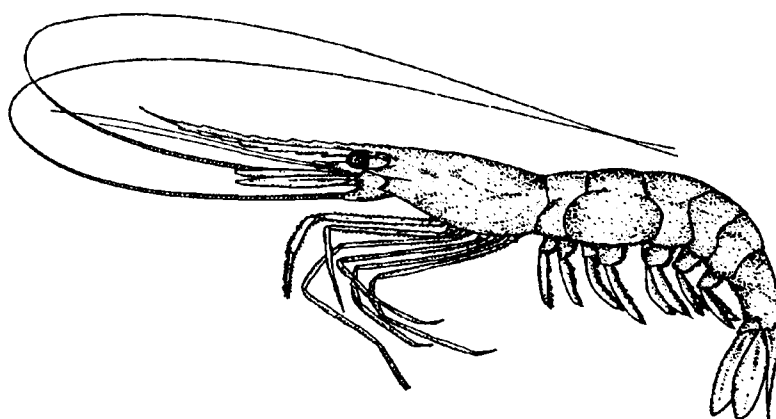




REPORT OF THE
PANDALUS ASSESSMENT WORKING GROUP

Lysekil Sweden
9-12 September 1997



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1 TERMS OF REFERENCE

The **Pandalus Assessment Working Group (WGPAND)** (Chairman Mr. S. Tveite, Norway) will meet in Lysekil, Sweden from 9-12 September 1997 to:

- a) assess the status of the stocks of *Pandalus borealis* in the North Sea, Skagerrak and Kattegat and provide catch options for 1998;
- b) provide information on quantities of discards by gear type and area for the stocks of *Pandalus* and fisheries considered by this group (OSPAR 1997/5:3) and report to WGECCO;
- c) determine the predation mortality of *Pandalus* stocks;
- d) continue the work on determining the criteria for ageing;
- e) continue the work on the definition of population and assessment units;
- f) report to the ACFM and the Shellfish Committee.

The above terms of reference are set up to provide ACFM with information required to respond to the requests for advice from NEAFC, the EC and OSPAR.

2 PARTICIPANTS

P. Koeller	Canada
S.A. Pedersen	Denmark
B. Sjöstrand	Sweden
S. Tveite (Chairman)	Norway

Data from Scottish and English shrimp fishery in the North Sea were supplied by Jim Kinnear and Jon Elson.

3 PANDALUS STOCKS IN SUB-AREA IV AND DIVISION IIIA

A detailed overview of the various stocks is given in ICES (CM 1990/Assess:9) The Working Group grouped them into three assessments units:

1. Skagerrak and Norwegian Deep combined
2. Fladen Ground
3. Farn Deep

Nominal landings for Division IIIa and Sub-area IV are shown in Table 3.1.

3.1 Natural mortality

The level of natural mortality for *Pandalus* has been discussed at several occasions. The value used i.e., 0.75 for Divisions IIIa, IVaE is not well founded.

Work is initiated to elucidate predation mortality, however, no changes were made in the values of natural mortality used in this year's assessments.

3.1.1 Landings

Landings are given in Table 3.1 by area (Division IIIa and Sub-area IV) as officially reported to ICES. The reported amounts for both areas are similar to the 1995 levels.

Table 3.1.1 presents the landings and estimated discards for the assessment unit, i.e. Division IIIa and eastern part of Sub-area IVa. These landings have increased compared to 1995 and are on the same record high level as in 1987, viz. around 14 200 t.

Landings from Norway and Sweden (and to a small extent from Denmark) consist of a fraction of larger shrimps that are boiled on board and a remaining portion of smaller shrimps landed fresh. The boiling causes the shrimps to loose weight. The conversion factor to obtain live weight is 1.15. Official reported figures from Norway are

given as landed weight. The same procedure has been adopted by Sweden for the last few years. In the amounts used by Working Group, the Swedish landings of large shrimps have, however, been converted to live weight. The amount added for 1996 was 171 tonnes. No conversion has been applied on the Norwegian landings by the Working Group. The underestimate of total landings by this omission is for 1996 roughly estimated to about 500 t. The Working Group felt this estimate too inaccurate to include in the assessment figures. When more accurate estimates become available, the landings for all years should be updated.

3.1.2 Discards

Discarded shrimps are of two categories:

The smallest size fractions from the sieving procedure is not accepted by the canning industry and are discarded. This practice is traditional in the Norwegian and Swedish fisheries. The Working Group estimated the amounts of discards by using the Norwegian length measurements from samples taken onboard before discarding. The proportion below 15 mm carapace length are considered discarded.

More recently, the substantial price difference between large, boiled shrimps and medium sized fresh ones has resulted in high grading by discarding the latter. The amounts of discards in this category were estimated for 1996 only. Using the proportions of large and medium sized shrimps (by month and statistical rectangle) from a time period when no high grading occurred.

The estimate of total discards in 1996 of 1280 t was added to the total catch for assessment purpose.

3.1.3 Effort

Annual figures for landings per unit of effort (LPUE) and effort are given in Table 3.1.2 Total effort values have been estimated from LPUE data based on logbook records. Swedish and Norwegian effort decreased from 1995 while Danish effort increased.

3.1.4 Assessment

3.1.4.1 Age distributions

Length frequencies from Danish, Norwegian and Swedish quarterly samples were added and weighted by the numbers of animals measured. Numbers at age were then estimated by first splitting the length frequency distributions into normal distribution using the Bhattacharya method as implemented in ELEFAN (Pauly 1987). The numbers caught by each country were then calculated from numbers per kilo in their quarterly samples and split into age groups using the combined age distribution. Quarterly growths are shown in Figure 3.1.1. Total catch in numbers at age are given in Table 3.1.3

3.1.4.2 Mean weight and maturity at age

Weights at age for 1996 were obtained by applying average Danish and Swedish mean weight per length group data to the length frequencies of each year class. The mean weights at age in the catch is given in Table 3.1.4. The same weights at age are used as stock weights.

The 0- and 1-group were assumed to be immature, and the 3+ groups fully mature. The mature part of the 2-group or potential spawners was taken as the sum of intersexes and females in the first quarter of the year. These proportions have been:

1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0.62	0.09	0.20	0.30	0.68	0.73	0.73	0.68	0.70	0.64	0.45	0.46

Spawning stock size has in this assessment been calculated per 1 Jan, i.e. FPROP=MPROP=0 for all years.

3.1.4.3 Natural mortality

M was, as earlier, set at 0.75 for all ages.

3.1.4.4 Assessment

An XSA was performed on the 1985-1996 dataset to estimate stock sizes and exploitation levels. Data on effort and catch per unit of effort by age for three commercial fleets and catch at age from the annual Norwegian shrimp survey was used for tuning (Table 3.1.5).

Default values were accepted, in most instances, as input variables in the XSA (Table 3.1.6). Catchabilities were, however, assumed independent of stock size for all ages, and independent of age for ages 2 and older. Survivor estimates were shrunk towards the mean F of final 5 years or the 2 oldest ages.

Fishing mortalities, expressed as unweighted mean over age groups 1-3, (see Table 3.1.7) decreased from 1992 to a minimum in 1994. This decrease is mainly due to a major drop in the high values for the 3-group.

Stock size in terms of number at age is given in Table 3.1.8. Spawning stock decreased to below the average level from 1994 to 1996. The total stock biomass increased due to the strong 1995 year class.

Summary results without SOP corrections are given in Table 3.1.9

3.1.4.5 Recruitment

The abundance indices of young shrimps obtained by the Norwegian survey in October are given in Table 3.1.10. The 1995 year class had a low 0-group index but turned out to be very strong as 1-group. The 1996 0-group index is above average and preliminary results for 1997 seems to confirm that the year class as 1-group is relatively strong.

The 1996 year-class was estimated as 0-group by a regression on XSA estimates (RCT3 was used). The input data is in Table 3.1.11 and the output in Table 3.1.12. The year-class was thus estimated to 20,286 billion.

3.1.4.6 Catch prediction

Input data for the prediction are shown in Table 3.1.13. The fishing pattern used for 1997 is the 1994-1996 average scaled to the 1996 level (mean of ages 1-3). Mean weights are averages for the period 1994-1996. Recruitment in 1996 is the RCT3 estimate. The 1996 year-class as 1-group in 1997 was taken from the RCT3 estimate and recalculated as 1-group by applying the total mortality for 1996. Recruitment in 1997 - 1999 is the geometric average for the period 1985-1996.

The spawning stock estimates are very dependent on the maturity ogive, which has varied considerably during the period of investigation. In this year's prediction the maturity for age group 2 is based on the percentage intersexes and females in the 2-group observed in Norwegian samples during quarter one 1997.

The *status quo* landings for 1997 is predicted to 17,550 tonnes, whereas the agreed TAC is 15,000 t. Predicted *status quo* catches in 1998 is 17,830 assuming mean recruitment (Table 3.1.13). If the minimum recruitment observed over the 12 year period is applied the predictions is 16,860.

3.1.4.7 Management consideration

Predictions of yield and spawning stock size for the period 1997-2006 were performed based on a model developed at the Danish Institute for Fisheries Research. It is implemented in Excel. The model includes uncertainties in the estimated population size in 1997, in mean weights at age and in the proportion mature of age group 2. The uncertainty in population size in 1997 is the one estimated in the XSA. Uncertainties in mean weights and maturity are estimated from the historic data. Recruitment (at age 0) is based on the historic relationship between SSB and recruitment assuming a Ricker function. Recruitment is assumed to be lognormally distributed around the Ricker curve using the variance observed in the historic data.

The percentiles of the probability distributions after 200 runs are presented in Figure 3.1.2 for yield and SSB under constant fishing mortality at the 1997 level.

The results indicates a drop in yield and SSB to 1999 and thereafter a likely catch of about 15 000 t and a 10% risk that SSB will be less than 12 000 t.

Long-term evaluation

A stock-recruitment relationship was calculated as a Ricker curve based on the 1985-1996 data points (Figure 3.1.3). The estimated values for the parameters are $a = 2,2764$ and $b = 22,068$, when recruitment is expressed in billions and SSB in thousand tonnes. Maximum recruitment would consequently occur at around 22,000 t SSB. The rather narrow range of SSB (12,000-24,000 t), so far experienced, makes the estimation of the relationship unprecise.

Equilibrium yield and SSB based on this S-R relationship and a Yield per recruit calculation are given on Figure 3.1.4.

Biological Reference Points

The following BRP:s were estimated from yield per recruit calculations and from equilibrium yield and SSB calculations based on a Ricker type relationship (Figures 3.1.3 and 3.1.4). The rather narrow range of SSB (12 000 - 24 000 t) so far experienced, makes the estimation of the relationship unprecise:

$$\begin{aligned}F_{0.1} &= 0.8 \\F_{med} &= 1 \\F_{MSY} &= 1 \\B_{MSY} &= 15\ 000\ t.\end{aligned}$$

Trawl selection

The high discard figures indicate that the selection properties of commercial shrimp trawls are poor. Sorting grids or other means facilitating the escape of small shrimps should be included in the management of the stock.

3.1.4.8 Assessment quality

Most of the samples used for length frequencies for the stock assessment are from the Skagerrak area. Figure 3.1.5 shows that in the fourth quarter the length frequencies from survey in the Skagerrak area and the one used for VPA are quite similar (when the catches of 0-group caught in the fine meshed survey trawl are omitted), while there are considerable higher proportion of large ones in the Norwegian Deeps, indicating a considerable bias in sampling of commercial catches.

Stock Assessment based on Survey data

Imprecision in landing data and commercial cpue, uncertain discard estimates and the possibility of a bias in the samples of landings encouraged the WG to attempt an assessment based on Survey data only. The data from the Norwegian Surveys were analysed with the RCPUE model (Cook, 1995). Inputs are given in Table 3.1.14. Both natural mortality, maturity and mean weights at age in catch and in stock were kept constant for all years. The 0 and 4+ group were given lower relative weights in the estimation procedure as they were assumed to be more variable (noisier) than other age groups. The relative catchability is obviously much lower for the 0 group than for older shrimps. This is due to both the mesh selectivity and to their changing availability at the time of the survey. The relative catchability for this age group had to be put to 0.08 in order to avoid negative age effects.

