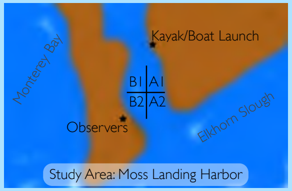
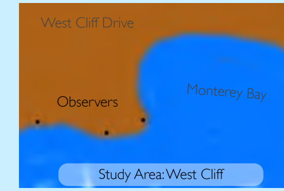


Anthropogenic Influences on the California Sea Otter (Enhydra lutris nereis)



INTRODUCTION

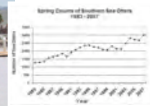


Fig. 1: Recent sea otter population growth graph from the Western Ecological Research Center (2007)

Among the greatest mysteries concerning the California sea otter (Enhydra lutris nereis) is the slow population growth rate of 3-4% per year (see fig.1) at which the population is recovering from its near extinction over a century ago. California sea otters have been highly endangered since the 1800s, when over hunting reduced the population to only fifty. The most recent count of slightly over 3000 individuals (WERC, 2007) is surprising given that the carrying capacity for this population is estimated to be between 10,000 and 15,000 (Laidre et al, 2001). This is an incredibly slow growth rate. In theory, the population should have reached its carrying capacity years ago. Why is it still so far away?

Otters are a keystone species in the kelp forest ecosystem; without them, urchin populations would explode, devouring the kelp, which could cause the ecosystem to disintegrate, causing low primary productivity and biodiversity.

There are currently many theories concerning the slow population growth rate, but, as of yet, no single cause has been pinpointed. A plausible theory is that otters are expending more energy as a result of human disturbance. There has been remarkably little research to quantify human disturbance. In theory, frequent disturbance of sea otters, which causes them to dive or otherwise submerge their feet, may interfere with their thermoregulation. This theory is consistent with data in Estes' 2003 experiment, which indicated that otter mortality rates were higher in the spring and summer months, when the bay is at its coldest due to upwelling. The colder temperatures make it especially important that otters employ all of their thermoregulatory tactics without interference. For the well-being of our entire coast, it is essential that we learn about the impact that humans are having on sea otters while we still have time to change it.

PURPOSE

To determine what effects, if any, humans are having on sea otters in California, the impacts of such effects, and whether the current laws are appropriate for protecting the sea otter population.

QUESTION

Do humans cause otters in the Monterey Bay to alter their behavior? Does this pose a threat to otter well-being by causing otters to increase energy expenditure? How much energy is lost in such an occurrence?

HYPOTHESIS

The over-arching hypothesis is that human disturbance is significantly altering sea otter behavior such that otters expend more energy than they would were no humans present. The specific hypotheses for this study are that:

- Specified sea otter behaviors will be more or less frequent when humans are present than when they are not present.
- Behavior changes in places other than Moss Landing Harbor will be equally or more sever than in Moss Landing Harbor.

- The sea otter energy expenditure will be positively correlated with the nearness of humans.
- The amount of energy lost to human interactions will be a significant portion of an otter's daily intake.

MATERIALS

- 1 spotting scope
- 1 tripod
- 2 sets of binoculars
- 1 field journal
- 1 outdoor thermometer
- data sheets
- digital clock
- digital camera
- pen or pencil
- Microsoft Excel 2000

PROCEDURE

Observational behavioral data were collected in Moss Landing Harbor (see fig. 2) and other locations (see fig. 3) using a modified time-budget sampling system:

1. Scan entire sample area with spotting scope and binoculars. Record data for all pre-determined categories, such as number of groups present, their overall activity levels, specific behaviors within each group, the number of individual otters, specific behaviors being performed by each of these otters, the number of animals of other species present, the temperature, the water conditions in the harbor, and the level of cloud cover.
2. Record location of all groups, using pre-determined sections of the harbor.
3. Obtain other atmospheric data from NOAA buoy websites.
4. Continue watching activity in harbor, noting any abnormal occurrences.
5. Repeat steps 1-3 any time a human enters the sample area and every ten minutes after the first data point.

