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Consideration of present management regime for harp seals in relation to recent scientific analysis

by

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ICNAF Res. Doc. 75/121 by Benjaminsen and Øritsland presented a new series of harp seal age composition data. Analysis by these authors suggest the total pup production was 390,000 for 1966 (50,000 higher than previous estimates) and they project a sustainable yield of 200,000 (total) harp seals when catches of mature females are kept at a low level.

Critiques of 75/121 by Ricker (Res.Doc. 75/XII/143) and by Sergeant (Res.Doc. 75/XII/147) indicate systematic errors such that the estimate of 390,000 pups produced in 1966 should be reduced to about 300,000. Projections (75/121) suggesting a sustainable catch of 200,000 in 1976 are based on estimated mortality rates that are shown by Canadian analyses to be too low.

Summary of Canadian Research Documents

75/XII/141 Ronald and Capstick
75/XII/142 Sergeant
75/XII/143 Ricker
75/XII/144 Lavigne et al.
75/XII/145 Lett and Lavigne
75/XII/147 Sergeant

General Methods of Analysis

The referenced Canadian documents differ in certain details because of assumptions and methodology employed, but the general conclusions are similar. The following is a generalized guide:

Ronald and Capstick (75/XII/141) employed a modified Allen model and iteratively derived logical total mortality rates. Their method does not include density dependant changes in maturity rates, nor is it based on the catch equation.

Ricker (75/XII/143) applies new mortality rates which he has calculated from the Norwegian age composition data to his earlier dynamic model and calculates the estimated number of age 6+ females. He does not incorporate density dependant changes in the maturity ogive.

Lett and Lavigne (75/XII/145) employ virtual population analysis and construct a simulation model which incorporates density dependant changes in the maturity ogive. (The age at which the first pup is produced decreases as the population decreases).

Estimates Of Population Status At Start Of 1975

	Thousands		
	Pups	Age 1+ (Total excluding pups)	Age 6+
Ronald & Capstick (2 mortality rates)	139-264	492-1155	310-593 (males & females)
Ricker	181		181 (females only)
Lett & Lavigne VPA	216	650	225 (males & females)
Lavigne et al (ultra-violet census)	126±71 to 157±99		
(Protection Officers* estimates)	(250-265)		
Harvest	141	42	16

* Visual estimates of 100,000 in Gulf by S. Dudka and 150,000 to 165,000 at Front by T. Curran

The results of the above analyses suggest the 1975 pup production was about 200,000. The harvest of 140,629 (133,079 at the Front and 7,550 in the Gulf; 75/XII/142) gives an exploitation rate of 70%. Even for the larger estimate of 250,000 pups (provided by Protection Officers with long experience in the field), the exploitation rate was still an excessive 56%.

Equilibrium Exploitation Rate on Pups

If the harp seal population were in equilibrium, the sustainable harvest of pups could not exceed 20% of the production even with only incidental harvest of older seals (Ricker; Lett and Lavigne).

The herd is certainly not in equilibrium. If if were,then only 40,000 would have been the allowable catch for an estimated 200,000 pups and 50,000 for an estimated 250,000 for the 1975 season.

Estimates of Mortality Rates

Using the Norwegian age composition data, Ricker calculates an actual mortality rate of 23.2% per year for adult seals from data prior to 1968 and 21.7% since. This figure, which incorporates a correction for decreasing recruitment, includes both natural and hunting mortality. By estimating the hunting mortality component, he derives natural mortality estimates of 18.6% from data prior to 1968 and 16.6% since.

The iterative method of Ronald and Capstick suggests the natural mortality rate may lie between 15 and 16% for the period since 1952. However, because density dependant maturity was not taken into account, these rates are probably equivalent to about 18% and 19%.

The detailed analysis of Lett and Lavigne (considering total mortality as a function of effort) provides a minimum estimate of natural mortality of 15% (M = 0.16) and a value of 19% (M = 0.21) taking systematic biases due to decreasing recruitment into account. The higher figure provides close correspondence between their simulation analysis and their Virtual Population Analysis.

It must be realized that such estimates of natural mortality include an unknown and variable component which should be attributed to hunting mortality. The catch data provides no indication of the number of seals killed and lost, so no refinements are possible.

The present estimates of natural mortality, approaching 19%, are higher than those used in any previous analysis or prediction. For example, Benjaminsen and Øritsland (75/121) use a total female mortality of 10% as a basis for their predictions.

Prognosis

Low and decreasing pup escapement plus an increased take of age one and older seals has set up an age distribution such that the number of breeding females will unavoidably decline. Ricker's calculations (Table 5) predict there will be only 103,000 age 6+ females by 1980, even if all sealing is stopped now. Lett and Lavigne incorporate a density dependant maturity ogive in their model to account for reproduction by females younger than age 6. The effect of this is to slightly temper the drop predicted by Ricker, but only slightly because recruitment from recent year classes will be small.

The herd now appears to be in worse condition than predictions in 1972 suggested it would be. A major reason for this is that the management strategy has utilized the most optimistic values from the available range of estimates. The prognosis for the herd is good, provided the hunt is drastically curtailed. A new range of estimates and projections are available, but the risk associated with continuing to go with the more optimistic ones is considerable.

Projections by Ronald & Capstick for a range of hunting levels are given on pages 8 and 9 of their Table 1. Depending on which natural mortality rate estimate is used, and what mix of pups, young and adults, is taken, they predict that even modest hunts could drive the herd to extinction.

The portrayal of the simulation model of Lett and Lavigne (their Fig. 9) is easier to follow and has the advantage that it incorporates density dependant changes in the maturity ogive. The maximum continuing take that would not further deplete the herd is of the order of 10,000 or slightly more pups, in addition to the Canadian Arctic and Greenlander catch. It must be emphasized that these projections are based on a population in equilibrium and the harp seal is badly out of equilibrium.

Their simulation model indicates that the harp seal herd requires about 100 years to reach equilibrium at any particular population size. Thus, even the prediction that the above catch would not further deplete the herd must be accepted with caution.

Management Alternatives

Maximum sustainable yield is a recognized and useful reference point for management considerations. Lett and Lavigne have calculated the MSY population and the time required to reach that level using population parameters equivalent to those estimated for the past two decades. Maximum sustainable yield may be in the range of from 83,000 to 115,000 and the population size about 1.7 million at equilibrium.

Examples of projections for reaching MSY conditions assuming the minimum estimate of natural mortality (15%) are:

- Total moratorium except Canadian Arctic and Greenland, 20 years
- 10,000 pups plus Canadian Arctic and Greenland, 24 years
- Any larger take, as in a phase-down,would prolong the period of recovery and increase the risk

Other sustainable yields can be considered, of course, (and might be ecologically desirable) but the population requires several years of recovery before any significant sustainable level is reached. At the minimum, the directed fishery on age 1+ should cease, perhaps permanently, and there should be a drastic reduction in pup kill for at least 5 years to allow adequate recruitment.