponding to boiled shrimp landed in Swedish ports have been corrected. Norwegian, Swedish and Danish landings in 2012 consisted of respectively 41, 48 and 36% boiled shrimps, respectively.

### 1.2.2 Discards

An updated overview of the current practices of discarding of shrimp is given in SCR Doc. 13/68.

### 1.2.3 Effort and LPUE

Annual national figures for effort and landings per unit of effort (LPUE) based on logbook records are shown in Table 3. The Danish, Norwegian and Swedish standardised LPUEs show the same trend since 2005: Increasing LPUEs up to 2007, followed by a decreasing trend (Fig. 10). The standardisation of the Danish effort data has taken development both in vessel size and gear into account (SCR Doc. 08/75). The Swedish fishery has mainly used single trawls, except for the four most recent years when twin trawls has increased (Fig. 6). The Swedish LPUE has now been standardized according to engine power and gear. The information in Norwegian log books from Divs. IIIa and IVa east on the use of trawl gear is not correct. 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. 11/68). The Norwegian LPUE indices have thus been standardised according to area, month, gear, and vessel for the years 2000-2013. Further information on the Norwegian logbook data is given in SCR Doc. 12/064.

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, Table 3).

## 1.3 Biological sampling of landings and catches

### 1.3.1 Sampling frequency and 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 in 2012 was around 24 kg per 1000 t landed or 5082 specimens. An increasing amount of the Swedish and Danish samples are taken as at-sea samples during fishing trips. In this way samples of discards and information on discarding are also provided. Notice, that in 2009 to 2012, according to mutual agreement between Denmark and Sweden, some samples from Danish shrimp landings in Sweden has been included in the Swedish samples.

### 1.3.2 Catches in numbers at age

The length data have been pooled by quarter, and the national quarterly length distributions have then been partitioned into age compositions by the Bhattacharya and Norm Sep methodology (Bhattacharya 1967) (software: FISAT).

Table 5 gives the “catch-at-age” data on an annual basis. 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 Norwegian 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 (mm CL). The Swedish weight at length figures are derived from individually measured shrimps. The mean weights-at-age in the catches are given in Table 6.

#### 1.4 Trawl survey data (SCR Doc. 12/059)

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

##### 1.5.1 State of Stock in 2011 and 2012

After an ICES inter benchmark meeting in 2013 (ICES 2013), it was decided to use two analytical assessment models for the assessment of the state of the *Pandalus* stock in IIIa and IVa East; a stochastic length-based assessment model (SCR 12-061) and a Bayesian surplus production model (SCR 12/66 and SCR 13/070). Both the length-based and the biomass dynamic models gave generally similar results (except for the recent period) and were considered capable of forming the basis for the stock assessment. The length-based analytical assessment model that was adopted at the 2013 benchmark meeting was not fully operational for providing advice for this year's assessment. The surplus production model was used this year instead.

Danish, Swedish and Norwegian landings and effort data from logbooks have been analysed standardized (SCR Doc. 08/75; 13/66) and there was an upwards trend in the standardized LPUE for all three series from 2000 to 2007 followed by a decreasing trend until 2010, which stabilized at a low level (see Fig. 11).

##### 1.5.2 Biological Reference Points. MSY evaluation

The view of 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 (ICES 1999) pointed out that there was no 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.

This years assessment is considered indicative of stock trends and provides relative rather than absolute measures of stock status. Since the beginning of the 1990s stock biomass has been above  $MSY B_{trigger}$  and fishing mortality below  $F_{MSY}$ , although in recent years stock biomass approached  $MSY B_{trigger}$  and  $F$  has been very close to  $F_{MSY}$ . Recruitment indices have increased from a low value in 2010.

According to previous assessments (1985-2002), predation accounts for at least twice as much removal from the *Pandalus* stock compared to fishery removals. 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.

## 2 Genetic investigations of northern shrimp

Results from the two research projects focusing on the genetic stock structure of northern shrimp in respectively the whole North Atlantic (POPBOREALIS) and the Skagerrak/North Sea area (Sustainable shrimp fishing in Skagerrak), were presented to the 2012 NIPAG working group. As the data set from the North Sea/Skagerrak is not yet finalized, and since the statistical analyses are still ongoing, the results are still preliminary. However, the results indicate that shrimp in some areas, especially around Iceland, Jan Mayen and in Gulf of Maine, and possibly also on Flemish Cap, constitute isolated populations, while shrimp in other areas like the Barents Sea and the eastern coast of Canada constitute large interbreeding populations. The genetic differences between samples within Skagerrak and the North Sea are small compared with the differences observed in the North Atlantic. A finalized data set is expected before the end of 2012 such that conclusions on the stock structure in this area can be made as part of the benchmark process.

## 3 By-catch in the *Pandalus* fisheries in Subarea IV and Division IIIa

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In recent years there has been increasing focus on (mixed) fisheries with by-catches of species 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. WGPAND has since the 1980s regularly compiled and presented relevant information on by-catch in the WG reports.

Tables 7 A - G give for the three most recent years the available Danish, Norwegian and Swedish data on by-catch of the main species in the *Pandalus* fisheries landed for human consumption (h.c.) In some years significant 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 - G also give cod percentage of *Pandalus* landings. It is believed that this is a better estimator than % of total catch, since logbook recordings probably not always are consistent in recordings of e.g. Norway pout and/or blue whiting. Notice 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 from this gear type, seem to be very efficient in reducing by-catch (Table 7 C).

