

Factors Influencing the Activity Budget of Territorial Male California Sea Lions

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INTRODUCTION

- This summer I participated in a behavioral study on territorial male California sea lions on San Miguel Island, California in the Channel Islands National Park. The internship was offered through the National Marine Fisheries Service, Alaska Fisheries Science Center, National Marine Mammal Laboratory. I chose this internship out of a love of field work and a curiosity for behavioral research.
- Background on the California sea lion (*Zalophus californianus*):
 - California sea lions have a polygynous breeding system, in which males compete with each other for territories that provide access to breeding females.
 - Males hold territories from early June to early August.
 - Territories are defined by physical boundaries or distribution of females.
 - Territories are held in a variety of substrates (water, rock, sand).
 - Access to breeding females is determined by daily migrations of females to and from water areas.
 - Breeding primarily occurs in water for thermoregulatory reasons.
- The purpose of this study was to examine several factors that influence the behaviors, the activity budget, and reproductive success of territorial male California sea lions.

MATERIALS AND PROCEDURE

- Between 20 June and 15 July 2009, males were observed for a minimum of 8 hours per day between 7am and 7pm. Three 24 hour observation surveys were also conducted, using night vision goggles during nighttime hours.
- 14 male California sea lions in West Shelf Rock were distinguished by natural marks, brands, or paint marking.
- Territories were classified as:
 - Water: $\geq 50\%$ of territory in water at high tide
 - Border: 1-50% of territory in water at high tide
 - Land: 0% of the territory in water at high tide
- Territorial tenure was defined as the date males were first observed on territory to the last date observed on territory.
- Activity was determined every 10 minutes using scan sampling.
 - Males were recorded as resting or active. Resting was used to describe an animal lying down. Active included interacting with other animals, swimming, patrolling, barking, and upright resting.
 - Any interaction (e.g. display, fight, or copulation) was recorded with the start and end time, the participants, and the outcome of the interaction.
- Successful copulations were defined as those that included a rapid thrusting phase. Copulations that did not include this phase were defined as unsuccessful (Heath 1989).
- Environmental conditions (air temperature and tide height) were recorded every hour.

HYPOTHESES AND PREDICTIONS

- H_{01} : The behaviors and activity budget of male territorial California sea lions do not differ with territory type (water, border, and land).
- P_{01} : The behaviors and activity budget of male territorial California sea lions do differ with territory type (e.g. activity level: water>border>land).
- H_{02} : The behaviors and activity budget of male territorial California sea lions in different territory types do not differ with time of day or environmental conditions (air temperature, tide height).
- P_{02} : The behaviors and activity budget of male territorial California sea lions in different territory types do differ with time of day or environmental conditions (e.g. activity level of water males increases with tide height).

RESULTS

- We observed 3 water, 4 border, and 8 land males (Table 1).
- Water males spent the highest proportion of their time active, whereas border males had intermediate activity and land males spent the least amount of time active (Fig. 1, ANOVA, $p > .001$).
- All males spent a greater portion of their time active as air temperature and tide height increased. The correlation was strongest in water males (Figs. 2 and 3).
- Water and border males had the highest activity levels during mid-day and mid-night corresponding to tide cycles. Activity level did not correlate with time of day for land males (Fig. 4).
- Water and border males had similar tenures (water males: mean=25.0, S.E. = 0.577; border males: mean=24.8, S.E. = 0.946). Land males had significantly shorter tenures (mean = 19.4, S.E. = 1.674) (Fig. 5; ANOVA, $p = .040$).
- Copulations were observed in each territory type. Successful copulations were observed only in water and border territories. Male #9 had 46% of the total copulations and 71% of the successful copulations (Fig. 6).
- We found no correlation with territory type and displays and fights between males (ANOVA, $p = 0.456$) or with territory type and non-copulatory female interactions (ANOVA, $p = 0.561$). However, there was a high degree of variation in these behaviors among individuals within each territory types.

Territory Type	ID	Start Date	End Date	Minimum Tenure (Days)	Proportion of Time Spent Active
Water	2	< 6/20/2009	7/15/2009	26	0.72
	8	< 6/20/2009	7/13/2009	24	0.57
	9	< 6/20/2009	7/14/2009	25	0.78
Border	4	< 6/20/2009	7/15/2009	26	0.58
	13	< 6/20/2009	7/14/2009	25	0.37
	16	< 6/20/2009	7/15/2009	26	0.38
	21	6/24/2009	7/15/2009	22	0.28
Land	3	< 6/20/2009	7/7/2009	18	0.34
	5	< 6/20/2009	7/10/2009	21	0.21
	6	< 6/20/2009	7/1/2009	12	0.17
	12	< 6/20/2009	7/8/2009	19	0.25
	14	< 6/20/2009	7/13/2009	24	0.15
	18	6/21/2009	7/15/2009	25	0.15
	20	6/24/2009	7/10/2009	17	0.28

