International Commission for the Northwest Atlantic Fisheries

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SPECIAL MEETING OF PANEL A (SEALS) - DECEMBER 1975

Report of Scientific Advisers to Panel A (Seals)

Ottawa, Canada, 17-19 November 1975

1. In the absence of Dr A.W. Mansfield (Canada), Dr M.A. Bigg (Canada) was requested to serve as Chairman.

2. Participants.

Canada -	Dr M.A. Bigg	Mr P.F. Lett	Dr K. Ronald
	Dr P. Brodie	Dr A.W. May	Dr D.E. Sergeant
	Dr C.K. Capstick	Dr B.S. Muir	Dr G.H. Winters
	Dr D.M. Lavigne	Dr W.E. Ricker	
Denmark -	Mr Sv.Aa. Horsted	Mr F.O. Kapel	
Norway -	Mr T. Benjaminsen	Mr T. Øritsland	Mr Ø. Ulltang

3. Rapporteur. Dr G.H. Winters (Canada) was appointed Rapporteur.

4. Agenda. The agenda (Appendix I), as proposed by the Chairman, was adopted without revision. A list of pertinent documents and working papers is at Appendix II.

5. Harp Seals

(a) Results of research in 1975

Canada reported results of 1975 studies relating to photographic aerial surveys of whelping harp seals in the Gulf and Front areas, ultra-violet sensing results, marking of pups in the Gulf, and analysis of age frequencies from shore-based fisheries (Res.Docs. 75/XII/142, 75/XII/144). Aerial and ultra-violet photographic surveys indicated a level of production of 46,000 pups in the Gulf and about 141,000 on the Front for a combined production in 1975 of about 187,000 pups, a decrease since 1972 of 12.5% per annum. Catches of young seals in 1975 were 140,629, of which 7550 were taken in the Gulf. Analyses of tagging studies indicated a poor representation of year-classes 1969-1971 with catches in excess of 200,000 annually and strong representation of year-classes 1972-1973 following imposition of the 150,000-quota.

In addition to research results presented to Panel A Scientific Advisers at the 1975 Annual Meeting (Proc. 12, Appendix I), Norway presented additional data on age composition analyses and adjusted estimates of year-class survival, mortality and production which confirmed similar analyses presented in Res.Doc. 75/121.

Denmark presented a breakdown on catches of harp seals in West Greenland during 1954-1974 which indicated a relationship between survival of pups in the Gulf and Front areas and subsequent 0-group catches in West Greenland during the following summer (ICNAF Working Paper 75/XI/4).

(b) Mortality estimates

Information on levels of total and natural mortality since the early 1960's were provided, based on a variety of methods. Cohort analysis utilizing effort data (Res.Docs. 75/XII/145, 75/XII/148) indicated a level of $Z = 0.24$ and $M = 0.20$ for age-groups 1+; analysis of catch curves indicated a range of estimates of mortalities from $Z = 0.26$, $M = 0.21$ for adult seals (both sexes combined) (Res.Doc. 75/XII/143) to $Z = 0.09$ for breeding adult females (ICNAF Working Paper 75/XI/3). After considerable discussion, it was felt that variability and bias in catch and age composition, hunting effort and recruitment were the main confounding factors in the wide range of estimates and a small working group was established to compute revised estimates of mortality incorporating appropriate adjustments for the above factors. The results of catch analyses for adult males are presented below:

see ICNAF Redbook 1976: 193-196

	Sampling year	Age-group	Z	Mean Z	Rate of change in recruitment	Total Z	Estimated hunting mortality	Natural mortality (M)
i)	1973	6-13	-.138	-.073	-.137	-.210	-.057	-.153
	1974	7-14	-.008					
ii)	1969-1974	8-21	-.073		-.02	-.093	-.04	-.05

The range of estimates of Z and M calculated in this manner were considered too large to be acceptable with confidence. Consequently, an alternative method of calculating mortality was considered involving levels of Z which would provide estimates of breeding stock within the limits considered probable in 1975, starting from an estimate of breeding stock in 1967. The following assumptions are made in the models presented below:

i) total mortality (Z) is constant over the various age-groups and years;
ii) whelping age = 6 years;
iii) breeding stock (age 6 years and older) in 1967 = 359,000 females.

Calculated breeding stock

Year	A Z = .13	B Z = .14	C Z = .15	D Z = .16	E Z = .17	F Z = .18
1967	359	359	359	359	359	359
1968	371	365	359	353	347	342
1969	370	358	348	338	328	319
1970	353	338	325	312	299	287
1971	338	320	305	289	274	261
1972	339	318	300	281	264	249
1973	323	300	280	260	243	227
1974	303	278	257	237	220	204
1975	315	287	262	240	220	202

Models A, B, C, D, E, and F were variously considered acceptable under the assumptions made, depending on interpretations of information relating to estimates of pup production (and hence breeding stock) in 1975.

