

PART C

Scientific Council Meeting, 8-15 November 2000

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Participants, Scientific Council Meeting, 8-15 November 2000 at ICES Headquarters, Copenhagen, Denmark.

Back (left to right) H.-J. Rätz, A. Nicolajsen , M. C. S. Kingsley, K. Wieland, D. C. Orr, H. Siegstad, W. R. Bowering, D. C. A. Auby, C. Hvingel, U. Skuládóttir, P. Kannevorff
 Front: S. Bakanev, D. M. Carlsson, W. B. Brodie, T. Amaratunga



Back (left to right):

D. M. Carlson (Designated Expert: Shrimp in Denmark Strait)
 H. Siegstad (Designated Expert: Shrimp in Subareas 0+1)
 D. C. Orr (Designated Expert: Shrimp in Div. 3LNO)
 U. Skuládóttir (Designated Expert: Shrimp in Div. 3M)

Front: H.-J. Rätz (Chairman STACFIS), W. B. Brodie (Chairman Scientific Council)

REPORT OF SCIENTIFIC COUNCIL MEETING

8-15 November 2000

Chairman: W. B. Brodie

Rapporteur: T. Amaratunga

I. PLENARY SESSIONS

The Scientific Council met at the International Council for the Exploration of the Sea (ICES) Headquarters, Copenhagen, Denmark, during 8-15 November 2000. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), European Union (Germany), Iceland, Norway and Russia. The Assistant Executive Secretary was in attendance.

The Executive Committee and the Designated Experts met briefly before the opening to discuss the plan of work.

The opening session was called to order at 0930 hours on 8 November 2000

The Chairman W. B. Brodie (Canada) welcomed everyone to Copenhagen, and expressed the Council's appreciation to Denmark/Greenland for hosting this meeting at ICES Headquarters. H. Lassen (ICES Fishery Advisor), welcomed the NAFO Scientific Council and introduced members to the ICES Headquarters facilities.

The Provisional Agenda was considered and **adopted** without changes (see Agenda III, Part D, this volume). The Assistant Executive Secretary was appointed rapporteur.

The Council noted that STACFIS would undertake the assessments of the stocks (see Appendix I) while the prognoses and advice would be undertaken by the Council.

The session was adjourned at 1000 hours.

The Council met as needed through 8-15 November 2000, while STACFIS was welcome to conduct its business.

The concluding session was convened at 0900 hours on 15 November 2000. The Council addressed the requests of the Coastal States and considering the results of the assessments, provided advice and recommendations. The Council addressed 'Other Matters' in the agenda.

The Council then considered and **adopted** the STACFIS Report, and considered its own report and **adopted** the report of this meeting of 8-15 November 2000.

The meeting was adjourned at 1030 hours on 15 November 2000.

The Report of Standing Committee on Fisheries Science (STACFIS) as **adopted** by the Council is given at Appendix I.

The Agenda, List of Research (SCR) and Summary (SCS) Documents, List of Participants and List of Recommendations of this meeting are given at Part D, this volume.

The Council's considerations on the Standing Committee Report, and other matters addressed by the Council follow in Sections II-IV.

II. FISHERIES SCIENCE

The Council **adopted** the Report of Standing Committee on Fisheries Science (STACFIS) as presented by the Chairman, H.-J. Rätz. The full report is given at Appendix I.

The Council's summary sheets and conclusions on northern shrimp in Div. 3M, northern shrimp in Subareas 0+1 and northern shrimp in Denmark Strait are presented in Section III.1 of this report. The recommendations with respect to stock advice appear therein.

The **recommendations** made by STACFIS for the work of the Scientific Council as **endorsed** by the Council, are as follows:

1. For northern shrimp in Div. 3M,

- *number-at-age from the EU survey results should be estimated to provide insights into mortality and year-class strengths.*
- *work on age structured population models should be continued.*

2. For northern shrimp in Division 0A and Subarea 1,

- *an analysis of the length-frequency data of shrimp in order to obtain the age composition be conducted.*
- *the effect of recent changes in survey design and execution be further studied.*

3. For northern shrimp in Denmark Strait,

- *a survey be conducted, to provide fishery independent data of the stock throughout its range.*
- *commercial catch sampling of the fishery be improved to fully cover seasonal and spatial variation, so that size, sex and age composition of the catch can be accurately described.*

III. FORMULATION OF ADVICE

1. Advice for Northern Shrimp Stocks

The Council reviewed the STACFIS assessments of northern shrimp in Div. 3M, Subareas 0 and 1, and Denmark Strait and the agreed summaries are as follows:

Northern Shrimp (*Pandalus borealis*) in Division 3M

Background: The shrimp fishery in Div. 3M began in 1993. Since then as many as 15 nations have joined the fishery.

Fishery and catches: Total catches were approximately 27 000 tons in 1993, increased to 48 000 tons in 1996 and declined thereafter.

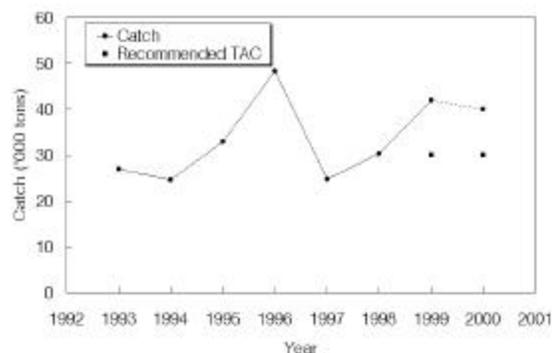
Year	Catch ¹ (‘000 tons)	TAC (‘000 tons)	
		Recommended	Agreed
1997	25	lpl	er
1998	30	lpl	er
1999	42	30	er
2000	40 ²	30	er
2001		30	

¹ STACFIS estimates.

² Catch to 1 October. STACFIS estimate to end of 2000 is about 50 000 tons.

lpl Lowest possible level.

er Effort regulations.

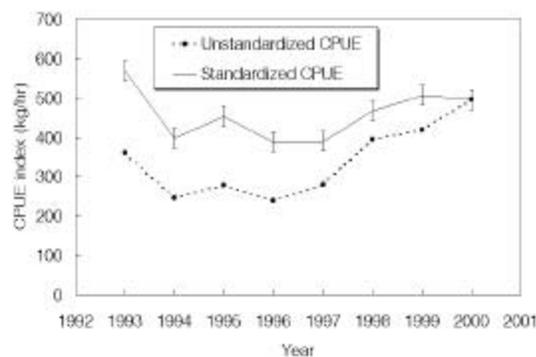


Data: Catch, effort and biological sampling data were available from several Contracting Parties. A standardized CPUE index was developed to account for changes in gear (single and double trawl), fishing power and seasonality. Time series of size and sex composition data were available from Icelandic CPUE and survey indices from Faroese and EU research surveys.

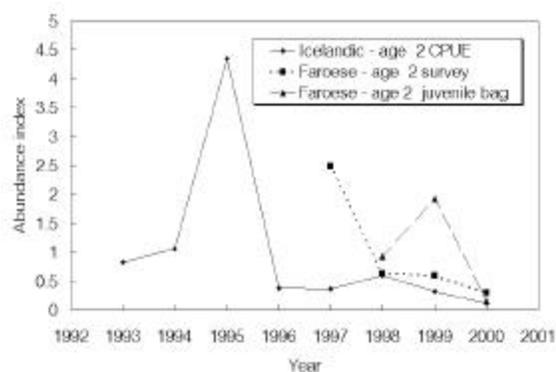
Assessment: No analytical assessment is available and fishing mortality is unknown. Evaluation of stock status is based upon interpretation of commercial fishery and research survey data.

CPUE: Standardized catch rates declined between 1993 and 1994, fluctuated without trend until 1997, increased in 1998 and remained stable thereafter. The

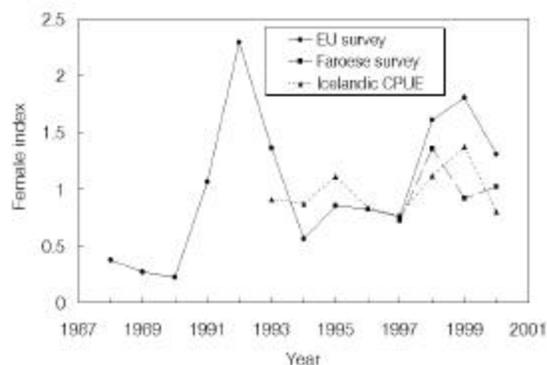
unstandardized CPUE series is not considered to be reflective of stock status.



Recruitment: The 1997 year-class is indicated to be below average in 1999 and the 1998 year-class in 2000 is the lowest observed.



SSB: Indices of female biomass from the EU-surveys were relatively stable between 1994 and 1997. The female biomass index increased considerably from 1997 to 1998, remained high in 1999 and declined in 2000. Icelandic CPUE indicated female biomass to be low in 2000. Index of female biomass from Faroese surveys varied without a trend.



State of the Stock: Scientific Council is unable to estimate absolute stock size. Biomass and SSB are indicated to be higher in 1998-2000 than in 1994-97.

The 1997 and 1998 year-classes appear to be below average.

Recommendations: Considering that the stock appears to have sustained an average catch of more than 40 000 tons in 1999-2000 and that there are concerns regarding recruitment, Scientific Council advises a reduction in catch in 2001 to the previously advised TAC of 30 000 tons. Based on the reduced recruitment expected from the 1997 and 1998 year-classes, Scientific Council anticipates that a further reduction in catches in 2002 will be warranted, particularly if catches in 2001 exceed 30 000 tons. Scientific Council was not able to advise on a specific catch level for 2002 and recommends that the advice for 2002 be re-evaluated by Scientific Council in November 2001.

Reference Points: Scientific Council is not in a position to propose reference points at this time.

Special Comments: Given the concerns with high catches of juveniles, the Scientific Council suggests that the Fisheries Commission consider technical measures known to be effective in improving the size selectivity of shrimp trawls.

Sources of Information: SCR Doc. 00/54, 65, 71, 72, 73, 74, 80, 82, 83, 87, 88.

Northern Shrimp (Pandalus borealis) in Subareas 0 and 1

Background: A small-scale inshore fishery began in SA 1 during the 1930s. Since 1969 an offshore fishery has developed and the shrimp fishery is the largest fishery in Davis Strait.

Fishery and catches: The fishery is conducted by Greenland and Canada. Recent catches from the stock are as follows:

Year	Catch ('000 tons) ¹			TAC ('000 tons)
	Inshore	Offshore	Total	Recommended
1997	13.5	51.0	64.5	60.0
1998	9.5	56.6	66.1	55.0
1999	17.0	59.5	76.5	65.0
2000			76.5 ²	65.0

¹ Provisional.

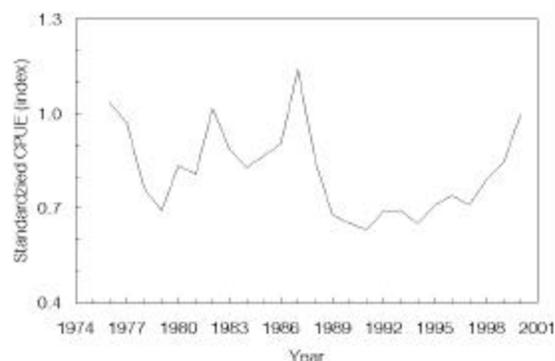
² Projected to the end of 2000.



Data: Catch and effort data were available from all vessels. Biological sampling data were available from the offshore fishery. Time series of biomass and recruitment indices, size and sex composition data were available from research surveys from both offshore and inshore areas.

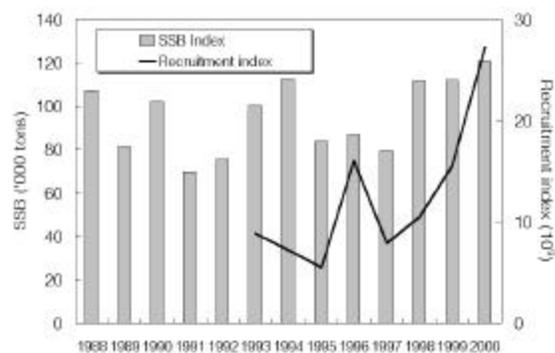
Assessment: No analytical assessment is available and fishing mortality is unknown. Evaluation of the status of the stock is based on interpretation of commercial fishery data (catch, effort and standardized catch rates), research survey indices and biological data.

CPUE. The standardized catch-rate index for 1976-2000 showed an increasing trend in the 1990s. The provisional 2000 value is the highest since the early-1990s. Catch rates of female shrimp show an increasing trend since 1995.

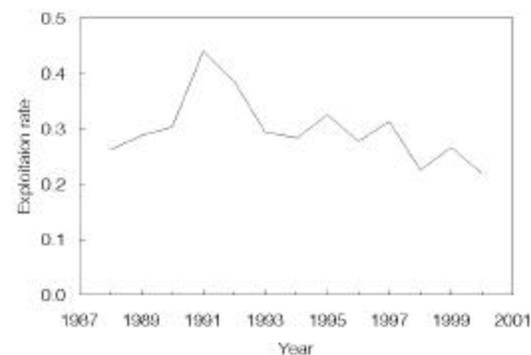


Recruitment. The recruitment index (shrimp less than 17 mm CL) show an increasing trend since 1997 with the 2000 value the highest since 1993, the beginning of the time series.

Exploitation rate. An approximate exploitation rate (ratio of catch to survey biomass) showed a declining trend since the early-1990s.



SSB. SSB (female biomass) shows an increasing trend since 1997 and the value in 2000 is the highest observed in the time series.



