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An update of the Assessment of the International Fishery for Shrimp (*Pandalus borealis*) in Division 3M (Flemish Cap), 1993-2003 in November 2003

by

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Abstract

The development of the international shrimp (*Pandalus borealis*) fishery in NAFO Division 3M is described. Various indices show that the stock is a bit lower in 2004 than in 2003. Female biomass is either decreasing a little or stable depending on which index one looks at. The standardized CPUE is significantly lower in 2004 as compared to 2003. The recruitment indices from the Faroese survey are not available for year 2004 but the indices from the 2003 year-class pointed to recruitment for 2 year olds being above or about average. Recruitment as judged from the 2 year olds in the commercial fishery is good in 2004. Nominal catch was 62 000 tons in 2003 as compared to 48 600 tons in 2002. The catch in 2004 is 31 000 tons to 1 October and is expected to reach 48 000 tons in the whole year of 2004.

The results from the ageing which is based on biological sampling shows a great number of three year olds per hour in 2004 proving that the 2001 year-class to be very rather strong, although that was not clear in last year´s assessment. The 1999 year-class, now 5 year old appears to be the strongest ever seen in the fishery.

1. INTRODUCTION

The fishery for northern shrimp at Flemish Cap began in the spring of 1993 and has since continued with estimated annual catches (as estimated by STACFIS) of approximately 27 000 to 48 000 in the years 1993 through 1996. After 1996 catches were lower or rising slowly from 25 000 tons in 1997 to 52 000 tons in 2000 and further to 54 000 tons in 2001. There was 49 000 tons taken in 2002. The catch was higher than ever before in 2003, namely 62 000 tons. Removals to October 2004 of about 31 000 tons are much lower than reported for the same period in 2003 (46 300 tons). Vessels from as many as 19 nations have participated in this fishery since its beginning.

The development of the international shrimp (*Pandalus borealis*) fishery in NAFO Div. 3M is described. Various indices are listed with the purpose of tracking the status of the Flemish Cap shrimp stock. Among these the standardized CPUE and an international database of observer samples is used on which ageing was carried out. The results from the ageing, is presented as well as numbers/hour per age based on the standardised CPUE. The indices of female stock are mainly from the EU survey. Also there is calculated a standardized CPUE series of female index. Moreover there is recruitment index from the commercial fishery whereas the Faroese survey was not carried out in 2004.

Background on the assessment and management of this resource since 1993 can be found in Parsons (1998), Skúladóttir and Orr (2002), Skúladóttir (2003), Gudmundsdóttir (2003), Gudmundsdóttir and Nicolajsen (2003) and NAFO Scientific Council Reports (2003).

2. **MATERIAL AND METHODS**

Standardization of CPUE

A standardized dataset, consisting of data from Canada, Faroe Islands, Greenland, Iceland, Norway and Russia from 1993 to 2004 exists. All data from Norway were extracted from the standardized dataset as a new datafile was provided from Norway, which was then added to the datafile. Data were selected from the standarized datafile where catch >0 kg and/or effort >10 hours. Like in 2003 the Norwegian data before 1999 were not used as it was not possible to split the logbook data into single, double or triple trawls. As area is not defined in the Norwegian data and it has been noticed that area is not important to the regression (Gudmundsdottir, 2003) area is not used in the regression. CPUE is modelled against year, vessel, month and gear, by using the generlaized Linear Model function glm in Splus (version 6) where the modelled CPUE is log-linked. Effort is used as the weighting factor. The model is standardized to data from 1993, June, single trawl and Icelandic data.

Samples

Shrimp were separated into 3 categories namely, males, primiparous females (including transitionals) and multiparous females according to the sternal spine criterion (McCrary, 1971), oblique carapace lengths were measured using sliding calipers and grouped into 0.5 mm length-classes. These data form the International shrimp aging database as recommended Appendix II of the 1999 NAFO Scientific Council meeting on shrimp (NAFO, 1999). Modal analysis (MacDonald and Pitcher, 1979) was conducted on an individual month by month basis using each nation's catch, for weighting. This analysis provided the mean lengths and proportions at age and sex per month. The mean lengths were converted to mean weights using length weight relationships for the appropriate months to calculate the number caught (Skuladottir, 1997). An average length at age was calculated for the whole period, weighted by number caught each month and by nation. The mean lengths were then converted to weights using the length weight relationship for April-June. This was said to be the average weight for that particular year at age and sex.

Since the Canadian data (Parsons and Veitch, 1996) were only available as annual results for the years 1993-1995, the following two equations were used for this period:

For males and primiparous females for April and all year around:	ln y = 3.037*ln x - 7.549
For multiparous females in April-June:	ln y = 2.778*ln x - 6.689

Analyses for 1996 - 2001 also made use of the following:

For multiparous females July:	ln y = 2.921*ln x - 7.144
For multiparous females August:	ln y = 3.111*ln x - 7.689
For multiparous females Sept-March:	ln y = 2.929*ln x - 7.085

3. **CATCH**

The catch is shown by months in Tables 1 to 3 as reported to NAFO as preliminary figures. The total catch per year is listed by nations in Table 4. The catch is mostly as it is reported to NAFO. But in some cases information are got from the shrimp specialists of the individual countries. The total catch per year is shown in Fig. 1. Although the year is not complete the projected catch to the end of the year is anticipated to be about 48 000 tons be the end of year 2004.

4. **CPUE MODEL**

A summary table was made from the data in Table 5. Table 6 shows the no. of data records used in the model by year and country. Whether the data had constant variance was tested by plotting standard errors versus mean CPUE (Smith and Showell, 1996) and fitting a line through the points (Figure 2). Since the coefficients of variance was constant (Table 7), a gamma distribution can be used, so the family parameter in glm was set as Gamma. The model was run and the diagnostic plots inspected. Outliers were observed so it was decided to exclude data with the deviance >=10 and the model was fitted again. Some results from the model fit are shown in Table 8. Standard

Splus diagnostic plots for the fit are shown in Fig. 3. From the deviance residuals plots it can be seen that the right link function as well as the assumed variance function has been chosen. In spite of the right tail being broad the model is considered appropriate. The resulting index is shown in Table 9 and Fig. 4. The index declined from 1993 to 1994 and were at low levels until 1997. From 1998 it gradually increased and reached a peak in 2003, but has declined again to a similar level as seen in the years 1998-2002. Index values of all years were significantly different ($P<0.05$) from zero.

Standardized nominal effort is shown in Fig. 5. The effort was highest in 1996 when fishing was quite intense. After that there was little effort in the years 1997 and 1998. The effort increased in 1999 and remained at a stable rather high level since then.

5. RECRUITMENT

The Faroese survey provides two recruitment indices in the years 1996-2003. Since 1997, a juvenile shrimp bag has been attached to the gear in the Faroese survey. The results are shown in Fig. 6 and the table 10 (Nicolajsen and Brynjólfsson, 2003). The abundance of two year olds obtained in the main trawl in the Faroese survey was observed for 7 years and is also shown in Fig. 6 and Table 10 (Nicolajsen, 2003). The two indices do not agree in all years. In 1999 the juvenile bag showed a greater abundance of two-year-olds, which was not apparent in the main survey gear. The 1997 year-class is average or above average in the commercial catch. Both indices showed that the 1998 year-class was weak in 2000 and that the 1998 year-class has been weak in all years. During 2001, two-year-olds were abundant in both the main trawl and the juvenile bag. This, the 1999 year-class which has turned out to be quite strong. The 2000 year-class appears to be small in both the main trawl and the juvenile bag. The 2001 year-class however could be bigger as it is prominent in the main trawl in 2003 although not well presented in the juvenile bag. The 2001 year-class is above average in 2004. As the Faroese survey has not taken place in 2004 a series of 2 year olds in the commercial fishery is presented (Table 11, Fig. 7). The 2002 year-class appears to be one of the strongest. This is substantiated by the occurrence of one year olds in the EU survey in 2003 and also the two year olds in the EU survey of 2004.

