

Final Report, SiMON Research Grant

Long-term Monitoring of Northern Elephant Seals: Colony Development and Population
Growth in the Monterey Bay National Marine Sanctuary

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In late 2003, we were awarded \$20,000 by the Monterey Bay Marine Sanctuary SiMON program to convert 40 years of paper records on the northern elephant seal population at Año Nuevo into a thorough and modern computer database. The funds were used during 2004-2005 to hire assistants to code data. This is our final report on the project.

The SiMON grant was used to support seven students hired for periods of 6-9 months to code and review data. R. Condit and J. Reiter supervised. A total of 2500 hours of data entry was accomplished. The funds were exhausted in December, 2005. Three different sets of data were included in the work:

- 1) Counts of pinnipeds at Año Nuevo Island and mainland since 1968.
- 2) Tags placed on elephant seals at Año Nuevo, 1968-2003.
- 3) Resightings of the same tags subsequent to the original tagging, 1987-2003.

Below we summarize details of what was accomplished with the SiMON funds and the current state of each database.

Pinniped censuses

Coding of old censuses began in 2003 with other funds. They were entered into an old Panorama system that did not allow web access and did not use SQL (Structured Query Language) or a standard database programming system. In early 2004, 685 censuses over 14 years (1979-1986, 1989-1992, 1996, 2001) were redesigned into a MySQL database on a web-accessible server, and subsequently, data were entered directly into this database via a PHP interface.

Since mid-2004, all current censuses are entered directly by researchers via this interface. With SiMON funds, students finished entering 5028 old censuses from paper forms stored in the Le Boeuf lab: September, 1967 to March, 2004. The database currently has 5218 censuses, with a gap only in 1997-1998 (missing data). The elephant seal census database is thus nearly complete, and has been screened for errors. Sea lion and harbor seal censuses from 1967-1985 are all entered into the database, but we currently have a data-sharing hold-up and have not incorporated censuses of these other species since 1986.

All daily censuses in the database are available to rangers at Año Nuevo so they can be distributed to tourists, and other pinniped researchers can access any individual censuses via a password-protected web site. We worked with Josh Pederson to post annual summaries of elephant seal counts at SiMON; we would like to update and improve these summaries for SiMON in the near future. Three manuscripts based on the elephant seal census database are in preparation.

Tagging record

A regular program for marking elephant seals at Año Nuevo with permanent numbered tags began in 1964 by Tom Poulter of Stanford Research Institute. Le Boeuf took over the program in 1967. Most of these tagging records were computerized during the mid-1990s, and organized into a Panorama database. Starting in 2004, we reorganized this into a MySQL database on a web-accessible server, and researchers began entering new tag information directly (via another PHP interface). With the SiMON funds, student assistants entered 2102 old records that had been missed, nearly all prior to 1985.

The database is now essentially complete for elephant seals tagged at Año Nuevo since 1969. A total of 17,672 individual animals are in the database, including 14,031 tagged as pups. The latter are those whose ages are known exactly at any later sighting. Modest error-screening has been done, but there are still several problems that need attention.

Researchers at UCSC frequently consult the tagging record via a web portal. Elephant seal researchers elsewhere -- J. Cordaro, B. Hatfield, S. Allen – have also used the data for looking up Año Nuevo tags that they find. In addition, J. Pederson has created a mirror of our tagging record at the SiMON website, but this requires updating.