State of the Stock. Scientific Council is not able to provide estimates of absolute stock size. The indices of stock sizes show that both the recruitment and SSB estimates in 2000 are the highest observed. In addition, the stock appears to be well represented by a broad range of size groups.

Recommendations: Scientific Council notes that all available indices of size and age composition were favorable and with exploitation rates near 30% from 1988 to 1997 the survey biomass remained stable. Combining an exploitation rate of this order with the most recent survey results, allowance made for possible estimation errors, Scientific Council considers that the stock can sustain a catch of 85 000 tons in 2001.

Therefore, Scientific Council recommends a TAC of 85 000 tons for 2001 for shrimp in Subareas 0+1.

Special Comments: Although recruitment has apparently improved, there is potential for increased catch and discard of small shrimp, which may result in future loss of yield.

Sources of Information: SCR Doc. 00/77, 78, 79, 81, 84, 86.

Northern shrimp (Pandalus borealis) in Denmark Strait

Background: The fishery began in 1978 in areas north of 65°N in Denmark Strait, where it occurs on both sides of the midline between Greenland and Iceland. Areas south of 65°N in Greenlandic waters have been exploited since 1993.

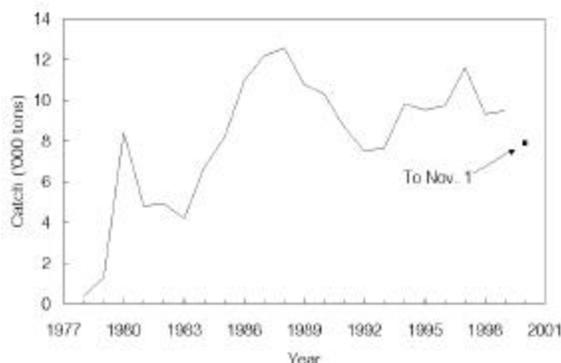
Fishery and Catches: The fishery soon became multi-national, with recent catches and TACs as follows:

Year	Catch ¹ (‘000 tons)	TAC (‘000 tons)	
		Recommended	Agreed ²
1997	11.6	5.0	9.6
1998	9.3	5.0	9.6
1999	9.5	9.6	10.6
2000	7.9 ³	9.6	10.6

¹ Provisional.

² Only for Greenland EEZ.

³ To November 1.



Data: Catch and effort data were available from trawlers of several nations. Biological sampling data were available from the fishery throughout its history, but were not considered reliable because of incomplete coverage over time and areas. Surveys have not been conducted since 1996.

Assessment: No analytical assessment is available and fishing mortality is unknown. Evaluation of the status of the stock is based on interpretation of commercial fishery data and biological data.

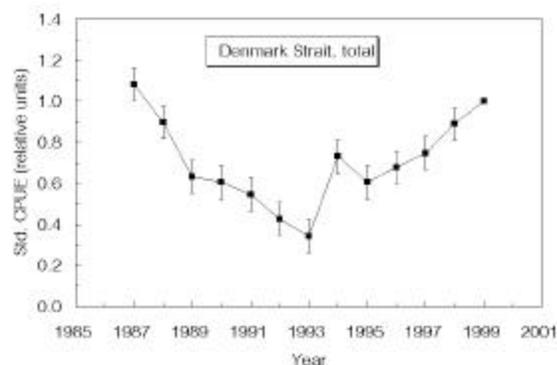
CPUE: Combined standardized CPUE indices for the total fishing area declined from 1987 to 1993, but increased thereafter to near the same level in 1999 as in 1987. Available data for 2000 were considered too incomplete to be of value in the assessment.

Recruitment: No recruitment estimates were available.

Biomass: No direct biomass estimates were available.

State of the Stock: Scientific Council is not able to provide estimates of absolute stock size. Standardized CPUE data from all areas combined indicate a general increasing trend in fishable biomass since 1993 and was in 1999 near the highest observed.

Several year-classes of both male and female shrimp are evident in sampling data in recent years.



Recommendation: Mean catches in recent years around the advised TAC of 9 600 tons for 1999 and 2000 has resulted in improvement of the stock. Under the present level of exploitation the fishable biomass is not expected to decrease in the short term. Scientific Council therefore advises a TAC of 9 600 tons for shrimp in Denmark Strait in 2001

Special Comments: Insufficient commercial data and a lack of survey data along with uncertainty on stock structure make assessment of this stock difficult.

Sources of Information: SCR Doc. 00/75, 76.

2. Responses to Special Requests

a) Shrimp in Divisions 3LNO

With regard to shrimp in Divisions 3LNO, the Fisheries Commission (FC Doc. 99/14) with the concurrence of the Coastal State, requested that the Scientific Council:

- a) *provide information on the fishing mortality on shrimp in Divisions 3LNO in recent years, as well as information on by-catches of groundfish in 3LNO shrimp fisheries;*
- b) *provide information on abundance indices and the distribution of the stock in relation to groundfish resources, particularly for the stocks which are under moratorium;*
- c) *provide information on the geographical distribution of shrimp in Divisions 3L, 3N and 3O, as well as describe the relative and seasonal distribution inside and outside the NAFO Regulatory Area; and*
- d) *provide information on annual yield potential for this stock.*

Regarding item a) the Council responded: Scientific Council was unable to provide any estimates of absolute fishing mortality on shrimp in Div. 3LNO in recent years. Scientific Council noted however that the ratio of catch to biomass from Canadian research surveys has been low, not exceeding about 1% during 1995-99. Catches during this period have been almost exclusively taken by the Faroes Islands during exploratory fisheries in the NAFO Regulatory Area (NRA). In 2000, a TAC of 6 000 tons was put in place for shrimp in Div. 3L, 5 000 tons of which was allocated to Canadian vessels inside the Canadian EEZ. The preliminary catch estimated to 1 November 2000 was 4 100 tons. A catch of 5 000 tons would correspond to between 5 and 10% of the biomass estimates from Canadian surveys in Div. 3L during autumn 1999 and spring 2000.

Preliminary information on by-catches in the shrimp fishery was available from the Canadian fleet, where use of a sorting grate with 22-mm bar spacing was mandatory. Data were available for cod, Greenland halibut, American plaice and redfish, although sample sizes were very small. By-catch proportions by weight were relatively low for all species although they were comprised mainly of small fish (see STACFIS report, Section 4b).

Scientific Council reiterated its **recommendation** that the use of a sorting grate with a maximum bar spacing of 22 mm be mandatory for any shrimp fishery in this area. Scientific Council again cautioned that selection experiments with a 22 mm bar spacing indicate that selection is not effective for Greenland halibut less than about 20 cm and redfish less than about 15 cm.

Regarding item b) the Council responded (SCR Doc. 00/85): Data on shrimp biomass and distribution were available from Canadian research vessel surveys from autumn in 1995-99, and spring in 1999 and 2000. In the autumn survey, the index of biomass in Div. 3LNO increased from about 6 000 tons in 1995 to a level between 46 000 and 60 000 tons in 1997-99. The spring 1999 survey estimate for Div. 3LNO was also in this recent range (54 000 tons), but the estimate for spring 2000 was 120 000 tons. However, the 2000 estimate was influenced by 2 large catches of shrimp and consequently this estimate has a very large standard error.

A review of the current distribution of shrimp from research survey data compared to current and historical distribution of juveniles of various groundfish species currently under moratorium indicated some overlap of shrimp with cod in Div. 3L (Fig. 1) and also with American plaice (Fig. 2). There is more overlap with areas where juvenile redfish (Fig. 3) have been traditionally found, particularly in the Sackville Spur and 'nose' areas of Div. 3L. These are the same areas where the highest concentrations of shrimp occur. In addition, there is considerable overlap in the distribution of shrimp and juvenile Greenland halibut (Fig. 4).

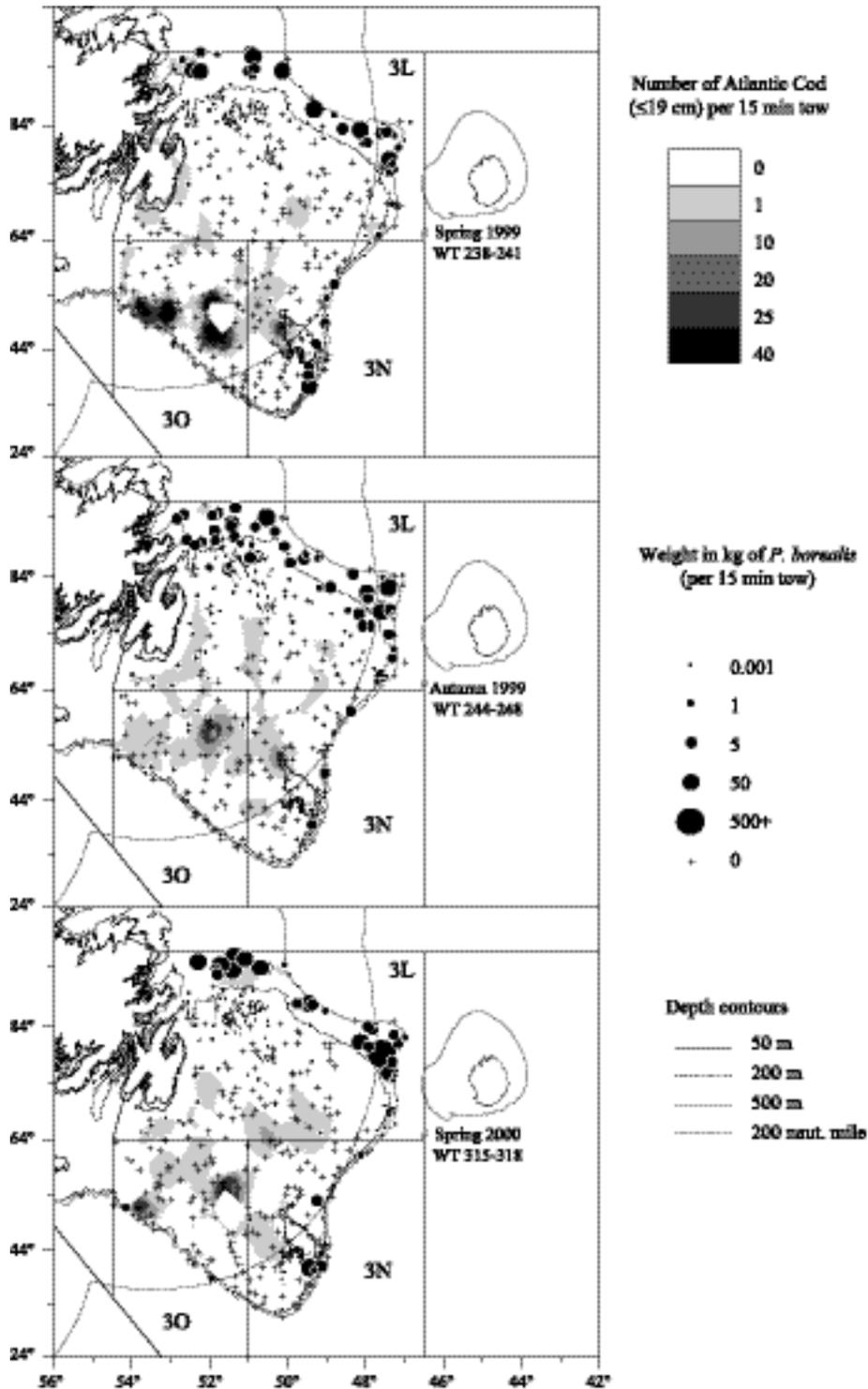


Fig. 1. Shrimp in Div. 3LNO: distribution of northern shrimp in relation to Atlantic cod with lengths ≤ 19 cm, collected during Canadian 1999-2000 autumn and spring multi-species research surveys (with a Campelen 1800 shrimp trawl, tows were standardized to 15 min.).

