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The Fishery for Northern Shrimp (*Pandalus borealis*) in Denmark Strait / off East Greenland 1978 – 2020.

by

Frank Rigét

Pinngortitaleriffik, Greenland Institute of Natural Resources
P.O. Box 570, DK-3900 Nuuk, Greenland

Abstract

Northern shrimp (*Pandalus borealis*) occurs off East Greenland from Cape Farewell to about 70°N in depths down to about 800 m. North of 65°N the stock spans the adjacent Greenlandic and Icelandic economic zones. Prior to 2011 the stock was assessed as a single population by evaluation of fishery dependent data only, since 2011 data from research survey was included in the assessment. Data from an annual survey series has been available during the period from 2008 to 2020; however, no survey were performed in the period 2017 to 2019. The stock is managed by catch quotas in the Greenlandic zone. There are no management related restrictions on the fishery in the Icelandic zone. The fishery in the Icelandic zone ceased in 2006.

A multinational fleet of large factory trawlers exploited the stock taking annual catches between 11 500 tons and 14 000 tons from 1994 to 2003. From 2004 until 2016 annual catches decreased and since 2016 the catch rates index has been increasing considerably and in 2019 the annual catch was 1576 tons. Preliminary data indicating increasing catches in 2020. However, the recent catch rate index might not be a reliable index for the biomass because of the low fishing effort in a restricted area in these years.

Introduction

Northern shrimp (*Pandalus borealis*) occurs off East Greenland in ICES Divisions XIVb and Va. The stock is distributed from Cap Farewell, up through the Denmark Strait to about 70°N in depths down to around 800 meters. Most shrimp biomass concentrations occur from 150-600 m. There is no evidence of distinct sub-populations and the stock is assessed as a single population.

The exploitation of this stock began in the late 1970's initiated by Icelandic trawlers. It soon became a multinational fishery with annual catches increasing rapidly to more than 15 000 tons then catches fluctuated around 12 000 tons until 2003 (Table 1, Fig. 2A). Since 2004, catches have been decreasing and was 1 600 tons in 2019 and 3 000 tons until 1July 2020. The fishery was originally conducted north of 65°N on both sides of the territorial midline between Greenland and Iceland. However, in 1993 a fishery was also initiated in various smaller areas south of 65°N extending south to the Cap Farewell but since 2013 no or very little fishing has been taken place south of 65°N. At any time, access to fishing grounds depends on ice conditions.

Greenland, EU, the Faroe Islands and Norway fleets have since 2014 participated in the fishery in the Greenlandic zone. Vessels taking part in the fishery are large factory trawlers in the range of 1000-4000 GRT. The fishery is

managed by a Total Allowable Catch (TAC) in the Greenlandic EEZ. Icelandic vessels operate exclusively in the Icelandic EEZ and the fishery is unrestricted by management initiatives. Annual catches in the Greenlandic zone from 1999 to 2005 accounted for 70-99 % of the total catches. No fishery has since 2006 been conducted in the Icelandic zone.

This paper presents and analyses data from the shrimp fishery off East Greenland to provide a basis for the assessment of the shrimp stock in this area; i.e. time series of catch, fishing effort, geographical distribution and CPUE based biomass indices and indices of harvest rate.

Materials and methods

Raw data

Logbooks from Greenland, Iceland, Faroe Islands and EU since 1980 and from Norway since 2000 supplied data on catch and effort (hours fished) on a haul by haul basis. From 1998 approximately 40% of all hauls were performed with double trawl and since 2004 more than 60% of all hauls were performed with double trawl. The 2020 assessment included both single (12% of the effort) and double trawl (78% of the effort) in the standardized catch rates calculations. In 2020 one vessel used triple trawl (9% of the total effort), however, no significant difference in catch rate (ANOVA, followed by Tukey's *post hoc* test, $p > 5\%$) was seen between double and triple trawl. Therefore, it was decided in this year's assessment to treat triple trawl as double trawl in the estimation of standardised CPUE indices and considering this first year with triple trawl as a "learning" year. The catches in the Greenland EEZ were corrected for "overpacking" according to Hvingel (2003).

Catches and corresponding effort were compiled by year, month, and areas north and south of 65°N. CPUE was calculated and applied to the total catch of the year to estimate the total annual effort. The geographical distribution of the fishery is shown by plotting the catch and effort by statistical units of 7.5' latitude and 15' longitude (Fig. 4a, b).

Catch rate indices

Three standardised CPUE indices were constructed: one for each of the areas north and south of 65°N and a combined index series representing the total area. The indices were based on logbook data from Greenlandic, Faeroese, EU, and Norwegian vessels, operating exclusively in the Greenlandic zone and from the Icelandic fleet fishing exclusively in the Icelandic zone (north of 65°N). Until 2005 Norwegian fishery data was considered to have too sparse information on the different areas fished and data was therefore not included in the standardized catch rates calculations. In 2006 Norwegian fishery data was included in the catch rates calculations after a positive evaluation of new logbook data from the Greenland Fishery and License Control (GFLK), where Norwegian fishery data has been recorded in standard format since 2000.

For the indices of the northern areas and the total areas involves a two-step process. In the first step multiplicative General Linear Modelling (GLM) were used to standardise the CPUE data from the Greenlandic zones separately. There is no area overlap between the vessels fishing in the two zones. The "first step" was performed following the method described in Hvingel *et al.* (2000). The multiplicative models included the following variables: (1) individual vessel fishing power, (2) seasonal availability of shrimp, (3) spatial availability of shrimp, (4) annual mean CPUE and (5) single and double trawl. Input data were mean CPUE by vessel, area, month, trawl type and year. The calculations were done using the SAS statistical software (Anon., 1988). The main effects model was represented in logarithmic form:

$$\ln(CPUE_{mjkhi}) = \ln(u) + \ln(A_m) + \ln(S_j) + \ln(V_k) + \ln(G_h) + \ln(Y_i) + e_{mjkhi}$$

here $CPUE_{ijkhi}$ is the mean CPUE for vessel k, fishing in area m in month j and trawl type h during year i (k = 1,...,n; m = 1,...,a; j = 1,...,s; h = 1,2; i = 1,...,y); ln(u) is overall mean ln($CPUE$); A_m is effect of the m^{th} area; S_j is the effect of the j^{th} month; V_k is the effect of the k^{th} vessel; G_h is the effect of trawl type; Y_i is the effect of the i^{th} year; e_{mjki} is the error term assumed to be normally distributed $N(0,\sigma^2/n)$, where n is the number of observations in the cell. A two levels trawl effect was introduced to account for the effect of twin trawling. The number of hauls was used as weighting factor. The standardised CPUE indices are the antilog of the year coefficient.

For the model pertaining to the Greenlandic zone 83 vessels were included in the analysis. The year*area cross-effect was calculated to give separate indices for the northern and southern areas.

In the Icelandic zone 126 different Icelandic vessels had been registered in the area from 1987 to 2005. Almost no fishery has been conducted in 2005 (21 tons) and there has been no or very little fishery since 2006. The 61 vessels qualifying for the index were collapsed into 18 groups consisting of 1-8 vessels of equal fishing power. The month effect was reduced to 6 levels. No area effect was included. A two levels trawl effect was introduced to account for the effect of twin trawling.

Results and diagnostically output from the GLM run show that data from the Icelandic zone in 2005 was unsuitable to further analyses and therefore not included. This analysis has not been repeated since 2006 (Siegstad and Hvingel 2006).

The index of the area south of 65˚N
From this first step of calculations, the biomass index for the areas south of 65˚N came directly as the 'year-area south' cross effect of the Greenlandic zone model (see appendix 1).

The combined index of the area north of 65˚N
In the second calculation step the biomass index for the areas north of 65˚N was derived by combining the year coefficients of the Icelandic zone model and the year effects for the northern areas in the Greenlandic zone model (i.e. the 'year-area north' cross effect, see appendix 1). A Monte Carlo Markov Chain (MCMC) sampling process was used to construct distributions of likelihoods of possible values of the combined index. This was done within the R using the rjags library programming framework in R (version 3.6.1, R Core Team, 2019). The individual CPUE series for the p^{th} fleet, μ_{pi}, was assumed to reflect an overall biomass series, Y_i, and a constant fleet coefficient, v_p, so that:

$$\mu_{pi} = v_p Y_i \exp(e_{pi})$$

The error, e_{pi}, were assumed distributed with mean zero and variance σ_{pi}^2. The error term was assumed that e_{pi}, have variances inversely proportional to the area of fishing ground, a_p, covered by fleet p. The factor, a_p, was taken to be the area of sea bottom between 150-600 m. Hence, σ_{pi}^2 was calculated by:

$$\sigma_{pi}^2 = \frac{cv_{pi}^2}{a_p}$$

Where cv_{pi} is the annual fleet specific coefficient of variation as calculated in the GLM-run. The area weighting factors, a_p, for the Greenlandic area north of 65° and the Icelandic zone were estimated to be 0.9 and 0.1, respectively.

The combined index of the total area
In a similar second calculation step a single combined index of the development of the population biomass in the whole area was derived by aggregating the overall year coefficients from the Greenlandic zone model (appendix 2) and the year coefficients from the Icelandic zone model (Siegstad and Hvingel 2006). This was also done by the method described above using an area-weighting factor of 0.875 for the Greenlandic zone data and thus 0.125 for the Icelandic zone data.

Harvest rate indices
Indices of harvest rate were calculated by dividing total annual catch of the area by the respective standardised CPUE indices.