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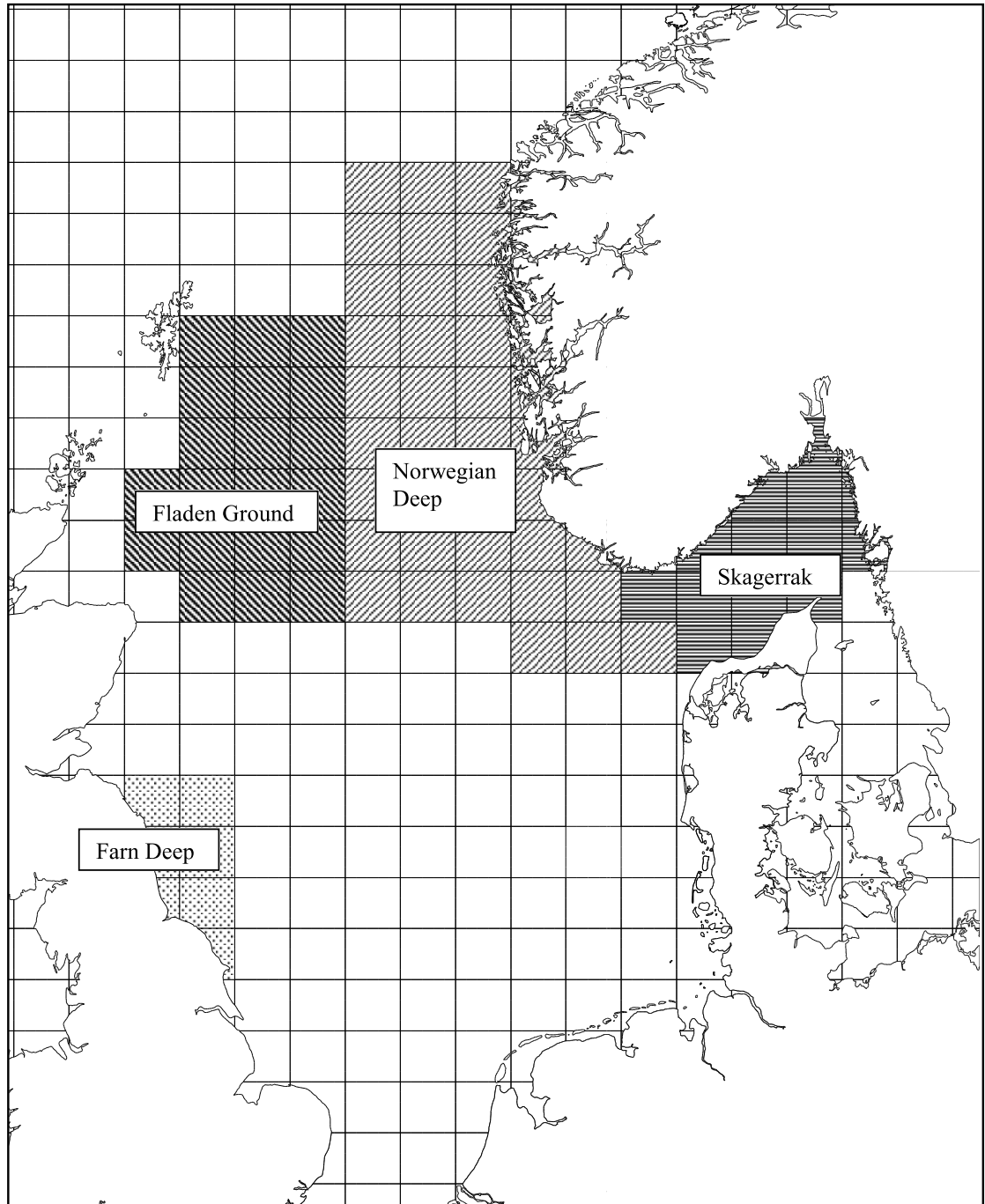
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**Fig.1.** The distribution of the *Pandalus* stocks in the North Sea area as defined by the ICES squares.





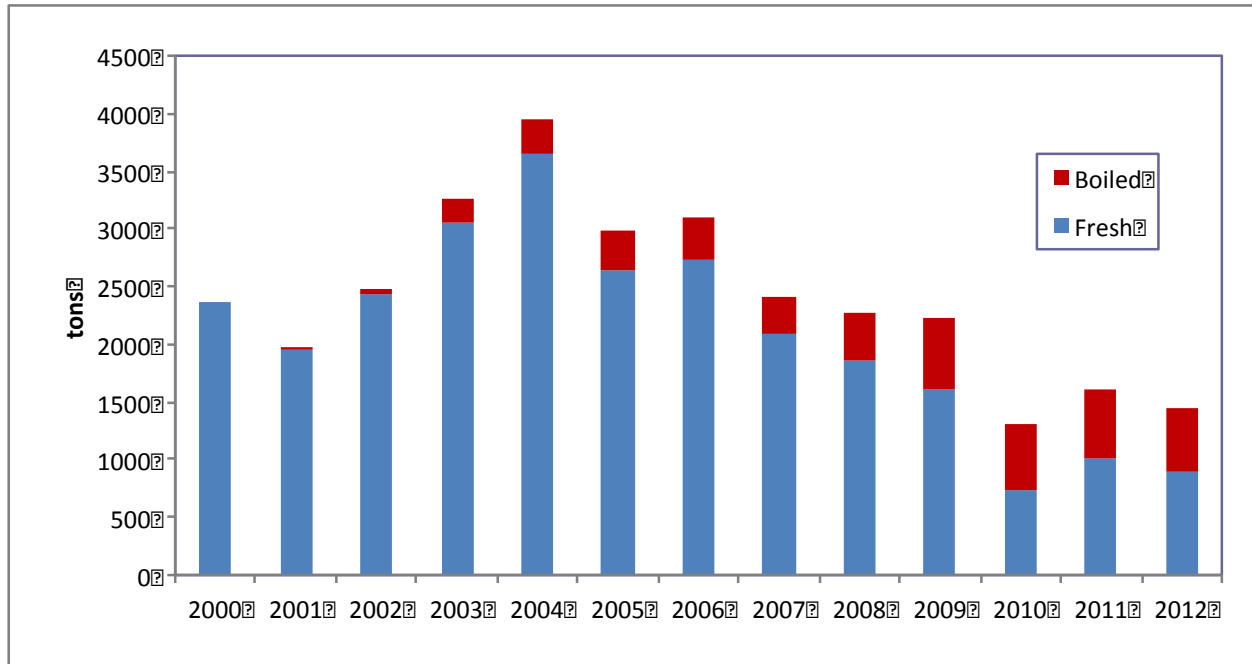


Fig. 2. Danish landings of *Pandalus* partitioned into the two landing categories 2000 to 2012.