6 FEMALE BIOMASS

Similarly a spawning stock biomass (SSB) index was calculated as kg/hr of primiparous (including transitionals) plus multiparous females from the international observer database and the standardized CPUE model. This was compared to the results of the EU survey (Diaz, 2003) and Faroese survey biomass indices (Nicolajsen, 2003). The raw data are provided in table 12. Once again, each index was standardized to the mean of the series and shown in Fig. 8 and 9.

The spawning stock (female biomass) as determined from the EU survey biomass index gradually increased during the years prior to the fishery. This may have been due to a gradual increase in stock size after the cod biomass declined in the area. But this was also a reflection of the very strong 1987 year-class, most of that were female during 1992. The index showed a decrease from 1994 through to 1997 then an increase during 1998. The SSB of EU survey has fluctuated and increased to a high peak in 2002 to decrease again in 2003 and 2004 to the level of the years 2000-2001. The biomass indices have been corrected for the years 2003-2004 adjusting for the more efficient research vessel taken into use in 2003.

The female biomass from the Faroese survey indices have shown much the same trend as the EU although not fluctuating as much. The female CPUE decreased from 1993 to 1997 then rose in 1998 and 1999, remaining stable to 2003.

7. AGE ASSESSMENTS

Age analysis was carried out on biological samples obtained from a few nations in the past years. Table 13 provides results of the age analyses (length and weight at age and sex are listed). This analysis allows the calculation of the number per hour caught and number caught per year (based on nominal catch and the CPUE model) by age group. It should be noted that there are difficulties in the aging once shrimp reach carapace lengths of 26 mm. For this reason, it is likely that 6 and 7 year olds are badly defined. As the modal analysis is quite flexible in fixing age

groups the deviation method was used as a guide (Skúladóttir, 2004) and sometimes the number of male age classes were found to be four instead of three if that was used as a basis.

In table 14 the calculated mean lengths are listed. The weights at age (Table 15) are calculated from the length weight relationship for each month. A new overall weight at age and sex for the months January to September was calculated by weighting by total catch of each nation in each month. In Table 16 listed number of shrimp caught. Again the mean weight-at-age and sex group are calculated for the period January through September and the proportions are applied to the nominal catch every year to get the total number of shrimp caught every year.

Table 17 lists the number per hour harvested in the commercial fishery. This is also calculated from Table 13 by first calculating proportions of standardized kg/hour for each age and sex class. The female part of the standardized CPUE is that of transitionals, primiparous and multiparous females combined. This is presented in Fig. 9.

Finally there is a Table of age groups when shrimp change sex from male to female (Table 18). Following the slow growth of shrimp in the last couple of years, the shrimp appear to be changing sex later or mainly as 5 year olds as compared about half of the 4 year olds changing sex in most years. The rest of an age-class then changed sex as 5 year olds in the years 1997 to 2003.

In 1993, the 1987 year-class appeared as a very strong age-class (6+ cohort) as approximately 12,000 animals/ hr. The next prominent year-class was the 1993-class, two years old in 1995. It was strong in 1995 and 1996, but later the year-class appears to have decreased in strength resulting in fewer 4 and 5 year olds as might be expected. The 1996 year-class was considered mediocre during 1998, but appeared stronger during 1999-2001. The EU survey is not in agreement with the commercial data as the 1995 year-class appears to be a very strong year-class. It is important to note that the 1998 year-class is by far the weakest in the series in the commercial fishery. There are some inconsistencies between the strength of the year-classes in the EU survey and the commercial samples. This is caused by the difficulties in ageing in general by modal analysis and has to be revised especially the last two years. The 1999 year-class appears e.g. to be very strong in the commercial samples in year 2003 but not so in the EU survey, but in 2004 the 1999 year-class is very abundant as five year olds. The 2000 year-class appears to be weak as 3 year olds both in 2003 and 2004 in the commercial samples. The 2001 and 2002 year-class on the other hand appear to be above average.

8. **SUMMARY**

Catches of shrimp on the Flemish Cap have been maintained at a high level averaging about 50 000 tons for the last five years. The CPUE model indicated that there was a general decline between 1993 and 1996. Then beginning in 1997, catch rates began to increase and increased to 2003 similar to that in 1993. The spawning stock biomass also decreased between 1993 and 1994. The survey SSB of the Faroese survey remained low during 1997 but showed an increasing trend to 2003. The SSB of the EU survey also increased from 1997 to 2002. The 1999 year-class appears to be very strong, but will be 6 year old in 2005 and is not expected in to last in great numbers to 2006. The 2000 year-classes is considered to be weak. The 2001 and 2002 year-classes are considered to be above average.

9. **ACKNOWLEDGEMENT**

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Table 1. Catch (tons) by nations and months as reported provisionally to NAFO in year 2002.

Nation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Total**	**Year to date**
Canada						8			8				**16**	**8**
Cuba								106	47				**153**	**153**
Estonia	316	1027	1286	1666	1325	1356	1692	1418	1041	1246	787	514	**13674**	**13674**
EU/Denmark													**0**	**0**
EU/Spain				54			358	339		70	211	13	**1045**	**1045**
Faroe Is.	523	554	485	725	1501	1043	1043	1346	727	360	438	365	**9110**	**8509**
France							29			99	33		**161**	**161**
Greenland						347							**347**	**680**
Honduras													**0**	**0**
Iceland			524	564	748	818	301	587		604	454	406	**5006**	**5351**
Japan													**0**	**100**
Latvia		100	142	365	175	403	206	95	344	55			**1885**	**1885**
Lithuania		336	378	404	246	345	370	284	336	299	218	105	**3321**	**3321**
Norway		83		451	1362	1484	1694		1739		1123	329	**8265**	**11225**
Poland													**0**	**0**
Portugal													**0**	**0**
Russia	178	189	206			142	114	83	175	59			**1146**	**1145**
Ukraina													**0**	**0**
USA									96				**96**	**96**
Total	**1017**	**2289**	**3021**	**4229**	**5357**	**5946**	**5807**	**4258**	**4513**	**2792**	**3264**	**1732**	**44225**	**47353**

Table 2. Catch (tons) by nations and months as reported provisionally to NAFO in year 2003.

Nation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Total**	**Year to date**
Canada													**0**	
Cuba													**0**	**81**
Estonia	602	392	1279	1318		1217	1506	1371	1169	883			**9737**	**12732**
EU/Denmark													**0**	
EU/Portugal													**0**	
EU/Spain				6	15	6	21		19	33	26	11	**137**	**161**
Faroe Is.	125	294	1087	1022	1239	1705	1380	1453	1253	952	851	501	**11862**	**12622**
France													**0**	
Greenland						15	760						**775**	**873**
Honduras													**0**	
Iceland		382	240	440	721	591	595	431	194	376	312	306	**4588**	**4588**
Japan										73	29	15	**117**	**116**
Latvia		254	530	480	425	319	363	247	245	159	192		**3214**	**3453**
Lithuania		87	289	453	382	365	450	338	292	402	333	353	**3744**	**3744**
Norway	165	306	1257	2305	2402	2995	2435		3074		1234	680	**16853**	**22874**
Poland													**0**	
Portugal													**0**	
Russia				3									**3**	**3**
Ukraina							73	141	24				**238**	**238**
USA								162	215	245		6	**628**	**628**
Total	**892**	**1715**	**4682**	**6027**	**5184**	**7213**	**7583**	**4143**	**6485**	**3123**	**2977**	**1872**	**51896**	**62113**

Table 3. Catch (tons) by nations and months as reported provisionally to NAFO in year 2004.

