PART B

Scientific Council Annual Meeting, 18-22 September 2000

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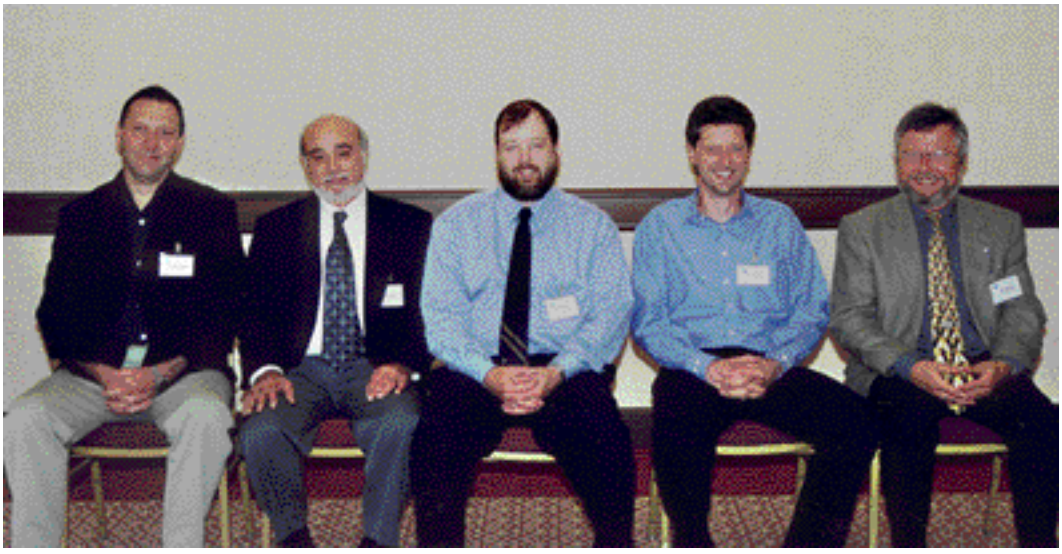
Participants at Scientific Council Meeting, 18-22 September 2000 (left to right):

Back Rows: E. de Cárdenas, R. Aploim, F. M. Serchuk, A. Vazquez, D. B. Atkinson, S. Junquera, D. Cross, L. C. Hendrickson, T. Saat, D. C. A. Auby, D. Kulka, W. R. Bowering, V. A. Rikhter, K. Patterson, Å. Nicolajsen, H. Murua, T. Amaratunga, A. Avila de Melo, V. N. Shibanov, D. Rivard, D. Briand

Front Row: O. A. Jørgensen, R. K. Mayo, W. B. Brodie, H-J. Rätz, M. Stein, S. Kawahara



Left to Right: Chairman STACPUB – O. A. Jorgensen (Greenland), Chairman STACFIS – R. K. Mayo (USA), Chairman Scientific Council – W. B. Brodie (Canada), Chairman STACFIS – H.-J. Rätz (EU – Germany), Chairman STACFEN – M. Stein (EU – Germany)

SCIENTIFIC COUNCIL ANNUAL MEETING, 13-22 SEPTEMBER 2000

REPORT OF SCIENTIFIC COUNCIL MEETING

18-22 September 2000

Chairman: W. B. Brodie Rapporteur: T. Amaratunga

I. PLENARY SESSIONS

The Scientific Council met at the Boston Back Bay Hilton, 40 Dalton Street, Boston, Massachusetts, USA, during 18-22 September 2000. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), European Union (France, Germany, Portugal and Spain), Estonia, Japan, Russian Federation and United States of America. The Assistant Executive Secretary was in attendance.

The Executive Committee met prior to the opening session of the Council, and the Provisional Agenda, plan of work and other related matters were discussed. The Council noted the Workshop on Assessment Methods was successfully conducted during 13-15 September 2000.

The opening session of the Council was called to order at 1015 hours on 18 September 2000.

The Chairman welcomed everyone to Boston and to this venue for the Meeting. The Assistant Executive Secretary was appointed rapporteur.

In the review of the Provisional Agenda, it was noted that the advice given for shrimp in Div. 3M during the Council Meeting of November 1999 was for the year 2001. The Council recognized there were some uncertainties expressed in the assessment then and catches have exceeded recommended TACs, and noted that status of the stock may have changed since then. It was accordingly agreed STACFIS should review and report on the advice given in November 1999. The Council **adopted** the agenda with the proposed revision (see Agenda II, Part D, this volume).

Having reviewed the plan of work noting formal requests from the concurrent meetings of the Fisheries Commission may be addressed by the Council, the session was adjourned at 1040 hours.

The Council reconvened at 0930 hours on 19 September 2000.

The Council considered Agenda item IX.2 on standardizing assessment reporting and documentation. The Council noted that while criteria for preparation of Scientific Council Reports, particularly the STACFIS reports and the Summary Sheets, have been evolving through the years, there was a need to pay attention to consistency and further standardization (see Section IX.2 below). The session was adjourned at 1000 hours.

The Council reconvened at 0945 hours on 20 September 2000 to address Agenda items VII on Future Meeting Arrangements, VIII on Future Special Sessions and IX on Working Procedures and Protocols, as reported under relevant sections below. The session was adjourned at 1050 hours.

The Council during this Annual Meeting received a request from the Fisheries Commission regarding cod in Div. 2J and 3KL. The Council during its sessions on 21 September 2000 prepared its responses (see Section V below).

The concluding session was called to order at 0900 hours on 22 September 2000 when the Council considered and **adopted** the reports of the Standing Committees (STACFIS, STACREC, STACPUB). The Council then addressed other outstanding agenda items and **adopted** its report of this Scientific Council Meeting of 18-22 September 2000.

The meeting was adjourned at 1215 hours on 22 September 2000.

The Reports of the Standing Committees as **adopted** by the Council are appended as follows: Appendix I – Report of Standing Committee on Fisheries Science (STACFIS), Appendix II – Report of Standing Committee on

Research Coordination (STACREC), and Appendix III – Report of Standing Committee on Publications (STACPUB).

The Report of the Scientific Council Special Session on "Workshop on Assessment Methods" is presented at Annex 1 of this Scientific Council Report.

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

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

II. FISHERIES SCIENCE

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

III. RESEARCH COORDINATION

The Council **adopted** the Report of the Standing Committee on Research Coordination (STACREC) as presented by the Chairman, R. K. Mayo. The full report of STACREC is given at Appendix II.

IV. PUBLICATIONS

The Council **adopted** the Report of the Standing Committee on Publications (STACPUB) as presented by the Chairman, O. Jørgensen. The full report of STACPUB is at Appendix III.

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

1. *the documents from the Workshop on Assessment Methods along with the discussions should be compiled and issued as a Scientific Council Studies publication.*

2. *a Working Group with representatives from General Council, Fisheries Commission and Scientific Council should be established in order to ensure that all relevant material becomes available on the NAFO website*.The Scientific Council agreed to pursue this matter further and requested the Chairman of the Scientific Council to contact the Chairs of General Council and Fisheries Commission intersessionally.

The Council was pleased to receive from STACPUB, two nominees to be appointed to the Journal's Editorial Board . The Scientific Council Chairman agreed to write to the nominees K. F. Drinkwater (Canada) and V. Siegel (EU-Germany), welcoming them as new members of the Editorial Board.

V. SPECIAL REQUESTS FROM CONCURRENT FISHERIES COMMISSION MEETING

1. Greenland Halibut Depth Distribution and Protection of Juveniles

The Fisheries Commission requested the Scientific Council to provide information on Greenland halibut depth distribution and protection of juveniles. The Scientific Council was requested to evaluate:

"*The biomass of Greenland halibut available to the commercial fishery over the whole distribution area of this species, in depth strata of 0-99 m, 100-199 m, 200 -299 m, 300-399 m, 400-599 m, 600-799 m and 800-1,000 m. It was further specified that separate values should be provided for: a) Fish above and below the length of 50% maturity and b) Fish above and below the current minimum landing size*."

The Council responded that, at present there were no available information to provide a complete answer to this question and it can be only addressed in partial aspects. Analyses of two sets of available data showed the following:

a) Catch data from Canadian annual autumn stratified random trawl surveys from 1995 to1999 combined, covering the offshore areas of Div. 2G, 2H, 2J, 3K, 3L, 3N and 3O pooled into depth intervals were used to examine distribution of Greenland halibut. No attempt was made in this preliminary analysis to break down the biomass into size or maturity components.

At depths less than 500 m the biomass comprised of a high proportion of pre-recruits. In terms of biomass, nearly 90% occurred at depths deeper than 250 m, 69% deeper than 400 m and 27% deeper than 1 000 m. The following table summarizes total biomass and percent biomass at depth for Div. 2G, 2H, 2J, 3K, 3L, 3N, and 3O for all sizes taken in the autumn 1995-1999 surveys.

	Depth Range (m)							
	0-50	51-100	101-150	151-200	201-250	251-300	301-350	351-400
Biomass (tons)	0	3 820	2 416	6 100	20 994	41 181	55 237	72 565
% of Biomass	0.00%	0.59%	0.37%	0.94%	3.24%	6.36%	8.52%	11.20%

	Depth Range (m)							
	401-450	451-500	501-600	601-700	701-800	801-900	900-1000	1001-2000
Biomass (tons)	133 708	41 731	29 892	15 068	17 508	19 247	15 269	173 257
% of Biomass	20.63%	6.44%	4.61%	2.33%	2.70%	2.97%	2.36%	26.74%

b) Data from the Spanish scientific observers in Div. 3LMNO in 1999, with 5% coverage of the Spanish fleet, indicated the following (taking this information as an indicator of the depth distribution pattern of the species fishable biomass, without any attempt to quantify fishable biomass):

- In Div. 3L, no Greenland halibut were found at depths less than 700 m. The magnitude of these catches increased sharply from 1 000 to 1 400 m and Greenland halibut did not occur in catches deeper than 1 500 m.
- In Div. 3M, Greenland halibut were caught at depths between 600 and 1 600 m, with a peak at 1 200-1 300 m. No catches of this species were found at depths less than 600 m.
- In Div. 3N, Greenland halibut catches were taken at depths between 700 and 1 400 m. Only 1% occurred at shallower depths.
- In Div. 3O, Greenland halibut catches occurred at depths between 700-1 000 m.

Catch rates for Greenland halibut were highest in depths 600-1 100 m, consistent with depth distribution of catches described above.

At present, only data regarding Greenland halibut in Div. 3LMNO from the scientific observers on board the Spanish fleet and from the Spanish bottom trawl survey in Div. 3N are available. Based on the survey data, more than 90% of the SSB was found at depths greater than 800 m (see table below). This pattern was also reflected in the commercial catch distribution.

Year	Biomass	SSB	%	Percentages of SSB by depth strata (m) 0-99	100-199	200-299	300-399	400-599	600-799	800-999	1000-1199	1200-1600
1996	34 246	8 124	24	0	0	0	0	0	4	74	22	ns
1997	71 000	21 731	31	0	0	0	0	0	0	9	90	ns
1998	147 864	33 657	23	2	2	0	0	0	3	35	28	29
1999	121 043	31 664	26	0	0	0	0	0	5	16	42	36

ns – not surveyed

2. **Long-term Effects on the Greenland Halibut Stock of Increasing Mesh Size**

The Fisheries Commission requested the Scientific Council to: *provide information on the long-term effects on the Greenland halibut stock (biomass and yield) of increasing mesh size from 130 mm to 145 mm*.

Scientific was unable to answer this question at the present time and will consider this issue during the next meeting of the Scientific Council in June 2001.

3. **New Pelagic Fishery for Oceanic Redfish in NAFO Regulatory Area (Div. 1F)**

The Fisheries Commission requested the Scientific Council to: *provide information regarding the new pelagic fishery for oceanic redfish in the NAFO Regulatory Area (Div. 1F) as follows*:

In responding to the requests below, the Scientific Council noted that the assessment of the oceanic redfish stock in ICES areas is conducted annually in May by the ICES Northwestern Working Group. The ICES advice on management of this stock is provided to NEAFC.

a) "*Description of the geographical distribution and stock structure of oceanic redfish*."

The Scientific Council responded that, since the initiation of systematic surveys of the oceanic redfish distribution in the early-1990s, the stock was found to be distributed in the NEAFC Convention Area in ICES Div. Va, XII and XIV. Any previous survey information available for the NAFO Convention Area has never been considered in the assessment of the stock. Until 1999, directed fishing activities have occurred almost exclusively in the NEAFC Convention Area. During the most recent international survey conducted in 1999, the stock was found distributed to a great extent inside the NAFO Regulatory Area (Div. 1F, see Fig. 1). In 2000, there has been reported significant fishing activities directed towards oceanic redfish in NAFO Div. 1F for the first time. Scientific Council considers the oceanic redfish distributed in the NAFO Div. 1F as a part of the oceanic redfish stock previously being distributed inside the NEAFC Convention area where it is currently managed as a single stock unit. However, the stock structure (one or more stock units) remains unclear and scientific work is ongoing addressing this question.

b) "*Biomass of oceanic redfish in NAFO Div. 1F*."

The Scientific Council responded that, it is unable to provide absolute or relative estimates of the oceanic redfish biomass in NAFO Div. 1F during the course of this September 2000 Meeting. The Scientific Council would be able to assess such a figure in June 2001 for the year 1999 given the databases available.

c) "*Advise on appropriate mesh size regulation for the pelagic fishery directed towards oceanic redfish in NAFO Div. 1F*."

In response the Scientific Council noted that, there is at present no mesh size regulation for the pelagic fishery directed towards oceanic redfish in the NEAFC Regulatory Area. This is due to the fact that the biomass consists almost exclusively of adult redfish as the juveniles are distributed outside the fishing grounds. Inside the NAFO Regulatory Area there is, however, the use of a minimum mesh size of 130 mm obligatory for trawl fisheries including those for redfish. Scientific Council considers that any

proposed changes in mesh size regulations for a portion of the NAFO Regulatory Area, regardless of species, is a regulatory issue and should therefore be addressed by NAFO Fisheries Commission.

