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Report on a Stratified-Random Trawl Survey for Shrimp (Pandalus borealis) in ICES Subarea XIV.b

by

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INTRODUCTION

In August and September 1989 a stratified-random trawl survey was carried out in Denmark Strait (ICES Subarea XIV b).

Since the first assessment of offshore shrimp (Pandalus borealis) in Denmark Strait took place in 1980, NAFO continuously has recommended that stratified-random trawl surveys be conducted to determine changes in distribution and abundance of shrimp.

Norwegian surveys have been conducted since 1983 in Denmark Strait to assess the shrimp stock. These surveys cover most of the stock distribution area.

Because it was known that the Norwegian survey would be carried out also in 1989, the aim of the present survey was to concentrate on estimating the shrimp stock found in the area where commercial fishing occurs. This stock component was expected to be more or less equivalent to the female part of the Denmark Strait shrimp stock, as the length and sex distribution obtained by the Norwegian surveys prior to 1989 showed that the females were located mainly in that area.

September was chosen as the survey month for the Denmark Strait survey since this month is normally the best month of the year to avoid ice cover on the shrimp stock distribution area.

The survey was carried out from August 28th to September 12th; the scientific staff was P. Kannevorff, P. Houmark and A. E. Kristensen. Icelandic authorities kindly granted permission for carrying out research in the Icelandic economic zone. The surveying conditions were good with few problems of ice covering the planned fishing sites. Bad weather did not hamper the fishing operations.

MATERIAL AND METHODS

The survey area selected was the commercially important part of the offshore area between 65°N and 68°N in Denmark Strait, from the Greenland 3-mile limit to 600 meters depth except for some minor areas with greater depths within the survey area.

The survey area in the Greenland economic zone was selected as

that part in which logbooks (1985-88) from the Greenland shrimp trawlers gave information on commercial fishery. Since no logbook information was available from the Iceland part of the shrimp stock area, the survey area there was chosen as the area adjacent to the Greenland commercial area bordered to the east by the 600 m depth contour according to the sea charts.

The trawler, M/T SISIMIUT, is a commercial 722 GRT shrimp trawler. The trawling gear used was a 'SKJERVOY' 3300 meshes (20 mm) shrimp trawl equipped with bobbingear and a double-bag with 44 mm meshes (stretched) in the codend. The doors were of the type 'BMV no. 8'.

The duration of hauls was held as close as possible to one hour. A mean distance of 17.2 m between wings measured with Scanmar-equipment at the West Greenland survey (Carlsson, Kannevorff & Lehmann, 1990) with the same gear and doors, was used as the width of the swept area, and the distance between the setting and hauling positions for each haul was used as length of swept area.

The survey area was stratified in four depth zones: <200 m, 200-400 m, 400-600 m and >600 m based on available sea charts. The greater depth strata were subdivided into smaller substrata to get strata of fairly uniform size. In total the area was subdivided into 15 strata (Table 1 and Fig. 1).

It was estimated that about 100 hauls could be taken during the time available for the survey, with 4-5 trawling operations per day. In order to minimize the influence of vertical shrimp migration trawlings were carried out in day-time only (0700-1700 UTC).

Hauls were allocated proportionally to stratum areas. However, a minimum of two hauls per stratum was always scheduled. The size of the strata and the number of planned trawlings are given in Table 1. The total survey area was estimated to 36 thousand km<sup>2</sup> which gives a mean coverage of 360 km<sup>2</sup> per haul. Within strata trawling sites were chosen at random according to the NAFO 'Manual of Groundfish Surveys in the Northwest Atlantic' (Doubleday, 1981). The positions of all trawling stations are shown in Fig. 2.

In total, 87 trawl stations were occupied during the survey. Due to inaccuracy of the sea charts used, several of the trawling sites chosen were not in the depth stratum in which they were allocated. Despite of the observed depths, however, trawlings were carried out at the prechosen positions, and the stations were accordingly included in the relevant depth strata in the biomass calculations. Due to time constraints strata A1, B2, C3, D1 and the northern part of stratum C2 were not occupied.

Stratum A2 was expected to have depths less than 200 m, but showed up with depths between 200 and 400 m, and was thus included in strata B4 and B5 in the biomass calculations (Table 3).

