Norway request to ICES on management of the harp and hooded seal stocks in the Northeast Atlantic

Advice summary

Greenland Sea harp seal

ICES estimates the 2019 total stock size of Greenland Sea harp seals at 433 900 (95% CI = 312 300–555 500) animals. This is based on the pup production estimate from the most recent aerial survey in 2018, which was 54 200 (95% CI: 36 100–72 200) animals; significantly lower than the estimate of 89 600 (95% CI: 68 600–117 000) animals from the previous survey flown in 2012. The reported catch in 2019 was 5813 animals, which included 2168 pups, during the 52-day season (10 April–31 May).

The age-structured population dynamics model used was not able to reliably fit to the pup production estimates from the 1990s, and there were concerns regarding the reliability of the sparse reproductive data. Due to these problems, ICES concluded that the population model could not be used to produce a reliable catch forecast. ICES cannot, therefore, advise on an annual harvest in scenarios 2 and 3 mentioned in the request (see Request section below).

ICES did, however, examine the sensitivity of model estimates of total abundance to changes in model inputs. It was found that although the different runs identified different population trends, the final estimates of abundance in 2019 were similar between different runs.

ICES advises that a catch option should be set using the potential biological removal (PBR) framework with a recovery factor (F_R) of 0.5. The estimated PBR level for the Greenland Sea harp seal population is 11 548 animals, which represents the maximum number of animals that could be caught annually. An annual catch at the current 2019 level is consistent with the PBR harvest level and would therefore not adversely affect the stock; this is harvest scenario 1 in the request. The PBR framework does not explicitly take into account the age and sex structures of the populations and so the removal of animals should be random with respect to age and sex. As the natural mortality for pups is higher than for older animals, a bias towards younger animals would be a more conservative approach, whereas a bias towards 1+ animals would require additional simulations to calculate the PBR.

White Sea/Barents Sea harp seal

ICES estimates the 2019 total stock size of White Sea/Barents Sea harp seals at 1 497 200 (95% CI: 1 292 900–1 701 400) animals. No survey to estimate pup production has been completed since the 2016 assessment, but new information on reproductive parameters was available. The reported catch in 2019 was 602 animals, which included 34 pups.

The pup production model does not fit the pup production estimates well, and cannot accommodate the rapid decline in pup production that occurred after 2003. For this reason, and because the time since the last pup survey is greater than five years, this stock is considered data limited. ICES concluded that the population model could not be used to produce a reliable catch forecast. ICES cannot, therefore, advise on an annual harvest in scenarios 2 and 3 mentioned in the request (see Request section below).

ICES advises that a precautionary approach is used when estimating PBR catch options, i.e. employing a low F_R (0.25). Based on this, ICES advises a PBR level of 21 172 animals annually; this represents the maximum number of animals that could be caught annually. An annual catch at the current 2019 level is, therefore, consistent with the PBR harvest level and would not adversely affect the stock: this is harvest scenario 1 in the request. PBR does not explicitly take into account the age and sex structures of the populations, so the removal of animals should be random with respect to age and sex. As the natural mortality for pups is higher than for older animals, a bias towards younger animals would be a more conservative approach, whereas a bias towards 1+ animals would require additional simulations to calculate the PBR.

Greenland Sea hooded seal

ICES estimates that the stock remains at a historically low level, with a 2019 total stock estimate of about 77 000 animals. There have been no reported catches in recent years.

ICES advises that no catches should be taken from this stock, with the exception of those taken for scientific purposes.

Request

We understand that new information is now available on both the harp and hooded seal stocks. Therefore, we would request an assessment of status and harvest potential of the harp seal stocks in the Greenland Sea and the White Sea/Barents Sea, and of the hooded seal stock in the Greenland Sea.

ICES should also assess the impact on the harp seal stocks in the Greenland Sea and the White Sea/Barents Sea of an annual harvest of:

1. current harvest levels,
2. sustainable catches (defined as the fixed annual catches that stabilizes the future 1 + population),
3. catches that would reduce the population over a 15-years period in such a manner that it would remain above a level of 70% of the maximum population size, determined from population modelling, with 80% probability.

Elaboration of the advice

Greenland Sea harp seal

Harp seals from this stock were historically taken by Russian and Norwegian sealers, but Russia has not harvested in this area since 1994. The historical hunt during the 1980s was, on average, 9200 seals per year; this declined to around 5300 seals, on average, during the 1990s. Since the 2000s, annual catch rates have ranged between 1232 and 16 033 seals (Table 7).

The annual quota for 2017–2019 was set at 26 000 1+ animals, where two pups are equivalent to removing one 1+ animal (Table 4). The total catches of harp seals were 2000 (including 1934 pups) in 2017, 2703 (including 1218 pups) in 2018, and 5813 (including 2168 pups) in 2019 (Table 7).

The current aerial survey methodology has been used since 1990. Estimated pup production increased from 55 625 (coefficient of variation, CV = 0.08) pups in 1990 to a maximum of 110 530 (CV = 0.25) pups in 2007, but has since declined to current levels of 54 181 (CV = 0.17) pups in 2018 (ICES, 2019).

An age-structured population dynamics model that incorporates information on catches and reproductive parameters, is fitted to the independent estimates of pup production by adjusting the starting population size and mortality rates to minimize the log-likelihood function (ICES, 2019).

ICES has concerns regarding the following:

- variable estimates of pup production obtained using the mark–recapture data collected during the 1980s and 1990s, and the poor fit of the model to these data;
- reliability of some of the reproductive parameters that have been measured at sparse intervals throughout the period, from 1946 to the present; and
- reproductive data that are introduced into the model as fixed parameters.

As a result, model estimates of mortality, total abundance, and pup production will underestimate the level of uncertainty associated with these parameters.

To explore the impact of using different reproductive data, three model runs were completed:

i) using all data,
ii) using all fecundity data, excluding the mark–recapture estimates, but including all aerial survey estimates; and
iii) with fecundity (F) fixed at the long-term mean from all sampling (F = 0.84), and a single maturity curve and all aerial survey data.