Nation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Total**	**Year to date**
Canada													**0**	
Cuba	95	2	178	218	241								**734**	**969**
Estonia	50	829	510	971			1214	1063					**4637**	**7446**
EU/Denmark													**0**	
EU/Portugal													**0**	
EU/Spain				22	528	570		222					**1342**	**1373**
Faroe Is.	26		60	227	434	564	455	491					**2257**	**2762**
France													**0**	
Greenland													**0**	
Honduras													**0**	
Iceland		272	290	360		356	476	456					**2210**	**2210**
Japan													**0**	
Latvia			305	240	267	154	73	444					**1483**	**1934**
Lithuania	203	529	410	443	576	790	604	462					**3814**	**4017**
Norway		579			369	447		2319					**3714**	**5584**
Poland		93	242	62									**397**	**397**
Portugal													**0**	
Russia													**0**	
Ukraina						147	132	35					**314**	**314**
USA			153	180			287	32					**652**	**952**
Total	**374**	**2304**	**2148**	**2723**	**2415**	**3028**	**3241**	**5524**	**0**				**21554**	**27958**

Table 4. Catch (tons) by nations as estimated by STACFIS.

Nation	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003*	2004*
Canada	3724	1041	970	906	807	484	490	618	1 295	4 16		
Cuba							119	46	1 797	4 153	81	969
Estonia		1081	2092	1900	3240	5694	10835	13256	3 9850	2 14215	4 12732	2 10386
EU/Denmark	800	400	200			437	235		4 92	4 359		
EU/Portugal	300		150		170	203	227	289	4 420	4 15		
EU/Spain	240	300	158	50	421	913	1019	1388	4 799	671	4 161	4 1373
Faroe Is.	7333	6791	5993	8688	7410	9368	9199	7719	3 10228	2 8516	2 12676	4 2762
Greenland	3788	2275	2400	1107	105	853	576	1636		2 684	4 873	
Honduras	1265											
Iceland	2243	2300	7623	20681	6381	6572	9277	8912	2 5265	2 5741	2 4695	2 2480
Japan									1 130		116	
Latvia		300	350	1940	997	1191	3080	3105	4 2990	4 1885	4 3453	4 1934
Lithuania		1225	675	2900	1785	3106	3370	3595	1 2702	4 3321	4 3744	4 4017
Norway	7183	8461	9533	5683	1831	1339	2975	2669	1 13291	4 11624	4 22765	4 5584
Poland					288	148	894		1 209			4 397
Russia		350	3327	4445	1090		1142	7078	1 5687	2 1148	2 3	
France		75			150				1 408	4 161		
Ukraina									1 348		4 238	4 314
USA									1 411	4 96	4 628	4 952
Total	**26876**	**24599**	**33471**	**48300**	**24675**	**30308**	**43438**	**50311**	**53922**	**48605**	**62165**	**31168**

1 NAFO Statlant 21 A
2 From the fisheries biologist of respective countries
3 Assessed by Stacfis
4 Reported to NAFO provisionally

* Provisional to 1 October

Table 5. Analysis about the CPUE data.

year	Number of obs.	Mean cpue	Std. dev.	Minum	Maximum
1993	170	386.27	147.74	92.82	894.5
1994	130	246.42	126.22	10.38	720.88
1995	362	276.78	141.39	38.14	1181.92
1996	863	229.43	116.99	45.24	847.59
1997	365	284.83	99.62	44.31	602.3
1998	316	377.06	147.24	34.39	1315.73
1999	346	383.07	149.04	35.26	851.38
2000	316	447.85	162.14	47.96	1185.86
2001	274	413.71	141.15	59.23	976.9
2002	172	503.38	165.22	123.88	944.84
2003	146	696.26	223.77	251.4	1370.7
2004	49	617.99	154.3	301.77	1023.31

Table 6. Number of data records which are used in the final model fit by year and country.

	ICE	CAN	FRO	GRL	NOR	RUS
1993	41	54	0	75	0	0
1994	47	38	0	44	0	0
1995	171	51	84	37	0	13
1996	469	27	235	30	0	101
1997	152	17	168	7	0	9
1998	131	16	153	14	0	0
1999	164	10	112	8	18	26
2000	107	4	121	25	19	35
2001	126	8	0	0	75	65
2002	69	0	0	15	63	25
2003	56	0	0	13	76	0
2004	22	0	0	0	26	0

Table 7. Results of fitting standard error versus mean CPUE.

Call: lm (formula = cpue.std ~ cpue.mean, data = tab)
Residuals:

Min	1Q	Median	3Q	Max
-31.68	-2.25	3.812	6.65	23.78

Coefficients

	Value	Std. Error	t value	Pr(>[t])
(Intercept)	75.3691	14.8509	5.075	0.0005
cpue.mean	0.179	0.0347	5.1615	0.0004

Residual standard error: 16.64 on 10 degrees of freedom
Multiple R-squared: 0.7271
F-statistic: 26.64 on 1 and 10 degrees of freedom, p-value is 0.0004243

Correlation of Coeffients:

	(Intercept)
cpue.mean	-0.9462

Table 8. Results from the multiplicative model. The ship factors are not shown.

Call:glm (formula = cpue ~ factor (year) + factor (ship.nr) + factor (month.nr) + factor (gear), family = Gamma (link = log), data = new.reg.data, weights = effort.
Deviance Residuals:

Min	IQ	Median	3Q	Max
-11.54895	-1.776158	-0.349766	1.132347	10.4367

Coefficients:

	Value	Std. Error	t.value
(Intercept)	6.434598	0.0392059	164.1234
factor (year) 1994	-0.545822	0.0327685	-16.6569
factor (year)1995	-0.361654	0.0331275	-10.9171
factor (year)1996	-0.476594	0.0332810	-14.3203
factor (year)1997	-0.434914	0.0344433	-12.6270
factor (year)1998	-0.226335	0.0351426	-6.4405
factor (year)1999	-0.187585	0.0350245	-5.3558
factor (year)2000	-0.090395	0.0354511	-2.5498
factor (year)2001	-0.112743	0.0379135	-2.9737
factor (year)2002	-0.084176	0.0397384	-2.1183
factor (year)2003	0.822140	0.0404085	2.0346
factor (year)2004	-0.139432	0.0456451	-3.0547
Factor (month.nr)2	-0.091217	0.0367406	-2.4827
Factor (month.nr)3	-0.044954	0.0295822	-1.5196
Factor (month.nr)4	-0.027236	0.0182451	-1.4928
Factor (month.nr)5	-0.067026	0.0154681	-4.3331
Factor (month.nr)6	-0.051084	0.0138356	-3.6921
Factor (month.nr)7	-0.072468	0.0128889	-5.6225
Factor (month.nr)8	-0.162899	0.0148799	-10.9476
Factor (month.nr)9	-0.233940	0.0154655	-15.1266
Factor (month.nr)10	-0.268507	0.0166386	-16.1376
Factor (month.nr)11	-0.275835	0.0188108	-14.6636
Factor (month.nr)12	-0.198342	0.0272605	-7.2758
Factor (gear)2	0.166126	0.0169566	9.7972
Factor (gear)3	0.170811	0.0600035	2.8467

(Dispersion Parameter for Gamma family taken to be 6.811117)
Null Deviance: 136354.1 on 3471 degrees of freedom
Residual Deviance: 22651.64 on 3299 degrees of freedom
Number of Fisher Scoring Iterations:3

Table 9. CPUE index by year and the approximate 95% confic

year	index	upper 95% conf. limits	lower 9 conf.lin
1993	1.0000000	1.0000000	1.(
1994	0.5793651	0.6177965	0.:
1995	0.6965234	0.7432487	0.(
1996	0.6208948	0.6627464	0
1997	0.6473205	0.6925292	0.(
1998	0.7974509	0.8543147	0
1999	0.8289584	0.8878635	0.'
2000	0.9135704	0.9793065	0.:
2001	0.8933806	0.9622969	
2002	0.9192693	0.9937308	0.:
2003	1.0856881	1.1751722	1.(
2004	0.8698521	0.9512602	0.'