A list of trawl stations and catches is given in Table 2; Table 3 summarizes the calculated trawlable biomass, and in Table 4 the trawlable biomasses are given for each stratum with standard deviation, standard error and minimum and maximum values.

## RESULTS AND DISCUSSION

Catches in all trawl hauls are tabulated in Table 2. The trawling

time for all hauls was close to one hour. The catch rate of shrimp in all hauls was low. In 27 hauls no shrimp were caught. Of the remaining 60 hauls 36 hauls gave catches of 10 kg of shrimp or less, and in 22 hauls the shrimp catches were between 10 and 100 kg. In only two hauls the shrimp catches were greater than 100 kg (130 and 146 kg, respectively). Best catches of shrimp were taken in stratum B4 and B5 in the center of the survey area.

The trawlable biomass for the survey area was calculated to 4,879 tons (+/-35%) of which 3,130 tons was located in stratum B4 and B5 in the northern part of the survey area. (Tab. 3 and Fig. 1).

The main species in the by-catch were redfish and Greenland halibut. Greatest by-catch of redfish was taken in stratum B1, which is overlapping the 'Redfish Box', a redfish nursery area, in which commercial trawling is prohibited. By-catch of Greenland halibut was taken in all strata except in stratum B1, B3 and B6 where only few hauls contained Greenland halibut.

Up to the time of the survey the commercial fishery had taken about 6.5 thousand tons out of a normal yearly shrimp fishery between 8,000 and 12,000 tons in Denmark Strait.

The Norwegian surveys 1985-1988 carried out in the same time period (Smedstad, 1989) which included areas north and west of the present survey, gave as a result a mean trawlable biomass estimate of 37,000 tons for the four years. In the 1988 survey, the males were found in greatest numbers in the western and northern areas, and in smallest numbers around Dohrn Bank. Females were found in greatest numbers in areas west and northeast of Dohrn Bank.

#### CONCLUSION

The low trawlable biomass estimate compared to the commercial fishery and to the Norwegian trawlsurvey indicates that in 1989 it was not possible to estimate the female part of Denmark Strait shrimp stock by the area covered by the survey. In order to estimate that part of the stock which includes the total female component of the Denmark Strait shrimp stock the survey should have been carried out early in the year when the females concentrate. During that period, however, ice normally will cover more or less of the stock area.

The conclusion can only be that as the best survey time due to environmental conditions normally will be in September, when the shrimp stock might be very dispersed, the only possible way to estimate the shrimp stock is to cover the total supposed shrimp distribution area, as has been done in the Norwegian surveys.

#### REFERENCES.

- Doubleday, W.G. (Ed.), 1981. Manual of Groundfish Surveys in the Northwest Atlantic. NAFO Sci. Coun. Studies, 2:7-55.
- Smedstad, O.M. 1989. Preliminary Report of a Cruise with M/T HAAROV-11 to East Greenland Waters in September 1988. NAFO SCR Doc. 89/19:1-11.
- Carlsson, D.M., P. Kannevorff & Klaus M. Lehmann, 1990. Report on a Stratified-Random trawl survey for Shrimp (*Pandalus borealis*) in NAFO Subarea 0+1 in July-August 1989. NAFO SCR Doc. 90/46. Serial No. N1763.

Tabel 1. Stratumareas (in km<sup>2</sup>), depth interval, relative size of area in % and number of hauls. Number of planned hauls are given in brackets.

STRATUM	AREA km <sup>2</sup>	DEPTH- INTERVAL	PERCENT	NUMBER OF HAULS
A1	314	< 200	0.9	- (1+1)
A2	502	< 200	1.4	- (1+1)
B1	2291	200-400	6.4	8 (6)
B2	377	200-400	1.1	- (1+1)
B3	3672	200-400	10.3	12 (10)
B4	4363	200-400	12.2	14 (12)
B5	4896	200-400	13.7	17 (13)
B6	2197	200-400	6.1	4 (6)
B7	1883	200-400	5.3	3 (5)
C1	3704	400-600	10.3	10 (10)
C2	4551	400-600	12.7	6 (12)
C3	785	400-600	2.2	- (2)
C4	3558	400-600	9.9	7 (10)
C5	2354	400-600	6.6	6 (6)
D1	377	> 600	1.1	- (1+1)
SUM	35824			87 (100)

Table 2. List of trawl hauls in the ten strata given in table 1.  
Catches are given in kg.

