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Preliminary Assessment of Shrimp (*Pandalus borealis*) in Division 3M (Flemish Cap)

by

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1. INTRODUCTION

The Flemish Cap shrimp fishery began in the spring of 1993 and, since then, has developed into a multi-national operation with landings totalling approximately 28,000 tons in 1993 and 20,000 tons up to August 31, 1994. As many as 79 different vessels from 9 countries participated in 1993 compared to 72 vessels from 12 countries so far in 1994.

STACFIS conducted an initial assessment of the resource in September, 1993 but concluded that data were insufficient to provide a basis for the calculation of a TAC. A cautious approach to exploitation was advocated but no preemptive or precautionary catch limit was recommended or implemented for 1994. The area is currently treated separately for assessment purposes in the absence of information on if and/or how shrimp on the Cap are related to those residing in adjacent areas.

STACFIS also was concerned that the by-catch of small redfish in the new shrimp fishery might significantly impact the redfish resource in Division 3M and, at the September 1993 Meeting, recommended the mandatory and immediate use of sorting grates to minimize the by-catch problem. Canadian surveillance reports indicated that there was a high level of compliance with this recommendation both for the remainder of 1993 and to date in 1994.

The following presents the preliminary assessment of the status of the shrimp resource on Flemish Cap by summarizing and interpreting data from the various fisheries, research vessel surveys and other studies on shrimp biology.

2. COMMERCIAL FISHERY

2.1 History of the Fishery

The shrimp fishery in Division 3M began on April 30, 1993, when two Canadian offshore vessels were granted exploratory permits to fish for Pandalus borealis in the area. The only known commercial activity prior to 1993 was in 1990 when two Canadian vessels fished unsuccessfully in April and May. In 1993, however, initial catch rates were favourable and, shortly thereafter, vessels from several Scandinavian countries joined the fishery. Fishing activity (monitored by Canada) increased to include about 50 vessels in early July but subsequently declined over the remainder of the year. Only 4 vessels were reported fishing shrimp at the end of December.

Fishing continued into 1994, albeit at low intensity. Activity increased over winter to 21 vessels by late March but then decreased in early spring, presumably due to low catch rates. In May, effort began to increase again and the number of vessels grew from 16 to 47 by the middle of June. Since then, the number has decreased to 30 as of the end of August.

The Canadian fishery occurred from late April to early August in 1993 and from mid March to late June in 1994. Vessels from Denmark fished during July - October in 1993, returning in late June, 1994. Both the Faroe Islands and Norway have been continually active since the fishery began in 1993 and were the two main participants. Greenlandic vessels fished up to the end of September, 1993 but did not return until April, 1994. Iceland first participated in June, 1993, employing one to five vessels up to mid March, 1994. No activity was reported in April or May but several vessels returned in June and the fishery has since continued. Estonia, Latvia and Lithuania began to fish for shrimp in February, 1994 and have operated more or less continuously to date. Two Russian vessels operated briefly in mid July, 1993 but no further activity was reported until July, 1994. Spain fished from late September to late November, 1993 but only in June, 1994. One vessel from St. Vincent fished during November and December, 1993 and from March to June, 1994. This summary of fishing activity is based on Canadian surveillance reports and, as such, might not be an entirely accurate representation of fishing practices by the various nations.

2.2 Trends in Catch

A synopsis of catch by nation, month and year is provided in the following tables. In 1993, over half of the estimated catch of 28,000 tons was taken by Faroe Islands and Norway. Canada and Greenland each caught approximately 3700 tons and Iceland about 2200. Lesser amounts were reported for Denmark and Russia and, although vessels from Spain and St. Vincent apparently fished in 1993, no catch estimates are available.

Again, in 1994, the Faroes and Norway accounted for over half the estimated catch taken up to the end of August. Estonia, Latvia and Lithuania joined the fishery in 1994 and caught a combined 2000 tons. Canadian vessels departed the area in late June, having taken 1030 tons, about one quarter of their 1993 catch.

Fleets fished at different times of year, as noted above, affecting the seasonal pattern of catch.

1993

Nation	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot.
Canada	<1	696	2091	922	14					3724
Denmark										800
Faroes Is.		1004	1747	1250	1565	1000	653	573	753	8545
Greenland		53	2067	1279	223	155	9			3786
Iceland			691	376	424	364	80	180	128	2243
Norway										8700
Russia										300
Spain										?
St.Vincent										?
Total										28098

1994

Nation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Tot.
Canada			91	99	493	347			1030
Denmark									375
Estonia		17	55	109	148	179	89		597
Faroe Is.	159	417	574	10	396	1630	1074	639	4899
Greenland				81	462	1045	538		2126
Iceland	33	223	157			333	448	211	1405
Latvia		12	15	26	70	69	69		261
Lithuania									1150
Norway									8100
Russia									25
Spain									250
St. Vincent									75
Total									20293

2.3 Trends in Effort

Available effort data (hours fished), based on vessel log records from a few nations, are given below by year and month.

