

**STATUS OF HARBOR AND GRAY SEAL POPULATIONS IN
NORTHERN NEW ENGLAND**

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ABSTRACT

We conducted an aerial survey of harbor seals along the coast and islands of Maine in late May and early June, 1997, and a second survey in August, 1997. In the pupping season survey in May-June, we counted 30,990 seals on ledges, of which 5,359 were pups. This count was 7.6 percent higher than the count in 1993, and pup numbers were higher than in 1993 by 17.3 percent. In August, we counted 19,956 harbor seals, which was much lower than in 1993. We observed a minimum of 100 gray seals in the May-June survey and 45 in the August survey, all on the outer islands of Penobscot Bay.

INTRODUCTION

Harbor seals are widely distributed throughout the Pacific and Atlantic oceans. Of the six subspecies worldwide, the northwestern Atlantic Harbor Seal (*Phoca vitulina concolor*) is found in Maine. It is common from Labrador to Rhode Island (Richardson 1976) and has been seen as far south as Florida (Bigg 1981). The northwest Atlantic subspecies, *P. v. concolor*, is considered to represent one breeding population. Breeding and pupping is normally restricted to areas north of the Maine/New Hampshire border (Temte et al. 1991).

The Maine harbor seal population has been rapidly increasing since the early 1980's. The annual rate of increase between 1981 and 1993 was 8.7%. Minimum number of seals observed in June 1981 was 10,543 and 28,810 in June of 1993. Estimated pup production has increased from 676 individuals in June 1981 to 4,250 individuals in June of 1993 (Kenney 1994).

Gray seals (*Halichoerus grypus*) are found throughout the coastal areas of the North Atlantic Ocean. Gray seals are abundant and increasing in waters of Eastern Canada (Zwanenburg and Bowen 1990). There are relatively fewer gray seals in U.S. waters. Unlike harbor seals, gray seals have pups in January. There has always been a small population in the Cape Cod area, and recently more gray seal pups have been born in this area (Rough 1995). During aerial surveys for harbor seals, gray seals were not observed in Maine until the summer of 1993. Richardson (1978) believed the summer gray seal population to be a minimum of 80 individuals.

Harbor seals are generally considered to be animals of inlets, islands and reefs (Boulva and McLaren 1979). Haul-out sites are required in order to pup, molt, thermoregulate and rest. Haul-out substrates vary with availability. Sandy beaches in California (Yochem et al. 1987, Allen et al. 1989), floating glacier ice in Alaska (Calambokidis et al. 1986), and tidally exposed sand and mud flats in California and Oregon (Brown and Mate 1983, Allen et al. 1989) are used as haul-outs. In Maine, harbor seals haul-out on rocky outcroppings and inter-tidal ledges off of the coast (Gilbert and Wynne 1984). Easily accessible, undisturbed rocky ledges of gentle slope and vegetative covering are often utilized (Richardson 1976).

Harbor seal haul-out patterns closely reflect the tidal cycle in Maine. Maine experiences tides up to 5.5 m that create extensive inter-tidal zones around coastal islands and ledges that are exposed only at low tide. Individual seals return to islands and ledges at the falling tide, and are left 'stranded' as the tide goes out, forming loose gregarious groups at low tide within the inter-tidal zone. As the tide returns, individuals return to the water (Richardson 1976). Because of the restricted availability of haul-out habitat at high tide, haul-out patterns in Maine are dictated by tidal stage.

The two annual peaks in haul-out numbers occur during the pupping and molting season (Sullivan 1980, Brown and Mate 1983, Kreiber and Barrette 1984, Allen et al. 1988, Allen et al. 1989). In Maine, harbor seals come inshore to have their pups on islands and inter-tidal ledges in late May and early June. During the nursing period of roughly 24 days (Thompson et al. 1994), the mother/pup pairs tend to stay close to their birth sites and remain hauled out for longer periods of time (Thompson 1993, Jeffries 1986). High haul-out numbers during the first two weeks in August in Maine can be attributed to molting. While hauled out, hair growth is enhanced and warming of the skin accelerates the molting process (Hoover-Miller 1994). The number of seals hauled out at a given low tide during a peak haul-out season is likely to vary with year to year change in the timing of pupping and molting (Temte et al. 1991). The number of seals hauled out on a given day may also be effected by the time of day a low tide occurs and weather conditions (Schneider and Payne 1983, Allen et al. 1984, Stewart 1984, Yochem et al. 1987, Kovacs et al. 1990, Roen and Bjorge 1994, Frost 1997).

