Aquatic Mammals 1991, **17.2**, 91–97

Distribution and behaviour of Steller sea lions (*Eumetopias jubatus*) in Prince William Sound, Alaska, June 1989

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Summary

The distribution and behaviour of Steller sea lions (*Eumetopias jubatus*) on their rookeries and haul-out areas in Prince William Sound, Alaska were studied in June 1989. An aerial count at low tide showed more animals hauled out than a similar survey, flown 9 days later at high tide. In this geographical area, and in this period of the year, the haul-out pattern of Steller sea lions seems influenced by the tide in varying degrees depending on the colony. A larger number of Steller sea lions were counted in the colonies in 1989 than in a similar study during the same period of the previous year. One colony was only used as a haul-out in 1988, but was used on a small scale as a rookery in 1989.

Key words: Steller sea lion, *Eumetopias*, distribution, abundance, tidal cycle, behaviour.

Introduction

When studying the behaviour of Steller sea lions (*Eumetopias jubatus*) in Prince William Sound in June 1988, Kastelein & Weltz (1990) observed tidal-influenced haul-out behaviour of territorial bulls. This behaviour could influence the outcome of aerial surveys used to evaluate the changes in abundance and distribution of this species for management purposes. So far, the tide has not been taken into consideration in the planning of aerial surveys (Kenyon & Rice, 1961; Mathisen & Lopp, 1963; Fiscus *et al.*, 1981; Loughlin *et al.*, 1984; Calkins, 1985; Merrick *et al.*, 1987; Hoover, 1988).

In March 1989 the tanker *Exxon Valdez* ran aground in Prince William Sound. The crude oil polluted a large part of the Sound and killed many birds and marine mammals shortly after the accident. Some of the oil drifted through part of the distribution area of Steller sea lions, and may have affected the animals.

This report reviews an expedition to Prince William Sound and adjacent coastal waters in June 1989. The numbers and distribution of animals seen during the aerial surveys of this study are compared to similar counts from the previous year (Kastelein & Weltz, 1990); and possible impacts from the *Exxon Valdez* oil are considered. The tidal-influenced haul-out behaviour observed during a study from a boat (Kastelein & Weltz, 1990) is compared with results from the aerial counts done at high and low tide.

Materials and Methods

Behavioural observations

The Steller sea lion colony at the Needle (a sheltered island in the Sound) was studied from a boat on June 19 for 8 hours. There was no precipitation, Beaufort 2 windforce, and the air temperature was around 14°C.

Aerial surveys

The first aerial survey was flown over Seal Rocks, Wooded Island, The Needle and Cape Elrington on 16 June 1989 between 18.08 and 19.15 (at low tide) (Fig. 1). The second survey was flown over Seal Rocks and The Needle on 25 June 1989 between 06.25 and 06.45 hrs (at high tide). All colonies were photographed from an altitude of 152 m. Weather conditions were fairly equal during both surveys. There was no precipitation, Beaufort 2 windforce, and moderate sunshine.

Afterwards, the colour slides from the surveys were projected on white sheets of paper, and individual animals were counted by marking them with pencil. The following parameters were distinguished:

(a) The total number of animals at the colonies.
(b) The number of territorial bulls. Territorial bulls are defined as mature bulls with a group of associated females, and without other males in their surroundings.
(c) The number of non-territorial bulls. Non-territorial bulls consist of 2 groups: (1) large males that are maturing, but have not yet been able to establish a territory, and (2) very old bulls that do not take part anymore in reproduction. Animals in both groups are either single in the periphery of the colonies, or with other bulls in their immediate