STATION-IDENTIFIKATION	AREA CODE	DEPTH	TR-TIME	SHR	COD	GHL	RED	MIX	TOTAL
STRATUM B1									
89SI0240001	001 JR110	392.5	62	0	10	0	7	2	18
89SI0240002	002 JS107	344.5	60	0	2	0	561	7	569
89SI0240004	005 JT104	264.5	60	0	0	0	3	3	6
89SI0240003	006 JT105	307.0	64	0	0	0	24	4	28
89SI0240009	007 JT108	388.0	60	6	0	0	9	2	16
89SI0240005	011 JV104	274.5	61	1	0	4	1	11	18
89SI0240006	012 JV107	382.5	60	10	0	0	8	9	27
89SI0240007	017 JX107	367.5	61	6	0	0	8	9	23
STRATUM B3									
89SI0240014	003 JS112	379.5	60	0	0	0	0	2	2
89SI0240016	004 JS114	378.0	60	0	2	0	1	0	4
89SI0240015	010 JT113	341.0	61	0	1	0	0	0	1
89SI0240018	014 JV113	345.0	60	0	5	0	2	4	10
89SI0240017	015 JV114	319.5	60	0	0	0	8	13	21
89SI0240019	020 JX113	330.0	60	0	0	0	0	0	1
89SI0240020	021 JX114	302.0	60	0	0	0	0	1	1
89SI0240021	022 JX115	287.5	60	0	0	0	0	1	1
89SI0240023	031 KA112	333.0	60	5	5	1	1	3	16
89SI0240022	032 KA114	310.5	60	4	3	0	0	13	20
89SI0240049	039 KB113	341.0	60	10	0	4	1	2	17
89SI0240067	040 KB117	289.0	60	98	0	0	0	12	109
STRATUM B4									
89SI0240048	046 KD114	314.0	62	14	0	0	1	1	16
89SI0240047	054 KD115	313.5	61	37	0	3	0	1	41
89SI0240050	047 KD115	325.5	60	2	0	2	0	0	4
89SI0240051	048 KD115	329.5	60	3	0	1	0	1	4
89SI0240046	063 KE115	307.0	60	33	0	1	1	1	35
89SI0240031	061 KF112	384.5	60	11	1	7	0	1	19
89SI0240038	062 KF113	314.5	60	31	0	5	0	1	37
89SI0240045	073 KF116	356.0	60	74	0	23	4	3	103
89SI0240032	071 KG111	390.5	60	9	0	4	0	2	14
89SI0240044	074 KG116	317.0	60	7	0	0	0	2	9
89SI0240033	081 KH111	385.0	60	10	0	2	0	0	12
89SI0240039	072 KH114	284.5	60	28	0	0	0	2	30
89SI0240040	086 KJ114	246.5	61	1	0	0	0	1	2
89SI0240041	087 KJ115	291.0	60	8	0	3	.	3	13
STRATUM B5									
89SI0240066	056 KD118	329.5	60	41	0	4	0	4	49
89SI0240052	055 KE117	328.0	60	7	0	0	0	0	7
89SI0240053	064 KF117	344.5	60	22	0	2	0	1	25
89SI0240064	065 KF120	318.5	61	130	1	2	0	59	192
89SI0240062	067 KF121	342.5	60	11	0	1	.	2	14
89SI0240063	075 KF121	349.0	60	146	2	1	.	7	157
89SI0240065	066 KF121	319.5	60	49	0	0	0	21	70
89SI0240061	076 KF122	335.5	60	65	0	0	0	8	74
89SI0240043	082 KG117	306.0	60	39	0	.	.	5	44
89SI0240060	077 KG122	365.5	60	13	0	0	.	3	16
89SI0240054	083 KH121	372.5	60	11	0	3	.	9	23
89SI0240042	088 KJ118	320.0	60	4	0	.	.	3	6
89SI0240055	089 KJ122	385.5	60	1	0	1	0	6	8
89SI0240056	090 KJ123	379.0	60	6	0	3	0	3	12
89SI0240057	091 KJ123	378.0	63	1	0	1	0	5	6
89SI0240058	084 KJ124	389.5	60	0	0	2	0	10	12
89SI0240059	092 KJ125	399.5	60	0	0	0	0	3	3
STRATUM B6									
89SI0240071	016 JV116	378.5	60	0	0	0	0	1	1
89SI0240068	033 KA117	302.0	60	30	0	1	0	76	107
89SI0240069	034 KA118	330.5	60	2	0	0	0	15	17
89SI0240077	041 KB120	352.5	60	19	5	0	0	19	44