Coast-wide standardized aerial surveys have been conducted in May/June during pupping in 1981, 1982, 1986, and 1993, and during August molt in 1993 (Gilbert and Stein 1981, Gilbert and Wynne 1983, Gilbert and Wynne 1984, Kenney and Gilbert 1994). All surveys were complete except for the 1982 survey, which covered the portion of the Maine coast between the Maine/Canada border and the west edge of Casco Bay. Smaller sections of the Maine coast were also surveyed in 1972, 1973, 1978, 1983, 1984 and 1985 (Richardson 1976, Gilbert and Wynne 1984).

The objective of this research was to determine the size and distribution of the harbor seal population in New England waters during the pupping season and compare these results to previous information.

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STUDY AREA

The survey was conducted over the entire coast of Maine and New Hampshire. With exception of a few ledges far up rivers, all 3000+ islands and ledges were surveyed. The study area in Maine was divided into the same three regions used in the 1993 survey: south, middle and downeast regions (fig. 1). The south region covered the portion of the coast between the Maine/New Hampshire border and Pemaquid point; the middle region was between Pemaquid point and Schoodic Peninsula; and the downeast region is the portion of the coast between Schoodic Peninsula and the Maine/Canada border (Cobscook Bay). The study area in New Hampshire included islands in the Isle of Shoals and small ledges along the immediate coastline.

METHODS

Aerial surveys were conducted for the entire coast of Maine and New Hampshire from a single engine Cessna 206 in 1997. Survey methods were consistent with the previous four coast-wide surveys. Surveys were flown during the pupping season between May 27 and June 10 and during molt between August 9 and August 14 (Table 1) (New Hampshire was not surveyed in August). Surveys were flown between 0700h and 1800h and were restricted to two hours on either side of low tide. The May/June survey was executed in 10 days (including 2 days of replicate counts) and the August survey was completed in 4 days of flying.

Surveys were flown at an altitude between 180 and 220 meters. The observer in the front seat of the plane navigated between sites and visually counted seals and pups for each island or ledge. The person in the back would photograph the seals, recording the frames used for each island or ledge. Overlapping photographs were taken at each site, allowing complete coverage. The observer called the ledge name to the photographer, and that name was assigned to the recorded frame numbers. Each roll of film was assigned a unique number, and day and time were recorded on each frame. Photographs were taken with a Nikon N70. A 300-mm Tamron F1-2.8 or a 200 to 400-mm Nikon F56 zoom lens was used depending on light conditions. Kodak 400 Ektachrome slide film was used. The camera was set to automatic aperture with fixed shutter speed ranging from 1/500 to 1/1000.

Each roll maintained its unique number during processing and each slide was printed with its slide number. Slides were projected onto a screen and two observers simultaneously and independently counted the seals. Groups of seals were counted between specified landmarks, so as not to recount replicate slides of seals. Per island totals were summed for each observer. If a discrepancy larger than 15% per ledge occurred between observers, sites were recounted. The two totals were then averaged per haul-out, and rounded down to the nearest whole seal.

Total harbor seals and pups were counted from the May/June survey slides. Pups were distinguishable by their small size, brighter newborn pelage and their proximity to an adult. Total seals and pups for each observer were then averaged per haul-out, and rounded down to the nearest whole seal and pup. Pups were indistinguishable by the August molt survey, therefore, we restricted our counts to total seals.