The three runs resulted in some differences in estimated population trends (Figure 1), but the estimates of the 2019 population size were relatively consistent between runs (Figure 1; Table 1). Combining the estimates from these three runs results in a 2019 abundance estimate of 433 900 animals (95% CI: 312 300–555 500) for the Greenland Sea harp seals.

Owing to the unexplained variability and uncertainty with the mark–recapture and reproductive input data identified above, ICES concluded that the population model could not be used to produce a reliable catch forecast. ICES cannot, therefore, advise on an annual harvest based on scenarios 2 and 3 mentioned in the request.

ICES advises that the PBR framework approach be used to estimate total allowable catches. The strength of the PBR approach is that it only requires a single abundance estimate to calculate a compliant harvest level (see the Methods section for more information on PBR). Using a (default) F_R of 0.5 results in a PBR level of 11 548 animals, which represents the maximum number of animals that could be caught, PBR does not explicitly take into account the age and sex structures of the populations. The removal of animals should therefore be random with respect to age and sex. As the natural mortality for pups is higher than for older animals, a bias towards younger animals would be a more conservative approach, whereas a bias towards 1+ animals would require additional simulations to calculate the PBR. An F_R of 0.5 was selected, given that the population remains abundant compared to historical estimates despite the decline in pup production.

Table 1 Population size estimates, and their uncertainties, for the Greenland Sea harp seal stock, determined using the age-structured population dynamics model. Various population sizes were estimated using various pup production data subsets and fecundity input. "All surveys" = aerial surveys and mark–recapture surveys; "only aerial" = only aerial surveys (includes an additional aerial survey from 1991); "only aerial, constant fecundity" = all fecundities set to their historical mean (0.84), and one combined maturity curve used throughout time-series. N_{min} is the lower 20th percentile of the lognormal distribution around the abundance estimate.

Scenarios	Population estimate (number of individuals)	N_{min}	CV
All surveys (i)	426 808	379 624	0.140
Only aerial (ii)	422 688	374 224	0.145
Only aerial , constant fecundity (iii)	452 117	400 999	0.143
Average of three runs	***433 871***	***384 948***	***0.143***

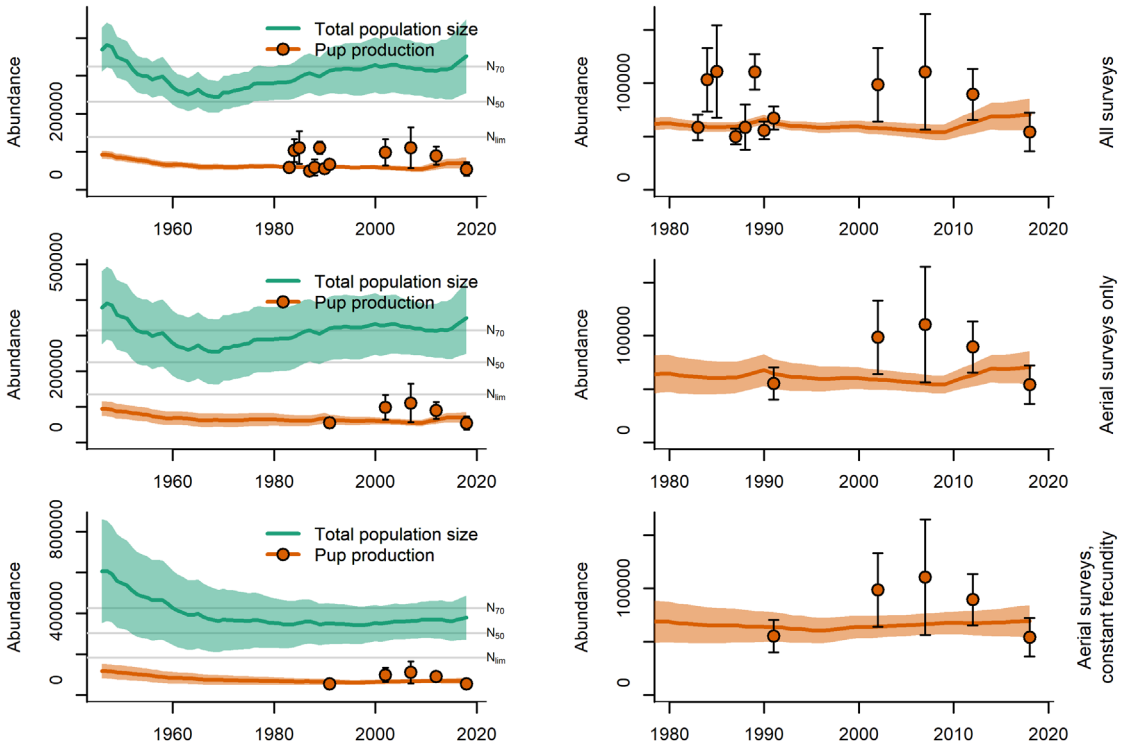

Figure 1 Model trends for the Greenland Sea harp seal population, with models fitted to different combinations of historical pup production estimates and fecundity values. Left (full lines): Total population and pup abundance estimates. Right (full line): Pup abundance estimates. Abundances are in number of animals. The shaded areas are the 95% confidence intervals. N_{70}, N_{50}, and N_{lim} denote 70%, 50%, and 30% of the historical maximum population size, respectively. Observed pup production estimates are indicated by filled circles. Top row: all surveys were included (aerial surveys and mark–recapture surveys); middle row: only aerial survey data were fitted (includes an additional aerial survey from 1991); bottom row: only aerial survey data were fitted, all fecundities set to their historical mean (0.84), and one combined maturity curve used throughout time-series.