Results and Discussion

Geographical distribution of the fishery
The fishery was originally conducted north of 65˚N in the Dohrn bank-Strede bank area on both sides of the territorial midline between Greenland and Iceland and on the slopes of Storfjord Deep. In 1993, a fishery was also initiated south of 65°N in various smaller areas extending south to the Cap Farewell. Since 2013, no or very little fishery has been conducted south of 65˚N (Table 2, Fig. 1).

Catch

As the fishery developed, catches increased rapidly to more than 15 000 tons in 1987-88 but declined thereafter to about 9 000 tons in 1992-93 (Fig. 1A, Table 1 and 2). Following the area expansion of the fishery south of 65˚N in 1993 catches increased again reaching 11 900 tons in 1994. From 1994 to 2003 catches fluctuated between 11 500 and 14 000 tons (Fig. 1A). In 2004 the catches started decreasing, from 10 000 tons in 2004 to 49 tons in 2016. The catches have since then increased to 1574 tons in 2019. In 2020 catches have further increase and were 2 966 tons until July.

In the northern area the amount caught declined by about 85% from 1988 to 2001, i.e. from 15 000 tons to 2 200 tons (Fig. 1A, Table 2). Catches more than doubled in the period 2002-2004 (Table 2, Fig. 1A), but have been decreasing since then except for an increase in the recent two years.

Catches in the southern area increased from 1 900 tons in 1993 (the first year of fishery in this area) to about 11 700 tons in 2001 (Fig. 1A). Since then catches in the area south of 65˚N has been decreasing. No or very little fishing has been conducted in the southern area since 2012.

Fishing effort

The high increase in catches during the first ten-year period was mainly driven by increased fishing effort and peaked in 1989 with nearly 120 000 hours (Fig. 1B, Table 2). Since then the total effort gradually decreased and 1140 hours in 2018. In 2020, the effort has increased and until 1 July to 3138 hours.

The historic development of fishing effort spent in the northern area follows the one described for the total area closely – except for 2001, where a lot of effort shifted to the south.

In the southern areas, effort increased from about 10 000 hours in 1993 to 25 000 hours in 1997. In 1999 it reached a low of 7 500 hours but increased again to 20 000 hours in 2001. Since then effort in the southern area has been declining (Fig. 1B, Table 2).

Catch rate

Catch rates (total area) decreased from 298 kg/hr to 109 kg/hr in the period 1981-1989 follow by increasing trend until 2009. From 2010 to 2015 catch rates have continuously been declining to the lowest value of 117 kg/hr in the latest 2 decades (Fig. 1C, Table 2). Since 2016, the catch rates increased considerably and preliminary 2020 data, until 1 July, indicating catch rate at 945 kg/hour (Fig. 1C).

Catch rates in the northern area follow the same trend as the overall figure (Fig. 1C) except for the period 1993 to 2009 when catch rate in the southern area were considerably higher than in the northern area.

In the southern area, catch rates increased considerably in the period 1993 to 1999 followed by a general decrease to 2008. The high catch rates observed in the years 2010 to 2012 are based on relatively few hauls.

Standardised catch rate indices

The CPUEs for the southern area in 2011 and from 2013 to 2019 were omitted from the GLMs because of no hauls or very low number of hauls (below 10) conducted.

Results of the two multiplicative models to standardise catch rates showed that all main effects and interaction between YEAR and AREA were highly significant ($p<0.001$). The R-squared of the models for Greenland and Iceland were 67% and 78%, respectively (see appendix 1 for the Greenland model).

The combined CPUE index for the total area (Fig. 2, Table 3) indicated that the stock more than halved during the period 1987-1993. Since then it has been improved and the mean index values increased until the end of the 1990s and stabilized at a level one third above that of 1987. In the subsequent years, the biomass index was fluctuating without a trend until 2009, where the index more than doubled compared to 1987. From 2010, the index decreased to a low level in 2014 not seen since the beginning of 1990s. In recent years, the index has increased considerably. However, in these years, the fishing effort has been relatively small and carried out in a relatively small area.

The CPUE index series of the northern areas (Fig. 2, Table 3) is rather similar to that for the total area, except that during the period when the fishing area expand south of 65°N the CPUE index was at a lower level. The recent years catch rates similarly to index for the total area has been obtained by a relative low fishing effort in a relatively small area.

The CPUE index series of the southern area (Fig. 3, Table 3) increased until 1999 and has since then fluctuated without a trend. No index for the southern area was calculated in 2011 and from 2013 to 2019.

Indices of harvest rate

The standardised effort i.e. the index of harvest rate, have shown a decreasing trend since the mid-1990s for the total area (Table 3, Fig. 3) reaching its lowest levels from 2016 to 2019. The separate indices for the Northern and Southern areas are also shown in Fig. 3 and they follow the trend seen for the total area. No standardised effort for the southern area was calculated for 2011 and 2013 to 2020.

Conclusions

Total catches fluctuated around 12 000 tons from 1994 to 2003 (Table 1, Fig. 1A), catches then decreased to 49 tons in 2016. Since then catches have increase and the 2020 catches until July were 2 966 tons.

The combined CPUE index for the total area (Fig. 2, Table 3) indicated that the catch rate more than halved during the period 1987-1993. In the succeeding years, the catch rate increased until the end of the 1990s, stabilized at a level one third above that of 1987. From the late 90'ties the CPUE index has been fluctuating without a clear trend until 2009, where the index more than doubled compared to 1987. Nevertheless, the combined index once more decreased to the lowest level observed in 2014. In the last five years, the index has increased considerably. However, the recent years index values have been based on historical low fishing effort in a relative limited area.

Since the mid-1990s exploitation rate index (standardized effort) has decreased, being at historical low level in the last five years.

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Table 1. Catch (tons) of shrimp by the fishery in Denmark Strait/off East Greenland from 1978 to July 2020. Values for the fishery in the Greenland EEZ by EU, Faeroe Islands, France, Greenland, and Norway are corrected according to Hvingel 2003.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
North of 65°N																			
EU (DK,EST,LTU)	-	0	878	727	926	255	554	442	626	703	554	454	476	450	199	138	250	302	26
Faroe Islands	-	0	5296	892	922	554	836	843	910	754	847	738	1029	1265	1355	689	462	931	995
France	-	0	63	442	518	364	626	803	976	1305	616	472	62	148	0	0	0	0	0
Greenland	-	0	250	1256	1395	1835	2815	3248	7232	8396	9304	7408	7580	5283	2496	1771	1326	2390	359
Iceland	363	485	759	125	0	43	742	1794	1150	1330	1431	1326	281	465	1750	2553	1514	1151	566
Norway	-	1001	3079	2522	2372	2161	2662	2566	2535	2586	2561	2601	3052	3146	3102	1831	2180	2402	1544
Total	363	1486	10325	5964	6133	5212	8235	9696	13428	15073	15313	12999	12480	10757	8901	6982	5731	7176	3490
South of 65°N																			
Denmark (EU)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	613	731	1167
Faroe Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	280	974	295	402
Greenland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1141	3603	2667	5295
Norway	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	424	1011	720	1590
Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1904	6201	4412	8453
Total area																			
EU (DK,EST,LTU)	-	0	878	727	926	255	554	442	626	703	554	454	476	450	199	198	863	1033	1193
Faroe Islands	-	0	5296	892	922	554	836	843	910	754	847	738	1029	1265	1355	968	1436	1225	1397
France	-	0	63	442	518	364	626	803	976	1305	616	472	62	148	0	0	0	0	0
Greenland	-	0	250	1256	1395	1835	2815	3248	7232	8396	9304	7408	7580	5283	2496	2912	4929	5057	5655
Iceland	363	485	759	125	0	43	742	1794	1150	1330	1431	1326	281	465	1750	2553	1514	1151	566
Norway	-	1001	3079	2522	2372	2161	2662	2566	2535	2586	2561	2601	3052	3146	3102	2255	3190	3122	3133
Total	363	1486	10325	5964	6133	5212	8235	9696	13428	15073	15313	12999	12480	10757	8901	8886	11932	11588	11944
Total all areas	363	1486	10325	5964	6133	5212	8235	9696	13428	15073	15313	12999	12480	10757	8901	8886	11932	11588	11944
Advised TAC	-	-	-	-	4200	4200	4200	5000	-	-	-	100003	100003	100003	8000	5000	5000	5000	5000
Effective TAC[1]	-	-	-	8000	4500	5725	5245	6090	75255	75255	87255	90255	14100	14500	13000	9563	9563	9563	9563