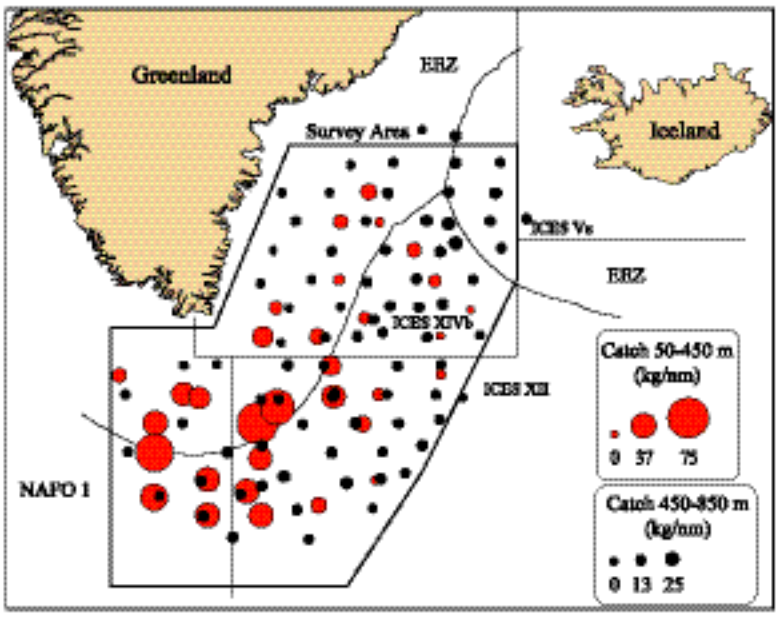


Fig. 1. Distribution area of oceanic (pelagic) redfish (*Sebastes mentella* Travin) in NEAFC and NAFO Convention Areas. Results of survey catches from the June-July 1999 international hydro-acoustic survey with participation of Iceland, Russia and EU-Germany.

4. Questions Regarding Divisions 2J and 3KL Cod

a) The Fisheries Commission requested the Scientific Council to: *evaluate the use made of information from a) the index fishery; b) the sentinel fishery in the assessment of Div. 2J and 3KL cod; c) the food/recreational fishery*

The Scientific Council responded that, the autumn surveys in Div. 2J and Div. 3KL and the spring surveys in Div. 3L provide biomass estimates of the offshore area in Div. 2J and 3KL (combined). This biomass index declined abruptly in the early-1990s and remained at a very low level through 1999.

There is no fishery-independent index available for the inshore region of Div. 2J and 3KL. It is difficult to gather comprehensive fishery independent information from the inshore areas. The bottom topography is largely unsuitable to trawling. Acoustics of the inshore area were tried in 1997. However, due to problems with fish avoidance of the vessel due to vessel noise in the relatively shallow waters, coupled with fish being rendered 'invisible' due to their proximity to the bottom, the estimate of biomass was considered unreliable.

Catches since 1992 have come from several sources. Small by-catches have been taken in fisheries for other species. A Canadian food/recreational fishery was permitted in 1992-94, 1996, 1998 and 1999 but not in 1995 and 1997. A limited inshore fishery for scientific purposes (sentinel survey) has been conducted during 1995-2000. In addition, an index or test fishery that caught 3 000 tons was conducted in the inshore in 1998.

The Council noted that the commercial fishery was reopened in 1999. The directed commercial fishery was conducted during two periods (July and September to mid-November). The total landings of 8 470 tons in 1999 came from the commercial fishery (8 050 tons), the sentinel survey (200 tons) and the food/recreational fishery (220 tons).

Catch rates were calculated from catch and effort data recorded in logbooks maintained by participants in both the index fishery in 1998 and the commercial fishery in 1999. An among-year comparison has not been attempted because of a difference in dates of fishing between the two years. The index fisheries were sampled intensively for both lengths and ages, as well as fish condition and fish maturity data.

The inshore sentinel survey in Div. 2J and 3KL was initiated in 1995 to provide commercial-like indices of cod abundance in coastal waters during the period of the moratorium. It has been conducted primarily with gillnets. Line trawls have been used extensively in only a few areas. Handlines and cod traps have been used much less. The sentinel survey data were standardized to remove site and seasonal effects and produce annual indices of total catch rate and catch rate at age for Div. 3K and Div. 3L combined. Gillnets and line trawls were treated separately. The sentinel surveys were sampled intensively for both lengths and ages, as well as fish condition and fish maturity data. The directed commercial fishery was well sampled during July and September.

The food/recreational fishery was not sampled in 1999. Age compositions of the landings (all sources combined) were initially calculated by gear, unit area (a Subdivision of NAFO Division for statistical purposes) and month.

Catch rates and catch-at-age data were used to evaluate the relative strength of the cohorts entering the exploitable stock during the moratorium years as well as tracking their abundance over time.

The Scientific Council noted that the status of cod in the inshore was determined from the analysis of tag return data. The inshore was divided into three geographic areas: Div. 3K, northern Div. 3L (Bonavista and Trinity bays) and southern Div. 3L. Information from recaptures of cod tagged in the inshore of Div. 3KL during 1997, 1998 and 1999 were used to estimate exploitation rates for each of the two periods of the 1999 fishery. The exploitation rates for each period represent the fractions of fish available to the fishery that were removed by the fishery. Reliable estimates of exploitation rate could not be produced for southern Div. 3L because of the strong seasonal contribution of fish from Subdiv. 3Ps. When combined with the catches recorded for each area and time period, the exploitation rates allow the estimation of corresponding available (to the fishery) biomass levels occurring in each area and time period.

In summary, data from the sentinel fisheries, index fisheries and food fisheries are being used as part of the assessment in developing catch-at-age matrices, maturity ogives, fish condition indices and CPUE indices for the inshore components. The catches in these fisheries also enable the conduct of the very critical mark-recapture work that has given estimates of exploitation on the inshore components as well as estimates of the biomass. Overall, the limited fisheries in the inshore area provide invaluable information that form a critical part of the resource assessment.

b) The Fisheries Commission requested the Scientific Council to: *evaluate the state of the stock of Div. 2J and 3KL cod and the impact of a fishery at a level of 7 000 tons in 2000, with respect to precautionary criteria as proposed by Scientific Council, and reference points previously used for management of this stock.*

The Scientific Council responded that, in June 2000 it had reported that the Div. 2J and 3KL cod stock "as a whole remains at a very low level". It also indicated that "in the offshore there are no signs of recovery".

With respect to the Precautionary Framework of Scientific Council, it is noted that there have been no biological reference points determined for this stock. However, it is considered that the Div. 2J and 3KL cod resource overall is such that no fishing mortality would be recommended. This is the course of action, under the Scientific Council PA Framework, that would be recommended when the spawning stock biomass is below B_{buf}.

The reference point used historically for Div. 2J and 3KL cod was $F_{0.1}$ (18% exploitation rate) that corresponds to a fishing mortality considered to be conservative in relation to reference points used in other parts of the world. The dynamics of the stock overall have changed dramatically in the 1990s such that this past reference level is no longer considered useful. In its June 2000 report the Scientific Council stated that "Exploitation rates for the first and second openings in the inshore fishery in 1999 were estimated to have been at least 19% and 13% in Div. 3K and 2.3% and 3.8% in northern Div. 3L". Thus exploitation was about equal to the historical reference in Div. 3K but well below in northern Div. 3L.

Canada has implemented a number of conservation measures that may be considered to be consistent with the Scientific Council interpretation of the Precautionary Approach as well as representative of supportive management measures under a Precautionary Approach as reported during the Joint Scientific Council/Fisheries Commission Working Group meetings as part of a carefully controlled fishery.

c) The Fisheries Commission requested the Scientific Council to: *evaluate the effect of fisheries of the order of 7 000 tons to 9 000 tons on the prospective recovery of the Div. 2J and 3KL cod.*

The Council responded that, in 1999 the Scientific Council responded to a similar question noting that due to the lack of an analytical assessment it was not possible to provide risks associated with different catch levels similar to those provided for Div. 3NO cod. The situation this year is similar in that again no analytical assessment is available.

Scientific Council reiterated its 1999 advice that "any removals (including directed catch and by-catch in other fisheries) will hamper recovery of the resource although the extent of the delay cannot be determined with available data". Additionally, Scientific Council noted that projections using stock dynamics determined prior to the moratorium would be inappropriate due to the dramatic changes seen in more recent years.

Scientific Council, during its June 2000 Meeting, noted that total mortality, as calculated from research vessel data, has remained well above 0.2 since declaration of the moratorium in 1992. The cause for this has not been determined. Predation by harp seals may be an important contributor. Scientific Council noted in June 2000 that seal consumption was estimated to be about 50 000 tons in 1998, the most recent year for which estimates were available.

It was not possible to carry out in depth analyses during this meeting. Preliminary analyses that were conducted clearly indicated that the rate of recovery of the Div. 2J and 3KL cod stock is highly sensitive to future natural mortality relative to fishing mortality.

d) The Fisheries Commission requested the Scientific Council to: *evaluate the proportion of juvenile fish taken by the various gears in the inshore fishery.*

The Council responded that, the proportion of juvenile and mature cod in the total catch (numbers in '000s) of the inshore fishery for the period 1995-99 for all gears combined was as follows:

Year	Catch	Mature Abundance	Juvenile Abundance	Fishery
1995	197	78%	22%	Sentinel fishery
1996	1 076	61%	39%	Sentinel + Food/Recreational
1997	251	74%	26%	Sentinel
1998	2 125	82%	18%	Sentinel + Food/Recreational + Index
1999	3 596	81%	19%	Sentinel + Food/Recreational + Commercial

The proportion of juvenile and mature cod in the total catch of the inshore fishery in 1997, 1998 and 1999 by individual gear was as follows:

1997	All gears	Gillnet	Line trawl	Handline	Trap
Mature	74%	82%	58%	64%	63%
Juvenile	26%	18%	42%	34%	37%
Catch in No. ('000)	251	166	38	11	35
1998	All gears	Gillnet	Line trawl	Handline	Trap
Mature	82%	90%	77%	66%	79%
Juvenile	18%	10%	23%	34%	21%
Catch in No. ('000)	2 125	1 038	742	307	33
1999	All gears	Gillnet	Line trawl	Handline	Trap
Mature	81%	85%	62%	67%	59%
Juvenile	19%	15%	38%	33%	41%
Catch in No. ('000)	3 596	2 927	101	563	6

e) The Fisheries Commission requested the Scientific Council to: *consider the implications of concentrated fishing on local aggregations for the preservation of the genetic biodiversity of the stock.*

The Council responded that, during its June 2000 Meeting, information on genetic structure of the Div. 2J and 3KL cod resource was made available to Scientific Council. However, at that time it was agreed that due to the unavailability of appropriate expertise, the information could not be evaluated. Similarly, appropriate expertise was not available to Scientific Council during this September 2000 Meeting so the Council was not able to evaluate the potential impacts of the current fishery on the preservation of genetic biodiversity.

Nonetheless, in situations where there are different spawning components in a stock, it is important that exploitation on any one component not be excessive as a precautionary measure in order to preserve possible genetic biodiversity. This is in accordance with international obligations under the Biodiversity Convention.

The Scientific Council noted that during 1999, exploitation rates for the first and second openings in the inshore fishery were estimated to have been at least 19% and 13% in Div. 3K and 2.3% and 3.8% in northern Div. 3L. However, how these may relate to possible different inshore genetic components is unknown.

For the 2000 fishery, and as indicated above, Canada developed the protocols for the prosecution of the limited inshore fishery based on consultation with assessment scientists in order to ensure that the best possible information is collected for assessment purposes. The primary concern for scientists was the distribution of the index fishery harvest over space and time. This distribution is required to enable reliable estimation of exploitation rates (and thus stock size) through analysis of tagging data. This was also considered to ensure that there would not be overexploitation of any one stock component.

Resultant management measures included:

- Two separate fishing seasons – one in July and one in early autumn – to spread fishing effort over time.
- Restrictions on areas fished to spread fishing effort over space. Fishers were restricted to their NAFO Division of residence. Division 3L was further subdivided into fishing areas.

- Implementation of individual index quotas for each fisher to further ensure distribution of catch throughout the area.
- Closure of areas of high density of potentially spawning cod (Smith Sound).

All of these will act together to better preserve genetic biodiversity of the various stock components.

VI. DEVELOPMENT OF PRECAUTIONARY APPROACH

1. **Review of Papers Related to Precautionary Approach**

The Council did not consider any papers related to Precautionary Approach.

2. **Future Development**

There were no further developments on the Precautionary Approach during this meeting.

VII. REVIEW OF FUTURE MEETING ARRANGEMENTS

1. **Scientific Council Meeting, June 2001**

The Council reconfirmed the Scientific Council Meeting will be held from 31 May to 14 June 2001 at Alderney Landing, Dartmouth, Nova Scotia. The Council noted the considerations mentioned in its June 2000 Meeting Report regarding the facilities at Alderney Landing.

2. **Special Session and Annual Meeting, September 2001**

The Council reconfirmed the Scientific Council Meeting will be held 17-21 September 2001 in Havana, Cuba. The Scientific Council Special Session, the Symposium on "Deep-sea Fisheries" will be held during 12-14 September 2001 at the same venue.

3. **Other Meetings in 2001 and 2002**

The Council noted the dates and venue for its northern shrimp meeting of November 2001 will be finalized during the Scientific Council Meeting of 8-15 November 2000 in Copenhagen, Denmark.

The Council agreed to tentative dates of 06 June to 20 June for its 2002 Scientific Council Meeting, to be held at Alderney Landing, Dartmouth, Nova Scotia.

The Council noted the Annual Meeting of the Scientific Council will be held 11-20 September 2002 in Spain. The Scientific Council Special Session, the Symposium on "Elasmobranch Fisheries", will be held during 11-13 September 2002 at the same venue.