Figure 1. Activity Budget by Territory Type

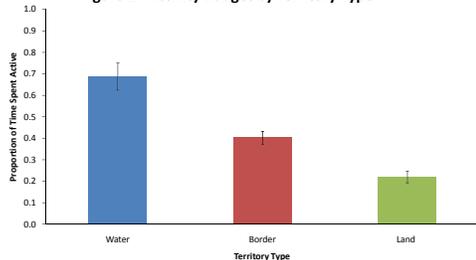


Figure 2. Activity and Temperature

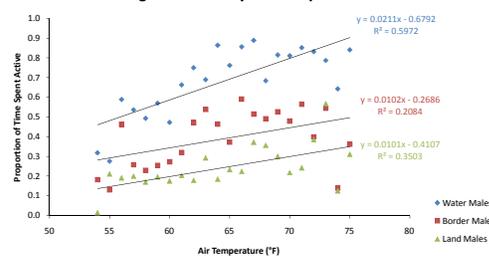


Figure 3. Activity and Tide

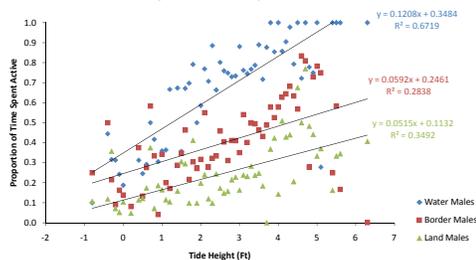


Figure 4. Activity and Time of Day

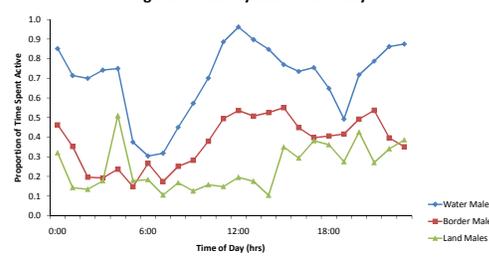


Figure 5. Tenure by Territory Type

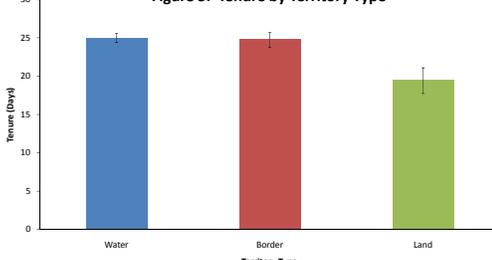
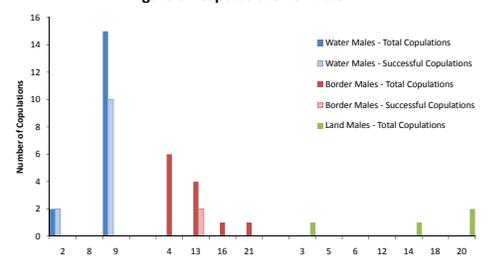


Figure 6. Copulations Per Male



CONCLUSIONS

- The behaviors and activity budget of male territorial California sea lions are influenced by territory type, temperature, and tide.
- Tide, time of day, and air temperature had the greatest effect on the activity level of males with water territories.
 - Increased tide height, which correlates with time of day, causes flooding of the water territories resulting in water males becoming more active.
 - At higher air temperatures, females migrate from inland to water territories causing water males to become more active because they have access to breeding females.
- Males with water territories had the greatest number of copulations. Most copulations observed were attributed to male #9, suggesting that factors other than territory type (e.g. female mate choice) may also influence male reproductive success.
- Land males had the shortest tenure, were the least active, and had the fewest copulations.
- Additional analyses will include an evaluation of female distribution by territory type, time of day, temperature, and tide as a proxy for reproductive opportunity for territorial males.
- Future studies include molecular genetic analysis of territorial males and pups in order to determine paternity, and a comparison of reproductive success between paternity analysis and behavioral observations.
- Considerations for the study design include:
 - Have we defined the behaviors in a manner to avoid biasing a territory type?
 - Initial reports of an El Niño event have been made. Could this affect the behaviors of territorial males?



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LITERATURE CITED
Heath, C. B. 1989. The behavioral ecology of the California sea lion, *Zalophus californianus*. University of California, Santa Cruz.

The recommendations and general content presented in this poster do not necessarily represent the views or official position of the Department of Commerce, the National Oceanic and Atmospheric Administration, or the National Marine Fisheries Service.

