Revised 5/15/2009

HARBOR SEAL (*Phoca vitulina richardsi*): Gulf of Alaska Stock

NOTE – January 2009: NMFS has new genetic information on harbor seals in Alaska which indicates that the current division of Alaskan harbor seals into the Southeast Alaska, Gulf of Alaska, and Bering Sea stocks needs to be reassessed. NMFS, in cooperation with our partners in the Alaskan Native community, is evaluating the new genetic information and hopes to make a joint recommendation regarding stock structure in 2009. In the interim, new information on harbor seal mortality levels is provided within this report. A complete revision of the harbor seal stock assessments will be postponed until new stocks are defined.

STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals inhabit coastal and estuarine waters off Baja California, north along the western coasts of the United States, British Columbia, and Southeast Alaska, west through the Gulf of Alaska and Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. They haul out on rocks, reefs, beaches, and drifting glacial ice, and feed in marine, estuarine, and occasionally fresh waters. Harbor seals generally are non-migratory, with local movements associated with such factors as tides, weather, season, food availability, and reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969, 1981). The results of recent satellite tagging studies in Southeast Alaska, Prince William Sound, and Kodiak are also consistent with the conclusion that harbor seals are non-migratory (Swain et al. 1996, Lowry et al. 2001, Small et al. 2001). However, some long-distance movements of tagged animals in Alaska have been recorded (Pitcher and McAllister 1981, Lowry et al. 2001, Small et al. 2001). Strong fidelity of individuals for haulout sites during the breeding season has been documented in several populations (Härkönen and Harding 2001), including in Alaska (Pitcher and Calkins 1979, Pitcher and McAllister 1981).

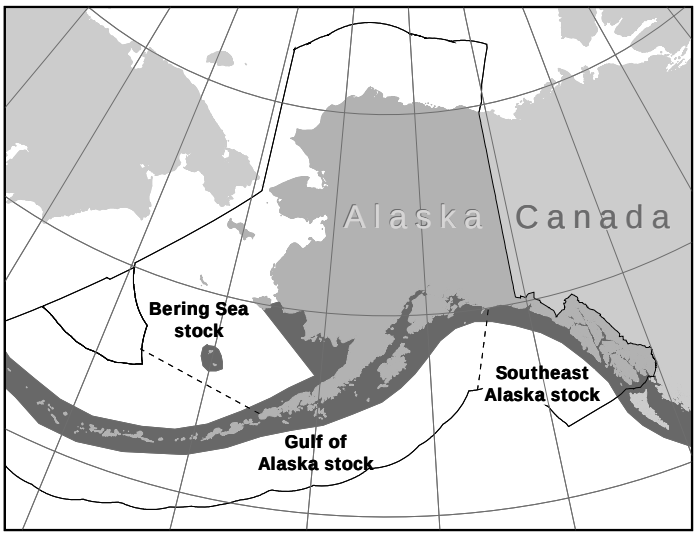

Figure 9. Approximate distribution of harbor seals in Alaska waters (shaded area).

Westlake and O'Corry-Crowe's (2002) analysis of genetic information revealed population subdivisions on a scale of 600-820 km. These results suggest that genetic differences within Alaska, and most likely over their entire North Pacific range, increase with increasing geographic distance. New information revealed substantial genetic differences indicating that female dispersal occurs at region specific spatial scales of 150-540 km. This research identified 12 demographically independent clusters within the range of Alaskan harbor seals; however additional research is required as unsampled areas within the Alaskan harbor seal range remain (O'Corry-Crowe et al. 2003).

Currently there are three stocks of harbor seals identified in Alaska: 1) the Southeast Alaska stock - occurring from the Alaska/British Columbia border to Cape Suckling, Alaska (144°W), 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, including animals throughout the Aleutian Islands, and 3) the Bering Sea stock - including all waters north of Unimak Pass (Fig. 8). Information concerning the three harbor seal stocks recognized along the West Coast of the continental United States can be found in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

The National Marine Mammal Laboratory (Alaska Fisheries Science Center) routinely conducts aerial surveys of harbor seals across their entire range in Alaska. Each of five survey regions is surveyed, with one region surveyed per year. To derive an accurate estimate of population size from these surveys, a method was developed to address the influence of external conditions on the number of seals hauled out on shore, and counted, during the

surveys. Many factors influence the propensity of seals to haul out, including tides, weather, time of day, and date in the seals' annual life history cycle. A statistical model defining the relationship between these factors and the number of seals hauled out was developed for each survey region. Based on those models, the survey counts for each year were adjusted to the number of seals that would have been ashore during a hypothetical survey conducted under ideal conditions for hauling out (Boveng et al. 2003). In a separate analysis of radio-tagged seals, a similar statistical model was used to estimate the proportion of seals that were hauled out under those ideal conditions (Simpkins et al. 2003). The results from these two analyses were combined for each region to estimate the population size of harbor seals in Alaska. Discussions of estimates from previous surveys (1994 and 1996) can be found in earlier stock assessment reports.

