Predicting southern sea otter (*Enhydra lutris nereis*) movements

Principal Investigator:

Dr. James Harvey  
Moss Landing Marine Laboratories  
8272 Moss Landing Road  
Moss Landing, CA 95039  
(831) 771-4434  
harvey@mlml.calstate.edu

Collaborators:

Emily Golson  
Moss Landing Marine Laboratories  
San Jose State University

Dr. M. Tim Tinker  
US Geological Survey  
UC Santa Cruz

Dr. Greg Breed  
Harvard University
Hypotheses and Objectives:

The overall objective of this project is to develop and apply a mechanistic movement model that describes the spatial use of southern sea otters (*Enhydra lutris nereis*) in the event of an oil spill. By combining this model with US Geological Survey (USGS) sea otter survey data and GIS-based oil spill simulation models (as developed by the Bureau of Ocean Energy Management, Regulation and Enforcement, BOEMRE), it will be possible to estimate the number of sea otters that would be exposed to oil under various oil spill scenarios, thus the cost associated with rehabilitation of individual oiled animals (Estes 1991, Jessup 1998). Based on a review of previous analyses of sea otter movements, the following variables will be included into the models: the effect of season (Ralls et al. 1996a), wave height (Garshelis and Garshelis 1984), age and sex (Kenyon 1969, Loughlin 1980, Garshelis and Garshelis 1984, Jameson 1989, Ralls et al. 1996a, Tinker et al. 2008b, Laidre et al. 2009), reproductive status of the animal (Garshelis and Garshelis 1984), and geographic variation in home range size and the number of centers of use (one center of use vs. multiple centers of use within a home range; Ribic 1982, Tinker et al. 2008a, Tinker et al. 2008b, Johnson et al. 2009). Specific hypotheses are: 1) the probability of an individual otter's location through time can be described by a biased correlated random walk (BCRW) model, a random walk model with a bias and persistence (Turchin 1998); 2) having multi-centers of greater use in a home range is a pattern observed for many sea otters that can be accounted for by a modification of the BCRW model to incorporate multiple central-point attractors; 3) individual mobility (described as net linear displacement along the coast over a specified time interval) is dependent on season; 4) mobility is dependent on wave height; 5) mobility is dependent on age and sex, with sub-adults and male sea otters moving greater distances than adults and/or female sea otters; 6) the number and geographic distribution of centers of use (in the case of multi-centers of use in home ranges) differs between males and females; and 7) transitions between centers of use are more likely for female sea otters with large pups (greater than ten weeks). The null hypothesis for all hypotheses is that otter movement is distributed uniformly and there is no pattern of space use overtime.