White Sea/Barents Sea harp seals

Harp seals from this stock were historically taken by Russian and Norwegian sealers. Harvesting by Russian sealers occurred primarily in the White Sea, while harvesting by Norwegian sealers targeted animals that had drifted out of the White Sea into international waters. The annual historical catch has been, on average, 68 362 seals in the 1980s, which declined to about 38 000 seals, on average, between 1990 and 2003. Since 2009 catch rates have been in the 100s, with the exception of 2018 (Table 8).

Due to concern over the sharp decline in pup production after 2003, ICES (2016) advised that removals be restricted to the estimated sustainable equilibrium level. This was 10 090 1+ animals (where two pups balanced one 1+ animal).

The Joint Norwegian–Russian Fisheries Commission followed this advice, allocating 7000 seals of this annual total allowable catch (TAC) to Norway and 3090 seals to Russia in 2017–2019. A ban implemented on all pup catches prevented a Russian hunt in the White Sea during the period 2009–2013. This ban was removed before the 2014 season; however, the restricted availability of ice has not allowed for any sealing since 2014. This has resulted in no commercial Russian harp seal catches in the White Sea after 2014. No Norwegian vessels targeted the hunting area in the southeastern Barents Sea in 2017. Norway hunted in the area in both 2018 and 2019. In September 2017, one harp seal (1+ animal) was taken for scientific purposes north of Svalbard – presumably from the White Sea/Barents Sea population. The total catches of harp seals were 1 in 2017, 2241 (including 21 pups) in 2018, and 602 (including 34 pups) in 2019 (Table 8).

No new survey to estimate pup production has been completed since 2013. New reproductive data (N = 169) were collected between 20 April and 13 May 2018.

Pup production in this stock, estimated via aerial surveys, fell from roughly 300 000 pups between 1998 and 2003 to less than 160 000 pups between 2005 and 2013 (ICES, 2019).

The same age-structured population dynamics model was employed for the Barents Sea/White Sea harp seal stock, which incorporated information on catches and reproductive parameters and was fitted to data on the independent estimates of pup production (ICES, 2019).

The population model estimate of abundance for Barents Sea/White Sea harp seals in 2019 is 1 497 200 (95% CI: 1 292 900–1 701 400) animals. The model fit to the pup production data is very poor and the model is unable to account for the marked drop in pup production that occurred after 2003 (Figure 2). For this reason, model estimates are highly uncertain and ICES concluded that the population model could not be used to produce a reliable catch forecast. ICES cannot, therefore, advise on an annual harvest based on scenarios 2 and 3 mentioned in the request.

ICES advises that the PBR limit should be estimated with an F_R of 0.25 for the reasons outlined above and because it has been more than five years since the last survey, which classifies this stock as a data-limited stock.

Table 2 Abundance, N_{min}, recovery factor, and PBR estimates for Barents/White Sea harp seals. N_{min} is the lower 20th percentile of the lognormal distribution around the abundance estimate. In number of individuals.

2019 Abundance	N_{min}	F_R	PBR
1 497 190	1 411 469	0.5	42 344
1 497 190	1 411 469	0.25	21 172

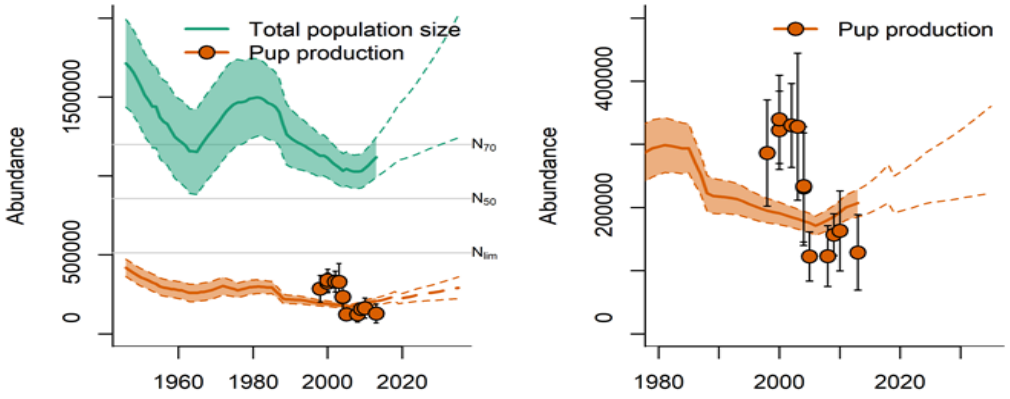

Figure 2 Modelled population trajectories for Barents Sea/White Sea harp seals. Left (full lines): Total population and pup abundance estimates. Right (full line): Pup abundance estimates. Abundances are in number of animals. The shaded areas are the 95% confidence intervals and the dashed lines the future projections. N_{70}, N_{50}, and N_{lim} denote 70%, 50%, and 30% of the historical maximum population size, respectively. Observed pup production estimates are indicated by filled circles.

From 2007 to the present the model predicted an increase in population size, but this is inconsistent with the dramatic reduction in observed pup production. The inability of the population model to account for the rapid decline in pup production in the mid-2000s is not surprising, given the deterministic nature of the current model and the fact that three parameters are estimated (initial population size [N for the year 1946], mortality of pups [M_0], and mortality of adults [M_{1+}]). Additional data were included in the final population model runs in 2019, including high mortality numbers from seals caught in fisheries gear or found dead on beaches (commonly referred to as seal invasions) in the 1980s and 1990s. Some of the scenarios examined included changes in capelin and cod abundance, to see if changes in abundance of capelin and cod could improve the fit of the population model to the independent estimates of pup production. Capelin is a major prey species for harp seals, and cod is an important predator of capelin. These scenarios showed promise for future model development.

The precautionary approach (PA) framework, developed by the Working Group on Harp and Hooded Seals (WGHARP; ICES, 2003, 2005), is shown below in the Advice Rule section. Under this PA framework, removals from a data-limited population should be estimated using the PBR approach (ICES, 2003, 2005).

