Anna Fabiani, Dept. of Biology, University of Durham, Durham, UK
Filippo Galimberti, ESRG, Milano, Italy
Simona Sanvito, Dept. of Biology, Memorial University, St. John's, Canada

Research on elephant seals of Sea Lion Island

Significance of the project and ethical background

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Address for correspondence:
Dr. Filippo Galimberti, Via Buonarroti 35, 20145 Milano, Italy, Fax + 39 0248008145, fgalimbe@libero.it

Abstract

In this report, we examine the value of our research on elephant seals of Sea Lion Island, considering the scientific results produced and the increase in knowledge of the ecology of the population. We then examine the ethical implications of our research. We consider the effect of the whole project, and of specific research techniques, on animal welfare. We emphasize that we use standard techniques, in strict adherence to guidelines for research on wild animals. We then examine the impact of the research on the status of the seal population and on the local ecosystem of Sea Lion Island. We conclude that the impact of our research is more than balanced by the results we are achieving. We re-affirm our wish to improve our methodology to reduce and better evaluate the impact of the work, in the prospect of a long-term carry on, that will hopefully make Sea Lion Island a notable example of field research.

In this report, we describe the scientific and environmental value of the results obtained by our research team during an ongoing, long-term study of the southern elephant seals (*Mirounga leonina*; SES hereafter) of Sea Lion Island. Then, we examine the ethical aspects of our research, including the effects on animal welfare and the impact on the status of the population and the local ecosystem. Lastly, we outline our policy of presence in the field and relationship with the other visitors of the island.

Quality of scientific results

The universal criterion to evaluate the quality of scientific research is publication of the results on international peer-reviewed scientific journals. In the last one and a half year our research team published, or had accepted for publication, 11 peer-reviewed papers on the elephant seals of Sea Lion Island. These papers regarded various aspects of elephant seal biology, including demography and population dynamics, reproductive behaviour, and communication. They were accepted by 6 different international peer-reviewed journals, including *Marine Mammal Science*, the leading journal on marine mammal studies, and *Animal Conservation*, a journal dedicated to the application of conservation biology to animal populations. Although the core of our research is theoretical and evolutionary biology, many of these papers are related to basic ecology of the population, and have an obvious applied value. We are attaching below a full ESRG bibliography. PDF files of all ESRG literature, including technical papers and reports, are available on our Internet site (http://web.tiscalinet.it/esrg/es_lit.htm). Reprints are available on request (please send an e-mail to Filippo Galimberti, fgalimbe@libero.it).

Methodology

We are using standard field methods widely accepted within research on seals and sea lions (for a general reference see Laws 1993). An updated and detailed technical account of the theoretical background and methodology of the research is available on line (http://web.tiscalinet.it/esrg/es_lit.htm/pdf_vari/pro_ses.pdf). We have been using the same methodology since the beginning of the study in 1995, however we have introduced various improvements to specific techniques (e.g. in weighing and skin sampling protocols) during the years.

Our research is carried out under a license released by the Falkland Islands Government (1995-1998 by the Secretariat, 1999-now by the Environmental Planning Officer) in accordance with the Conservation of Wildlife and Nature Ordinance 1999. We strictly adhere to the following research ethics guidelines:

- the *SCAR code of conduct for use of animals for scientific purposes in Antarctica* (http://www.scar.org/intro/animalconduct.htm)
- the *Animal Behaviour Guidelines for the treatment of animals in behavioural research* and teaching (http://www.academicpress.com/anbehav)

The following techniques have an invasive component or involve handling of animals.

1) Marking

We are using three marking procedures: tagging, dye marking and implantation of transponders. Marking is the single most important technique of our research. Our goal is to obtain long-term data on individual behaviour and ecology. Without realiable identification of individuals the whole research project will lose most of its value and interest.

We are trying to mark as many individuals as possible. A correct identification of all individuals of the population permits to avoid sampling bias and to reduce the error in data collection and recording. This high data reliability is obviously relevant for all research targets, but it is of particular importance in demography and population dynamics studies. The accurate identification of all individuals permits to greatly reduce the error in parameter estimates. For example, the very accurate estimate of the number of females hauled out on SLI permits to achieve a notable power in detection of population trends notwithstanding the small size of the population (Galimberti and Sanvito 2001; Galimberti in press). This is a crucial aspect in forecasting and population viability analysis (Forcada 2000).