VIII. FUTURE SPECIAL SESSIONS

1. **Progress Report on Symposium in 2001**

a) The Council noted that the Hydrobiological Variability Symposium as described in the STACFEN Report of June 2000, has been widely announced by ICES. A flyer was presented to the Council at this meeting. The Symposium titled "Hydrobiological Variability in the ICES Area, 1990-1999" will be held during 6-10 August 2001 in Edinburgh, Scotland. It was noted that the Steering Committee included M. Stein (STACFEN Chairman), who will lead the subject-area "Physical Oceanography and Fisheries of West Greenland and NW Atlantic, and Interface with NAFO", and K. Drinkwater (Canada) was on the editorial board for the publication of the Symposium proceedings.

The Council noted that, during this present meeting, NAFO agreed to contribute CDN $8 000 to cover partial costs of conducting this ICES Symposium.

b) The Council was informed that the preparation for the Symposium on "Deep-sea Fisheries" to be held during 12-14 September 2001 in conjunction with the 23rd Annual Meeting of NAFO in Cuba, showed little progress. The Council Chairman had intersessionally initiated contact with the nominated co-sponsors ICES and CSIRO, and was awaiting further information. The Chairman agreed to continue his communications and with the hope of finalizing arrangements shortly.

It was recognized that the co-conveners J. Moore (NAFO/USA), J. Gordon (ICES/EU-United Kingdom) and T. Koslow (CSIRO/Australia) should announce plans and details on the subject matter of this Symposium shortly, to provide potential participants adequate lead time.

The Council noted that, during this present meeting, NAFO agreed to contribute CDN $8 000 to cover partial costs of conducting this Symposium.

2. **Progress Report on Special Session 2002**

The Council welcomed the up-date presented by F. Serchuk (USA) on the preparation for the Scientific Council Special Session, the Symposium on "Elasmobranch Fisheries", in September 2002 to be held in conjunction with the 24th Annual Meeting of NAFO. The Council noted the venue announced by the General Council at this meeting was Spain.

The Council was informed that three potential co-conveners, P. Walker (International Council for the Exploration of the Sea – ICES), J. Musick (Virginia Institute of Marine Science, USA), and T. Walker (Marine Fisheries Research Institute, Australia) were contacted in July 2000 conveying the interests of the Scientific Council to host the Symposium and its intention of publishing the proceedings in the NAFO Journal.

These experts (and others in the field) had confirmed the timeliness and the global scientific interest of such a Symposium.

The Council invited the Scientific Council Designated Expert on Elasmobranchs, D. Kulka (Canada), to coordinate further discussions with the 3 experts, and development of plans for the Symposium for review at the June 2001 Meeting. It was noted that co-sponsorship and funding from these experts' organizations should be sought to make this a successful Symposium.

IX. SCIENTIFIC COUNCIL WORKING PROCEDURES AND PROTOCOLS

1. **Review of Rules of Procedure**

a) **Observers at Scientific Council Meetings**

The Council noted that the General Council and the Fisheries Commission during the September 1999 Meeting had modified the Rules of Procedures regarding Observers to those Constituent Bodies, and the Scientific Council had deferred its review of Rule 1.3 to this meeting.

The Council agreed that there was no change required to its Rule 1.3 of the Rules of Procedure.

2. **Standardizing Assessment Reporting and Documentation**

Presentation of stock assessment documentation at three levels in the assessment system: SCR documents, STACFIS reports, and in Scientific Council was reviewed (Table 1). This highlighted that in several cases it was not clear why Scientific Council had chosen to present some information, yet other data had been omitted from presentations. After discussion, it was agreed that it would be helpful for Scientific Council to adopt a more consistent approach to presenting information in support of advice.

A protocol to help guide the presentation of such information was proposed for further consideration and is outlined below:

a) The preferred tool for the presentation of a synthetic view of the past dynamics of an exploited stock and its future development is a stock assessment model, whether age-based or age-aggregated. When such models are used at any stage in the provision of advice, the following graphs should be presented in the Scientific Council report:

Time trends of :

(for age-structured assessments)
- Biomass (Spawning Biomass and Total Biomass)
- Fishing Mortality
- Recruitment

(for age-aggregated assessments)
- Exploitable Biomass (both absolute and relative to B_{msy})
- Yield/Biomass ratio as proxy for fishing mortality (both absolute and relative to F_{msy})
- Accessory estimates of recruitment form surveys, if available

Short- and Medium-Term Forecasts of :
- Yield at recent fishing mortalities
- Yield corresponding to any proposed reference points

For age-structured assessments :
- Yield-per-recruit graphs and associated estimates of yield-per-recruit based reference points.

b) Use of such analytic methods should not however preclude the presentation of information about the reliability of assessments. To this end, the follwing information could be included in synoptic form:

- Robustness of assessments to alternative assumptions or data series
- Parametric uncertainty in assessments, possibly as confidence intervals
- Illustration of conflicts in data series

c) Where analytic assessments are not attempted, the following should normally be presented, for one or several surveys:

Time trends of survey abundance estimates, over :
(1) An age- or size-range chosen to represent the spawning population
(2) An age- or size-range chosen to represent the exploited population

A recruitment proxy :
(3) An age- or size-range chosen to represent the recruiting population

A fishing mortality proxy :
(4) The ratio of reported commercial catches to quantities in (2) above.

d) The above presentation may be accompanied by quality statements giving Scientific Council's opinion about the reliability of the various data series for particular purposes.

Table 1. Summary of information available in SCR Documents, and reported in Scientific Council and STACFIS Reports of the June 2000 Meeting of the Scientific Council.

Stock	Source	Model-based assessment available	Recruit-ment	Fishing mortality, or proxy	Modelled spawning biomass	Modelled total or exploitable biomass	Survey abundance estimates	Short-term catch forecast	Medium-term forecast	Yield-per-recruit data	Reference points
Redfish in Div. 3M	Sci. Council STACFIS SCR Docs.	Yes Yes Yes	**No** **No** Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	**No** **No** Yes	**No** **No** Yes	**No** **No** Yes	**No** **No** Yes
Yellowtail flounder In Div. 3LNO	Sci. Council STACFIS SCR Docs.	Yes Yes Yes	**No** Yes Yes	Yes Yes Yes	**No** Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	**Part** Yes Yes	Yes Yes Yes	Yes Yes Yes
Shortfin squid In Subareas 3+4	Sci. Council STACFIS SCR Docs.						Yes Yes Yes				
Capelin in Div. 3NO	Sci. Council STACFIS SCR Docs.										Yes
Greenland halibut In Subarea 2 + Div. 3KLMNO	Sci. Council STACFIS SCR Docs.	Yes Yes Yes	**No** **No** Yes	Yes Yes Yes	**No** **No** Yes	**No** Yes Yes	Yes Yes Yes	Yes Inputs only Yes	Yes Yes Yes		Yes
Cod in Div. 3M	Sci. Council STACFIS SCR Docs.	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes				Yes Yes Yes
American plaice In Div. 3M	Sci. Council STACFIS SCR Docs.			Yes Yes Yes			Yes Yes Yes				
Cod in Div. 2J+3KL	Sci. Council STACFIS SCR Docs.	Partial Partial Exit elsewhere	**No** Yes Yes	**No** Yes Yes			Yes Yes Yes				
Greenland halibut In Div. 1A inshore	Sci. Council STACFIS SCR Docs.	No Yes (part area) Yes (part area)	Yes Yes Yes	No No Yes	No No Yes	No No Yes	**No** Yes Yes			No No Yes	
Greenland halibut In Subareas 0 + Div. 1A, offshore	Sci. Council STACFIS SCR Docs.	No No Yes	Yes Yes Yes	No No Yes	No No Yes	No No Yes	Yes Yes Yes				
Roughhead grenadier in Subareas 2+3	Sci. Council STACFIS SCR Docs.	No No Yes	No No No	No No Yes	No No Yes	No No Yes	No Yes Yes			No No Yes	

3. **Matters Related to NAFO Website**

The Council noted previous discussion on the matter of including brief summaries of Standing Committee Reports on the home page of the Website. The Council agreed the summary prepared for STACFEN, as presented to the June 2000 Meeting, should be placed on the Website. It was recognized that inclusion of summaries of all Standing Committee Reports was desired, and that such summaries should be placed visibly on the Website for easy access. It was however noted such summaries require considerable work and technical considerations.

The Council accordingly agreed to strike a technical working group, with the STACPUB Chairman taking a lead role. The Council requested O. A. Jørgensen (STACPUB Chairman) to form a small technical working group, and intersessionally develop a template for consideration by the Council during its June 2001 Meeting.

4. **Possible Implementation of Symposium Fees**

The Council renewed its June 2000 discussion on the suitability of imposing fees for Scientific Council Symposia.

The Council was informed that certain Contracting Party representatives have directives that restrict attendance when fees are charged. However, it was also noted that funds are particularly important to make Symposia attractive to participants and to invite eminent scientists. The Council observed that historically the NAFO budget accommodated costs of running symposia and publishing the proceedings.

It was agreed that budget requirements to conduct Scientific Council symposia in the future should be reviewed by the Council on a case by case basis.

5. **Other Procedures or Protocols**

Facilitating Workload of Scientific Council during the NAFO Annual Meeting

During the course of the current meeting, concern was expressed by members of the Scientific Council regarding performing "on the spot" technical analyses in response to *ad hoc* requests from the Fisheries Commission. During the Annual Meetings a smaller complement of scientific expertise within the Scientific Council is in attendance, and this quite often presents considerable difficulty in the Council's ability to provide the best possible advice on many technical requests when the required experts are unavailable.

The Council Chairman was asked to continue discussions with the Fisheries Commission Chairman on this matter. The Council agreed to further discuss this matter at its June 2001 Meeting.

X. OTHER MATTERS

1. **Report of STACTIC Intersessional Meeting, June 2000**

The Council noted STACTIC (Standing Committee on International Control) had its intersessional meeting during 27-29 June 2000. The Council was represented by D. Kulka (Canada), who was nominated by the Council to present its report on Observer Protocol for data collection (see STACREC Report at Appendix II).

Greenland Halibut Depth Distribution and Protection of Juveniles. The Council noted STACTIC had discussed the issue of depth distribution of Greenland halibut and the protection of juveniles. The Council reviewed that data available at this meeting in relation to this subject, and noted that two sources of data could provide some information.

a) Catch data from Canadian annual autumn stratified random trawl surveys from 1995 to 1999 covering the offshore areas of Div. 2G, 2H, 2J, 3K, 3L, 3N and 3O pooled into depth intervals were used to examine distribution of Greenland halibut as well as a number of other commercial species that may be taken as by-catch

with Greenland halibut. No attempt was made in this preliminary analysis to break down the biomass into size or maturity components. For Greenland halibut, both the distribution at depth and spatial distribution showed a high degree of consistency for the years examined, 1995-99. Survey catch rates (kg per tow) were observed to peak at 350-500 m and at 700-900 m. The 350-500 m peak was believed to comprise a high proportion of juveniles. In terms of biomass, nearly 90% occurred at depths greater than 250 m, 69% below 400 m and 27% in greater than 1 000 m.

The species that overlap with Greenland halibut with respect to depth in the shallower part of their range (350-500 m) were redfish, white hake, spotted wolfish, witch and monkfish. Overlap in the deepest (700-900 m) part of the range occurred with roundnose and roughhead grenadier.

The following table summarizes total biomass and percent biomass at depth for Div. 2G, 2H, 2J, 3K, 3L, 3N, and 3O for all sizes taken in the autumn 1995-99 surveys.

Biomass	Depth Range															
Species	0-50	51-100	101-150	151-200	201-250	251-300	301-350	351-400	401-450	451-500	501-600	601-700	701-800	801-900	901-1000	1001-2000
Greenland halibut	**0**	**3 820**	**2 416**	**6 100**	**20 994**	**41 181**	**55 237**	**72 565**	**133 708**	**41 731**	**29 892**	**15 068**	**17 508**	**19 247**	**15 269**	**173 257**
Yellowtail flounder	343 547	365 556	589	0	0	0	0	0	0	0	0	0	0	0	0	0
Thorny skate	120 573	151 987	16 498	4 793	5 665	6 819	8 290	5 955	7 710	4 299	1 760	1 783	632	399	293	822
American plaice	41 427	217 389	86 083	23 716	22 743	9 790	16 016	6 641	13 856	4 856	3 967	3 382	3 778	7 135	1 012	759
Cod	35 134	71 074	9 192	6 100	6 956	6 286	10 094	3 555	2 866	1 388	758	357	104	0	0	0
Haddock	83	2 662	2 887	373	1 999	190	226	0	0	0	0	0	0	0	0	0
White hake	333	2 547	3 182	1 183	1 375	1 295	5 188	523	141	778	136	83	0	0	0	63
Spotted Wolffish	0	116	412	1 494	2 583	2 857	1 720	2 563	1 049	452	117	369	94	34	61	83
Striped Wolfish	83	3 473	943	1 432	3 416	6 248	3 299	740	323	179	19	45	0	0	0	0
Witch flounder	208	12 154	7 365	622	1 083	457	338	307	807	1 041	1 371	1 580	1 207	1 310	741	569
Monkfish	0	0	412	311	125	114	226	307	0	168	58	25	0	0	0	0
Redfish	0	232	63 516	24 837	36 156	146 589	95 671	108 964	102 083	112 830	55 942	85 672	6 915	758	5 411	1 834
Roughhead grenadier	0	0	0	62	167	990	1 748	1 011	2 382	2817	3 860	4 318	3 075	6 554	7 712	80 305
Roundnose grenadier	0	0	0	0	0	0	0	217	121	126	360	1 280	2566	2 925	3 447	998 959