The statewide abundance estimate for Alaskan harbor seals based on 1996-2000 surveys was 180,017 (CV=0.03; NMFS, unpublished data). Those surveys had incomplete coverage of terrestrial sites in Prince William Sound and of glacial sites in the Gulf of Alaska and the Southeast Alaska regions. Those problems have been addressed in the most recent surveys (2001-2005). Prince William Sound was surveyed completely in 2001. Data analyses are currently underway, and a manuscript describing the regional and statewide population estimates is in preparation. The current abundance estimate for the GOA stock (45,975; CV = 0.04) is calculated from GOA surveys in 1996 (35,982; 30,035 $\times$ 1.198; CV = 0.05) and Aleutian Islands surveys in 1999 (9,993; 8,341 $\times$ 1.198; CV = 0.06; NMFS, unpublished data).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 45,975 and its associated CV(N) of 0.04, results in an N_{MIN} of 44,453 harbor seals for the Gulf of Alaska stock.

Current Population Trend

There are data on population trends available from three areas within the Gulf of Alaska stock of harbor seals: Prince William Sound, Kodiak, and the Aleutian Islands. In Prince William Sound, harbor seal numbers declined by 57% from 1984 to 1992 (Pitcher 1989, Frost and Lowry 1993). Frost et al. (1999) reported a 63% decline in Prince William Sound from 1984-97; more recent information on trends in this area is not available. The decline began before the 1989 *Exxon Valdez* oil spill, was greatest in the year of the spill, and may have lessened thereafter. Between 1989 and 1995, aerial survey counts of 25 haulout sites in Prince William Sound (trend route A) showed significant declines in the number of seals during the molt (19%) and during pupping (31%) (Frost et al. 1996). Adjusted molt period counts for 1996 were 15% lower than the 1995 counts, indicating that harbor seal numbers in Prince William Sound have not yet recovered from the spill or whatever was causing the decline and that the long-term decline has not ended (Frost et al. 1997).

A steady decrease in numbers of harbor seals has been reported throughout the Kodiak Archipelago from the mid-1970s to the 1990s. Trend counts from Kodiak documented a significant increase of 6.6%/year (95% CI: 5.3-8.0; Small et al. 2003) over the period 1993-2001, which was the first documented increase in harbor seals in the Gulf of Alaska. On southwestern Tugidak Island, formally one of the largest concentrations of harbor seals in the world, counts declined 85% from 1976 (6,919) to 1988 (1,014) (Pitcher 1990). More recently, the Tugidak Island mean count has increased from 769 in 1992 to 2,090 in 2001 (Small 1996, Withrow et al. 2002), although this still only represents a fraction of its historical size. Despite some positive signs of growth in certain areas, the overall Gulf of Alaska stock size likely remains small compared to its size in the 1970s and 1980s.

Small et al. (2008) compared harbor seal counts from 106 islands in the Aleutian Islands surveyed in 1977-1982 with counts from the same islands surveyed in 1999. An overall decline of 67% was observed during this 20-year period; the largest decline of 86% was in the western Aleutians, followed by 66% in the central Aleutians, and 45% in the eastern Aleutians (Small et al. 2008). These findings indicate that harbor seal abundance throughout the Aleutian Islands was significantly lower in the late 1990s than in the 1970s and 1980s.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Reliable rates of maximum net productivity have not been estimated for the Gulf of Alaska or Bering Sea harbor seal stock. Population growth rates were estimated at 6% and 8% between 1991 and 1992 in Oregon and Washington, respectively (Huber et al. 1994). Harbor seals have been protected in British Columbia since 1970, and the population has responded with an annual rate of increase of approximately 12.5% since 1973 (Olesiuk et al. 1990). However, until additional data become available from which more reliable estimates of population growth

can be determined, it is recommended that the pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% be employed for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for pinniped stocks with unknown status (Wade and Angliss 1997). Thus, for the Gulf of Alaska stock of harbor seals, PBR = 1,334 animals (44,453 × 0.06 × 0.5).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

The previous stock assessment for harbor seals indicated that there were five observed commercial fisheries that operated within the range of the Gulf of Alaska stock of harbor seals. As of 2003, changes in how fisheries are defined in the List of Fisheries have resulted in separating these fisheries into 22 fisheries based on both gear type and target species (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. During the 5-year period from 2002 to 2006 there were no observed incidental takes of harbor seals by any of these fisheries (Perez 2006, Perez unpubl. ms.). More current data on estimated fishery-related serious injury and mortality are being analyzed and will be available for inclusion in the 2010 SARs.