[1]For Greenland zone only; no restrictions in Iceland zone

Table 1 (continued). Catch (tons) of shrimp by the fishery in Denmark Strait/off East Greenland from 1978 to July 2020. Values for the fishery in the Greenland EEZ by EU, Faeroe Islands, France, Greenland, and Norway are corrected according to Hvingel 2003.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014[2]
North of 65°N																		
EU (DK,EST,LTU)	85	401	793	459	72	816	861	482	304	618	421	389	892	1345	927	1411	1533	434
Faroe Islands	635	1268	867	956	214	1029	1062	894	615	342	319	612	1325	781	0	0	0	0
France	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Greenland	105	646	614	115	650	638	695	578	454	223	802	14	844	426	183	481	170	175
Iceland	2856	1421	769	132	10	1231	703	411	29	0	0	0	0	0	0	0	0	0
Norway	797	1628	1783	2759	1291	1630	2861	2700	2613	2704	1771	1514	883	770	36	2	0	0
Total	4478	5364	4827	4420	2237	5344	6183	5065	4015	3887	3313	2529	3945	3323	1145	1893	1703	609
South of 65°N																		
Denmark (EU)	1657	1300	1095	1900	2473	2309	1827	1022	644	683	431	251	28	101	0	0	0	0
Faroe Island	656	138	453	340	2402	1013	303	255	176	227	169	14	28	0	0	0	0	0
Greenland	4701	3950	4966	5235	4943	4333	4194	3488	2737	316	638	0	447	178	53	215	3	0
Norway	2261	670	378	157	1855	1098	197	186	180	76	48	0	107	0	0	0	0	0
Total	9276	6057	6893	7632	11674	5985	6522	4951	3737	1302	1286	266	610	279	53	215	3	0
Total area																		
EU (DK,EST,LTU)	1742	1701	1888	2358	2545	2548	2688	1504	948	1301	852	640	920	1446	927	1411	1533	434
Faroe Islands	1292	1406	1321	1296	2616	1322	1365	1149	791	569	488	627	1354	782	0	0	0	0
France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greenland	4806	4595	5581	5349	5593	4484	4890	4066	3191	539	1440	14	1292	605	236	696	173	175
Iceland	2856	1421	769	132	10	1231	703	411	29	0	0	0	0	0	0	0	0	0
Norway	3059	2298	2160	2917	3147	1743	3059	2886	2793	2780	1819	1514	990	770	36	2	0	0
Total	13754	11422	11719	12053	13911	11329	12705	10016	7752	5189	4599	2794	4555	3602	1199	2109	1706	609
Total all areas	13754	11422	11719	12053	13911	11242	12637	9985	7752	5189	4599	2794	4555	3602	1199	2109	1706	609
Advised TAC	5000	5000	9600	9600	9600	9600	9600	12400	12400	12400	12400	12400	12400	12400	12400	12400	12400	2000
Effective TAC[1]	9563	9563	10600	12600	10600	10600	10600	15043	12400	12400	12400	12400	12835	11835	12400	12400	12400	8300

[1]For Greenland zone only; no restrictions in Iceland zone

[2]Catch until July

Table 1 (continued). Catch (tons) of shrimp by the fishery in Denmark Strait/off East Greenland from 1978 to July 2020. Values for the fishery in the Greenland EEZ by EU, Faeroe Islands, France, Greenland, and Norway are corrected according to Hvingel 2003.

	2015	2016	2017	2018	2019	2020[2]
North of 65°N						
EU (DK,EST,LTU)	402	49	178	547	1009	1929
Faroe Islands	0	0	0	0	267	907
France	-	-	-	-	-	-
Greenland	174	0	383	0	298	0
Iceland	0	0	0	0	0	0
Norway	0	0	0	0	0	0
Total	576	49	561	547	1574	2836
South of 65°N						
Denmark (EU)	0	0	0	0	2	1
Faroe Island	0	0	0	0	0	0
Greenland	0	0	0	0	0	1
Norway	0	0	0	0	0	0
Total	0	0	0	0	2	2
Total area						
EU (DK,EST,LTU, GBR)	402	49	178	547	1011	1930
Faroe Islands	0	0	0	0	267	907
France	0	0	0	0	0	0
Greenland	174	0	383	0	298	1
Iceland	0	0	0	0	0	0
Norway	0	0	0	0	0	0
Total	576	49	561	547	1576	2839
Total all areas	576	49	561	547	1576	2839
Advised TAC	2000	2000	2000	2000	2000	2000
Effective TAC[1]	6100	5300	5300	4300	3384	4750

[1]For Greenland zone only; no restrictions in Iceland zone

[2]Catch until July

Table 2. Catch (tons), effort (hrs) and Catch-Per-Unit-Effort (kg/hr) by trawlers fishing in Denmark Strait / off East Greenland in areas north and south of 65°N and total area.

	Area north			Area south			Total area		
Year	Catch	Effort	CPUE	Catch	Effort	CPUE	Catch	Effort	CPUE
1980	10325	37198	278				10325	37198	278
1981	5964	19986	298				5964	19986	298
1982	6133	23081	266				6133	23081	266
1983	5212	23855	219				5212	23855	219
1984	8235	34983	235				8235	34983	235
1985	9696	62911	154				9696	62911	154
1986	13428	61863	217				13428	61863	217
1987	15073	79881	189				15073	79881	189
1988	15313	109455	140				15313	109455	140
1989	12999	119629	109				12999	119629	109
1990	12480	72736	172				12480	72736	172
1991	10757	78714	137				10757	78714	137
1992	8901	68349	130				8901	68349	130
1993	6982	52381	133	1904	9335	204	8886	61003	146
1994	5731	31417	182	6201	18371	338	11932	49428	241
1995	7176	33953	211	4412	13157	335	11588	46927	247
1996	3490	27029	129	8453	24589	344	11944	51049	234
1997	4478	22175	202	9276	25992	357	13754	47519	289
1998	5364	20881	257	6057	10498	577	11422	31205	366
1999	4827	19388	249	6893	7449	925	11719	25742	455
2000	4420	17474	253	7632	10705	713	12053	28096	429
2001	2237	9822	228	11674	20435	571	13911	29933	465
2002	5344	20052	267	5985	8546	700	11329	22843	496
2003	6183	18053	342	6522	9317	700	12705	25295	502
2004	5065	15848	320	4951	8972	552	10016	27450	365
2005	4015	11249	357	3737	8003	467	7752	19255	403
2006	3887	10414	373	1302	2436	534	5189	12851	404
2007	3313	8976	369	1286	1974	651	4599	10949	420
2008	2529	6106	414	266	585	454	2794	6691	418
2009	3945	6500	607	610	617	989	4555	7117	640
2010	3323	10286	323	280	263	1062	3602	10550	341
2011	1145	3301	347	53	25	2136	1199	3326	360
2012	1893	6343	298	215	170	1267	2109	6513	324
2013	1714	8162	210	3	75	45	1717	8235	208
2014	622	4364	142	0	-	-	622	4374	142
2015	576	4573	126	0	-	-	576	4905	117
2016	49	327	150	0	-	-	49	327	150
2017	561	1633	344	0	-	-	561	1633	344
2018	547	1140	480	0	0	0	547	1140	480
2019	1574	1999	787	2	7	286	1576	2006	786
2020*	2966	3138	945	0	0	100	2966	3147	943

*until July the 1

Table 3. Means and standard errors (se) of standardised CPUE and effort index values based on logbook information from trawlers fishing in Denmark Strait/off East Greenland in areas north and south of 65°N and total area.

	Area north				Area south				Total			
	Std.CPUE		Std. Effort		Std.CPUE		Std. Effort		Std.CPUE		Std. Effort	
Year	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
1987	1.00	-	1.00	-					1.00	-	1.00	-
1988	0.93	0.09	1.09	0.11					1.01	0.11	1.00	0.10
1989	0.66	0.06	1.30	0.13					0.69	0.07	1.24	0.13
1990	0.65	0.07	1.27	0.13					0.69	0.07	1.20	0.13
1991	0.56	0.06	1.28	0.13					0.59	0.06	1.21	0.13
1992	0.45	0.05	1.30	0.13					0.48	0.05	1.23	0.13
1993	0.37	0.04	1.26	0.13	1.00	-	1.00	-	0.45	0.05	1.30	0.14
1994	0.85	0.10	0.45	0.05	0.66	0.05	1.50	0.15	1.21	0.13	0.65	0.07
1995	0.71	0.08	0.67	0.07	0.57	0.05	1.28	0.12	0.97	0.11	0.79	0.09
1996	0.63	0.08	0.37	0.04	0.58	0.05	1.69	0.12	1.23	0.14	0.65	0.07
1997	0.85	0.12	0.35	0.05	0.89	0.08	1.92	0.14	1.50	0.17	0.61	0.07
1998	1.07	0.13	0.33	0.04	0.61	0.09	1.09	0.16	1.56	0.18	0.48	0.06
1999	0.97	0.13	0.33	0.04	0.52	0.08	0.94	0.10	1.84	0.23	0.42	0.05
2000	1.18	0.14	0.25	0.03	0.90	0.08	1.06	0.11	1.94	0.23	0.41	0.05
2001	1.03	0.15	0.14	0.02	0.77	0.08	2.14	0.10	1.94	0.23	0.48	0.06
2002	1.06	0.14	0.34	0.05	0.61	0.11	0.90	0.18	2.19	0.26	0.34	0.04
2003	1.01	0.12	0.41	0.05	0.63	0.11	1.17	0.08	1.67	0.20	0.50	0.06
2004	1.39	0.16	0.24	0.03	0.50	0.08	0.93	0.11	1.84	0.22	0.36	0.04
2005	1.37	0.17	0.19	0.02	0.47	0.08	0.55	0.11	2.12	0.27	0.24	0.03
2006	1.34	0.17	0.19	0.03	0.58	0.10	0.20	0.07	1.93	0.26	0.18	0.02
2007	1.29	0.17	0.17	0.02	0.31	0.16	0.18	0.03	1.77	0.24	0.17	0.02
2008	1.71	0.24	0.10	0.01	1.22	0.38	0.06	0.03	2.16	0.33	0.09	0.01
2009	2.44	0.33	0.11	0.01	0.72	0.09	0.07	0.02	2.96	0.43	0.10	0.01
2010	1.28	0.16	0.17	0.02	0.81	0.10	0.04	0.02	1.61	0.23	0.15	0.02
2011	1.37	0.25	0.06	0.01	-	-	-	-	1.66	0.33	0.05	0.01
2012	1.07	0.16	0.12	0.02	-	-	-	-	1.36	0.22	0.10	0.02
2013	0.67	0.10	0.17	0.02	-	-	-	-	0.88	0.14	0.13	0.02
2014	0.54	0.10	0.08	0.01	-	-	-	-	0.77	0.16	0.05	0.01
2015	0.46	0.08	0.08	0.01	-	-	-	-	0.59	0.11	0.06	0.01
2016	0.66	0.31	0.005	0.002	-	-	-	-	0.93	0.50	0.00	0.002
2017	1.17	0.27	0.032	0.007	-	-	-	-	1.36	0.34	0.03	0.01
2018	1.93	0.49	0.019	0.005	-	-	-	-	-	2.42	0.68	0.01	0.004
2019	2.97	0.57	0.035	0.000	-	-	-	-	-	3.54	0.74	0.03	0.006
2020*	3.51	0.56	0.056	0.000	-	-	-	-	-	4.61	0.81	0.04	0.007