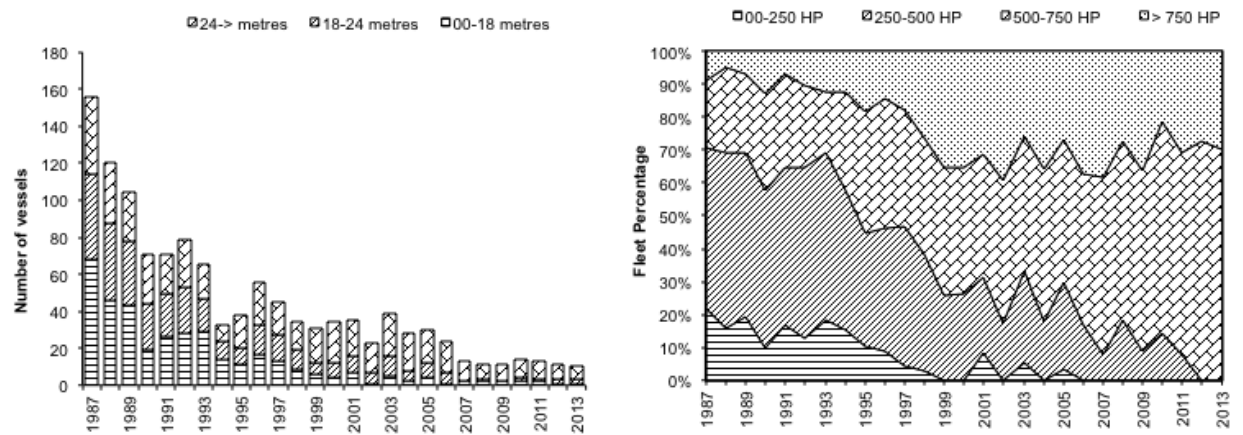
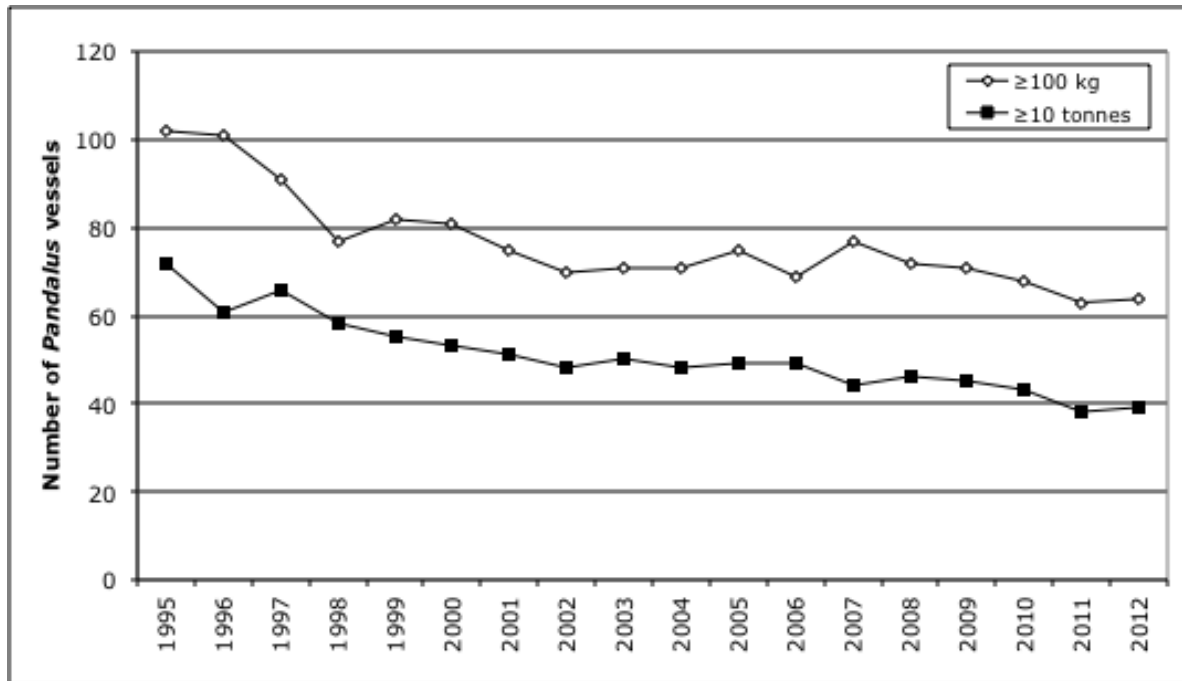
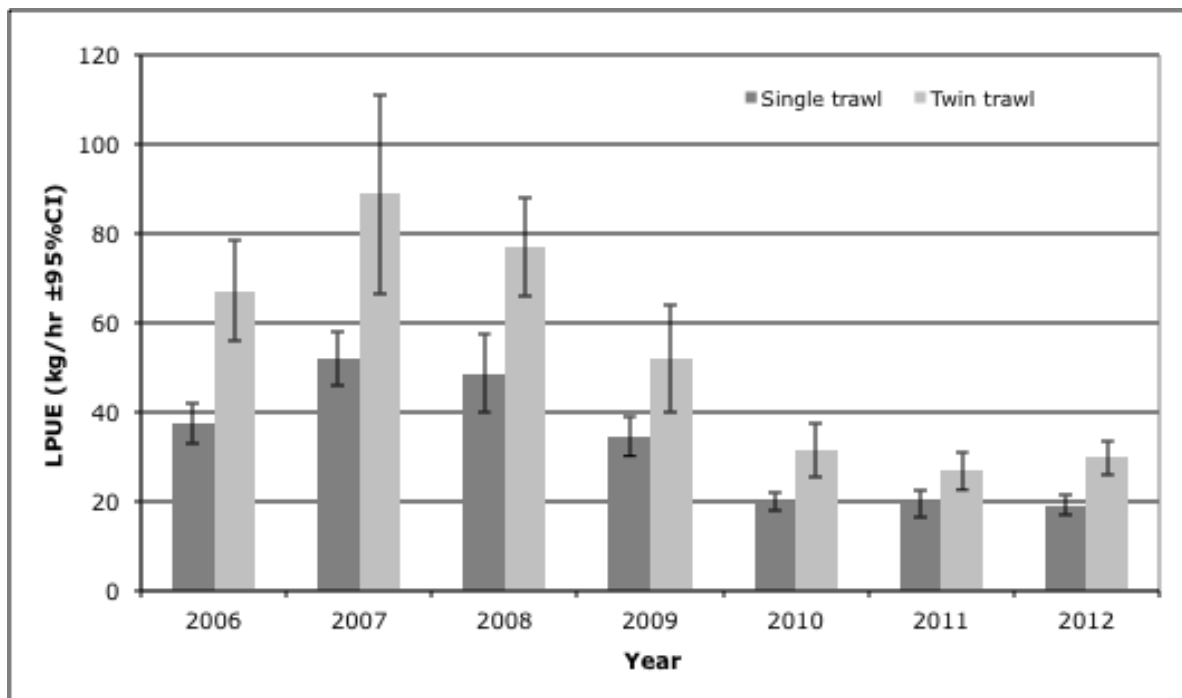


Fig. 3. Trend in numbers (left) and engine power (right) by size groups of Danish *Pandalus* trawlers from 1987 to 2012.



**Fig. 4.** Number of total Swedish *Pandalus* vessels during 1995 to 2012. Vessels landing  $\geq 10$  tonnes are considered as specialised *Pandalus* trawlers.



