Aquatic Mammals 1994, **20.2,** 73–79

Capturing male northern fur seals from haulout sites: estimates of capture efficiency and escapement

Andrew W. Trites[1] and Joe Scordino[2]

[1]*Marine Mammal Research Unit, Fisheries Centre, University of British Columbia, 2044 Main Mall, Vancouver, B.C., V6T 1Z4 Canada*
[2]*Fisheries Management Division, National Marine Fisheries Service, 7600 Sand Point Way, Seattle, Washington 98115, USA*

Abstract

The ability to capture northern fur seals (*Callorhinus ursinus*) was observed at two haulout sites on St. Paul Island, Alaska, during annual harvests conducted from 1980 to 1983. Males using these sites were classified as bachelors if within the size limit of the harvest (less than 49 inches in length) and as bulls if longer. The ability of sealers to capture bachelors was dependent on the numbers of bulls present at each haulout: the more bulls on land, the greater the capture rate of bachelors. Capture efficiency dropped on the few occasions when low numbers of bulls enabled the bachelors to remain close to the water edge. A decline in capture efficiency was also detected at low wind speeds, presumably because the bachelors were better able to hear the approaching sealers. On average, sealers captured 92.7% of the bachelors and 41.5% of the bulls that were onshore at any given time. The ability to easily capture immature males is potentially useful for researchers to obtain biological information about northern fur seals. Over 50% of a haulout population can be captured in as little as 4 days.

Introduction

Much of what is known today about the population biology of Pribilof northern fur seals (*Callorhinus ursinus*) came from immature males captured at haulout sites (Roppel 1984; Scheffer *et al.* 1984). The young males that were killed for their furs provided biologists with large samples to estimate pup production and natural mortality rates, and formed the basis for inferences about the dynamics and health of the population (e.g. Chapman 1961; Lander 1975, 1979, 1981; Eberhardt 1981; York & Hartley 1981; Smith & Polacheck 1984; Scordino 1985; Fowler 1987, 1990; Trites & Larkin 1989; Trites 1989).

Commercial harvesting is no longer conducted on the Pribilof Islands, having been stopped in 1972 on St. George Island and in 1985 on St. Paul Island. In its place is a subsistence harvest conducted by resident Aleuts.

Our study was designed to determine the efficiency of capturing young males for harvesting and for management-research purposes. We estimated the proportion of haulout animals forcefully moved inland to the killing fields (*capture efficiency*) and the proportion of seals that eluded the sealers or were absent from their haulout on the day of harvesting (*escapement*). We determined these rates at two haulout sites on St. Paul Island, Alaska, over a 4 year period (1980 to 1983). These data are used to illustrate the feasibility of capturing young males for management purposes, such as tagging or sampling. Our observations also provide insights into interactions between environmental factors, fur seal behaviour, and capture efficiency.

Study Area and Methods

Nonbreeding animals tend to congregate on 'haulout' sites adjacent to their rookery of birth (Nagasaki & Matsumoto 1957). The haulout populations consist primarily of sub-adult males aged 2 to 5 y and some bulls aged 6 y+ that are unable to hold a territory (Lander 1980). The seals are gregarious on land but appear to segregate themselves by size. In general, bulls haul out a bit separately from other seals near the water edge. Progressively smaller animals occur further inland.

Observations were made at Lukanin and Little Zapadni haulouts on St. Paul Island during the commercial harvest from 1980 to 1983 (Fig. 1). Both sites are adjacent to a rookery and are the only major haulouts for each rookery. They were selected because of the ease with which the initial round up could be observed and because they were