The resulting estimates of stock size, fishing mortalities and yield are found in Table 3.1.15 in which also the diagnostic output is given.

The trends of stock estimates, yield and exploitation level obtained in this analysis and with the XSA is compared in Figure 3.1.6.

It is apparent that the two methods give different pictures of the stock dynamic and of yield. When exploitation is expressed as yield per biomass instead of fishing mortality, the two methods depict similar trends.

Causes for the observed differences in results from the two assessments could be the quality of the fishery related data, the constrain in the model assuming constant mean weights and natural mortality. In both models M were assumed large and constant over time. If natural mortality has varied during the period of assessment (for

example due to changes in the predation rate on shrimps) the effect on the estimates of fishing mortality (and yield) would be different in the two models as the partitioning of total mortality is performed quite differently.

The estimates of Stock biomass from the survey based assessment have in other cases been demonstrated to be fairly robust (Cook, 1995). The WG therefore made a comparison between biomass estimates/indices from surveys and from fishery based data. (XSA, RCPUE, survey data expressed as kg/hr and commercial cpue). Figure 3.1.7.

The general trends are similar between survey estimates (from RCPUE) and the fishery data (commercial cpue) with a correlation of $r = 0.74$.

3.2 Fladen Ground

Table 3.2.1 shows the landings from the Fladen Ground since 1972. Only Denmark and Scotland exploited this stock during 1996.

The total catch increased due to a doubling of Scottish effort (Table 3.2.2) There was a reduction in CPUE for both countries. No further data for assessment purpose were available.

3.3 Farn Deep

In recent years *Pandalus* in the Farn Deep have been fished by UK vessels only. Total landings fell from 500 t in 1988 to none in 1993. In 1994 there was a small fishery of 4 tonnes, 171 t in 1995 and 60 t in 1996 (Table 3.3.1).

4 BYCATCH

Bycatch in the 1996 shrimp fishery is available from Danish log books and from a Danish discard project (Table 4.1 and Table 4.2).

The Danish discard project in the North Sea was started in 1995. Information on bycatch in the Danish shrimp fishery in 1996 was collected during fishing trips with four randomly selected fishing vessels representative of the Danish shrimp fishing fleet (vessel size from 83 to 114 GRT, length from 22 to 28 m, crew of 3 or 4 men, and shrimp trawls with a codend meshsize of 36-38 mm). The entire catch (or a subsample raised to the entire catch) of all species from randomly selected shrimp fishing hauls were weighed and counted by biological assistants from the Danish Fisheries Research Institute. The number of samples (i.e. hauls) in 1996 by fishing area and quarter is given in Table 4.2.

A first estimate of the total bycatch in the international shrimp fishery was obtained by raising the species bycatch from the Danish discard project in kg and numbers per kg shrimp to the total catch of shrimp by all nations (Table 4.2).

Logbook information is usually unreliable for species other than the target species due to under or misreporting. Information from the discard project provides a check for the reliability of logbook information and allows a rough estimation of the discard of bycatch species. In general the fish not reported in logbooks are under sized and low value species not landed and therefore discarded at sea. A comparison of bycatches from logbooks and the discard project on the Fladen Ground in the 1. Quarter shows that catches of small and under sized fish e.g. Norway Pout, haddock and whiting are under reported in the logbooks, while estimates of market sized high value fish species e.g. cod and Anglerfish (Monk) using these two methods are in relatively close agreement. These trends are even more pronounced in the data from the Norwegian Deep and the Skagerrak area.

5 REFERENCES

- ICES (1990). Report on the Working group on the assessment of *Pandalus* Stocks ICES C.M.1990/Assess:9.
Cook, R.M. (1995). A simple model for the analysis of research vessel data to determine stock trends. ICES CM 1995/D:12.
Pauly, D 1987. A review of the ELEFAN system for analysis of length-frequency data in fish and aquatic invertebrates. ICLARM Conf. Proc. 13: 7-34.

Table 3.1 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	2920	3877	1421	8218	1069	1545	92		354	3060
1983	1571	3722	988	6281	5752	1657	112	65	1836	9422
1984	1717	3509	933	6159	4638	1274	120	277	25	6334
1985	4105	4772	1474	10351	4582	1785	128	415	1347	8257
1986	4686	4811	1357	10854	3896	1681	157	458	358	6550
1987	4140	5198	1085	10423	9223	3145	252	526	774	13920
1988	2278	3047	1075	6400	2647	4614	220	489	109	8098
1989	2527	3156	1304	6987	3298	3418	122	364	579	7802
1990	2277	3006	1471	6754	2079	3146	137	305	365	6083
1991	3256	3441	1747	8444	750	2715	161	130	54	3810
1992	3296	4257	2057	9610	1881	2945	147	69	116	5158
1993	2490	4089	2133	8712	1985	3449	167	29	516	6146
1994	1973	4389	2553	8915	1352	2425	176	41	35	4029
1995	2494	5181	2512	10187	4698	2972	166	217	1324	9377
1996	3664	5143	1985	10792	4063	2772	82	97	1899	8913

* 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

1996 figures are preliminary.

Tabel 3.1.1 *Pandalus borealis* landings from divisions IIIa (Skagerrak) and IVa (eastern part). (Norwegian Deeps) as estimated by the Working Group

Year	Denmark	Norway	Sweden	Total	Estimated discards	TAC	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	1747	4783	1022	7552			
1985	3827	6646	1571	12044	584		12628
1986	4834	6490	1463	12787	477		13264
1987	4599	8343	1321	14263	808		15071
1988	3068	7661	1278	12007	830		12837
1989	3150	6411	1433	10994	1548		12542
1990	2479	6139	1540	10158	1723		11881
1991	3583	6106	1908	11597	765		12362
1992	3725	7136	2154	13015	713	15000	13728
1993	2915	7504	2300	12719	1340	15000	14059
1994	2118	6813	2719	11650	426	18000	12076
1995	2465	8153	2678	13296	642	16000	13938
1996	3979	7883	2371	14233	1282	15000	15515

Tabel 3.1.2 National landings and effort as estimated by the Study Group *Pandalus borealis*. Div. IIIa - IVa E

Year	Denmark		Norway		Sweden		combined
	LPUE kg/day	effort days	LPUE kg/hr	effort Khrrs	LPUE kg/hr	effort Khrrs	effort index rel. to 1986
1984	452	3869	no data		25	40	0.00
1985	719	5326	no data		32	49	0.00
1986	556	8700	36	179	30	49	1.00
1987	499	9212	36	230	23	57	1.20
1988	432	7104	31	251	22	57	1.22
1989	421	7477	23	273	23	63	1.30
1990	585	4236	26	232	26	58	1.08
1991	653	5487	30	206	31	61	1.01
1992	634	5875	35	204	27	80	1.09
1993	571	5015	31	243	25	91	1.27
1994	677	3120	31	218	33	82	1.17
1995	801	3076	35	255	39	76	1.26
1996	860	4626	37	214	32	74	1.06

Table 3.1.3 Virtual population analysis. Catch number at age. Pandalus in Division IIIa and IVa east

Run title : Pandalus IIIa + IVb Assessment

1997 WG

At 10/09/1997 11:49

Table 1	Catch numbers at age				Numbers*10**-3							
YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE												
0	36461	14935	11110	55226	109572	46434	13460	108487	42707	15713	22855	1000
1	1027292	975704	1252658	613709	1557376	1333574	816547	436766	1227845	581274	432136	1090621
2	1260871	1045879	1173137	971146	681884	1094654	1108258	1477651	872517	1242004	943017	997667
3	191514	508662	474785	429783	338637	158695	295515	579407	440173	288130	725522	427399
4	47929	22332	75088	164479	43328	38431	30660	19039	13896	17674	57653	62322
+gp	0	1444	712	4104	816	319	0	0	591	0	1606	1494
TOTNO	2564067	2568956	2987490	2238447	2731613	2672107	2264440	2621350	2597729	2144795	2182789	2580503
TONLAN	12628	13264	15071	12837	12542	11881	12362	13728	14059	12076	13938	15515
SOPCOF	92	100	100	104	91	90	103	92	99	106	103	109
%												

Table 3.1.4 Mean weight at age in Pandalus catches Div.IIIa and IVa east

Table 2	Catch weights at age (kg)											
YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE												
0	0,0009	0,0015	0,0011	0,0013	0,0013	0,0014	0,0011	0,0013	0,0012	0,0008	0,0003	0,0006
1	0,0036	0,0034	0,0031	0,0032	0,0037	0,0035	0,0039	0,0040	0,0038	0,0035	0,0034	0,0034
2	0,0060	0,0053	0,0052	0,0049	0,0062	0,0060	0,0057	0,0055	0,0062	0,0055	0,0056	0,0058
3	0,0095	0,0080	0,0088	0,0083	0,0091	0,0092	0,0076	0,0083	0,0084	0,0082	0,0084	0,0091
4	0,0116	0,0117	0,0107	0,0113	0,0121	0,0107	0,0106	0,0124	0,0127	0,0116	0,0118	0,0121
+gp	0,0000	0,0129	0,0129	0,0177	0,0152	0,0138	0,0000	0,0000	0,0156	0,0000	0,0147	0,0171
SOPCOFAC	0,9208	1,0022	1,0036	1,0443	0,9098	0,8977	1,0260	0,9151	0,9936	1,0557	1,0311	1,0914

Table 3.1.5 Virtual population analysis. Tuning input file. Pandalus in Division IIIa and IVa east

Pandalus IIIa-IVaE tuning file WG 1997

104												
Denmark												
85	96											
1	1	0	1									
1	5											
5326	276485583	339351114	51544154	12899660	0							
8700	326611687	350102566	170271875	7475389	483300							
9212	340689967	319062162	129128971	20421873	193607							
7105	142836988	226028144	100029250	38281428	955148							
7477	410334845	179661620	89223659	11416082	214880							
4236	271383830	222763369	32294578	7820680	65011							
5487	195430088	265247147	70727586	7338002	0							
5875	120202880	406666023	159459280	5239699	0							
5015	263225692	187050350	94364469	2978960	126699							
3120	97470046	208263515	48314692	2963602	0							
3076	84689163	184810603	142186264	11298627	314731							
4626	368911153	320439748	133624428	19647255	444115							

Table 3.1.5 continued

Norway

86	96				
1	1	0	1		
1	5				
179	463152872	496464196	241454641	10600502	685345
230	670513635	627947843	254139376	40192390	381040
251	390658044	618185205	273579216	104699406	2612321
273	1003745988	439481640	218255629	27925599	525632
232	820255904	673300868	97610156	23637954	196496
206	356160180	483397786	128896988	13373090	0
204	244702376	827868200	324618385	10666689	0
237	745684975	529889898	267322564	8439016	358922
218	327720895	700238771	162447181	9964439	0
255	271284059	592002196	455464023	36192794	1008176
214	451278823	467627924	216509613	31702907	792571

Sweden

85	96				
1	1	0	1		
1	5				
49.0	120833122	148307388	22526459	5637568	0
49.2	104423689	111934149	54439011	2390018	154520
57.1	105315499	98629822	39916884	6312894	59849
56.9	65074167	102974680	45571670	17440385	435149
62.8	219731053	96207372	47778561	6113221	115067
58.3	205786106	168917972	24488472	5930299	49297
61.0	120557947	163627064	43630807	4526706	0
80.3	78094762	264207367	103599303	3404187	0
90.8	229436995	163039822	82251471	2596569	110435
81.8	130529143	278900638	64701676	3968773	0
76.0	84593442	184601719	142025557	11285857	314376
73.5	270431338	209600358	77265633	10972810	258048

Norwegian Surveys

85	96				
1	1	0.833	0.917		
0	4				
100	2694	35741	16347	3228	1443
100	1304	10456	6853	2823	201
100	909	26002	11055	7289	933
100	2196	3368	4150	2935	533
100	10247	20024	5791	466	10
100	4546	18504	9186	980	66
100	2240	25208	9958	2112	263
100	22644	19058	11070	4232	382
100	4763	30753	8903	3323	166
100	2674	18622	10238	4135	1360
100	1702	13839	7590	9288	365
100	9150	28273	12045	5380	425

Table 3.1.6 Virtual Population Analysis. XSA tuning output. Pandalus in Division IIIa and IVa east

Lowestoft VPA Version 3.1

10/09/1997 12:51

Extended Survivors Analysis

Pandalus IIIa + IVb Assessment 1996 WG

CPUE data from file h:\vpa97\panef97.dat

Catch data for 12 years. 1985 to 1996. Ages 0 to 5.