**Fig. 5.** LPUE for Swedish single and twin trawlers during 2006 - 2012. Error bars are 95% confidence interval.

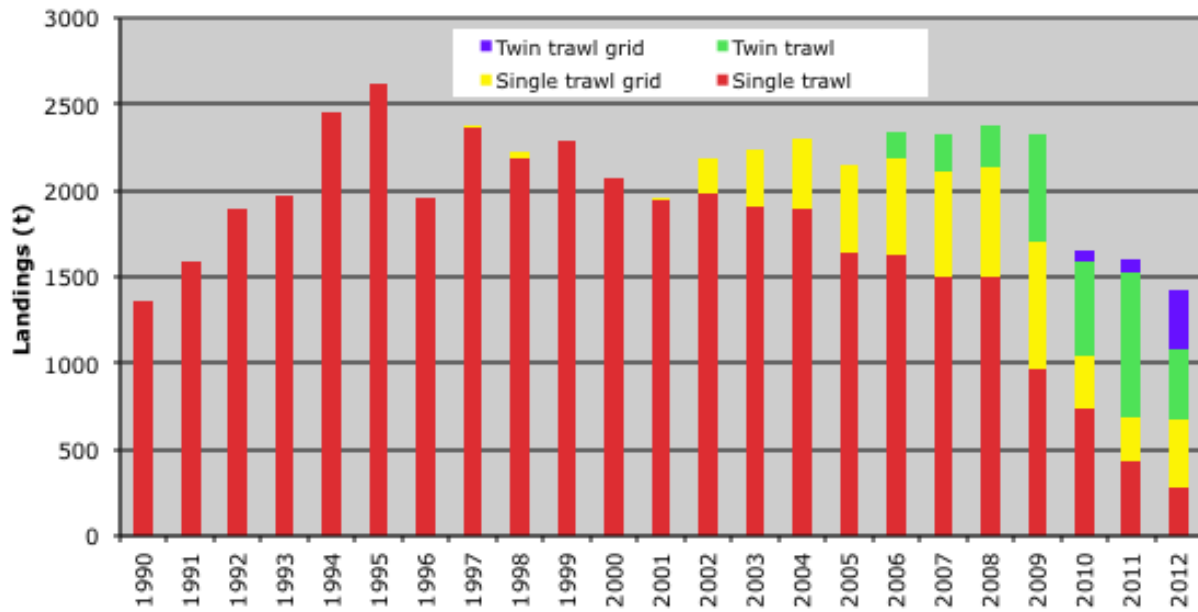
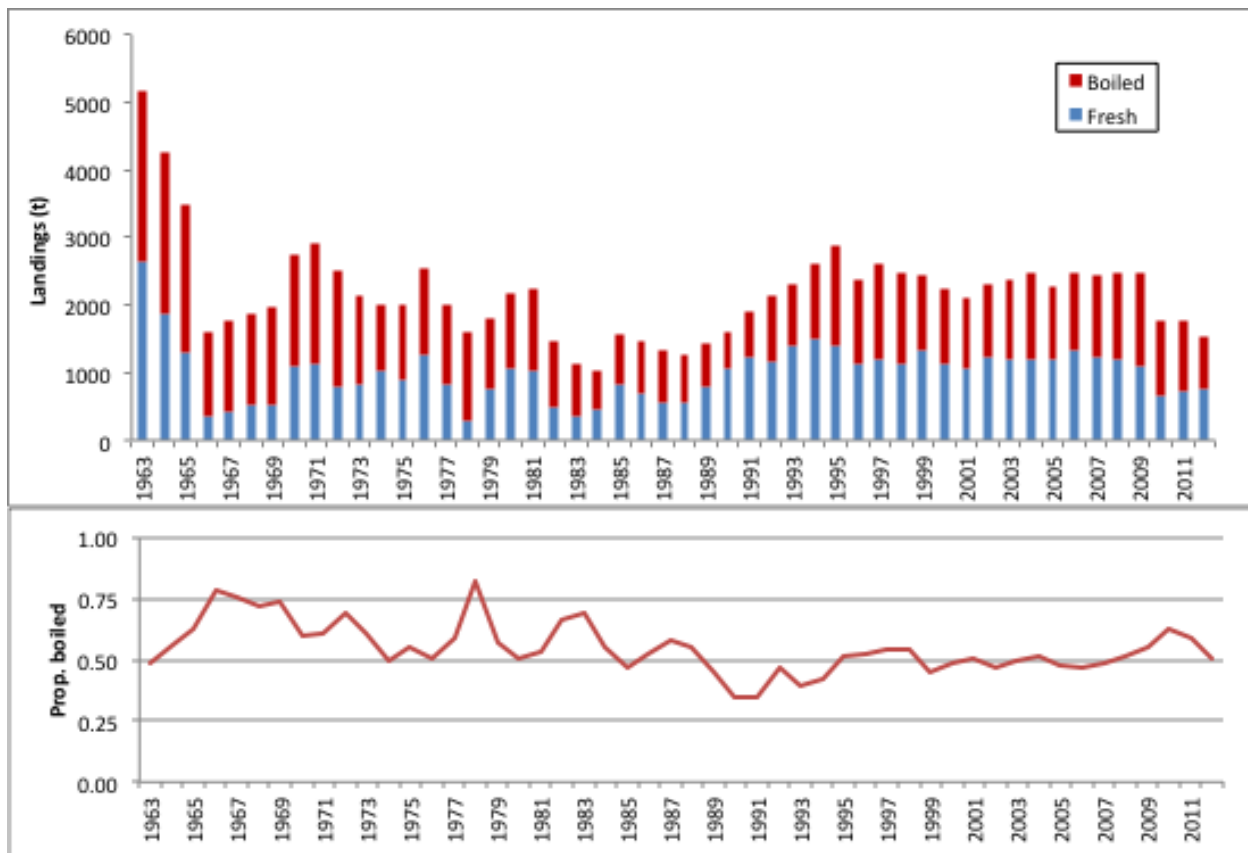
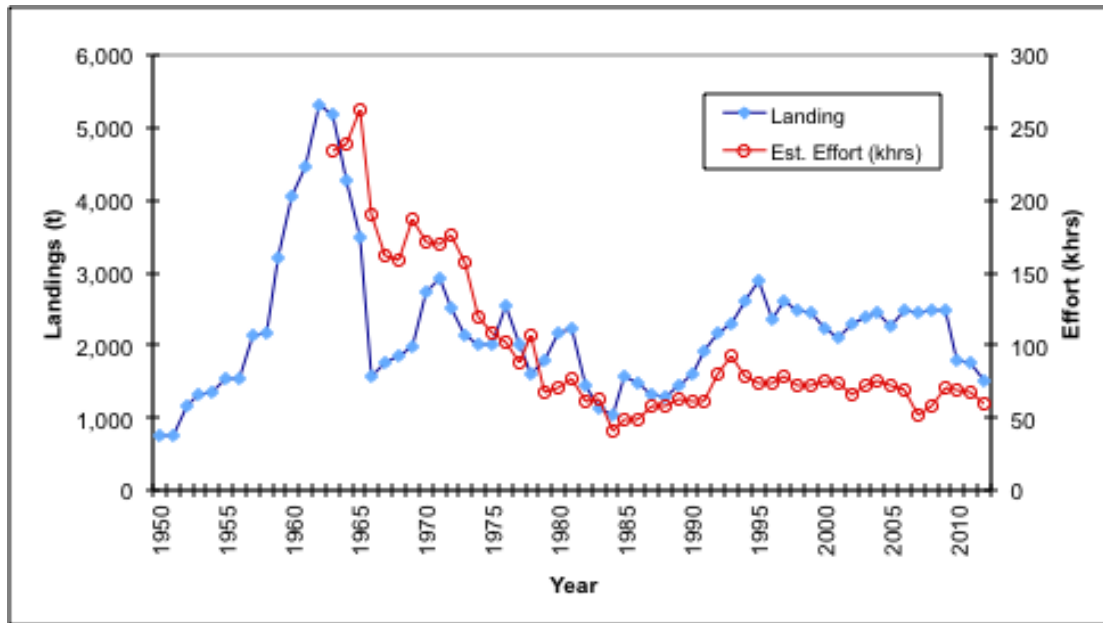