* Until July

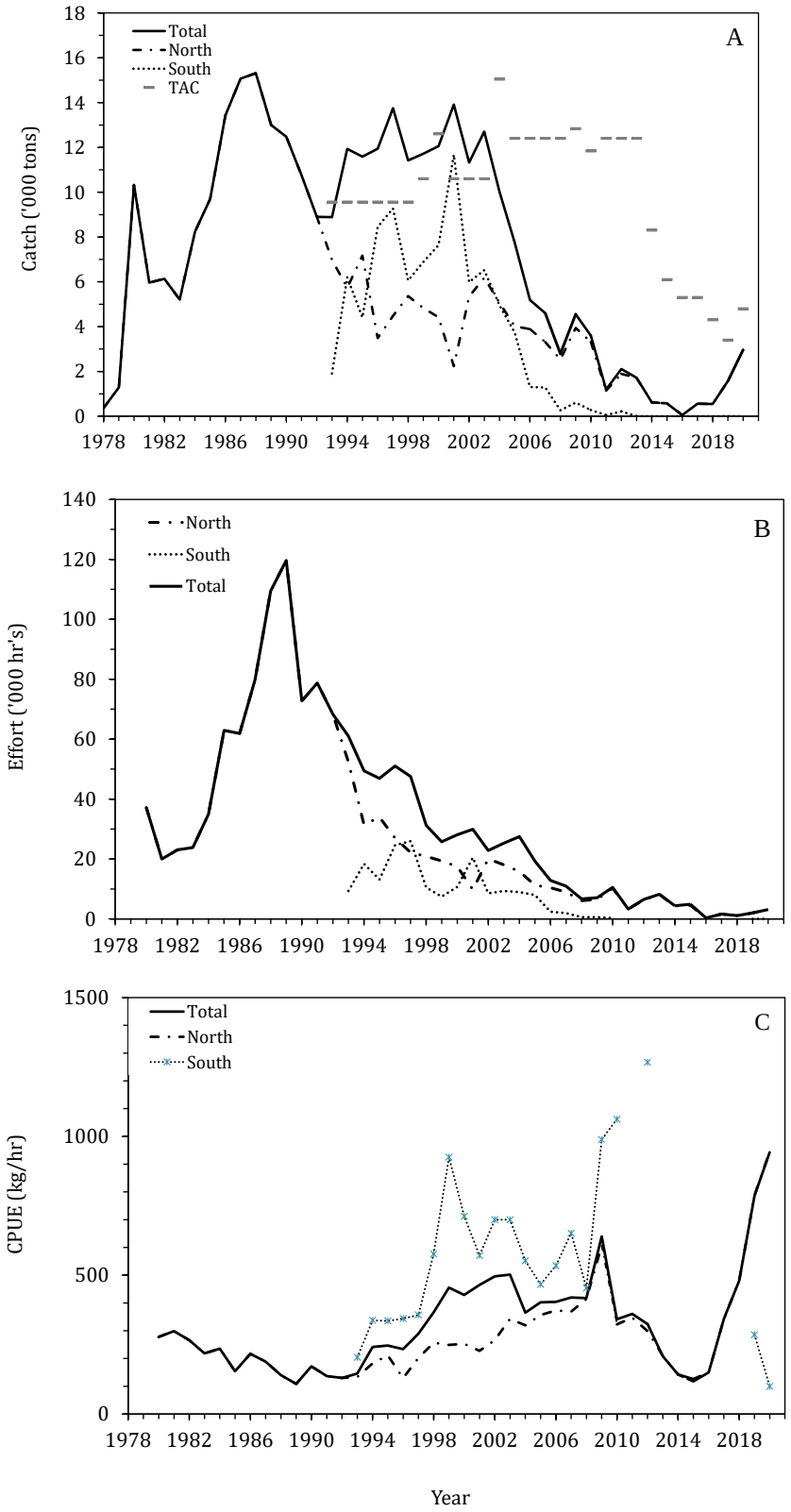

Figure 1. Catch (A), fishing effort (B) and catch-per-unit-effort (C) by shrimp trawlers fishing in Denmark Strait/off East Greenland. Series are given for the areas north and south of 65°N and overall. (Data for 2020 is part-years data, until July).

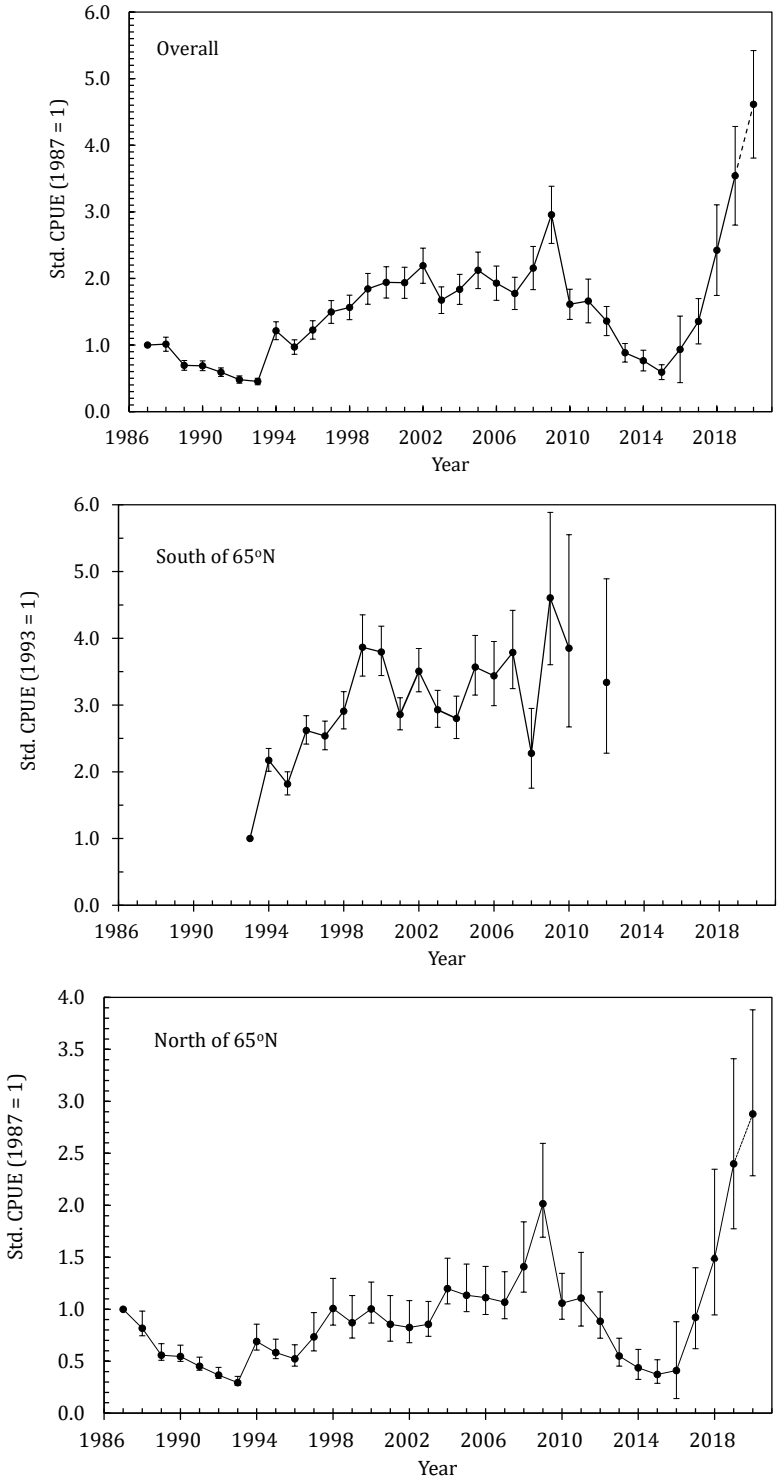

Figure 2. Standardized Catch-Per-Unit-Effort indices of the shrimp fishery in Denmark Strait and off East Greenland in the areas south of 65°N, overall fishery north of 65°N (both in Greenland and Iceland EEZ), and overall standardized CPUE for the stock (Estimates for 2020 are based on data until July). No index for the southern area has been calculated since 2012 due to a low number of hauls (less than 10 each year).