Table 10. Shrimp in Div. 3M. Recruitment indices of 2 year olds (numbers). in the Faroese survey.

Year	Main trawl	juvenile bag
1997	855	
1998	210	2532
1999	214	5683
2000	108	456
2001	1242	4377
2002	416	913
2003	1119	1337

Table 11. Shrimp in Div. 3M. Recruitment ment indices of 2 year olds (numbers per standardized hour) in the commercial fishery.

Year	No.per hour
1993	5306
1994	5894
1995	23909
1996	2425
1997	2058
1998	3072
1999	2462
2000	851
2001	6422
2002	4228
2003	4552
2004	8823

Table 12. Shrimp in Div. 3M. Indices of female biomass in the EU survey, Faroese survey and the commercial fishery standardized CPUE. The indices in the EU survey were converted by the Warren method in 2003 and 2004 after the introduction of a new vessel.

Year	EU survey biomass	Faroese Survey biomass	Standardized CPUE Kg/hour
1988	1.874		
1989	1.34		
1990	1.132		
1991	5.362		
1992	11.509		
1993	6.839		275.9
1994	2.823		130.1
1995	4.286		146.6
1996	4.149		122.6
1997	3.807	6731	122.4
1998	8.091	12559	165.6
1999	9.051	8863	204.3
2000	6.553	10154	211.3
2001	8.977	9374	176.3
2002	11.664	11761	197.1
2003	7.756	12402	235.4
2004	8.079		187.3

Table 13. Mean weights at age and sex for the period January-September. Nominal catch for the whole year used for calculating proportion of weight and number caught at age and sex. Standardized CPUE for the whole year of single, double and triple trawl is used to calculate CPUE and abundance in numbers at age and sex group.

1993

Sex	Age	Mean CL mm	Prop. by no.	Mean weight g	Prop. by weight	Nominal catch 26876 tons	kg/hr 386.3	No./hour	Number (´000´000)
Males	1	10.4	0.0041	0.646	0.00265	9	0.1	190	13.2
Males	2	16.8	0.1148	2.772	0.31823	1023	14.7	5306	369.2
Males	3	20.7	0.2146	5.225	1.12129	3606	51.8	9919	690.2
Males	4	24.0	0.1156	8.188	0.94653	3044	43.8	5343	371.8
Primip.	5	26.0	0.2619	10.441	2.73450	8794	126.4	12106	842.3
Multip.	6+	26.5	0.2890	11.189	3.23362	10400	149.5	13358	929.4
Total			1.0000		8.35681	26876	386.3	46222	3216.1

1994

Sex	Age		Prop. by no.	Mean weight g	Prop. by weight	Nominal catch 24599 tons	kg/hr 223.8	No./hour	Number (´000´000)
Males	1								
Males	2	16.4	0.1817	2.576	0.46806	1670	15.2	5897	648.1
Males	3	20.4	0.3629	4.998	1.81377	6470	58.9	11777	1294.5
Males	4	22.9	0.0854	7.101	0.60643	2163	19.7	2772	304.6
Primip.	5	25.7	0.1944	10.08	1.95955	6990	63.6	6309	693.5
Multip.	6+	26.9	0.1756	11.664	2.04820	7306	66.5	5699	626.4
Total			1		6.89601	24599	223.8	32454	3567.1

1995

Sex	Age		Prop. by no.	Mean weight g	Prop. by weight	Nominal catch 33471 tons	kg/hr 269.0	No./hour	Number (´000´000)
Males	1								
Males	2	15	0.4516	1.965	0.88739	6079	48.9	24862	3093.5
Males	3	20.3	0.2714	4.924	1.33637	9154	73.6	14941	1859.1
Primip.	4	22.2	0.0507	6.462	0.32762	2244	18.0	2791	347.3
Primip.	5	25.3	0.0962	9.611	0.92458	6333	50.9	5296	659.0
Multip.	6+	26.2	0.1301	10.84	1.41028	9660	77.6	7162	891.2
Total			1		4.88625	33471	269.0	55052	6850.0

1996

Sex	Age		Prop. by no.	Mean weight g	Prop. by weight	Nominal catch 48300 tons	kg/hr 239.8	No./hour	Number (´000´000)
Males	1								0.0
Males	2	15.3	0.0622	2.066	0.12860	1011	5.0	2430	489.4
Males	3	20.0	0.6076	4.728	2.87283	22585	112.1	23716	4776.9
Primip.	3	21.4	0.0379	5.788	0.21921	1723	8.6	1478	297.7
Primip.	4	24.8	0.1511	9.034	1.36509	10732	53.3	5898	1187.9
Multip.	3	22.2	0.0063	6.799	0.04274	336	1.7	245	49.4
Multip.	4	24.8	0.0474	9.296	0.44108	3468	17.2	1852	373.0
Multip.	5	26.6	0.0574	11.306	0.64930	5105	25.3	2242	451.5
Multip.	6	28.8	0.0300	14.167	0.42486	3340	16.6	1171	235.8
Total			1		6.14372	48300	239.8	39032	7861.7

Table 13. Continued

1997

Sex	Age		Prop. by no.	Mean weight g	Prop. by weight	Nominal catch 24675	kg/hr 250.0	No./hour	Number (´000´000)
Males	1	10.4	5.5E-05	0.910	0.0002	1			0.9
Males	2	15.7	0.0522	3.201	0.16714	650	6.6	2057	203.1
Males	3	19.0	0.4092	4.117	1.68462	6552	66.4	16123	1591.3
Males	4	22.3	0.2089	6.633	1.38567	5389	54.6	8231	812.4
Primip.	3	20.6	0.0029	5.237	0.01498	58	0.6	113	11.1
Primip.	4	24.3	0.1724	8.390	1.44630	5625	57.0	6792	670.4
Multip.	3	19.1	0.0025	5.018	0.01240	48	0.5	97	9.6
Multip.	4	24.2	0.0488	9.570	0.46737	1818	18.4	1924	189.9
Multip.	5	25.6	0.0845	10.631	0.89822	3493	35.4	3329	328.6
Multip.	6	28.3	0.0171	14.350	0.24558	955	9.7	674	66.6
Multip.	7	29.3	0.0015	15.070	0.02232	87	0.9	58	5.8
Total			1		6.34481	24675	250.0	39400	3889.6

1998

Sex	Age	CL mm	Prop. by no.	Mean weight g	Prop. by weight	Nominal catch 30308	Kg/hr 308	No./hour	Number (´000´000)
Males	2	14.90	0.0596	1.923	0.11460	581	5.9	3068	301.9
Males	3	18.75	0.3462	3.868	1.33904	6783	68.9	17822	1753.7
Males	4	21.23	0.2321	5.642	1.30929	6633	67.4	11947	1175.6
Primip.	4	23.17	0.1399	7.355	1.02911	5213	53.0	7203	708.8
Primip.	5	25.87	0.0218	10.287	0.22439	1137	11.6	1123	110.5
Multip.	3	18.56	0.0025	4.160	0.01020	52	0.5	126	12.4
Multip.	4	23.51	0.0359	8.02	0.28781	1458	14.8	1847	181.8
Multip.	5	25.17	0.1083	9.7	1.05035	5321	54.1	5575	548.6
Multip.	6	26.47	0.0484	11.15	0.53946	2733	27.8	2491	245.1
Multip.	7	29.07	0.0054	14.47	0.07848	398	4.0	279	27.5
Total			1.0000		5.98273	30308	308.0	51482	5065.9