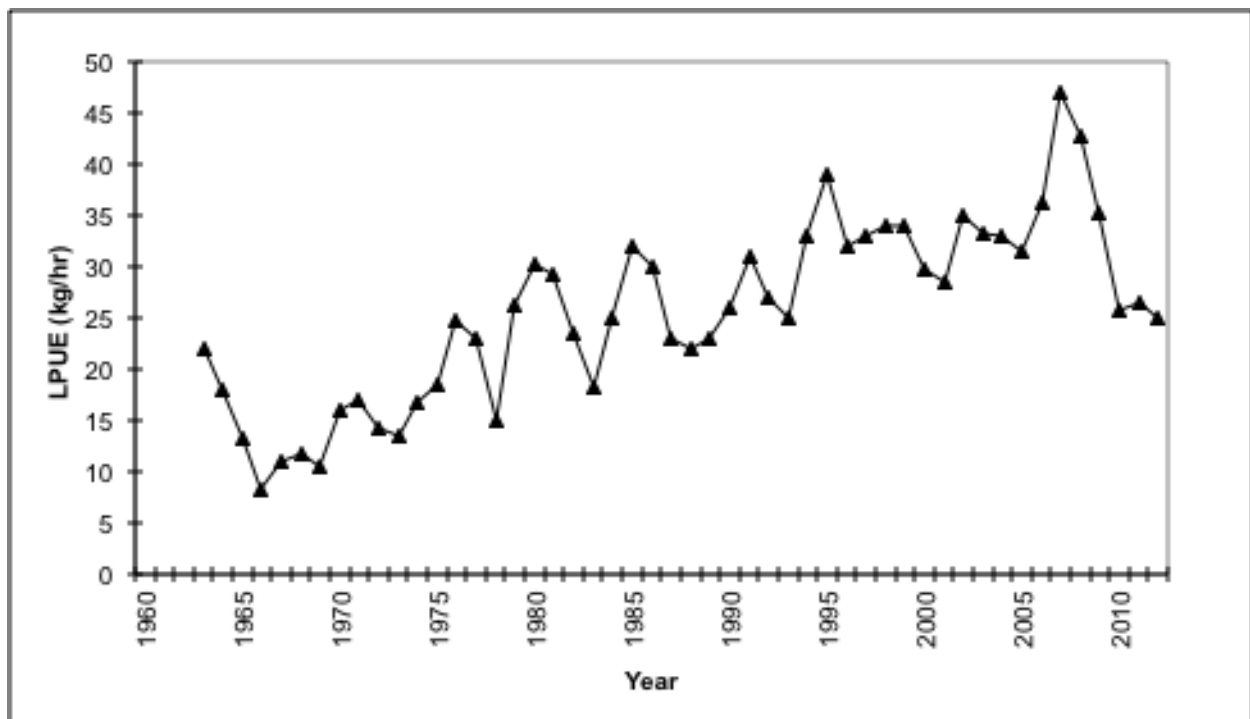
Fig. 6. Swedish *Pandalus* logbook landings per trawl type 1990-2012.



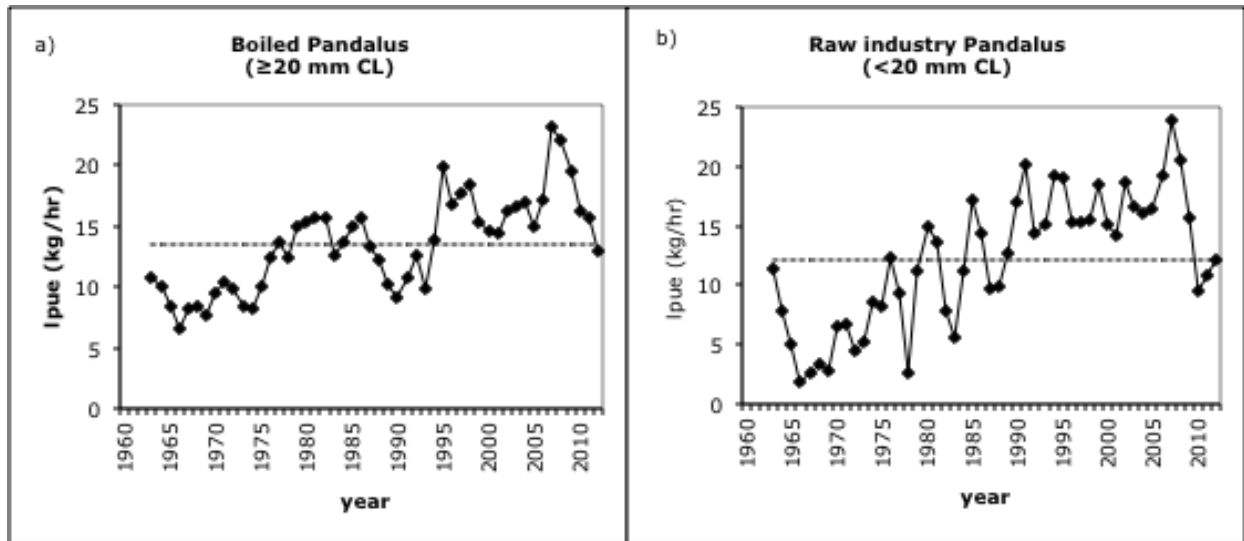
**Fig. 7.** Total Swedish landings 1963 to 2012 separated into boiled and fresh fractions (upper graph) and proportion of boiled *Pandalus* (lower graph).