1993

Nation	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot.
Canada	5	1081	5488	4433	28					11035
Greenland		113	4829	3675	724	622	33			9996
Iceland			1849	1159	1361	1066	373	605	581	6994

1994

Nation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Tot.
Canada			532	460	1780	1157			3929
Estonia		142	448	620	786	962	599		3557
Greenland				540	1486	3914	1811		7751
Iceland	152	685	559			1320	2054	921	5691
Latvia		207	176	256	375	346	411		1771

Effort by Greenland for June and July, 1994 was about two-thirds the 1993 level for the same months. Total Canadian effort in 1994 was about one-third the 1993 level. Icelandic logbook records are incomplete for 1994 but suggest that most effort occurred in July, 1994 compared to June in 1993.

Information from two fleets showed that the spatial distribution of effort in 1994 differed from that observed the previous year. Canadian vessels shifted effort to the western and southwestern portions of the Cap after poor catches were experienced early in the season on grounds fished in 1993 (Parsons and Veitch, 1994). Similarly, fishing by Greenland east of 45^{0}W was greatly reduced in 1994 compared to 1993, especially during June and July (Siegstad, 1994).

2.4 Trends in Catch Rates

Catch rates in 1993 for Canada and Iceland were similar at roughly 330 kg/hr while Greenland's rate was higher at 380 kg/hr. Canadian surveillance reports indicated that Russian rates were very low, by comparison, to all other fleets.

A seasonal pattern is evident in the monthly values which cannot be interpreted from either the catch or effort data due to the inconsistency in fleet operations. CPUE generally declined over the season for several fleets. Canadian rates showed a large decline from May to July, Greenland from May to September and Iceland from June to October. The decline was not so obvious at the end of the season.

1993

Nation	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot.
Canada	63	644	381	208	506					337
Greenland		470	428	348	308	249	275			379
Iceland			374	324	311	342	215	297	221	321

In 1994, Canada, Greenland and Iceland produced similar catch rates, ranging from about 250 to 275 kg/hr. CPUE's for Estonia and Latvia were considerably lower at 168 and 147 kg/hr, respectively.

The seasonal pattern of 1993 was not evident in 1994. Catch rates for several fleets were generally variable over the year, without trend.

1994

Nation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Tot.
Canada			171	215	277	300			262
Estonia		123	123	176	188	186	148		168
Greenland				150	311	267	297		274
Iceland	216	325	281			252	218	230	247
Latvia		58	85	102	187	199	168		147

Catch (tons) per vessel per week were provided for vessels from Faroe Islands (Nicolajsen, 1994a) for 1993 and 1994. The 1993 data showed a pronounced decrease during May and June, a steady decline over most of the season and a slight recovery at the end of the year. The 1994 data showed variation around 30 tons per vessel per week for most of the season. Some very low rates were reported in March and April.

2.5 Biological Data

Size composition data from commercial sampling by Canada, Faroe Islands and Iceland in 1993 showed three size groups of males (about 16, 20 and 23 mm) and one of females (26 -27 mm). Overall sizes ranged between 14 and 30 mm (CL) and included at least 5 ages (2 to 6). Females (ages 5+) dominated the catches by number and weight.

Samples from Canada (Parsons and Veitch, 1994), Faroe Islands Nicolajsen, 1994b), Iceland (Skuladottir, 1994) and Greenland (Siegstad, 1994) in 1994 showed a similar occurrence of modes in the length distributions but data from the former three indicated that males were much more prevalent in the catches than in 1993. Greenland samples from June, on the other hand, consisted primarily of large female shrimp, similar to observations by other nations in 1993. However, the more extensive data support the view that catches taken after February, 1994 were composed of primarily smaller/younger male shrimp which contrasts 1993 when large females clearly dominated.

Ageing of shrimp from commercial samples has been attempted by Canada, Faroe Islands, Norway and Iceland and there seems to be a degree of consistency among interpretations. The Faroe Islands study (Nicolajsen, 1994b) showed a difference in growth rate of shrimp between Flemish Cap and the adjacent Div. 3L.

Nicolajsen (1994a) produced a biomass estimate of 23,000 tons based on 2483 commercial trawl hauls of Faroese vessels made between May, 1993 and March, 1994. Faroese sampling data over the same period showed that females hatched their eggs from March through May and it was concluded that the egg-bearing period lasts from about August to April (nine months).

2.6 Shrimp Discards

The only data on shrimp discarding were from the Canadian fishery (Parsons and Veitch, 1994) which showed low relative levels in all months, except for an estimate of 6.3% of the total shrimp catch in July, 1993.

2.7 By-catch Data

By-catch in 1993 consisted primarily of small redfish (14 cm) and Canadian observer data indicated levels of 9 and 13% of the total catch weight in May and June, increasing to 44% in July. Redfish were still a problem in 1994 (up to 32% in April), despite the mandatory use of sorting grates, and occurred in large numbers at 17 - 18 cm (Parsons and Veitch, 1994). If the Canadian data

represent overall shrimp fishing conditions on the Cap, then it is highly likely that several thousand tons of small redfish have been taken as by-catch in both 1993 and 1994. Although sorting grates with 28 mm bar spacings appear largely ineffective to eliminate by-catch of small redfish, they are very efficient at eliminating the larger sizes (>21 cm). By-catch of other commercial species does not appear to be a problem.