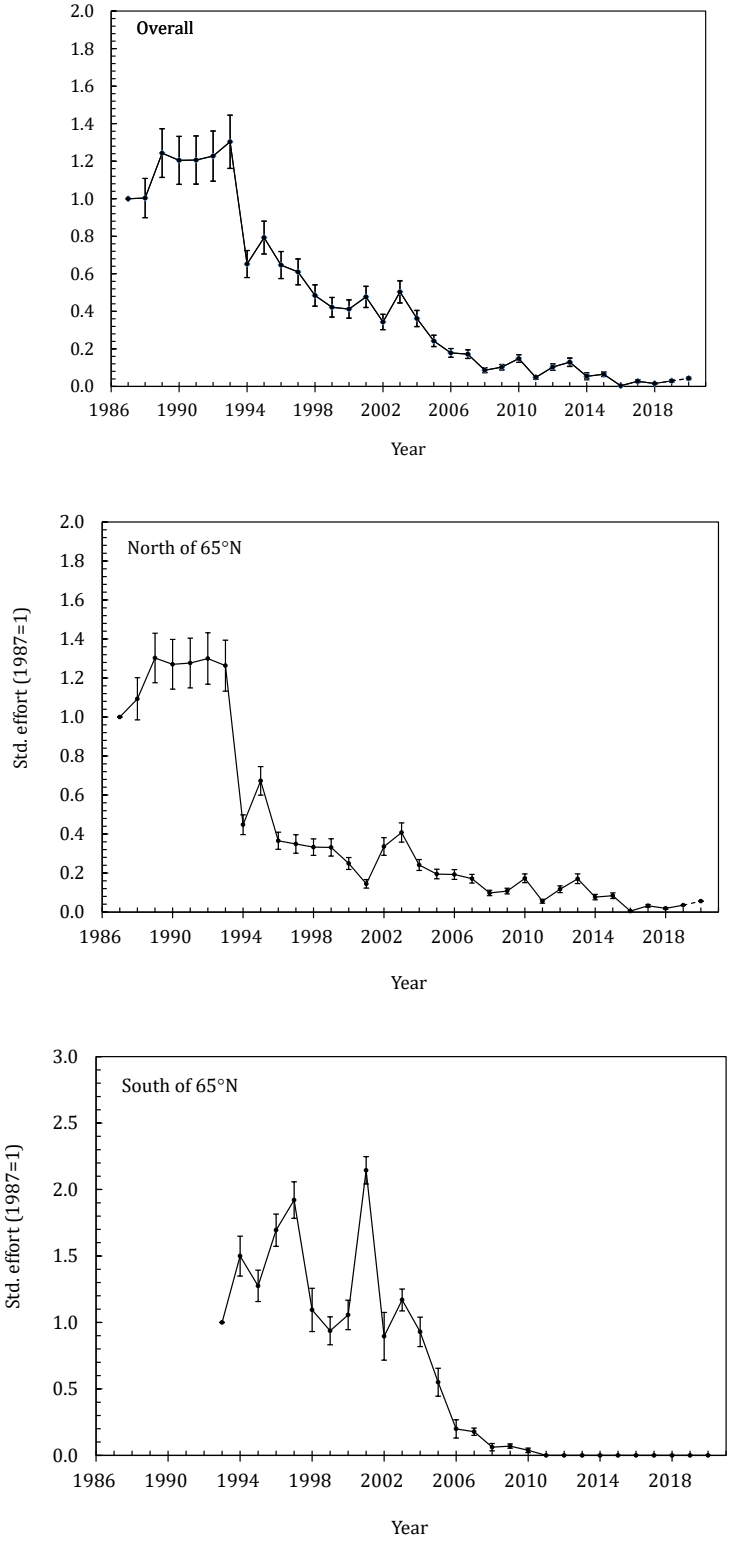

Figure 3. Standardised effort indices of the shrimp fishery in Denmark Strait and off East Greenland in the areas north of 65°N, south of 65°N and overall (Estimates for 2020 are based on data until July).

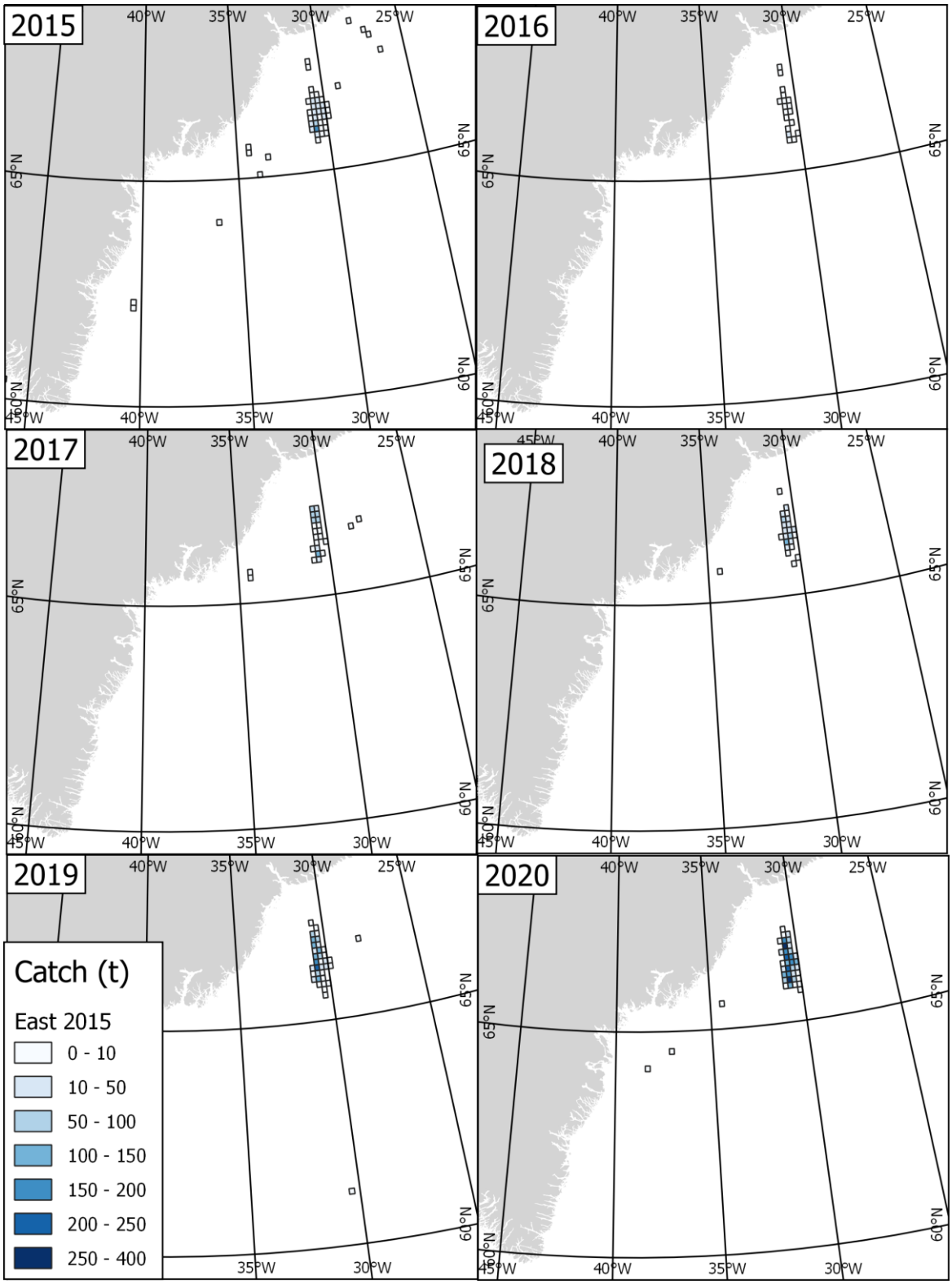

Figure 4a. Thematic mapping of different levels of catch in the shrimp fishery in Denmark Strait/off East Greenland 2013-2020 (2020 until July).

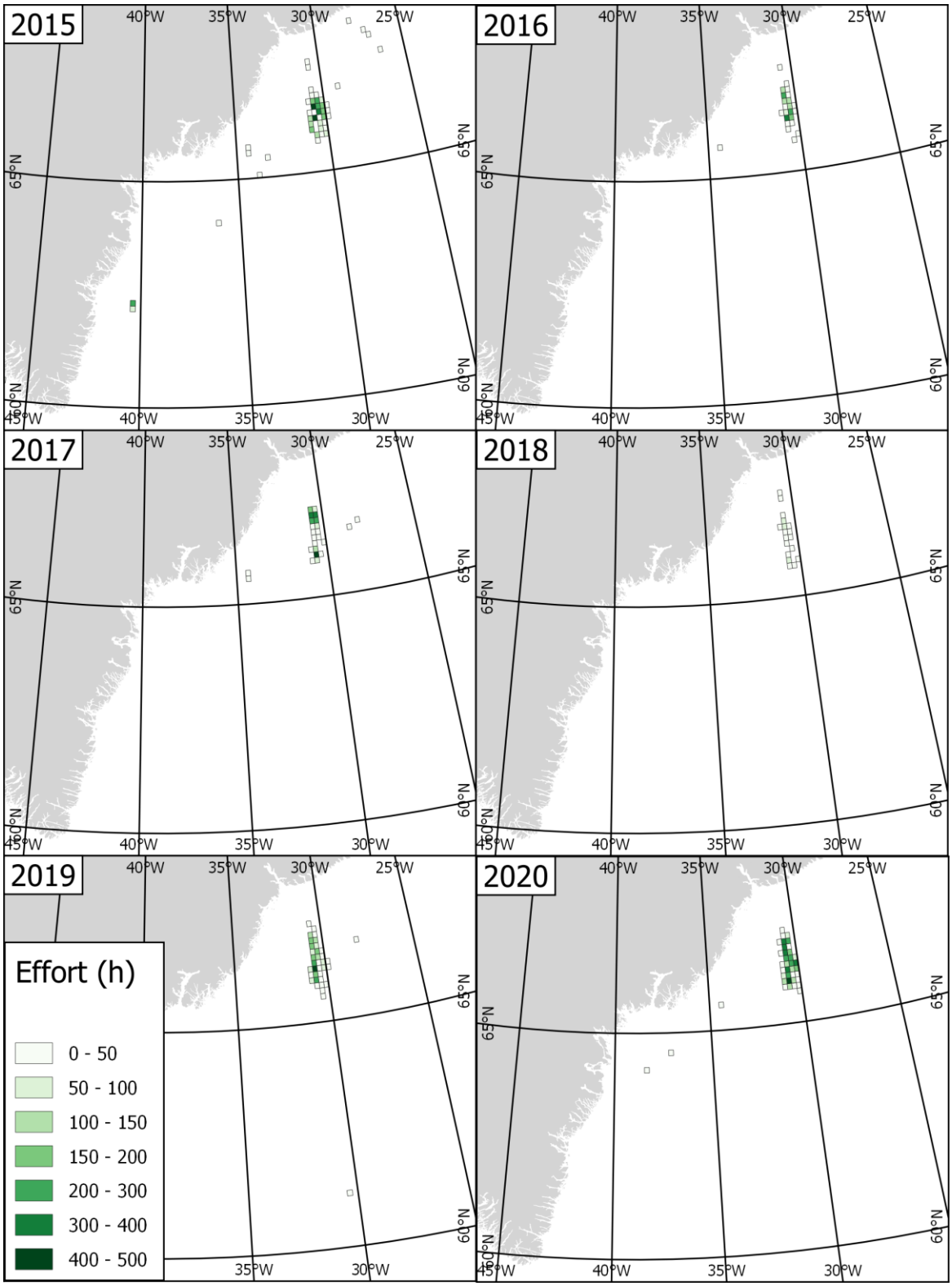

Figure 4b. Thematic mapping of different levels of effort in the shrimp fishery in Denmark Strait/off East Greenland 2013-2020 (2020 until July).