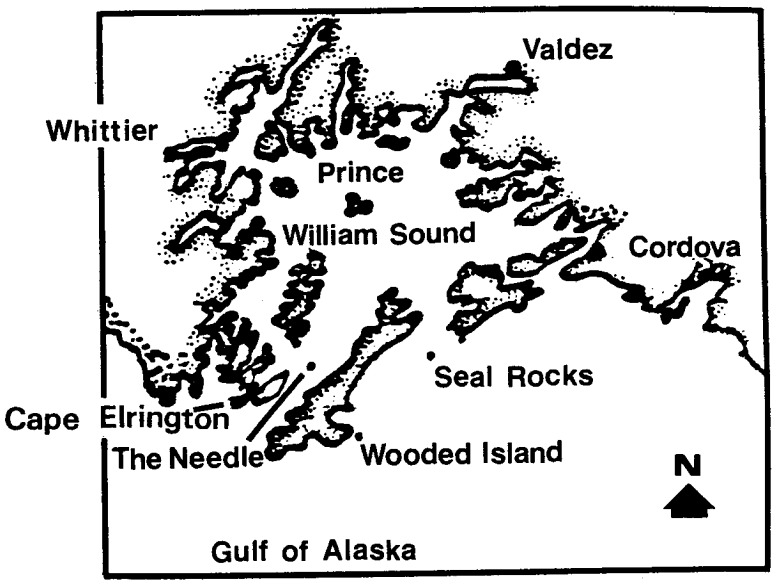

Figure 1. The study area: Prince William Sound, Alaska, with the studied rookeries and haul-out areas.

surrounding and without a group of females around them. Because it is difficult to judge a large male as a mature bull, the count of non-territorial bulls must not be taken as a very accurate figure.
(d) The number of pups and the location of the pupping areas.

Results

Distribution and abundance
The results of the aerial surveys are shown in Table 1.

Seal Rocks: During the low tide on June 16, 6% more animals were present on the islands than during the high tide on June 25. On both days, many 1-year-old suckling young were seen mainly at the periphery of the colony. There were fewer territorial males on June 25 than on June 16. Most territorial bulls were seen at the central island (on the boulder area). The number of pups was much higher during the June 25 survey than during the June 16 survey. Fresh placentas were seen on June 16, and the many fresh placentas and a birth seen on June 25 indicate that more pups would probably be born that season. Pups were seen only on the boulder area of the central island (Fig. 2). More non-territorial bulls were seen during the June 25 survey than during the June 16 survey. Most of the non-territorial bulls were seen on the low islands at the periphery of the colony. During the June 25 high tide survey, 22 animals were seen in the water surrounding the islands in contrast to none during the June 16 low tide survey.

Wooded Island: Steller sea lions were seen on almost all the coastline of this island. Pups were only seen at the N/W side of the island where the rocks were relatively flat, horizontal and with only few crevices. Several fresh placentas were visible and many 1-year-old suckling young were seen.

The Needle: More animals (43%) were seen during the June 16 low tide survey compared to the June 25 high tide survey (Fig. 3). The number of territorial bulls was similar during both surveys. No pups were seen on both days. The number of non-territorial bulls was much higher during the June 16 low tide survey compared to the June 25 high tide survey. During high tide, many (108) animals were seen in the water around the islands, whereas none were seen during the survey at low tide. Many 1-year-old suckling young were seen during both survey days.

Cape Elrington: No pups were seen at this colony. The number of territorial bulls was relatively high.

Behaviour
During the study period at the Needle the following observations were made:

1. Several females had swollen labiae, which probably indicates oestrus.
2. Several 1-year-old young were seen suckling.
3. Only the 1-year-old animals showed interest in the inflatable boat which was propelled by a 15 HP outboard engine. When the boat went full speed (approx. 35 km/hr) they followed by porpoising alongside the boat.
4. Many animals had conspicuous circular patches of skin without hair.

Table 1. The number of Steller sea lions on the study locations recorded by aerial surveys in the present 1989 study and those from the 1988 aerial surveys (Kastelein & Weltz, 1990). Pups are not included in the total number of animals. *Pups in the tide pools, and thus difficult to count.

Seal Rocks				
Date	16-06-89	25-06-89	12-06-88	23-07-88
Time	18.15	06.25	16.30	16.30
Tide	low	high	half	half
Total no. of animals	2201	2077	1839	1740
No. of territorial bulls	61	41	—	Very few
No. of pups	199	757	487	Many*
No. of non-territ. bulls	158	217	—	Many
Wooded Island				
Date	16-06-89		12-06-88	23-07-88
Time	18.35		17.00	17.00
Tide	low		half	half
Total no. of animals	1475		945	1221
No. of territorial bulls	19		0	0
No. of pups	28		0	0
No. of non-territ. bulls	91		92	Many
The Needle				
Date	16-06-89	25-06-89	12-06-88	23-07-88
Time	19.15	06.45	17.30	17.30
Tide	low	high	half	half
Total no. of animals	871	609	421	950
No. of territorial bulls	18	18	15	15
No. of pups	0	0	0	0
No. of non-territ. bulls	50	23	5	65
Cape Elrington				
Date	16-06-89			
Time	18.50			
Tide	low			
Total no. of animals	456			
No. of territorial bulls	25			
No. of pups	0			
No. of non-territ. bulls	12			