The PBR approach resulted in a catch estimate of 42 344 animals using an F_R of 0.5, and a PBR of 21 172 animals assuming an F_R of 0.25. ICES advises using the lower, more conservative, F_R; this is more in line with the uncertainty regarding the current status of this stock. PBR does not explicitly take into account the age and sex structures of the populations, so the removal of animals should be random with respect to age and sex. As the natural mortality for pups is higher than for older animals, a bias towards younger animals would be a more conservative approach, whereas a bias towards 1+ animals would require additional simulations to calculate the PBR.

Greenland Sea hooded seal

Hooded seals from this stock were historically taken by Russian and Norwegian sealers, but Russia has not harvested in this area since 1994. The historical hunt led to catches of more than 20 000 seals annually in the early 1970s; this dropped to around 180–8500 seals annually between 1989 and 2006. A sharp drop in catches has occurred thereafter, and in the last ninbe years about 20 seals have been captured annually (Table 9). Concerns over low pup production estimates in 2007 resulted in advice from ICES that no harvest of Greenland Sea hooded seals should be permitted, with the exception of catches for scientific purposes (ICES, 2006). This advice was immediately implemented, and has been maintained due to a subsequent low pup production estimate in 2012 (ICES, 2016). Total catches were 17 animals (including 14 pups) in 2017, 17 (including 9 pups) in 2018, and 23 (including 14 pups) in 2019 (Table 9). Three pups (2018) and one adult (2019) were taken by mistake by the commercial sealers.

Pup production of Greenland Sea hooded seals was estimated from images obtained during the harp seal aerial survey in March 2018. No stage determination survey for hooded seals was flown. Instead, observers noted the stages on the aerial survey imagery and adjusted the expected proportion of pups born; they assumed the distribution of births to be similar to that observed in 2012. After correcting for reader error, and adjusting for pups that were born after the survey was flown, estimated hooded seal pup production was 12 977 (95% CI = 9867–17 067) animals. This is lower than estimates obtained from comparable surveys in 2005 and 2007, but similar to the estimate from the most recent survey in 2012 of 13 655 (95% CI: 13 655–17 348) animals.

The same age-structured population dynamics model used for the harp seal populations was also used for the hooded seal populations. The model incorporated information on hooded seal catches and limited data on reproductive parameters and was fitted to the new aerial survey estimates of pup production (ICES, 2019). The estimated total abundance of Greenland Sea hooded seals was 76 623 (95% CI: 58 299–94 947) animals in 2019.

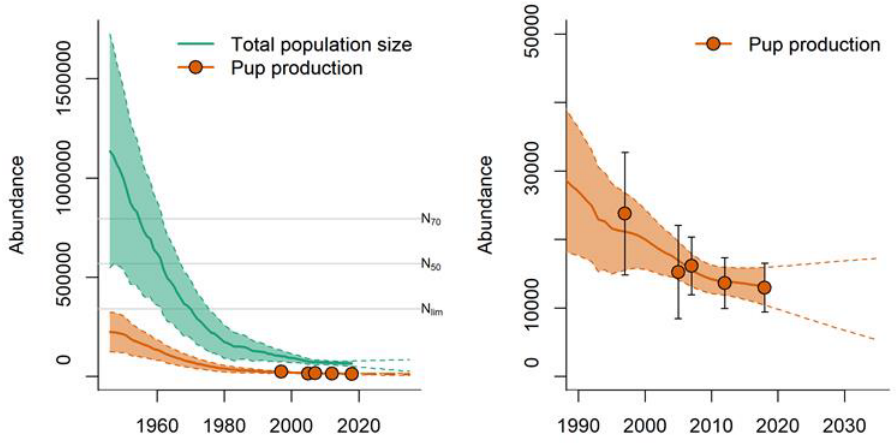

Figure 3 Modelled population trajectories for Greenland Sea hooded seals. Left (full lines): Total population and pup abundance estimates. Right (full line): Pup abundance estimates. Abundances are in number of animals. The shaded areas are the 95% confidence intervals and the dashed lines the future projections. N_{70}, N_{50}, and N_{lim} denote the 70%, 50%, and 30% of the historical maximum population size, respectively. Observed pup production estimates are indicated by filled circles.

The model indicates a population currently well below the limit reference level (N_{lim}; 30% of largest observed population size) (Figure 3). Following the precautionary approach framework developed by WGHARP (ICES, 2003, 2005), no commercial catches should be taken from this population.

Suggestions

More work needs to be undertaken, possibly through of a dedicated workshop, that includes:

- benchmarking the assessment model;
- examining the inclusion of biological and environmental parameters (e.g. prey availability, ice cover), in order to improve the fit of the population model to the independent estimates of pup production and reproductive parameters; and
- further definition of the choice of F_R levels, if the PBR framework is to be used in future as the basis for the advice.

New surveys, particularly for the Barents Sea/White Sea harp seal stock, are also needed to reduce the uncertainty in the model and in the advice provided.

Basis of the advice

Methods

Surveys to estimate pup production of Greenland Sea harp and hooded seals were flown in 2018. No surveys have been flown to estimate Barents Sea/White Sea harp seal pup production since 2013. The 2018 survey of the Greenland Sea harp and hooded seal stocks followed the typical survey design for these species; it is characterized by extensive reconnaissance flights to detect all patches of pups, a photographic survey of the concentrations to estimate numbers of animals on the ice at the time of the survey, and a stage determination survey where pups are aged from the air using specific morphometric and behavioural criteria to assign animals to one of seven developmental stages. Modelling the change in proportion of these stages during the pupping season provides an estimate of the proportion of pups born when the photographic survey is flown. This proportion is used to correct the photographic counts for pups born after the photographic survey has been completed. Normally several stage surveys are completed, but in March 2018 a single survey was completed. This was because of a combination of poor weather and the premature departure of the survey vessel. To correct the photographic counts, it was assumed that the distribution of births was similar to that observed in 2012.

