

# SEASONAL FORAGING BEHAVIOR OF LACTATING CALIFORNIA SEA LIONS FROM SAN MIGUEL ISLAND, CALIFORNIA



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## INTRODUCTION

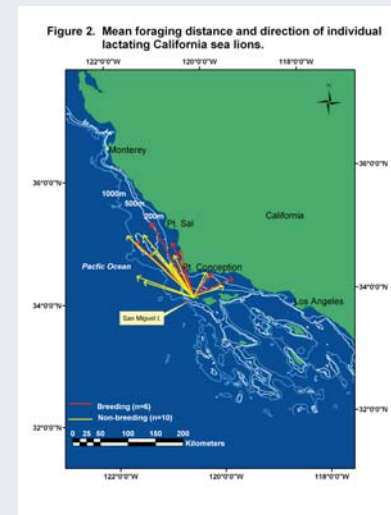
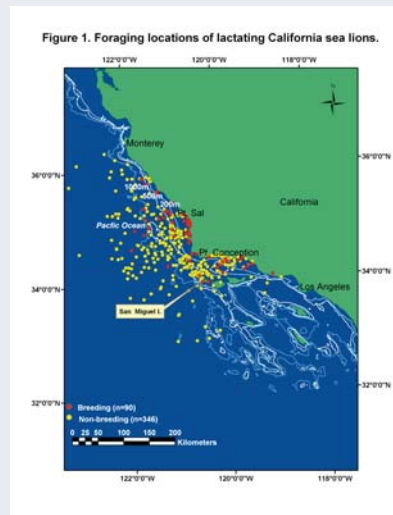
- The lactation period of California sea lions (*Zalophus californianus californianus*) lasts up to 11 months, and spans the breeding (May-July) and non-breeding seasons (August-April).
- Females frequent San Miguel Island throughout the lactation period, alternating 3-4 day foraging trips to sea with 1-2 day nursing visits ashore.
- Early studies of foraging behavior of lactating California sea lions during the breeding season characterized them as coastal feeders and shallow divers (Feldkamp et al. 1989, Antonelis et al. 1990).
- The breeding season represents only 30% of the time a female invests in her pup. A greater proportion of the maternal investment occurs during the non-breeding season, for which the foraging behavior is unknown.
- Food habits studies have reported shifts in the composition of the sea lion diet during the breeding and non-breeding seasons (Antonelis et al. 1984). The changes in diet suggested different foraging behavior between the seasons.

## OBJECTIVE

Describe annual patterns in foraging behavior to test the null hypothesis that there are no changes in foraging behavior of lactating California sea lions during breeding and non-breeding seasons.

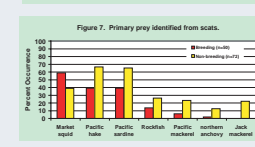
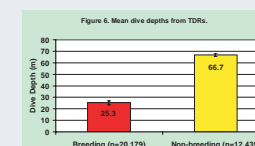
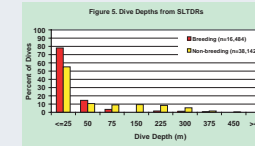
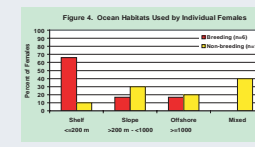
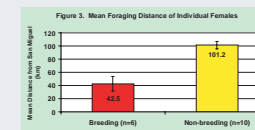
## METHODS

- Satellite-Linked Time Depth Recorders (SLTDRs) were deployed on 6 lactating females in the 1995 breeding season and 10 females in the 1995-1996 non-breeding season at San Miguel Island, California.
- SLTDRs were programmed to collect locations, dive depths and dive durations 8 hours/day. ARGOS location qualities and a speed filter of 10 km/hr were used to determine locations retained for analyses (Melin, 2002).
- The median distance and direction for each foraging trip were calculated for each female. The median of each trip was used to calculate the mean distance and direction for all trips to produce a vector describing the mean distance and direction of foraging for individuals.
- Mean dive depth was calculated from TDR dive records for 6 females in the 1995 breeding season and 6 females in the 1995-1996 non-breeding season. TDR data were only available if the instrument was recovered.
- Primary prey were determined from hard parts recovered from scats collected at San Miguel Island while females were instrumented. Primary prey species were defined as those occurring in frequencies greater than 10%.
- We compared six parameters of foraging behavior between seasons using nested ANOVA or  $\chi^2$  tests and  $\alpha < 0.05$ .



## RESULTS

- 90 foraging locations were obtained from 6 females during the 1995 breeding season and 346 foraging locations were obtained from 10 females during the 1995-1996 non-breeding season (Figure 1).
- Lactating California sea lion females were year-round residents of the California Current feeding northeast and northwest of San Miguel Island to Monterey Bay, California (Figure 2).
- Females foraged farther from San Miguel Island during the non-breeding season compared to the breeding season (ANOVA,  $p < 0.001$ ) (Figure 3).
- Females primarily utilized the shelf habitat during the breeding season but shifted to the slope and offshore habitats during the non-breeding season ( $\chi^2 = 23.295$ ,  $p < 0.001$ ) (Figure 4). Some females in each season used multiple habitats.
- Females exploited a greater range of dive depths ( $\chi^2 = 17.152$ ,  $p < 0.001$ ) (Figure 5) and dove deeper during the non-breeding season compared to the breeding season (ANOVA,  $p = 0.014$ ) (Figure 6). Maximum dive depth was 464 m.
- Market squid was the dominant prey species during the breeding season but Pacific hake and Pacific sardine were also important prey items (Figure 7). Pacific hake and Pacific sardine dominated the non-breeding season diet but market squid, rockfish, Pacific mackerel and jack mackerel were also important prey items.



## CONCLUSIONS

- Lactating California sea lions are year-round residents of the California Current.
- Differences that occurred in the foraging distance, ocean habitat, dive depth, and diet of females are consistent with changes in prey distribution in the California Current.
  - Market squid, Pacific hake and Pacific sardine are abundant and are distributed close to the colony and over the shelf during the summer due to productive coastal upwelling along the California coast.
  - Pacific hake, Pacific sardine, Pacific mackerel, and jack mackerel are distributed farther from the colony, along the slope and offshore during the winter. The re-distribution of prey occurs in response to the relocation of ocean productivity to the inshore edge of the California Current located about 100 km offshore.
- Why don't San Miguel Island females use foraging areas south of San Miguel Island? About half (90,000) of the California sea lion population breeds on San Miguel Island while the other half of the population breeds on the California Islands south of San Miguel Island. The results of our study suggest that there is segregation of the population by foraging areas, with the southern populations feeding near the southern islands and the northern population feeding to the north.
- Future analyses will include investigating annual patterns in foraging behavior at other California Channel Islands to test hypotheses about partitioning of the foraging resources of the California Current by island sub-populations of California sea lions.

## References

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