5. One copulating female had a very deep 20 cm long fresh wound. During the copulation her 1-year-old offspring was biting the bull. Immediately after the copulation the young started to suckle from its mother.
6. Several copulations were observed and all occurred in the tidal area to which the bulls had descended and where they were splashed by wave action.
7. Several animals were observed with ropes or plastic materials around their necks.

Discussion and Conclusions

Distribution and abundance

Seal Rocks: The total number of animals seen in the present study was higher than in June 1988 (Table 1). The fact that many fresh placentas were visible amongst the pups on the second aerial survey (25 June 1988) indicates that possibly more pups would be born later that month. Previous surveys recorded 545 (1978), 491 (1979), 799 (1984), 487 (1988, probably not all pups born yet that season) pups at Seal Rocks (Hoover, 1988; Kastelein & Weltz, 1990). The number of pups seen in the present study (757, when probably not all pups had been born) is within the upper range of these observations.

Wooded Island: The total number of animals seen in the present study was higher than in June 1988 (Table 1). This colony was considered a haul-out area because of the high percentage of non-territorial bulls and the lack of pups in 1988 (Kastelein & Weltz, 1990). However, during the present study territorial bulls and pups together with fresh placentas were seen. This would qualify Wooded Island as a

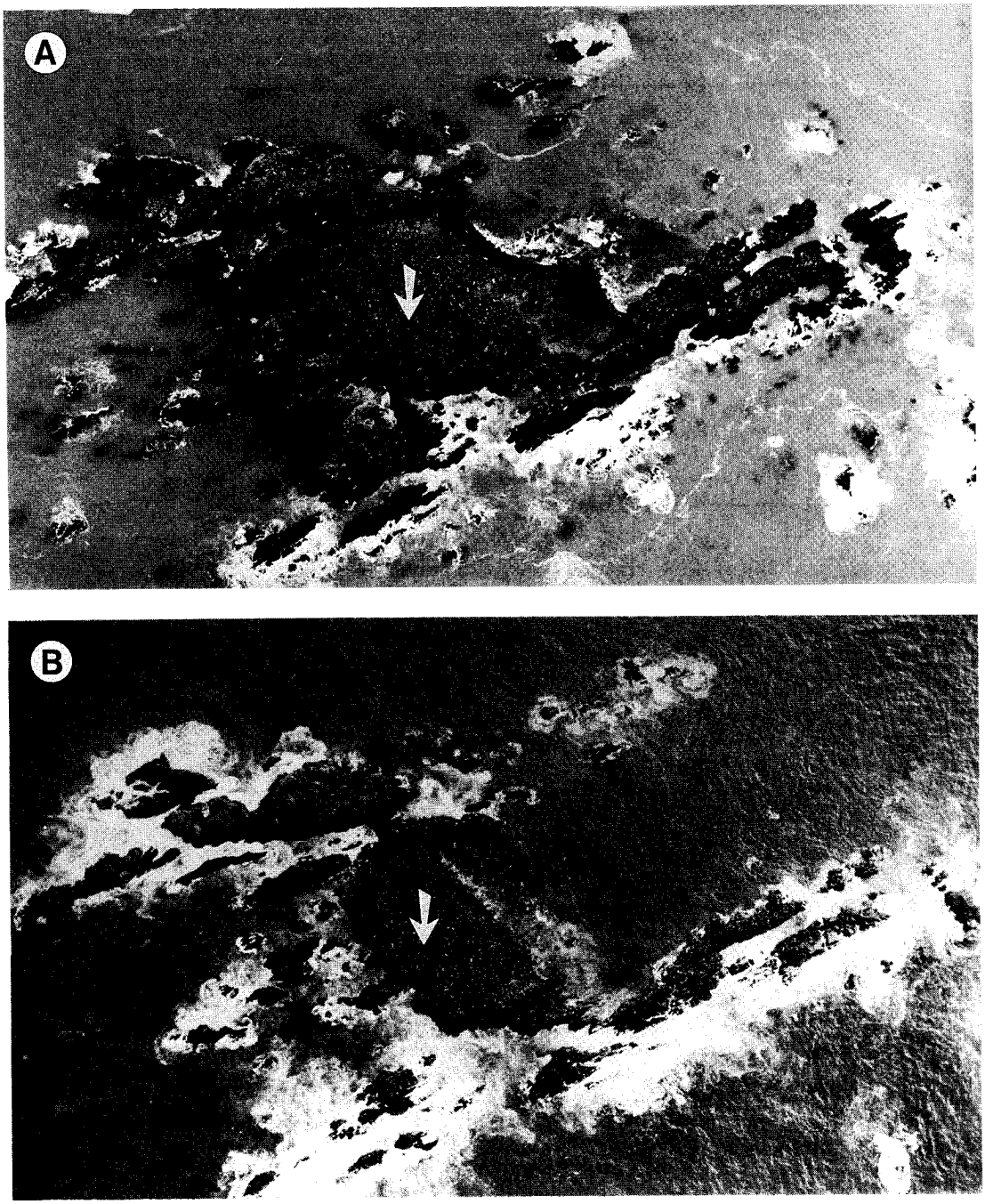

Figure 2. An aerial photograph of Seal Rocks. (A) during low tide, and (B) during high tide. The arrow indicates the boulder (= pupping) area (Photos: Henk Merjenburgh).

rookery. Maybe the larger number of animals in the Sound caused some of the females to give birth at less favourable areas. This shows that the function of the different colonies can vary from year to year and that aerial surveys directed to investigate the reproductive success in a given year should include all colonies.