% of biomass	Depth Range															
Species	0-50	51-100	101-150	151-200	201-250	251-300	301-350	351-400	401-450	451-500	501-600	601-700	701-800	801-900	901-1000	1001-2000
Greenland halibut	**0.00**	**0.59**	**0.37**	**0.94**	**3.24**	**6.36**	**8.52**	**11.2**	**20.63**	**6.44**	**4.61**	**2.33**	**2.70**	**2.97**	**2.36**	**26.74**
Yellowtail flounder	48.41	51.51	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thorny skate	35.64	44.93	4.88	1.42	1.67	2.02	2.45	1.76	2.28	1.27	0.52	0.53	0.19	0.12	0.09	0.24
American plaice	8.96	47.00	18.61	5.13	4.92	2.12	3.46	1.44	3.00	1.05	0.86	0.73	0.82	1.54	0.22	0.16
Cod	22.83	46.19	5.97	3.96	4.52	4.09	6.56	2.31	1.86	0.9	0.49	0.23	0.07	0.00	0.00	0.00
Haddock	0.99	31.61	34.28	4.43	23.74	2.26	2.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White hake	1.98	15.13	18.91	7.03	8.17	7.70	30.83	3.11	0.84	4.62	0.81	0.49	0.00	0.00	0.00	0.38
Spotted Wolffish	0.00	0.83	2.895	10.68	18.47	20.43	12.30	18.32	7.50	3.23	0.83	2.64	0.67	0.25	0.44	0.45
Striped Wolfish	0.41	17.19	4.67	7.99	16.91	30.93	16.33	3.66	1.60	0.88	0.10	0.22	0.00	0.00	0.00	0.00
Witch flounder	0.67	39.03	23.65	2.00	3.48	1.47	1.090	0.99	2.59	3.34	4.40	5.01	3.88	4.21	2.38	1.83
Monkfish	0.00	0.00	23.6	17.81	7.15	6.54	12.91	17.56	0.00	9.63	3.34	1.46	0.00	0.00	0.00	0.00
Redfish	0.00	0.03	7.50	2.93	4.27	17.3	11.29	12.86	12.05	13.31	6.60	10.11	0.82	0.09	0.64	0.22
Roughhead grenadier	0.00	0.00	0.00	0.05	0.14	0.86	1.52	0.88	2.07	2.45	3.36	3.75	2.67	5.70	6.71	69.83
Roundnose grenadier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.11	0.11	0.33	1.16	2.33	2.66	3.13	89.96

b) Data from the Spanish scientific observers in Div. 3LMNO (taking this information as an indicator of the depth distribution pattern of the species fishable biomass, with no attempt to quantify fishable biomass) indicate the following:

- In Div. 3L no Greenland halibut were registered at depths less than 700 m. The magnitude of these catches increased sharply from 1 000 to 1 400 m and disappeared beyond 1 500 m. In this same range, 7% (in weight relative to the total catch) of redfish were caught. Less than 1% of American plaice and witch flounder appeared at depths between 900-1 000 m depth. No cod catches were registered.

- In Div. 3M Greenland halibut were caught at depths between 600 and 1 600 m, with a peak in the 1 200-1 300 m depth interval. No catches of this species were registered at depths less than 600 m. In this same depth range 13% of redfish (in weight) and 4% of skate were caught. Occasional presence of witch flounder (0.07%), and American plaice (0.04%) were recorded only in the 900-1 000 m interval, without presence of cod catches.

- In Div. 3N the catch composition in terms of weight was as follows: 9% of Greenland halibut, 4% of redfish, 28% of skate, 34% of American plaice, 14% of yellowtail flounder, 4% of cod and less than1% of witch flounder. Greenland halibut catches were taken at depths between 700-1 400 m, and only 1% of them occurred at shallower depths. Skate were caught exclusively at depths less than 200 m and American plaice, yellowtail flounder and cod only above 400 m depths.

- In Div. 3O, 70% of the catch in weight was redfish, 13% Greenland halibut and 11% American plaice. No presence of cod, witch or yellowtail flounders were recorded. Greenland halibut catches occurred at depths between 700-1 000 m, redfish up to 800 m and American plaice up to 500 m.

According to this pattern of depth distribution of catches of the Spanish fleet it appeared that, the Greenland halibut fishery did not overlap significantly with either American plaice, yellowtail flounder, skate or cod.

The analysis of standardized catch-per-unit-effort of this fleet using a multiplicative model in the period (1990-99) indicated that the depth factor has a significant effect on the CPUEs. The values of this factor at depths less than 600 m were small, increased sharply in the 600-700 m interval, remained stable to depths of about 1 100 m and started to decrease thereafter. This result supported the well-known fact that Greenland halibut fishery performs better in the deepest strata. Besides, the results showed a sharp change in catchability occurring between the 500 and 600 m depth strata. This pattern was consistent in all the area of the Spanish fleet activity, that is Div. 3LMNO.

Regarding fish above and below the length of 50% maturity, only data regarding Greenland halibut in Div. 3LMNO from the scientific observers on board the Spanish fleet and from the Spanish bottom trawl survey in Div. 3N were available. According to those data, the proportion of mature fish (and corresponding total numbers of mature fish sampled in brackets) obtained from the catch length distributions at depth, using a maturity ogive that considers a female length at 50% maturity between 65-70 cm are presented in the following table:

Depth (m)	1991	1997	1998	1999
		Div. 3L		
600-799	14 (19 038)	8 (15 840)	10 (11 114)	23 (1 711)
800-999	28 (195 368)	14 (54 419)	10 (32 694)	19 (9 769)
1 000-1 199	37 (419 875)	15 (70 637)	10 (11 119)	19 (65 674)
1 200-1 600+	50 (58 894)	-	40 (1 616)	21 (36 779)
Total for the year	33 (693 175)	13 (140 896)	12 (56 538)	20 (113 933)
		Div. 3M		
600-799	-	-	17 (3 732)	17 (9 056)
800-999	-	21 (11 436)	31 (7 579)	29 (11 204)
1 000-1 199	46 (524 050)	19 (34 090)	17 (3 733)	26 (39 000)
1 200-1 600+	56 (266 474)	19 (34 090)	34 (2 013)	33 (87 729)
Total for the year	49 (790 524)	20 (79 616)	17 (17055)	29 (146 989)
		Div. 3N		
400-599	-	-	0 (0)	-
600-799	-	5 (445)	8 (2 649)	5 (627)
800-999	-	14 (54 394)	8 (11 046)	25 (6 482)
1 000-1 199	-	12 (7 164)	9 (2 517)	24 (4 336)
1 200-1 600+	-	13 (8 167)	12 (771)	5 (670)
Total for the year	-	14 (70 169)	9 (16 982)	21 (12 115)

The proportion of mature fish increases with depth, generally attaining a maximum at the 1 200-1 6000 m interval in all Divisions. The proportion of adult fish in the catches was higher in the first year of activity of this fleet (1991) than it is at present, and also this proportion was always smaller in Div. 3N than in Div. 3M and 3L.

The distribution pattern by depth of the SSB obtained form the Spanish bottom trawl survey in Div. 3N is as follows:

				Percentages of SSB by depth strata (m)								
Year	Biomass	SSB	%	0-99	100-199	200-299	300-399	400-599	600-799	800-999	1000-1199	1200-1600
1996	34 246	8 124	24	0	0	0	0	0	4	74	22	ns
1997	71 000	21 731	31	0	0	0	0	0	0	9	90	ns
1998	147 864	33 657	23	2	2	0	0	0	3	35	28	29
1999	121 043	31 664	26	0	0	0	0	0	5	16	42	36

ns – not surveyed

These data indicate that most of the SSB in Div. 3N occurred beyond 800 m.

2. **Report on STACFAD Progress on Scientific Council Requests**

M. Stein, Scientific Council representative to the Standing Committee on Finance and Administration (STACFAD), reported to the Council on the progress made by STACFAD during its concurrent sessions at this meeting regarding financial requirements for Scientific Council work. Noting that the STACFAD Report will be submitted to General Council for adoption, the Council was informed of the relevant funding approved by STACFAD.

The Council extended its appreciation to M. Stein for presenting the Scientific Council needs to STACFAD and for his comprehensive report to the Council.

XI. ADOPTION OF REPORTS

1. **Consideration of Report from the Workshop of 13-15 September 2000**

The Council reviewed and **adopted** the Report of the "Workshop on Assessment Methods" as presented by the co-conveners (Annex 1).

The Council was pleased with the success of the Workshop. The Council extended special thanks to the co-conveners D. Rivard (Canada) and C. Darby (EU-United Kingdom), and R. K. Mayo (USA) for his presentations and support. The Council recognized this Workshop was very informative and a valuable contribution to the scientific work of the Scientific Council. While adopting the STACPUB **recommendation** that a workbook should be published in the Scientific Council Studies series, the Council noted the publication could constitute previously published information as well as public domain material.

2. **Committee Reports of Present Meeting** (STACFIS, STACREC, STACPUB)

The Council at its session on 22 September 2000 considered and **adopted** the reports of its Standings Committees, STACFIS, STACREC and STACPUB. These reports are given in Appendix I, II and III, respectively. The recommendations by the Standing Committees as endorsed by the Council are given in Sections II and IV above.

3. **Report of Scientific Council Present Meeting 13-22 September 2000**

The Council at its concluding session on 22 September 2000 considered and **adopted** its own Report of this 13-22 September 2000 Meeting.

XII. ADJOURNMENT

The Chairman expressed his gratitude to the members of Scientific Council for their excellent work and coperation during the meeting. He extended his special thanks to the Chairmen of the Standing Committees for their exellent work and support.

In addition the NAFO Secretariat was thanked for its extraordinary support during the meetings of the Scientific Council. The Chairman also expressed thanks to the USA hosts of the meetings.

There being no further business, the Chairman wished all participants a safe trip home, and adjourned the meeting.

Scientific Council Workshop on Assessments Methods, 13-15 September 2000, Boston, Masschussetts, USA
(Left to Right)

Back Row: R. Aploim, D. Maddock Parsons, E. F. Murphy, D. E. Stansbury, O. A. Jørgensen, L. Motos, D. Power, H. Murua, A. Avila de Melo, M. J. Morgan, M. A. Showell, V. K. Babayan, V. N. Shibanov, H. Okamura, T. Amaratunga

Middle Row: B. Healy, L. C. Hendrickson, W. R. Bowering, Å. Nicolajsen, M. A. Treble, E. de Cárdenas, P. A. Shelton, D. B. Atkinson, D. C. A. Auby

Front Row: S. J. Walsh, S. Cerviño, R. K. Mayo, C. Darby, D. Rivard, W. B. Brodie, A. Vazquez, S. Junquera

Co-conveners of Workshop: D. Rivard (Canada), C. Darby (EU-United Kingdom), R. K. Mayo (USA)

ANNEX 1. SCIENTIFIC COUNCIL SPECIAL SESSION

WORKSHOP ON ASSESSMENT METHODS

Hosted by the Scientific Council of the Northwest Atlantic Fisheries Organization (NAFO)
13-15 September 2000

THE WORKSHOP

The Scientific Council Special Session, "*Workshop on Assessment Methods*", was held at the Boston Back Bay Hilton, Boston, Massachusetts, United States of America, with co-conveners D. Rivard (Canada) and C. Darby (EU-United Kingdom) during 13-15 September 2000. R. K. Mayo (USA) also played a key role in the preparation of this Workshop and the presentation of tutorials. There were 31 participants from Canada, Denmark (in respect for Greenland and Faroe Islands), European Union (Portugal, Spain and United Kingdom), Japan, Russia Federation and the United States of America.

The Workshop was opened by W. B. Brodie (Canada), Chairman of Scientific Council, who on behalf of the Scientific Council welcomed participants to Boston and to the Workshop.

Co-convener D. Rivard (Canada), welcomed the participants, and gave a general outline of the objectives of the Workshop.

This Workshop was designed to provide an opportunity for the members of Scientific Council to explore assessment techniques and the various tools available for their application. In particular, he noted the Workshop would focus on tools to perform age-structured analyses and stock abundance estimations, calculate reference points in the context of the Precautionary Approach and carry out risk analyses.

Each session was designed to begin with a brief comment on the theory and common practices, followed by demonstrations or tutorials making use of a common data set, and working sessions inviting participants to apply these tools to specific data sets.

To facilitate the planning of this Workshop, the Council agreed (in June 2000) the list of participants be limited to about 35 participants.

1. Age-structured Analyses and Stock Abundance Estimation

1.1 Lowestoft Tuning Suite

1.1.1 **Introduction: principles of VPA tuning** (SCR Doc. 00/61)

The evolution of VPA tuning from *ad hoc* age-aggregated methods to age-disaggregated methods employing a specific objective function with least squares minimization was presented. VPA tuning methods have evolved considerably over the past 2-3 decades, but current state-of-the-art techniques still do not account for all of the uncertainty in data (e.g. sampling uncertainty for which measurements exist, and variability of survey indices).

In this tutorial, the Lowestoft VPA suite of assessment programs was introduced. These include Separable VPA, *Ad-hoc* tuning and Extended Survivors Analysis methods. The structure of the data files required for performing an assessment was examined and a basic example, the running of a VPA with user defined starting values, was used to illustrate the reading of input data files, specification of key fishery summary statistics and the output of results.

1.1.2. **Separable VPA** (SCR Doc. 00/62)

The development of the Separable VPA has been described by Pope (1977, 1979), and Pope and Shepherd (1982). Separable VPA determines values of fishing mortality from a matrix of catch-

at-age data, on the assumption that the exploitation pattern is constant over time. The method provides a useful filter for examining catch at age before tuning; high individual residuals may indicate data anomalies. By partitioning the data (e.g. fitting the model for a specific period, the method can be used to investigate changes in the exploitation pattern over time). However, the information contained within the data matrix is insufficient for the determination of a unique solution. In addition to natural mortality, the user must specify a 'reference age for unit selection', against which the selection values for other ages will be scaled; and values for:

a) the fishing mortality on a reference age in the last year , and
b) the terminal selection value, i.e. that for the oldest independent age in the data range (used for all years). Selection-at-age is the fishing mortality at age relative to that on the reference age.

