Project Title: Intra-annual movements and habitat-associations of sea otters in Prince William Sound, Alaska

Principal Investigator (s): Randall W. Davis

Position/Title: Professor, Dept. Marine Biology

Organization/Affiliation: Texas A&M University at Galveston

Address: 5007 Avenue U, Galveston, Texas 77551

Office Telephone: 409-740-4712

Office E-mail: **davisr@tamug.tamu.edu**

Co-principal Investigator: Fred C. Weltz

Organization/Affiliation: Alice Cove Research

Address: P.O. Box 982, Cordova, AK 99574

Office Telephone: 907-424-7506

Office E-mail: weltzfred@ctcak.net

Research Site: Simpson Bay, North-eastern Prince William Sound, Alaska

Local Management Status of the Research Site: U.S. Forestry Service, Eyak Corporation, State of Alaska

Scientific names of primary species being studied (if appropriate): Sea otter (*Enhydra lutra*)

Key Research Objectives (5-8 brief bullet points):

The sea otter is a near-shore carnivore and the smallest marine mammal of the North Pacific Ocean. Sea otters forage, socialize, reproduce and rest in water between the intertidal and the 100-m isobathymetry contour. Sea otters forage in the benthos of rocky and soft-sediment communities, and differences in regional diet reflect the prey composition of those habitats. The diet of sea otters in Alaska consists mostly of macroinvertebrates, although epibenthic fish may be important in some areas. In soft-sediment habitats, sea otters feed on clams by excavating them with their forepaws. Prey species such as crabs, urchins, mussels and snails are also important dietary components in both rocky and soft-sediment habitats. Adult male and female sea otters exhibit home ranges that typically include a few-to-ten of kilometers of coastline. They have a polygynous reproductive system, where some adult males gain access to females by excluding rival males from relatively small territories.

In Prince William Sound (PWS), sea otters have been studied since the 1970's. These studies have focused on territoriality and mating behavior, social organization,

movement patterns, postnatal development and mortality, prey preferences and population biology. Similar studies of sea otters in near-shore communities have been conducted in other parts of Alaska and in California. Many of these studies were based on direct observations of otters that were either untagged or had small plastic identification tags attached to their hind flippers, often making re-identification difficult or impossible. Some otters had conventional radio telemeters attached to their hind flippers or surgically implanted in their abdomens to monitor their movements. However, radio tracking is labor-intensive and, when conducted from an aircraft, can be expensive. In addition, it often provides infrequent locations, with days or weeks between resightings. As a result, long-term (i.e., 5-10 years) longitudinal studies of daily, seasonal and inter-annual movements and habitat-associations of known animals have not been possible in Alaska. The use of photo-identification offers new opportunities to obtain detailed spatial and temporal data on sea otter movements and habitat-associations.

Research Objectives and Hypotheses

1. Develop and validate photo-identification as a non-invasive method for studying sea otters.
2. Monitor intra-annual movement patterns and behavior of male and female sea otters using photo-identification.
3. Characterize the physiography and bathymetry of the study area (Simpson Bay)
4. Determine seasonal habitat-associations and prey preferences
5. Assess potential predation of sea otters by killer whales and sharks

We will test the following null hypotheses:

1. Male and female sea otters exhibit overlapping, random use of near-shore habitats for foraging and reproduction
2. Sea otters show no preference for certain prey items
3. Sea otters do not exhibit emigration or immigration within a home range
4. Predation by killer whales and sharks is not a significant source of mortality in sea otters

Date this report was completed: September 19, 2004

Data Collection and Results

a) Give a concise account of the data you have collected during the past field season.
   1. Database of photo-identified female sea otters since 2002: includes location and behavior
   2. Database of territorial male sea otters since 2002: includes location and behavior
   3. Database of dive behavior: includes location, depth and duration of dive and prey
   4. Physiographic and bathymetric data on study area: includes detailed GIS maps generated by this study

b) What progress have you made towards achieving your original objectives?