It was possible to distinguish gray seals in a number of the slides for the May/June and August counts. They are quite large in comparison to harbor seals and their pelage has a mottled appearance that is apparent in the slides. They were counted independently by each observer and their totals were averaged and rounded down to the nearest whole seal. Because there is some uncertainty in identifying gray seals, their estimated number was expressed in terms of minimum and maximum numbers per haul-out, as in Kenney and Gilbert, 1994. The minimum number was a mean of those positively identified as gray seals, and the maximum number was the total number of seals present on the ledge. This maximum number assumes that all seals on a ledge containing gray seals are also gray seals. The methods described above are nearly identical to the methods employed by Kenney and Gilbert (1994).

Counts from both surveys are minimum population estimates, because surveys do not account for the portion of the population in the water. In an attempt to evaluate count variability, replicate counts were flown for a portion of the coast (fig. 1). Seals were

surveyed two additional times for a portion of Penobscot Bay (islands and inter-tidal ledges south of Cape Rosier, west of Deer Isle, North of Vinalhaven and in the Muscle Ridge area).

RESULTS and DISCUSSION

Harbor Seal Numbers during the Pupping Season

The estimate of harbor seal population in Maine for May-June was derived from an average of the three counts of replicated area added to the single count for the rest of the area. The replicated counts averaged $4,230 \pm 352$ (s.dev.) harbor seals (Table 2). This, combined with the count from the remainder of the coast, yielded a minimum estimate of 30,990 harbor seals between the Canadian-U.S. Border and the Isle of Shoals (Table 3). In addition to the above numbers, 5 harbor seals were observed in New Hampshire. We used 77 rolls of 36-exposure film to do the original survey, and 23 rolls for the replicates.

This total number is an increase of 7.6 percent from the count in 1993 (Table 3). The annual rate of increase since 1993 has been 1.8 percent. The average annual increase in the counts since 1981 has been 4.2 percent, as compared to 8.9 percent annual increase estimated by Kenney and Gilbert (1994) for the period between 1981 and 1993. These results suggest the harbor seal population may not be increasing much more in future years.

The estimate of the number of pups was derived in a manner similar to that of the total harbor seals. There was an average of 945 ± 82 (s.dev.) harbor seal pups in the replicated region (Table 2). This, combined with the other count, yielded a minimum estimate of 5,359 pups in Maine waters (Table 3). There were no harbor seal pups observed in New Hampshire.

The number of pups represented 17.3 percent of the population in 1997, which was higher than in previous years (Table 3). There were 26 percent more pups on the coast of Maine in 1997 than in 1993. Since 1981, the number of pups in Maine has increased at an annual rate of 12.9 percent.

Harbor Seal Numbers during the Molt

Initial counting of a portion of the slides from May-June surveys indicated that numbers of seals might be much lower than in 1993. For example, the first count for Region PBMC (Table 2) was approximately 40% below the 1993 count. We were not sure whether this reflected a true change in the population or whether it was the result of habitat irregularities. Anadromous fish runs were late in the spring of 1997. Because we knew we could not get a definitive count from the slides in a timely manner, we scheduled and conducted a second survey in August during the molting period. We hoped to compare this to counts made in August 1993.

For August, we counted from slides a total of 19,956 harbor seals (Table 4). We used 26 rolls of film. The August survey required less time (Table 1) than the May-June survey, mostly because there were fewer ledges with seals in August.

Regional Variations

There were considerable differences among the three regions in the status of the harbor seal population. The Middle Region (from Schoodic Point to Pemaquid Point)

still has the most seals and pups. Over the years, counts in this region have represented approximately half of the total population. Pup production in this region, which includes Greater Penobscot and Muscongus bays, has also accounted for about half of the total number (Table 3). The number of ledges with pups and the total number of used ledges were higher than in any previous surveys (Table 3).

The harbor seal population in the Southern Region may be worthy of additional scrutiny. Total seals counted in May-June of 1997 increased only 356 from 1993, and pup production was essentially the same in the two years (Table 3). Pup production as a percent of the total population is less than half that of the other regions. This may be partly due to this area being the southern limit of the range of the harbor seal, and more non-breeding individuals are present. However, human activities could also cause this low productivity. Note (Table 3) that the number of ledges in this area with pups declined from 91 in 1993 to 56 in 1997, perhaps because there are fewer suitable sites than before. In fact, all seals in this region used fewer sites.