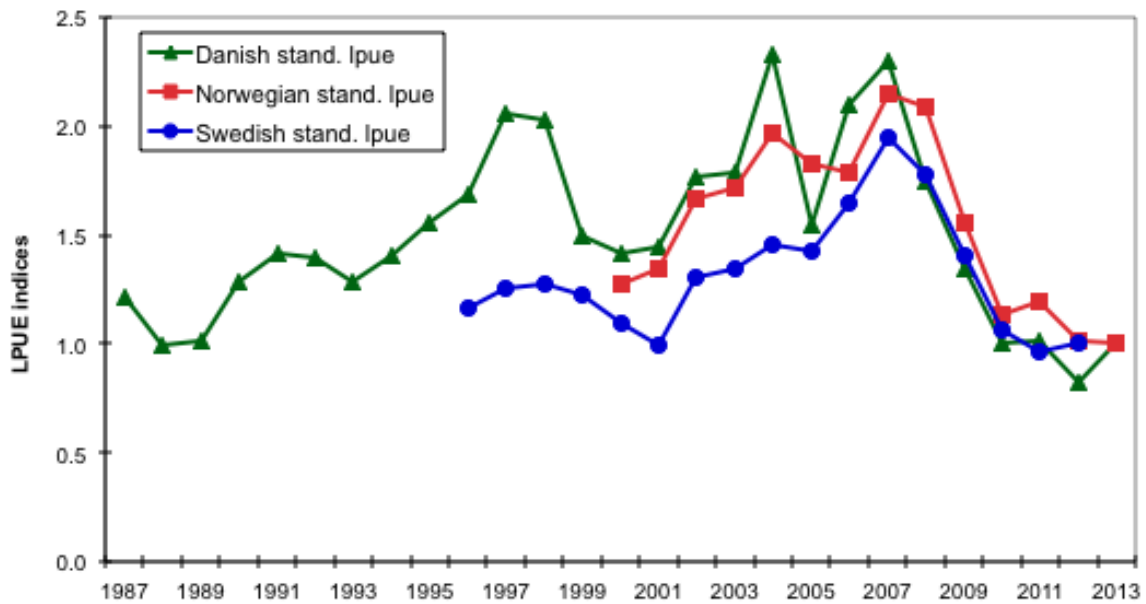
**Fig. 8.** Swedish yearly landings from IIIa and IVa east during 1950 to 2012 and estimated unstandardised effort during 1963 to 2012.



**Fig. 9.** Swedish unstandardised lpue (kg/hour) for areas IIIa and IVa east during 1963 to 2012.



**Fig. 10.** Unstandardised Swedish lpue for areas IIIa and IVa east during 1963 to 2012 partitioned into a): large shrimps ( $\geq 20$  mm) and b): small shrimps. Dotted lines show averages.



**Fig. 11.** Comparison of Danish, Norwegian and Swedish trends in standardised LPUE.

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

Year	Division IIIa				Sub-area IV					
	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	4615	220	489	109	8108
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	2714	161	130	54	3806
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	2427	176	41	35	4041
1995	2421	5181	2512	10114	4698	2879	166	217	1324	9284
1996	3664	5157	1985	10806	4063	2785	82	97	1899	8926
1997	3617	5461	2281	11359	3314	3115	316	52	365	7162
1998	2933	6515	2086	11534	3297	3192	187	55	1364	8095
1999	1398	3985	2114	7497	1679	2763	182	46	479	5149
2000	1898	3554	1890	7342	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	3995	144	0	0	5770
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
2007	2285	5928	2164	10377	95	2307	160	0	0	2562
2008	2155	5744	2246	10145	104	2039	114	0	0	2257
2009	1931	4268	2157	8356	224	1672	169	0	0	2065
2010	1119	2598	1511	5228	109	1710	141	0	0	1960
2011	1274	2693	1498	5465	260	1773	143	0	0	2176
2012	1227	3565	1309	6101	164	1007	123	0	0	1294

\* Includes small amounts of other Pandalid shrimp

† 1970 to 1974 includes subarea IV.

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

**Table 2.** *Pandalus borealis* landings and catches in ICES Divs. IIIa (Skagerrak) and IVa east (Norwegian Deep) as estimated by the Working Group. Norwegian figures have been revised since last year.

Year	Denmark	Norway*)	Sweden *)	Total landings	Est. Swedish discards	Est. Norw discards	Est. Danish discards	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	5187	2241	10021					
1982	3766	5422	1450	10638					
1983	1804	5370	1136	8310					
1984	1800	4770	1022	7592					
1985	4498	6550	1571	12619					
1986	4866	6492	1463	12821					
1987	4488	8343	1322	14153					
1988	3240	7659	1278	12177					
1989	3242	6574	1433	11249					
1990	2479	6152	1608	10239					
1991	3583	6104	1908	11595					
1992	3725	7202	2154	13081				15000	
1993	2915	7538	2300	12753				15000	
1994	2134	6814	2601	11549				18000	
1995	2460	8019	2882	13361				16000	
1996	3868	7910	2371	14149				15000	
1997	3909	8568	2597	15074				15000	
1998	3330	9704	2469	15504				18800	
1999	2072	6737	2445	11254				18800	
2000	2371	6442	2225	11038				13000	
2001	1954	7266	2108	11328				14500	
2002	2470	7703	2301	12474				14500	
2003	3270	8177	2389	13836				14500	
2004	3944	9544	2464	15952				15690	
2005	2992	8958	2257	14207				15600	
2006	3111	8669	2488	14268				16200	
2007	2422	8685	2445	13552				16600	
2008	2274	8261	2479	13014	540			16300	13554
2009	2224	6364	2483	11071	337	93	41	16600	11542
2010	1301	4672	1781	7754	386	133	60	14558	8333
2011	1601	4801	1768	8170	504	246	129	11928	9049
2012	1454	4796	1521	7771	683	288	92	10115	8834

\*) Swedish (all years) and Danish+Norwegian landings (2000-12) have been corrected for loss in weight due to boiling.

**Table 3.** National LPUE and total effort. *Pandalus* in ICES Divs. IIIa and IVa east.

Year	Denmark		Norway		Sweden	
	LPUE kg/hr	effort Khrs	LPUE kg/hr	effort Khrs	LPUE kg/hr	effort Khrs
1987	14	328	36	230	23	57
1988	9	344	31	251	22	57
1989	10	338	23	273	23	63
1990	16	153	26	232	26	58
1991	21	173	30	206	31	61
1992	21	181	35	204	27	80
1993	16	178	31	243	25	91
1994	22	96	31	218	33	82
1995	29	85	35	255	39	76
1996	31	126	37	214	32	74
1997	49	80	42	212	33	78
1998	45	74	44	219	34	73
1999	26	80	32	219	34	72
2000	25	94	34	192	30	75
2001	24	80	34	214	29	74
2002	35	70	44	176	35	65
2003	38	87	48	171	33	72
2004	57	69	55	174	33	74
2005	30	99	52	173	31	68
2006	38	82	50	173	36	65
2007	44	55	65	134	47	52
2008	39	58	65	127	43	58
2009	30	73	50	128	35	71
2010	21	62	34	137	26	69
2011	22	72	39	123	27	67
2012	20	73	34	140	25	60