Appendix 1. Results and diagnostical outputs from GLM run of model for standardising CPUE in the Greenlandic zone including the area effect. Data from Greenlandic, Faeroese, Norway and EU vessels.

The SAS System

The GLM Procedure

Class Level Information

Class	Levels	Values
BAAD	82	E001 E002 E003 E004 E005 E006 E007 E008 E009 E010 E011 E012 E013 E014 E015 E017 E018 E019 E020 E021 E022 E023 E024 E025 E026 E027 E028 E029 E030 E031 E032 E033 E034 E035 E036 E037 E038 E039 E040 E041 E042 E043 E044 E045 E046 E047 E048 E049 E050 E051 E052 E053 E054 E055 E056 E057 E058 E059 E060 E061 E062 E063 E064 E065 E066 E067 E068 E069 E070 E071 E072 E073 E074 E075 E076 E077 E078 E079 E080 E081 E082 E083
AAR	34	87 88 89 90 91 92 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 999
MAA	12	1 2 3 4 5 6 7 8 9 10 11 12
AREA	2	21 22
X	2	2 9

Number of Observations Read 3413

Number of Observations Used 3413

The SAS System

The GLM Procedure

Dependent Variable: LNCPUE

Weight: Hauls

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	145	58109.47103	400.75497	46.28	<.0001
Error	3267	28291.62306	8.65982		
Corrected Total	3412	86401.09409			

R-Square	Coeff Var	Root MSE	LNCPUE Mean
0.672555	56.83774	2.942757	5.177470

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BAAD	81	33312.56457	411.26623	47.49	<.0001
AAR*AREA	52	20172.74305	387.93737	44.80	<.0001
MAA	11	4591.29400	417.39036	48.20	<.0001
AREA	0	0.00000	.	.	.
X	1	32.86941	32.86941	3.80	0.0515

Source	DF	Type III SS	Mean Square	F Value	Pr > F
BAAD	81	9617.04425	118.72894	13.71	<.0001
AAR*AREA	51	15389.65081	301.75786	34.85	<.0001
MAA	11	4580.63865	416.42170	48.09	<.0001
AREA	1	1278.36626	1278.36626	147.62	<.0001
X	1	32.86941	32.86941	3.80	0.0515

Parameter	Estimate		Standard Error	t Value	Pr > |t|
Intercept	5.111668962	B	0.14092585	36.27	<.0001
BAAD E001	-1.209883755	B	0.18905372	-6.40	<.0001
BAAD E002	-1.151771725	B	0.18965670	-6.07	<.0001
BAAD E003	-1.093403121	B	0.14396626	-7.59	<.0001
BAAD E004	-1.178326665	B	0.18172373	-6.48	<.0001
BAAD E005	-1.215632183	B	0.18678106	-6.51	<.0001
BAAD E006	-0.875076680	B	0.18028929	-4.85	<.0001
BAAD E007	-1.072652730	B	0.17448609	-6.15	<.0001
BAAD E008	-0.865136159	B	0.15452442	-5.60	<.0001

Parameter	Estimate		Standard Error	t Value	Pr > |t|
BAAD E009	-0.830627904	B	0.18026526	-4.61	<.0001
BAAD E010	-1.084791005	B	0.13452428	-8.06	<.0001
BAAD E011	-1.050364079	B	0.14902176	-7.05	<.0001
BAAD E012	-0.918643434	B	0.26585135	-3.46	0.0006
BAAD E013	-1.021779219	B	0.18450634	-5.54	<.0001
BAAD E014	-0.943378780	B	0.13986110	-6.75	<.0001
BAAD E015	-0.995900021	B	0.14520417	-6.86	<.0001
BAAD E017	-0.841541989	B	0.15217713	-5.53	<.0001
BAAD E018	-0.920171114	B	0.14939990	-6.16	<.0001
BAAD E019	-0.839050208	B	0.21098925	-3.98	<.0001
BAAD E020	-1.031955974	B	0.17960568	-5.75	<.0001
BAAD E021	-0.554493862	B	0.17219236	-3.22	0.0013
BAAD E022	-0.913673441	B	0.14274477	-6.40	<.0001
BAAD E023	-0.725391345	B	0.23227875	-3.12	0.0018
BAAD E024	-0.793106456	B	0.13188438	-6.01	<.0001
BAAD E025	-0.476078758	B	0.16567842	-2.87	0.0041
BAAD E026	-0.533990786	B	0.18746638	-2.85	0.0044
BAAD E027	-0.694191173	B	0.13350166	-5.20	<.0001
BAAD E028	-1.009212530	B	0.18705696	-5.40	<.0001
BAAD E029	-0.817792231	B	0.14605636	-5.60	<.0001
BAAD E030	-0.796339121	B	0.14708555	-5.41	<.0001
BAAD E031	-0.704267805	B	0.13312970	-5.29	<.0001
BAAD E032	-0.716301778	B	0.13901783	-5.15	<.0001
BAAD E033	-0.920926944	B	0.40268929	-2.29	0.0223
BAAD E034	-0.731403341	B	0.17584124	-4.16	<.0001
BAAD E035	-0.358248052	B	0.18387217	-1.95	0.0515
BAAD E036	-0.582512691	B	0.21023301	-2.77	0.0056
BAAD E037	-0.679779802	B	0.13735647	-4.95	<.0001
BAAD E038	-0.480950461	B	0.16019171	-3.00	0.0027
BAAD E039	-0.388527041	B	0.14924893	-2.60	0.0093
BAAD E040	-0.331711500	B	0.14728096	-2.25	0.0244
BAAD E041	-0.430473976	B	0.16517861	-2.61	0.0092
BAAD E042	-0.418902170	B	0.14758466	-2.84	0.0046
BAAD E043	-0.593401002	B	0.13345069	-4.45	<.0001
BAAD E044	-0.535019403	B	0.13038881	-4.10	<.0001
BAAD E045	-0.552947311	B	0.15668106	-3.53	0.0004

Parameter	Estimate		Standard Error	t Value	Pr > |t|
BAAD E046	-0.585547175	B	0.14382983	-4.07	<.0001
BAAD E047	-0.538540986	B	0.13671015	-3.94	<.0001
BAAD E048	-0.532939667	B	0.13435738	-3.97	<.0001
BAAD E049	-0.635027772	B	0.12998214	-4.89	<.0001
BAAD E050	-0.476174921	B	0.15200369	-3.13	0.0017
BAAD E051	-0.560810923	B	0.13897837	-4.04	<.0001
BAAD E052	-0.509928782	B	0.14282603	-3.57	0.0004
BAAD E053	-0.451803921	B	0.22560740	-2.00	0.0453
BAAD E054	-0.555173193	B	0.13752971	-4.04	<.0001
BAAD E055	-0.362775269	B	0.15775814	-2.30	0.0215
BAAD E056	-0.161979075	B	0.14259075	-1.14	0.2561
BAAD E057	-0.438846876	B	0.14915546	-2.94	0.0033
BAAD E058	-0.337928027	B	0.18712450	-1.81	0.0710
BAAD E059	-0.188165718	B	0.22722034	-0.83	0.4077
BAAD E060	-0.330091575	B	0.15813864	-2.09	0.0369
BAAD E061	-0.307078628	B	0.12853146	-2.39	0.0169
BAAD E062	-0.390326709	B	0.13352131	-2.92	0.0035
BAAD E063	-0.337237698	B	0.15335070	-2.20	0.0279
BAAD E064	-0.326552676	B	0.14149931	-2.31	0.0211
BAAD E065	-0.353022346	B	0.16763452	-2.11	0.0353
BAAD E066	-0.438360417	B	0.18559442	-2.36	0.0182
BAAD E067	-1.048049172	B	0.43126508	-2.43	0.0151
BAAD E068	-0.312705551	B	0.20987985	-1.49	0.1363
BAAD E069	-0.261577215	B	0.13527582	-1.93	0.0532
BAAD E070	-0.193622981	B	0.12757855	-1.52	0.1292
BAAD E071	-0.214101575	B	0.12912726	-1.66	0.0974
BAAD E072	-0.271069301	B	0.18224343	-1.49	0.1370
BAAD E073	-0.367506142	B	0.16753632	-2.19	0.0283
BAAD E074	-0.212918676	B	0.13412426	-1.59	0.1125
BAAD E075	-0.147096759	B	0.14790871	-0.99	0.3200
BAAD E076	-0.218061866	B	0.14059076	-1.55	0.1210
BAAD E077	-0.128455330	B	0.17622813	-0.73	0.4661
BAAD E078	-0.115766428	B	0.13194758	-0.88	0.3804
BAAD E079	0.033784013	B	0.22095869	0.15	0.8785
BAAD E080	-0.118350523	B	0.18792502	-0.63	0.5289
BAAD E081	-0.104286271	B	0.14679126	-0.71	0.4775