This was the fourth year of our investigation of the intra-annual movements, behavior and habitat-associations of sea otters in Simpson Bay, located in eastern Prince William Sound, Alaska. With the results from past three years, we have successfully demonstrated the usefulness of photo-identification as a non-invasive method for studying sea otters. We now have over 80 sea otters in our study area that can be identified from facial scars and other features, and we anticipate that this number will continue to increase. These otters, both adult males and females, form the core of our database on intra-annual distribution and movements, feeding behavior and prey preference, male territorial behavior, and habitat-associations. In addition, we completed the development of proto-type software that will enable daily identification of sea otters (using digital images) in the field. This year, volunteers worked in two teams that divided their time between photo-identification of individual sea otters and behavioral observations of territorial males. Our results will contribute to an overall understanding of sea otter ecology and the factors that may influence fluctuations in the population.

c) Please provide a summary of your results (even if they are preliminary).

In terms of data collection, this year was very successful. We imaged over 800 otters and have identified about 80 based on nose scars. The location and behavior of adult females will be used to characterize habitat-associations. Territorial males were observed to collect focal-animal behavioral data. Obtaining GPS coordinates of territories and recording male-female mating interactions were of particular interest. Once a presumed territorial male was encountered, images were taken of the animal for the photo-ID database. While observing the male otter from a distance (ca. 75 m or more), interval data were recorded every 5 minutes. Along with imaging focal males, an attempt was also made to image each otter with which male interacted. This technique thereby enhanced both the behavioral database, as well as the photo-ID database. Data were collected on approximately ten identifiable territorial males in Simpson Bay throughout the summer. We will plot male territories using the GIS and correlate territory size and location with bottom-type. Our hypothesis is that the more fit males will maintain larger and more desirable territories (in terms of feeding, resting, and shelter areas) to attract the most females. Additionally, the photo-ID of females will indicate if territorial males exhibit any patterns in their mating strategy. Finally, we collected dive data (location, dive depth and duration) for females and males along with prey type to characterized feeding behavior.

Validation of photo-identification for the study of sea otters (2002-03)

We evaluated the use of naturally occurring nose scars to identify individual sea otters in Simpson Bay, Prince William Sound, Alaska. We spent 520 hours over 103 days conducting photo-identification surveys during the months of June, July and August of 2002 and 2003. Sea otters were sighted during all surveys. Both male and female sea otters bore nose scars. Forty-five percent of all individuals encountered were considered identifiable from nose scars, and a total of 114 individuals were identified. This compares favorably with the results of photo-identification studies of other marine mammals, suggesting that nose scars are useful for identifying individual sea otters.

Preliminary results for study of habitat-associations

Habitat associations of sea otters during resting and feeding were investigated in Simpson Bay, Prince William Sound, Alaska during the summer months of 2001-2003. Sea otter locations determined during boat surveys were overlaid (using GIS) on bathymetry and sediment maps and water depth, sediment type, distance from shore, and position in the bay (peripheral vs. central) was determined for each. Logistic regression analysis was used to determine whether sea otter habitat use was non-random according to any of these habitat variables. Water depth was the most significant habitat association for feeding behavior, with the majority of feeding dives occurring in shallow water less than 20m deep. Position in the bay was the most significant habitat association for resting behavior, with more otters resting in the center of the bay.

Preliminary results for study of territorial males

Photo-identification and focal animal sampling were used to examine the behavior of territorial male sea otters in Simpson Bay, Prince William Sound, Alaska during the summers (June –August) of 2002 and 2003. The mean population size in the Simpson Bay for both years was 127 ± 13.3 SD (n = 11). Activity budgets, bout lengths, and interactions with females were analyzed at both individual and group levels. Two hundred thirty-nine focal follows of 14 territorial male otters totaling 159 observation hours were conducted over two years. More time was spent feeding (29%) than in any other activity, and feeding bouts were longer than most other activities. Males interacted more often with females with pups than with single females ($p < 0.05$). Additionally, males interacted less often with females in rafts (i.e., a group of three or more otters) than with single females ($p < 0.001$) or females with pups ($p < 0.001$). Eighty percent of consortships were formed with single females. Eight-three percent of interactions between territorial males were aggressive; 27% involved physical contact, and all lasted one minute or longer. Behavior among all males was not a good indicator of individual behavior, suggesting the importance of conducting studies at both population and individual levels.