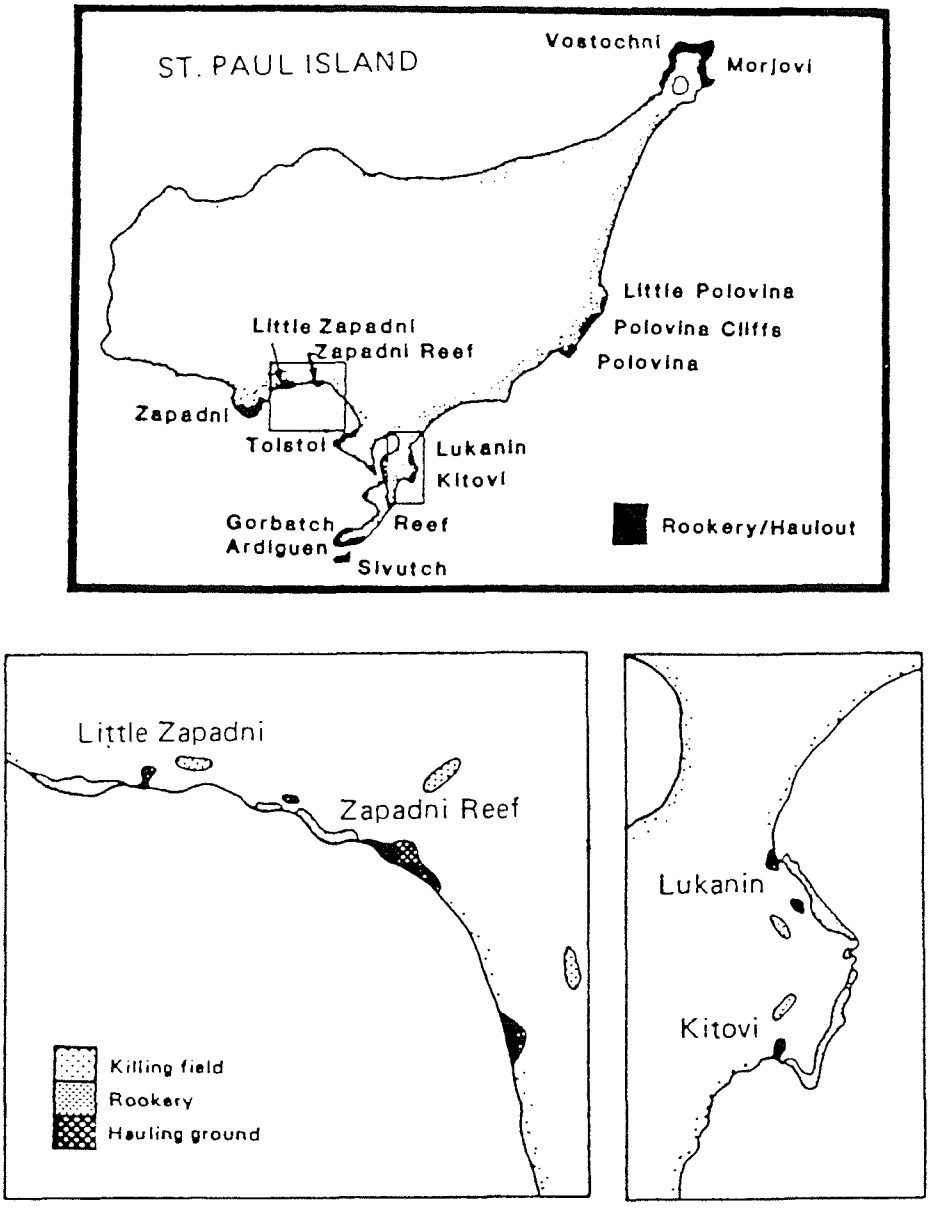

Figure 1. Rookery and hauling sites on St. Paul Island, Alaska. Bottom panels are detailed inserts for Little Zapadni and Lukanin (adapted from Lander 1980).

relatively small with short drives. This ensured that the observer could keep all sealers in view and be able to record all seals that escaped.

The animals were classified as bachelors if they were shorter than the regulated 49 inch upper size limit of the harvest (124.5 cm, tip of nose to tip of tail, belly down); otherwise they were defined as bulls. The observer and sealers relied on their experience and judgement to determine the size of the seals. Bulls were unquestionably big with manes, while obviously small seals and those of uncertain size were classified as bachelors. At no point were seals measured, either prior to or after the kill. Each haulout was harvested 3 to 5 times at approximately weekly intervals from June 30th to August 5th over 4 years.

On each day of harvesting, small groups of experienced sealers approached the young males from the downwind side of the haulout between 0500 and 0600 hrs. They moved quickly and quietly among the rocks and sand along the beach, until within 50 to 100 meters of the main group of seals. The pace then broke abruptly into a run between the seals and the sea, accompanied by the whistles and claps of the sealers. A few of the bulls usually charged towards the sea as soon as they first spotted the sealers. However, the majority of fur seals tended to bunch together and moved inland away from the sealers.

The observer moved with the sealers as they ran to cut the seals off from the water. He was familiar with the harvest and used counters held in each hand to record the number of bulls and bachelors that escaped. At Lukanin haulout, the observer was able to see all the seals that escaped during the round-up; but he sometimes missed a few (generally bulls) in the boulder area near the water of Little Zapadni.

After the round-up, the seals were herded to the killing field. The number of bulls and bachelors that were rejected or escaped along the drive and at the killing field was recorded, as well as the number of bachelors killed. The data were later tabulated to obtain the numbers of bulls and bachelors present on the haulout at the start of round-up and at the killing field at the end of the drive. Bachelors at the killing field were recorded as harvested or escaped. The number of bachelors that escaped at the killing field over 4 years were few (58 of 8386 captured bachelors) and are not considered further. Similarly, the number of females captured and released was also insignificant (7 females compared to 8386 bachelors).