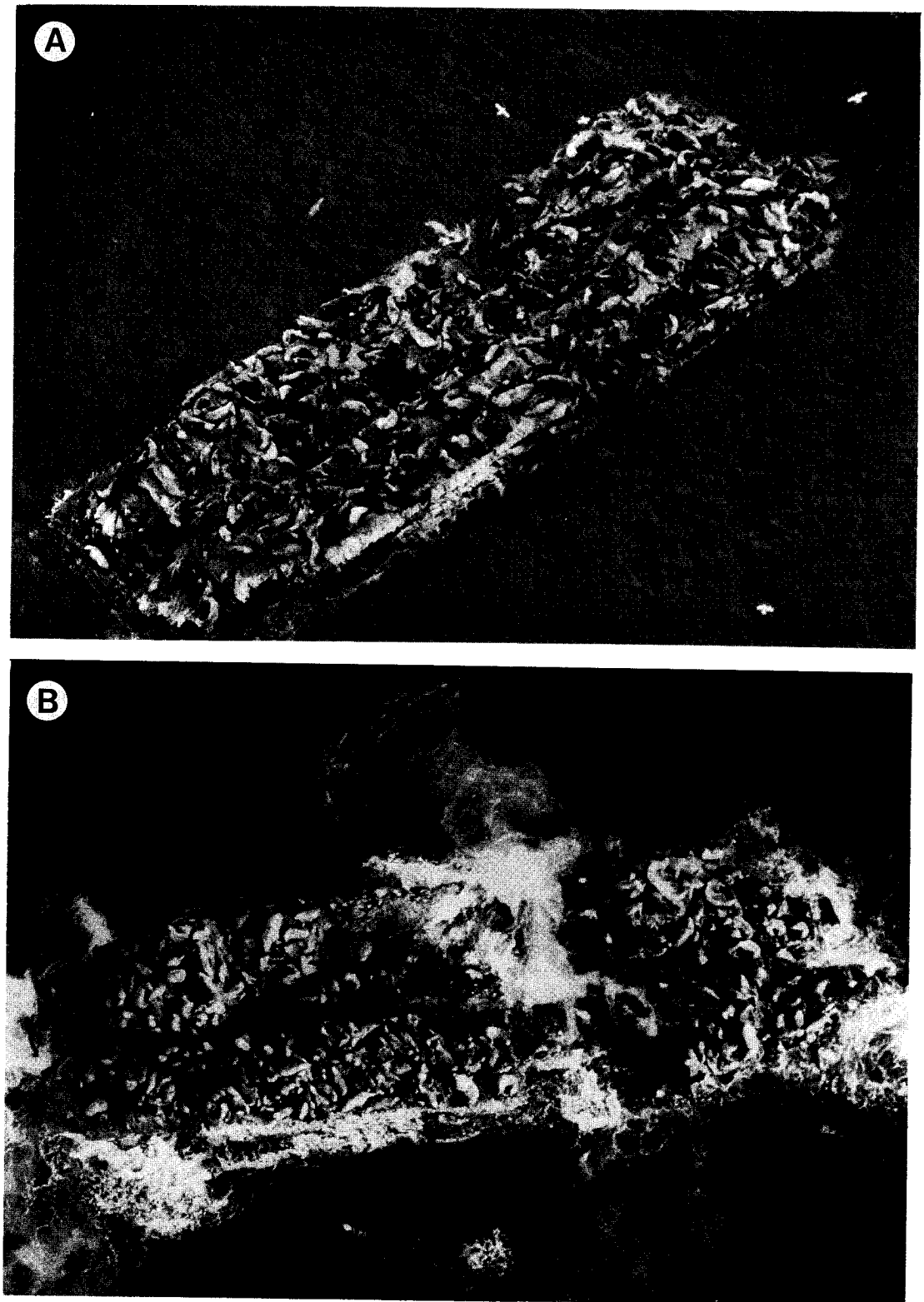

Figure 3. An aerial photograph of the western rock of the Needle. (A) during low tide, and (B) during high tide (Photos: Henk Merjenburgh).

The Needle: The total number of animals seen in the present study was higher than in June 1988 (Table 1). The number of territorial bulls was similar during both years. Because no pups were seen in 1988 and 1989, the Needle only served as a haul-out and mating area in those years.

Cape Elrington: No pups were seen at this colony, so the rocks only served as a haul-out site.

A number of animals are always in the water, so that the counts from the rookeries and haul-out areas are underestimates for the total number of animals present in the survey area. In the evening of June 19, 4 young Steller sea lions were seen in Snug Harbor at low tide. This means that not all animals haul out at the Needle (the nearest haul-out area, 16 km away) at low tide. What proportion of the total population in Prince William Sound does not haul out at low tide is not known. The haul-out behaviour may be location, sex and age dependant. Non-reproductive non-suckling animals probably have a smaller need to haul out than other age classes.

Surveys in the western Gulf of Alaska and Aleutian Islands indicate that the number of Steller sea lions has declined between 1958 and 1989 (Merrick *et al.*, 1987; Calkins & Goodwin, 1988; Loughlin *et al.