In the Prince William Sound salmon drift gillnet fishery, observers recorded two incidental mortalities of harbor seals in 1990 (Wynne et al. 1991), and one in 1991 (Wynne et al. 1992). The extrapolated kill estimates were 36 (95% CI: 2-74) in 1990 and 12 (95% CI: 1-44) in 1991, resulting in a mean kill rate of 24 (CV = 0.5) animals per year for this fishery. In 1990, observers were onboard 300 (57.3%) of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet. In 1991, observers were onboard 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet. The estimated mortality rate of harbor seals based on the 1990 and 1991 observed mortalities for this fishery is 0.0002 kills per set. Fisher self-reports of harbor seal mortalities due to this fishery detail 19, 4, 7, 24, and 0 mortalities in 1990, 1991, 1992, 1993, and 1996, respectively. The extrapolated (estimated) mortality from the 1990-91 observer program (24 seals per year) accounts for these mortalities, so they do not appear in Table 11. In 1990, observers were onboard 59 (38.3%) of the 154 vessels participating in the Alaska Peninsula/Aleutian Island salmon drift gillnet fishery, monitoring a total of 373 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991).

Between 1998 and 2002 there were no fishery related standings of Gulf of Alaska harbor seals documented in the Alaska Region stranding records.

The estimated minimum annual mortality rate incidental to commercial fisheries is 24.0, based on observer data (24.0), and stranding data (0) where observer data were not available. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer programs in several salmon gillnet fisheries known to interact with this stock.

Table 11. Summary of incidental mortality of harbor seals (Gulf of Alaska stock) due to fisheries from 1990 through 2004 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from stranding data. Data from 2000 to 2004 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. N/A indicates that data are not available.

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Prince William Sound salmon drift gillnet	90-91	obs data	4-5%	2, 1	36, 12	24 (CV = 0.50)
Alaska Peninsula/Aleutian Islands salmon drift gillnet	90	obs data	4%	0	0	0

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Cook Inlet salmon drift gillnet	1999 2000	obs data	1.8% 3.7%	0 0	0 0	0
Cook Inlet salmon set gillnet	1999 2000	obs data	7.3% 8.3%	0 0	0 0	0
Kodiak Island salmon set gillnet	2002	obs data	6.0%	0	0	0
Observer program total						24.0 (CV = 0.50)
Minimum total annual mortality						24.0 (CV = 0.50)

Subsistence/Native Harvest Information

Table 12 provides a summary of the subsistence harvest information for the Gulf of Alaska stock. The Alaska Native subsistence harvest of harbor seals has been estimated by the Alaska Native Harbor Seal Commission (ANHSC) and the Alaska Department of Fish and Game (ADFG). The previous stock assessment reported that the mean annual subsistence take from this stock of harbor seals, including struck and lost, over the 3-year period from 1994 to 1996 was 791 animals. Recent information from the ADFG indicates the average harvest level from 2003 to 2007, including struck and lost, was 807 harbor seals per year.

Table 12. Summary of the subsistence harvest data for the Gulf of Alaska stock of harbor seals, 2003-2007. Data are from Wolfe et al. 2004; Wolfe et al. 2006; Wolfe et al. 2008; J. Fall, ADFG, pers. comm., 04 February 2009.

Year	Estimated total number taken	Number harvested	Number struck and lost
2003	688	613	75
2004	857	747	110
2005	958	861	97
2006	848	766	82
2007	686	620	66
Mean annual harvest (2003-2007)	807	721	86

Other Mortality

Illegal intentional killing of harbor seals occurs, but the magnitude of this mortality is unknown (Note: the 1994 Amendments to the MMPA made intentional lethal take of any marine mammal illegal except where imminently necessary to protect human life). The Alaska Region stranding records from 1998 to 2002 document three reports of stranded harbor seals found shot in the Gulf of Alaska, for an average of 0.6 over 5 years. It is not known whether these animals were killed illegally or if they were struck but lost in the subsistence harvest. Because the reason for the shooting is not known, these animals are added to the total number of human-related mortalities.

The Alaska Region stranding records document one Gulf of Alaska harbor seal was killed by a ship collision, and one was killed by massive blunt trauma between 1998 and 2002.

Mortalities may occasionally occur incidental to marine mammal research activities authorized under MMPA permits issued to a variety of government, academic, and other research organizations. Between 2003-2007, there was one mortality resulting from research on the Gulf of Alaska stock of harbor seals, which results in an average of 0.2 mortalities per year from this stock (Tammy Adams, Permits, Conservation, and Education Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910).

STATUS OF STOCK

Harbor seals are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. At present, annual U.S. commercial fishery-related mortality levels less than 133 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. A reliable estimate of the annual rate of mortality incidental to commercial fisheries is unavailable.

Therefore, it is unknown whether the kill rate due to commercial fishing is insignificant. Based on currently available data, the minimum estimated annual level of total human-caused mortality is 832 (24.0 + 0.4 + 807 + 0.6 + 0.2) harbor seals which does not exceed the PBR (1,334) for this stock. Until additional information on mortality incidental to commercial fisheries becomes available, the Gulf of Alaska stock of harbor seals is not classified as strategic. The status of this stock relative to its Optimum Sustainable Population size is unknown.

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