

**1. Title:** Long-term survival, behavior and reproductive success of stranded southern sea otter pups reared for release with a surrogate mother

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**3. Hypotheses and objectives:** This proposal is submitted specifically to obtain funding for VHF transmitters and time/depth recorders (TDRs) in rehabilitated sea otter pups to collect detailed post-release information on foraging ecology, habitat-use, and activity budgets. This is one component of a broader study assessing the effectiveness of using captive adult female sea otters as surrogate mothers for sea otter pups rehabilitated for release to the wild. We predict that surrogates provide a social environment that stimulates natural behavior and facilitates learning among young sea otters. This social environment may override potentially detrimental effects of captivity and close contact with humans, so after release as juveniles, these otters avoid interactions with humans, exhibit greater success readapting to life in the wild when compared with non-surrogate reared pups, demonstrate survival in the wild at a rate comparable to free-ranging juveniles, and contribute reproductively to the wild population. Specific objectives include (1) estimate and compare annual survival rates of male and female rehabilitated pups from release through adulthood, and compare post-release survival of male and female rehabilitated sea otters with estimates of post-weaning survival of wild con-specifics (Siniff and Ralls 1991, Hanni et al. in prep., Tinker et al. in press), and pups rehabilitated for release to the wild at MBA prior to 2001 using alternative techniques (Hanni et al. in prep, SORAC unpubl. data); (2) quantify growth and development of behavioral milestones in male and female dependent pups and correlate various developmental factors such as weight-at-age with post-weaning survival; (3) compare activity budgets, diets, foraging behavior, and movement patterns between males and females, and between rehabilitated pups and wild con-specifics (Estes et al. 1986, Siniff and Ralls 1991, Hanni et al. in prep, Tinker et al. in press); and (4) evaluate reproductive contribution of rehabilitated pups to the wild population.

**4. Experimental Plan:** Sea otter pups (< 12 weeks of age) will be selected opportunistically among live-stranded individuals. The projected sample size over the duration of the project (5 years sample collection) is 10 males and 10 females, which is the maximum number that could be rehabilitated and released during a 5-year period with existing SORAC resources. The proposed sample is comparable or greater than samples used by other studies investigating survival in southern sea otters (Siniff and Ralls 1991, Hanni et al. in prep.).

In preparation for release, pups will be surgically implanted with a VHF radio transmitter (Ralls et al. 1989) equipped with temperature-sensitive mortality switch (Advanced Telemetry Systems, Inc., Isanti, MN) and a TDR (Wildlife Computers, Archival Custom AK9), and tagged with color-number coded plastic Temple Tags (Temple, TX) in the inter-digital space of the hind flippers (Ames et al. 1983), and with a passive integrated transmitter tags (PIT tag) inserted subcutaneously in the inguinal region. The surgical procedure will occur when the pups are 22-24 weeks of age (minimum body weight = 18 lbs., Dr. M. Murray, pers. comm.). Anesthetic and surgical procedures will be performed by MBA veterinarian in accordance with IACUC-approved Veterinary Standard Operating Procedures (SOP).

Rehabilitated juveniles will be released at approximately 28 weeks of age. Radio signals from instrumented otters will be detected with directional 4-element Yagi antenna (Ralls and Siniff

1990). Twenty-four hour activity budgets will be collected from re-sighted individuals at 3-month intervals to verify TDR data. An instantaneous sample of behavior will be recorded at 10-minute intervals (Ralls and Siniff 1990). Foraging data (dive and surface time, prey type, number and size of prey, tool use, and whether focal otter steals prey or has prey stolen) will also be collected during daylight portion of activity budget monitoring.

Because minimum battery life of VHF transmitters is estimated at 2-years (ATS, Isanti, MN), individuals will need to be recaptured using Wilson trap, tangle nets, or hand-held dip nets (Ames et al. 1986), and transmitter replaced at 2-3 year intervals. TDR will be removed after the first transmitter replacement surgery. Sea otters will be tracked until 9 years of age, which will allow individuals to reach sexual maturity and either pup multiple times or establish mating territories.

Maximum Likelihood Method (Bart and Robson 1982) and Kaplan-Meier Method (Krebs 1989) will be used to calculate annual survival rate estimates for male and female pups from release through reproductive maturity. Pair-wise chi-square (Monnett and Rotterman 2000) will be used to compare annual survival rates for male and female rehabilitated pups with post-weaning survival rate estimates (Siniff and Ralls 1991, Hanni et al. in prep).

Long-term observation of these rehabilitated individuals also will allow monitoring of mating behavior, pair bonding, establishment and defense of territories, length of gestation, pup dependency, inter-birth interval, natality, pre-weaning pup survival, and provide insights regarding reintegration into the wild population.

**5. Significance to oiled wildlife health:** The southern sea otter (pop. 2825; USGS 2004) is currently listed as threatened under the Endangered Species Act and susceptible to a catastrophic population decline in the event of an oil spill, primarily due to its limit range, extending 300 miles from Half Moon Bay to Point Conception along the California coastline, its slow recovery from commercial exploitation (USFWS 2003), and increasing mortality rates of prime-aged females (Tinker et al. in press). This study is an effort to advance research to improve the success of rehabilitation and reintroduction efforts necessary in the event of an oil spill.

Success of rehabilitation and reintroduction efforts depends upon demonstrating not only survival, but also reproductive contribution to the wild population. This study focuses on refinement of rehabilitation protocols to minimize or reduce effects of extended periods in captivity on the future reproductive success of young sea otters. Differences in foraging ecology and habitat-use strategies between juvenile males and females (Hanni et al. 2003, Tinker et al. in press) may provide insights regarding decreasing survival rates of wild females in the population and also may prove relevant to managing rehabilitation and release of oiled sea otters.

This is also the first study to implant TDRs in juvenile sea otters to provide baseline information regarding their survival, foraging ecology, activity budgets, and habitat use.

**6. Project duration:** 1 year

**7. Estimated budget:**

5 Archival Tag MK9's (Wildlife Computers)	5 x 1500	=	\$7,500
3 VHF transmitters	5 x 800	=	<u>\$2,400</u>
(Advanced Telemetry Systems: Custom Transmitter Temperature)			\$9,900

Personnel, other equipment (+ 2 VHF transmitters), supplies, travel, other expenses, and overhead funded by Monterey Bay Aquarium.