1.1.3. **Laurec-Shepherd tuning method** (SCR Doc. 00/63)

The Laurec-Shepherd VPA tuning method is one of many *ad hoc* tuning algorithms which derive estimates of fishing mortality at age in the final year from an analysis of the logarithms of fleet catchabilities. They are based on the assumption that catchability is separable by fleet and by age within a fleet. The *ad hoc* methods have been reviewed and tested by Pope and Shepherd (1985). The algorithms have no formal statistical basis and are based on an iterative process, which relies solely on the convergence properties of Virtual Population Analysis.

An iterative algorithm is used to derive estimates of fleet catchability-at-age in the final year. Fleet catchabilities and effort in the final year are used to calculate partial F-at-age: the fraction of overall F-at-age contributed by each fleet. Fleet partial Fs are then 'raised' by the ratio of the total catch-at-age and the fleet catch-at-age to give fleet based estimates of total F-at-age. Final year Fs for each new VPA iteration are derived from a weighted average of the fleet-based estimates. The Laurec-Shepherd method assumes constant catchability with respect to time for each fleet.

1.1.4. **Extended survivor analysis** (SCR Doc. 00/64)

Extended Survivor Analysis (XSA) (Shepherd 1999), an extension of Survivors Analysis (Doubleday 1981), focuses on the relationship between catch per unit effort and population abundance, allowing the use of a more complicated model for the relationship between CPUE and year class strength at the youngest ages. The XSA algorithm performs:

a) a cohort analysis of the total catch-at-age data to produce estimates of population abundance-at-age, and fishing mortalities,
b) adjustment of the CPUE values for the period of fishing into CPUE values corresponding to the beginning of the year,
c) calculation of fleet-based population abundance-at-age from the adjusted CPUE values and fleet catchabilities, which are assumed to be constant with respect to time , or dependent on year class abundance and
d) calculation of a least squares estimate (weighted mean) of the terminal population (survivors at the end of the final assessment year) for each cohort in the tuning range using the fleet-derived estimates of population abundance-at-age.

The technique allows for weighting the survivors estimates using various methods. It also allows for shrinkage towards the mean. The detailed algorithm is presented in Darby and Flatman (1994).

1.2 **Integrated Catch Analysis (ICA)**

In the ICA model, the last years of the available catch-at-age matrix are fitted by a separable model. The earlier years in the data set are modeled by a conventional VPA, estimated backwards using the first year of the separable model as the starting point. In the separable model, the fishing mortality at each age in

each year is partitioned into a year effect, which may change with changing effort, and an age effect, which represents the susceptibility to fishing. Parameters for the separable model are estimated by minimizing the squared differences between observed and predicted catch at age. In the VPA model, F on the last age that is required to drive the VPA is derived from the Fs at earlier ages and the (assumed constant) selection-at-age vector.

Tuning indices may be age-structured or based on age-aggregated measures of spawning stock biomass. The assumed relationship between a given index and the corresponding separable or conventional VPA estimate of expected stock size can be selected to be absolute, linear, or non-linear. Weighting of indices in the separable model may be manual, based on prior information, or by inverse-variance re-weighting. A Beverton-Holt stock-recruitment relationship may be imposed on the model fit, with appropriate weighting, and a VPA may be 'shrunk' to a mean.

Two methods of estimating uncertainty in parameter estimates are available: traditional statistical methods using the variance-covariance matrix of the estimated parameters, and a Bayesian method using analyses of the parameter posterior distributions.

1.3. **Adaptive Framework (ADAPT)**

1.3.1. **Introduction to ADAPT VPA tuning**

ADAPT is an age-structured, adaptable framework for estimating historical stock sizes of an exploited population. It is not a rigidly defined model in the mathematical sense, but rather a flexible set of modular tools designed to integrate all available data that may contain useful information on population size.

The statistical basis of the ADAPTive approach is to minimize the discrepancy between observation of state variables and their predicted values. The observed state variables are usually (but are not limited to) age-specific indices of population size, e.g. from commercial catch-effort data, research surveys, mark-recapture experiments, etc. The predicted values are a function of a vector of estimated population size (age-specific) and catchability parameters; and standard population dynamics equations (usually Gulland's (MS 1965) VPA). Nonlinear least squares objective functions are employed to minimize the discrepancies.

The ADAPT VPA model uses the application of a statistical technique, non-linear least squares, to determine the most appropriate estimate of the population matrix. Gavaris (1988) initially describes the ADAPT objective function in general terms, as a minimization of the difference between observation of variables and the values of those variables predicted as functions of the population matrix (i.e. as function of the catch-at-age).

1.3.2. **Woods Hole Fishery Assessment Compilation Toolbox (FACT) version** (SCR Doc. 00/69)

FACT is the Fishery Assessment Compilation Toolbox and the Woods Hole Assessment Toolbox's successor. Several existing fishery software programs have been added to FACT making it a powerful and user-friendly tool. The assessment programs had previously existed in a DOS or UNIX version. These programs now have a user-friendly interface that makes editing of inputs and completion of assessment more intuitive.

This is the VPA implementation using the ADAPT approach towards minimizing sums of squares in a specified objective function. In ADAPT, there is a calibration block and an estimation block. The calibration block is the set of indices, which are used to 'calibrate' the VPA terminal populations. A value of q is estimated for each index in the calibration block.

The estimation block is the set of ages for which you are estimating a terminal population stock size. In ADAPT, these are considered as survivors at the end (December 31) of the terminal year of the catch-at-age matrix, or at the beginning (January 1) of the year following the terminal year.

Input

The ADAPT module requires the following input: catch at age, mean catch weights-at-age, mean stock weights-at-age, tuning indices, natural mortality, and maturity schedules. There are also several initialization specifications to be set before the VPA can run.

Diagnostics

- In addition to the residuals, one can look for a retrospective pattern in the estimates of F, stock size-at-age, and SSB. The retrospective may be selected from the Diagnostics dialog box.

- The final formulation of the VPA may be run through a bootstrap procedure in which a normalized residual is drawn at random from the pool, and subtracted from an observed normalized survey index. This is done for each index in the calibration block. Generally, between 500 and 1 000 bootstrap runs are performed. This may take time, so 100 is recommended for the Workshop.

Output

After the VPA has run successfully, formatted output will be written by default to a file based on the name of the input file**.** This file should be brought into a word processor for viewing and printing. If a Retrospective Analysis has been selected, the results will be appended to the end of this file.

An ASCII 'Flat File' may also be output as an option. This file contains VPA results and residuals selected by the user. This file should be brought into a spreadsheet for further analysis, tabulation, and plotting. After the Bootstrap procedure has run successfully, formatted output containing a summary of all bootstrapped variables will be written to a file which should also be brought into a word processor for viewing and printing.

The Bootstrap procedure allows the user to keep track of key biological measures including:

1. Fully recruited F in terminal year of the VPA
2. Estimated stock sizes at age at the end of the terminal year
3. Spawning Stock Biomass in all years of the VPA
4. Mean Stock Biomass in the terminal year of the VPA
5. Beginning-year Biomass in the terminal year of the VPA
6. Biomass-weighted F in the terminal year of the VPA

This information may be brought into a spreadsheet for further analysis, tabulation, and plotting.

1.3.3. **St. Andrews (S. Gavaris) version** (SCR Doc. 00/56)

This tutorial aimed at introducing the use of version 2.1 of the software developed by S. Gavaris, St. Andrews Biological Station (New Brunswick, Canada), who introduced the concept of the ADAPTive framework in the late-1980s. The framework was introduced to allow flexibility in the exploration of various formulations for the estimation of stock abundance from fisheries and survey data. The ADAPTive framework uses a non-linear least-squares fit to calibrate a virtual population analysis against independent indices of abundance. This software has served both as a research tool for exploring various aspects of parameter estimation and as a production tool for stock assessment.

The tutorial used a data set mimicking a gadoid stock having four indices of abundance exhibiting various anomalies (trends in catchability, year effects, and conflicting trends in indices). The tutorial outlined working procedures that would permit a user to analyze the results using the various diagnostics available and to explore the impact of various formulations of the estimation problem.

To assist in the preparation of data for using ADAPT, a template was provided in the form of a computer spreadsheet, which includes data validation and pre-formatting. Essentially, the spreadsheet operates as a front-end to the ADAPT program which implements the non-linear estimation procedure, procedure that has been so far easier to handle outside the spreadsheet environment because of its complexity. Essentially, the template provides placeholders for your input data and output data. It also provides a means to display data in a graphical form or to carry out additional analyses using the spreadsheet graphical and statistical functions.

The tutorial highlighted the importance of verifying the sensitivity of the results to initial assumptions regarding survey catchability and the constraints imposed to reduce the dimensionality of the estimation problem (e.g. by imposing a functional relationship for the calculation of the oldest age-group in each year). It also highlighted the need to inspect the result carefully using the diagnostic tools available: i.e. variance and correlation matrix of parameter estimates, distribution of residuals, retrospective analyses, etc.

2. PA Reference Points

In this session, the functionality of FISHLAB was explained through a demonstration. This was be followed by a demonstration, and a hands-on session, on the PA software.

2.1 **FISHLAB** (Demonstration): FISHLAB (MRAG. 1997) provides a series of functions for use in Excel for simulations and sketching assessment problems.

FISHLAB is a set of fisheries tools developed at the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) with partial funding from the European Union. The tools are in the form of Excel add-ins and functions as well as routines that can be called from Visual Basic. Standard assessment methods such as Separable VPA, ADAPT, XSA and the calculation of reference points are provided as well as routines to allow the evaluation of management under uncertainty.

This software package was developed to assist in the modeling of uncertainty in fish stock assessment and management. It is essentially a library of functions that can be called from Excel or Visual Basic, although interfaces to other packages have also been developed. The intention was to make existing commercial applications more suitable for fisheries modeling by adding specialist routines. It is assumed that the average user would be familiar with Excel particularly in the use of functions. Whilst the more advanced user would be familiar with Visual Basic. A comprehensive help system is provided which should be consulted for use and documentation of FISHLAB methods

2.2 **PA software** (Demonstration and hands-on)

A key concept in implementing a precautionary approach is defining limit and target reference points. Limit reference points set boundaries which are intended to constrain harvesting within safe biological limits, whilst Target reference points are intended to meet management objectives. The PA software was developed at CEFAS (Smith and Kell, 1998) to enable ICES working groups to estimate limit and precautionary reference points for fishing mortality and spawning. It is in the form of an Excel add-in and functions that can be used from Excel or Visual Basic.

3. Risk Analyses

These sessions explored newly developed tools for producing risk analysis and long-term simulations.

3.1. **Long-term Simulations Based on Excel Spreadsheets Using @Risk** (SCR Doc. 00/59)

This session was intended as a tutorial to explore risk analyses using spreadsheets. The tutorial used @Risk (Anon., 2000a), an Add-in to the Excel spreadsheet software (Anon., 2000b) to add risk analysis capabilities to models. The Add-in provides a framework to handle probability distributions for any variable or input parameter to a model. It also provides tools to analyze the distribution of the results, i.e. any calculated field (or cell) dependent upon your input.

The tutorial covered various aspects of the @Risk software, including how to use @Risk functions and menus for setting up simulations, how to develop models and run simulations, and how to explore simulation results using the @Risk interface.

These tools were applied to a fisheries model allowing long-term projections in the context of the Precautionary Approach. The use of @Risk, in combination with this model, allows someone to specify uncertainty in initial conditions of the state variables and in certain population dynamic parameters (we focussed on the definition of the stock-recruit relationship). Many authors have suggested various ways to capture both the dynamics and the uncertainties of the recruitment process by re-sampling the recruit-SSB scatter points. In this spreadsheet, one option available is to split the observed range of SSB into quartiles and to resample the observed recruitment within these quartiles. Since this approach is based on re-sampling observations, it does not require making assumptions about the recruitment probability density function (pdf). The resulting model provides a framework to calculate the probability of achieving limits or targets in the simulation years, to calculate the time it takes to reach these targets and to evaluate other elements of interest to managers (e.g. number of closures after re-opening, recovery time).

As the participants were lead through the tutorial, they were asked to discuss how such a model could be modified to account for uncertainty in other population dynamics parameters, or to account for regime shifts and uncertainties related to management implementation. The take-home message is that long-term projections make a number of assumptions on the "realization" of key population dynamics parameters in future years; while some of the variability is taken into account, projection models rarely capture all possible sources of uncertainty or the full dynamic range of the possible outcomes. Consequently, actual trajectories may deviate substantially from the model results, even when these are expressed in terms of probabilities. For this reason, when long-term projections are used to investigate the impact of various approaches, the results should be interpreted in relation to the results of other scenarios rather than in absolute terms.

3.2. **Woods Hole AgePro Stochastic Simulations (AGEPRO)** (SCR Doc. 00/70)

The AGEPRO program performs stochastic projections of the abundance of an exploited age-structured population over a time horizon of up to 25 years. The primary purpose of the AGEPRO model is to characterize the sampling distribution of key fishery system outputs such as landings, spawning stock biomass, and recruitment under uncertainty. The acronym "AGEPRO" indicates that the program performs age-structured projections in contrast to size- or biomass-based projection models. In this framework, the USER chooses the level of harvest that will be taken from the population by setting quotas or fishing mortality rates in each year of the time horizon.

There are three elements of uncertainty incorporated in the AGEPRO model: recruitment, initial population size, and natural mortality. Recruitment is the primary stochastic element in the population model in AGEPRO, where recruitment is either the number of age-1 or age-2 fish in the population at the beginning of each year in the time horizon. There are a total of nine stochastic recruitment submodels that can be used for population projection. It should be noted that it is possible to simulate the case of deterministic recruitment with AGEPRO through a suitable choice of recruitment submodel and input

data. Initial population size is a second potential source of uncertainty in AGEPRO that can be incorporated into population projection. To use this feature, the USER must have an initial distribution of population sizes that can be projected through the time horizon. Alternatively, the USER can choose to base the projections on a single estimate of initial population size. A third potential source of uncertainty in the AGEPRO model is natural mortality. In particular, the instantaneous natural mortality rate is assumed to be equal for all age classes in the population. The USER can choose to have a constant or a stochastic natural mortality rate. In the stochastic case, the natural mortality rates are taken to be realizations from a uniform distribution specified by the USER.