Fleet	First	Last	First	Last	Alpha	Beta
		year	year	age	age	
Denmark	1985	1996	1	4	.000	1.000
Norway	1986	1996	1	4	.000	1.000
Sweden	1985	1996	1	4	.000	1.000
Norwegian Surveys	1985	1996	0	4	.833	.917

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages ≥ 2

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 2 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 28 iterations

1

Regression weights

.751	.820	.877	.921	.954	.976	.990	.997	1.000	1.000
------	------	------	------	------	------	------	------	-------	-------

Fishing mortalities

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	.002	.005	.008	.003	.001	.006	.004	.002	.001	.002
1	.254	.205	.331	.229	.138	.098	.159	.122	.093	.123
2	.659	.644	.766	.876	.602	.840	.568	.462	.587	.647
3	.610	1.284	1.103	.838	1.615	2.453	1.770	.766	1.295	1.453
4	.776	.957	.815	.661	.768	.797	.775	.535	.668	.658

Table 3.1.6 Virtual Population Analysis. XSA tuning output. Pandalus in Division IIIa and IVa east (continued)

XSA population numbers (Thousands)

YEAR	AGE				
	0	1	2	3	4
1987	1.02E+07	8.12E+06	3.54E+06	1.51E+06	2.02E+05
1988	1.71E+07	4.82E+06	2.97E+06	8.65E+05	3.88E+05
1989	2.02E+07	8.04E+06	1.85E+06	7.38E+05	1.13E+05
1990	1.95E+07	9.49E+06	2.73E+06	4.07E+05	1.16E+05
1991	1.45E+07	9.20E+06	3.57E+06	5.37E+05	8.32E+04
1992	2.58E+07	6.84E+06	3.78E+06	9.22E+05	5.04E+04
1993	1.57E+07	1.21E+07	2.93E+06	7.72E+05	3.75E+04
1994	1.50E+07	7.39E+06	4.89E+06	7.84E+05	6.21E+04
1995	2.90E+07	7.08E+06	3.09E+06	1.45E+06	1.72E+05
1996	7.34E+05	1.37E+07	3.05E+06	8.12E+05	1.88E+05

Estimated population abundance at 1st Jan 1997

0.00E+00	3.46E+05	5.71E+06	7.54E+05	8.97E+04
----------	----------	----------	----------	----------

Taper weighted geometric mean of the VPA populations:

1.33E+07	8.60E+06	3.31E+06	8.03E+05	1.07E+05
----------	----------	----------	----------	----------

Standard error of the weighted Log(VPA populations) :

1.0238	.2878	.2645	.4102	.6801
--------	-------	-------	-------	-------

1

Log catchability residuals.

Fleet : Denmark

Age	1985	1986	1987	1988	1989	1990
0	No data for this fleet at this age					
1	-.02	-.07	.04	-.07	.47	.42
2	-.01	-.63	-.38	-.30	-.06	.38
3	.63	.28	-.46	.35	.28	.33
4	.20	-.10	-.23	.08	.00	.11
	1991	1992	1993	1994	1995	1996
0	No data for this fleet at this age					
1	-.17	-.45	-.05	-.09	-.19	.23
2	-.08	.31	-.16	-.13	.27	.45
3	.85	1.30	.91	.36	1.02	1.19
4	15	.26	.14	.01	.40	.45

Mean log catchability and standard error of ages with catchability

independent of year class strength and constant w.r.t. time

Age	1	2	3	4
Mean Log q	-4.9685	-3.6196	-3.6196	-3.6196
S.E(Log q)	.2696	.3248	.8242	.2414

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	.75	1.122	7.73	.70	12	.20	-4.97
2	1.53	-.864	-2.47	.23	12	.51	-3.62
3	1.12	-.258	1.74	.36	12	.58	-2.99
4	.98	.251	3.68	.93	12	.20	-3.48

1

Table 3.1.6 Virtual Population Analysis. XSA tuning output. Pandalus in Division IIIa and IVa east (continued)

Fleet : Norway

Age	1985	1986	1987	1988	1989	1990
0	No data for this fleet at this age					
1	99.99	.18	.43	.30	.70	.45
2	99.99	-.39	-.01	.05	.15	.39
3	99.99	.52	-.09	.71	.49	.35
4	99.99	.14	.15	.43	.21	.12

Age	1991	1992	1993	1994	1995	1996
0	No data for this fleet at this age					
1	-.27	-.35	.06	-.20	-.51	-.47
2	-.19	.39	-.06	-.25	-.07	-.09
3	.74	1.38	1.01	.24	.68	.75
4	.04	.34	.24	-.11	.06	.01

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1	2	3	4	
Mean Log q		-.9913	.3748	.3748	.3748
S.E(Log q)		.4193	.2420	.7763	.2159

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	1.29	-.435	-3.30	.22	11	.57	-.99
2	1.84	-1.616	-13.25	.32	11	.41	.37
3	1.07	-.192	-2.09	.46	11	.44	1.01
4	.98	.321	-.22	.96	11	.16	.52
1							

Fleet : Sweden

Age	1985	1986	1987	1988	1989	1990
0	No data for this fleet at this age					
1	-.09	.03	.02	.04	.70	.50
2	-.07	-.52	-.39	-.18	.17	.46
3	.57	.40	-.47	.47	.52	.42
4	.14	.01	-.24	.20	.23	.19

Age	1991	1992	1993	1994	1995	1996
0	No data for this fleet at this age					
1	-.09	-.52	-.11	-.09	-.42	.13
2	.02	.25	-.20	-.11	.05	.25
3	.95	1.24	.87	.37	.80	.86
4	.25	.20	.10	.03	.18	.09

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1	2	3	4	
Mean Log q		-1.0375	.3006	.3006	.3006
S.E(Log q)		.3466	.2769	.7717	.1824

Table 3.1.6 Virtual Population Analysis. XSA tuning output. Pandalus in Division IIIa and IVa east (continued)

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	.80	.624	4.04	.53	12	.29	-1.04
2	1.92	-1.499	-14.31	.24	12	.50	.30
3	1.30	-.670	-5.22	.37	12	.56	.92
4	1.01	-.158	-.55	.96	12	.14	.42
1							

Fleet : Norwegian Surveys

Age	1985	1986	1987	1988	1989	1990
0	-.68	-1.31	-1.15	-.78	.60	-.18
1	.35	-.59	.48	-1.08	.30	-.04
2	.27	-.83	.17	-.65	.26	.43
3	1.45	.21	.56	.80	-1.04	.06
4	1.39	.15	.66	-.39	-3.26	-1.53

Age	1991	1992	1993	1994	1995	1996
0	-.59	1.14	.08	-.45	-1.56	3.80
1	.23	.21	.17	.13	-.15	-.07
2	.01	.26	.06	-.40	-.13	.39
3	1.23	2.12	1.46	.79	1.44	1.61
4	.28	1.18	.62	2.01	-.21	-.16

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	0	1	2	3	4	
Mean Log q		-12.1279	-9.9535	-9.3101	-9.3101	-9.3101
S.E(Log q)		1.5162	.4201	.3988	1.3037	1.4099

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	-5.83	-3.778	41.33	.03	12	5.72	-12.13
1	.60	1.478	12.34	.62	12	.24	-9.95
2	3.15	-1.482	-2.93	.05	12	1.18	-9.31
3	.78	.403	9.56	.27	12	.71	-8.39
4	3.24	-1.034	4.09	.02	12	4.54	-9.27
1							

Terminal year survivor and F summaries :

Age 0 Catchability constant w.r.t. time and dependent on age

Year class = 1996

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Denmark	1.	.000	.000	.00	0	.000	.000
Norway	1.	.000	.000	.00	0	.000	.000
Sweden	1.	.000	.000	.00	0	.000	.000
Norwegian Surveys	15402450	1.587	.000	.00	1	.090	.000
F shrinkage mean		237416.		.50		.910	.003

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
345880.	.48	3.98	2	8.346	.002

Table 3.1.6 Virtual Population Analysis. XSA tuning output. Pandalus in Division IIIa and IVa east (continued)

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 1995

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Denmark	7180616.	.300	.000	.00	1	.327	.099
Norway	3558170.	.440	.000	.00	1	.152	.191
Sweden	6501317.	.363	.000	.00	1	.224	.109
Norwegian Surveys	4790992.	.424	.384	.91	2	.164	.145
F shrinkage mean	5603198.	.50			.133	.126	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
5714225.	.17	.13	6	.750	.123

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 1994

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Denmark	839130.	.225	.321	1.42	2	.264	.597
Norway	608014.	.248	.193	.78	2	.223	.755
Sweden	748823.	.231	.327	1.41	2	.254	.650
Norwegian Surveys	856335.	.298	.203	.68	3	.152	.588
F shrinkage mean	764959.	.50			.107	.640	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
753652.	.12	.10	10	.822	.647

Age 3 Catchability constant w.r.t. time and age (fixed at the value for age) 2

Year class = 1993

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Denmark	110376.	.223	.280	1.25	3	.204	1.298
Norway	91703.	.243	.218	.90	3	.180	1.436
Sweden	100624.	.228	.214	.94	3	.201	1.366
Norwegian Surveys	101109.	.296	.270	.91	4	.114	1.362
F shrinkage mean	67961.	.50			.301	1.672	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
89661.	.17	.10	14	.606	1.453

Table 3.1.6 Virtual Population Analysis. XSA tuning output. Pandalus in Division IIIa and IVa east (continued)

Age 4 Catchability constant w.r.t. time and age (fixed at the value for age) 2

Year class = 1992

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Denmark	65367.	.235	.142	.61	4	.273	.504
Norway	45883.	.241	.086	.36	4	.265	.659
Sweden	49326.	.235	.087	.37	4	.272	.625
Norwegian Surveys	44756.	.369	.243	.66	5	.045	.671
F shrinkage mean		21157.	.50			.144	1.107

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
46036.	.13	.10	18	.769	.658

Table 3.1.7 Virtual Population Analysis. Fishing mortality at age. Pandalus in Division IIIa and IVa east

Run title : Pandalus IIIa + IVb Assessment

WG 1997

At 10/09/1997 12:53

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age													
YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996 FBAR 94-96	
AGE													
0	0	0	0	0	0.01	0	0	0.01	0	0	0	0	0
1	0.14	0.17	0.25	0.21	0.33	0.23	0.14	0.1	0.16	0.12	0.09	0.12	0.11
2	0.55	0.39	0.66	0.64	0.77	0.88	0.6	0.84	0.57	0.46	0.59	0.65	0.57
3	1.09	1	0.61	1.28	1.1	0.84	1.62	2.45	1.77	0.77	1.29	1.45	1.17
4	0.69	0.67	0.78	0.96	0.82	0.66	0.77	0.8	0.77	0.53	0.67	0.66	0.62
+gp	0.69	0.67	0.78	0.96	0.82	0.66	0.77	0.8	0.77	0.53	0.67	0.66	
FBAR 1-3	0.6	0.52	0.51	0.71	0.73	0.65	0.79	1.13	0.83	0.45	0.66	0.74	

Table 3.1.8 Virtual Population Analysis. Stock numbers at age. Pandalus in Division IIIa and IVa east

Run title : Pandalus IIIa + IVb Assessment

1997 WG

At 10/09/1997 12:53

Terminal Fs derived using XSA (With F shrinkage)

Table 10	Stock number at age (start of year)			Numbers*10**4		
YEAR	1985	1986	1987	1988	1989	1990
AGE						
0	1891297	1721079	1021516	1710757	2024567	1954166
1	1149748	890879	811954	481766	804309	948807
2	430877	472498	353763	297446	185391	272892
3	41937	116874	151310	86477	73758	40707
4	13969	6647	20247	38842	11310	11566
+gp	0	403	179	894	198	90
0 TOTAL	3527828	3208380	2358969	2616183	3099533	3228229