**Table 4.** National sampling effort of commercial catches in 2012. *Pandalus* in ICES Divs. IIIa and IVa east.

Denmark*)	Landings (tons)		samples	Weight (kg)	Numbers measured-sexed		
Quarter							
1	294	15	15.4	2764			
2	302	12	7.9	1617			
3	422	9	5.7	1159			
4	373	6	4.2	1122			
Total	1391	42	33	6662			
Norway	Landings (tons)		samples	Weight (kg)	Numbers measured-sexed		
Quarter							
1	1289	18	26.6	5035			
2	765	17	20.1	4574			
3	1340	14	17.3	3902			
4	1178	10	13.8	2895			
Total	4572	59	78	16406			
Sweden	Landings (tons)		samples	Weight (kg)	Numbers measured-sexed		
Quarter							
1	358	5	15.2	3407			
2	393	6	14.8	3881			
3	429	5	15.0	3385			
4	252	6	18.5	3839			
Total	1432	22	63	14512			
Total	Landings (tons)		samples	Weight (kg)	Numbers measured-sexed	Sampling per 1000 ton landed	
Quarter						Weight	Numbers
1	1941	38	57.2	11206	29.5	5773.5	
2	1460	35	42.8	10072	29.3	6900.4	
3	2191	28	38.0	8446	17.4	3855.0	
4	1803	22	36.5	7856	20.2	4356.0	
Total	7395	123	174.5	37580	23.6	5081.8	

\*) Following a Danish Swedish agreement, samples from Danish shrimp landings in Sweden in 2 and 3 q have included in the Swedish samples

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

Numbers*10**-6														
AGE\Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	17.7	7.4	2.7	14.1	31.3	0.0	3.9	25.5	27.2	0.7	2.7	61.1	19.7	12.7
1	1200.8	1146.4	1260.5	1086.6	2083.6	2250.1	1231.8	1071.4	1889.6	671.9	646.0	1211.6	2175.6	903.4
2	1305.4	1029.7	1205.6	923.9	385.5	910.8	1035.8	1289.2	803.8	1380.4	970.5	991.4	1181.9	1597.9
3	187.9	482.7	390.2	300.2	173.8	121.1	326.7	569.1	262.7	143.0	851.5	454.6	295.6	468.1
+gp	52.3	25.1	203.2	146.7	13.6	31.3	25.6	57.5	15.5	30.5	42.0	69.5	29.8	48.2
TOTALNUM	2764.1	2691.3	3062.1	2471.5	2687.9	3313.3	2623.8	3012.7	2998.7	2226.4	2512.5	2788.2	3702.6	3030.2

AGE\Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	4.6	88.1	0.1	3.9	2.4	5.7	13.7	4.8	0.1	1.2	0.1	4.9	19.1	9.3
1	1436.1	1270.7	904.7	922.3	668.7	1062.9	749.4	1021.4	433.1	701.9	555.1	297.9	744.8	1108.8
2	720.1	836.3	824.5	858.4	1466.5	1251.4	1172.7	1149.2	1349.9	915.0	853.2	787.6	662.0	569.1
3	318.3	199.3	390.0	581.8	283.8	477.6	410.1	379.0	220.1	673.7	592.9	238.2	203.8	197.9
+gp	43.3	39.2	68.3	101.8	0.0	50.4	0.0	28.5	0.0	0.0	16.5	0.0	0.0	0.0
TOTALNUM	2522.4	2433.5	2187.6	2468.3	2421.4	2847.9	2345.9	2582.8	2003.1	2291.9	2017.8	1328.6	1629.7	1885.1

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

Catch weights at age (kg)

AGE/YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	0.0009	0.0012	0.0009	0.0009	0.0011	0.0009	0.0015	0.0010	0.0009	0.0009	0.0009	0.0007	0.0009	0.0007
1	0.0032	0.0032	0.0024	0.0030	0.0034	0.0030	0.0033	0.0035	0.0035	0.0034	0.0033	0.0037	0.0031	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	0.0067	0.0061	0.0055
3	0.0104	0.0083	0.0077	0.0090	0.0099	0.0083	0.0079	0.0078	0.0088	0.0093	0.0089	0.0094	0.0094	0.0087
+gp	0.0134	0.0140	0.0114	0.0117	0.0133	0.0106	0.0122	0.0095	0.0109	0.0117	0.0116	0.0138	0.0119	0.0133

AGE/YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	0.0007	0.0007	0.0006	0.0008	0.0014	0.0017	0.0014	0.0014	0.0014	0.0010	0.0015	0.0011	0.0013	0.0009
1	0.0033	0.0032	0.0031	0.0036	0.0035	0.0037	0.0038	0.0035	0.0032	0.0036	0.0049	0.0039	0.0038	0.0035
2	0.0063	0.0063	0.0056	0.0054	0.0060	0.0061	0.0059	0.0061	0.0057	0.0059	0.0057	0.0059	0.0058	0.0059
3	0.0088	0.0103	0.0085	0.0083	0.0082	0.0077	0.0092	0.0075	0.0075	0.0070	0.0069	0.0085	0.0078	0.0079
+gp	0.0112	0.0139	0.0118	0.0113	0.0121	0.0107	0.0113	0.0123	0.0123	0.0123	0.0091	0.0123	0.0123	0.0123