With an annual growth of 4.5 percent since 1993 and 7.4 percent since 1981, compared with 1.8 and 4.2 percent respectively for the entire coast, the harbor seal population in the Downeast Region is increasing faster than in the other regions. The number of pups in this region has increased markedly since the early 1980's (Table 3), with annual growth of 9.5 percent since 1993 and 17.6 percent since 1981. The percent pups (24.8) is higher than the generally accepted standard of 20 percent (Bigg 1969, Boulva and McClaren 1979). As seals have become more abundant in this region, they have increased the number of sites used both for pupping and for resting (Table 3).

Gray Seal Numbers

In both the May-June and the August surveys, we noted the number of gray seals observed visually and seen on slides. There was a minimum of 100 gray seals counted from slides in the May-June survey and only 45 in the August survey (Table 5). All gray seals were in the Middle Region.

These counts were lower than the minimum observed gray seals in 1993. However, not much meaning should be attached to such counts that are outside of the reproductive season. Varying ability of the observers to distinguish gray seals may affect counts. Many of the seals we observe in Maine waters in the summer must come from Canadian populations.

EVALUATION

The results of this survey and the previous surveys are only minimum population estimates. They are counts of the portion of the population hauled out, and not the total population. Without some information about the fraction of the seals that are hauled out and available for counting during surveys, this will continue to be a minimum estimate.

For the first time, we did replicate counts over a small part of the study area. The three replicate counts were more similar than we had anticipated. Seals can be scared off the ledges prior to counting by any of a variety of human activities (Renouf et al. 1981) and counts have been shown elsewhere to vary with time of day, sea state, and weather conditions; therefore we expected more variability between days.

In addition, we found consistent counts of pups between May 27-29 and June 9-10. We did not observe the beginning and end of pupping or lactation. There was no evidence that females had not begun to leave their pups by the end of the survey. During the survey, we did note several placentas, and we likely surveyed some sites before all pups were born.

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Table 1. Dates and number of hours flown to conduct harbor and gray seal surveys in 1997.

Date	Hours
27-May	4.4
28-May	5.1
29-May	4.3
30-May	4.9
31-May	3.9
2-Jun	4.7
3-Jun	3.7
4-Jun	3.3
9-Jun*	3.5
10-Jun*	3.6
Survey Total	41.4
9-Aug	4.7
10-Aug	4.9
12-Aug	5.1
14-Aug	5.2
Survey Total	19.9

*Dates of replicate surveys.

Table 2. Numbers of Harbor Seals and Pups Observed on Three Replicate Surveys of an Area in Penobscot Bay, Maine, 1997.

Region	Replicate 1 May 27-29	Replicate 2 June 9	Replicate 3 June 10	Average	Standard Deviation
All Seals					
PBEA ¹	2,018	1,869	1,749	1,878.7	134.8
PBMC ²	989	1,714	1,802	1,501.7	446.2
PBMW ³	850	974	725	849.7	124.5
Total	3,857	4,557	4,276	4,230.0	352.3
Seal Pups					
PBEA	561	462	450	491.0	60.9
PBMC	193	367	364	308.0	99.6
PBMW	104	191	143	146.0	43.6
Total	858	1,020	957	945.0	81.7

¹Eastern Penobscot Bay²Mid-Central Penobscot Bay³Mid-West Penobscot Bay

Table 3. Comparison of Numbers of Harbor Seals, Pups, and Ledges with Seals from May-June surveys, 1981 to 1997.