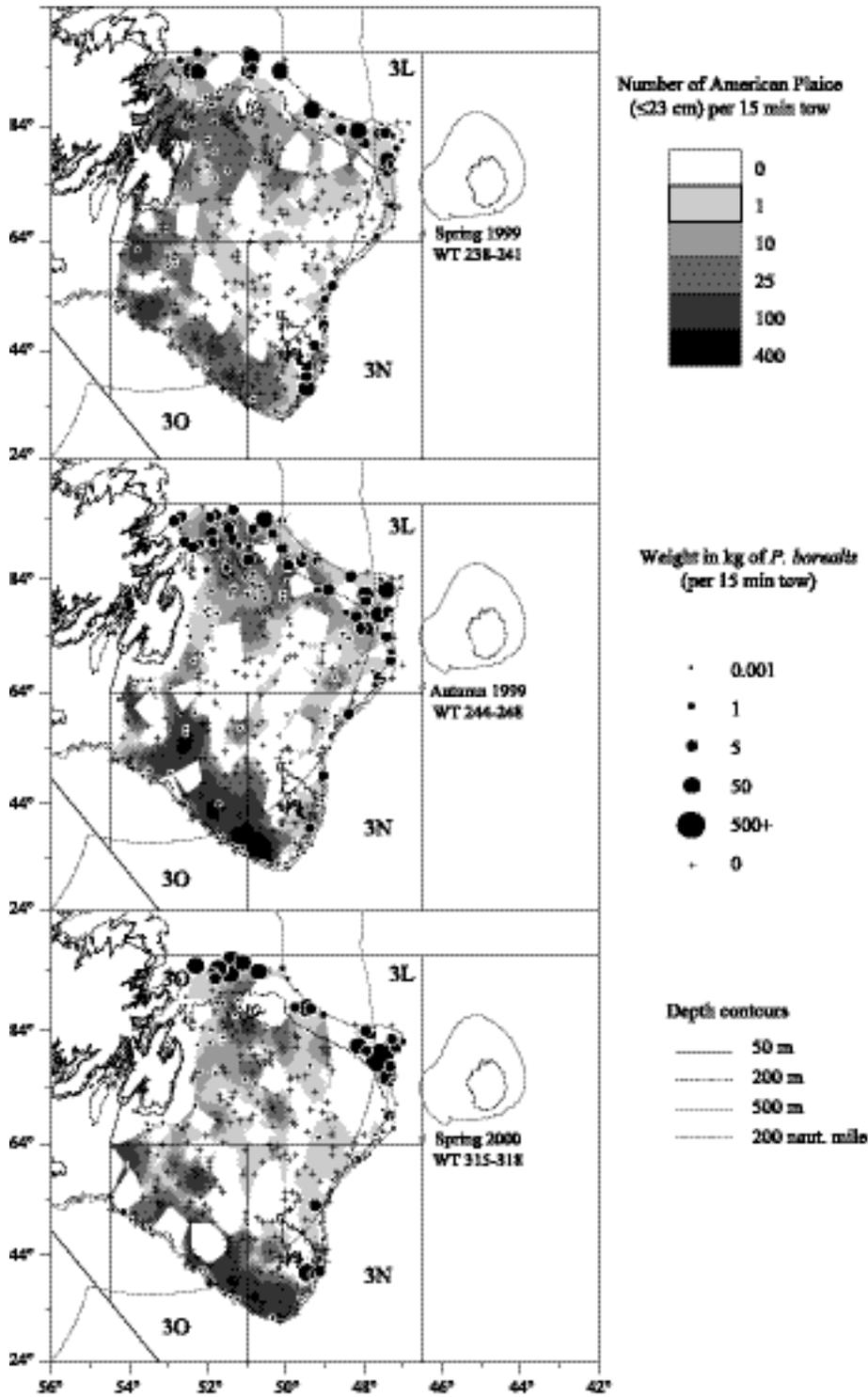


Fig. 2. Shrimp in Div. 3LNO: distribution of northern shrimp in relation to American plaice with lengths ≤ 23 cm, collected during Canadian 1999-2000 autumn and spring multi-species research surveys (with a Campelen 1800 shrimp trawl, tows were standardized to 15 min.).

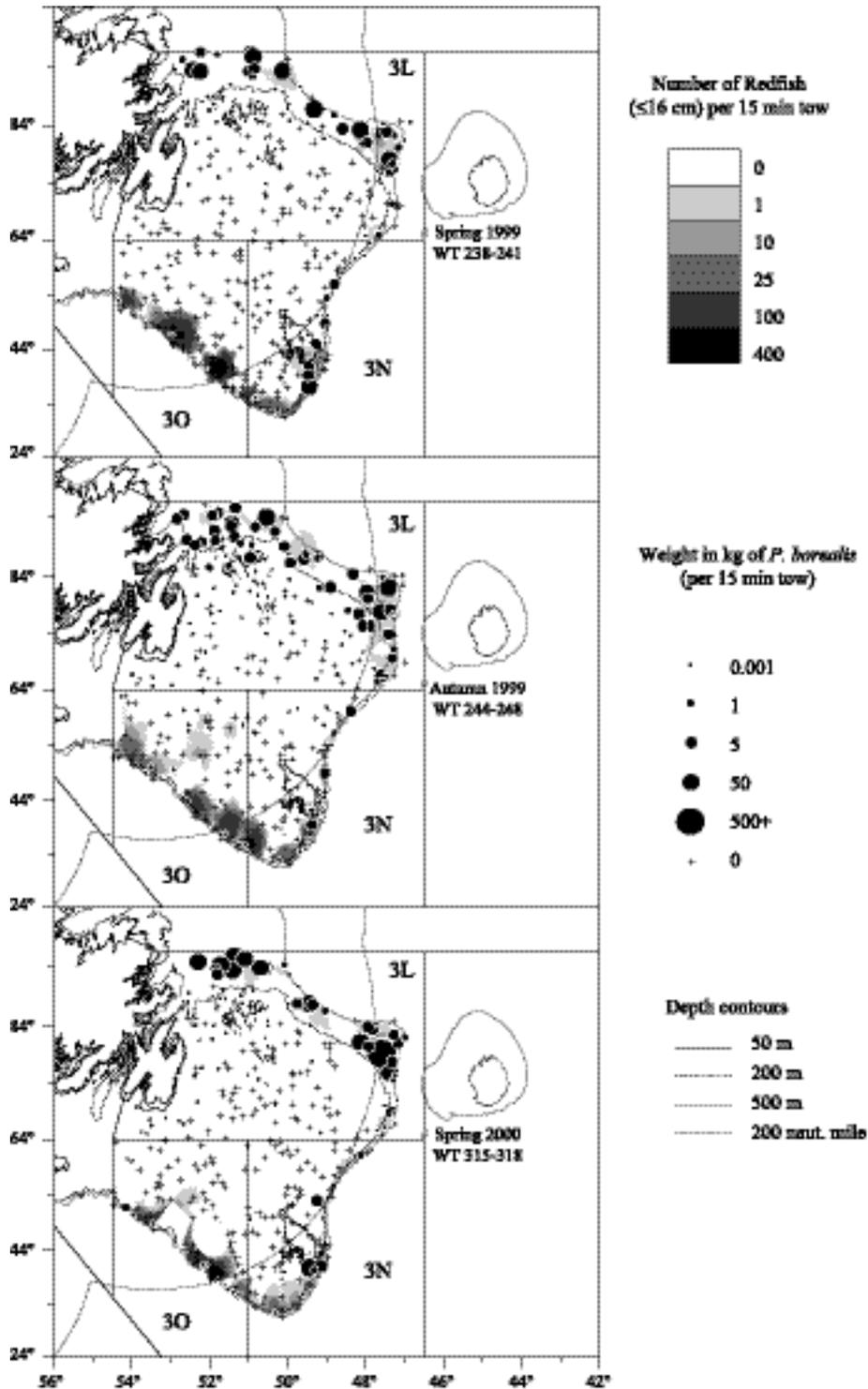


Fig. 3. Shrimp in Div. 3LNO: distribution of northern shrimp in relation to redfish with lengths ≤ 16 cm, collected during Canadian 1999-2000 autumn and spring multi-species research surveys (with a Campelen 1800 shrimp trawl, tows were standardized to 15 min.).

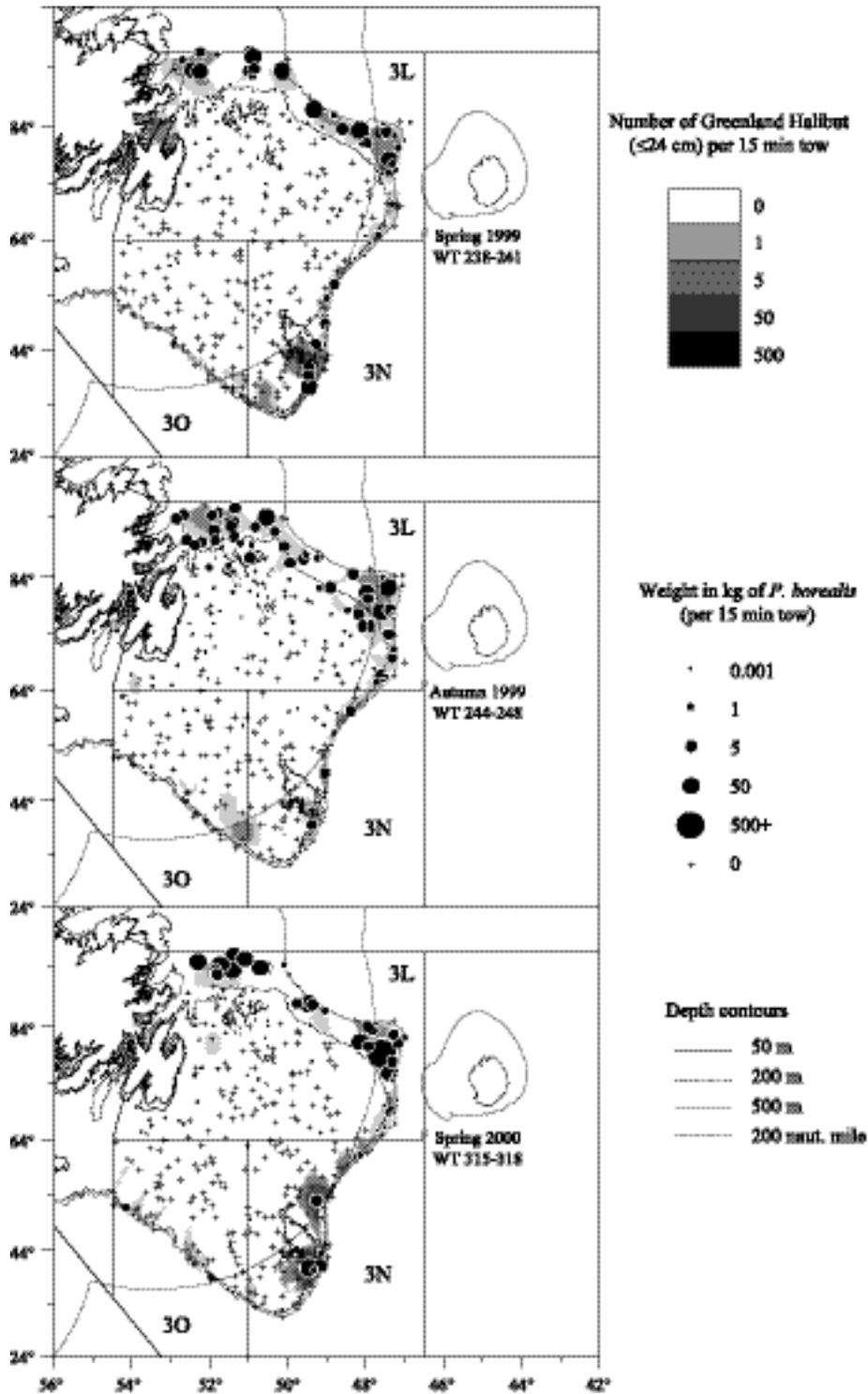


Fig. 4. Shrimp in Div. 3LNO: distribution of northern shrimp in relation to Greenland halibut with lengths ≤ 24 cm, collected during Canadian 1999-2000 autumn and spring multi-species research surveys (with a Campelen 1800 shrimp trawl, tows were standardized to 15 min.).

The data indicate some overlap with juvenile Atlantic cod and American plaice in areas of highest shrimp biomass. Juveniles of these species are, however, present in shallower water. Scientific Council **recommended** that fishing be restricted to depths greater than 200 m to reduce overlap in distribution of fishing effort and these juveniles. For redfish and Greenland halibut there is considerable overlap in distribution such that exclusion zones would not be feasible. Other measures, in addition to sorting grids, should be considered for these species such as use of longer toggle chains. This will allow greater separation between the foot-gear of the trawl and the trawl itself allowing small fish such as Greenland halibut to pass over the foot gear but escape under the net itself.

Regarding item c) the Council responded (SCR Doc. 00/85): As indicated in the response to (b), data on shrimp biomass and distribution were available from Canadian research surveys from autumn in 1995-99, and spring in 1999 and 2000. At least 90% of the shrimp biomass was within Div. 3L in each survey, mostly at depths from 185 to 550 m. The percentage of biomass in Div. 3LNO in the NRA ranged from 12 to 31, averaging 23% over the seven surveys. For Div. 3L alone, the range was similar (11 to 30) and the average was 21%. The proportion of biomass in the NRA was higher in the 2 spring surveys (29 and 31%) than in most of the autumn surveys (12 to 29%).

Divisions 3NO accounted for less than 10% of the overall biomass estimates, and less than 3% of the estimates in 1999 and 2000.

Based on these data, Scientific Council **recommended** that the shrimp fishery in Div. 3LNO be restricted to Div. 3L due to low amounts of shrimp in Div. 3NO, and the closer proximity of areas where shrimp have been found to the very important nursery areas of groundfish in Div. 3NO.

Regarding item d) the Council responded: Scientific Council was unable to provide information at this time on annual yield potential for this resource. As indicated previously, a cautious approach to development of the fishery in this area was **recommended** and fishing should be restricted to Div. 3L. Scientific Council noted the basis for its previous advice (NAFO Scientific Coun. Rep., 1999, page 207, Section V.1), and considered the survey results for 1999 and 2000 available since that advice was given. Scientific Council reiterated its **recommendation** that for the shrimp fishery in Div. 3L, catches be restricted to no more than 6 000 tons until the response of the resource to this catch level can be evaluated. Scientific Council also again **recommended** that fishing effort be distributed proportional to the distribution of biomass.

b) **Closed Area for Shrimp in Division 3M** (see Annex 1)

Further to the Fisheries Commission request in September 1999, the Fisheries Commission at its Annual Meeting in September 2000 requested Scientific Council to reply to the following question (FC Doc. 00/20, item 3h): *the Scientific Council is requested at its November 2000 Meeting to evaluate, on the basis of the best data available, whether the provision for a Div. 3M shrimp closure in FC Doc. 99/16(Rev.) would be a precautionary approach-based measure and, if so, whether proposed area and timing of the closure are appropriate.*

The Scientific Council responded: The Scientific Council was not able to assess the effect of the area closure with respect to the Precautionary Approach but on the issue of the appropriateness of the area and timing Scientific Council noted the following. The timing of the closure, June-September, is not effective as it does not coincide with the season of highest fishing effort in this area, i.e. March-April (SCR Doc. 00/74). The closed area is limited by about the 140 fathom depth contour where as age-group 2 generally is distributed down to 200 fathom as suggested in the EU survey in 2000 (SCR Doc. 00/71). Estimates based on the Faroese survey in 2000 suggest that about half of age-group 2 are within the closed area. The closed area covers about 40% of the total area of Flemish Cap down to 600 m. If the closure is to continue, Scientific Council **recommends** that it extend to the whole year for the closure to be effective. To protect the juveniles in the whole fishing area, Scientific Council suggests that Fisheries Commission also consider other technical measures known to be effective in improving the size selectivity of shrimp trawls.