Population sizes of all three stocks are estimated using the age-structured population dynamics model (ICES, 2019). Data inputs include information on catches, the age-specific proportion of mature females, and the proportion of mature females that are pregnant at a given year (as a proxy for the fecundity rate). The model is fitted to independent estimates of pup production obtained from aerial surveys, as well as historical mark–recapture estimates of pup production. There are no independent estimates of mortality rates for harp seals or hooded seals. Model fitting to the pup production data is achieved by adjusting the starting population, pup mortality (M_0) rate, and mortality rates of animals aged 1 year and older (M_{1+}) (Table 2).

Table 2 Model outputs for the three seal stocks. Production and population values are in number of animals. Fecundity rates are estimated from field samples. SD: Standard Deviation.

Variable	Greenland Sea harp seal	White Sea/Barents Sea harp seal	Greenland Sea hooded seal
Pup production (SD)	66 407 (7 552)	220 291 (14 845)	12 944 (1593)
Total population (SD)	433 871 (62 044)	1 497 190 (104 209)	76623 (9348)
Fecundity rate (range)	0.84 (0.8–0.92)	0.84 (0.68–0.86)	0.70
Adult mortality M_{1+} (SD)	0.14 (0.16)	0.13 (0.05)	0.17 (0.09)
Pup mortality M_0 (SD)	0.24 (1.09)	0.27 (0.25)	0.34 (0.22)

The fecundity rate data are an important input to the model. This information is needed for the "conversion" of pup numbers into an estimate of total population size. The amount of information available for each stock varies. In periods where data are missing, a linear transition between estimates is assumed. For the Greenland Sea harp seal stock, reproductive data are available from three periods (1959–1990, 2009, and 2014) over the model fitting period (1950–2019). For the White Sea/Barents Sea harp seal stock, information on reproductive rates is available for five periods (1962–

1972, 1976–1985, 1988–1993, 2006, and 2018). For the Greenland Sea hooded seal stock, the reproductive data are limited to two periods (1990–1994 and 2008–2010).

The PBR method estimates levels of removals that will allow a population to recover above the level of maximum sustainable yield (MSY) over a period of 100 years. Simulations have examined the robustness of the approach to reasonable violations of the assumptions, and it has been found to perform as expected 95% of the time. The PBR is estimated as:

$$PBR = N_{min} \cdot 0.5 \cdot R_{max} \cdot F_R$$

where: $\mathrm{N_{min}}$ is the minimum estimated population size (usually calculated as the 20th percentile of the log-normal distribution around the estimate of N); $\mathrm{R_{max}}$ is the maximum rate of population increase, with a default value for pinnipeds of 0.12; $\mathrm{F_R}$ is a recovery factor (between 0.1 and 1) (Wade, 1998).

Advice rule

ICES uses the following control rules in its precautionary approach framework for harp and hooded seals, as described in ICES (2003, 2005), to determine which assessment approach to follow:

1. Data-limited stocks.
   a) If the stock has no recent abundance estimates, then no harvest should occur.
   b) If the stock has 1–2 recent abundance estimates, then the control rules collapse to the point where the only concern is whether the abundance is less than or greater than N_{lim}, such that:
      i. if the abundance is greater than N_{lim}, then the potential biological removal (PBR) protocol is used to set the TAC;
      ii. if the abundance is less than N_{lim}, then no harvest should occur.

2. Data-rich stocks. For these stocks the full set of control rules established under the multi-tier system would apply. For example:
   a) if the abundance is greater than N_{70}, management objectives would be based upon the appropriate ICES model and would require that the population remain above the N_{70} level;
   b) if the abundance is greater than N_{50}, the management objective must include efforts to conserve the population (i.e. projections of proposed management actions must have a > 0.8 probability of the population returning to N_{70} within 10 years);
   c) if the abundance is greater than N_{lim}, and less than N_{50}, then significant conservation measures will be required (i.e. a 95% chance of recovery would be required, leading to something like the PBR protocol for setting harvest levels);
   d) if the abundance is less than N_{lim}, then no harvest should occur.

Quality of the assessment

The amount of data available for the assessments is limited compared to many fish stock assessments, but is good compared to many other marine mammal stocks. The age-structured population dynamics model is similar in structure to that used for other seal stocks (Canada harp, hooded, and grey seals; UK grey seals).

The model estimates pup production, and fits the estimates to observed pup production obtained from the aerial surveys by adjusting adult and juvenile mortality rates.

For comparison, reproductive rates for stocks in the northwestern Atlantic can vary considerably between years. For the three northeastern stocks concerned, however, the amount of data available on reproductive rates is limited. To make up for the lack of information, ICES estimates reproductive data for years where they are missing by interpolating between years with data. This means that the reproductive rates used for years with no data are changing in a straight line, when changes may not be linear from year to year. This results in model "stiffness", and the inability of the model to capture the year-to-year variability of pup production. The fit between estimated and observed pup production, therefore, is poor.

For the White Sea/Barents Sea stock, the observed pup abundance shows a major shift in 2005. Since 2005 there has been little change in pup production. This shift implies a significant change in production. Nevertheless, the model is unable to capture this sudden step-like shift, owing in part to the lack of annual data on reproductive rates. For the Greenland Sea harp seal stock there was unexplained variability of the mark–recapture estimates and a poor fit of the model to all historical pup production estimates (to be addressed by the Working Group on Harp and Hooded seals in 2021).

The model estimates mortality rates and their uncertainty, but uncertainty in the observed reproductive rates is not included. The total model uncertainties presented in Figures 1, 2, and 3 are thus underestimates; therefore, the precision of the model is overestimated.

Because there is no independent information on mortality rates to help bound these parameters, the model estimates of pup mortality (M_0) and the mortality rates of animals one year and older (M_{1+}) are highly correlated.

Despite the uncertainties associated with the estimated stock sizes, ICES considers the information sufficiently robust to form the basis for the best possible advice on catch using PBR and an appropriate recovery factor for the stock concerned.