Results and Discussion

Capture efficiency

The ability of the sealers to round up bachelors and cut out bulls varied greatly from week to week (Fig. 2). Some variability in the percentage captured can be attributed to haulout patterns and weather conditions. If the seals occupied the higher areas of the haulout, rounding up the entire haulout was possible, while dramatic decreases in percentage of the haulout captured occurred when there were unobtainable seals near the water (indicated by asterisks in Fig. 2). On these occasions the haulout of bachelors was usually small (shown by vertical bars at the top and bottom of each panel). At other times, inclement weather resulted in haulouts that were essentially bare.

The different composition of bulls and bachelors on the two haulouts did not affect the ability of the sealers to capture and roundup the seals (Fig. 2). Of all the bachelors counted from 1980 to 1983 on the two haulouts, the sealers captured $92.7\% \pm 3.1$ (95% CI). More bachelors were captured on Little Zapadni ($95.0\% \pm 2.9$) than on Lukanin ($90.3\% \pm 6.0$), possibly because the physical layout of Little Zapadni enabled the escape route to be more effectively cut off. However the difference between the two haulouts was not significantly different [$t = -2.24$, $P = 0.07$]. On average, only $41.5\% \pm 8.9$ (95% CI) of the bulls on the haulout were captured and driven to the killing fields (these bulls were later released). This is low compared to the capture of bachelors, confirming that sealers either avoid rounding up bulls or cut them out during the drive. Significantly fewer bulls were captured on Little Zapadni ($39.6\% \pm 20.8$) than at Lukanin ($43.5\% \pm 14.3$) [$t = -2.783$, $P = 0.032$]. Again this might be explained by the physical layout of the haulouts. For example, many bulls at Little Zapadni are in the boulder area near the water edge and are unobtainable or avoided by the sealers. It might also be easier to separate bulls at Little Zapadni because fewer animals are rounded up.

Capture efficiency on both haulouts was similar despite the different make-up of the two sites. It is reasonable to expect similar estimates at other haulouts on St. Paul Island. There was little change in the efficiency of the sealers through the 5 week harvest season or over the 4 years of study. This is not surprising since the sealers are experienced and the method of harvest is traditional and has been practiced in essentially the same way for the past two centuries. Indeed it is likely that the efficiency of the sealers has remained consistently high over the past century.

The few occasions we observed a drop in capture efficiency (Fig. 2) might be related to an absence of bulls (Fig. 3) or to a lack of wind (see following analysis) that affected the behavior of the bachelors. For example, significantly more of the hauled bachelors were captured by the sealers when large numbers of bulls were also present at both Lukanin [$t = 4.11$, $P < 0.001$] and Little Zapadni [$t = 2.14$, $P < 0.05$] (see Fig. 3). We suspect that bull densities determine how closely bachelors can approach the water edge. At high bull densities, bachelors are further inland and are easily cut off by the sealers; but at low bull densities, bachelors can occupy the water edge and therefore escape more readily.

The success of the sealers at capturing bachelors may also have been influenced by wind. On two days in particular (July 30, 1981 and August 3, 1982) there was a high escapement from Lukanin despite large numbers of bachelors ashore. The only thing unusual about these days was a lack of wind. The relationship between wind speed (recorded at