Parameter	Estimate		Standard Error	t Value	Pr > |t|
BAAD E082	-0.073885439	B	0.26174347	-0.28	0.7777
BAAD E083	0.000000000	B	.	.	.
AAR*AREA 87 21	0.718863022	B	0.07575417	9.49	<.0001
AAR*AREA 88 21	0.516597227	B	0.07114981	7.26	<.0001
AAR*AREA 89 21	0.133839972	B	0.06953292	1.92	0.0543
AAR*AREA 90 21	0.112422844	B	0.06960958	1.62	0.1064
AAR*AREA 91 21	-0.076962887	B	0.06775501	-1.14	0.2561
AAR*AREA 92 21	-0.283881742	B	0.07063300	-4.02	<.0001
AAR*AREA 94 21	0.348298194	B	0.08756828	3.98	<.0001
AAR*AREA 94 22	0.775613461	B	0.07846497	9.88	<.0001
AAR*AREA 95 21	0.181075330	B	0.07890368	2.29	0.0218
AAR*AREA 95 22	0.597126850	B	0.09521304	6.27	<.0001
AAR*AREA 96 21	0.070286339	B	0.09522081	0.74	0.4605
AAR*AREA 96 22	0.963135264	B	0.08097438	11.89	<.0001
AAR*AREA 97 21	0.409460877	B	0.12185139	3.36	0.0008
AAR*AREA 97 22	0.930509487	B	0.08476992	10.98	<.0001
AAR*AREA 98 21	0.726239626	B	0.10858191	6.69	<.0001
AAR*AREA 98 22	1.067327677	B	0.09593980	11.12	<.0001
AAR*AREA 99 21	0.580087462	B	0.11377647	5.10	<.0001
AAR*AREA 99 22	1.351887596	B	0.11825428	11.43	<.0001
AAR*AREA 100 21	0.721613457	B	0.09599384	7.52	<.0001
AAR*AREA 100 22	1.333630507	B	0.09748824	13.68	<.0001
AAR*AREA 101 21	0.561506088	B	0.12465273	4.50	<.0001
AAR*AREA 101 22	1.050135481	B	0.08382345	12.53	<.0001
AAR*AREA 102 21	0.526221505	B	0.11959070	4.40	<.0001
AAR*AREA 102 22	1.254952113	B	0.09233299	13.59	<.0001
AAR*AREA 103 21	0.561909300	B	0.09529013	5.90	<.0001
AAR*AREA 103 22	1.074942230	B	0.09441372	11.39	<.0001
AAR*AREA 104 21	0.900143533	B	0.08955693	10.05	<.0001
AAR*AREA 104 22	1.029140618	B	0.11345516	9.07	<.0001
AAR*AREA 105 21	0.845419084	B	0.09826214	8.60	<.0001
AAR*AREA 105 22	1.272238458	B	0.12504428	10.17	<.0001
AAR*AREA 106 21	0.824106750	B	0.10158023	8.11	<.0001
AAR*AREA 106 22	1.234872180	B	0.13964854	8.84	<.0001
AAR*AREA 107 21	0.783903117	B	0.10298450	7.61	<.0001
AAR*AREA 107 22	1.331564949	B	0.15427722	8.63	<.0001

Parameter	Estimate		Standard Error	t Value	Pr > |t|
AAR*AREA 108 21	1.062125115	B	0.11628888	9.13	<.0001
AAR*AREA 108 22	0.822423900	B	0.25945761	3.17	0.0015
AAR*AREA 109 21	1.419266678	B	0.10897458	13.02	<.0001
AAR*AREA 109 22	1.527287119	B	0.24531758	6.23	<.0001
AAR*AREA 110 21	0.775352710	B	0.10140616	7.65	<.0001
AAR*AREA 110 22	1.348320649	B	0.36592527	3.68	0.0002
AAR*AREA 111 21	0.821140310	B	0.15527051	5.29	<.0001
AAR*AREA 112 21	0.595505353	B	0.12220382	4.87	<.0001
AAR*AREA 112 22	1.205453891	B	0.38178139	3.16	0.0016
AAR*AREA 113 21	0.121242525	B	0.11878221	1.02	0.3075
AAR*AREA 114 21	-0.112215568	B	0.16086169	-0.70	0.4855
AAR*AREA 115 21	-0.268758859	B	0.14755007	-1.82	0.0686
AAR*AREA 116 21	-0.171514874	B	0.42554445	-0.40	0.6869
AAR*AREA 117 21	0.637022016	B	0.20422914	3.12	0.0018
AAR*AREA 118 21	1.117187352	B	0.22734337	4.91	<.0001
AAR*AREA 119 21	1.593974263	B	0.16538837	9.64	<.0001
AAR*AREA 120 21	1.775917596	B	0.13481611	13.17	<.0001
AAR*AREA 999 21	-0.506354413	B	0.07341553	-6.90	<.0001
AAR*AREA 999 22	0.000000000	B	.	.	.
MAA 1	0.321262792	B	0.03125540	10.28	<.0001
MAA 2	0.293426146	B	0.03112244	9.43	<.0001
MAA 3	0.175803509	B	0.03223123	5.45	<.0001
MAA 4	0.139366587	B	0.03765900	3.70	0.0002
MAA 5	0.065982223	B	0.04267756	1.55	0.1222
MAA 6	-0.092041568	B	0.08114021	-1.13	0.2567
MAA 7	0.342903745	B	0.07575425	4.53	<.0001
MAA 8	0.041821987	B	0.05506444	0.76	0.4476
MAA 9	-0.293153701	B	0.05347775	-5.48	<.0001
MAA 10	-0.275345910	B	0.04572900	-6.02	<.0001
MAA 11	-0.260384716	B	0.03905411	-6.67	<.0001
MAA 12	0.000000000	B	.	.	.
AREA 21	0.000000000	B	.	.	.
AREA 22	0.000000000	B	.	.	.
X 2	0.061618797	B	0.03162799	1.95	0.0515
X 9	0.000000000	B	.	.	.

Note: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

Appendix 2. Results and diagnostical outputs from GLM run of model without area interaction for standardising CPUE in Greenlandic zone. Data from Greenlandic, Faeroese, Norway and EUvessels.

The SAS System

The GLM Procedure

Class Level Information

Class	Levels	Values
BAAD	83	E001 E002 E003 E004 E005 E006 E007 E008 E009 E010 E011 E012 E013 E014 E015 E016 E017 E018 E019 E020 E021 E022 E023 E024 E025 E026 E027 E028 E029 E030 E031 E032 E033 E034 E035 E036 E037 E038 E039 E040 E041 E042 E043 E044 E045 E046 E047 E048 E049 E050 E051 E052 E053 E054 E055 E056 E057 E058 E059 E060 E061 E062 E063 E064 E065 E066 E067 E068 E069 E070 E071 E072 E073 E074 E075 E076 E077 E078 E079 E080 E081 E082 E083
AAR	41	80 81 82 83 84 85 86 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 999
MAA	12	1 2 3 4 5 6 7 8 9 10 11 12
X	2	2 9

Number of Observations Read 4009

Number of Observations Used 4009

The SAS System

The GLM Procedure

Dependent Variable: LNCPUE

Weight: Hauls

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	134	65417.0710	488.1871	47.45	<.0001
Error	3874	39853.3093	10.2874		
Corrected Total	4008	105270.3804			

R-Square	Coeff Var	Root MSE	LNCPUE Mean
0.621420	61.04823	3.207395	5.253869

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BAAD	82	38874.04205	474.07368	46.08	<.0001
AAR	40	23258.67055	581.46676	56.52	<.0001
MAA	11	3221.97268	292.90661	28.47	<.0001
X	1	62.38573	62.38573	6.06	0.0138

Source	DF	Type III SS	Mean Square	F Value	Pr > F
BAAD	82	16452.08677	200.63520	19.50	<.0001
AAR	40	23508.13088	587.70327	57.13	<.0001
MAA	11	3240.51352	294.59214	28.64	<.0001
X	1	62.38573	62.38573	6.06	0.0138

Parameter	Estimate		Standard Error	t Value	Pr > |t|
Intercept	6.218635416	B	0.10894856	57.08	<.0001
BAAD E001	-1.973636633	B	0.17533657	-11.26	<.0001
BAAD E002	-1.672414726	B	0.18224015	-9.18	<.0001
BAAD E003	-1.568221645	B	0.12482990	-12.56	<.0001
BAAD E004	-1.569105622	B	0.15892719	-9.87	<.0001
BAAD E005	-1.565426628	B	0.18023151	-8.69	<.0001
BAAD E006	-1.549309753	B	0.16945353	-9.14	<.0001
BAAD E007	-1.520622034	B	0.16313584	-9.32	<.0001
BAAD E008	-1.461758402	B	0.13556406	-10.78	<.0001
BAAD E009	-1.493544076	B	0.16971509	-8.80	<.0001
BAAD E010	-1.457380861	B	0.11071514	-13.16	<.0001