Issues relevant for the advice

Harp and hooded seals require ice for pupping, moulting, and resting. Throughout their range, ice cover is declining either through a general decline in ice cover and stability and/or an increase in frequency of years with little ice and small pans which are less stable for pupping and nursing. Further work is needed to fully understand the effect of changing ice cover on these populations.

Reference points

Table 3 Reference points (RPs) for each stock of harp and hooded seals (ICES, 2019). N_{max} = historical maximum population size (estimated). N_{70} = 70% of N_{max} (first precautionary RP). N_{lim} = 30% of N_{max} (limit RP or N_{lim}). Values are in number of animals.

Stock	N_{lim}	N_{70}	N_{max}
Greenland Sea harp seal	142 189	370 266	473 963
White Sea/Barents Sea harp seal	639 109	1 422 716	2 130 362
Greenland Sea hooded seal	390 840	911 960	1 302 800

History of management

Tables 4, 5, and 6 indicate the quota and allocations for the three seal stocks.

Table 4 Greenland Sea harp seal quota and allocations in number of individual animals, 1985–2019.

Year	Annual quota	Allocations	
		Norway	Soviet Union/Russia
1985	25000	7000	4500
1986	11500	7000	4500
1987	25000	20500	4500
1988	28000	21000	7000
1989	16000	12000	9000
1990	7200	5400	1800
1991	7200	5400	1800
1992 to 1993	10900	8400	2500
1994	13100	10600	2500
1995	13100	10600	2500
1996	13100	10600	2500
1997 to 1998	13100	10600	2500
1999 to2000	17500	15000	2500
2001 to 2005	15000	15000	0
2006 to 2007	31200	31200	0
2008	31200	31200	0
2009	40000	40000	0

Year	Annual quota	Allocations	
		Norway	Soviet Union/Russia
2010	42000	42000	0
2011	42000	42000	0
2012 to 2013	25000	25000	0
2014 to 2016	21270	21270	0
2017 to 2019	26000	26000	0

Table 5 White Sea/Barents Sea harp seal quota and allocations in number of individual animals, 1979–2019.

Year	Annual quota	Allocations	
		Norway	Soviet Union/Russia
1979 to 1980	50000	16000	34000
1981	60000	17500	42500
1982	75000	17500	57500
1983	82000	18000	64000
1984	80000	18000	62000
1985 to 1986	80000	19000	61000
1987	80000	19000	61000
1988	70000	16600	53400
1989 to 1994	40000	9500	30500
1995	40000	8750	31250
1996	40000	9500	30500
1997 to 1998	40000	5000	35000
1999	21400	5000	16400
2000	27700	5000	22700
2001 to 2002	53000	5000	48000
2003	53000	10000	43000
2004 to 2005	45100	10000	35100
2006	78200	10000	68200
2007	78200	15000	63200
2008	55100	10000	45100
2009	35000	7000	28000
2010	7000	7000	0
2011	7000	7000	0
2012 to 2013	7000	7000	0
2014	7000	7000	0
2015 to 2016	19200	7000	12200
2017 to 2019	10090	7000	3090

Table 6 Greenland Sea hooded seal quota and allocations in number of individual animals, 1985–2019.

Year	Annual quota	Allocations	
		Norway	Soviet Union/Russia
1985	20000	8000	3300
1986	9300	6000	3300
1987	20000	16700	3300
1988	20000	16700	5000
1989	30000	23100	6900
1990	27500	19500	8000
1991	9000	1000	8000
1992 to 1994	9000	1700	7300
1995	9000	1700	7300
1996	9000	1700	7300
1997	9000	6200	2800
1998	5000	2200	2800
1999 to 2000	11200	8400	2800
2001 to 2003	10300	10300	
2004 to 2005	5600	5600	
2006	4000	4000	

Year	Annual quota	Allocations	
		Norway	Soviet Union/Russia
2007 to 2016	0	0	0
2017 to 2019	0	0	0

History of catches

Information is available on numbers caught (either as part of a harvest, or for scientific purposes) for all stocks (Tables 7, 8, and 9).

Table 7 Catches of harp seals in the Greenland Sea from 1946 through 2019. Totals include catches for scientific purposes. Catches are in numbers.

Year	Norwegian catches			Russian catches			Total catches		
	Pups	1+ animals	Total	Pups	1+ animals	Total	Pups	1+ animals	Total
1946 to 1950*	26606	9464	36070	-	-	-	26606	9464	36070
1951 to 1955*,**	30465	9125	39590	-	-	-**	30465	9125	39590
1956 to 1960*,**	18887	6171	25058	1148	1217	2365**	20035	7388	27423
1961 to 1965*	15477	3143	18620	2752	1898	4650	18229	5041	23270
1966 to 1970*	16817	1641	18458	1	47	48	16818	1688	18506
1971	11149	0	11149	-	-	-	11149	0	11149
1972	15100	82	15182	-	-	-	15100	82	15182
1973	11858	0	11858	-	-	-	11858	0	11858
1974	14628	74	14702	-	-	-	14628	74	14702
1975	3742	1080	4822	239	0	239	3981	1080	5061
1976	7019	5249	12268	253	34	287	7272	5283	12555
1977	13305	1541	14846	2000	252	2252	15305	1793	17098
1978	14424	57	14481	2000	0	2000	16424	57	16481
1979	11947	889	12836	2424	0	2424	14371	889	15260
1980	2336	7647	9983	3000	539	3539	5336	8186	13522
1981	8932	2850	11782	3693	0	3693	12625	2850	15475
1982	6602	3090	9692	1961	243	2204	8563	3333	11896
1983	742	2576	3318	4263	0	4263	5005	2576	7581
1984	199	1779	1978	-	-	-	199	1779	1978
1985	532	25	557	3	6	9	535	31	566
1986	15	6	21	4490	250	4740	4505	256	4761
1987	7961	3483	11444	-	3300	3300	7961	6783	14744
1988	4493	5170	9663	7000	500	7500	11493	5670	17163
1989	37	4392	4429	-	-	-	37	4392	4429
1990	26	5482	5508	0	784	784	26	6266	6292
1991	0	4867	4867	500	1328	1828	500	6195	6695
1992	0	7750	7750	590	1293	1883	590	9043	9633
1993	0	3520	3520	-	-	-	0	3520	3520
1994	0	8121	8121	0	72	72	0	8193	8193
1995	317	7889	8206	-	-	-	317	7889	8206
1996	5649	778	6427	-	-	-	5649	778	6427
1997	1962	199	2161	-	-	-	1962	199	2161
1998	1707	177	1884	-	-	-	1707	177	1884
1999	608	195	803	-	-	-	608	195	803
2000	6328	6015	12343	-	-	-	6328	6015	12343
2001	2267	725	2992	-	-	-	2267	725	2992
2002	1118	114	1232	-	-	-	1118	114	1232
2003	161	2116	2277				161	2116	2277
2004	8288	1607	9895				8288	1607	9895