Shrimp in Division 3M. Fisheries Commission at its Annual Meeting in September 2000 (FC Doc. 00/20, item 3h) further requested the Scientific Council respond to the following: *For shrimp in Div. 3M, the Fisheries Commission notes that information to date from the commercial fishery in 2000 is showing relatively high catch rates. In light of this apparent change in stock status, the Scientific Council is requested to review information from the 2000 fishery at its November 2000 Meeting and to evaluate the impact on this resource of removals in year 2001 and 2002 corresponding to 25 000 tons, 30 000 tons, 35 000 tons and 40 000 tons, respectively.*

The Scientific Council responded: Standardized CPUE for Div. 3M shrimp has remained stable from 1998 to 2000. Unstandardized CPUE is not considered to reflect changes in stock status. In November of 1999, Scientific Council **recommended** a TAC in 2001 of 30 000 tons for Div. 3M shrimp. Scientific Council pointed out then that this assumed that the 1997 year-class would be of average strength, and the Council noted that the advice would be re-evaluated during this meeting of November 2000.

At this November 2000 Meeting, Scientific Council noted that the catch estimate for 1999 used last year was 7 000 tons less than the actual catch, and that the catch in 2000 was expected to be close to 50 000 tons, some 60% higher than the 30 000 ton TAC recommended by Scientific Council. From a retrospective view of the advised TAC for 2000, Scientific Council considers that the level of 30 000 tons may have been somewhat conservative, based on the stock size indices in the current assessment and known catches for 1999 and catches to 1 October 2000. The advised TAC of 30 000 tons for 2001 anticipated stability in the resource particularly with respect to expected average abundance of the 1997 year-class. This November 2000 assessment estimates the 1997 year-class to be below average, which will have a significant impact on the size of the fishable stock in 2001.

Considering that the stock appears to have sustained an average catch of more than 40 000 tons in 1999-2000 and that there are concerns regarding recruitment, Scientific Council advises a reduction in catch in 2001 to the previously advised TAC of 30 000 tons. Based on the reduced recruitment expected from the 1997 and 1998 year-classes, Scientific Council anticipates that a further reduction in catches in 2002 will be warranted, particularly if catches in 2001 exceed 30 000 tons. Scientific Council was not able to advise on a specific catch level for 2002 and **recommended** that *for shrimp in Div. 3M the advice for 2002 be re-evaluated by Scientific Council in November 2001.*

Scientific Council notes that the precision of its assessment of this stock is such that it cannot evaluate the impact of removals in 2001 and 2002 in 5 000 ton increments as requested. Catches above 30 000 tons in 2001 will likely result in declines to stock biomass

3. Formulation of Advice Under a Precautionary Approach Framework

At its meeting during 11-17 November 1999, Scientific Council agreed to proceed with the "Traffic Light" Approach for the application of the Precautionary Approach to the northern shrimp stocks (Subareas 0+1, Div. 3M, Denmark Strait). It was noted that progress with this method would require some quantification of the evaluations and links to proposed management measures when the "traffic lights" change color. Scientific Council also recommended that the Designated Experts for these 3 stocks work by correspondence to develop the traffic light methodology for the current meeting.

Scientific Council was informed that some progress had been made in Canada on some cod stocks using this method in conjunction with more analytical PA frameworks, but that this methodology could not be attempted with the shrimp stocks at this meeting. Scientific Council again debated the merits and shortcomings of the "Traffic Light" Approach, noting that this method did not provide reference points as required under the PA framework. It was concluded that the "Traffic Light" Approach would not be used by Scientific Council at this meeting, but that further exploration of this methodology should be carried out. Scientific Council noted some progress in the use of age structured models for the shrimp stocks and encouraged further work in this area. Eventual development of such models would allow calculation of PA reference points based on biomass and fishing mortality.

IV. OTHER MATTERS

1. Scientific Council Meeting on Northern Shrimp, November 2001

The Council reconfirmed its meeting on northern shrimp will be held from 7 to 14 November 2001, at NAFO Headquarters, 2 Morris Drive, Dartmouth, Nova Scotia.

2. Scientific Council Meeting on Northern Shrimp, November 2002

The Council noted that dates for its meeting on northern shrimp would be finalized during its meeting in November 2001.

The Council extended its appreciation to Denmark/Greenland for its invitation to host the November 2002 Meeting in Nuuk, Greenland. The Council tentatively agreed to this venue.

V. ADOPTION OF REPORTS

The Council at its session on 15 November 2000 considered and **adopted** the Report of STACFIS (see Appendix I). The recommendations made by STACFIS and endorsed by the Scientific Council are given in Section II and III above. The Council then considered and **adopted** its own Report of this 8-15 November 2000 Meeting.

VI. ADJOURNMENT

There being no further business, the Chairman thanked all participants for their contributions during the meeting. Special thanks were extended to the Designated Experts of the three stocks, and particularly to the Chairman of STACFIS for effectively guiding the Committee on the assessment work. On behalf of the Council, the Chairman extended special appreciation to Denmark/Greenland, the hosts of the meeting, and for the hospitality extended by the hosts as well as ICES Secretariat. The Chair also thanked the NAFO Secretariat for their excellent work and support during the meeting. The Council expressed its appreciation for the Scientific Council Chairman's contribution during the meeting. The meeting was then adjourned.

APPENDIX I. REPORT OF STANDING COMMITTEE ON FISHERIES SCIENCE (STACFIS)

Chairman: H.-J. Rätz

Rapporteur: Various

I. OPENING

The Committee met at the International Council for the Exploration of the Sea (ICES) Headquarters, Copenhagen, Denmark, during 8-15 November 2000, to consider and report on matters referred to it by the Scientific Council, particularly those pertaining to the provision of scientific advice on certain finfish and invertebrate marine stocks. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), European Union (Germany), Iceland, Norway and Russia. The Assistant Executive Secretary was in attendance.

The Chairman, H.-J. Rätz (EU-Germany), opened the meeting at 1000 hours on 8 November 2000 welcoming the participants. The Agenda was reviewed and a plan of work developed for the meeting. The provisional agenda was **adopted** (see Agenda III, Part D, this volume)

Review of Recommendations in 1999 and 2000. STACFIS noted the recommendations made by the Scientific Council in 1999 and 2000 considered relevant to this meeting. STACFIS agreed that where possible, individual recommendations would be attended to and reported under the specific shrimp stocks considered at this meeting.

II. GENERAL ENVIRONMENTAL REVIEW

STACFIS noted that detailed accounts of environmental conditions related to the stocks being considered during this meeting were reviewed and reported by the Standing Committee on Fisheries Environment (STACFEN) during its meeting of 1-15 June 2000. No further reviews were undertaken at this meeting.

III. STOCK ASSESSMENTS

1. Northern Shrimp (*Pandalus borealis*) in Division 3M (SCR Doc. 00/54, 65, 71, 72, 73, 74, 80, 82, 83, 87, 88)

a) Introduction

The shrimp fishery in Div. 3M began in 1993. Initial catch rates were favourable and, shortly thereafter, vessels from several nations joined. The number of vessels was 66 in 1993, increased to 110 in 1996, but decreased thereafter to 45 in 1998 and 46 in 1999. Vessels from 16 nations have participated in this fishery.

Total catches were approximately 27 000 tons in 1993, then increased to 48 000 tons in 1996 and declined thereafter (Fig. 1.1). Total catch increased in 1999 to some 42 000 tons. Catch statistics to 1 October 2000 indicated removals of about 40 000 tons. This will likely result in a total catch of about 50 000 tons by the end of the year.

Recent catches and STACFIS estimates of catches (tons) are as follows:

	1993	1994	1995 ¹	1996 ¹	1997 ¹	1998 ¹	1999 ¹	2000 ^{1,2}
Catch	25 398	22 315	32 982	48 299	24 675	30 308	42 005	39 952
Recommended TAC							30 000	30 000

¹ Provisional (STACFIS estimate of catch).

² STACFIS estimate of catch to October.

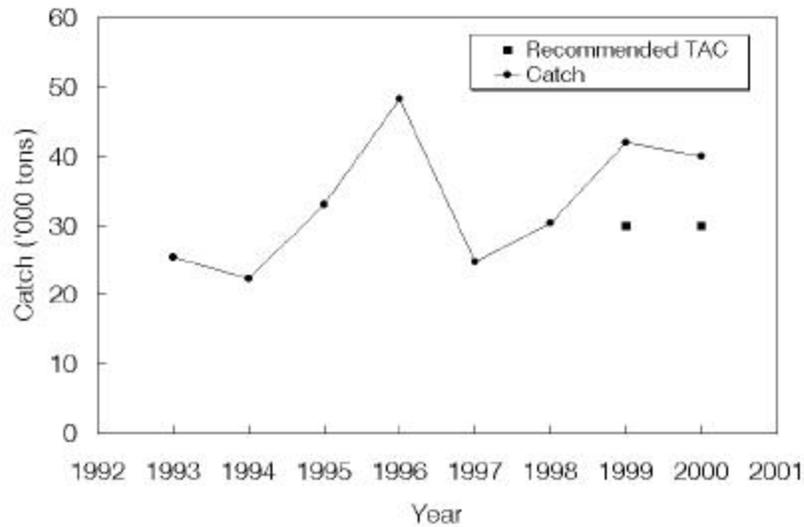


Fig. 1.1. Shrimp in Div. 3M: nominal catches.

b) **Input Data**

i) **Commercial fishery data** (SCR Doc. 00/72, 74)

Effort and CPUE. Data from logbooks of Canadian, Greenlandic, Icelandic and Norwegian vessels were available. The spatial distribution of effort differed among years, but approximately 50% was applied in the northwestern area every year. For the calculation of standardized CPUE, area effect was omitted due incomplete geographical information. A standardized CPUE series addressed differences due to seasonality, fishing power and gear (single and double trawl). CPUE decreased by 30% from 1993 to 1994, CPUE fluctuated without trend until 1997 increased until 1998 after which it remained the same (Fig. 1.2).

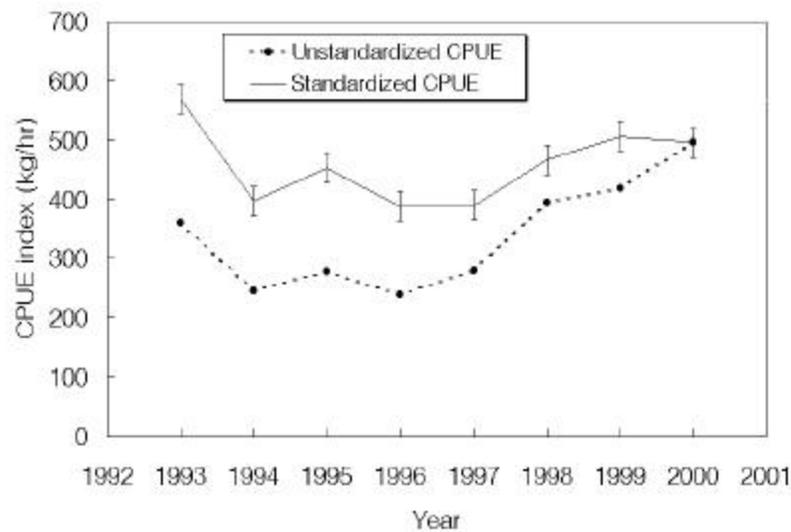


Fig. 1.2. Shrimp in Div. 3M: standardized CPUE (± 1 standard error) and unstandardized CPUE.

The unstandardized CPUE shows an increasing trend since 1996. The unstandardized CPUE does not take into account changes in gear (single and double trawls) which make the vessels more effective. The unstandardized CPUE series is therefore not considered to be reflective of stock status.

Icelandic CPUE Female SSB and recruitment at age 2. The CPUE of Icelandic logbooks was standardized according to size of gear and kg/hr was calculated to be that of a 3 000 meshes trawl, where the effort of double trawl was multiplied by 1.9 to match the catch-per-hour of a single trawl. From this a recruitment series, number/hour of 2 year olds was calculated (Fig. 1.3). The abundance of 2-year olds was the lowest in 2000 of the whole series of 1993 through 2000. Also a spawning stock was calculated as kg/hr of primiparous plus multiparous females. The spawning stock in 2000 was a little below the average for the whole series (Fig. 1.4).