Table 10	Stock number at age (start of year)			Numbers*10**4					
YEAR	1991	1992	1993	1994	1995	1996	1997 GMST 85-94	AMST 85-94	
AGE									
0	1448935	2583316	1570289	1501006	2900214	73369	0	1697411	1742693
1	919891	683503	1212816	738817	707945	1368393	34588	838724	864249
2	356530	378406	292846	488505	309042	304709	571423	340448	352915
3	53671	92243	77189	78363	145392	81169	75365	75178	81253
4	8322	5042	3751	6209	17213	18814	8966	9931	12591
+gp	0	0	149	0	450	423	4707		
TOTAL	2787348	3742510	3157039	2812900	4080256	1846877	695049		

Table 3.1.9 Virtual Population Analysis. VPA summary tables without SOP corrections. Pandalus in Division IIIa and IVa east

At 10/09/1997 12:53

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 1- 3
Age 0						
1985	18912968	90516	21786	12628	.5796	.5953
1986	17210788	90647	12453	13264	1.0651	.5218
1987	10215159	69906	19240	15071	.7833	.5076
1988	17107574	64158	16115	12837	.7966	.7112
1989	20245670	76222	15956	12542	.7860	.7332
1990	19541660	82658	16987	11881	.6994	.6475
1991	14489346	76925	19765	12362	.6255	.7851
1992	25833162	90694	22343	13728	.6144	1.1299
1993	15702888	89438	19621	14059	.7088	.8326
1994	15010057	72470	24277	12076	.4974	.4497
1995	29002138	64966	22023	13938	.6329	.6583
1996	733691	74759	17905	15515	.8665	.7411
Arith.						
Mean	17000428	78613	19039	13312	.7213	.6928
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 3.1.10 Indices of 0- and 1-group shrimp from Norwegian trawl surveys in October and VPA values

Year-class	Survey		VPA		
	0-gr (IIla)	1-gr(IIla)	0-gr	1-gr	2-gr
1983		7023			4309
1984	3077	20902		11497	4725
1985	1813	6914	18913	8909	3538
1986	1432	5988	17211	8120	2974
1987	675	2541	10215	4818	1854
1988	2002	8714	17108	8043	2729
1989	9388	10743	20246	9488	3565
1990	4052	12116	19542	9199	3784
1991	1877	10739	14489	6835	2928
1992	19967	22294	25833	12128	4885
1993	4743	9911	15703	7388	3090
1994	2371	7890	15010	7079	3047
1995	1740	19022	29002	11616	
1996	9075		20570		

Bold figures estimated by regression survey-VPA

Table 3.1.11 Input data for the RCT3 analysis pandalus iiia and iva east. VPA 0-group 2,12,2

1985	18913	1813	6914
1986	17211	1432	5988
1987	10215	675	2541
1988	17108	2002	8714
1989	20246	9388	10743
1990	19542	4052	12116
1991	14489	1877	10739
1992	25833	19967	22294
1993	15703	4743	9911
1994	15010	2371	7890
1995	29002	1740	19022
1996	-11	9075	-11

survag0

survag1

Table 3.1.12 Result from estimation of year-class 1996 as 0-group Analysis by RCT3 ver3.1 of data from file :

pandsurv.txt

pandalus iiia and iva east. VPA 0-group

Data for 2 surveys over 12 years : 1985 - 1996

Regression type = C

Tapered time weighting applied

power = 3 over 20 years

Survey weighting not applied

Final estimates shrunk towards mean

Minimum S.E. for any survey taken as .20

Minimum of 3 points used for regression

Table 3.1.12 Result from estimation of year-class 1996 as 0-group (continued)
Forecast/Hindcast variance correction used.

Yearclass = 1990

I-----Regression-----I I-----Prediction-----I

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare Pts	No. Value	Index Value	Predicted Error	Std Weights	WAP
survag	.36	6.96	.25	.609	5	8.31	9.95	.376	.155
survag	.52	5.19	.11	.896	5	9.40	10.04	.173	.547

VPA Mean = 9.70 .271 .298

Yearclass = 1991

I-----Regression-----I I-----Prediction-----I

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare Pts	No. Value	Index Value	Predicted Error	Std Weights	WAP
survag	.35	7.04	.21	.642	6	7.54	9.66	.283	.235
survag	.48	5.48	.11	.876	6	9.28	9.93	.149	.472

VPA Mean = 9.73 .254 .293

Yearclass = 1992

I-----Regression-----I I-----Prediction-----I

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare Pts	No. Value	Index Value	Predicted Error	Std Weights	WAP
survag	.36	6.95	.20	.637	7	9.90	10.49	.359	.221
survag	.55	4.78	.20	.636	7	10.01	10.31	.319	.279

VPA Mean = 9.71 .238 .501

Yearclass = 1993

I-----Regression-----I I-----Prediction-----I

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare Pts	No. Value	Index Value	Predicted Error	Std Weights	WAP
survag	.28	7.50	.16	.765	8	8.46	9.90	.205	.393
survag	.50	5.28	.17	.759	8	9.20	9.83	.207	.386

VPA Mean = 9.77 .274 .221

Yearclass = 1994

I-----Regression-----I I-----Prediction-----I

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare Pts	No. Value	Index Value	Predicted Error	Std Weights	WAP
survag	.29	7.38	.18	.702	9	7.77	9.67	.219	.353
survag	.51	5.10	.17	.723	9	8.97	9.70	.208	.393

VPA Mean = 9.76 .258 .254

Table 3.1.12 Result from estimation of year-class 1996 as 0-group (contiued)

Yearclass = 1995

I-----Regression-----I I-----Prediction-----I									
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare Pts	No. Value	Index Value	Predicted Value	Std Error	WAP Weights
survag	.30	7.35	.17	.707	10	7.46	9.57	.205	.385
survag	.52	5.00	.17	.718	10	9.85	10.14	.215	.350
VPA Mean = 9.74 .247 .265									

Yearclass = 1996

I-----Regression-----I I-----Prediction-----I									
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare Pts	No. Value	Index Value	Predicted Value	Std Error	WAP Weights
survag	.54	5.44	.46	.307	11	9.11	10.40	.574	.201
survag									
VPA Mean = 9.80 .288 .799									

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1990	20387	9.92	.15	.11	.51	19542	9.88
1991	18202	9.81	.14	.08	.37	14489	9.58
1992	23130	10.05	.17	.25	2.12	25833	10.16
1993	18847	9.84	.13	.04	.08	15703	9.66
1994	16344	9.70	.13	.02	.03	15011	9.62
1995	18306	9.82	.13	.18	1.92	29002	10.28
1996	20286	9.92	.26	.24	.88		

Table 3.13

The SAS System
 Pandalus in Divisions IIIa & IVa East(Skagerrak & Norwegian Deep)

15:27 Sunday, October 5, 1997

Multi fleet prediction with mangement option table: Input data

1997	landings		discards							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0000	0.570	0.0000	0.570	16974.000	0.7500	0.0000	0.0000	0.0000	0.570
1	0.0660	3.430	0.0660	3.430	9572.000	0.7500	0.0000	0.0000	0.0000	3.430
2	0.6840	5.630	0.0000	1.000	5714.000	0.7500	0.5200	0.0000	0.0000	5.630
3	1.4040	8.570	0.0000	1.000	754.000	0.7500	1.0000	0.0000	0.0000	8.570
4	0.7440	11.830	0.0000	1.000	90.000	0.7500	1.0000	0.0000	0.0000	11.830
5+	0.7440	15.900	0.0000	1.000	47.000	0.7500	1.0000	0.0000	0.0000	15.900
Unit	-	Grams	-	Grams	Millions	-	-	-	-	Grams

1998	landings		discards							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Recruit- ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0000	0.570	0.0000	0.570	16974.000	0.7500	0.0000	0.0000	0.0000	0.570
1	0.0660	3.430	0.0660	3.430	.	0.7500	0.0000	0.0000	0.0000	3.430
2	0.6840	5.630	0.0000	1.000	.	0.7500	0.5200	0.0000	0.0000	5.630
3	1.4040	8.570	0.0000	1.000	.	0.7500	1.0000	0.0000	0.0000	8.570
4	0.7440	11.830	0.0000	1.000	.	0.7500	1.0000	0.0000	0.0000	11.830
5+	0.7440	15.900	0.0000	1.000	.	0.7500	1.0000	0.0000	0.0000	15.900
Unit	-	Grams	-	Grams	Millions	-	-	-	-	Grams

1999	landings		discards							
Age	Exploit. pattern	Weight in catch	Exploit. pattern	Weight in catch	Recruit- ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock
0	0.0000	0.570	0.0000	0.570	16974.000	0.7500	0.0000	0.0000	0.0000	0.570
1	0.0660	3.430	0.0660	3.430	.	0.7500	0.0000	0.0000	0.0000	3.430
2	0.6840	5.630	0.0000	1.000	.	0.7500	0.5200	0.0000	0.0000	5.630
3	1.4040	8.570	0.0000	1.000	.	0.7500	1.0000	0.0000	0.0000	8.570
4	0.7440	11.830	0.0000	1.000	.	0.7500	1.0000	0.0000	0.0000	11.830
5+	0.7440	15.900	0.0000	1.000	.	0.7500	1.0000	0.0000	0.0000	15.900
Unit	-	Grams	-	Grams	Millions	-	-	-	-	Grams

Notes: Run name : MANHS07
 Date and time: 05OCT97:15:28

Continued.....

Table 3.13 (Continued)

The SAS System

15:27 Sunday, October 5, 1997

Pandalus in Divisions IIIa & IVa East(Skagerrak & Norwegian Deep)

Multi fleet prediction with mangement option table

Year: 1997								
landings			discards			Total		
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.7180	17550	1.0000	0.0330	1440	18990	82951	25002
-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes

Year: 1998									Year: 1999	
landings			discards			Total				
F Factor	Reference F	Catch in weight	F Factor	Reference F	Catch in weight	Catch in weight	Stock biomass	Sp.stock biomass	Stock biomass	Sp.stock biomass
0.0000	0.0000	0	0.0000	0.0000	0	0	72681	24796	83039	35627
0.1000	0.0718	2331	0.1000	0.0033	127	2458	.	24796	80638	33361
0.2000	0.1436	4471	0.2000	0.0066	252	4723	.	24796	78447	31301
0.3000	0.2154	6439	0.3000	0.0099	377	6815	.	24796	76442	29427
0.4000	0.2872	8252	0.4000	0.0132	499	8751	.	24796	74604	27718
0.5000	0.3590	9925	0.5000	0.0165	620	10546	.	24796	72916	26158
0.6000	0.4308	11473	0.6000	0.0198	740	12213	.	24796	71363	24731
0.7000	0.5026	12906	0.7000	0.0231	859	13765	.	24796	69931	23423
0.8000	0.5744	14236	0.8000	0.0264	976	15212	.	24796	68608	22222
0.9000	0.6462	15473	0.9000	0.0297	1092	16564	.	24796	67384	21119
1.0000	0.7180	16624	1.0000	0.0330	1206	17830	.	24796	66248	20102
1.1000	0.7898	17698	1.1000	0.0363	1319	19017	.	24796	65193	19164
1.2000	0.8616	18702	1.2000	0.0396	1431	20133	.	24796	64211	18298
1.3000	0.9334	19641	1.3000	0.0429	1542	21182	.	24796	63294	17496
1.4000	1.0052	20521	1.4000	0.0462	1651	22172	.	24796	62438	16753
1.5000	1.0770	21347	1.5000	0.0495	1759	23106	.	24796	61636	16063
1.6000	1.1488	22124	1.6000	0.0528	1866	23989	.	24796	60885	15421
1.7000	1.2206	22855	1.7000	0.0561	1972	24826	.	24796	60178	14824
1.8000	1.2924	23544	1.8000	0.0594	2076	25620	.	24796	59514	14267
1.9000	1.3642	24196	1.9000	0.0627	2179	26375	.	24796	58888	13746
2.0000	1.4360	24811	2.0000	0.0660	2281	27093	.	24796	58296	13259
-	-	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANHS07
Date and time : 05OCT97:15:28
Computation of ref. F: landings: Simple mean, age 1 - 3
discards: Simple mean, age 1 - 2
Basis for 1997 : F factors

3.1.14 Input data for the RCPUE from Norwegian survey

INPUT DATA

```

Pandalus in Div IIIa, IVaE      ! TITLE
5,12                            ! No. of age groups, no. of years
0,0,1985,1                      ! accuracy, lowest age, first year, plus group (0=no,1=yes)
2694,35741,16347,3228,1443
1304,10456,6853,2823,201
909,26002,11055,7289,933
2196,3368,4150,2935,533
10247,20024,5791,466,10
4546,18504,9186,980,66
2240,25208,9958,2112,263
22644,19058,11070,4232,382
4763,30753,8903,3323,166
2674,18622,10238,4135,1360
1702,13839,4590,9288,365
9150,28273,12045,5380,425
0.5,1,1,1,0.7                  ! relative weight give to each age
.75,.75,.75,.75,.75           ! natural mortality
0,0,0.5,1,1                    !,proportion,mature
1.2,3.55,5.65,8.53,11.57      !,weight,at,age,in,catch
,0,0,0,0,0                     !,not,used
1.1,3.55,5.65,8.53,11.57      !,weight,at,age,in,stock
0,0,0,0,0                      !,not,used
1,3                             !,age,range,for,mean,F
0.08,0.9,1,1,1                ! relative catchability by age in survey

```

Table 3.1.15 Results and diagnostics of RCPUE5 analysis of Norwegian *Pandalus* trawl survey results in Div IIIa and IVa east.