3.RESEARCH SURVEY DATA

Oceanographic data were obtained from the Flemish Cap during a Canadian survey conducted in July 1993 and compared with historical data for the area. The general circulation in the area is characterized by an anticyclonic gyre which could play an important role in the retention of shrimp larvae. Also, the hydrographic data showed a cooling trend since 1988 which could favour the survival of shrimp. No data were obtained in 1994 from the Cap area and it is uncertain if this trend is continuing.

EEC/EU groundfish surveys were conducted on Flemish Cap from 1988 to 1994. Shrimp biomass estimates were calculated from the catches obtained using a groundfish bottom trawl and therefore do not represent the absolute shrimp biomass. However, they show that relative shrimp biomass from 1991 to 1993 was substantially higher than during the 88-90 period. Biomass apparently declined in 1994, the estimate approaching the level observed in the earlier period (Sainza, 1994).

Year	Biomass (t)	Average catch per mile (kg)	Standard Error
1988	2164	1.54	+/- 0.28
1989	1923	1.37	+/- 0.24
1990	2139	1.53	+/- 0.21
1991	8211	5.83	+/- 0.71
1992	16531	11.75	+/- 1.86
1993	9256	6.57	+/- 1.04
1994	3337	2.37	+/- 0.35

The surveys also showed that abundance was highest in the western, northern and northeastern parts of the Cap and in depths

ranging from about 300 to 500 m. These were the areas fished commercially during May - August, 1993. In 1994, proportionately more biomass was found in western and southwestern areas.

Age interpretation of the size distributions from the 1988 to 1994 surveys and the 1993 and 1994 commercial fishery samples identified the 1988 year class as strong, accounting for part of the higher biomass in recent years. This year class contributed substantially to the fishery in both years but apparently has declined in importance in 1994. The recruitment of the 1991 year class helped maintain catch rates in the 1994 fishery.

No new data on predation by cod were available to provide further insights into shrimp growth, distribution and/or abundance. A study by Rodriguez-Marin et al.(1994) concluded that the abundance of shrimp on the Cap in summer makes them an important prey for several fish species. Wolffish, Greenland halibut and thorny skate were important predators of shrimp. Redfish (Sebastes spp.) fed on shrimp which migrated vertically, presumably, at night.

4. ASSESSMENT RESULTS AND STATUS OF THE RESOURCE

The preliminary assessment results suggest several changes have occurred on Flemish Cap related to the distribution, abundance and demographic structure of the shrimp resource. Although catches have been maintained at a high level (about 20,000 tons to the end of August, 1994), catch rates from countries that fished both years were noticeably lower in 1994. There was no substantial recovery in catch rates after the initial decline from the high levels achieved in early 1993. Therefore, that decline might have been due more to exploitation than to seasonality. Further, there is evidence to suggest that the area fished has changed. Data from some nations showed a clear shift to the west and southwest. Catch, effort and catch per unit effort all were much lower in eastern areas in 1994 than in 1993. The 1994 EEC/EU survey results are consistent with the commercial fishery data, in that respect.

The composition of the shrimp catches has also changed between years. Males were much more prevalent in the 1994 catches compared to 1993. The large females in 1994 are believed to be the remains of the 1988 year class which cannot be expected to contribute to the catches much longer. Therefore, in the short term, catches will likely become more dependent on smaller male shrimp (1991 year class) which might still be mostly male in 1995. The effect on catch levels and catch rates is uncertain in the absence of estimates of the abundance of recruiting year classes.

Overall, the changes observed between 1993 and 1994 are sufficient to suggest that the fishery has had a noticeable effect on the shrimp resource. This would be expected, given that about 50,000 tons has been taken from the area over a 16 month period. It is clear that shrimp of year classes produced in the early 1990's will determine the success of the fishery in the near future. As there is no clear measure of their relative or absolute strengths, their effects on future catch rates remains uncertain.

The by-catch of small redfish observed in 1993 was considered as a potential for significantly impacting the redfish resource in this area. Even though sorting grates are now mandatory in shrimp fishing operations in this area, redfish continued to be a problem in 1994. Although the modal size of the small fish was larger than in 1993, significant amounts still passed through the grates with 28 mm bar spacings and were retained in the trawl. In 1995, the mean size of this year class may still be sufficiently small to allow a substantial by-catch at current bar spacings.

5. CONCLUSION

Although the history of the fishery for northern shrimp on Flemish Cap is brief, events of the past 16 months point to a need for some regulatory measures. There is still no basis from which a TAC for shrimp can be calculated but it is obvious that an annual catch in the order of 30,000 tons for an area the size of the Cap is neither cautious nor defensible. If concern for the well-being of the shrimp resource is not enough, then the well-being of other species, either directly or indirectly affected by the fishery, should be considered.

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