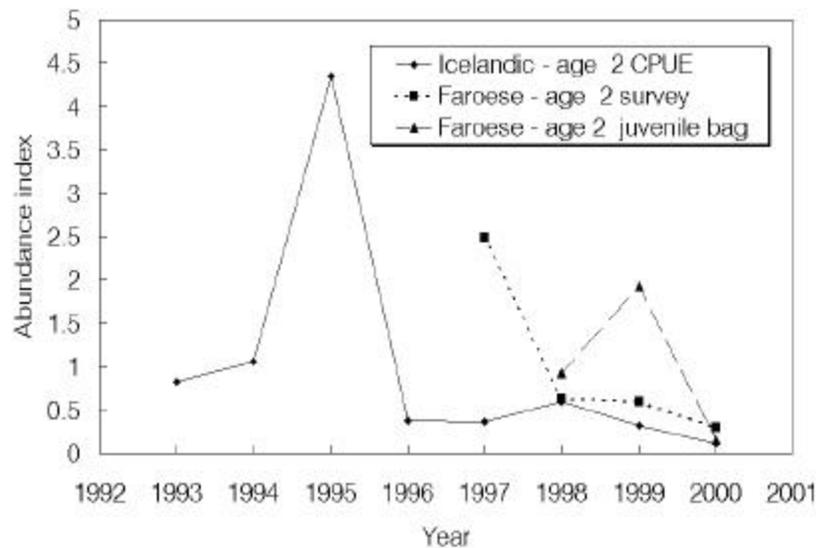


Fig. 1.3 Shrimp in Div. 3M: abundance of 2 year olds as from Icelandic standardized CPUE, abundance of 2 year olds from the Faroese survey and number of 2 year olds from the juvenile bag. Each series was standardized to the mean of that series.

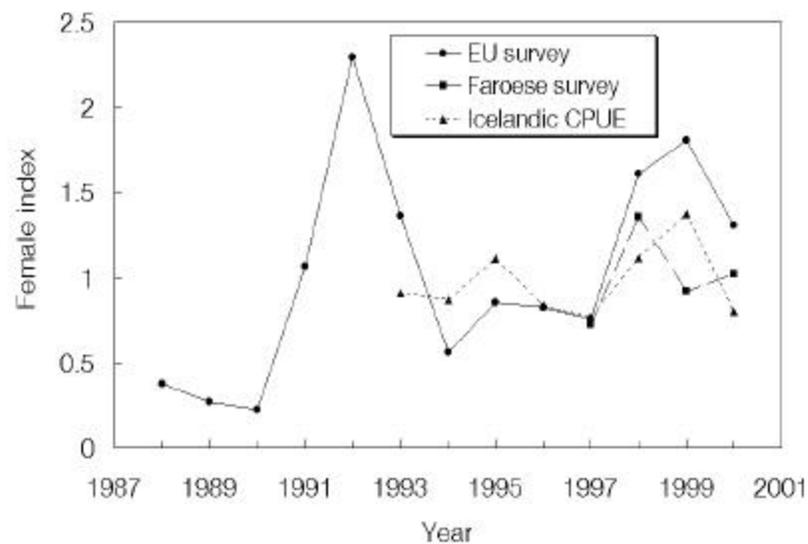


Fig. 1.4. Shrimp in Div. 3M: female biomass index from EU trawl surveys, 1988-2000, Faroese survey 1997-2000 and Icelandic female CPUE 1993-2000. Each series was standardized to the mean of that series.

Biological Data. Age composition was assessed from samples obtained from Canada, Greenland and Iceland. Number/hour was calculated for each year-class by applying a weight/age relationship and the total number as calculated from the nominal catch and the standardized Icelandic CPUE data.

Discards. Data on shrimp discarding from the Canadian and Greenlandic shrimp fisheries in 2000 showed that discard levels remained low as in previous years, indicating that all sizes were being kept.

ii) **Research survey data**

EU surveys (SCR Doc. 00/71) EU groundfish surveys have been conducted on Flemish Cap in July from 1988 to 2000. The 1994 and 1998 total biomass indices were likely biased due to changes in sizes of codend mesh. The female biomass was not considered to be affected by the change of gear. Female shrimp biomass from 1991 to 1993 was substantially higher than before or after and then increased again substantially after 1997 (Table below and Fig. 1.4).

Year	Biomass Index (tons)	Average catch per mile (kg)	Standard Error	Female Biomass Index (tons)
1988	2 164	1.54	± 0.28	1 874
1989	1 923	1.37	± 0.24	1 340
1990	2 139	1.53	± 0.21	1 132
1991	8 211	5.83	± 0.71	5 362
1992	16 531	11.75	± 1.86	11 509
1993	9 256	6.57	± 1.04	6 839
1994	*3 337	2.37	± 0.35	2 823
1995	5 413	3.85	± 0.44	4 286
1996	6 502	4.62	± 0.34	4 149
1997	5 096	3.62	± 0.25	3 807
1998	*16 844	11.81	± 0.80	8 091
1999	12 430	8.83	± 0.67	9 051
2000	9 720	6.91	± 0.52	6 553

* not comparable to others years because of different codend mesh size.

In 2000 a small meshed juvenile bag was attached to the cod end for the first time. The length frequency distributions obtained in the juvenile bag showed very distinctly the modes of ages 1 to 3 year olds and thus shows a great improvement in detecting the youngest age-classes.

Faroese survey (SCR Doc. 00/83). Stratified-random surveys were conducted in June-July 1997-2000 by a Faroese shrimp trawler. The total biomass index was about 17 000 tons in 1997, 23 500 tons in 1998, 16 500 in 1999 and 20 500 tons in 2000. Three and four year old males dominated the 1998 to 2000 estimated stock size in numbers. A recruitment index was also obtained (Fig. 1.3). A juvenile bag (mesh size 7 mm attached to the cod end) has been in use since 1998 to 2000. From this a recruitment index of 2-year-old shrimp was obtained (Fig. 1.3).

iii) **Other studies**

Stomach contents (SCR Doc. 00/65). Stomach contents of northern shrimp were studied at Flemish Cap. Detritus was most often found and this was 40% by volume. Other main Classes were Amphipoda 12.6% and unidentified Crustacea and Polychaeta 6.8% each.

Environmental data (SCR Doc. 00/73). The water mass over the Flemish Cap is a mixture of Labrador Current and North Atlantic Current waters. Oceanographic data from the summer of

1999 on the Flemish Cap were presented and compared to the long-term (1961-90) average, and to summer conditions during subsequent years. The cold near-surface temperatures (0.5 to 2.0°C below normal) experienced over the Cap during 1993, 1995 and 1996 had warmed 0.5 to 1.5°C above normal in July of 1997 and increased to 2°C above normal by the summer of 1998 and 1999. Surface temperatures during the summer of 2000 decreased somewhat but remained above normal in some areas of the Cap. Bottom temperatures on the Cap were slightly below normal during 1997, up to 0.5-1°C above normal during 1998 to 1999 and near normal during the summer of 2000. Upper layer (top 100 m) salinities were above the long-term mean (by 0.2-0.5 PSU) during 1997-99, but were otherwise about normal. In general the colder than normal temperatures experienced over the continental shelf and on the Flemish Cap from the late-1980s up to 1995 moderated by the summer of 1996 and continued above normal until July 1999. During the summer of 2000 the measurements show evidence of a reversal in the recent warm trend in some areas of the water column. As in previous years, summer chlorophyll levels in the upper 100-m of the water column over the Cap were higher compared to the adjacent Grand Bank. Dissolved oxygen levels were about normal for the region. Both the measured currents and the geostrophic estimates, while showing considerable differences and variability between years, indicate a general anticyclonic circulation around the Flemish Cap.

iv) **Estimation of stock parameters** (SCR Doc. 00/ 87)

STACFIS attempted to assess the shrimp stock in Div. 3M based on age disaggregated survey results and CPUE series derived from the commercial fleets. The data and analysis presented were discussed and were found not to represent a long enough series to be considered reliable for evaluation of the stock. However it was recognised that this was a first step towards the formulation of a structured production model that could improve information on projections of stock biomass and catches under different management option scenarios.

c) **Assessment Results**

Commercial CPUE. Standardized catch rates declined between 1993 and 1994, fluctuated without trend until 1997, increased in 1998 and remained stable thereafter. The unstandardized CPUE series is not considered to be reflective of stock status.

Recruitment. The 1997 year-class is indicated to be below average in 1999 and the 1998 year-class in 2000 is the lowest observed.

Spawning Stock Biomass. Indices of female biomass from the EU-surveys were relatively stable between 1994 and 1997. The female biomass increased significantly from 1997 to 1998, remained high in 1999 and declined in 2000. Icelandic CPUE indicated female biomass to be low in 2000. Index of female biomass from Faroese surveys varied without a trend.

State of the Stock. STACFIS is unable to estimate absolute stock size. Biomass and SSB are indicated to be higher in 1998-2000 than in 1994-1997. The 1997 and 1998 year-classes appear to be below average.

STACFIS considers it important to recognize that its ability to assess the resource will improve with the continuation of a series of research surveys directed for shrimp, particularly if a juvenile bag is used.

d) **Research Recommendations**

STACFIS **recommended** that, *for shrimp in Div. 3M:*

- *number-at-age from the EU survey results should be estimated to provide insights into mortality and year-class strengths.*
- *work on age structured population models should be continued.*

2. **Northern Shrimp (*Pandalus borealis*) in Subareas 0 and 1** (SCR Doc. 00/77, 78, 79, 81, 84, 86)a) **Introduction**

The shrimp stock off West Greenland is distributed in Div. 0A and Subarea 1 and the entire shrimp stock is assessed as a single population. The Greenland fishery exploits the stock in Subarea 1 (Div. 1A to 1F) in offshore and inshore areas (primarily Disko Bay). The Canadian fishery has been restricted to Div. 0A since 1981.

Three fleet components, one from Canada and two from Greenland (vessels above and below 80 GRT) participated in the fishery since the late-1970s. The Canadian fleet and the Greenland large-vessel fleet have been restricted by areas and quotas since 1977. The fishery by the Greenland small-vessel fleet was unrestricted until January 1997, when quota regulation was imposed. The use of a sorting grid with 22 mm bar distance to reduce by-catches of fish is mandatory for both the Greenland large-vessel fleet and the Canadian fleet. Discarding of shrimp is prohibited.

Overall catches increased until 1992. From 1993 to 1998 catches decreased to a level of 66 000 tons. In 1999 catches increased again to 76 500 tons, and catches in 2000 is projected to be at the 1999 level, based on 10 months (January to October 2000) data (Fig. 2.1).

Recent nominal catches and advised TACs (tons) for shrimp in Div. 0A and Subarea 1 are as follows:

	1990	1991	1992	1993	1994	1995 ¹	1996 ¹	1997 ¹	1998 ¹	1999 ¹	2000 ^{1,2}
Div. 0A Total	6 177	6 788	7 493	5 491	4 766	2 361	2 623	517	954	2 500	2 500
SA 1 Offshore	49 554	52 834	58 664	52 280	53 693	51 900	49 251	50 483	55 655	56 968	54 000
SA 1 Inshore	13 630	16 258	20 594	17 843	18 118	16 429	17 359	13 517	9 515	17 017	20 000
SA 1 Total	63 184	69 092	79 258	70 123	71 811	68 329	66 610	64 000	65 170	73 985	74 000
SA 0+1 Total	69 361	75 880	86 751	75 614	76 577	70 690	69 233	64 517	66 124	76 485	76 500
0+1 offshore catch	55 731	59 622	66 157	57 771	58 459	54 261	51 874	51 000	56 635	59 468	56 500
0+1 recomm. TAC ³	50 000	50 000	50 000	50 000	50 000	60 000	60 000	60 000	55 000	65 000	65 000

¹ Provisional (STACFIS estimates of catches from 1995-2000).

² Catches projected to end of 2000.

³ Until 1994 the advised TAC was only for offshore south of 71°N. After 1994, the advised TAC included offshore north of 71°N and inshore.

The nominal catch of shrimp in the **offshore areas** of Subarea 1 and the adjacent part of Subarea 0 (Div. 0A) increased from less than 1 000 tons before 1972 to almost 43 000 tons in 1976. Catches fluctuated thereafter and stabilized around a level of 54 000 tons during 1985-88, then increased to about 66 000 tons in 1992 and decreased thereafter to about 51 000 tons in 1997. Since then total catch in the offshore areas increased again to 59 500 tons in 1999. Catches in 2000 are projected to be at the 1999-level. The

Canadian fishery in Div. 0A amounted to about 2 500 tons in 1995 and 1996, declined to under 1 000 tons in 1997 and 1998. 2 500 tons has been reported in 1999 and 2 500 is reported up to October 2000.

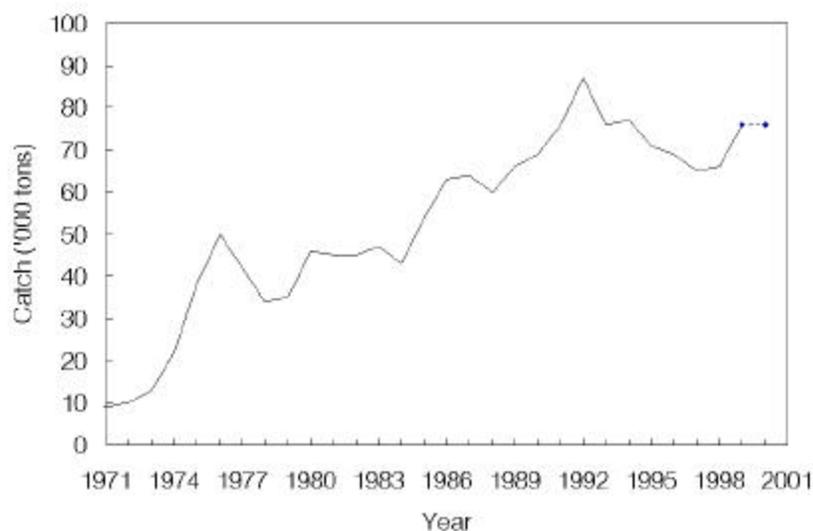


Fig. 2.1. Shrimp in Subareas 0 and 1: total catches (2000 projected to the end of the year).