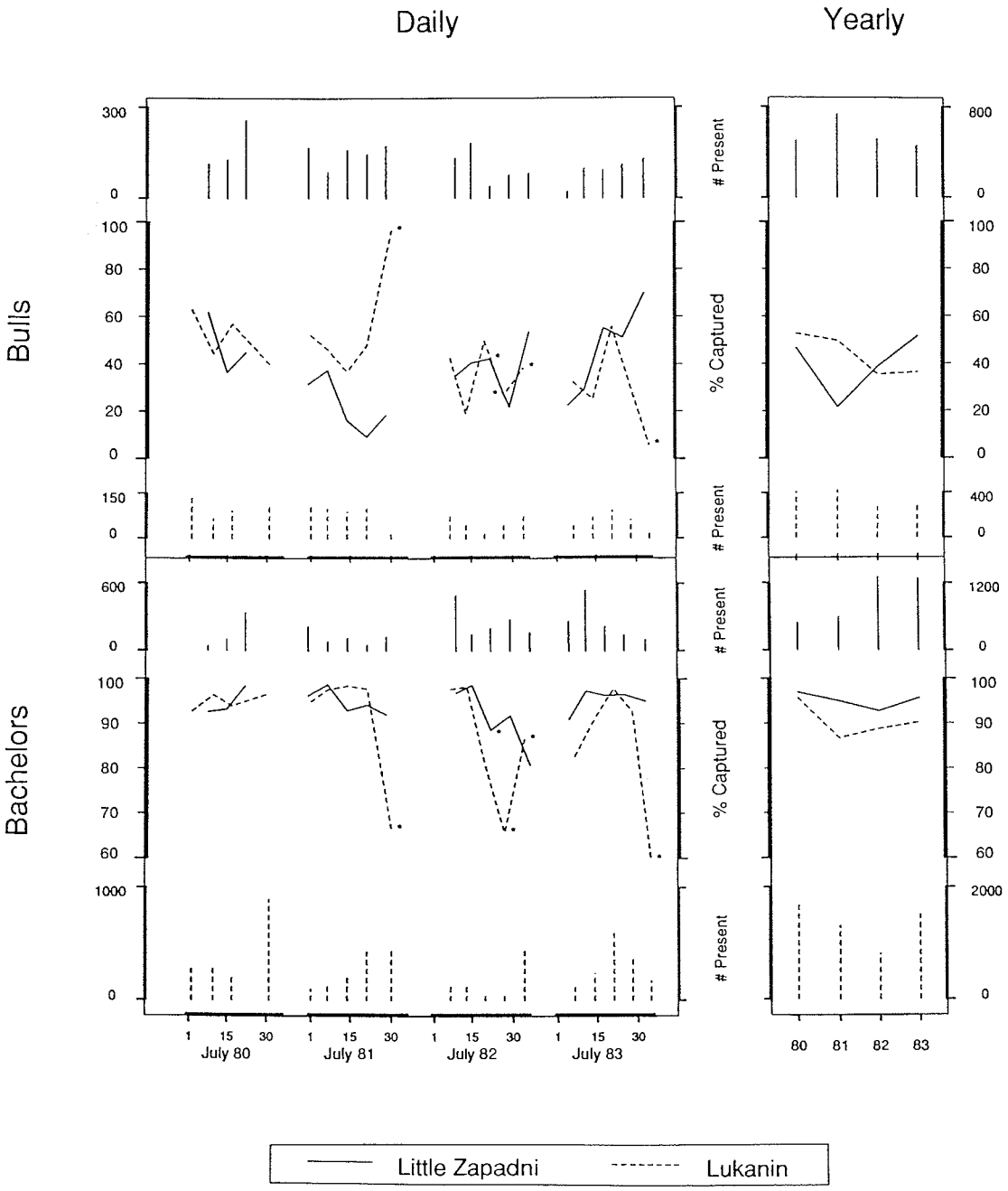

Figure 2. Percentage of hauled bulls (top panel) and bachelors (bottom panel) captured by sealers at Lukanin (dashed lines) and Little Zapadni (solid lines) from 1980 to 1983. The total numbers of seals present at each haulout prior to the harvest is indicated by vertical bars at the top and bottom of each panel. Both the daily rate of capture (left panels) and the weighted yearly value (right panels) are shown. The asterisks indicate the dates when many of the seals were near the water edge and were unobtainable by the sealers.

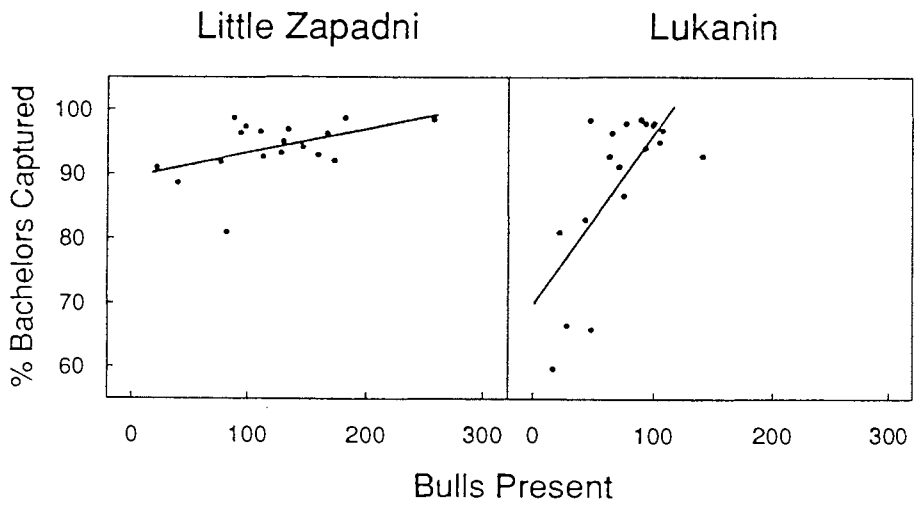

Figure 3. Number of hauled bulls present versus the rate of capture of bachelors at Little Zapadni and Lukanin from 1980 to 1983. The data were fit with unweighted linear regressions.