Parameter	Estimate		Standard Error	t Value	Pr > |t|
BAAD E011	-1.407737656	B	0.13198497	-10.67	<.0001
BAAD E012	-1.460101957	B	0.27179663	-5.37	<.0001
BAAD E013	-1.367645429	B	0.17740144	-7.71	<.0001
BAAD E014	-1.349285134	B	0.11836055	-11.40	<.0001
BAAD E015	-1.342415270	B	0.12684845	-10.58	<.0001
BAAD E016	-1.313761088	B	0.17235237	-7.62	<.0001
BAAD E017	-1.299121176	B	0.13567333	-9.58	<.0001
BAAD E018	-1.303692530	B	0.13203292	-9.87	<.0001
BAAD E019	-1.337227316	B	0.19091165	-7.00	<.0001
BAAD E020	-1.358580282	B	0.17139679	-7.93	<.0001
BAAD E021	-1.288228431	B	0.15531977	-8.29	<.0001
BAAD E022	-1.262612394	B	0.12106881	-10.43	<.0001
BAAD E023	-1.263426207	B	0.23192808	-5.45	<.0001
BAAD E024	-1.248721121	B	0.10772312	-11.59	<.0001
BAAD E025	-1.151602894	B	0.15072295	-7.64	<.0001
BAAD E026	-1.164755912	B	0.17948219	-6.49	<.0001
BAAD E027	-1.161296564	B	0.11003306	-10.55	<.0001
BAAD E028	-1.320232009	B	0.17238454	-7.66	<.0001
BAAD E029	-1.157046256	B	0.12805010	-9.04	<.0001
BAAD E030	-1.167447464	B	0.12939151	-9.02	<.0001
BAAD E031	-1.100344407	B	0.10949672	-10.05	<.0001
BAAD E032	-1.114477230	B	0.11739684	-9.49	<.0001
BAAD E033	-1.325259971	B	0.42413913	-3.12	0.0018
BAAD E034	-1.081032387	B	0.16665590	-6.49	<.0001
BAAD E035	-1.069943477	B	0.17433179	-6.14	<.0001
BAAD E036	-1.105118347	B	0.20806104	-5.31	<.0001
BAAD E037	-1.047068279	B	0.11583260	-9.04	<.0001
BAAD E038	-1.036134001	B	0.14572679	-7.11	<.0001
BAAD E039	-1.022622526	B	0.13039398	-7.84	<.0001
BAAD E040	-0.998448802	B	0.12720923	-7.85	<.0001
BAAD E041	-0.982066591	B	0.15169925	-6.47	<.0001
BAAD E042	-0.987404653	B	0.12844035	-7.69	<.0001
BAAD E043	-1.014416565	B	0.11002374	-9.22	<.0001
BAAD E044	-0.986142963	B	0.10520688	-9.37	<.0001
BAAD E045	-0.938391683	B	0.13591173	-6.90	<.0001
BAAD E046	-0.939976656	B	0.12496085	-7.52	<.0001

Parameter	Estimate		Standard Error	t Value	Pr > |t|
BAAD E047	-0.936122040	B	0.11471256	-8.16	<.0001
BAAD E048	-0.923857135	B	0.11124559	-8.30	<.0001
BAAD E049	-0.924415042	B	0.10498789	-8.80	<.0001
BAAD E050	-1.052208260	B	0.13389021	-7.86	<.0001
BAAD E051	-0.900645452	B	0.11750414	-7.66	<.0001
BAAD E052	-0.880543835	B	0.12127302	-7.26	<.0001
BAAD E053	-0.917688782	B	0.22636995	-4.05	<.0001
BAAD E054	-0.899889334	B	0.11574920	-7.77	<.0001
BAAD E055	-0.861555469	B	0.13952220	-6.18	<.0001
BAAD E056	-0.689112211	B	0.12224539	-5.64	<.0001
BAAD E057	-0.784069063	B	0.12798362	-6.13	<.0001
BAAD E058	-0.718419815	B	0.18036925	-3.98	<.0001
BAAD E059	-0.661539189	B	0.20461933	-3.23	0.0012
BAAD E060	-0.775917711	B	0.14317307	-5.42	<.0001
BAAD E061	-0.699793989	B	0.10211689	-6.85	<.0001
BAAD E062	-0.683563718	B	0.10949816	-6.24	<.0001
BAAD E063	-0.689020304	B	0.12559668	-5.49	<.0001
BAAD E064	-0.627416961	B	0.11942033	-5.25	<.0001
BAAD E065	-0.603148615	B	0.15183529	-3.97	<.0001
BAAD E066	-0.576050896	B	0.16519559	-3.49	0.0005
BAAD E067	-0.586096213	B	0.36393085	-1.61	0.1074
BAAD E068	-0.721831674	B	0.20731545	-3.48	0.0005
BAAD E069	-0.538767733	B	0.11085061	-4.86	<.0001
BAAD E070	-0.562175514	B	0.10173690	-5.53	<.0001
BAAD E071	-0.489502941	B	0.10334852	-4.74	<.0001
BAAD E072	-0.530526635	B	0.16045555	-3.31	0.0010
BAAD E073	-0.477065337	B	0.14236893	-3.35	0.0008
BAAD E074	-0.453102729	B	0.10988508	-4.12	<.0001
BAAD E075	-0.448957823	B	0.12645133	-3.55	0.0004
BAAD E076	-0.405486778	B	0.11743691	-3.45	0.0006
BAAD E077	-0.435328891	B	0.15820642	-2.75	0.0060
BAAD E078	-0.368040557	B	0.10657253	-3.45	0.0006
BAAD E079	-0.364601832	B	0.21951987	-1.66	0.0968
BAAD E080	-0.319280052	B	0.16552696	-1.93	0.0538
BAAD E081	-0.281304674	B	0.11924880	-2.36	0.0184
BAAD E082	-0.202522361	B	0.24076654	-0.84	0.4003

Parameter	Estimate		Standard Error	t Value	Pr > |t|
BAAD E083	0.000000000	B	.	.	.
AAR 80	0.400279324	B	0.28537205	1.40	0.1608
AAR 81	0.461050662	B	0.26914618	1.71	0.0868
AAR 82	-0.091274710	B	0.59488918	-0.15	0.8781
AAR 83	0.210622845	B	0.32033265	0.66	0.5109
AAR 84	0.731322003	B	0.25835801	2.83	0.0047
AAR 85	0.238131582	B	0.12785515	1.86	0.0626
AAR 86	0.306460447	B	0.07338676	4.18	<.0001
AAR 88	-0.170995852	B	0.05104549	-3.35	0.0008
AAR 89	-0.582665189	B	0.05146266	-11.32	<.0001
AAR 90	-0.580446338	B	0.05134843	-11.30	<.0001
AAR 91	-0.754581684	B	0.05156193	-14.63	<.0001
AAR 92	-0.970349504	B	0.05755931	-16.86	<.0001
AAR 93	-1.025294265	B	0.05742202	-17.86	<.0001
AAR 94	-0.006239554	B	0.05947410	-0.10	0.9165
AAR 95	-0.232275389	B	0.05914679	-3.93	<.0001
AAR 96	0.022314885	B	0.06066500	0.37	0.7130
AAR 97	0.255138609	B	0.06650577	3.84	0.0001
AAR 98	0.343517769	B	0.07344329	4.68	<.0001
AAR 99	0.507892502	B	0.08247411	6.16	<.0001
AAR 100	0.489994557	B	0.07330602	6.68	<.0001
AAR 101	0.469201078	B	0.07205839	6.51	<.0001
AAR 102	0.608195661	B	0.07748271	7.85	<.0001
AAR 103	0.354108875	B	0.07362218	4.81	<.0001
AAR 104	0.440925396	B	0.07777868	5.67	<.0001
AAR 105	0.550395151	B	0.08448438	6.51	<.0001
AAR 106	0.452840347	B	0.08900147	5.09	<.0001
AAR 107	0.369060277	B	0.09235655	4.00	<.0001
AAR 108	0.558673860	B	0.11057123	5.05	<.0001
AAR 109	0.875301936	B	0.10390847	8.42	<.0001
AAR 110	0.271184837	B	0.09767121	2.78	0.0055
AAR 111	0.273368456	B	0.16204084	1.69	0.0917
AAR 112	0.091730811	B	0.12126142	0.76	0.4494
AAR 113	-0.338067425	B	0.11923942	-2.84	0.0046
AAR 114	-0.505210377	B	0.16756003	-3.02	0.0026
AAR 115	-0.755357886	B	0.15203019	-4.97	<.0001

Parameter	Estimate		Standard Error	t Value	Pr > |t|
AAR 116	-0.622269532	B	0.46084991	-1.35	0.1770
AAR 117	0.035670238	B	0.21561217	0.17	0.8686
AAR 118	0.594048350	B	0.24284367	2.45	0.0145
AAR 119	1.023432376	B	0.17381919	5.89	<.0001
AAR 120	1.306089313	B	0.13802772	9.46	<.0001
AAR 999	0.000000000	B	.	.	.
MAA 1	0.184135741	B	0.03168234	5.81	<.0001
MAA 2	0.176240265	B	0.03170282	5.56	<.0001
MAA 3	0.096991454	B	0.03294493	2.94	0.0033
MAA 4	0.127779682	B	0.03840270	3.33	0.0009
MAA 5	-0.024583487	B	0.04402875	-0.56	0.5766
MAA 6	-0.058488461	B	0.08419964	-0.69	0.4873
MAA 7	0.392932566	B	0.07272061	5.40	<.0001
MAA 8	0.120488947	B	0.05376968	2.24	0.0251
MAA 9	-0.274067026	B	0.05484424	-5.00	<.0001
MAA 10	-0.280833844	B	0.04627386	-6.07	<.0001
MAA 11	-0.226398196	B	0.03901301	-5.80	<.0001
MAA 12	0.000000000	B	.	.	.
X 2	-0.081354745	B	0.03303639	-2.46	0.0138
X 9	0.000000000	B	.	.	.

Note: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.