Until 1988, the fishing grounds in Div. 1B have been the most important. Since then, a southward shift in the offshore fishery has taken place, and from 1990 catches in Div. 1C and 1D have exceeded those from Div. 1B. At the end of the 1980s, exploitation began in Div. 1E and 1F, and catches from these areas now account for about 20% of the total catch. The distribution of the fishery has not changed since 1996.

The West Greenland **inshore** shrimp fishery was relatively stable from 1972 to 1987 with estimated catches of 7 000-8 000 tons annually (except for 10 000 tons in 1974). Inshore catches in recent years have increased to over 20 500 tons in 1992, but decreased to 9 515 tons in 1998. Catches in 1999 increased again to 17 000 tons and preliminary data for 2000 (January-October) suggest catches at the same level as in 1999. During the 1990s inshore catches have accounted for about 25% of the total catch in Subarea 1.

b) Input Data

i) Commercial fishery data

Fishing effort and CPUE. Catch and effort data from the shrimp fishery were available from fishing records from Canadian vessels in Div. 0A and from Greenland logbooks for Subarea 1 (SCR Doc. 00/81).

A standardized catch rate (CPUE) index (Fig. 2.2) was presented (SCR Doc. 00/81). CPUE data from Greenland vessels above 50 GRT fishing in Subarea 1 and Canadian vessels fishing in Div. 0A were used in multiplicative models to calculate annual catch rate indices. One unified time series covering 1976-2000 was calculated. All fleets included in the analysis mainly exploit shrimp greater than 16 mm carapace length. The CPUE indices are therefore indicative of the older male and the female stock combined.

The standardized CPUE series showed an increasing trend in the 1990s. The projected 2000 value marks the highest value of continuously increasing trend since the early-1990s.

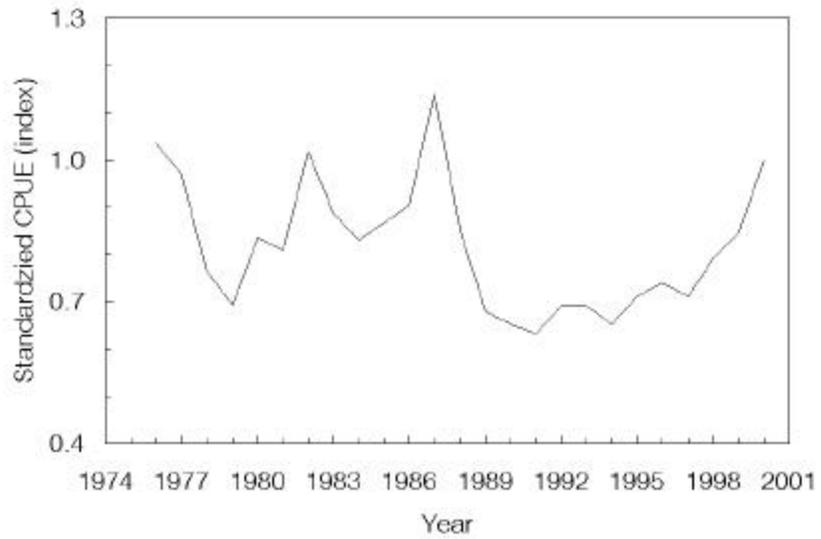


Fig. 2.2. Shrimp in Subareas 0 and 1: standardized CPUE index.

The standardized CPUE of male shrimp increased steadily from 1990 to 1999 (Fig. 2.3), while the CPUE of female remained relatively constant during the same period. CPUE of male shrimp in 2000 decreased, while the female CPUE increased in 2000 compared to the 1999-level (numbers of shrimp in the catch is divided by standardized effort).

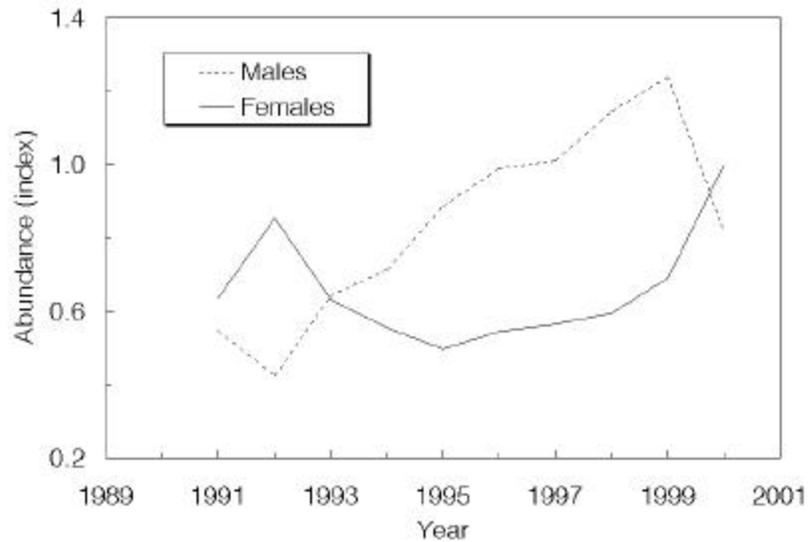


Fig. 2.3. Shrimp in Subareas 0 and 1: CPUE indices of male and female component of West Greenland shrimp stock 1991-2000 (indices are standardized to the number of females in 2000).

Catch composition. Length frequency data were obtained by observers in the commercial fishery in Div. 0A from 1991 to 1998, and in Subarea 1 from 1991 to 2000 (SCR Doc. 00/81). The proportion of males in the catch increased from 30-40% in 1991-92 to 60-70% between 1995-99. In 2000 the proportion of males decreased again to the early-1990s level. The length-frequency distribution of the 2000 catches showed good representation of all sizes.

ii) **Research survey data**

Greenland trawl survey. Stratified-random trawl surveys have been conducted since 1988 in offshore areas (Subarea 1 and Div. 0A) and since 1991 in inshore Subarea 1 (SCR Doc. 00/78). In 1990 and from 1993, the survey extended further south into Div. 1E and 1F.

The design of the survey and the analysis of the resulting data were reviewed in 1998 and 1999 and some changes were suggested. Among those that could modify the design and executions of the survey were a) shorten the tows; b) use buffered random sampling to choose trawl stations; c) fix the location of some stations from year to year; d) review the allocation of stations. Most of these suggestions were simultaneously implemented in the 1999 and 2000 survey. About 50% of the stations from the surveys in 1998 and 1999, randomly chosen, were repeated as fixed stations in the surveys in 1999 and 2000, respectively. The remainder of the stations was re-selected, using the above-mentioned buffer zone method, and using the fixed stations as already chosen stations.

Analyses show that fixing stations increases the reliability of estimated changes in biomass (SCR Doc. 00/86). The mean tow length in 2000 was about 27 minute and therefore shorter than in previous years. Analyses show that this would raise the biomass index upward with 8% relative to 1998; no correction has been applied in this document for this effort.

The survey estimates of biomass ('000 tons) are as follows:

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Offshore (Div. 1A-1F, 0A)	183	181	182	122	178	223	231	170	195	154	232	226	266
Inshore (Div. 1A)	47 ¹	47 ¹	47 ¹	51	47	34	40	47	54	52	62	61	84
Total	230	228	228	173	225	257	271	217	249	206	293	287	350

¹ No inshore survey in 1988-90. 47 000 tons is the average of the biomass inshore from 1991-97.

Biomass. During the period of stratified random surveys in the offshore areas of shrimp distribution the biomass estimates have indicated a good stability until 1998 around a level of 250 000 tons, apart from somewhat lower values in 1991, 1995 and 1997(SCR Doc. 00/78). From 1998 an increase was observed with record high estimated biomass in 2000 (Fig. 2.4).

The biomass in 2000 had a fairly traditional distribution with high densities in Disko Bay and in the deeps between the shallow banks along the coast, especially in Sukkertoppen and Holsteinsborg Deeps.

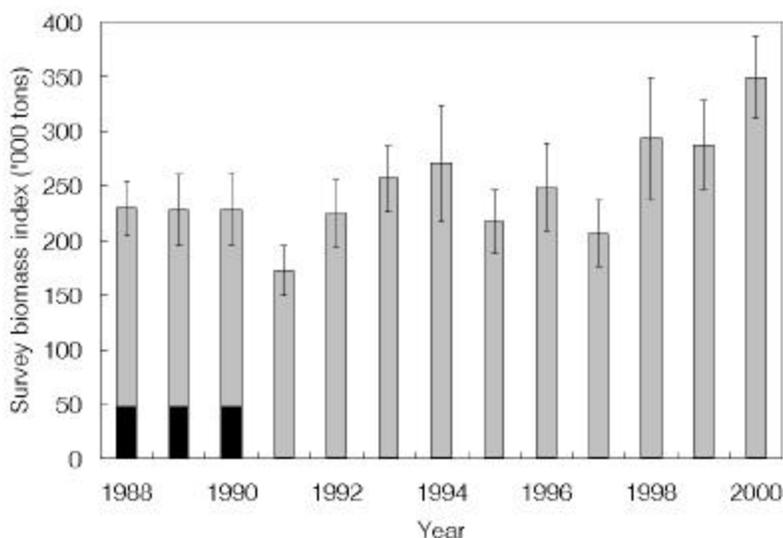


Fig. 2.4. Shrimp in Subareas 0 and 1: Survey estimates of biomass from inshore and offshore surveys, ± 1 standard error. 1988-90 includes an average of 47 000 tons for the inshore area.

Sex and length composition. Estimated total number ($\times 10^9$) of shrimp in the survey area (including both inshore and offshore areas) from 1988 to 2000 is as follows:

Year	Males	Females	Total	Males, %	Females, %
1988 ¹	24.3	9.9	34.2	71.0	29.0
1989 ¹	35.0	7.6	42.5	82.2	17.8
1990 ¹	28.5	10.0	38.5	74.1	25.9
1991	17.4	6.2	23.6	73.8	26.2
1992	29.7	7.3	36.9	80.3	19.7
1993	35.5	9.7	45.2	78.5	21.7
1994	33.9	10.9	44.8	75.7	24.3
1995	29.2	7.9	37.1	78.7	21.3
1996	41.4	8.1	49.5	83.7	16.3
1997	29.5	7.6	37.0	79.6	20.4
1998	42.9	11.5	54.5	78.8	21.2
1999	44.8	11.3	56.2	79.9	20.1
2000	66.7	12.7	79.4	84.0	16.0

¹ No inshore survey in 1988-90. The numbers in 1988 to 1990 represent an average of the estimated numbers of shrimp inshore from 1991-97 added to the actual estimates from the offshore area.

Estimated total number of shrimp in 2000 was higher than all other years, and numbers of both male and female are the highest on record.

The overall length-frequency distributions for the offshore area in 2000 showed a number of distinct male modes (at 9, 15, 19-20 and 22 mm CL), a mode of primiparous females at 24.5 mm CL and one of multiparous females at 26.5 mm CL. As in 1999 the presence of several male groups is promising in terms of recruitment to the female group in coming years.

Inspection of overall length-frequencies by the deviation method and a preliminary modal analysis of offshore and inshore length distributions indicate a change between 1997 and 1998 to faster growth. At the same time age at sex reversal appears to have changed from six years to five years.

A recruitment index (shrimp less than 17 mm CL, mainly age 2) show an increasing trend since 1997 with the 2000 value the highest since 1993, the beginning of the time series (Fig. 2.5).

The index of exploitation rate for 1988-2000 derived from the catch/biomass ratio is presented in Fig. 2.6.

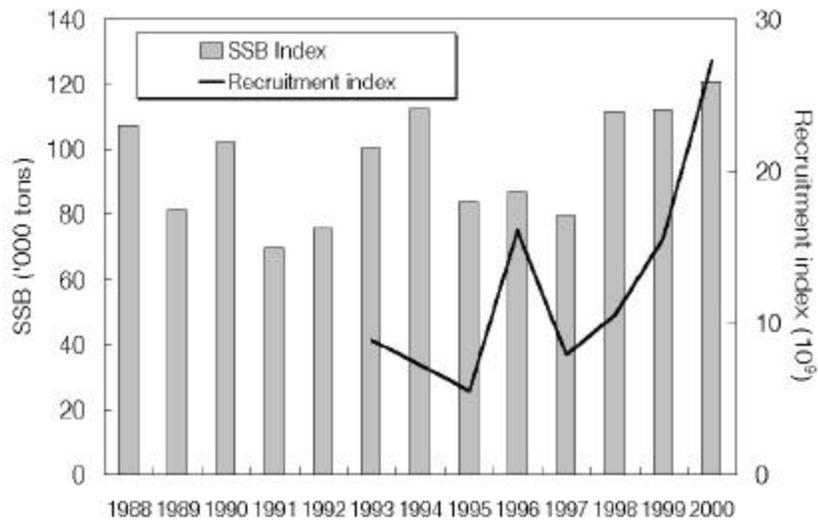


Fig. 2.5. Shrimp in Subareas 0 and 1: total female biomass index (inshore and offshore) and index for recruit for 1993-2000 (shrimp CL less than 17 mm, mainly age 2).