Table 2 (continued)

STATION-IDENTIFIKATION	AREA CODE	DEPTH	TR-TIME	SHR	COD	GHL	RED	MIX	TOTAL
STRATUM B7									
89SI0240076	049 KD120	351.5	60	8	2	3	0	17	29
89SI0240087	057 KE122	374.5	60	32	0	12	0	10	55
89SI0240085	068 KF123	389.5	60	17	0	0	0	6	23
STRATUM C1									
89SI0240012	008 JT111	415.0	60	1	0	0	1	0	2
89SI0240013	009 JT112	400.5	60	0	0	0	2	1	3
89SI0240010	013 JV110	460.0	60	1	0	0	1	1	2
89SI0240008	018 JX107	431.0	60	7	0	2	4	3	16
89SI0240011	019 JX110	466.0	60	0	0	1	0	0	2
89SI0240027	024 JZ108	469.0	60	2	0	0	3	1	6
89SI0240025	029 KA109	515.5	60	6	0	8	1	1	16
89SI0240026	028 KA109	488.5	60	3	0	2	1	2	7
89SI0240024	030 KA111	440.0	60	2	0	14	1	2	20
89SI0240028	038 KB109	499.0	61	2	0	0	1	1	4
STRATUM C2									
89SI0240029	045 KD110	470.0	60	2	0	7	1	2	12
89SI0240030	053 KE111	435.5	62	6	0	8	1	1	16
89SI0240036	060 KF110	498.5	60	0	0	0	0	1	1
89SI0240037	059 KF110	494.0	60	1	0	9	0	1	11
89SI0240034	080 KG110	481.0	60	3	0	10	0	1	14
89SI0240035	070 KG110	491.5	60	3	0	0	0	3	5
STRATUM C4									
89SI0240070	025 JX118	403.5	60	0	4	0	0	8	12
89SI0240072	023 JX119	522.0	60	0	0	0	0	1	1
89SI0240073	026 JZ120	475.5	60	0	0	0	12	17	29
89SI0240074	036 KA120	471.0	60	0	5	0	1	11	17
89SI0240075	035 KA120	469.5	52	0	0	0	0	2	3
89SI0240078	042 KB122	441.5	60	1	0	1	0	9	11
89SI0240079	043 KB123	463.5	60	1	0	0	0	2	2
STRATUM C5									
89SI0240080	044 KD124	516.0	60	0	0	0	0	1	1
89SI0240081	050 KD124	499.0	60	4	0	7	.	3	14
89SI0240086	069 KF124	420.0	60	28	0	8	0	7	42
89SI0240084	078 KG124	416.0	60	0	0	3	0	3	7
89SI0240082	079 KG126	543.5	60	0	0	4	0	1	5
89SI0240083	085 KH125	497.0	60	0	0	2	0	1	3

Tabel 3. Calculated trawlable biomass (i tons) af shrimp for the survey area in Denmark Strait 1989.

STRATUM	DEPTH STRATUM	AREA	NO. OF HAULS	CALCULATED BIOMASS
B1	200-400	2291	8	96
B3	200-400	3672	12	441
B4	200-400	4575	14	1228
B5	200-400	5186	17	1902
B6	200-400	2197	4	381
B7	200-400	1883	3	433
C1	400-600	3704	10	104
C2	400-600	4551	6	124
C4	400-600	3558	7	14
C5	400-600	2354	6	155
SUM	-	33971	87	4878

Tab 4. Trawlable biomass of shrimp in the surveyed area in Denmark Strait by stratum.