1999

Sex	Age	CL mm	Prop. by no.	Mean weight g	Prop. by weight	Nominal catch 43438	kg/hr 320.22	No./hour	Number (´000´000)
Males	1	6.0	0.0001	0.122	0.00001	0	0.0	5	0.7
Males	2	14.5	0.0467	1.769	0.08268	591	4.4	2461	333.8
Males	3	17.6	0.2773	3.176	0.88073	6291	46.4	14602	1980.7
Males	4	21.0	0.2253	5.490	1.23680	8834	65.1	11862	1609.1
Males	5	22.3	0.0003	6.560	0.00187	13	0.1	15	2.0
Primip.	4	22.07	0.0758	6.348	0.48118	3437	25.3	3991	541.4
Primip.	5	24.22	0.1327	8.418	1.11680	7977	58.8	6986	947.6
Multip.	3	18.25	0.0009	3.970	0.00361	26	0.2	48	6.5
Multip.	4	22.00	0.0207	6.672	0.13820	987	7.3	1091	147.9
Multip.	5	24.18	0.1259	8.674	1.09238	7802	57.5	6631	899.5
Multip.	6	26.42	0.0932	11.06	1.03086	7363	54.3	4908	665.7
Multip.	7	29.57	0.0011	15.171	0.01638	117	0.9	57	7.7
Total			1.0000		6.08151	43438	320.2	52656	7142.8

Table 13 continued

2000

Sex	Age	CL mm	Prop. by no.	Weight g	Prop. by weight	Nominal catch 50311	kg/hr 352.9	No./hour	Number (´000´000)
Males	2	13.16	0.0157	1.326	0.02078	191	1.3	1012	144.3
Males	3	17.31	0.3258	3.035	0.98868	9101	63.8	21034	2998.7
Males	4	19.99	0.2457	4.692	1.15299	10614	74.4	15867	2262.1
Males	5	21.90	0.0049	6.200	0.03026	279	2.0	315	44.9
Primip.	4	21.01	0.0776	5.458	0.42336	3897	27.3	5008	714.0
Primip.	5	24.16	0.0935	8.514	0.79646	7332	51.4	6040	861.1
Multip.	3	18.35	0.0021	4.012	0.00854	79	0.6	137	19.6
Multip.	4	21.89	0.0580	6.613	0.38387	3534	24.8	3748	534.3
Multip.	5	24.33	0.1271	8.825	1.12131	10322	72.4	8204	1169.6
Multip.	6	26.32	0.0473	10.703	0.50630	4661	32.7	3054	435.4
Multip.	7	27.64	0.0023	14.320	0.03289	303	2.1	148	21.1
Total			1.0000		5.46543	50311	352.9	64569	9205.3

2001

Sex	Age	CL mm	Prop. by no.	Mean weight g	Prop. by weight	Nominal catch 53922	kg/hr 345.1	No./hour	Number (´000´000)
Males	2	15.23	0.1040	2.058	0.21403	2035	13.2	6419	988.7
Males	3	17.78	0.1393	3.292	0.45858	4360	28.3	8598	1324.3
Males	4	20.82	0.3925	5.315	2.08614	19833	128.8	24227	3731.4
Males	5	21.76	0.0095	6.081	0.05777	549	3.6	586	90.3
Primip.	4	21.48	0.0293	5.848	0.17135	1629	10.6	1809	278.6
Primip.	5	24.02	0.1147	8.204	0.94100	8946	58.1	7080	1090.4
Multip.	4	20.50	0.0240	5.484	0.13179	1253	8.1	1483	228.5
Multip.	5	23.24	0.1111	7.769	0.86314	8206	53.3	6858	1056.2
Multip.	6	25.13	0.0666	9.652	0.64282	6111	39.7	4111	633.2
Multip.	7	26.93	0.0090	11.701	0.10531	1001	6.5	556	85.6
Total			1.0000		5.67192	53922	350.1	61727	9507.1

2002

Sex	Age	CL mm	Prop. by no.	Mean weight g	Prop. by weight	Nominal catch 48605	kg/hr 355.1	No./hour	Number (´000´000)
Males	1	12.05	0.0003	1.011	0.00030	3	0.0	21	2.9
Males	2	15.43	0.0605	2.142	0.12959	1240	9.1	4228	578.8
Males	3	18.14	0.5095	3.497	1.78172	17045	124.5	35609	4874.1
Males	4	20.57	0.0681	5.124	0.34894	3338	24.4	4760	651.5
Primip.	4	20.32	0.0458	4.94	0.22625	2164	15.8	3201	438.1
Primip.	5	23.04	0.0675	7.231	0.48809	4669	34.1	4718	645.7
Multip.	3	19.42	0.0009	4.718	0.00425	41	0.3	63	8.6
Multip.	4	22.17	0.0598	6.818	0.40772	3900	28.5	4179	572.1
Multip.	5	24.11	0.1430	8.6	1.22980	11765	86.0	9994	1368.0
Multip.	6	25.69	0.0430	10.266	0.44144	4223	30.9	3005	411.4
Multip.	7	28.25	0.0017	13.359	0.02271	217	1.6	119	16.3
Total			1.0001		5.08082	48605	355.1	69897	9567.3

Table 13 continued

2003

Sex	Age	CL mm	Prop. by no.	Mean weight g	Prop. by weight	Nominal catch 62165	kg/hr 419.4	No./hour	Number (´000´000)
Males	1	12.09	0.0086	1.02	0.00875	93	0.6	618	91.6
Males	2	15.81	0.1111	2.303	0.25586	2733	18.4	8006	1186.7
Males	3	18.41	0.1222	3.658	0.44702	4775	32.2	8806	1305.3
Males	4	20.49	0.3638	5.062	1.84139	19668	132.7	26214	3885.5
Primip.	4	21.73	0.0855	6.052	0.51737	5526	37.3	6160	913.1
Primip.	5	24.15	0.0554	8.347	0.46263	4941	33.3	3994	592.0
Multip.	3	19.96	0.0004	4.678	0.00198	21	0.1	30	4.5
Multip.	4	21.98	0.0409	6.653	0.27199	2905	19.6	2946	436.7
Multip.	5	24.34	0.1358	8.833	1.19913	12808	86.4	9783	1450.1
Multip.	6	26.01	0.0753	10.622	0.79948	8540	57.6	5424	803.9
Multip.	7	27.88	0.0011	12.885	0.01437	153	1.0	80	11.9
Total			1.0000		5.81996	62165	419.4	72062	10681.3

2004

Sex	Age	CL mm	Prop. by no.	Mean weight g	Prop. by weight	Nominal catch 48000 project to end of the year	kg/hr 336	No./hour	Number (´000´000)
Males	1								
Males	2	14.08	0.1379	1.620	0.22340	2042	14.3	8823	1260.4
Males	3	18.28	0.3661	3.579	1.31027	11976	83.8	23424	3346.2
Males	4	21.06	0.1248	5.504	0.68690	6278	43.9	7985	1140.7
Males	5	21.51	0.0177	5.867	0.10385	949	6.6	1132	161.8
Primip.	4	20.91	0.0105	5.386	0.05655	517	3.6	672	96.0
Primip.	5	23.43	0.1786	7.609	1.35897	12421	86.9	11427	1632.4
Multip.	4	21.60	0.0114	6.342	0.07230	661	4.6	729	104.2
Multip.	5	23.84	0.0707	8.337	0.58943	5387	37.7	4524	646.2
Multip.	6	25.48	0.0592	10.028	0.59366	5426	38.0	3788	541.1
Multip.	7	26.42	0.0231	11.090	0.25618	2342	16.4	1478	211.1
Total			1.0000		5.25150	48000	336.0	63982	9140.2

Table 14. Shrimp. Mean length (oblique carapace length mm) at age

Age gr.	1993	1994	1995	Agegr.	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	10.4			1		10.44					12.05	12.09	
2	16.8	16.4	15	2	15.25	15.73	14.9	14.49	13.18	15.23	15.43	15.81	14.08
3	20.7	20.4	20.3	3	20.54	19.01	18.75	17.58	17.32	17.78	18.14	18.41	18.28
4	24	22.9	22.2	4	24.7	23.32	22.09	21.34	20.46	20.84	21.06	20.83	21.09
5	26	25.7	25.3	5	24.8	25.56	25.29	24.2	24.27	23.56	23.76	24.28	23.41
6+	26.5	26.9	26.2	6	26.6	28.33	26.47	26.42	26.08	25.13	25.69	26.01	25.48
				7	28.8	29.28	29.07	29.57	29.32	26.93	28.25	27.88	26.42

Table 15. Shrimp. Mean weight at age for the period January to September based on international data base.

