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LONG-TERM OBSERVATIONS OF A HARBOR SEAL HAUL-OUT SITE IN A PROTECTED COVE IN CASCO BAY, GULF OF MAINE

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ABSTRACT - We counted the numbers of seals hauled out at low tide on two near-shore ledges in a protected cove in Casco Bay, Gulf of Maine a minimum of 12 times per month, for four years starting in August 1997. The highest mean monthly counts were in August (moltling season) and the lowest in either January or February. Counts during pupping season (May and June) were lower than during April or July. As no mother-pup pairs were observed, these ledges are molting but not pupping ledges. Time-series analysis revealed no overall trend in the number of seals present, but did show a decreasing trend in the fraction of days each month that seals were present. Further observations are needed to determine if this trend is continuing and if it is present in other locations on the Maine coast.

Harbor seals (Phoca vitulina) are widely distributed in ocean waters, bays, estuaries, and occasionally lakes above 30 degrees north latitude. In the western Atlantic, they have been reported as far north as Greenland (Teilmann and Dietz 1994) and are routinely seen as far south as New York, but they generally pup north of the Maine–New Hampshire border (Waring et al. 2001).

Harbor seals haul out to rest, thermoregulate, pup, and nurse their young on ledges, beaches, and near-shore ice (Katona et al. 1993, Riedman 1990). In the waters off Maine, they predominantly use rocky ledges exposed at low tide and are seen in greatest numbers during the spring and summer (Gilbert and Guldager 1998, Richardson 1976). However, less is known about the number of harbor seals hauled out during other seasons.

We observed the harbor seals that haul out on two near-shore ledges in Gun Point Cove, Casco Bay, Gulf of Maine (43°47′N, 69°57′W). The cove is 3 km long by 325 m wide. It runs north to south and is formed on the west by Orrs Island and on the east by Gun Point on Sebascodegan Island. At its south end this cove opens to Casco Bay, while at its north end the cove narrows to a < 10 m wide passage between the two islands. The two ledges on which the seals haul out are located in mid-channel approximately 200 m from Orrs Island and 125 m from Gun Point and

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lie parallel to the channel. Depending on tide height, the ledges are above the water surface for as much as six hours centered on low tide. At dead low tide, they are each approximately 35 m long by 2 m wide. This site is protected from wind and waves, and according to local residents, harbor seals have hauled out here for many years. While Gun Point Cove does freeze over during particularly severe winters (e.g., the winter of 2003), it did not freeze during the study period. The mean tidal range at this location is approximately 3 m.

Beginning in August 1997, we counted seals a minimum of 12 times per month for a 4-year period. We used a 15X–45X spotting scope (Bushnell, Denver, CO), and counted the seals within 30 minutes of low tides that occurred between 0700 and 1900 hr local apparent time. To avoid over-counting under conditions when the seals were lying close together, only the number of individuals that we could clearly distinguish (e.g., head clearly visible) were counted. Using this counting procedure, count numbers by different observers varied by 3% or less.

Our observation point was located on Orrs Island, 200 m from the south ledge and 250 m from the north ledge. At this distance, the seals did not respond to the presence of the observers by raising their heads to look or entering the water. From this position, all seals hauled out on the west side and crest of the ledges were visible. Only the middle one-third of the ledges is high enough to block the view of the east side of the ledges.

For each month, we computed two values: the mean number of seals counted for those days when seals were present, and the fraction of days

![Figure 1. Time series plot of the average number of harbor seals hauled out each month on days when seals were present from August 1997 to July 2001. Error bars show 95% confidence limits. They are unidirectional for clarity. Note the seasonality with period 12 in monthly means.](image-url)
when seals were present. The number of seals hauled out is reported as 95% confidence limits around the mean unless noted otherwise. The confidence limits were computed using parametric methods because these data were found to be normally distributed.

To examine temporal trends in these data, we applied time-series analysis to both the mean number of seals hauled out and the fraction of days when seals were present (Statistica Website 2002). Thus, we considered the data as two sets of 48 measurements, each representing a single month of the study (August 1997 to July 2001). We determined the period and extent of the seasonal component, removed this component (de-seasonalized the data), and tested for an overall trend by subjecting the de-seasonalized values to linear regression analysis. A trend was considered present if the slope of this best-fit linear regression line was significantly different from zero.

From August 1997 through July 2001 we conducted counts on a total of 763 days, an average of $15.9 \pm 1.5$ days/month. Seals were present on 71% of the days. On those days when seals were present, the mean number of seals was 27.1. During each of the study years, the monthly mean number of harbor seals counted (± monthly variability) was greatest during August (from $40.6 \pm 7.5$ to $54.2 \pm 13.1$ seals) and fell to its lowest value (from $3.8 \pm 1.9$ to $5.1 \pm 2.1$ seals) during January in three years or February in one year.

![Figure 2. Time series plot of de-seasonalized monthly number of harbor seal hauled out with linear regression line shown. The seasonal components (August –July) were computed to be: August = 22.4, September = 8.5, October = 7.5, November = 0.36, December = -1.9, January = -16.0, February = -9.0, March = -4.1, April = 7.4, May = -9.2, June = -11.8, July = 5.9. Linear regression equation is: $Y = 22.5 - 0.04X$. For this linear regression, $r^2 = 0.009$, and $p = 0.52$ (i.e. the slope is not significantly different from zero).](image-url)
The fraction of days that seals were present showed a similar pattern. There were harbor seals on the study site ledges on 83.4% to 97% of days during August but only 20% to 30.8% of days during January (Fig. 3). The highest single-day count was 118 harbor seals on 8/28/97. Mean monthly counts for May (2.5 ± 2.9 to 14.7 ± 9.7) and June (5.0 ± 3.8 to 10.8 ± 5.4) were lower during each study year than in either April or July (Fig. 1). No nursing mother-pup pairs were observed.