0700 hrs) and the percent of bachelors captured at Lukanin was significant [$t=2.56$, $P<0.01$ suggesting that more seals escaped when the air was still because sound alerted them much earlier to the sealers' presence.

No one factor seems to determine the numbers of bulls and bachelors that will be present at a haulout site. The presence of seals on the haulouts may induce others to join them, causing densities to 'snowball'. This could account for some of the large variability we observed in the numbers of seals using the haulouts from one round to the next. Some authors have noted that fewer animals use haulouts following hard rains and/or wind (Gentry 1981; Griben 1979). We examined hourly weather data collected on St. Paul Island by the National Climatic Center, NOAA, but could find no consistent pattern that could account for the variability in animal abundance. This might be because our ability to detect the effect of weather on the number of fur seals onshore was confounded by the harvests of previous days and by the arrival of progressively younger animals returning from their annual migration (Bigg 1986).

Escapement

The size of the harvest depends upon the number of males at the haulout, the effort devoted to harvesting specific sites, the efficiency of the sealers trying to capture them, and the restriction imposed by the length limit. Conversely, the number of seals that escape the harvest and enter the breeding reserve depends upon the size of the animals, the length of time spent on land, and their ability to elude the sealers during the round up.

Gentry (1981) estimated that only 19% of the young males that have returned to the Pribilof Islands are on land at any one time. Of the 19% hauled out at any one time, the present study indicates that sealers captured 92.7% of them. Finally, of those bachelors present and successfully captured, Bigg (1986) estimated that 71–100% of the 3 yr olds and 35–98.8% of the 4 yr olds were harvested depending upon the length restrictions imposed from 1956 to 1982. The product of these three sets of estimates (% present × % captured × % killed) imply that the kill on any particular day removed 12.5–17.6% of the 3 yr olds that used a given haulout and 6.2–17.4% of the 4 yr olds. In other words, more than 82% of the 3 and 4 yr old seals that returned to St. Paul Island and used a haulout site were either absent or escaped the harvest on any particular day. Thus the probability of being alive at the end of five rounds[1] of commercial harvesting was between 0.38 ($=0.824^5$) and 0.73 ($=0.938^5$).

Our estimates of escapement differ from those of other studies. At least 6 different sets of estimates have been published for northern fur seals over the years (see Kenyon *et al.*, 1954; NPFSC 1962; Nagasaki 1961; Chapman 1964; Gentry 1981; Lander 1981). Yet none are comparable because escapement held a different meaning for each study. Our estimated rates of escapement refer to the

[1]The traditional commercial harvest was usually a 25 day season that began on July 1 and consisted of 5 rounds of the Island in which every major haulout area was harvested once each week (Lander 1980).

proportion of seals that eluded the sealers or were absent from their haulout during the harvest.

Feasibility of capturing and releasing bachelors for research

The ability to easily capture immature males is potentially useful for obtaining additional biological data about northern fur seals and about the large scale changes that appear to be occurring in the abundance of harbour seals, Steller sea lions and some sea-birds breeding in the North Pacific (Trites 1992). Fur seals can be captured (and released) from haulout sites to take blood and tissue samples, to record morphometric measures, or to attach and read tags. Given that 19% of young males are on shore at one time (Gentry 1981) and 93% of them are captured (this study), over 50% of the population can be captured in as few as 4 days (i.e. assuming that the probabilities of hauling out on any particular day are independent of each other, the proportion of population captured $= 1 - [1 - (0.19 \times 0.927)]^{days}$).

Traditionally there were 14 major commercial harvest areas on St. Paul Island (Fig. 1) consisting of approximately 32 haulout sites, of which 27 were accessible to the sealers. While some of these sites are now subject to subsistence harvesting, others can be used exclusively for research purposes. The results of our study indicate that bachelors can be captured and released with relative ease and efficiency, thereby continuing to provide a rich source of biological information about northern fur seal populations.

Acknowledgements

We wish to thank C. Hansen and M. Tomita for their assistance in field data collection, and extend special thanks to V. Melovidov, sealer foreman, and the sealing crew for their cooperation during the study. We are also grateful to G. A. Antonelis, D. Ludwig, D. Robinson, C. Walters, P. Watts and an anonymous reviewer for providing useful comments and suggestions on earlier drafts of this paper.

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