ANALYSIS BY RCSEP OF Pandalus in Div IIIa, IVaE ! TITLE

Source data

Age	M	Prop.mat.	cat.wt	stk.wt
0	.75	.00	1.2000	1.1000
1	.75	.00	3.5500	3.5500
2	.75	.50	5.6500	5.6500
3	.75	1.00	8.5300	8.5300
4	.75	1.00	11.5700	11.5700

Abundance index data

Age	1985	1986	1987	1988	1989	1990
0	2694.0	1304.0	909.0	2196.0	10247.0	4546.0
1	35741.0	10456.0	26002.0	3368.0	20024.0	18504.0
2	16347.0	6853.0	11055.0	4150.0	5791.0	9186.0
3	3228.0	2823.0	7289.0	2935.0	466.0	980.0
4	1443.0	201.0	933.0	533.0	10.0	66.0

Age	1991	1992	1993	1994	1995	1996
0	2240.0	22644.0	4763.0	2674.0	1702.0	9150.0
1	25208.0	19058.0	30753.0	18622.0	13839.0	28273.0
2	9958.0	11070.0	8903.0	10238.0	4590.0	12045.0
3	2112.0	4232.0	3323.0	4135.0	9288.0	5380.0
4	263.0	382.0	166.0	1360.0	365.0	425.0

Continued...

Relative weight applied by age

Value for smoother set to 2.0000

IFAIL on exit from E04FDF = 0

Residual sum of squares= 14.6393

Number of observations= 70

Number of parameters = 30

Residual mean square = .3660

Coefficient of determination = .8845

Adj. coeff. of determination = .8008

IFAIL from E04YCF= 0

Parameter Correlation matrix

```

1.0000
.3987 1.0000
.0214 .2623 1.0000
-.1460 -.0702 .2358 1.0000
-.2141 -.1999 -.0683 .2520 1.0000
-.2360 -.2495 -.1914 -.0572 .2516 1.0000
-.2377 -.2631 -.2357 -.1763 -.0504 .2561 1.0000
-.2338 -.2633 -.2488 -.2199 -.1686 -.0480 .2496 1.0000
-.2309 -.2623 -.2540 -.2377 -.2142 -.1652 -.0506 .2467
-.2261 -.2590 -.2539 -.2434 -.2324 -.2108 -.1664 -.0538
.0151 .0254 .0297 .0127 .0072 -.0066 -.0246 -.0230
.0480 .0561 .0238 .0116 -.0166 -.0486 -.0389 -.0214
.0876 .0382 .0092 -.0300 -.0699 -.0434 -.0170 -.0117
-.0399 -.0512 -.1055 -.1147 -.0190 .0435 .0540 .0528
.1598 .0645 -.0044 -.0340 -.0372 -.0355 -.0349 -.0343
.3041 .1228 -.0084 -.0647 -.0709 -.0675 -.0664 -.0654
.2748 .3155 .0679 -.0647 -.1117 -.1090 -.1015 -.0993
.1046 .1910 .2206 .0319 -.0648 -.0981 -.0960 -.0890
.0349 .0666 .1360 .1518 .0087 -.0550 -.0778 -.0769
.0150 .0178 .0394 .1097 .1506 .0018 -.0583 -.0720
.0054 .0035 -.0011 .0180 .0887 .1263 -.0042 -.0490
-.0068 -.0091 -.0185 -.0245 .0033 .0718 .1168 .0101
-.0169 -.0245 -.0380 -.0527 -.0423 -.0031 .0862 .1475
-.0231 -.0357 -.0540 -.0731 -.0762 -.0592 -.0061 .1089
-.0230 -.0330 -.0515 -.0711 -.0781 -.0768 -.0543 .0084
-.0252 -.0373 -.0550 -.0760 -.0836 -.0844 -.0757 -.0426
.0211 .0179 .0051 -.0136 -.0315 -.0429 -.0422 -.0294
.0152 .0215 .0168 .0063 -.0021 -.0152 -.0214 -.0164
.0049 .0085 .0100 .0041 .0022 -.0026 -.0089 -.0082
.0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000

```

```

1.0000
.2468 1.0000
-.0148 -.0126 1.0000
-.0181 -.0138 -.3770 1.0000
-.0086 .0091 -.0002 -.4623 1.0000
.0635 .0536 -.0044 -.0052 -.4127 1.0000
-.0329 -.0330 .0022 .0069 -.0207 .0811 1.0000
-.0627 -.0628 .0041 .0132 -.0394 .1543 -.0749 1.0000
-.0958 -.0891 .0071 -.1544 .3384 -.0154 .0405 .0770

```

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Table 3.1.15 Results and diagnostics of RCPUE5 analysis of Norwegian *Pandalus* trawl survey results in Div IIIa and IVa east (continued).

-.0857	-.0797	-.1836	.3864	-.0070	.0236	.0197	.0375
-.0705	-.0648	.5693	-.0222	.0436	.0133	.0072	.0137
-.0721	-.0668	.4844	.0537	.0926	-.0427	-.0011	-.0021
-.0613	-.0621	.5437	.1421	-.0371	-.0224	-.0011	-.0022
-.0336	-.0489	.7059	-.0286	-.0353	.0111	-.0002	-.0004
.0266	-.0274	.6227	-.0551	.0083	.0214	-.0010	-.0018
.1823	.0506	.4856	.0107	.0307	.0104	-.0029	-.0056
.1229	.1790	.4694	.0516	-.0248	.0319	-.0011	-.0021
.0267	.1585	.5171	-.0413	.0340	.0286	-.0017	-.0032
-.0090	.0277	.3938	.0419	.0270	-.0701	-.0027	-.0051
-.0102	-.0041	.3948	.0299	-.0964	-.0026	.0022	.0042
-.0051	-.0038	.3485	-.1314	-.0001	-.0014	.0007	.0013
.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
1.0000							
.0574	1.0000						
.0418	.0302	1.0000					
.0362	.0601	.3986	1.0000				
-.0157	.0599	.4254	.4263	1.0000			
-.0153	-.0268	.4740	.4427	.5182	1.0000		
-.0025	-.0319	.4134	.3824	.4405	.5228	1.0000	
.0006	.0015	.3411	.3225	.3676	.4219	.3878	1.0000
-.0165	.0106	.3331	.3128	.3622	.4073	.3657	.3233
.0039	-.0214	.3473	.3203	.3601	.4188	.3731	.3242
.0067	.0209	.2885	.2771	.3134	.3439	.3012	.2590
-.0296	-.0071	.2644	.2400	.2865	.3278	.2830	.2322
.0023	-.0641	.1983	.1687	.1894	.2459	.2170	.1692
.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
1.0000							
.3366	1.0000						
.2600	.2772	1.0000					
.2339	.2384	.1958	1.0000				
.1637	.1806	.1373	.1376	1.0000			
.0000	.0000	.0000	.0000	.0000	1.0000		

Parameter s.d.

year effects

1.0667	.2632
.9627	.2108
1.1946	.1974
1.5155	.1971
1.1677	.1977
.8725	.1977
.8602	.1974
.9017	.1966
.7241	.1960
.8287	.2037

age effects

.0051	.3042
.0329	.2451
.3658	.2455
1.9588	.2568

y/c effects

7.2161	.7093
7.9909	.5660
9.6968	.4291
10.4467	.3713
10.2518	.4032
9.9521	.3877
9.7534	.4229
10.5851	.4742
10.8187	.4151
11.0338	.3722
10.6664	.3737
11.3649	.3807
10.6725	.3674
10.6135	.4260
10.7282	.5270
11.6472	.8555

Continued....

Table 3.1.15 Results and diagnostics of RCPUE5 analysis of Norwegian *Pandalus* trawl survey results in Div IIIa and IVa east (continued).

F-at-age

Age	1985	1986	1987	1988	1989	1990
0	.0054	.0049	.0061	.0077	.0060	.0044
1	.0351	.0317	.0394	.0499	.0385	.0287
2	.3902	.3522	.4370	.5544	.4271	.3192
3	2.0894	1.8858	2.3401	2.9686	2.2872	1.7090
4	2.0894	1.8858	2.3401	2.9686	2.2872	1.7090

Age	1991	1992	1993	1994	1995
0	.0044	.0046	.0037	.0042	.0046
1	.0283	.0297	.0239	.0273	.0298
2	.3147	.3299	.2649	.3031	.3312
3	1.6850	1.7663	1.4185	1.6232	1.7738
4	1.6850	1.7663	1.4185	1.6232	1.7738

Log fitted Index

Age	1985	1986	1987	1988	1989	1990
0	10.2518	9.9521	9.7534	10.5851	10.8187	11.0338
1	10.4467	9.4964	9.1972	8.9973	9.8274	10.0627
2	9.6968	9.6616	8.7146	8.4078	8.1974	9.0389
3	7.9909	8.5566	8.5594	7.5276	7.1034	7.0203
4	7.2161	5.5305	5.9682	5.5416	3.9377	4.1075

Age	1991	1992	1993	1994	1995	1996
0	10.6664	11.3649	10.6725	10.6135	10.7282	11.6472
1	10.2793	9.9120	10.6103	9.9188	9.8593	9.9736
2	9.2840	9.5010	9.1323	9.8365	9.1415	9.0795
3	7.9698	8.2193	8.4211	8.1174	8.7833	8.0602
4	4.6141	5.5690	5.7712	6.3210	5.8977	6.3139

Fitted index

Age	1985	1986	1987	1988	1989	1990
0	28333.2	20996.1	17213.0	39543.1	49945.8	61931.7
1	34432.0	13311.1	9869.3	8081.4	18535.0	23452.7
2	16265.9	15702.8	6091.4	4482.0	3631.5	8424.9
3	2953.9	5201.2	5215.7	1858.7	1216.2	1119.1
4	1361.1	252.3	390.8	255.1	51.3	60.8

Age	1991	1992	1993	1994	1995	1996
0	42890.8	86242.3	43151.5	40681.6	45624.0	114375.0
1	29124.6	20171.5	40551.1	20308.2	19135.6	21452.0
2	10764.3	13373.0	9249.4	18703.3	9334.5	8773.3
3	2892.2	3712.0	4542.1	3352.4	6524.6	3166.0
4	100.9	262.2	320.9	556.1	364.2	552.2

fitted catch-at-age

Age	1985	1986	1987	1988	1989	1990	1991	1992
0	108.2	72.4	73.6	214.3	208.7	193.5	132.1	278.5
1	838.4	293.0	268.6	277.8	493.3	468.4	573.6	416.2
2	3786.5	3350.9	1558.3	1388.0	911.6	1651.6	2084.4	2697.5
3	2046.6	3454.5	3770.1	1447.8	871.9	711.2	1826.1	2395.2
4	943.0	167.5	282.5	198.7	36.8	38.6	63.7	169.2

Age	1993	1994	1995
0	111.9	120.7	147.9
1	673.6	385.5	396.5
2	1539.2	3505.5	1889.8
3	2631.3	2079.3	4218.1
4	185.9	344.9	235.5

Continued....