Age gr.	1993	1994	1995	Agegr.	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	0.646			1		0.910					1.011	1.02	
2	2.772	2.576	1.965	2	2.066	2.270	1.923	1.639	1.326	2.058	2.142	2.303	1.620
3	5.225	4.998	4.924	3	4.79	4.130	3.815	3.069	3.044	3.292	3.499	3.661	3.579
4	8.188	7.101	6.462	4	8.945	7.671	6.439	6.347	5.122	5.359	5.659	5.367	5.561
5	10.441	10.080	9.611	5	9.296	10.631	9.800	8.502	8.641	7.913	8.161	8.692	7.686
6+	11.189	11.664	10.840	6	11.306	14.350	11.150	11.060	10.703	9.652	10.266	10.622	10.028
				7	14.167	15.070	14.470	15.100	14.32	11.701	13.359	12.885	11.090

Table 16. Shrimp. Number (000.000) of shrimp caught annually, based on the ageing of international samples in the period January to September.

Age gr.	1993	1994	1995	Agegr.	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	13.2			1		0.9		0.7			2.9	91.6	
2	369.2	648.1	3047.8	2	489.4	203.1	301.9	333.8	121.2	988.7	578.8	1186.7	1260.4
3	690.2	1294.5	1831.7	3	5124.1	1612.1	1766.2	1987.2	3026.5	1324.3	4882.7	1309.8	3346.2
4	371.8	304.6	342.2	4	1561.0	1672.8	2066.2	2298.5	3415.9	4238.4	1661.7	5235.3	1340.9
5	842.3	693.5	649.2	5	451.5	328.6	659.1	1849.2	2038.7	2237.0	2013.7	2042.1	2440.4
6+	929.4	626.4	878.0	6	235.8	66.6	245.1	665.7	510.4	633.2	411.4	803.9	541.1
				7		5.8	27.5	7.7	25.2	85.6	16.3	11.9	211.1
Total	3216.1	3567.1	6748.9		7861.8	3889.9	5066.0	7142.8	9137.9	9507.2	9567.5	10681.3	9140.1

Table 17. Shrimp. Number of shrimp caught per hour (Standardized CPUE) annually, based on the ageing of international samples in the period January to September.

Age gr.	1993	1994	1995	Agegr.	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	189			1				5			21	618	
2	5306	5894	23909	2	2425	2058	3072	2462	851	6422	4228	8006	8823
3	9919	11772	14369	3	25396	16338	17974	14658	21246	8601	35672	8837	23424
4	5343	2770	2684	4	7736	16953	21028	16954	23980	27529	12140	35321	9386
5	12106	6306	5093	5	2238	3330	6707	13640	14311	13943	14712	13777	17083
6+	13358	5696	6888	6	1169	675	2494	4911	3583	4112	3005	5424	3788
				7		58	280	57	177	556	119	80	1478
Total	46221	32438	52943		38964	39412	51555	52687	64148	61163	69897	72063	63982

Table 18. Shrimp. Maturity of females (transitionals , primiparous and multiparous) at age based on the period January to September.

Age gr.	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Mean
1	0	0	0	0	0	0	0	0	0	0	0	0	0.000
2	0	0	0	0	0	0	0	0	0	0	0	0	0.000
3	0	0	0	0.071	0.016	0	0	0.012	0	0	0	0	0.008
4	0	0	1	1	0.580	0.501	0.334	0.390	0.127	0.645	0.607	0.055	0.437
5	1	1	1	1	1	1	1	1	1	1	1	1	1.000
6	1	1	1	1	1	1	1	1	1	1	1	1	1.000
7				1	1	1	1	1	1	1	1	1	1.000

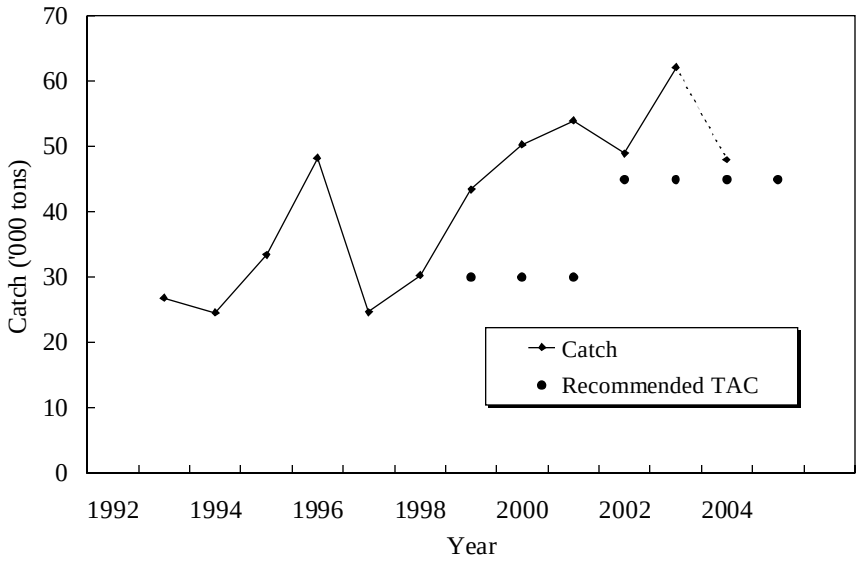

Fig. 1. Shrimp in Div. 3M: Catches (2004 projected to the end of the year).

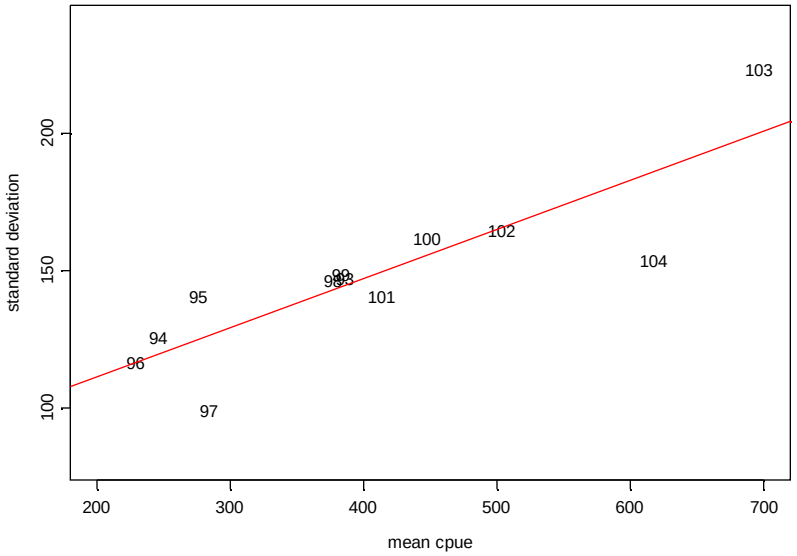

Fig. 2. Coefficient of variation around the annual mean CPUE. The numbers indicate the years.