Significance/Benefits of Research

a) What is/are the significance/benefits of your research at the following levels?

Although sea otters have declined dramatically in the Aleutian Islands, this has not occurred in eastern PWS. Detailed ecological information on the Prince William Sound population may be important in elucidating the cause of decline in other parts of the sea otter's range. One hypothesis for the otter decline in the Aleutian Islands is increased predation by killer whales, possibly due to the decline in Steller's sea lions (another important prey species for killer whales). There is currently no evidence for increased predation of sea otters by killer whales in Prince William Sound. However, an increase in the number of salmon sharks and sleeper sharks has been reported. These large sharks are known to prey on harbor seals and may also feed on sea otters. In a broader sense, our results contribute to an overall understanding of sea otter ecology and the factors that may influence fluctuations in the population.

Our results may have their most direct application in relation to the dramatic decline in the sea otter population in the Aleutian Islands. The U.S. Fish and Wildlife Service, U.S. Dept. of the Interior is requesting additional information that will provide insight into the cause of the decline. Potential threats include both natural fluctuations and human activities, which may have caused changes in the Bering Sea ecosystem. Additional factors may include disease, starvation, contaminants and predation.

b) How do your findings contribute to issues of sustainability?

Results from this study may provide insight into the cause of the decline in other areas of Alaska and provide important information for sea otter management by the U.S. Fish and Wildlife Service.

Dissemination of Results

a) Have you provided details of results from your research to or within:

- Scientific papers (indicate status; e.g., peer reviewed or in progress/press)
  Pearson, H.C., Davis, R.W. (submitted) Behavior of territorial male sea otters (*Enhydra lutris*) in Prince William Sound, Alaska. Aquatic Mammals.
  Gilkinson, A.K., Davis R.W. (in prep) Photo-identification as a technique to study sea otters.
  Gilkinson, A.K., Davis R.W. (in prep) Habitat-associations of sea otters in eastern Prince William Sound, Alaska.

- Presentations (given or planned)

  1. Gilkinson, A. and Davis, R. Habitat Associations of Sea Otters in Prince William Sound, Alaska. Biennial Conference on the Biology of Marine Mammals, Greensboro. December 14-19, 2003.
  2. Pearson, H and Davis, R. A cost-benefit analysis for territorial male sea otters in Prince William Sound, Alaska. Biennial Conference on the Biology of Marine Mammals, Greensboro. December 14-19, 2003.

     Who was the audience? Attendees of the scientific conference
     How many people attended? 1200 people attended the conference

We would appreciate copies of any relevant materials you can make available to us.

SECTION II: VOLUNTEERS

Cover Letter to Volunteers

Dear Volunteers,

A hearty hello from Fred Weltz, Shannon Finerty, Ryan Wolt, Travor Wright, Ian Davis, Barney Weltz, Ana Maria Davis, Georgina Davis and myself. We enjoyed our summer with you and express our thanks in helping to make the field season successful. We

are busily analyzing data and entering it into the Geographical Information System. In addition we are collaborating with Dr. Gilbert Hillman at the University of Texas Medical Branch in Galveston to develop software for identifying sea otters based on facial scars. We plan to use this program next summer to identify sea otters at Alice Cove rather than after the field season is over. We believe that a significant number (ca. 30% or more) of sea otters in our study area can be identified. We also obtained much data on territorial males. Our best wishes to all of you, and we look forward to the possibility of seeing you again. Thanks again for your help and enthusiasm. Please feel free to contact me (email is always the easiest) at any time in the future.