Table 3.1.15 Results and diagnostics of RCPUE5 analysis of Norwegian *Pandalus* trawl survey results in Div IIIa and IVa east (continued).

Log Population residuals

Age	1985	1986	1987	1988	1989	1990
0	.1221	-.1790	-.2937	-.2581	.6659	-.0609
1	.1427	-.1361	1.0741	-.7699	.1826	-.1316
2	.0050	-.8292	.5960	-.0770	.4667	.0865
3	.0887	-.6111	.3347	.4568	-.9593	-.1327
4	.0489	-.1901	.7281	.6165	-1.3680	.0687

Age	1991	1992	1993	1994	1995	1996
0	-.3015	.8404	.2276	-.1389	-.5395	.0000
1	-.0391	.0486	-.1712	.0187	-.2187	.3815
2	-.0779	-.1890	-.0382	-.6026	-.7098	.3169
3	-.3144	.1311	-.3125	.2098	.3531	.5302
4	.8015	.3149	-.5516	.7482	.0018	-.2190

Year	TSB	SSB	Yield	Fbar	RECS
1985	286247	86896	52868	.838	28333
1986	206355	91645	51465	.757	20996
1987	137398	66219	45273	.939	17212
1988	116315	31467	23734	1.191	39543
1989	152224	21226	15015	.918	49945
1990	209231	34049	17740	.686	61931
1991	237228	56247	30285	.676	42890
1992	276729	72475	39441	.709	86242
1993	286138	68586	35818	.569	43151
1994	257547	87866	43045	.651	40681
1995	230726	86238	50966	.712	45624
1996	284931	58179	0	.000	114375

Table 3.2.1 Landings in tonnes of *Pandalus borealis* from the Fladen Ground (Division IVa) as estimated by the Study Group

Year	Denmark	Sweden	Norway	UK (Scotland)	Total
1972	2 204			187	2 391
1973	157			163	320
1974	282			434	716
1975	1 308			525	1 833
1976	1 552			1 937	3 489
1977	425		112	1 692	2 229
1978	890		81	2 027	2 998
1979	565		44	268	877
1980	1 122		76	377	1 575
1981	685		1	347	1 033
1982	283			352	635
1983	5 729		8	1 827	7 564
1984	4 553		13	25	4 591
1985	3 649			1 341	4 990
1986	3 416			301	3 717
1987	7 326			686	8 012
1988	1 077		2	84	1 163
1989	2 438		25	547	3 010
1990	1 681	4	3	365	2 053
1991	422		31	53	506
1992	1 448			116	1 564
1993	1 521		38	509	2 068
1994	1 207		0	35	1 242
1995	4 578		30	657	5 265
1996	3 881		32	1823	5 736

Table 3.2.2 Pandalus borealis Fladen Ground. Reported CPUE (shrimp trawlers) and estimated effort.

Year	Denmark			UK (Scotland)			Combined index2
	CPUE (ton./day)	Total effort (Days)	Index1	CPUE (kg/hour)	Total effort (hours)	Index1	
1982	0 96	295	0 10	74	4 757	0 31	0 21
1983	1 18	4 855	1 61	89	20 528	1 32	1 54
1984	0 97	4 694	1 56	37	676	0 04	1 55
1985	1 21	3 016	1 00	86	15 593	1 00	1 00
1986	0 96	3 558	1 18	71	4 239	0 27	1 11
1987	1 24	5 908	1 96	81	8 469	0 54	1 84
1988	0 83	1 298	0 43	44	1 909	0 12	0 41
1989	0 99	2 463	0 82	65	8 415	0 54	0 77
1990	1 28	1 313	0 44	106	3 493	0 22	0 40
1991	1 5	281	0 09	124	429	0 03	0 09
1992	1 44	1 006	0 33	69	1 685	0 11	0 32
1993	1 83	831	0 28	90	5 229	0 34	0 29
1994	1 93	621	0 21	91	330	0 02	0 20
1995	2 00	2 292	0 76	130	5 038	0 32	0 71
1996	1 79	2 168	0 72	62	11 638	0 75	0 72

Table 3.3.1 Landings(t) of Pandalus borealis from Division IVb the Farn Deep as estimated by the Working Group

Year	UK (England)	UK (Scotland)	Denmark	Total
1977	227		No data	
1978	91	2	-	
1979	235	34	-	
1980	203	17	-	
1981	1		-	
1982			-	
1983	65		-	
1984	30		-	
1985	2	6	-	
1986	137	57	106	300
1987	212	86	92	390
1988	91	25	384	500
1989	168	8	72	248
1990	144	+	1	145
1991	3			3
1992	1			1
1993				0
1994	4			4
1995	171			171
1996	58	2		60

**Table 4.1 Catch (tonnes) by species in Danish shrimp fishery (data from log book information).
All bottomtrawling trips with codend meshsize 30-40 mm and vessel size ≥ 5 GRT.**

FLADEN GRUND 1996						
Species:	Quarter: Q.1	Q. 2	Q. 3	Q. 4	TOTAL	% of the total catch
Other market fish	3.3	2.2	0.5	0.0	6.1	0.1
Other industrial fish	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	61.8	23.4	15.4	1.1	101.6	2.3
Shrimp	1037.4	1495.4	1104.4	42.5	3679.7	82.6
Anglerfish (Monk)	93.5	71.7	20.0	1.4	186.5	4.2
Whiting	1.8	0.6	2.9	0.3	5.5	0.1
Haddock	16.4	9.8	24.7	3.3	54.2	1.2
European hake	0.0	0.0	0.2	0.0	0.2	0.0
Common Ling	1.3	1.1	0.7	0.0	3.1	0.1
Saithe	7.6	16.0	6.9	0.1	30.5	0.7
Witch	1.2	1.8	0.5	0.2	3.7	0.1
Norway Pout	0.0	0.0	0.0	0.0	0.0	0.0
Cod	119.3	134.2	89.3	8.5	351.3	7.9
Other fish	11.9	13.3	7.3	0.7	33.1	0.7
TOTAL	1355.3	1769.4	1272.8	58.0	4455.6	100.0

NORWEGIAN DEEPS 1996						
Species:	Quarter: Q.1	Q. 2	Q. 3	Q. 4	TOTAL	% of the total catch
Other market fish	0.1	0.1	0.0	1.2	1.4	0.5
Other industrial fish	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	9.2	1.8	1.8	5.7	18.5	7.5
Shrimp	98.7	39.4	11.2	31.9	181.3	73.5
Anglerfish (Monk)	9.5	2.4	0.4	1.4	13.7	5.6
Whiting	0.1	0.0	0.0	0.0	0.1	0.04
Haddock	1.8	0.1	0.0	0.0	1.9	0.8
European hake	0.0	0.8	0.2	0.8	1.8	0.7
Common Ling	0.3	0.3	0.0	0.2	0.9	0.4
Saithe	6.6	0.4	0.0	0.6	7.6	3.1
Witch	0.5	0.1	0.2	0.4	1.2	0.5
Norway Pout	0.0	0.0	0.0	0.0	0.0	0.0
Cod	8.8	2.8	0.4	1.1	13.1	5.3
Other fish	3.1	1.0	0.2	0.9	5.1	2.1
TOTAL	138.7	49.2	14.4	44.3	246.5	100.0

Table 4.1 continued.

SKAGERRAK 1996						
Species:	Quarter: Q.1	Q. 2	Q. 3	Q. 4	TOTAL	% of the total catch
Other market fish	3.0	0.7	0.7	1.4	5.8	0.1
Other industrial fish	28.0	14.1	0.0	11.0	53.1	1.2
Blue Whiting	40.3	15.8	5.0	28.0	89.0	2.0
Norway Lobster	24.3	9.4	8.1	23.2	65.1	1.5
Shrimp	1033.6	1061.6	671.8	845.1	3612.0	81.6
Anglerfish (Monk)	16.0	7.5	1.4	4.4	29.3	0.7
Whiting	1.0	0.0	0.0	0.0	1.0	0.0
Haddock	19.0	1.5	0.1	0.9	21.5	0.5
European hake	0.0	2.5	2.0	2.4	6.8	0.2
Common Ling	0.2	0.7	0.1	0.1	1.0	0.0
Saithe	53.4	17.8	1.7	13.0	85.8	1.9
Witch	11.7	7.4	2.7	10.4	32.2	0.7
Norway Pout	83.3	20.0	0.0	17.1	120.3	2.7
Cod	85.9	50.7	13.5	32.0	182.1	4.1
Other fish	45.8	37.8	16.4	21.5	121.5	2.7
TOTAL	1445.4	1247.5	723.3	1010.3	4426.6	100.0

Table 4.2 Bycatch in the Danish shrimp fishery (data from the Danish discard project).

Fladen Grund 1. Quarter				Total catch of shrimp in		
Number of haul samples=28				the international shrimp		
Total catch=33614 kg				fishery 1996= 1172 ton		
Species:	Catch (kg) per kg shrimp	Catch (numbers) per kg shrimp	Av. Weight (kg) per individual	Ton	Raised figures: Numbers (1000)	% weight of total catch
American Plaice	0.004	0.156	0.030	6	183	0.3
Anglerfish (Monk)	0.051	0.018	2.744	60	22	3.1
Blue Whiting	0.0002	0.003	0.075	0.3	4	0.0
Catfish (Wolffish)	0.0001	0.0001	1	0.2	0.2	0.0
Cod	0.181	0.140	1.29	213	164	11.1
Common Ling	0.007	0.005	1.580	9	6	0.5
European Plaice	0.0001	0.0004	0.312	0.1	0.4	0.0
European hake	0.00009			0.1		0.0
Four bearded Rockling	0.0009	0.009	0.100	1	11	0.1
Haddock	0.118	0.561	0.211	138	658	7.2
Halibut	0.0004	0.0001	2.733	0.5	0.2	0.0
Herring	0.001	0.012	0.089	1	14	0.1
Horse Mackerel (Scad)	0.001	0.004	0.292	2	5	0.1
Lemon Sole	0.00007	0.0003	0.202	0.1	0.4	0.0
Lesser Silver Smelt	0.0003	0.022	0.016	0.4	26	0.0
Lumpsucker	0.002	0.002	1.199	3	2	0.1
Norway Lobster	0.080			94		4.9
Norway Pout	0.072	3.307	0.021	84	3876	4.4
Saithe	0.0008	0.0002	2.865	1	0.3	0.1
Snake Blenny	0.0008	0.028	0.028	1	33	0.0
Spurdog(dogfish)	0.003	0.001	2.093	4	2	0.2
Starry Ray	0.0001	0.0009	0.202	0.2	1	0.0
Three bearded rockling	0.0001	0.0006	0.231	0.2	1	0.0
Turbot	0.0004	0.00005	8.4	0.5	0.1	0.0
Tusk	0.00009	0.00005	1.77	0.1	0.1	0.0
Whiting	0.110	0.853	0.129	129	1001	6.7
Witch	0.0005	0.001	0.325	1	2	0.0
Shrimp	1			1172		61.0

Table 4.2 continued.