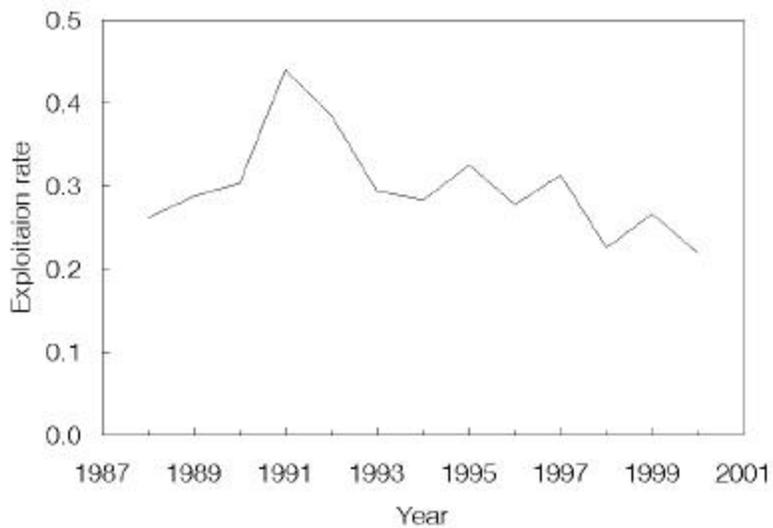


Fig. 2.6. Shrimp in Subareas 0 and 1: index of exploitation rate 1988-2000.

iii) **Other studies**

Spatial structure of the resource of *P. borealis*: results from an experimental trawl survey in the Sukkertoppen Deep were presented (SCR Doc. 00/79). *Pandalus borealis* was experimentally fished in the Sukkertoppen Deep off West Greenland in July 2000. Trawl stations were fished along transects at 300, 350 and 400 m as pairs of contiguous 15-minute tows, pairs being separated by a distance equivalent to a 30-minute tow. Each of the 50–60 km long transects comprised 19 or 20 tows. The design, of tows disposed in spaced pairs, proved an effective method of investigating both short-range and longer-range variation in density of the resource. This study indicated strongly that short-range variation in the density of *P. borealis* was much smaller than long-range variation and long tows would probably be unnecessary for getting adequate information about local densities. It indicated large long-range variation, with density changing by a factor of about 6, on average, in 20 km. The only limitation of the study was the restricted size of its study area. However, its conclusions do not contradict those of analyses of the data from the entire West Greenland survey area.

Occurrence of *Pandalus montagui* in trawl survey samples from NAFO Subareas 0+1 were reported (SCR Doc. 00/77). Since 1988, Greenland Institute of Natural Resources has conducted annual stratified-random survey in the distribution area of *Pandalus borealis* off West Greenland. *Pandalus montagui* has occurred frequently as by-catch in a large part of the surveyed area. Large variations in biomass are indicated, but no clear trend can be seen. However, as the survey design has been made with reference to the distribution of *P. borealis*, too few stations in the distribution area of *P. montagui* have been applied to give reliable estimates of the biomass. Compared to the stock of *P. borealis*, *P. montagui* occur in shallower water mainly in depths between 150 and 200 m. Compared to the biomass estimates of *P. borealis* the biomass estimates of *P. montagui* have normally been 1-2 % of the former, apart from two years with higher values (9 and 5%, respectively).

c) **Assessment Results**

CPUE. The standardized CPUE series showed an increasing trend in the 1990s. The provisional 2000 value is the highest since the early-1990s. Catch rates of female shrimp showed an increasing trend since 1995.

Recruitment. The recruitment index (shrimp less than 17 mm CL, mainly age 2) showed an increasing trend since 1997 with the 2000 value the highest since 1993, the beginning of the time series.

SSB. SSB (female biomass) showed an increasing trend since 1997 and the value in 2000 is the highest observed in the time series began in 1988.

Exploitation rate. An approximate exploitation rate (ration of catch to survey biomass) showed a declining trend since the early-1990.

State of the Stock. STACFIS is not able to provide estimates of absolute stock size. The indices of stock size show that both the recruitment and SSB estimates in 2000 are the highest observed. In addition the stock appears to be well represented by a broad range of size groups.

d) **Research Recommendations**

For shrimp in Div. 0A and Subarea 1, STACFIS **recommended** that:

- *an analysis of the length-frequency data of shrimp in order to obtain the age composition be conducted.*
- *the effect of recent changes in survey design and execution be further studied.*

3. Northern shrimp (*Pandalus borealis*) in Denmark Strait (SCR Doc. 00/75, 76)

a) Introduction

The fishery started in 1978 and, up to 1993, occurred primarily in the area of Stredbank and Dohrbank as well as on the slopes of Storfjord Deep, from approximately 65°N to 68°N and between 26°W and 34°W. In 1993 a new fishery began in the areas south of 65°N down to Cape Farewell. Availability of fishing grounds depends heavily on ice conditions at any given time. The use of a sorting grid with 22 mm bar distance to reduce by-catch of fish has been mandatory since October 2000. Discarding of shrimp is prohibited.

Except for 1978, when trawlers from Iceland started the exploitation in the northern area, this fishery has been multinational throughout its history.

Total catches increased rapidly to about 12 000 tons in 1987 and 1988, declined thereafter to about 7 500 tons in 1992 and 1993 and increased again to about 11 500 tons in 1997. Catches in recent years have been at a level of about 9 500 tons. Catches in the northern area decreased from 7 500 tons in 1993 to about 3 000 tons in 1996, but increased to about 4 000-4 500 tons in recent years. Catches in the southern area increased from 1 500 tons in 1993 to about 7 500 tons in 1997 and have decreased since to about 5 000 tons.

Recent nominal catches (tons) as estimated by STACFIS are summarized in the following table and Fig. 3.1:

	1990	1991	1992	1993	1994	1995 ¹	1996 ¹	1997 ¹	1998 ¹	1999 ¹	2000 ²
North of 65°N											
Greenland EEZ	9 994	8 192	5 764	3 563	3 359	4 823	2 351	1 300	3 115	3 223	3 273
Iceland EEZ	281	465	1 750	2 553	1 514	1 151	566	2 856	1 421	769	56
Sub-total	10 275	8 657	7 514	6 116	4 873	5 974	2 917	4 156	4 536	3 992	3 329
South of 65°N											
Greenland EEZ	-	-	-	1 532	4 939	3 532	6 796	7 433	4 785	5 475	4 533
Total	10 275	8 657	7 514	7 648	9 812	9 506	9 713	11 589	9 321	9 467	7 862
Recommended TAC	10 000	10 000	8 000	5 000	5 000	5 000	5 000	5 000	5 000	9 600	9 600

¹ Provisional catches as estimated by STACFIS.

² Catches January to 1 November 2000.

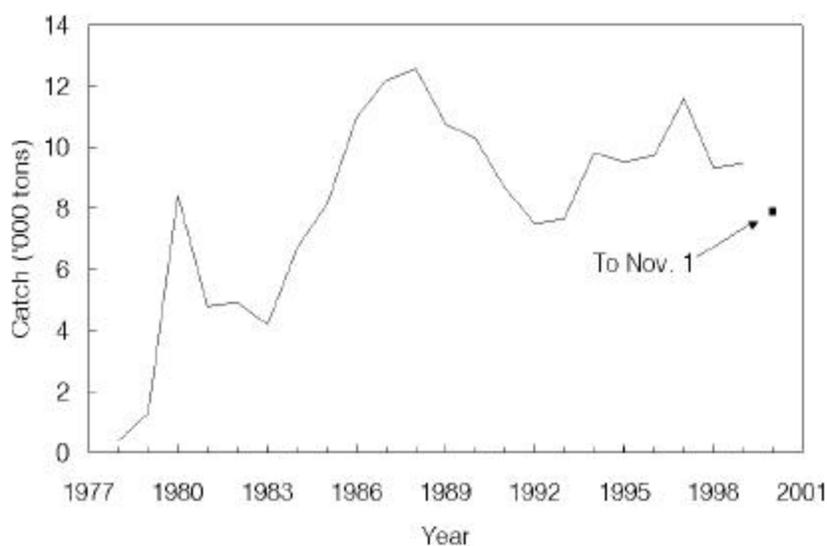


Fig. 3.1. Shrimp in Denmark Strait: nominal catches (January to 1 November in 2000).

b) Input Data

i) Commercial fishery data

Fishing effort and CPUE. Catch and effort (hours fished) from logbooks were available from Greenland, Norway, Iceland, Faroe Islands and EU-Denmark since 1980 and from EU-France for the years 1980 to 1991.

In the northern area, between 1981 and 1989, total unstandardized effort increased from about 20 000 hours to more than 100 000 hours, declining again to about 20 000 hours in 1999. The January to October effort as projected to the end of 2000 is at the same level as in 1999. In the southern area, effort increased from about 11 000 hours in 1993 to 26 300 hours in 1997 and remained at about 10 000 hours in 1999 and 2000 (projected). For the total area effort increased from 20 000 hours in 1981 to more than 100 000 hours in 1989 and afterwards declined steadily to 31 000 hours in 1999.

Standardized catch rates based on logbook data from Danish, Faroese and Greenlandic vessels in the Greenland zone in the northern area show a continuous decline from 1987 to 1993 and an increasing trend in the following years (available data for 2000 were too scarce to be included in the model - Fig. 3.2). A standardized catch-rate series for the same fleets in the southern area also showed an increasing trend from 1993 (Fig. 3.3). A standardized catch-rate index for the fishery of Icelandic vessels in the Icelandic zone (part of the northern area fished exclusively by Icelandic vessels) fluctuated from 1987 to 1997, but shows a decreasing trend in recent years (Fig. 3.4). A combined standardized catch-rate index for the total area, calculated from the indices for each area, showed a decrease from 1987 to 1993 and an increasing trend in the subsequent years (Fig. 3.5).

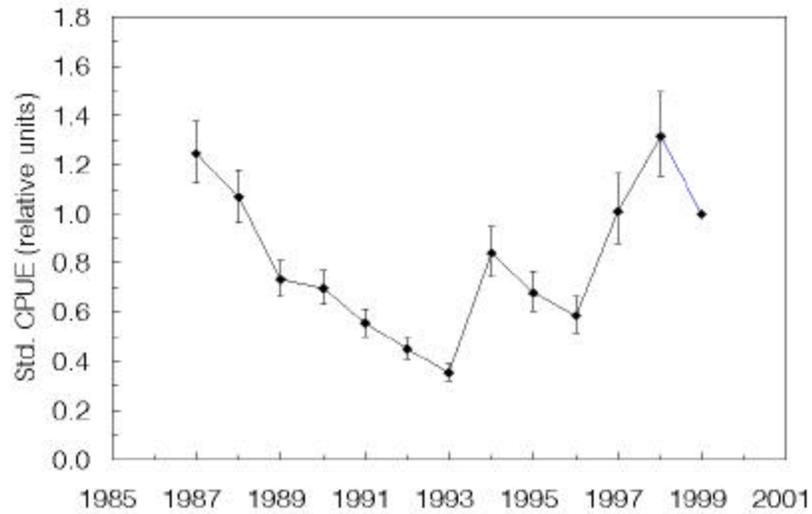


Fig. 3.2. Shrimp in Denmark Strait: annual standardized CPUE-indices (relative units) with ± 1 standard error calculated from logbook data from Danish, Faroese and Greenlandic vessels in the area north of 65°N, Greenlandic zone.

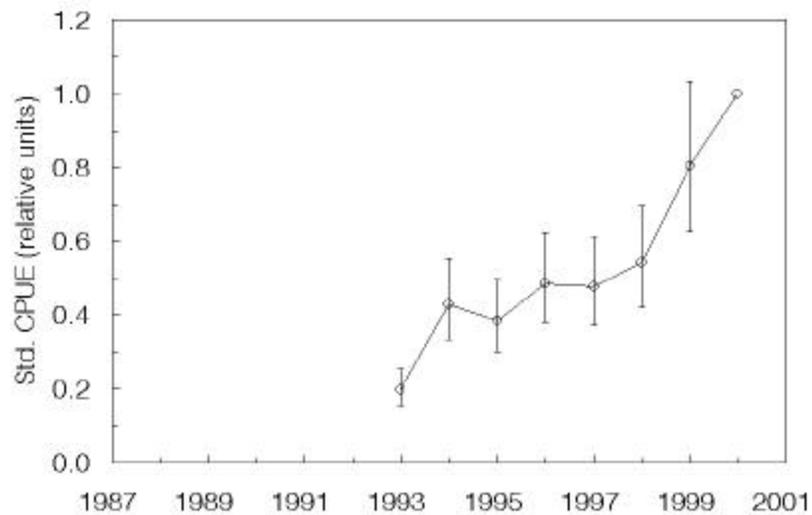


Fig. 3.3. Shrimp in Denmark Strait: annual standardized CPUE-indices (relative units) with ± 1 standard error calculated from logbook data from Danish, Faroese and Greenlandic vessels in the area south of 65°N, Greenlandic zone.

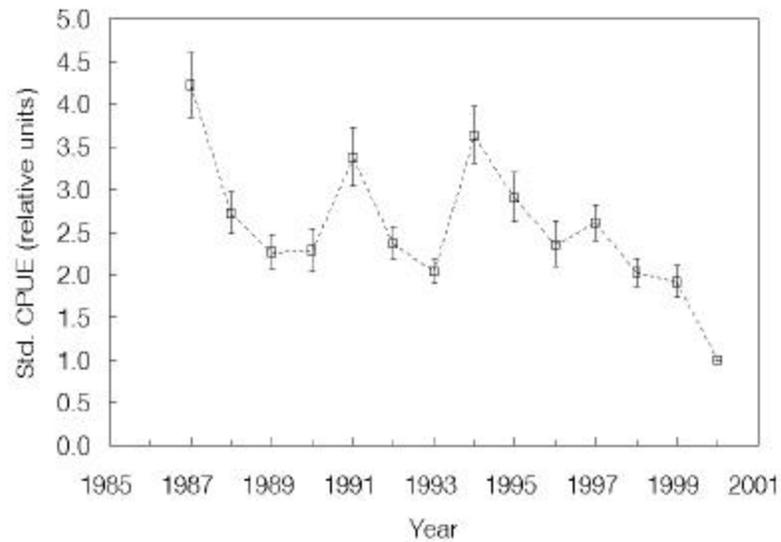


Fig. 3.4. Shrimp in Denmark Strait: annual standardized CPUE-indices (relative units) with ± 1 standard error calculated from logbook data from Icelandic vessels in the area north of 65°N , Icelandic zone.