*, 1990). The number of animals counted on the surveyed colonies in the Prince William Sound area was greater in 1989 than in 1988. It is possible that migration from other areas might have contributed to this increase. There may be short term migration between the sites of the present study and Cape St Elias (a haul-out site for Steller sea lions on Kayak Island, 150 km south-east of Prince William Sound). Steller sea lions can also migrate over long distances (Wynne, 1988). For example, during the last couple of years the number of Steller sea lions at Seal Rocks 2 (West of Prince William Sound in the direction of Kodiak Island) has declined from several thousand to several hundred animals. A few of these could have migrated to Prince William Sound where very large numbers of mature salmon returning to the hatcheries provide a food source which is seasonally very abundant for these opportunistic feeders (Wynne, 1990). An increase in other fish populations might have provided additional food sources for the Steller sea lions.

Because the high and low tide aerial surveys of the present study were conducted 9 days apart, migration may have occurred during this period. It is also possible that foraging or breeding patterns could have affected the number of animals hauled out on land. The increase in the number of non-territorial bulls at Seal Rocks from low tide on June 16 to high tide on June 25 is inconsistent with the observations of the tidal-influenced haul-out behaviour; but if this increase resulted from migration, then the aerial counts would even more strongly suggest that haul-out behaviour is influenced by the tides. Aerial surveys done at high and low tide on the same day could provide more useful data about haul-out patterns by minimizing some of these possibilities.