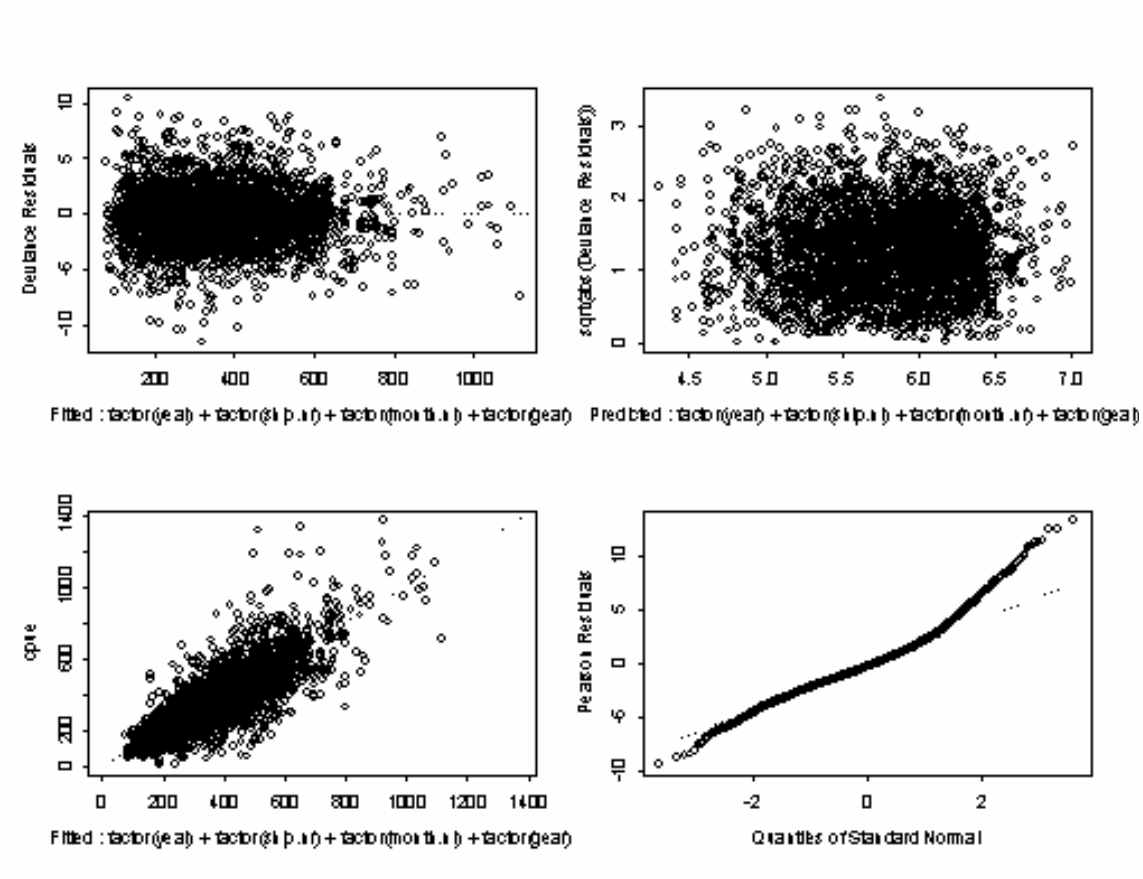

Fig. 3. Plots of the generalized linear model of cpue predicted by year, vessel, month and gear.

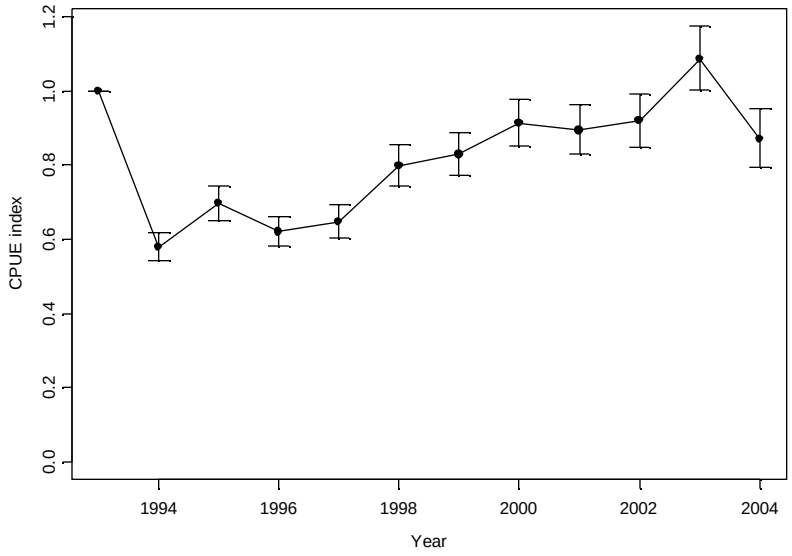

Fig. 4. The modelled CPUE index with approximate 95% confidence limits.

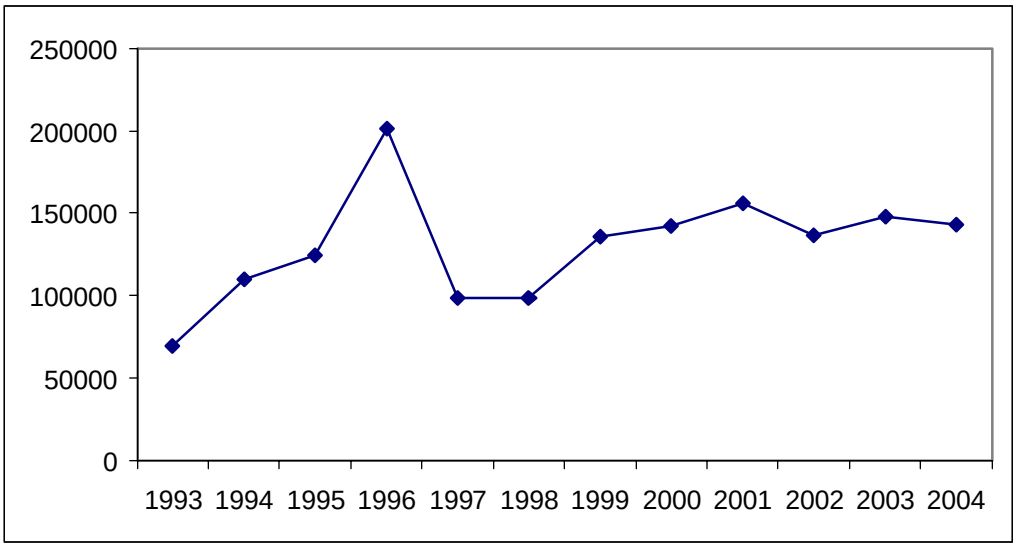

Fig. 5. Shrimp in Div. 3M: standardized effort in the commercial fishery. 2004 effort is projected to the end of the year.