STRATUM	SQKM	STRBIOM					
		TONS	HAULS	STD	STDERR	MIN	MAX
AREA B1, 200-400 M	2291	95.89	8	127.93	45.23	0	320
AREA B3, 200-400 M	3672	440.75	12	1240.35	358.06	0	4350
AREA B4, 200-400 M	4575	1228.12	14	1464.32	391.36	31	5508
AREA B5, 200-400 M	5186	1902.47	17	2466.44	598.20	0	8349
AREA B6, 200-400 M	2197	381.03	4	442.34	221.17	0	934
AREA B7 200-400 M	1883	432.87	3	277.91	160.45	192	737
AREA C1, 400-600 M	3704	103.96	10	99.99	31.62	8	323
AREA C2, 400-600 M	4551	124.04	6	89.99	36.74	22	279
AREA C4, 400-600 M	3558	14.46	7	25.85	9.77	0	64
AREA C5, 400-600 M	2354	155.30	6	325.30	132.80	0	815

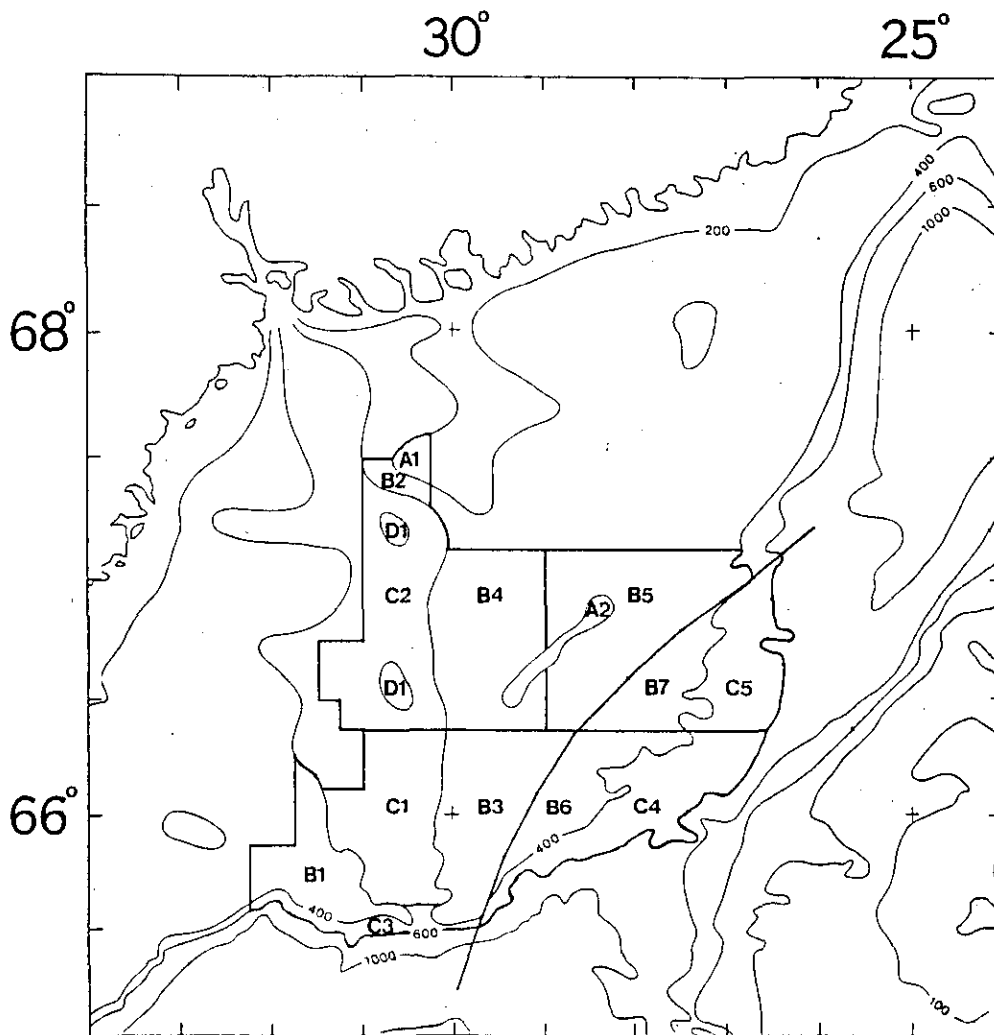


Figure 1. Strata in The Denmark Strait survey area in 1989. For stratum areas, see Table 2.