Region		1981	1982	1986	1993	1997
Total Seals	Downeast	1,708	2,830	3,220	6,038	7,091
	Middle	5,996	4,503	5,883	15,441	16,212
	South	2,836	1,998	3,837	7,331	7,687
	Total	10,540	9,331	12,940	28,810	30,990
Pups	Downeast	122	308	576	1,222	1,759
	Middle	435	692	793	2,416	2,993
	South	119	198	344	612	607
	Total	676	1,198	1,713	4,250	5,359
%Pups	Downeast	7.14	10.88	17.89	20.24	24.81
	Middle	7.25	15.37	13.48	15.65	18.46
	South	4.20	9.91	8.97	8.35	7.90
	Average	6.41	12.84	13.24	14.75	17.29
Ledges	Downeast	75	68	80	153	161
	Middle	176	140	135	297	339
	South	83	39	70	124	84
	Total	334	247	285	574	584
Pup Ledges	Downeast	35	49	61	111	136
	Middle	105	90	91	232	247
	South	50	32	45	91	56
	Total	190	171	197	434	439

Table 4. Counts of Harbor Seals and Ledges with Harbor Seals in August Surveys of the Maine Coast, 1993 and 1997.

	Region	1993	1997
Seals	Downeast	5,982	4,630
	Middle	14,045	12,612
	South	6,027	2,714
	Total	26,054	19,956
Ledges	Downeast	78	56
	Middle	151	133
	South	52	23
	Total	281	212

Table 5. Minimum and Maximum Numbers of Gray Seals Observed in 1997 Aerial Surveys of the Coast of Maine.

	Region	Minimum ¹	Maximum ²
June	Downeast	0	0
	Middle	100	423
	South	0	0
	Total	100	423
August	Downeast	0	0
	Middle	45	743
	South	0	0
	Total	45	743

¹Minimum is the number positively identified as gray seals.

²Maximum is the total number of seals on a ledge that had some gray seals.

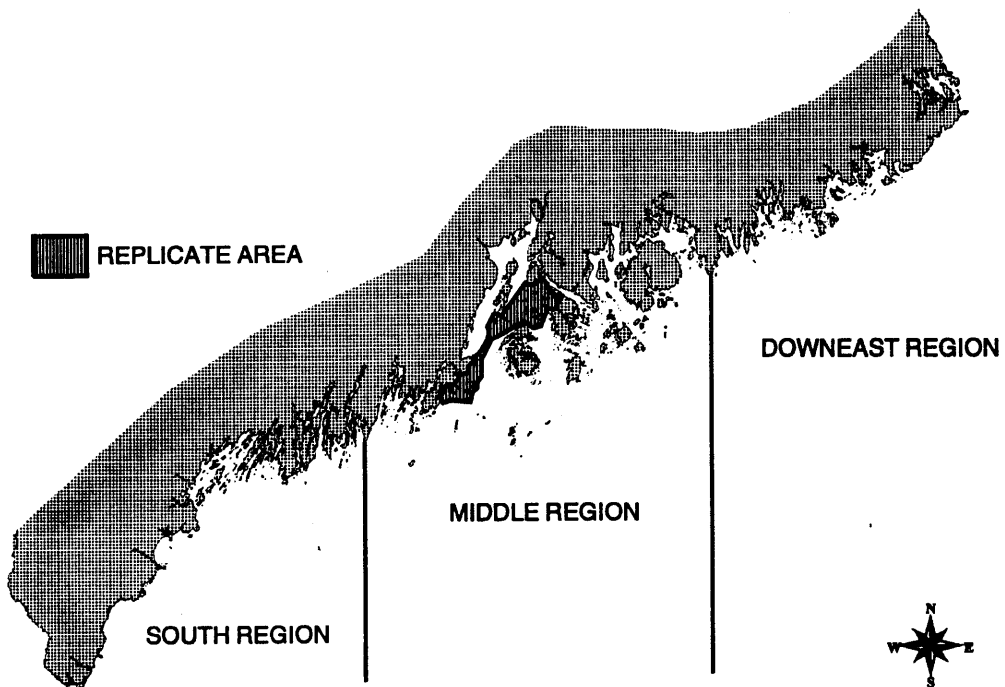


Figure 1. Data from the harbor seal surveys were classified into three regions on the Coast of Maine. Multiple counts were conducted in the replicate area of Penobscot Bay.