Norwegian Deepseas 3. Quarter		Total catch of shrimp in the international shrimp fishery 1996= 423 ton				
Number of haul samples=2 Total catch=1920 kg						
Species:	Catch (kg) per kg shrimp	Catch (numbers) per kg shrimp	Av. Weight (kg) per individual	Ton	Raised figures: Numbers (1000)	% weight of total catch
American Plaice	0.004	1.233	0.003	2	522	0.1
Anglerfish (Monk)	0.018	0.011	1.714	8	5	0.6
Blue Whiting	0.342	1.641	0.209	145	694	11.7
Cod	0.049	0.038	1.28	21	16	1.7
Common Ling	0.003	0.006	0.5	1	3	0.1
European hake	0.066	0.084	0.782	28	35	2.2
Invertebrates	0.027			12		0.9
Lesser Silver Smelt	0.028	0.550	0.050	12	233	0.9
Norway Lobster	0.367			155		12.5
Norway Pout	0.686	20.44	0.034	290	8646	23.4
Three bearded rockling	0.288	5.217	0.055	122	2207	9.9
Tusk	0.002	0.002	1	1	1	0.1
Witch	0.046	0.166	0.275	19	70	1.6
Shrimp	1			423		34.2

Skagerrak 1. Quarter		Total catch of shrimp in the international shrimp fishery 1996= 3209 ton				
Number of haul samples=3 Total catch=2205 kg						
Species:	Catch (kg) per kg shrimp	Catch (numbers) per kg shrimp	Av. Weight (kg) per individual	Ton	Raised figures: Numbers (1000)	% weight of total catch
American Plaice	0.001			4		0.1
Anglerfish (Monk)	0.004	0.0007	5	12	2	0.2
Cod	0.042	0.058	0.72	134	185	2.8
Common Ling	0.022	0.015	1.42	71	50	1.5
European Plaice	0.003	0.010	0.26	9	34	0.2
European hake	0.005			17		0.4
Haddock	0.028			91		1.9
Herring	0.044			142		2.9
Horse Mackerel (Scad)	0.003			9		0.2
Invertebrates	0.027			85		1.7
Lemon Sole	0.0003	0.0007	0.4	1	2	0.0
Saithe	0.231	0.261	0.8	741	838	15.3
Three bearded rockling	0.011			34		0.7
Whiting	0.008	0.015	0.5	25	50	0.5
Witch	0.084			269		5.5
Shrimp	1			3209		66.1

Table 4.2 continued.

Skagerrak 2. Quarter Number of haul samples=20 Total catch=14193 kg				Total catch of shrimp in the international shrimp fishery 1996= 3609 ton		
Species:	Catch (kg) per kg shrimp	Catch (numbers) per kg shrimp	Av. weight (kg) per individual	Ton	Raised figures: Numbers (1000)	% weight of total catch
American Plaice	0.005			20		0.4
Anglerfish (Monk)	0.006	0.003	2.137	22	10	0.4
Blue Whiting	0.041	0.232	0.180	151	838	3.0
Brill	0.00004	0.0001	0.4	0.1	0.4	0.003
Catfish (Wolffish)	0.0002	0.0001	2	1	0.4	0.01
Cod	0.054	0.067	0.816	198	242	3.9
Common Ling	0.007	0.004	1.972	27	14	0.5
Common Skate	0.002	0.0006	3.167	7	2	0.1
European Eel	0.00004	0.0001	0.4	0.1	0.4	0.0
European Plaice	0.0001	0.004	0.231	3	15	0.1
European hake	0.012	0.035	0.338	42	126	0.8
Four bearded Rockling	0.014	0.240	0.060	52	865	1.0
Garfish	0.0003	0.001	0.3	1	4	0.0
Haddock	0.023	0.087	0.261	82	313	1.6
Hagfish	0.0005			2		0.0
Halibut	0.007	0.0004	18	26	1	0.5
Herring	0.038	0.226	0.170	139	814	2.7
Invertebrates	0.006			21		0.4
Lemon Sole	0.0003	0.002	0.163	1	8	0.02
Norway Lobster	0.0001			0.4		0.01
Norway Pout	0.079	7.074	0.011	287	25530	5.7
Rabbit Fish (Rat tail)	0.003	0.024	0.134	12	87	0.2
Roundnose Grenadier	0.0006	0.0006	1.033	2	2	0.0
Saithe	0.046	0.064	0.725	168	231	3.3
Silvery Pout	0.0003	0.004	0.102	1	12	0.0
Spurdog(dogfish)	0.0003	0.0002	1.575	1	1	0.0
Three bearded rockling	0.006			21		0.4
Vahls Eelpout	0.0009	0.045	0.021	3	161	0.1
Whiting	0.007	0.036	0.184	24	129	0.5
Witch	0.039	0.786	0.050	140	2834	2.8
Shrimp	1			3609		71.3

Table 4.2 continued.

Skagerrak 3. Quarter Number of haul samples=7 Total catch=7150 kg				Total catch of shrimp in the international shrimp fishery 1996= 2654 ton		
Species:	Catch (kg) per kg shrimp	Catch (numbers) per kg shrimp	Av. Weight (kg) per individual	Ton	Raised figures: Numbers (1000)	% weight of total catch
American Plaice	0.056	2.370	0.024	149	6291	1.7
Anglerfish (Monk)	0.071	0.013	5.621	187	33	2.1
Blue Whiting	0.242	1.437	0.168	641	3813	7.2
Catfish (Wolffish)	0.0009	0.0005	2	2	1	0.03
Cod	0.069	0.038	1.818	184	101	2.1
Common Ling	0.009	0.004	2.313	23	10	0.3
Common Skate	0.008	0.003	3	22	7	0.3
Dab	0.003	0.051	0.050	7	135	0.1
European Plaice	0.0009	0.001	0.633	2	4	0.0
European hake	0.067	0.074	0.899	177	197	2.0
Haddock	0.088	4.289	0.021	234	11383	2.6
Halibut	0.002	0.0005	5	6	1	0.1
Herring	0.030			79		0.9
Invertebrates	0.082			219		2.5
Lemon Sole	0.0001	0.0005	0.3	0.4	1	0.004
Lesser Silver Smelt	0.0006	0.058	0.011	2	154	0.02
Norway Lobster	0.326			865		9.7
Norway Pout	0.736	23.527	0.031	1952	62441	22.0
Saithe	0.010	0.017	0.578	26	45	0.3
Three bearded rockling	0.457	8.146	0.056	1212	21620	13.6
Witch	0.090	0.404	0.222	238	1072	2.7
Shrimp	1			2654		29.9

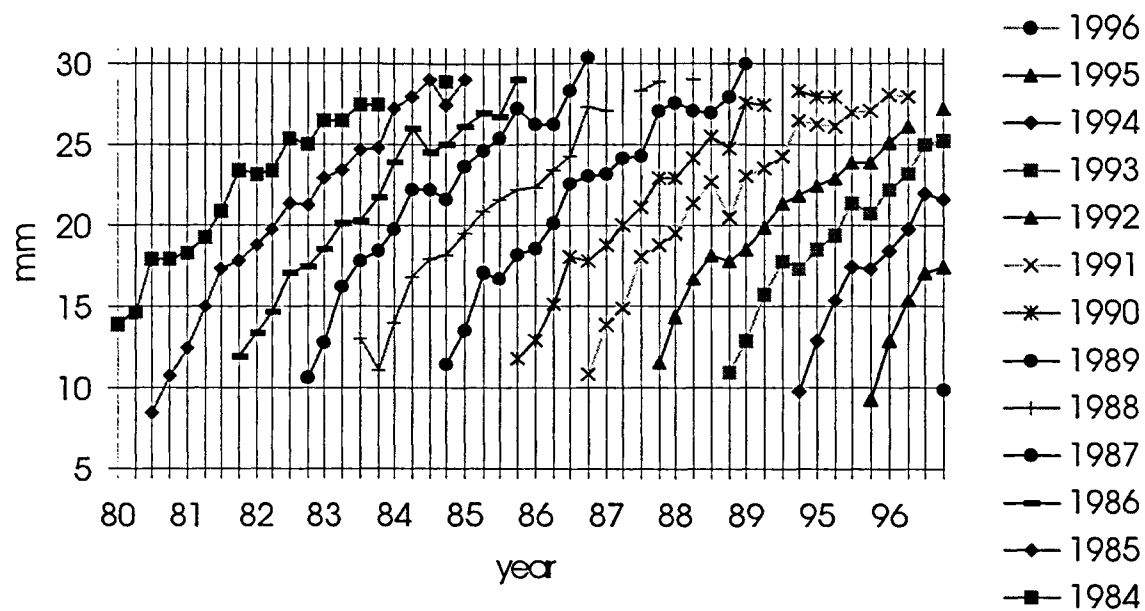
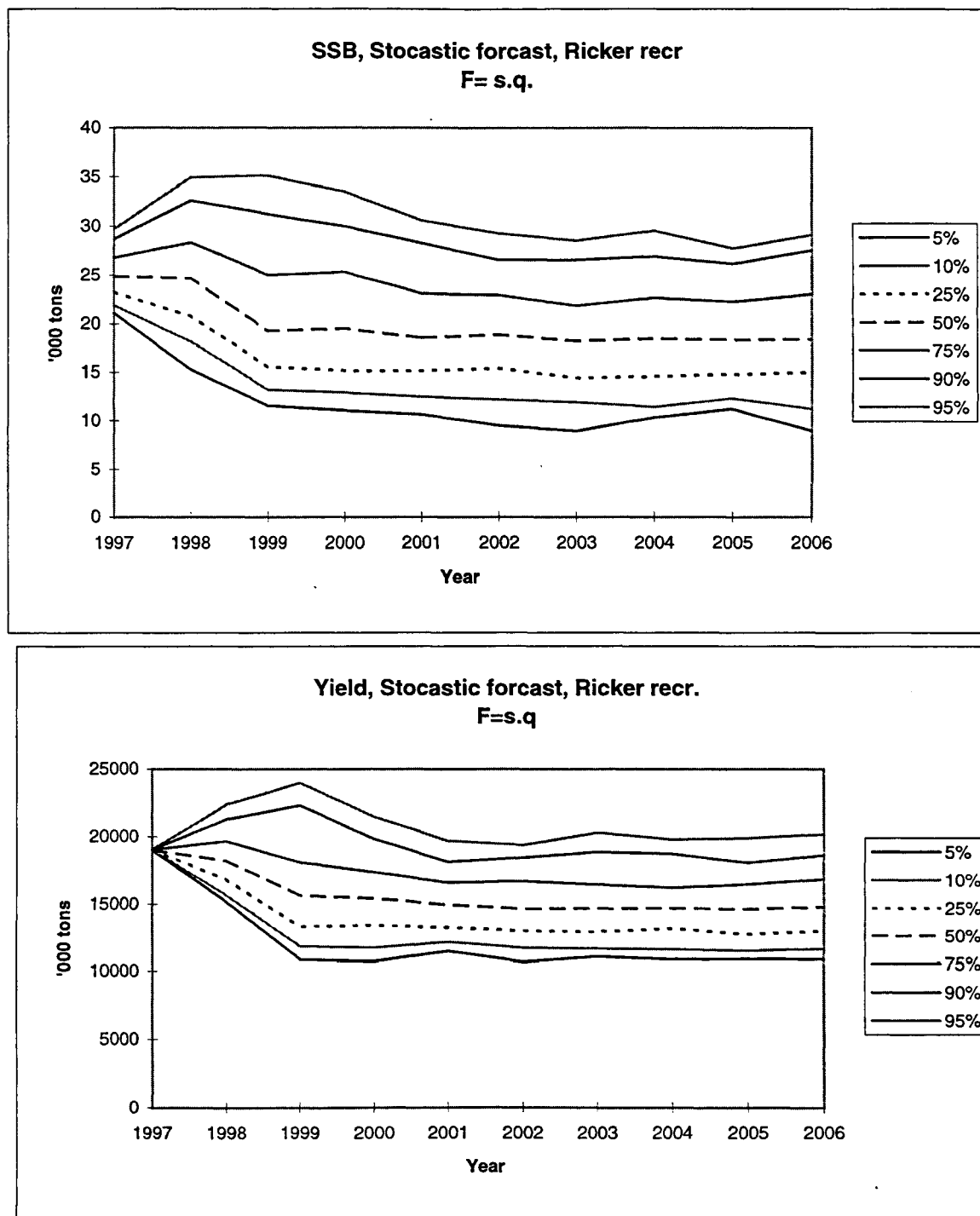


Figure 3.1.1 Mean carapace length (mm) at age (quarters) for *Pandalus* in Division IIIa and IVa east

Figure 3.1.2 Medium term prediction at status quo fishing mortality
Percentiles of the distributions of yield and SSB.