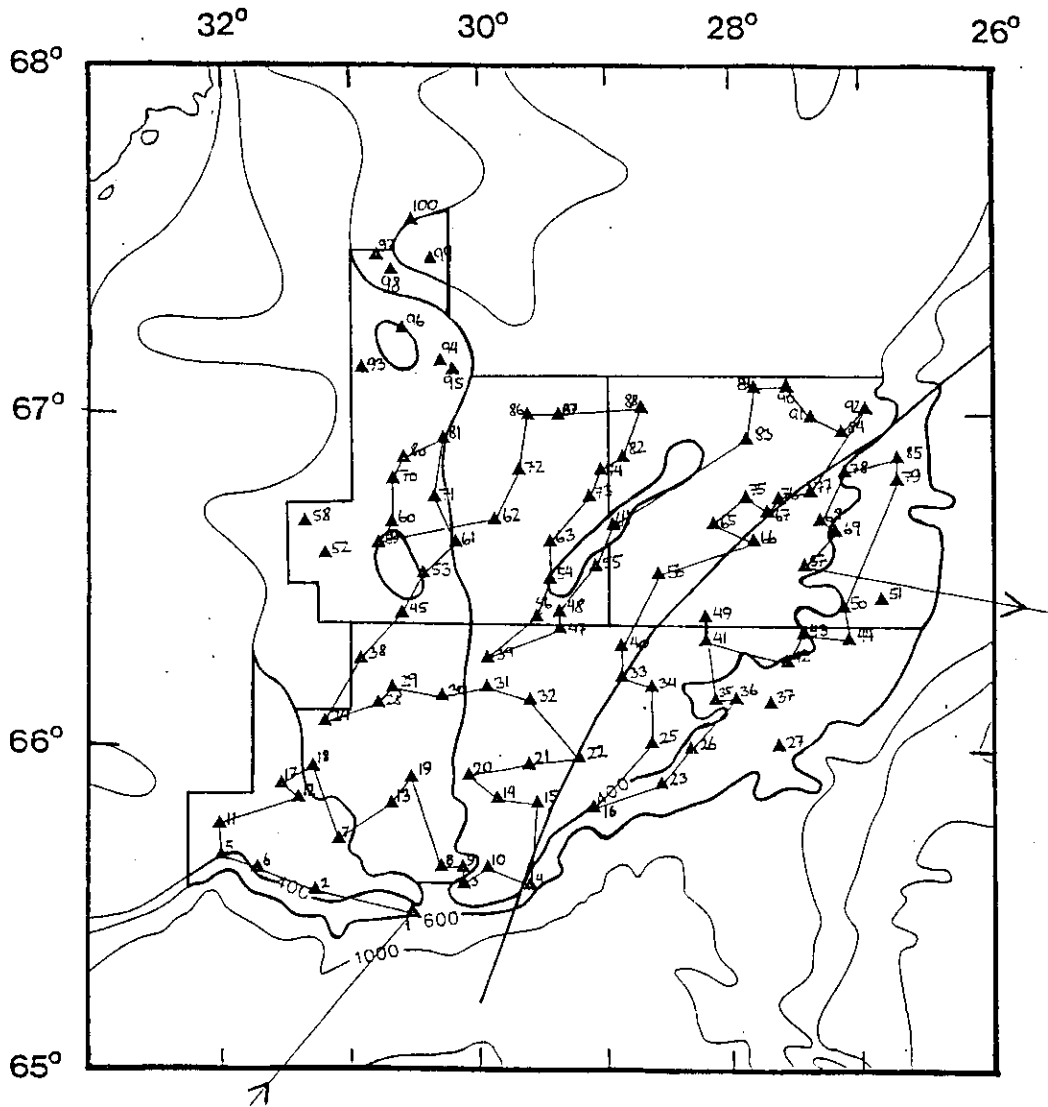


Figure 2. Selected stations and the survey route in the Denmark Strait survey in 1989.