Year	Norwegian catches			Russian catches			Total catches		
	Pups	1+ animals	Total	Pups	1+ animals	Total	Pups	1+ animals	Total
2005	4680	2525	7205				4680	2525	7205
2006	2343	961	3304				2343	961	3304
2007	6188	1640	7828				6188	1640	7828
2008	744	519	1263				744	519	1263
2009	5177	2918	8035	-	-	-	5117	2918	8035
2010	2823	1855	4678	-	-	-	2823	1855	4678
2011	5361	4773	10134	-	-	-	5361	4773	10134
2012	3740	1853	5593	-	-	-	3740	1853	5593
2013	13911	2122	16033	-	-	-	13911	2122	16033
2014	9741	2245	11986				9741	2245	11986
2015	2144	93	2237	-	-	-	2144	93	2237
2016	426	1016	1442	-	-	-	426	1016	1442
2017	1934	66	2000	-	-	-	1934	66	2000
2018	1218	1485	2703	-	-	-	1218	1485	2703
2019	2168	3645	5813	-	-	-	2168	3645	5813

* For the period 1946–1970 only 5-year averages are given.

** For the years 1955, 1956, and 1957 the Soviet Union combined catches of harp and hooded seals were reported at 3900, 11 600, and 12 900 animals, respectively. These catches are not included.

Table 8 Catches of harp seals in the White Sea/Barents Sea, 1946–2019. Catches are in numbers.

Year	Norwegian catches			Russian catches			Total catches		
	Pups	1+ animals	Total	Pups	1+ animals	Total	Pups	1+ animals	Total
1946 to 1950*			25057	90031	55285	145316			170373
1951 to 1955*			19590	59190	65463	124653			144243
1956 to 1960*	2278	14093	16371	58824	34605	93429	61102	48698	109800
1961 to 1965*	2456	8311	10767	46293	22875	69168	48749	31186	79935
1966 to 1970*			12783	21186	410	21596			34379
1971	7028	1596	8624	26666	1002	27668	33694	2598	36292
1972	4229	8209	12438	30635	500	31135	34864	8709	43573
1973	5657	6661	12318	29950	813	30763	35607	7474	43081
1974	2323	5054	7377	29006	500	29506	31329	5554	36883
1975	2255	8692	10947	29000	500	29500	31255	9192	40447
1976	6742	6375	13117	29050	498	29548	35792	6873	42665
1977	3429	2783	6212	34007	1488	35495	37436	4271	41707
1978	1693	3109	4802	30548	994	31542	32341	4103	36344
1979	1326	12205	13531	34000	1000	35000	35326	13205	48531
1980	13894	1308	15202	34500	2000	36500	48394	3308	51702
1981	2304	15161	17465	39700	3866	43566	42004	19027	61031
1982	6090	11366	17456	48504	10000	58504	54594	21366	75960
1983	431	17658	18089	54000	10000	64000	54431	27658	82089
1984	2091	6785	8876	58153	6942	65095	60244	13727	73971
1985	348	18659	19007	52000	9043	61043	52348	27702	80050
1986	12859	6158	19017	53000	8132	61132	65859	14290	80149
1987	12	18988	19000	42400	3397	45797	42412	22385	64797
1988	18	16580	16598	51990	2501	54401	51918	19081	70999
1989	0	9413	9413	30989	2475	33464	30989	11888	42877
1990	0	9522	9522	30500	1957	32457	30500	11479	41979
1991	0	9500	9500	30500	1980	32480	30500	11480	41980
1992	0	5571	5571	28351	2739	31090	28351	8310	36661
1993	0	8758	8758	31000	500	31500	31000	9258	40258
1994	0	9500	9500	30500	2000	32500	30500	11500	42000

Year	Norwegian catches			Russian catches			Total catches		
	Pups	1+ animals	Total	Pups	1+ animals	Total	Pups	1+ animals	Total
1995	260	6582	6842	29144	500	29644	29404	7082	36486
1996	2910	6611	9521	31000	528	31528	33910	7139	41049
1997	15	5004	5019	31319	61	31380	31334	5065	36399
1998	18	814	832	13350	20	13370	13368	834	14202
1999	173	977	1150	34850	0	34850	35023	977	36000
2000	2253	4104	6357	38302	111	38413	40555	4215	44770
2001	330	4870	5200	39111	5	39116	39441	4875	44316
2002	411	1937	2348	34187	0	34187	34598	1937	36535
2003	2343	2955	5298	37936	0	37936	40279	2955	43234
2004	0	33	33	0	0	0	0	33	33
2005	1162	7035	8197	14258	19	14277	15488	9405	22474
2006	147	9939	10086	7005	102	7107	7152	10041	17193
2007	242	5911	6153	5276	200	5476	5518	6111	11629
2008	0	0	0	13331	0	13331	13331	0	13331
2009	0	0	0	0	0	0	0	0	0
2010	0	105	105	5	5	10	5	110	115
2011	0	200	200	0	0	0	0	200	200
2012	0	0	0	0	9	9	0	9	9
2013	0	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0	0
2016	0	28	28	0	0	0	0	28	28
2017	0	1	1	0	0	0	0	1	1
2018	21	2220	2241	0	0	0	21	2220	2241
2019	34	568	602	0	0	0	34	568	602

* For the period 1946–1970 only 5-year averages are given.