(c) Estimates of production in 1975

Agreement could not be reached as to the most accurate level of pup production in 1975.

Results of Canadian aerial surveys, both black-and-white and ultra-violet photography, in 1975 indicated pup production of 46,000 in the Gulf (ultra-violet) and 141,000 (black-and-white) on the Front, for a combined total of 187,000 pups. Estiamtes of Front pup production by Canadian Fisheries Officer, Mr T. Curran, indicated a level of 150,000 with a maximum of 165,000. Based on a Gulf production of 50,000, the ratio of adults from Gulf to Front in 1975 (1:3) also indicates a level of Front production of 150,000 or 200,000 altogether.

Total pup kill in 1975 was 140,000 of which 133,000 were taken on the Front. Observations by Norwegian sealers and one Norwegian observer suggest that Front escapement was good in 1975; this was indicated by the high daily kill rate of beaters experienced by the Norwegian fleet during the last three days of the hunt and by the short period in which the white coat kill preferences were fulfilled in an area of approximately 80 x 60 nautical miles east of Grey Islands (Res.Doc. 75/120)[1]. The degree of variability associated with aerial surveys was also pointed out particularly in relation to probable under-estimates of production by this method. Thus, estimates of Front production in 1975 may have been considerably higher than indicated by aerial surveys, and a range of 200,000-250,000 was suggested as alternative estimates.

(d) Advice on catch levels in 1976

The differences in scientific opinion on the level of pup production (and breeding stock) in 1975 precludes definitive advice on catch levels in 1976. However, the output of Models A through F above represent the range of scientific opinion relating to probable levels of pup production in 1975. It was considered appropriate to provide a series of calculations illustrating the effects on future pup production and breeding stock under alternative estimates of mortality and 1975 breeding stock contained in Models A through F. These are shown in Table 1.

[1] However, a kill of 23,000 beaters was taken by landsmen on the Front through April and the greater part of May (ICNAF Working Paper 75/XI/1).

(e) Required future research on harp seals

Additional studies from rec ent biological material to establish maturity ogives were considered an important need. The bias resulting from small samples, the problem of obtaining samples on the Front, and the time lag in response of females to population fluctuations were discussed. A sample of 200 females was considered as a minimum sample for such a study.

On-ice control of any aerial survey either by black-and-white or ultra-violet photography was considered necessary and in particular on the Front ice.

Norway expressed a willingness to participate in any *ad hoc* study on the Front, but on a routine basis, and for economic reasons, studies off Newfoundland would be conducted on alternate years. It was agreed that a cooperative research effort be made towards the construction of a systems simulation of the western Atlantic harp seal population on the available data to assist in future harp seal assessments as well as to provide some insight into their community dynamics.

6. Hooded Seals

(a) Population status

A Canadian re-assessment (Res.Doc. 75/XII/147) of hooded seal production from regression analyses of survival index on pup catch indicated a somewhat lower (26,200) pup production than initial Norwegian estimates (32,000, Res.Doc. 75/122) using older age-groups.

(b) Recommendations for TAC

The Scientific Advisers agreed to defer advice on the 1976 TAC level until the next meeting of Panel A in Bergen, Norway, December 1975.

(c) Future research

The Scientific Advisers agreed that future research efforts be intensified towards providing better information on stratified sampling of kill and aerial reconnaissance northward to include Davis Strait.

7. Time and Place of Next Meeting. The Scientific Advisers noted that their next meeting would be held 9-10 December 1975 at the Institute of Marine Research, Bergen, Norway, just prior to the meeting of Panel A in the Fisheries Directorate, Bergen, on 12 December 1975.

8. There being no other business, the meeting adjourned at 1245 hrs, Wednesday, 19 November 1975.

Table 1. Characteristics of stock models A through F considered (see table on calculated breeding stock, page 2).

Column	1	2	3	4	5	6	7	8	9
Stock model	Z	A	R	1967 pups	1975 pups	Catch from 1976	Long-term trend	Minimum pups	Year of minimum
-	0.21	0.189	0.142	359	-	0	-	-	-
-	0.19	0.173	0.160	359	184	0	-	-	-
F	0.18	0.165	0.170	359	202	0	±	125	1982
						50	-	-	-
E	0.17	0.156	0.180	359	220	0	+	153	1982
						50	-	-	-
D	0.16	0.148	0.191	359	240	0	+	185	1982
						50	+	185	1982
						100	-	-	-
C	0.15	0.139	0.203	359	262	0	+	222	1978
						50	+	222	1978
						100	a	a	a
B	0.14	0.131	0.216	359	287	0	+	255	1978
						50	+	255	1978
						100	+	255	1978
						150	-	-	-
A	0.13	0.122	0.229	359	315	0	+	293	1978
						50	+	293	1978
						100	+	293	1978
						150	+	293	1978
						200	±	-	-

a = not computed

Column 1. Instantaneous total mortality rate of seals from age 1 onward; Z. This is mainly natural mortality, but it includes hunting mortality on seals older than age 0.