**Table 7.** By-catch, 2010-2012 in the *Pandalus* fisheries in the Norwegian Deep & Skagerrak

<b>A: Skagerrak, Sub-div. IIIA. Danish log book records</b>							<b>E: Norwegian Deeps, Sub-div. IVA Eas Danish log book records</b>						
Species:	2010		2011		2012		Species:	2010		2011		2012	
	Total	% of total catch	Total	% of total catch	Total	% of total catch		Total	% of total catch	Total	% of total catch	Total	% of total catch
Blue Whiting	0.0	0.0	0.0	0.0	0.0	0.0	Blue Whiting	0.0	0.0	0.0	0.0	0.0	0.0
Norway lobster	5.5	0.4	1.9	0.1	0.2	0.0	Norway lobster	0.3	0.2	0.4	0.1	0.2	0.1
<i>Pandalus</i>	1139.9	81.6	1272.7	84.9	1222.4	81.4	<i>Pandalus</i>	121.9	75.0	255.1	87.4	171.5	80.9
Angler fish	6.8	0.5	7.7	0.5	22.8	1.5	Angler fish	4.2	2.6	3.7	1.3	4.4	2.1
Whiting	0.0	0.0	0.1	0.0	0.4	0.0	Whiting	0.0	0.0	0.0	0.0	0.0	0.0
Haddock	3.2	0.2	5.6	0.4	15.4	1.0	Haddock	0.4	0.2	0.1	0.1	0.2	0.1
Hake	1.3	0.1	2.1	0.1	5.2	0.3	Hake	2.3	1.4	2.6	0.9	3.8	1.8
Ling	0.5	0.0	1.0	0.1	2.4	0.2	Ling	2.0	1.2	2.2	0.8	2.4	1.1
Saithe	164.4	11.8	133.0	8.9	137.6	9.2	Saithe	16.7	10.3	16.1	5.5	19.9	9.4
Witch flounder	14.2	1.0	15.7	1.0	19.2	1.3	Witch flounder	0.2	0.1	0.4	0.1	0.5	0.2
Norway pout	0.0	0.0	0.0	0.0	0.0	0.0	Norway pout	0.0	0.0	0.0	0.0	0.0	0.0
Cod	46.0	3.3	48.0	3.2	66.3	4.4	Cod	7.5	4.6	7.6	2.6	6.5	3.1
Other market fish	14.4	1.0	10.5	0.7	10.5	0.7	Other market fish	7.2	4.4	3.4	1.2	2.5	1.2
<b>Cod as % of shrimp:</b>	0.0	4.0	0.0	3.8	0.0	5.4	<b>Cod as % of shrimp:</b>	6.1	0.0	3.0	0.0	0.0	3.8
<b>B: Skagerrak, Sub-div. IIIA. Swedish log book records</b>							<b>F: Norwegian Deeps, Sub-div. IVA Eas Norwegian sales slips data</b>						
Species:	2010		2011		2012		Species:	2010		2011		2012	
	Total	% of total catch	Total	% of total catch	Total	% of total catch		Total	% of total catch	Total	% of total catch	Total	% of total catch
Blue Whiting	0.1	0.0	0.9	0.0	0.0	0.0	Blue Whiting	0.0	0.0	0.0	0.0	0.0	0.0
Norway lobster	8.2	0.4	9.5	0.5	6.4	0.6	Norway lobster	24.3	1.1	8.8	0.4	8.5	0.7
<i>Pandalus</i>	1287.5	65.0	1283.5	64.6	694.4	60.2	<i>Pandalus</i>	1687.8	77.2	1772.7	83.9	1003.9	77.1
Angler fish	13.8	0.7	0.0	0.0	20.0	1.7	Angler fish	62.7	2.9	56.0	2.6	39.2	3.0
Whiting	11.0	0.6	8.0	0.4	2.7	0.2	Whiting	2.7	0.1	3.0	0.1	1.3	0.1
Haddock	13.2	0.7	17.8	0.9	45.5	3.9	Haddock	18.5	0.8	8.1	0.4	8.0	0.6
Hake	10.5	0.5	11.4	0.6	5.1	0.4	Hake	32.2	1.5	24.8	1.2	20.2	1.6
Ling	12.3	0.6	14.5	0.7	8.3	0.7	Ling	31.8	1.5	36.7	1.7	31.1	2.4
Saithe	361.5	18.3	385.8	19.4	212.1	18.4	Saithe	176.4	8.1	76.5	3.6	92.7	7.1
Witch flounder	27.4	1.4	33.4	1.7	25.3	2.2	Witch flounder	2.3	0.1	1.3	0.1	1.0	0.1
Norway pout	0.1	0.0	0.7	0.0	2.2	0.2	Norway pout	0.0	0.0	0.0	0.0	0.0	0.0
Cod	180.4	9.1	159.0	8.0	103.2	8.9	Cod	62.9	2.9	57.4	2.7	50.9	3.9
Other market fish	53.3	2.7	60.9	3.1	29.0	2.5	Other market fish	85.3	3.9	68.6	3.2	46.0	3.5
<b>Cod as % of shrimp:</b>	14.0		0.0	12.4	0.0	14.9	<b>Cod as % of shrimp:</b>	3.7	0.0	3.2	0.0	0.0	5.1
<b>C: Skagerrak, Sub-div. IIIA. Swedish log book records (sorting grid)</b>							<b>G: Skagerrak, Sub-div. IIIA. Norwegian sales slips data</b>						
Species:	2010		2011		2012		Species:	2010		2011		2012	
	Total	% of total catch	Total	% of total catch	Total	% of total catch		Total	% of total catch	Total	% of total catch	Total	% of total catch
Blue Whiting	0.0	0.0	0.0	0.0	0.0	0.0	Blue Whiting	0.0	0.0	0.0	0.0	0.0	0.0
Norway lobster	2.3	0.6	1.9	0.6	2.8	0.6	Norway lobster	31.2	1.0	20.1	0.6	34.5	0.8
<i>Pandalus</i>	363.7	96.2	326.4	98.5	458.3	95.1	<i>Pandalus</i>	2598.1	83.2	2693.2	83.9	3564.6	83.8
Angler fish	0.2	0.0	0.0	0.0	0.7	0.2	Angler fish	35.6	1.1	36.3	1.1	37.9	0.9
Whiting	0.0	0.0	0.0	0.0	0.0	0.0	Whiting	4.2	0.1	4.1	0.1	4.3	0.1
Haddock	0.0	0.0	0.1	0.0	1.5	0.3	Haddock	24.7	0.8	32.3	1.0	48.4	1.1
Hake	0.2	0.1	0.0	0.0	0.4	0.1	Hake	10.6	0.3	10.1	0.3	11.4	0.3
Ling	0.1	0.0	0.0	0.0	0.2	0.0	Ling	28.4	0.9	31.3	1.0	35.0	0.8
Saithe	7.0	1.9	0.7	0.2	7.3	1.5	Saithe	116.0	3.7	104.0	3.2	124.9	2.9
Witch flounder	0.4	0.1	0.1	0.0	1.0	0.2	Witch flounder	17.6	0.6	18.4	0.6	28.1	0.7
Norway pout	0.0	0.0	0.0	0.0	0.0	0.0	Norway pout	0.0	0.0	0.0	0.0	0.0	0.0
Cod	2.5	0.7	0.3	0.1	3.3	0.7	Cod	156.0	5.0	151.4	4.7	231.7	5.4
Other market fish	1.6	0.4	1.8	0.5	6.2	1.3	Other market fish	100.7	3.2	108.4	3.4	135.2	3.2
<b>Cod as % of shrimp:</b>	0.7		0.0	0.1	0.0	0.7	<b>Cod as % of shrimp:</b>	6.0	0.0	5.6	0.0	0.0	6.5
<b>D: Skagerrak, Sub-div. IIIA. Swedish log book records (sorting grid and fish tunnel)</b>													
Species:	2010		2011		2012		Species:	2010		2011		2012	
	Total	% of total catch	Total	% of total catch	Total	% of total catch		Total	% of total catch	Total	% of total catch	Total	% of total catch
Blue Whiting					0.0	0.0	Blue Whiting					0.0	0.0
Norway lobster					1.1	0.3	Norway lobster					1.1	0.3
<i>Pandalus</i>					276.1	62.3	<i>Pandalus</i>					276.1	62.3
Angler fish					8.1	1.8	Angler fish					8.1	1.8
Whiting					0.1	0.0	Whiting					0.1	0.0
Haddock					9.6	2.2	Haddock					9.6	2.2
Hake					2.1	0.5	Hake					2.1	0.5
Ling					3.1	0.7	Ling					3.1	0.7
Saithe					83.5	18.8	Saithe					83.5	18.8
Witch flounder					10.2	2.3	Witch flounder					10.2	2.3
Norway pout					0.3	0.1	Norway pout					0.3	0.1
Cod					42.1	9.5	Cod					42.1	9.5
Other market fish					6.8	1.5	Other market fish					6.8	1.5
<b>Cod as % of shrimp:</b>					0.0	15.3	<b>Cod as % of shrimp:</b>					0.0	15.3