Stock sizes-at-age estimated at the end of the terminal year of the VPA are used as input for the forward projection. The stochastic aspect of the projection is based on 2 sets of input data:

1. The results of the Bootstrap procedure run in ADAPT.
2. The incoming recruitment estimated for each year in the projection time horizon.

AGEPRO is generally used to forecast catches several years ahead, based on an input set of annual fully recruited instantaneous fishing mortality rates. AGEPRO can also iteratively solve for F, given an input set of annual catches. It is also possible to specify a target SSB level, and AGEPRO will determine the probability of exceeding the target in each year of the projection time horizon.

Input

The age-based forward projection starts in the year immediately following the terminal year of the VPA. In addition to the initial stock sizes at age and incoming recruitment, many of the same input data used in the VPA are required in AGEPRO, including: mean catch weights-at-age, mean stock weights-at-age, natural mortality, maturation and partial recruitment-at-age.

In the case of AGEPRO, however, these data are input as smoothed multi-year averages, that are judged to be representative of the projection time horizon.

There are 9 recruitment models in AGEPRO, but only 4 are included in the workshop tutorial.

Output

After AGEPRO has run successfully, formatted output will be written to a file named during the run by the user. These files should be brought into a word processor for viewing and printing.

3.3. ADAPT-based Short-term Projections

This tutorial explored the functions available within the St. Andrews implementation of the ADAPTive framework to carry out stock forecasts and analyses of the risks associated with various scenarios. This implementation provides for two types of projections: deterministic and stochastic. Deterministic projections make forecasts of stock characteristics from the point estimates of stock abundance and from fishery scenarios that are specified by the user. Stochastic projections make forecasts using the point estimates as well as a measure of their precision. The measure of precision can either be obtained analytically, or through a bootstrap procedure.

The most common practice is to use the bootstrap procedure (as opposed to the analytical approach) for calculating risk curves from ADAPT results. While it takes longer to obtain results because of the re-sampling procedure, bootstrap is believed to give a better appreciation for the shape of the risk curve (assuming, of course, a sufficient number of replicates). In the current version of ADAPT, the bootstrap is performed by re-sampling all residuals assuming that they are independent and identically distributed (i.i.d.).

The discussion highlighted the point that, despite efforts to make the residuals i.i.d when calibrating VPAs, residuals often show significant departures from this assumption. It was noted that research is ongoing on possible refinements to bootstrap procedures for age-structured models so as to take such factors into account.

3.4 **Lowestoft Projection Software**

Projection software currently under development at Lowestoft was presented. This software integrates in a single environment the functionality of a number of programs used by ICES Working Groups to perform medium-term projections. The software was designed to be used in conjunction with the Lowestoft VPA tuning programs and offers features that are similar to the other projection programs explored during this Workshop.

4. **General Discussion**

The Workshop aimed not only at showing how the various software programs work but also at establishing good working practices to analyze the results. Discussion sessions were held throughout the Workshop. They served to clarify technical questions on the use of the software programs and to discuss common practices in stock assessment.

It was noted that the age-structured models explored during this workshop are based on the same population dynamics equations. However, the estimation problem (i.e. the problem of estimating population abundance in the most recent year) is defined differently in each of these models. The differences mainly lie in the assumptions (or constraints) that are imposed to reduce the number of parameters. When these methods are applied using (or forcing) similar assumptions, they essentially give similar results. The fact is that in their default mode, different methods make widely different assumptions to facilitate the estimation of stock abundance within their estimation framework. Some of the assumptions can free up parameters.

4.1. *Estimation - Strengths and Weaknesses of the various methods*

Extended Survivor Analysis (XSA):

This method estimates one survivor for each cohort represented in the indices of abundance without requiring constraints for the fishing mortality applied at the oldest age-group. Instead, the coefficients representing the catchability of the indices-at-age are assumed to be similar (i.e. reaching a plateau) for all fleets after a pre-determined age. The practice is to define the beginning of the plateau as the youngest age where the virtual population analysis has converged sufficiently to provide some stability in the estimation of population numbers without distorting the catchability pattern at age.

The eXtended Survivor Analysis allows for "Inverse variance weighting" of the indices. This self-weighting procedure has the advantage of ensuring that the estimation gives higher weight to the indices that are more precise. However, the procedure can lead to an assessment being tuned to a single age-group or survey. That would be fine if this index is unbiased but experience shows that indices with apparent high precision are often biased to a significant degree, which can seriously affect final estimates of stock abundance. To avoid this situation, the software provides an option, which allows the user to set the maximum weight allowed for any given index/value. The maximum weight is specified in that option as a minimum value for the "standard error of any observation".

As the convergence of the eXtended Survivor Analysis to a solution depends upon the convergence property of the underlying virtual population analysis, this method could be difficult to apply reliably at low F values. The same is true when there is a high degree of variability in the indices. Nevertheless, the method performs well in a wide range of situations where multiple indices of abundance are available.

ADAPT:

As the ADAPTive framework is based in a non-linear least-squares procedure, it benefits from a suite of diagnostics and tools that are well known to statisticians. For instance, the approach provides algorithms for calculating the variance and the correlation of parameter estimates. One drawback is that non-linear estimation is based on an iterative process that needs monitoring to avoid pitfalls such as local minimum, over-specifying the number of unknown parameters, etc.

The framework provides flexibility in formulating the estimation problem. For instance, the constraints in natural mortality could be relaxed by estimating it as an additional parameter. While such flexibility could be an advantage in research, it could also lead to over-parameterization of the estimation problem (i.e. trying to estimate too many parameters in relation to the information content of your data). We recommend being "parsimonious" in defining the number of parameters for your models. When a model is over-parameterized, the correlation of the parameters estimates becomes very high (e.g. absolute values in the range of 0.9 to 1.0). Inspect the correlation matrix at the end of the estimation process to ensure that this situation does not occur.

Another advantage of ADAPT in its current form is that it allows the use of aggregated indices, together with your age-disaggregated indices. This is a feature that is not available at present in many of the other methods.

ICA:

The Integrated Catch Analysis (ICA) has been developed to address specific situations of pelagic species. The method invokes the "separability" assumption, at least for a pre-specified time period, an assumption that may not be met in many situations. The approach is generally computer-intense because of the number of parameters requiring estimation. The approach produces diagnostics typical of non-linear approaches based on least-squares or maximum likelihood.

4.2. *Estimation - Diagnostics*

All methods produce a wide range of diagnostics to evaluate the validity and "quality" of the results.

Residuals. All methods provide log-normal residuals. Residuals should be independent and identically distributed. Do distribution plots of the residuals. It is also important to inspect the residuals (graphically or through analysis) for year effects, age effects, as well as for trends (with time, stock size, etc.). Outliers (i.e. large residuals) should be identified and their influence on the population size estimates should be investigated. High leverage observations should be given special attention and investigated in "sensitivity" runs.

Variance of parameter estimates. The variance of parameter estimates provides information on the precision of the results. Typically, results would be considered satisfactory when the coefficient of variation for most estimates of population abundance at age is below 40%. In a risk analysis context (where both the estimate and a measure of its precision is used), higher coefficients of variation could be used but the model formulation should be investigated carefully before using such results. Often, high variance is the result of residuals that are not i.i.d (e.g. much larger residuals for younger ages, which corrupts the calculation of the variance for other ages).

Correlation matrix of parameters. High correlation between parameter estimates is an indication of over-parameterization (trying to estimate too much for the information content of the data). This could be corrected by adding structure or constraints to the model (e.g. assumptions on survey catchability, on determination of fishing mortality for oldest age groups, etc.).

Functional form for catchability of each index. Assumption of constant q for commercial fleets can be a problem. Catchability estimates should be inspected for time trends (usually graphically). While time trends or power curves can be fitted to catchability, use these options sparingly. Keep the model as

simple as possible and do not go for power models or temporal trends at the beginning of your exploration. Use different techniques to investigate the possibility of changes in catchability through time. For instance, look at your indices with a separable model.

Bias-correction. Because of the non-linear nature of the estimation problem, the estimates obtained through the procedures described above are generally biased. Some methods provide a bias-correction to be applied to the estimates of population abundance for the most recent year. In ADAPT, this correction is also done for historical estimates of population abundance and fishing mortality. Some methods do the bias correction only for the final estimate of population abundance and such estimates are not directly comparable to historical reconstruction of stock abundance. Recent research sponsored by the EU suggests that bias correction is necessary.

Inverse weighting. The weights used in some methods (e.g. XSA) to individual indices of abundance combined should provide a balanced contribution from each index. Extreme values should be investigated with the aim of limiting the undue influence of indices that are potentially biased.

Retrospective analysis. Such analyses apply the estimation procedure repeatedly to data sets that are truncated of their most recent observations to determine if the estimation procedure has a tendency to either over- or under-estimate population abundance. There has been a tendency for many models to over-estimate abundance in the most recent year. Changes in catchability (e.g. due to learning or technological innovations for indices based on commercial catch rates; change in survey gear for research surveys), trends/changes in reporting practices (mis-reporting), changes in natural mortality, shifts in geographical distribution, as well as immigration or emigration can lead to retrospective patterns. When strong retrospective patterns are present, the condition that lead to such patterns must be identified and accounted for in model formulation.

Sensitivity analysis. As indicated above, the influential points should be investigated through sensitivity runs.

4.3. *Estimation - Model formulation*

Catchability. The "power function" available in most models should only be used when for species/ages where a contagious distribution is suspected (e.g. youngest ages). Contagious distributions are the result of the tendency for some species or age groups to aggregate. The current practice in some areas is use only the most recent years (e.g. 10 or 15 years) to do the calibration. Short time series (e.g. less than 10 years) are not sufficient for fitting power models. The truncation of the time series is also used frequently when abrupt changes in catchability are suspected (e.g. resulting from a change in survey gear); short series may result in the estimate of stock abundance for the terminal year being poorly determined. Regarding "time trends" in catchability, it is generally not possible to estimate such trends for all indices; catchability of at least one index has to be kept time invariant as the estimation procedure confounds time trends in catchability with trends in population abundance.

How many parameters? The number of parameters that could be estimated in a given situation depends on a number of factors, including the convergence properties of the virtual population analysis, the contrast or information content of the data, the length of the index series, the consistency of the series, etc. It is advisable to attempt to estimate as few parameters as required (the principle of "parsimony").

How much shrinkage? Some methods (e.g. XSA) implement shrinkage to improve the stability of the estimation. In essence, shrinkage biases the results towards the mean and too much shrinkage may result in substantial biases.

Functional relationship for fishing mortality for the oldest age-group. It is common practice to reduce the number of parameters to be estimated by assuming a functional relationship for the fishing mortality for the oldest age group in each year. For instance, the oldest age group could be defined as the mean of fishing mortality estimates for a range of younger ages. It is recommended to keep the age-groups used

for such calculation as close as possible to the oldest age-group to avoid forcing a flat top partial recruitment pattern when a dome is in fact present.

Age truncation. In many situations, the youngest age groups and oldest age groups of an index are inherently more variable than the age groups, which are targeted by the survey or fishing gear leading to the index. Because of this variability, including these ages in a model that assumes the same error structure for all ages may inflate the variance estimates of the ages of interest. It is common practice to truncate these ages from the indices. A better approach would be to account for this difference in error structure but current implementations do not include such a feature.

4.4. *Forecasts*

Retrospective patterns. There is no universal rule on how to account for retrospective effects in short term forecasts. As suggested above, someone should first attempt to understand the processes that leads to the retrospective effect and correct for it in the formulation of the model. In many cases, the cause(s) of the retrospective pattern cannot be readily identified. In some cases, the retrospective effect has been accounted for by adjusting the forecast accordingly but there is no guarantee that this will bring the results closer to the underlying "true value".

Regime shifts. Temporal shifts in biological parameters are often evidenced in maturity data, growth data or stock-recruitment data. In short-term forecasts, shift in biological parameters can be captured (with a lag) by using the most recent observations on these quantities (e.g. averaging the last three years). In long term simulations to assess harvest strategies, regime shifts have been investigated using sensitivity runs but other techniques are also possible.

Risk analyses. Most forecasts account only for some of the uncertainty in the processes being simulated. For instance, in the programs used in this workshop, the variance of population estimates in the starting year and the variability of the recruitment process was taken into account. Some programs (not reviewed here) also account for variability in other biological parameters (e.g. growth) or control parameters (partial recruitment or selection pattern). How to account for biases (as opposed to variance) from various sources in such forecasts is still unclear. In recent years, scientists have gained some experience in evaluating and communicating the risks associated with various management actions. However, more work is needed to evaluate the sensitivity of forecasts to plausible biases and directional shifts in biological parameters. Another approach might be to adhere to management approaches that are more robust so as to reduce the dependency upon the accuracy of annual assessments.

Biological metrics. While simulations have typically focussed on stock trends and fishery trends, they should capture other biological aspects as well (e.g. age structure).

4.5. *Suggestions for improving software tools*

It was observed that software tools are becoming easier to use, thanks to improvements in the user interface and to the improvements in computing technology. For instance, bootstrap procedures are now more accessible than they used to be, thanks both to the computing power and to their availability as options in current software implementations.

It was also observed that software programs are converging so as to offer the same functionality. Despite this convergence, the learning curve of these software tools remains steep in part because of the lack of standards for user interfaces, and input/output formats. Data entry remains a challenge when using these models.

It was noted that all of the software programs used during this workshop would benefit from improving the user-interface. Simple modifications could also enhance their usefulness or functionality. Suggestions for improvements included the following:

- User interface: Programs should allow the user to correct errors in input windows without having to restart the input process. Output files are often cryptic and difficult to read and would benefit from labels strategically placed to identify table contents (e.g. name of parameters being estimated, etc.)