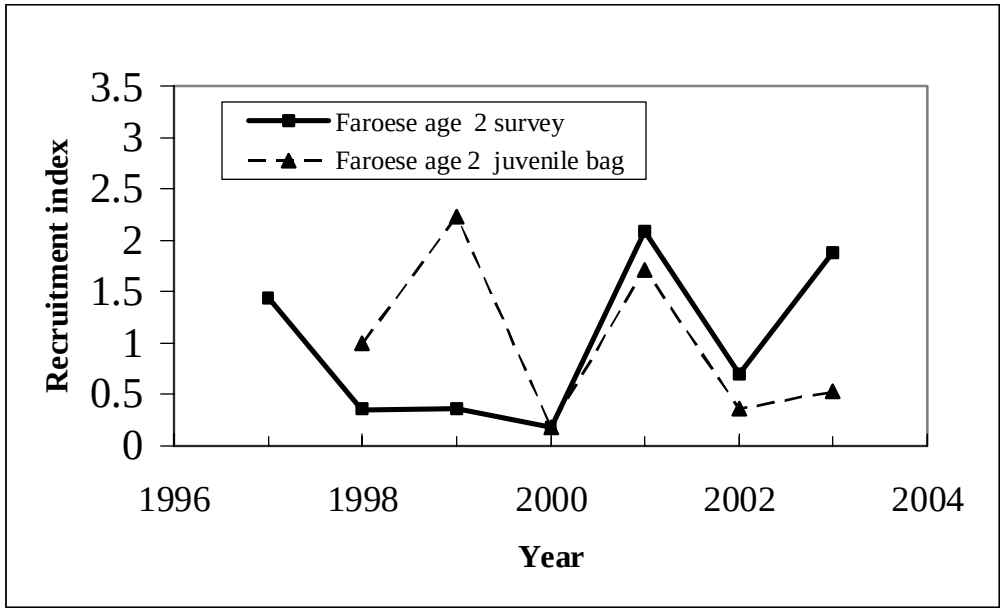

Figure. 6. Shrimp in Div. 3M: abundance indices at age 2 from the Faroese survey and from the juvenile bag. Each series was standardized to its mean.

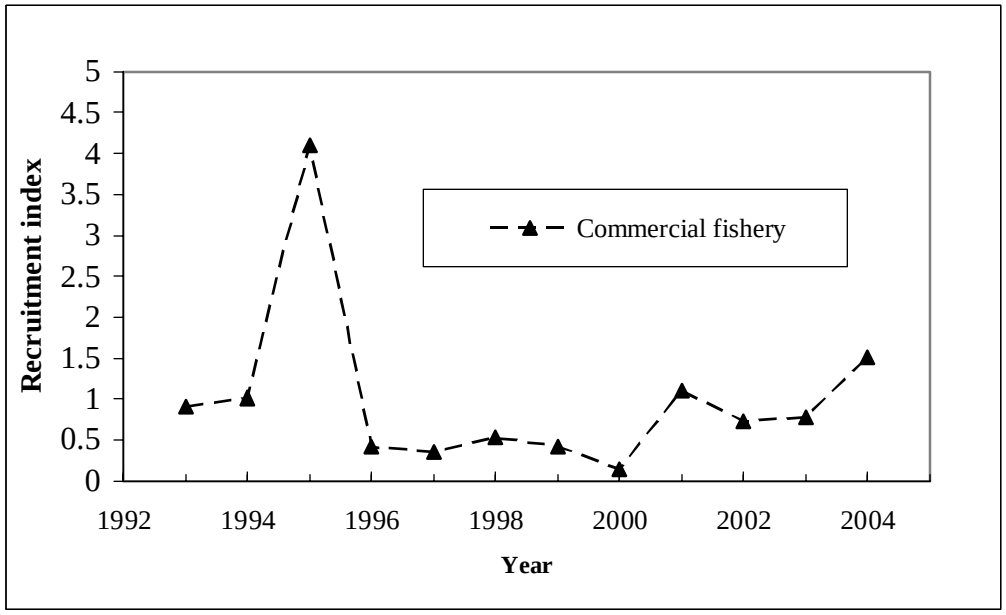

Figure. 7. Shrimp in Div. 3M: abundance indices (No./hour standardized) at age 2 from the commercial Fishery. The series was standardized to its mean.

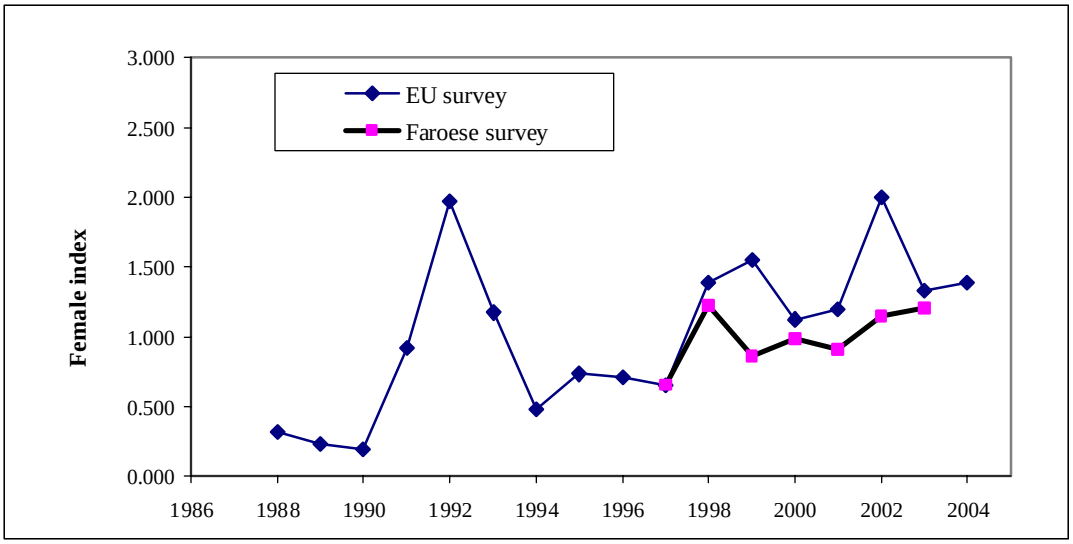

Figure. 8. Shrimp in Div. 3M: female biomass index from EU trawl surveys, 1988-2003, Faroese survey, 1997-2003 Each series was standardized to the mean of that series.

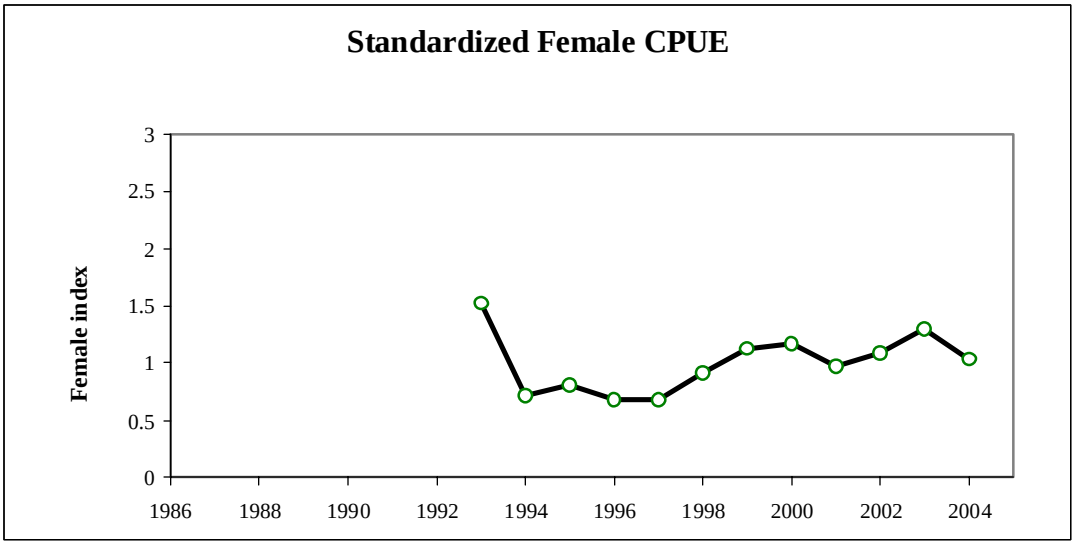

Figure. 9. Shrimp in Div. 3M: standardized female CPUE, 1993-2004. The series was , standardized to the mean of the series.