Best Regards,
Randall Davis

Volunteer Tasks and Accomplishments

During the fourth year of our investigation of intra-annual movements and habitat-associations of sea otters in eastern Prince William Sound, we worked with seven teams of volunteers. To accomplish the goals of this multi-year project, volunteers worked in two teams that divided their time between photo-identification of individual sea otters and male behavioral studies. Approximately 800 sea otters were imaged. As there are normally ca. 120 animals in the study area, many animals were photographed more than once. We are currently building a database of animals with distinguishing facial features. At this time, we believe that about 30% of the animals are distinguishable, and we have begun building a discovery curve. We have also continued our collaboration with Dr. Gilbert Hillman at the University of Texas Medical Branch in Galveston. Dr. Hillman and his computer team have developed software that will enable the computer-assisted identification of sea otters using images stored in a database. A beta-version of this software is currently being tested at Texas A&M University. In addition to photo-identification, we have continued our analysis of habitat associations of sea otters in the study area. These data will be integrated with the locations of photo-identified sea otters, their prey and diving behavior to analyze habitat use.

Project Development

a) What logistical or scientific challenges have you encountered in the past season and how will you address them during the next field season?

Scientifically, our project is running smoothly and we are preparing to publish our first results. In addition, one graduate student (Andrea Gilkinson) who participated on the project in 2002-03 has successfully completed her Masters Degree from Texas A&M University with data obtained from this project. A second graduate student (Heidi Pearson) will publish her data on the behavior of territorial male sea otters and then proceed to a new study that will lead to a Doctorate with a colleague and Earthwatch PI, Dr. Bernd Wursig. Logistically, we built a new cabin this spring so that we could operate without displacing the Co-PI, Fred Weltz, from his cabin. The new cabin had the necessary amenities to make the volunteers and staff comfortable, and we received good reviews from the volunteers.

b) Have you used any additional methods/strategies to meet your research objectives? If so, please describe them.

None

c) How will you develop your research in the coming field season?

We will continue our research as it has been conducted for the past four years to enlarge our databases. This is long-term project, and the benefits that will accrue will result from data collection over many years.

Educational Opportunities

a) Does your project directly or indirectly involve the following groups in your research topic?
- Local communities: Not at the present time
- Students: Students from Texas A&M University
- Early career scientists: Post-doctoral Fellow at Texas A&M University
- Other groups: Visiting scientists from other universities and federal agencies such as the USFWS

b) Please tell us the ways your research helps these groups better understand the conservation of a sustainable environment (see the UNESCO definition above).

Direct participation in our study gives the groups identified above the opportunity to observe sea otter behaviour and study their ecology. This leads to a better understanding of the management and conservations issues facing sea otters in Alaska.

c) Has your project helped lead to the completion of Masters' theses, or other educational research findings? One Masters Degree. Two new Masters Degree students began working on our project this summer.

Partnerships

a) List partnerships or collaborations with other organizations that you have developed or maintained in the past season.

Dr. Tim Dellapenna (sedimentologist) at Texas A&M University has worked with us for two summers to characterize the geology of the seafloor in Simpson Bay.

b) How have these organizations contributed to your project objectives?

Our collaboration with Dr. Dellapenna has provided detailed data on the physical habitat in our study area. This data will be used in the analysis of sea otter habitat-associations.

c) How do you anticipate these organizations will use the results generated by the project, and in what timeframes?

My graduate student (A. Gilkinson) used part of this data for her Masters thesis. A Masters student of Dr. Dellapenna will use the data for his thesis.

Acknowledgments

We thank the following people for assisting in this year's program: S. Finerty, R. Wolt, T. Wright, A.M. Davis, G.A. Davis, I. Davis, and M. Weltz. Some of the equipment used in this study was borrowed from Texas A&M University at Galveston.