There was an obvious 12-month periodicity in the average number of seals hauled out each month, corresponding to the yearly cycles in seal behavior (Fig. 1). The peaks correspond to August and the minima correspond to January or February. When this seasonal component was removed, there was no significant overall trend in the de-seasonalized counts (Fig. 2). Thus, we have found that, while the average number of seals hauled out on the Gun Point Cove ledges varied from month to month in year-long cycles, there was no year-to-year trend within the four-year study period.

The percent of days when seals were present (Fig. 3) also showed a 12-month periodicity. The best-fit linear regression line to the de-seasonalized data (Fig. 4) had a significant negative slope (-0.29). This suggests that the percent of days that seals were present each month varied in year-long cycles and that this percent decreased by 0.29 for each month of the study period, or nearly 14% over the entire 4 years.

The number of harbor seals at a haul-out site can vary greatly both within a year and from year to year. These changes may reflect fluctuations in the fraction of the harbor seal population hauled out, seasonal

![Figure 3. Time series plot of the percent days of each study month when seals were hauled out, from August 1997 to July 2001. Note the seasonality with period 12.](image-url)
movements of seals, weather conditions and changes in the size of the overall population, among other factors (Brown and Mate 1983, Grellier et al. 1996, Harvey et al. 1990, Huber et al. 2001, Pauli and Terhune 1987, Rosenfeld et al. 1988, Schneider and Payne 1983, Stewart 1984). However, because harbor seal haul-out behavior can vary even at sites separated by relatively small distances (Thompson et al. 1997), year-round intensive observations of harbor seals are necessary to define the number of harbor seals hauled out at any particular site, and results from one site may not be generalized to other locations.

The within-year variability in the numbers of harbor seals hauled out that we report here (highest in the summer and lowest in the winter) is in general agreement with previous reports from a range of areas. At 4 locations on the US Pacific coast, the number of harbor seals hauled out was greatest in the spring and summer (Allen et al. 1989, Bayer 1985, Stewart and Yokem 1984, Sullivan 1980). In Atlantic Canada, the number of harbor seals hauled out peaked in the late summer and early fall (Kriebel and Barrette 1984). High numbers of seals hauled out in the summer have been attributed (at least in part) to the timing of pupping and molting seasons (Brown and Mate 1983, Harkonen et al. 1999, Sullivan 1980), although other factors including the availability of prey species probably also play a role (Brown and Mate 1983). Along the

Figure 4. Time series plot of de-seasonalized data of the percent of each month that harbor seals were observed hauled out with the linear regression line shown. The seasonal components (August–July) were computed to be: August = 17.5, September = 15.9, October = 16.7, November = 7.3, December = -7.8, January = -43.6, February = -21.4, March = 13.8, April = 21.8, May = -12.7, June = -28.0, July = 20.6. The linear regression equation is: Y = 76.4– 0.29*X. For this linear regression, r^2 = 0.12, and p = 0.015.
Maine coast, harbor seals pup in late May and early June and molt in August (Gilbert and Guldager 1998).

The number of harbor seals hauled out at our study site, while generally higher in the summer than in the winter, dipped slightly during May and June, and reached a maximum during August (Fig. 1). This probably reflects the fact that our study site included molting but not pupping ledges. These results are in agreement with a report from the Oregon coast of a location that is also a harbor seal molting but not pupping area (Bayer 1985). Along the Maine coast, the use of different ledges by harbor seals to pup and molt has been reported previously (Gilbert and Wynne 1984, Kenney and Gilbert 1994). However, in these reports, the tendency of harbor seals to use offshore sites for haul-out during molt was noted, whereas Gun Point Cove is a very protected near-shore site.

The seasonal fluctuations in the number of seals hauled out we report here may also reflect movement in the harbor seal population. Aerial survey (Rosenfeld et al. 1998) and tagging (Gilbert and Wynne 1984) data suggest that many harbor seals that pup and mate in Maine and maritime Canadian waters in the summer move south to the Massachusetts coast in the winter. This results in peak numbers of harbor seal hauled out in southeast Massachusetts during the winter (December and January) (Schneider and Payne 1983). However, there is substantial heterogeneity in the movements of harbor seals, with younger seals more likely to move south than older ones (Whitman and Payne 1990). Complex movement patterns may also occur. One satellite-tagged harbor seal pup made the round trip between Massachusetts and mid-coast Maine multiple times during the winter of 2001 (WhaleNet Website 2002).

Frequently repeated counts of harbor seals at a few sites, such as those reported here, may not reflect activity at other sites, but can reveal interesting trends in local seal activity. For instance, we show that the percent days when seals were present at our study site declined over the study period. The reason for this trend is not known. It is interesting to note that the harbor seals in the general area of this study (e.g. the southern Maine coast) have a lower pup production rate, are increasing more slowly in number, and access fewer ledges than do seals farther north and east along the Maine coast (Gilbert and Guldager 1998). A variety of factors including the impact of human disturbances could contribute to these differences (Gilbert and Guldager 1998).

Human disturbance can certainly impact the number of harbor seals hauled out (Allen et al. 1984, Calambokidis et al. 1991), and human activity (e.g., boating) along the Maine coast is probably increasing overall. However, boat activity in Gun Point Cove is heavy only during the summer (it is nearly non-existent during the winter) and there is no 4-year trend toward seals being present on a decreased percent of days in either July or August (Fig. 3). Thus, an increase in human activity probably does
not account for our finding that the percent days when seals were present declined over our study period. Further observations of harbor seals on the Gun Point Cove ledges and other near-shore locations in Casco Bay are needed to determine if use of these locations by harbor seals is continuing to change with time, and to establish the reasons for this trend.

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LITERATURE CITED