Column 2. Annual actual mortality rate; $A = 1 - e^{-Z}$.

Column 3. Computed fraction of all pups surviving the age 0 kill that become pup-producing females at age 6; $R = e^{-6Z}/2$.

Column 4. Assumed number of pups produced in 1967.

Column 5. Computed number of pups produced in 1975.

Column 6. Annual level of catch (all ages) in 1976 and later years, used in the computation. Of these, 84% are considered to be pups, and the rest older ages.

Column 7. Final trend of the computed population.
+ = continually increasing;
- = continually decreasing;
± = very slow increase or decrease.

Column 8. The level to which the number of pups produced will decline, based on recruitment in 1975.

Column 9. The year of minimum pup production.

The model is started from initial conditions as below (numbers are in thousands):

Year	Pup production	Pup kill	Pup survivors
1961	406	160	246
1962	399	207	192
1963	384	260	124
1964	387	266	121
1965	367	183	184
1966	360	251	109
1967	359	278	81
1968		156	
1969		233	
1970		217	
1971		211	
1972		117	
1973		98	
1974		115	
1975		127	

The pup survivors in each year are multiplied by R and added to the female breeding stock 6 years later. The number of producing females (= pup production) in each year is multiplied by A and the result subtracted from the number present to give the number surviving at the start of the following year. After 1975 trial pup kill strategies are used as follows, as far as appropriate: 0; 42,000; 84,000; 126,000; 168,000. Notice that no adjustments made for increases or decreases in survival rate of bedlamers or adults because of the different numbers caught under the different kill strategies.

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Appendix I

SPECIAL MEETING OF PANEL A (SEALS) - DECEMBER 1975

Scientific Advisers to Panel A (Seals)
Ottawa, Canada, 17-19 November 1975

Agenda

1. Opening
2. Election of Chairman (*pro-tem*)
3. Appointment of Rapporteur.
4. Adoption of Agenda
5. Harp Seals
   (a) Population status
   (b) Recommendation for total allowable catch in 1976
   (c) Future research
6. Hooded Seals
   (a) Population status
   (b) Recommendation for total allowable catch in 1976
   (c) Future research
7. Time and Place of Next Meeting
8. Other Business
9. Approval of Report of Scientific Advisers
10. Adjournment

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Appendix II

SPECIAL MEETING OF PANEL A (SEALS) - DECEMBER 1975

List of Research Documents and Working Papers
presented to
Special Meeting of Scientific Advisers to Panel A (Seals)
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Res.Doc. 75/XII/141 + Addenda 1-2	Harp seal survival as predicted by a modification of Allen's model by K. Ronald and C.K. Capstick
Res.Doc. 75/XII/142	Results of research on harp seals in 1975 with an estimate of production by D.E. Sergeant
Res.Doc. 75/XII/143	Mortality and production of harp seals, with reference to a paper by Benjaminsen and Øritsland (ICNAF Res.Doc. 75/121) with Appendix - Comments on the West Atlantic harp seal herd and proposals for the 1972 harvest (presented to Special Meeting of Panel A Experts, Charlottenlund, Denmark, 23-24 September 1971) by W.E. Ricker
Res.Doc. 75/XII/144	An aerial census of western Atlantic harp seals (*Pagophilus groenlandicus*) using ultraviolet photography by D.M. Lavigne, S. Innes, K. Kalpakis, and K. Ronald
Res.Doc. 75/XII/145 (Revised)	The impact of current management policies on stocks of western Atlantic harp seals, *Pagophilus groenlandicus* by P.F. Lett and D.M. Lavigne
Res.Doc. 75/XII/146 (Revised)	Consideration of present management regime for harp seals in relation to recent scientific analysis by B.S. Muir
Res.Doc. 75/XII/147	Comments on new estimates of production and sustainable yield of harp and hooded seals by D.E. Sergeant
Res.Doc. 75/XII/148	The estimation of natural mortality for the harp seal (*Pagophilus groenlandicus*) by P.F. Lett and D.M. Lavigne

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ICNAF Working Paper 75/XI/1	Canadian seal statistics, 1975 - Atlantic summary
ICNAF Working Paper 75/XI/2	Documentation of comments on Canadian harp seal estimates by Ø. Ulltang, T. Benjaminsen, and T. Øritsland
ICNAF Working Paper 75/XI/3 + Addendum	Adjusted estimates of year-class survival and production with estimates of mortality for Northwest Atlantic harp seals by T. Benjaminsen and T. Øritsland
ICNAF Working Paper 75/XI/4	Catch of harp seals in West Greenland, 1954-1974 by Denmark
ICNAF Working Paper 75/XI/5	The management of harp seals in the West ice by T. Øritsland
ICNAF Working Paper 75/XI/6	Comments on methods used by Benjaminsen and Øritsland (ICNAF Res.Doc. 75/121) by Sv.Aa. Horsted