Reproduction

The data in Table 1 indicate that in 1989, 2 of the 4 studied colonies were rookeries where births occurred (Seal Rocks and Wooded Island). Although some pups were seen at one particular spot on Wooded Island, Seal Rocks is the main rookery where pups are born in this geographical area. All pups seen at the Seal Rocks rookery were located on the boulder area of the central island (Fig. 2). This type of habitat is probably the most favourable for delivering the pups, and for suckling them during the first 2 weeks of their life. In 1988, the animals only occupied the coastal borders of the boulder area, whereas in the present study the animals occupied the entire boulder area. This may have been caused by the increased number of animals.

Two of the 4 study sites were haul-out areas without births (The Needle and Cape Elrington). The Needle is considered a haul-out area because no pups were seen both in 1988 and in the present study. However, many copulations were seen at this colony. This suggests that females may copulate at different colonies, but will prefer delivering their pups only at specific rookeries. Females may have their first ovulation (and copulation) at such haul-out areas. Perhaps females that do not give birth in a particular year copulate at haul-out areas so that the valuable (=scarce), safe pupping areas remain reserved for pregnant females. At the study sites where no pups were seen, fairly large numbers of one-year-old suckling young were seen. At the Harderwijk Marine Mammal Park, females also often suckle their young for 1.5 years (Kastelein *et al.*, 1990).

Haul-out behaviour

Mature Steller sea lion bulls are known not to leave their territory for about 40 days during the breeding season (Mathisen *et al.*, 1962; Sandegren, 1970; Pitcher & Calkins, 1981). However, in Prince William Sound, they often go into the water next to their territories for short periods (Kastelein & Weltz, 1990). The time of day that the mature Steller sea lion bulls go into the water seems influenced by the tide, not only for those whose territories become flooded at high tide, but also for animals who occupy an area above the high tide line. When the territorial bulls go into the water they stay at the edge of their rock and do not go further out to feed. Also they do not swim much, but float as if they go into the water to cool down (Kastelein & Weltz, 1990). The fasting of the males during the breeding period seems to be regulated by hormones, since breeding bulls in zoological

parks also reduce their food intake considerably in June and July (Kastelein *et al.*, 1990). Some females and young animals show a tidal-influenced haul-out pattern that is similar to that of the bulls. However, they do not necessarily stay around the colony.

The physical geography of a colony site probably influences the degree to which animals exhibit the tidal-influenced haul-out behaviour observed at the Needle and Seal Rocks. The rocks composing the Needle rise steeply out of the water in steps, and the portion of the rocks that is exposed decreases as the tide rises. This causes crowding on the rocks and eventually some areas disappear completely under water, forcing some animals to leave the rock. At Seal Rocks, the periphery constitutes only a small proportion of the usable space, so only part of the animals of this colony experience the crowding effect discussed above for the Needle. This might explain why the counts at the extreme tides did not vary as much at Seal Rocks as they did at the Needle.

The two aerial surveys of the present study yielded varying numbers of animals present at the study sites during high and low tide. Although the present study was very small in scale, the aerial survey data support the behavioural observations of Kastelein & Weltz (1990) that in this geographical area, and at this time of year, the haul-out pattern of some Steller sea lions seems influenced by the tide. Sandegren (1970) also observed more animals in the water at high tide, than during low tide. However, tidal-influenced haul-out behaviour may be a seasonal and regional phenomenon. Stack (1981), noticed no tidal effect on the number of Steller sea lions hauled out at Klamath Cove, California between April and June. Withrow (1982) did a study which compared aerial surveys with ground observations. He too found no correlation between Steller sea lion numbers hauled out on land and the tide. This was confirmed by a study of Sullivan (1980) along Humboldt County, California.

More research is needed to investigate the geographical and seasonal haul-out behaviour of Steller sea lions so that in future aerial surveys this phenomenon can be taken into consideration. Aerial population surveys meanwhile should probably be done at a consistent stage of the tide.

Acknowledgements

We thank pilot Randall W. Epperley for his help during the aerial surveys and Henk Merjenburgh for the photography.