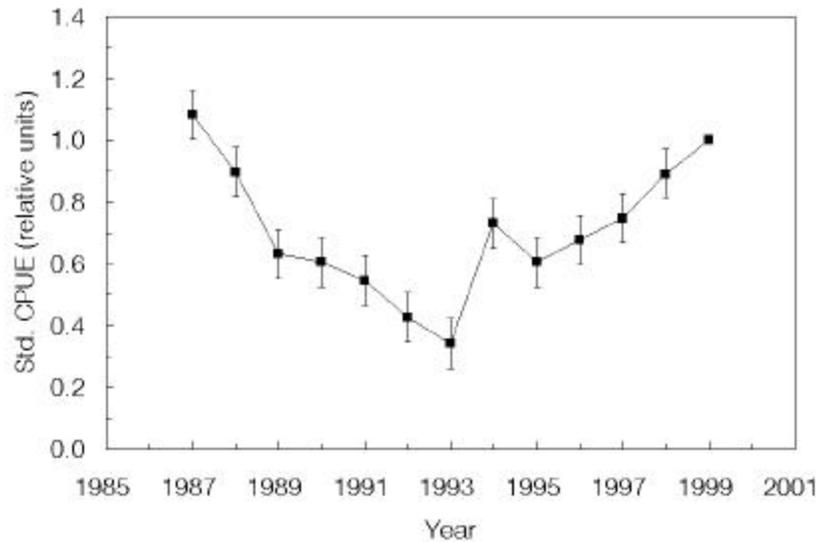


Fig. 3.5. Shrimp in Denmark Strait: annual standardized CPUE-indices (relative units) with ± 1 standard error combined for all areas.

Biological data. Samples from the Greenlandic fishery in the northern area indicated that the catches in the late-1980s and during the 1990s were dominated by females except for 2000, where males were more abundant. Samples from the Greenlandic fishery in the southern area showed a dominance of males in most years, except for 1994, when females were most numerous. For the total area several year-classes of male and female shrimp were evident in sampling data in recent years, and the male component was well represented at carapace lengths between 20 and 27 mm.

Commercial sampling of this fishery has generally been at a very low level but has improved in recent years. Available length information is however not representative of catch composition because of incomplete coverage over time and areas.

d) **Research survey data**

No surveys have been conducted since 1996.

e) **Assessment Results**

Commercial CPUE. Combined standardized CPUE indices for the total area declined from 1987 to 1993 and increased thereafter back to approximately the same level in 1999 as in 1987.

Recruitment. No recruitment estimates were available.

Biomass. No direct biomass estimates were available.

State of the stock. STACFIS is not able to provide estimates of absolute stock size. Standardized CPUE data for all the areas combined indicate a general increasing trend in fishable biomass since 1993. Several year-classes of male and female shrimp are evident in the sampling data in recent years.

Insufficient commercial data and a lack of survey data along with uncertainty on stock structure make assessment of this stock difficult.

f) **Research Recommendations**

For shrimp in Denmark Strait, STACFIS **recommended** that:

- *a survey be conducted, to provide fishery independent data of the stock throughout its range,*
- *commercial catch sampling of the fishery be improved to fully cover seasonal and spatial variation, so that size, sex and age composition of the catch can be accurately described.*

4. **Northern shrimp (*Pandalus borealis*) in Divisions 3LNO** (SCR Doc. 00/72, 85)

a) **Introduction**

The main component of the shrimp stock within Div. 3LNO is distributed along the edge of the Grand Banks within depths ranging from 184-549 m. The Faroese have been exploiting this stock since 1993. In 1999, Canada undertook exploratory fisheries along the edge of the Grand Banks.

For 2000 a 6 000 ton quota was implemented. The quota restricted fishing to Div. 3L, and to depths ranging from 200-500 m. Large (>500 ton) and small (<500 ton) Canadian vessels share a 5 000 ton quota that restricts fishing within the EEZ. Non-Canadian fleets were granted a 1 000 ton quota that restricts fishing to the NRA in Div. 3L. All vessels fishing this stock were required to utilize a Nordmore sorting grate with a maximum bar spacing of 22 mm, to reduce the by-catch of groundfish.

Recent catch and TACs (tons) are as follows (Fig. 4.1).

Year	1993	1994	1995 ¹	1996 ¹	1997 ¹	1998 ¹	1999 ¹	2000 ^{1,2}
Catch	1 789	356	0	79	485	515	827	4 113
TAC								6 000

¹ Provisional (STACFIS estimates).

² Catches to 1 November.

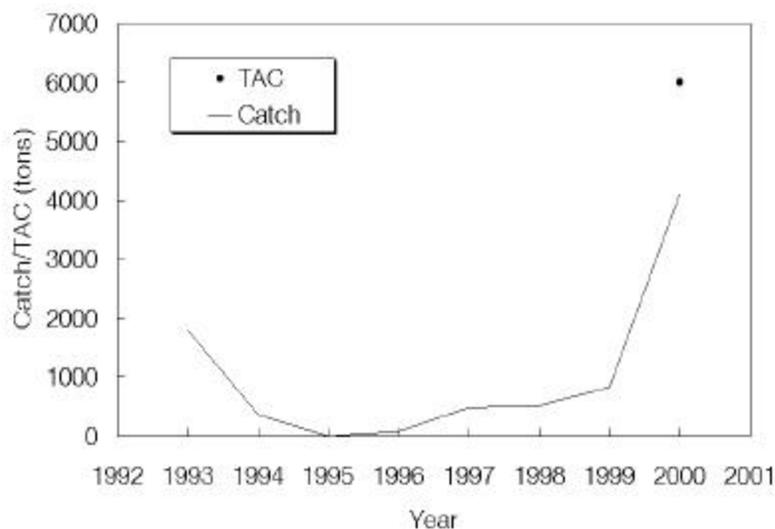


Fig. 4.1. Shrimp in Div. 3LNO: catches and TAC.

b) **Input data**

i) **Commercial fishery data**

Fishing effort and CPUE. Catch and effort data were available from all fleets participating in this fishery (SCR Doc. 00/85).

The catch rates for small vessels were higher than 300 kg/hr. Large vessels and non-Canadian fleets experienced catch rates ranging from 460-2 000 kg/hr. (SCR Doc. 00/72). Provisional catches up to 1 November 2000 were 4 113 tons. It is projected that quotas will be reached.

Catch, effort and CPUE were produced from Faroese logbook data. In Div. 3L the total annual CPUE for twin trawls increased from 681 kg/hr in 1998 to 746 kg/hr in 1999. The annual catches were 523 tons and 706 tons during 1998 and 1999, respectively.

Catch composition. Length frequency data were obtained by observers in the commercial fishery. Approximately 40% of the commercial catch consisted of males. There was good representation of all sizes of shrimp within the 2000 commercial length distributions.

Groundfish by-catch. Distributional plots (SCR Doc. 00/85) indicate that the shrimp fishery overlaps with several groundfish species presently under moratoria. Based upon a sample of 62 tons of shrimp the following table indicates the portion of by-catch per ton of shrimp.

Species	By-catch (kg/ton)
Atlantic cod	0.6
American plaice	3.9
Redfish	3.0
Greenland halibut	7.6

Atlantic cod and redfish are at very low biomass and abundance levels, therefore, any by-catch could prove detrimental to stock recovery.

ii) **Research survey data**

Canadian multi-species survey. Collections of shrimp have been a regular part of the Canadian multi-species survey each autumn since 1995, and each spring since 1999. During the spring of 2000, a juvenile shrimp bag was sewn into the belly of the trawl in an attempt to obtain a recruitment index of northern shrimp.

Biomass. Biomass and abundance steadily increased until 1998 and remained stable in 1999. The sharp increase in the estimated biomass in spring 2000 was attributed to two anomalously high samples resulting in broad confidence intervals (Fig. 4.2).

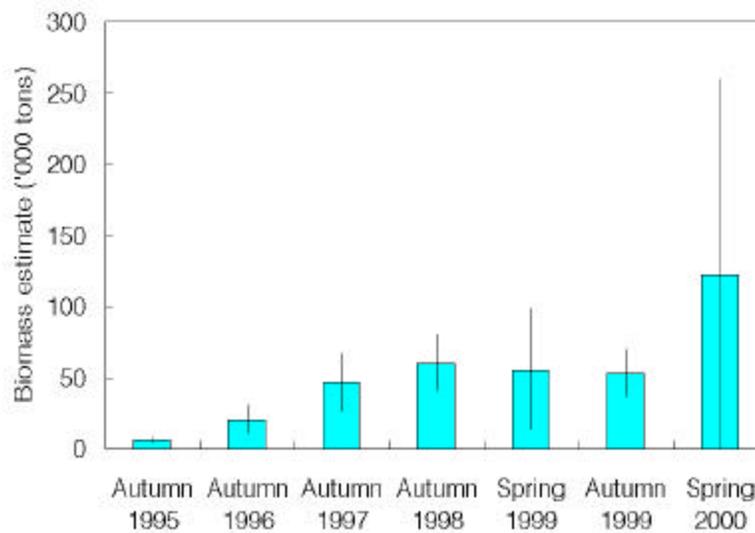


Fig. 4.2. Shrimp in Div. 3LNO: biomass estimates from Canadian multi-species surveys.

Sex and length composition. Estimated total number (10^9) of shrimp in Div. 3LNO from autumn 1995 to spring 2000 are as follows:

Survey	Males	Females	Total	Males %	Female %
Autumn 1995	1.3	0.8	2.1	60.5	39.5
Autumn 1996	5.5	0.4	5.9	93.2	6.8
Autumn 1997	7.7	2.9	10.5	72.8	27.2
Autumn 1998	13.3	2.0	15.3	86.9	13.1
Spring 1999	9.7	3.0	12.7	76.5	23.5
Autumn 1999	10.4	2.6	13.1	79.8	20.2
Spring 2000	17.0	8.0	25.0	67.8	32.2

As with the biomass estimates, the abundance of males and females increased over the first 3 years of the survey time period. Abundance of males and females remained stable until autumn 1999 and then increased greatly during spring 2000. The increase in the 2000 abundance estimates were due to 2 anomalously high survey catches. In any year, at least 60 % of the population are males.

Five distinct male modes (at 8.5, 14.0, 17.0, 19.5 and 20.5 mm), a mode of transitional and primiparous females at 23.0 mm and one of multiparous females at 24.0 mm were present in the length frequency distributions for the year 2000. Modal analysis indicated that the 1997 year-class is very strong, recruiting to the survey trawl during autumn 1999 and will recruit to the commercial gear during autumn 2000. The estimate of the 1996 year-class is much smaller. Sex reversal fluctuated between 20 and 21.5 mm throughout the time series, but usually occurred in shrimp 4 years of age.

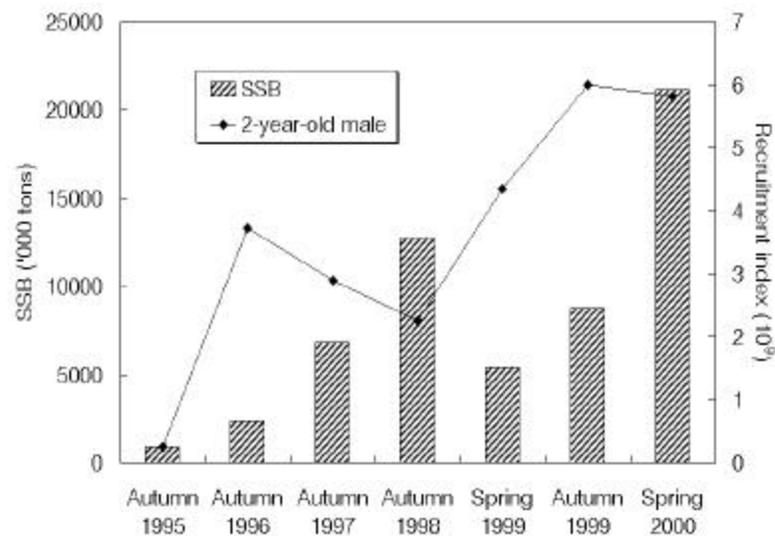


Fig. 4.3. Shrimp in Div. 3LNO: total female biomass index and recruitment index using 2-year-old male abundance from Canadian surveys.

c) Assessment Results

Total Abundance and Biomass. Both indices increased substantially between 1995 and 1998, remained stable and then doubled during spring 2000. The latter increase was driven by two anomalous high catches resulting in high variances and broad confidence intervals.

Recruitment. The 2-year-old male abundance generally has been increasing since 1995.

SSB. SSB has been stable between 1997-99 but increased substantially during 2000. However, this estimate is anomalously high due to 2 large catches.

State of the Stock. STACFIS is not able to provide estimates of absolute stock size. The stock appears to be well represented by a broad range of size groups.

IV. OTHER BUSINESS

1. Assessment Methodology

STACFIS revised its report in accordance with the Scientific Council conclusions of September 2000 pertaining to standardized presentation of the stock assessment results. As there were no age aggregated or structured analytical methods applied, survey series have also been presented in terms of spawning stock biomass and recruitment indices where applicable. Approximations of exploitation rates expressed as the catch/biomass ratio were provided when data requirements were met.

2. Adjournment

There being no other business, the Chairman expressed his gratitude to the members of the Committee for their valuable contributions, especially from the Designated Experts, and to the Secretariat for the excellent support in any respect, and adjourned the meeting.