- Input formats: All methods essentially require the same type of data in input. Users would benefit greatly from a common format for input data common to all programs.

- Bootstrap: Capture Recruitment-SSB pairs from the bootstrap, together with the corresponding estimates of population size, to allow re-sampling from them in forecasts or to allow further analyses on them (e.g. to determine correlation).

5. **References**

ANON. 2000a. Microsoft Excel. Microsoft Corporation. Redmont, WA USA.

ANON. 2000b. Guide to using @Risk - Risk Analysis and Simulation Add-In for Microsoft Excel. Palisade Corporation, Newfield, NY USA. 444 p.

DOUBLEDAY, W. G. 1981. A method for estimating the abundance of survivors of an exploited fish population using commercial catch-at-age and research vessel abundance indices. *Can. Spec. Pub. Fish. Aquat. Sci.*, **58**: 164-178.

GULLAND, J. A. 1965. Estimation of mortality rates. Annex to Arctic Fisheries Working Group Report (meeting in Hamburg, January 1965). *ICES C. M. Doc*., No. 3 (mimeographed)

MRAG. 1997. Core program development for the modelling of fishery management strategies. *Final Report of EC Study*, Project 94/110.

POPE, J. G. 1977. Estimation of fishing mortality, its precision and implications for the management of fisheries. *In*: Fisheries mathematics. J.H. Steele (ed.). Academic Press, London, New York, p. 63-76.

POPE, J. G. 1979. Population dynamics and management: current status and future trends. *Invest. Pesq*., **43**: 199-221.

POPE, J. G., and J. G. SHEPHERD. 1982. A simple methods for the consistent interpretation of catch-at-age data. *ICES J. Cons.*, **40**: 176-184.

POPE, J. G., and J. G. SHEPHERD. 1985. A comparison of the performance of various methods for tuning VPA's using effort data. *ICES J. Cons.*, **42**: 129-151.

SHEPHERD, J. G. 1999. Extended survivors analysis: An improved method for the analysis of catch-at-age data and abundance indices. *ICES J. Mar. Sci.*, **56**: 584-591.

SMITH, M. T., and L. KELL., 1998. Working Document to the Study group on the precautionary approach to fisheries management. *ICES C. M. Doc*., No. ACFM:10, Ref. D, 40 p.

(See also Part D, this volume, List of Research and Summary Documents, of 13-22 September 2000 Scientific Council Meeting Report.)

TIMETABLE

Time	Topic	Lead	Software tools
Wednesday, 13 September			
09:00-10:00	Registration and network setup and software installation		
10:00-10:30	Introduction, Principles of VPA tuning & separable VPA	C. Darby	Lowestoft tuning suite
10:30-11:00	Work session	C. Darby	Lowestoft tuning suite
11:00-11:20	Laurec-Shepherd	C. Darby	Lowestoft tuning suite
11:20-12:10	Work session	C. Darby	Lowestoft tuning suite
12:10-12:30	ADAPTive framework: theory, use of software, output overview	R. Mayo	Woods Hole Fishery Assessment Compilation Toolbox (FACT)
Lunch break			
14:00-15:15	Work session	R. Mayo	Woods Hole FACT
Health break			
15:30-16:15	ADAPT demo/tutorial	D. Rivard	ADAPT: Gavaris implementation
16:15-17:00	Discussion	All participants	
Thursday, 14 September			
9:00-9:45	Extended Survivor Analysis: theory, use of software, output overview	C. Darby	Lowestoft tuning suite (XSA)
9:45-10:45	Working Session	C. Darby	Lowestoft tuning suite (XSA)
Health break			
11:00-11:30	ICA: theory, use of software, output overview	C. Darby	ICA
11:30-12:30	Work session	C. Darby	ICA
Lunch break			
14:00-15:00	Discussion	All participants	
Health break			
15:15-16:00	FISHLAB (demo)	C. Darby	FISHLAB
16:00-16:30	PA Software (demo)	C. Darby	PA Software
16:30-17:30	Work session	C. Darby	PA Software
Friday, 15 September			
9:00-9:45	Long term simulations using @Risk	D. Rivard	Excel, @Risk
9:45-10:45	Work session	D. Rivard	Simulation Excel spreadsheet, @Risk
Health break			
11:00-11:30	Stochastic projections	R. Mayo	Woods Hole AgePro
11:30-12:30	Work session	R. Mayo	Woods Hole AgePro
Lunch break			
14:00-14:45	ADAPT-based risk analyses (Demo/tutorial)	D. Rivard	ADAPT Sofware
14:45-15:30	Stochastic projections	C. Darby	Lowestoft Projection Software
Health break			
15:45-16:15	Work session	C. Darby	Lowestoft Projection Software
16:15-17:00	Discussion	All participants	

Participants in session during Workshop on Assessment Methods.

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

Chairman: H.-J. Rätz Rapporteurs: Various

I. OPENING

The Committee met at the Boston Back Bay Hilton, 40 Dalton Street, Boston, Massachusetts, USA, during 18-22 September 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 (France, Germany, Portugal and Spain), Estonia, Japan, Russian Federation and United States of America. Various scientists assisted in the preparation of the reports considered by the Committee.

The Chairman, H.-J. Rätz (EU-Germany), opened the meeting by welcoming participants. The agenda was reviewed and a plan of work developed for the meeting. The provisional agenda with these modifications was accordingly **adopted**.

II. MATTERS RELATED TO STOCK CONSIDERATIONS

1. **Northern Shrimp in Division 3M: Stock Assessment, Advice and Catch**

Concern was expressed during the course of the STACFIS September 2000 Meeting about the appropriateness of the advice for 2001 on shrimp in Div. 3M, which was provided by the Scientific Council in November 1999. The concern was based on the fact that the catch in 1999 considerably exceeded the TAC advised for 1999 (GC Doc. 00/03) and the provisional catch figures indicate that the TAC advised for 2000 would also be exceeded (FC Working Paper 00/5). It was noted that the TAC advice provided by the Scientific Council since 1996 has always been exceeded and that the management of the stock is based on effort control. Consequently, any technical changes to improve the effectiveness of the fishing activities (bigger vessels, twin- and triple trawling) will lead to unforeseeable increases in catches. It was noted the Scientific Council will re-evaluate its advice for 2001 for shrimp in Div. 3M at the November 2000 Scientific Council shrimp assessment meeting.

Estimates of recruitment and exploitable biomass currently derived from surveys conducted by EU-Spain and EU-Portugal and Faroese vessels on the Flemish Cap are highly uncertain.

STACFIS stressed that the precision of the stock assessment and the derived prediction of biomass and catches will not be improved until a survey directed towards shrimp on Flemish Cap is established which will provide indices of shrimp recruitment and of the size of the exploitable stock.

2. **Nomination of Designated Experts**

STACFIS reviewed current vacancies in the list of Designated Experts for several stocks. After some deliberation, STACFIS nominated the following:

- From the Science, Oceans and Environment Branch, Northwest Atlantic Fisheries Centre, Department of Fisheries and Oceans, P. O. Box 5667, St. John's, Newfoundland A1C 5X1, Canada [Phone: listed below – Fax: + 709 772-4188 – E-mail: listed below]

			Phone No.	E-mail Address
for	Cod in Div. 3NO	D. Stansbury	+709-772-0559	stansburyd@dfo-mpo.gc.ca
	Redfish in Div. 3LN	D. Power	+709-772-4935	powerd@dfo-mpo.gc.ca
	American plaice in Div. 3LNO	M. J. Morgan	+709-772-2261	morganj@dfo-mpo.gc.ca
	Witch flounder in Div. 3NO	W. R. Bowering	+709-772-2054	boweringr@dfo-mpo.gc.ca
	Yellowtail flounder in Div. 3LNO	S. J. Walsh	+709-772-5478	walshs@dfo-mpo.gc.ca
	Greenland halibut in SA 2+3KLMNO	W. R. Bowering	+709-772-2054	boweringr@dfo-mpo.gc.ca

Roundnose grenadier in SA 2+3	D. Power	+709-772-4935	powerd@dfo-mpo.gc.ca
Shrimp in Div. 3LNO	D. C. Orr	+709-772-7343	orrd@dfo-mpo.gc.ca
Elasmobranchs	D. W. Kulka	+709-772-2064	kulkad@dfo-mpo.gc.ca

- From the Instituto de Investigaciones Marinas, Eduardo Cabello, 6, 36208 Vigo, Spain
[Phone: +34 9 86 231930 – Fax: +34 9 86 292762 –E-mail: avazquez@iim.csic.es]

  for Cod in Div. 3M — A. Vazquez

- From the Instituto Español de Oceanografia, Aptdo 1552, E-36280 Vigo (Ponteverda), Spain
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  for Roughhead Grenadier in SA 2+3 — S. Junquera

- From the Institute de Investigacao das Pescas e do Mar (IPIMAR), Av. de Brasilia, 1400 Lisbon, Portugal
[Phone: +351 21 302 7000 – Fax: +351 21 301 5948]

  for American plaice in Div. 3M — R. Alpoim – E-mail: ralpoim@ipimar.pt
  Redfish in Div. 3M — A. Avila de Melo – E-mail: amelo@ipimar.pt

- From the Greenland Institute of Natural Resources, P. O. Box 570, DK-3900 Nuuk, Greenland
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  for Northern shrimp in SA 0+1 — H. Siegstad – E-mail: helle@natur.gl
  Greenland halibut in Div. 1A — C. Simonsen – E-mail: claus@natur.gl

- From the Greenland Institute of Natural Resources, Box 2151, DK-1016, Copenhagen K, Denmark
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			Phone No.	E-mail Address
for	Roundnose grenadier in SA 0+1	O. Jørgensen	+45 33 69 3461	grfioaj@inet.uni2.dk
	Greenland halibut in SA 0+1	O. Jørgensen		
	Northern shrimp in Denmark Strait	D. M. Carlsson	+ 45 33 69 3457	danmc@inet.un2.dk

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  for Redfish in SA1 — C. Stransky
  Other Finfish in SA1 — C. Stransky

- From the Marine Research Institute, Skulagata 4, P. O. Box 1390, 121 - Reykjavik, Iceland
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  for Shrimp in Div. 3M — U. Skúladóttir

- From Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), 6 Knipovich Street, Murmansk, 183763, Russia [Phone: +7 8152 47 34 61 – Fax: +47 789 10518 – E-mail: inter@pinro.murmansk.ru]

  for Capelin in Div. 3NO — V. Shibanov

- From the Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543
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  for Squid in SA 3+4 — L. Hendrickson

III. OTHER MATTERS

1. **Review of SCR and SCS Documents**

a) Results of the Canadian 145 mm diamond codend mesh selection experiments for Greenland halibut in the NAFO area (SCR Doc. 00/66) were reviewed. Mesh selection experiments for Greenland halibut were carried out on board a Canadian commercial deep-sea trawler to determine the selectivity parameters of 145-mm diamond mesh codend. A common bottom trawl for fishing Greenland halibut was redesigned as a trouser trawl with a 50-mm control mesh. Fourteen (14) successful hauls of approximately 4-hour duration were made under commercial fishing conditions in depths ranging from 978 to 1283 m. Selection length at 25% was estimated to be 44.04 cm, 47.74 cm at 50% and 51.45 cm at 75%. The selection range (SR) was estimated to be 7.41, and the selection factor (SF) was 3.29.

Canadian fleets are required to use a minimum mesh size of 145 cm, and the 25% determined for this gear is very close to the Canadian minimum landing size of 45 cm.

b) Russian research of and fishery for pelagic redfish *(Sebastes mentella)* in the NAFO Regulatory Area (Div. 1F) (SCR Doc. 00/68) were presented. Soviet Union/Russian investigations and the fishery for pelagic redfish *(Sebastes mentella)* in Div. 1F outside 200-naut. m EEZ were conducted during 1980-2000. In total 23 research and exploratory expeditions were conducted mainly in June-September during two decades. Standard biological, oceanographic and hydro-acoustic data were collected.

The total catch (both exploratory and commercial fishery with pelagic trawls) amounted to about 4 700 tons. The catches were mainly taken in 1990 and 1991 (384 tons and 458 tons, respectively) and in 2000 (3 729 tons).

The length of pelagic redfish fished in the NAFO Regulatory Area in Div. 1F varied between 21 and 45 cm, with fish sizes of 33-38 cm being predominant. Catches were dominated by males, which were on the average 1.5 times more numerous than females. The majority of fish were mature, and in summer their gonads were usually in the condition of post-spawning recovery and ripening. The redfish fed intensively on crustaceans (euphausiids, copepods, hyperiids) and squid in summer season.

c) A report on Spanish research on feeding of the most frequent species in Flemish Cap (Div. 3M) (SCR Doc. 00/60) was presented. The food and feeding of 15 fish species caught during the summer EU-bottom trawl surveys in Flemish Cap (1993-2000) were described based on a total sample of 35 645 stomachs. The feeding intensity was high in all the species with a maximum value for *Gadus morhua* (96.8%) and a minimum for *Lycodes reticulatus* (51.5%). The prey spectrum was wide with a total of 175 items. According to the frequency of occurrence (F.O.) the crustaceans made up the most important prey group (F.O.= 71.4%), while in volume (V= 38.2%) they were consumed less significantly than fish (V= 41.4%). The main prey taxa in frequency of occurrence were Hyperiidea, Pisces, Ophiuroidea, *Pandalus borealis* and Chaetognata. Three categories of fish were established in relation to the variation in diet; *viz* specialists, low diversity feeders and high diversity feeders.

d) A description of the 1998 and 1999 yellowtail founder fishery on the Grand Banks with a comparison to the historic mixed fishery (SCR Doc. 00/58) was presented. A spatial/temporal description of the re-emergence of 1998 and 1999 yellowtail flounder fishery on the Grand Banks was presented. The fisheries were prosecuted on four distinct fishing grounds covering only 6.6% (1998) and 9.8% (1999) of the total area of the Grand Bank where bottom depth was less than 100 m. The 1999 fishery differed spatially from 1998 in that an area not fished in 1998 bordering on Div. 3L produced some of the highest catch rates ever observed for yellowtail flounder (average 2.4 tons per hour in April-May). Yellowtail flounder was successfully exploited as a single target species rather than part of a mixed fishery (as per the historical fishery) by concentrating effort where it was most abundant and other restricted species, particularly American plaice and cod were minimal.