References

Calkins, D. G. (1985). The Steller sea lion (*Eumetopias jubatus*). In: Marine Mammals Species Accounts (Eds J. J. Burns, K. J. Frost and L. F. Lowry) Alaska Dept. of Fish and Game, Technical Bulletin 7: 47-54.

Calkins, D. & Goodwin, E. (1988). Investigation of the declining sea lion population in the Gulf of Alaska. Alaska Dept. of Fish and Game, Anchorage, Alaska, 76 pp.

Fiscus, C. H., Rugh, D. J. & Loughlin, T. R. (1981). Census of northern sea lions (*Eumetopias jubatus*) in central Aleutian Islands, Alaska, 17 June–15 July 1979, with notes on other marine mammals and birds. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Seattle, Wash., Tech. Memo. NMFS1 F/NWC-17. 118 pp.

Hoover, A. A. (1988). Steller sea lion, *Eumetopias jubatus*. In: Selected Marine Mammals of Alaska, species accounts with research and management recommendations (Ed. J. W. Lentfer) Marine Mammal Commission, Washington D.C.: 159–193.

Kastelein, R. A., Vaughan, N. & Wiepkema, P. R. (1990). Food consumption of Steller sea lions (*Eumetopias jubatus*). *Aquatic Mammals* **15**(4), 137–144.

Kastelein, R. A. & Weltz, F. C. (1990). Distribution, abundance, reproduction and behaviour of Steller sea lions (*Eumetopias jubatus*) in Prince William Sound, Alaska. *Aquatic Mammals* **15**(4), 145–157.

Kenyon, K. W. & Rice, D. W. (1961). Abundance and distribution of the Steller sea lion. *Journal of Mammology* **42.2**, 223–234.

Loughlin, T. R., Rugh, D. J. & Fiscus, C. H. (1984). Northern sea lion distribution and abundance: 1956–80. *J. Wildl. Manage.* **48**(3), 729–740.

Loughlin, T. R., Perlov, A. S. & Vladimir, V. A. (1990). Survey of northern sea lions (*Eumetopias jubatus*) in the Gulf of Alaska and Aleutian Islands during June 1989. NOAA Technical Memorandum, NMF F/NWC-176. 26 pp.

Mathisen, O. A., Baade, R. T. & Lopp, R. J. (1962). Breeding and stomach contents of the Steller sea lion in Alaska. *Journal of Mammology* **43.4**, 469–477.

Mathisen, O. A. & Lopp, R. J. (1963). Photographic census of the Steller sea lions herds in Alaska, 1956–58. *U.S. Fish and Wildl. Serv. Spec. Sci. Rep. Fish.* **424**, 200 pp.

Merrick, R. L., Loughlin, T. R. & Calkins, D. G. (1987). Decline in abundance of the Northern Sea lion *Eumetopias jubatus*, in Alaska, 1956–86. *Fisheries Bulletin* **85.2**, 351–365.

Pitcher, K. W. & Calkins, D. (1981). Prey of the Steller sea lion, *Eumetopias jubatus*, in the Gulf of Alaska. *U.S. Natl. Mar. Fish. Serv. Fish. Bull.* **79**(3), 467–472.

Sandegren, F. E. (1970). Breeding and maternal behavior of the Steller sea lion (*Eumetopias jubata*) in Alaska. M.S. Thesis, Univ. Alaska, College. 138 pp.

Stack, J. D. (1981). Diurnal activity patterns of non-breeding *Zalophus californianus* and *Eumetopias jubatus* at Klamath cove, California. M.S. Thesis, The Faculty of Humboldt State University. 70 p.

Sullivan, R. M. (1980). Seasonal occurrence and haulout use in pinnipeds along Humboldt County, California. *J. Mammal.* **61**, 754–759.

Withrow, D. E. (1982). Using aerial surveys, ground truth methodology, and haulout behavior to census Steller sea lions, *Eumetopias jubatus*. M.S. Thesis, Univ. Washington, Seattle, 102 p.

Wynne, K. (1988). Personal communication, Cordova.

Wynne, K. (1990). Marine mammal interactions with the salmon drift gillnet fishery on the Copper river delta, Alaska, 1988–1989. Alaska Sea Grant College Program Technical Report No. 90-05.