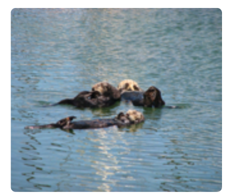
BEHAVIORS

Interacting

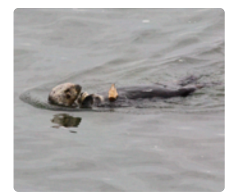
Diving

Traveling

Resting



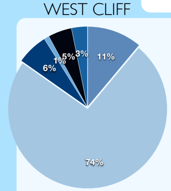
Grooming



Foraging

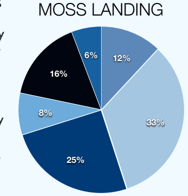
DATA/RESULTS

WEST CLIFF

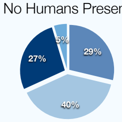


The data were analyzed first using a chi square test to see if there was a significant difference between our two sample otter populations: West Cliff in Santa Cruz, and Moss Landing Harbor. We used the otter population along West Cliff in Santa Cruz as an example of a "normal" population, with no human interference, while the Moss Landing Harbor population lives alongside a boat launch and kayak shop where they encounter interactions on an almost hourly basis. By taking a look at these samples, we hoped to determine whether there was a significant difference between the behavioral aspects of otters with and without human interference. The our results were evaluated using the formula: X^2 = (Observed Value - Expected Value)^2 / (Expected Value), we ended up with a chi square value of approximately 122, which corresponds to a p value of well below .0005, meaning that the null hypothesis can be rejected at an alpha level of .01, in favor of the alternative hypothesis that there is a significant difference in behavioral attributes of the two otter populations. To meet necessary independence conditions for this statistical test, an SRS was used for each location. Next, the data was analyzed to determine the average daytime caloric expenditure in circumstances involving various levels of human interaction. Data points were sorted into three categories: one in which no humans were present, another where humans were present, but far from the otters, and finally where humans were close to the otters. Using data obtained from a 2007 study by Laura Yeates, in which energy costs of various otter behaviors were established, the average daytime caloric expenditure was estimated for an otter, given each of the three conditions. Overall, the estimated average increase in caloric expenditure from the "no humans" group to the "humans nearby" group was approximately 100 kcal per 12 hour daytime period, which is approximately 5% of a sea otter's average caloric intake during that time period, 1875 kcal.

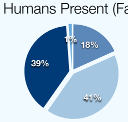
MOSS LANDING



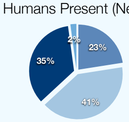
No Humans Present



Humans Present (Far)



Humans Present (Near)



Projected Daytime Caloric Expenditure for Otters in Moss Landing Harbor

Grooming | Resting | Traveling | Diving | Interacting | Foraging

TIME BUDGET METHODOLOGY

One of the most commonly used techniques for observational studies on sea otters is the time budget. A time budget is made by making observations about otters at predetermined time intervals. For the purposes of this study, which encompasses a broad swath of behavioral data, a ten-minute interval was determined to be most effective (It is frequent enough to ensure that, in general, all significant shifts in behavior will be included in a data point, but infrequent enough to allow time to collect each data point completely, without undue rush or strain on observers, which could reduce accuracy over time). Each data point is to be viewed as a "snapshot" of how the harbor looked at that exact second.

It was necessary to introduce one modification. In a traditional time budget methodology, data would be recorded only at the specified time. However, to avoid missing interactions, we used a modified time budget methodology, in which data points were recorded not only at each ten-minute mark, but at every single time when a human entered the sample area. As these data points were to be compared separately, and were randomly occurring, it was assumed that this would not introduce a significant bias.

CONCLUSION

Differences between Moss Landing and West Cliff:

Moss Landing harbor has a unique environment. It has an unusually large number of otters and, due to both tourism and fishing, an unusually large number of people. Thus, there is an unusually high rate of interaction between the two. There has been much speculation that, as a result, the otters living in the harbor have become desensitized. Although they will sometimes lie calmly next to a giant fishing boat as it comes in or out of the harbor, they are still disturbed to the point of behavior altering often. Although it was ultimately beyond the scope of this project to obtain data from a sufficiently wide range of locations to make generalizations about the plight of the California sea otter population as a whole, the data provides strong evidence that when humans are in too close proximity to otters, they alter their behavior significantly.

Degree of harm to otters:

Analysis of behavior data collected for this study in conjunction with data on energy requirements of assorted otter behaviors from another study made it possible to estimate and compare the average caloric expenditures of otters in varying degrees of contact with humans. Although the ultimate projected difference is only a 5% increase on a sea otter's normal daily caloric intake, it is large enough to add up over time. The additional 100-200 calories that otters are predicted to require daily if living in constant close proximity to humans is equivalent to one abalone. If all of the roughly 3000 California sea otters alive currently needed to eat an additional abalone each day to maintain stable body weight, prey would become much scarcer quickly. Given the studies suggesting that the environment is already food-limited, it seems quite possible that energy loss due to human interactions is a legitimate problem which we must address if we value the integrity of our near-shore ecosystems.

ACKNOWLEDGMENTS

We would like to offer our sincerest thanks to the following people for all of their help and encouragement with this project. First, we thank Sanaya Forbes, who helped conduct research for Phase I of this study. Second, we thank our mentor, Marissa Young, of the Monterey Bay Aquarium's Sea Otter Research and Conservation Center (SORAC), who volunteered her own time to help us turn our original idea into a feasible project, and to advise us on setting it up effectively, using proper data collection techniques, and analyzing our results. Third, we thank our teacher and project coordinator Jane Orbuch, who helped keep this project on track and gave advice on finding a mentor and presenting the project, in addition to setting up other opportunities for us to get practice talking about it. Fourth, we thank our parents for helping with proofreading and this presentation and transportation. Fifth, we thank our friend and photographer, Will Lawton, who took the otter photographs on the display.

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