By-catch levels were within the regulated 5% limit for cod (1998 – 2.3%, 1999 – 1.3%) and American plaice (1998 – 4.2%, 1999 – 4.3%) and were achieved primarily by targeted spatial concentration of effort. This general pattern of directing for yellowtail flounder where they were highly concentrated was in contrast to the past practise of taking yellowtail flounder in a mixed fishery over a very wide area (43% of the bank less than 100 m). Size of fish taken and particularly ratio of males to females in the catch was observed to differ among the 4 grounds fished. Over all areas, average size and range of sizes in the catch were very similar between years. Numbers of small fish less than 26 cm (juveniles) comprised less than 1% in both years with the numbers of fish less than 30 cm (management cut-off) amounted to about 5% in both years. A total of 7.3 million fish in 1998 and 12.9 million fish in 1999 were estimated to have been removed by the fishery.

2. **Other Business**

There being no other business, the Chairman thanked the members for their contributions, extended particular gratitude to the Secretariat for their assistance and support, and the meeting was adjourned.

APPENDIX II. REPORT OF STANDING COMMITTEE ON RESEARCH COORDINATION (STACREC)

Chairman: R. K. Mayo Rapporteur: D. G. Cross

The Committee met at the Boston Back Bay Hilton Hotel, 40 Dalton Street, Boston, MA 02115, USA during 18-22 September 2000 to consider matters pertaining to statistics and fisheries research as referred to it by the Scientific Council. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), European Union (France, Germany, Portugal and Spain), Estonia, Japan, Russian Federation and United States of America. The Assistant Executive Secretary was in attendance.

1. **Opening**

The Chairman opened the meeting by welcoming the participants. D. Cross (EU) was appointed rapporteur.

2. **Fisheries Statistics**

a) **Progress report on Secretariat Activities**

i) **Acquisition of STATLANT 21 data**

The Assistant Executive Secretary reported that, following the recommendation at the June 2000 Scientific Council Meeting, the Executive Secretary had written to the national delegates of the USA and Faroe Islands with reference to their obligations on the timely submission of data NAFO. To date there was no response and thus the situation with regard to the submission of STATLANT 21A and 21B data was much as at the time of the June 2000 Meeting.

ii) **Publication of statistical information**

The Assistant Executive Secretary reported that, in response to the recommendation of the Scientific Council at the June 2000 Meeting, the manuscript for Volume 44 of the *NAFO Statistical Bulletin* with data for 1994 was ready for printing. This publication would be missing the data for the USA and STACREC agreed that consideration would have to be given as to the most appropriate manner of publishing these data when they become available.

iii) **Progress report on Internet site for statistical information**

The Assistant Executive Secretary reported that annual files of STATLANT 21A data (aggregated from STATLANT 21B data where available) for the period 1960-99 were available for downloading from the NAFO website.

Progress on Loading FISHSTAT Software. D. Cross (EU) reported that the EUROSTAT and FAO work on developing procedures for converting the NAFO STATLANT 21A data to a format compatible with the FAO FISHSTAT Plus Software had continued. There were some difficulties in transferring these procedures to the NAFO Secretariat and, until these difficulties have been over-come, EUROSTAT offered to up-date the NAFO FISHSTAT Plus data-files.

The NAFO FISHSTAT Plus data-file for the period 1960-99 was ready for dissemination. STACREC accepted the proposal that this data-file (560 Kbytes) should be made available for downloading from the NAFO website and that a link to the FISHSTAT Plus program on the FAO website would be provided. Similarly it was anticipated that the FAO website should provide for the down-loading of the FISHSTAT Plus program and a link to the NAFO data-file on the NAFO website. This arrangement would ensure that the users would have ready access to the latest versions of the FISHSTAT Plus program and the NAFO STATLANT 21A data-file.

D. Cross (EU) also reported on the CWP work to develop an integrated data-file for Atlantic catch statistics. This data-file uses the regional data from NAFO, ICES, CECAF, GFCM, ICSEAF and

CCAMLR, the tuna catch data from ICCAT and FAO catch data for periods and regions not available from the other sources and it presents the data in a harmonized format for use with the FAO FISHSTAT Plus program. The data-file is being subjected to a final test by EUROSTAT and FAO and, once this process is completed, a CD-ROM including the data-file and the FISHSTAT Plus program will be made available for distribution. It was envisaged that this CD-ROM will also include the ICES STATLANT 27A and NAFO STATLANT 21A regional files in the FISHSTAT Plus format together with the other data-files currently available from the FAO website.

b) **19th CWP Session**

i) **Proposed agenda items**

The Assistant Executive Secretary reported that since the June 2000 Scientific Council Meeting there had been no additions to the proposed agenda items for the 19th CWP Session. STACREC invited members to contact the NAFO Secretariat should they have proposals for additions. The final agenda would be drafted at a CWP inter-secretariat meeting to be held at FAO Headquarters in February 2001. As proposed at the June 2000 Scientific Council Meeting, NAFO would be represented at this meeting by the Assistant Executive Secretary.

3. **NAFO Observer Protocol**

a) **Report of the *Ad hoc* Working Group on NAFO Observer Protocol**

Progress Report from the June 2000 STACTIC Meeting. STACREC reviewed the report of the 27-29 June 2000 STACTIC Meeting (FC Doc. 00/4), and received a verbal report by D. Kulka (Canada), who represented the Council at that meeting. At its 1-15 June 2000 Meeting, the Scientific Council had adopted a harmonized set of Observer Protocols (SCS Doc. 00/23), which incorporated most of the protocols proposed by the EU as well as those developed by the Scientific Council *ad hoc* Working Group. SCS Doc. 00/23 was presented to STACTIC at its June 2000 Meeting by D. Kulka (Canada). The EU had also presented a paper, which contained the same set of protocols, which had been incorporated into SCS Doc. 00/23. The main difference between the two proposals was the inclusion of a set of protocols in the Scientific Council document (SCS Doc. 00/23) for collecting length frequency data. After reviewing both documents, STACTIC concluded that further examination of the protocols as given in those documents should be reviewed again at the September 2000 STACTIC Meeting.

Progress Report from the concurrent 18-22 September 2000 STACTIC Meeting. The Scientific Council was represented by D. Kulka (Canada) and Chairman of STACREC (R. K. Mayo, USA) at the 18-22 September 2000 STACTIC Meeting. The STACREC Chairman presented a brief review of Scientific Council/STACTIC interactions since 1996 regarding the development of the Observer Protocols, followed by a summary of the content in SCS Doc. 00/23. D. Kulka provided an overview of the harmonized Scientific Council protocols, noting it included the collection of length frequency data. In this regard, STACTIC expressed concern that obtaining length measurements would place undue burden on observers, although it was also noted that Canadian observers perform this function successfully.

The Scientific Council representatives stressed to STACTIC that the set of harmonized Protocols do not constitute an Observer Manual, but rather a set of data elements and their description and codification. This distinction had not been made previously, and the two concepts had been a source of confusion. An Observer Manual currently used by Canadian observers on vessels fishing in the NAFO Regulatory Area was then discussed by STACTIC, and it was agreed that use of an existing manual as a basis for the NAFO Observer Manual is more efficient than developing one from scratch. STACTIC agreed that the development of such a manual was required.

4. **Other Matters**

a) **Review of SCR and SCS Documents**

There were no documents to be reviewed

b) **Other Business**

There being no other business, the Chairman expressed sincere thanks to D. Cross (rapporteur) and the NAFO Secretariat for their support to the Committee. The meeting adjourned at 0920 hours, 22 September 2000.

APPENDIX III: REPORT OF STANDING COMMITTEE OF PUBLICATIONS (STACPUB)

Chairman: O. A. Jørgensen Rapportuer: O. A. Jørgensen

The Committee met at Hilton Boston Back Bay, Boston, Massachusetts, USA on 19 and 20 September 2000. In attendance were V. A. Rikhter (Russian Federation), F. M. Serchuk (USA), M. Stein (EU-Germany), O. A. Jørgensen (Denmark in respect of Greenland) and the Assistant Executive Secretary (T. Amaratunga). J. Morgan (Canada) provided some information by correspondence.

1. **Opening**

The Chairman welcomed the Committee, and the agenda was reviewed and adopted.

2. **Review of Scientific Publications**

a) **Papers from June 2000 Meeting**

It was noted that all SCR and SCS papers submitted to the June 2000 Meeting were finalized and placed on the website.

Further, all SCR/SCS Documents submitted for consideration at this September 2000 Meeting were placed on a special directory on the website for access by Scientific Council members before the meeting, and for access through the LAN system during the meeting.

STACPUB reviewed one SCR Document (SCR Doc. 00/20) from the June 2000 Scientific Council Meeting, which authors had requested be considered for publication in the Journal. A discussion was held on the paper and it was agreed that STACPUB members comments and recommendations should be conveyed to the authors.

b) **Status of Papers from 1999 Symposium**

Volume 27 of the Journal of Northwest Atlantic Fisheries Science containing papers presented at the 1999 Symposium on "Pandalid Shrimp Fisheries – Science and Management at the Millennium", is expected to be complete by the end of year 2000. Twenty-one (21) of the 29 papers presented are in the final stage of the editorial process. Balance – 8 papers are with the editors or authors, some are likely rejected.

The review process noted large differences in quality among papers, and the editors agreed to conduct a 2nd tier of joint editorial review before final publication.

STACPUB noted this Journal issue will be published electronically, only after completion of the compilation.

c) **Information from 2000 Special Session**

Several documents (SCR Documents and Working Papers) were presented to the "Workshop on Assessment Methods" held during 13-15 September at Boston Back Bay Hilton, Boston USA. Noting that the information presented at the Workshop would be valuable for future reference, STACPUB **recommended** that *the documents from the "Workshop on Assessment Methods" along with the discussions should be compiled and issued as a Scientific Council Studies publication.*

d) **Status of Invitational Papers**

The invitational paper by V. A. Rikhter (on silver hake) had advanced to its final stages of editorial preparation for publication. The paper is due to be published in Journal Vol. 26.

There was progress on the invitational paper by Sv. Aa. Horsted (on Greenlandic cod fisheries) with editorial comments being addressed with the author.

3. **Considerations of NAFO Website**

Many structural changes were made on the website since the June 2000 Scientific Council Meeting. Particularly, a) the button called "What's New", as requested by STACPUB, was introduced and b) back issues of the Journal and Studies were being scanned and uploaded where possible.

Currently 4 papers accepted for publishing in Volume 26 of the Journal have been published electronically. One further paper slated for publication intersessionally was delayed due to further editorial review. This issue is expected to be completed by the end of the year 2000.

The Secretariat noted the inclusion of back issues of the Journal and Studies, along with the proposed inclusion of the FISHSTAT PLUS database of STATLANT 21, will result in an extremely large website. This would lead to an increase in the cost of maintaining the website and slow down the speed on the website.

There was some discussion about the structure of the website, and it was agreed that it was important to get old issues of Studies and Journal in an electronic format.

STACPUB stressed that the website should be the website of the entire organization and that it is important that information on other Constituent Bodies of NAFO (General Council, Fisheries Commission) and their reports should be accessible through the NAFO website. STACPUB therefore **recommended** that *a Working Group with representatives from General Council, Fisheries Commission and Scientific Council should be established in order to ensure that all relevant material becomes available on the NAFO website.*

A considerable amount of money and work is put into the maintenance of the website and STACPUB considered it important to keep track of how the website is used. It was therefore agreed that the website statistics should be presented to STACPUB members and the *ad hoc* website working group every three month, so that they could be evaluated and reported to Scientific Council.

STACPUB received a number of suggestions from Scientific Council members for improvement to the website. The suggestions included aspects of technical development as well as text modifications particularly related to publications. STACPUB saw significant value of including the changes. The Chairman agreed to introduce appropriate changes to the website in consultation with the Assistant Executive Secretary.

4. **Scientific Citation Index** (SCI)

The Assistant Executive Secretary has reestablished contact with SCI. Scientific Citation Index (SCI) was informed of the new electronic publication scheme of the NAFO Journal introduced by the Scientific Council. Scientific Citation Index (SCI) has agreed to continue to review recent Journal publications and future publications before a final decision will be made regarding the citation of the NAFO Journal.

5. **Review of Editorial Board** (new members)

STACPUB was pleased to receive names of eminent scientists to fill the two vacancies in the Editorial Board.

STACPUB proposed that the Scientific Council invite Kenneth Drinkwater (Department of Fisheries and Oceans, Canada) to the position of Associate Editor, Biological Oceanography and Volker Siegel (Institute für Seefischerei, Hamburg) to the position of Associate Editor, Invertebrate Fisheries Biology.

6. **Other Matters**

Difficulties have been encountered with a number of submitted papers due to the quality of the English. This is not an unexpected problem for Journals receiving international submissions but has caused difficulties for editors and referees. In order to deal with this, STACPUB agreed to ask the editors of other leading Journals how the problem is dealt with in those Journals.

STACPUB was informed that STACFAD did not accept the initial request of $ 51 000 to get the NAFO Journal and Studies into electronic form. Instead, in the budget estimate for the year 2001, $ 8 000 was allocated for website work and scanning of the NAFO Journal (21volumes) and Studies (21 volumes).

There being no other business, the Chairman thanked the members, the Secretariat and the Assistant Executive Secretary for their work during the STACPUB meeting. The meeting was adjourned.