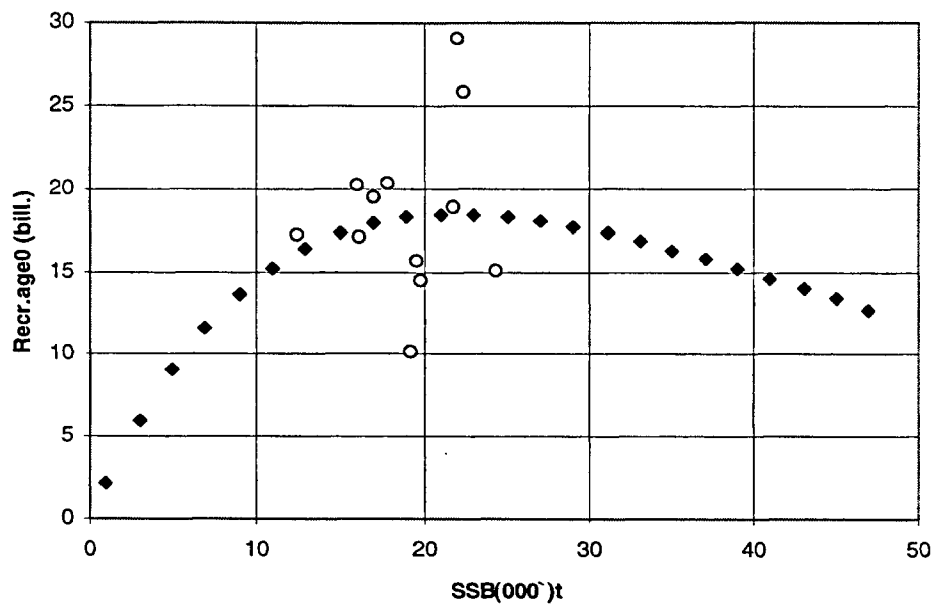


Figure 3.1.3 Stock-recruitment relationship based on XSA results. *Pandalus* Div. IIIa and IVa east

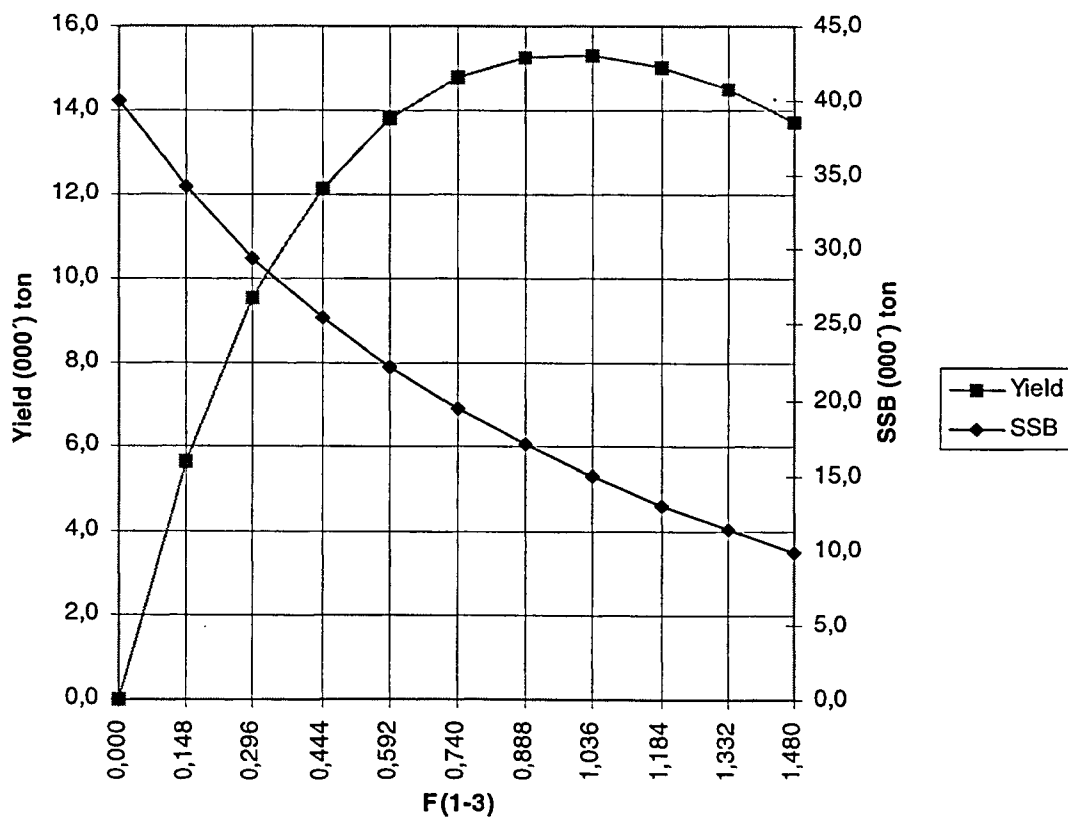


Figure 3.1.4 Equilibrium yield and Spawning Stock Biomass based on Ricker stock recruitment relationship. *Pandalus* Div. IIIa and IVa east.

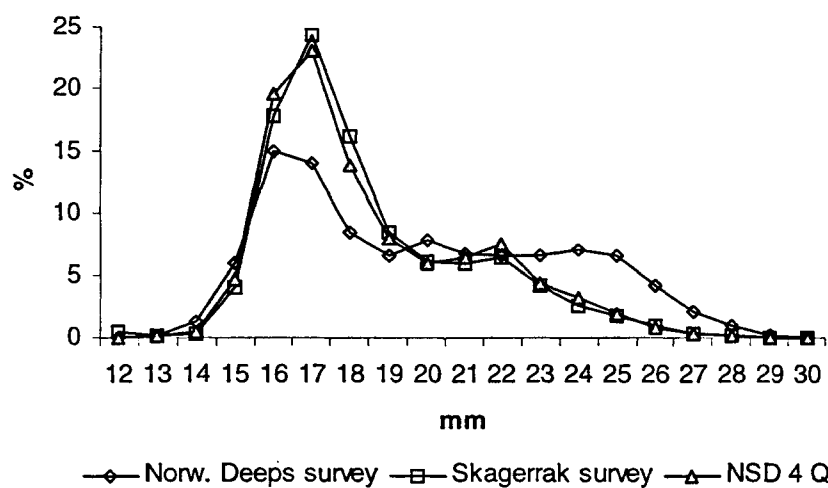


Figure 3.1.5 Length frequencies for *Pandalus* in the Norwegian Deeps and Skagerrak from survey and the combined length frequency for Norwegian, Danish and Swedish catches used in the VPA.

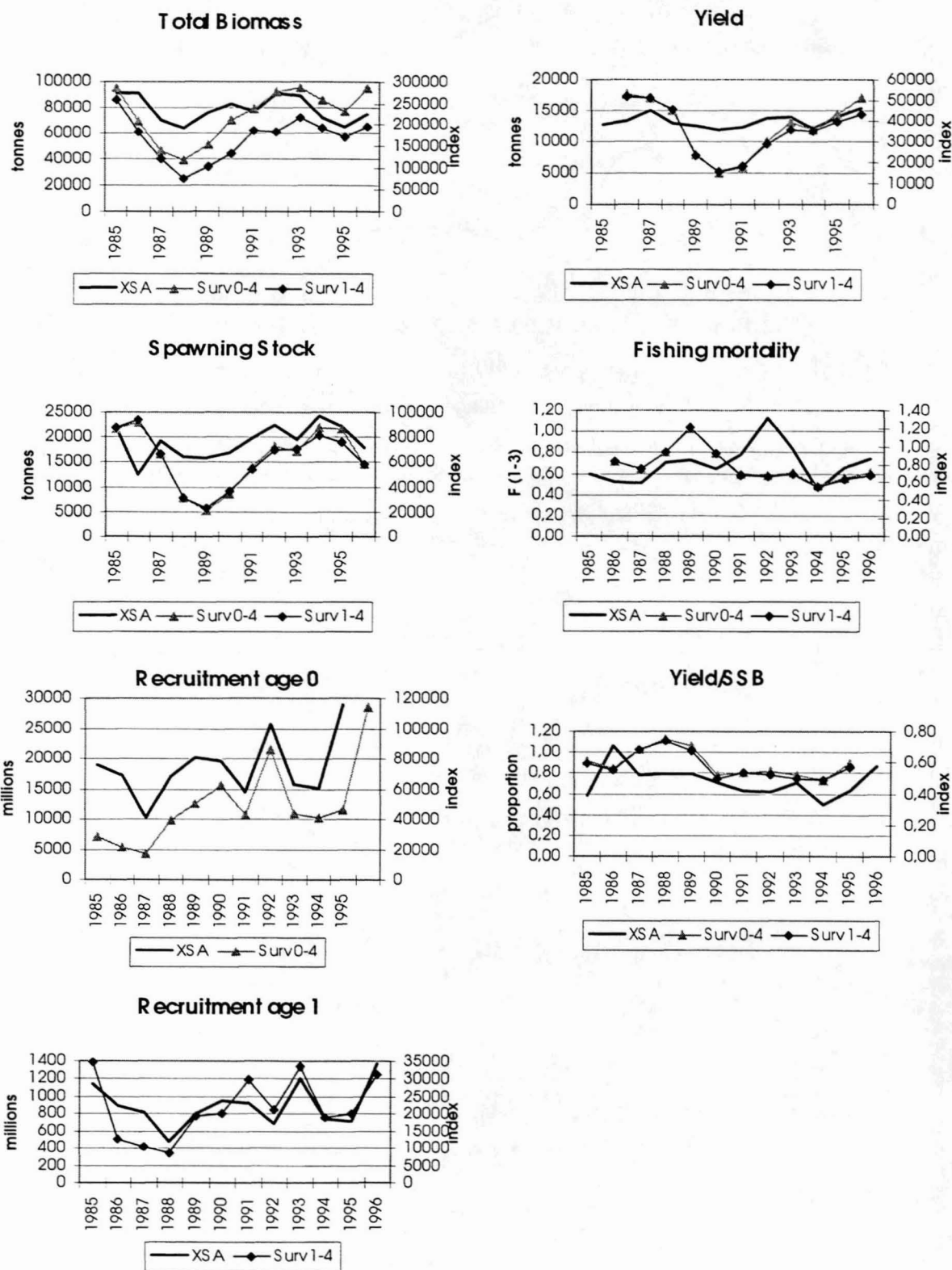


Figure 3.1.6 Trends in stock estimates, yield, stock exploitation and recruitment from XSA and RCPUE model based on Norwegian survey results . *Pandalus* in Div. IIIa and IVa east.

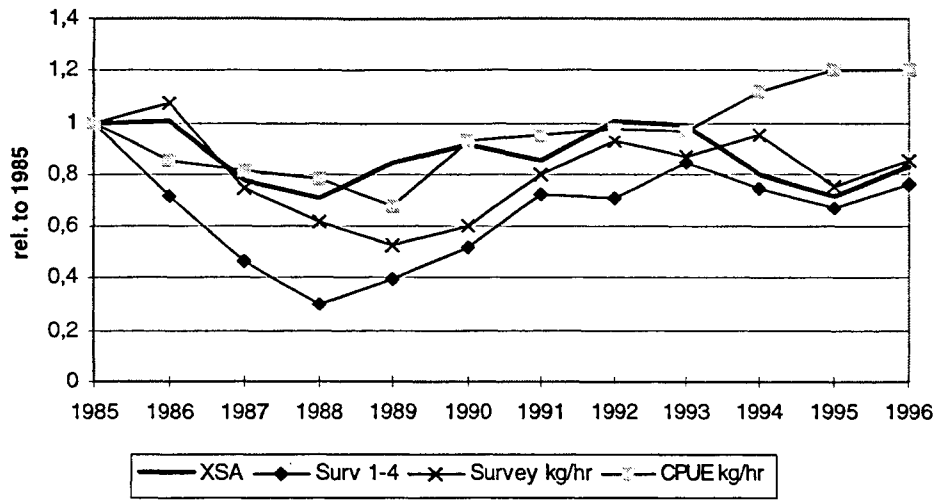


Figure 3.1.7 Biomass indices from XSA, Survey and commercial fishery for *Pandalus* in Division IIIa and IVa east