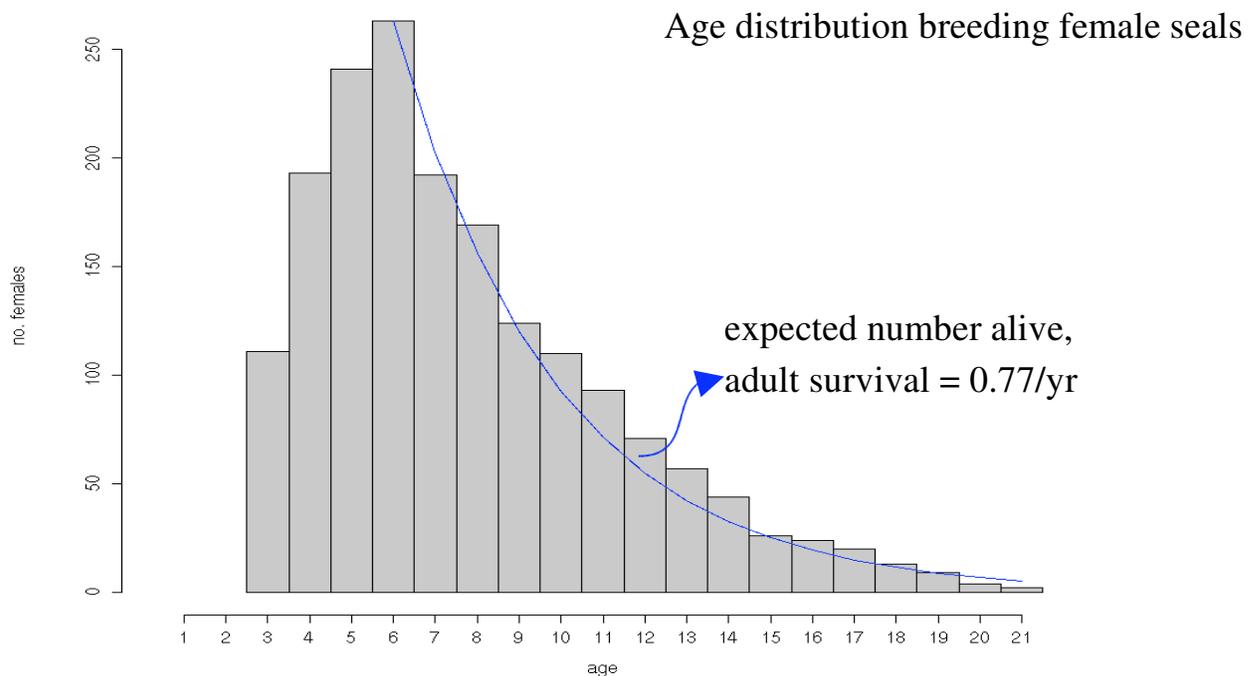
Tag resightings

The most important part of our SiMON-funded project involved creating a database of tag observed on juvenile and adult elephant seals. Tagged animals identified years after birth provide information on movements, lifetime pupping success, and longevity. They form the basis of mark-recapture analyses of survival and dispersal, and sightings have been carefully cataloged by UCSC researchers since 1969. As of 2004, these records were poorly organized, with most not even typed into computer files. In 2004, we designed a MySQL database to house the resightings and set up web-programs via PHP to enter data.

With the SiMON grant, we began entering tag-sightings on females during the breeding season and importing the records into the MySQL database. We have completed all 1987-2003 records, including error-screening, including 61,000 sightings. Since 2004, tag sightings have been entered directly by researchers who make the sightings. All together, the database includes 20 years of breeding records for 3697 animals. Sightings prior to

1987 were organized into a SAS database in 1988, and we have begun the task of merging this into the MySQL format, but not completed it.

These tag sightings provide lifetime survival and breeding histories for substantial samples. One female tagged at the Año Nuevo mainland in 1984 (tag H257) was seen breeding near her birthplace in 13 out of 18 breeding seasons, and raised a pup at age 21 in 2005. An animal branded in 1987 (#315) was seen in 14 out of 17 seasons and is still alive in 2006. Two other animals branded in 1987 are still alive in 2006, and it seems likely that one of them will live beyond age 21. The age distribution produces an estimate of 77% for annual survival rate of adult females (figure below). This method ignores tag loss, though; true survival rate is thus probably 80-83% per year. By comparison, published estimates of survival rate of adult female southern elephant seals are 77%. We will do detailed mark-resight analyses to compare the two species precisely and test whether adult survival regulates population growth (the northern species) vs. population decline (the southern species).



Future work

Our immediate need with past data is to merge the pre-1987 with the now completed post-1987 database. The heavy labor is done, since all the records are in computer format, but the merge requires care.

Meantime, the monitoring program continues, with much new information on foraging patterns at sea being linked to long-term survival information. Newly placed tags and resightings are entered regularly by researchers at U.C. Santa Cruz. We recently submitted a proposal to the National Science Foundation to strengthen the population monitoring program, linking with parallel programs at Pt. Piedras Blancas, Pt. Reyes, and the Farallon Islands. We hope to continue working with SiMON, providing more information on elephant seal populations in central California to a broader community.