Table 9 Catches of hooded seals in the Greenland Sea from 1946 through 2019. Totals include catches for scientific purposes. Catches are in numbers.

Year	Norwegian catches			Russian catches			Total catches		
	Pups	1+ animals	Total	Pups	1+ animals	total	Pups	1+ animals	Total
1946 to 1950*	31152	10257	41409	-	-	-	31152	10257	41409
1951 to 1955*,**	37207	17222	54429	-	-	-**	37207	17222	54429
1956 to 1960*	26738	9601	36339	825	1063	1888**	27563	10664	38227
1961 to 1965*	27793	14074	41867	2143	2794	4937	29936	16868	46804
1966 to 1970*	21495	9769	31264	160	62	222	21655	9831	31486
1971	19572	10678	30250	-	-	-	19572	10678	30250
1972	16052	4164	20216	-	-	-	16052	4164	20216
1973	22455	3994	26449	-	-	-	22455	3994	26449
1974	16595	9800	26395	-	-	-	16595	9800	26395
1975	18273	7683	25956	632	607	1239	18905	8290	27195
1976	4632	2271	6903	199	194	393	4831	2465	7296
1977	11626	3744	15370	2572	891	3463	14198	4635	18833
1978	13899	2144	16043	2457	536	2993	16356	2680	19036
1979	16147	4115	20262	2064	1219	3283	18211	5334	23545
1980	8375	1393	9768	1066	399	1465	9441	1792	11233
1981	10569	1169	11738	167	169	336	10736	1338	12074
1982	11069	2382	13451	1524	862	2386	12593	3244	15837
1983	0	86	86	419	107	526	419	193	612
1984	99	483	582	-	-	-	99	483	582
1985	254	84	338	1632	149	1781	1886	233	2119
1986	2738	161	2899	1072	799	1871	3810	960	4770
1987	6221	1573	7794	2890	953	3843	9111	2526	11637
1988	4873	1276	6149	2162	876	3038	7035	2152	9187
1989	34	147	181	-	-	-	34	147	181
1990	26	397	423	0	813	813	26	1210	1236
1991	0	352	352	458	1732	2190	458	2084	2542
1992	0	755	755	500	7538	8038	500	8293	8793
1993	0	384	384	-	-	-	0	384	384
1994	0	492	492	23	4229	4252	23	4721	4744
1995	368	565	933	-	-	-	368	565	933
1996	575	236	811	-	-	-	575	236	811
1997	2765	169	2934	-	-	-	2765	169	2934
1998	5597	754	6351	-	-	-	5597	754	6351
1999	3525	921	4446	-	-	-	3525	921	4446
2000	1346	590	1936	-	-	-	1346	590	1936
2001	3129	691	3820	-	-	-	3129	691	3820
2002	6456	735	7191	-	-	-	6456	735	7191
2003	5206	89	5295	-	-	-	5206	89	5295
2004	4217	664	4881	-	-	-	4217	664	4881
2005	3633	193	3826	-	-	-	3633	193	3826
2006	3079	568	3647	-	-	-	3079	568	3647
2007	27	35	62	-	-	-	27	35	62
2008	9	35	44	-	-	-	9	35	44
2009	396	17	413	-	-	-	396	17	413
2010	14	164	178	-	-	-	14	164	178
2011	15	4	19	-	-	-	15	4	19
2012	15	6	21	-	-	-	15	6	21
2013	15	7	22	-	-	-	15	7	22

Year	Norwegian catches			Russian catches			Total catches		
	Pups	1+ animals	Total	Pups	1+ animals	total	Pups	1+ animals	Total
2014	24	0	24	0	0	0	24	0	24
2015	5	6	11	0	0	0	5	6	11
2016	10	8	18	0	0	0	10	8	18
2017	14	3	17	0	0	0	14	3	17
2018	9	8	17	0	0	0	9	8	17
2019	14	9	23	0	0	0	14	9	23

* For the period 1946–1970 only 5-year averages are given.
** For the years 1955, 1956, and 1957 the Soviet Union combined catches of harp and hooded seals were reported at 3900, 11 600, and 12 900 animals, respectively. These catches are not included.

Sources and references

ICES. 2003. Report of the ICES/NAFO Working Group on Harp and Hooded Seals (WGHARP), 2–6 September 2003, Archangelsk, Russia. ICES CM 2004/ACFM:06. 59 pp.

ICES. 2005. Report of the ICES/NAFO Working Group on Harp and Hooded Seals (WGHARP), 30 August–3 September 2005, St Johns, Newfoundland, Canada. ICES CM 2006/ACFM:06. 54 pp.

ICES. 2006. Request from the Norwegian Government regarding Greenland Sea hooded seals. *In* Report of the ICES Advisory Committee on Fishery Management, Advisory Committee on the Marine Environment and Advisory Committee on Ecosystems, 2006. ICES Advice 2016, Book 3, Section 3.3.3.2, pp. 22–27.

ICES. 2016. Norway request to ICES on the status and harvest potential of the harp seal stocks in the Greenland Sea and the White Sea/Barents Sea, and of the hooded seal stock in the Greenland Sea. In Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 3, Section 3.4.3. 14 pp. https://doi.org/10.17895/ices.advice.5618

ICES. 2019. ICES/NAFO/NAMMCO Working Group on Harp and Hooded Seals (WGHARP).ICES Scientific Reports. 1:72. 194 pp. http://doi.org/10.17895/ices.pub.5617

Wade, P. 1998. Calculating limits to the allowable human-caused mortality of cetaceans and pinnipeds. Marine Mammal Science, 14: 1–37. https://doi.org/10.1111/j.1748-7692.1998.tb00688.x

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