We wish to emphasize that marking is currently carried out without any kind of restraint of the animals, by simply approaching them from the back while they are resting.

1.1 Tagging

About 99% of the females and 100% of the breeding males of the population are marked by cattle tags (Jumbo Rototag, Dalton Supplies Ltd, http://www.dalton.co.uk). Jumbo Rototag is the standard tag for elephant seal marking (Erickson et al. 1993), due to the small size and footprint (length = 45 mm; weight ≈ 2 grams), that reduce loss rate (Testa and Rothery 1992).

The tags are placed in the inter-digital web of the rear flippers and each individual is at least double-tagged. Double tagging is fundamental to reduce the risk of lack of recognition in following seasons, and to estimate tag loss rates. In the study population tag loss rate is very low (likelihood to lose two tags = 0.36% for females, 0.37% for males, unpublished data; see also Wilkinson and Bester 1997). Obviously, the loss of all marks by an individual means to loose all his data from the previous seasons and to introduce a bias in parameter estimates. With the double-tagging strategy, and the low tag loss rate, each year the majority of the animals are already tagged from the previous breeding seasons, and we need only to replace lost tags.

In most animals tagging produces a brief reaction (a few seconds) and a very small pain, although animal pain is obviously difficult to assess (Bateson 1991). Tagging may produce a wound in the inter-digital membrane and a local infection, but this rarely happens in our population, as showed by the very low tag loss rate (a bad tag, that produce local infection, tend to pass through the hole and get lost). After many years of continuous tagging (more than 12000 tags put in place) we have no indication of any adverse effect of the procedure. Tagging of elephant seals seems to have no effect on their survival rate (Testa and Rothery 1992).

1.2 Dye marking

We paint an identification code on animals' backs and flanks using commercial black hair dye in order to have a fast and easy recognition of individuals. Examples of marks and pictures of the dye-marking procedure are available on our web site. We mark with hair dye all breeding males, and 70-85% of the breeding females of the breeding area. We do not mark with dye individuals that come to the island only for

molting. We mark pups with hair bleach when they are weighed at birth. These bleach marks are put on about 1/5 of the pups, and are almost completely lost with the first change of the fur, that happens within a month from birth.

We understand that dye marks could be criticized from an esthetical point of view, but we firmly reject any complain on the ethical ground. If the basic principle of research is accepted, i.e. animals should be recognized, dye marks are a very effective way to reduce disturbance on animals. A dye mark permits the sure recognition of animals from distance, reducing the needing to come close and read the tag. They are put with a minimum disturbance to the animal, approaching it from the back: the best marks are put without waking-up the subject, not during the approach nor after it, to have a clearly readable mark and a safe setting of the dye. The use of dyes tested for human hairs exclude any risk of toxicity. Moreover, dye marks last just for a few weeks or months, and even the best marks disappear during the molt.

From the aesthetical point of view, we agree that dye marks are not very nice to see, although they permit to the causal observer to recognize animals, and this could be even considered an added value of the research. From the very beginning of the research we clarified that the dye marks have crucial role of in our research. We are leaving one of the breeding areas as much free from dye marks as possible, although seals are wild animals and we can't control their movements among areas. The lack of dye-marking in one of the breeding areas is a significant cost for the research, but we are more than happy to sustain this cost to improve the visiting experience of tourists.

1.3 Implantation of transponders

To improve the quality of long term marking of pups, in 1997 we employed an electronic identification system based on passive transponders (Galimberti et al. 2000). The system consists in a portable sensing device which transmits a radio-frequency signal to a specially designed implantable microchip, which responds with another radio message containing its ID code. We used a TROVAN system (Trovan Ltd., inform@trovan.com) based on ID100 passive integrated transponders, encapsulated in bio-compatible glass (2.2 x 11.5 mm). Transponders are packaged in disposable needles, pre-sterilized and ready-to-use, and are implanted with a special syringe-like applicator in a way similar to a subcutaneous injection.

510 weanlings (91%) were fitted with one transponder, implanted between the tail and the begin of the right hind flipper. We marked with transponders also 37 adult breeding males. The harassment of the animal is short. At the beginning we were used to restrain the weanling by hands, but then we developed a technique to implant the transponder by surprise without any kind of restrain: with this last protocols the implantation takes just few seconds. No detrimental effect of the implantation was detected (Galimberti et al. 2000). Transponders are now widely used to mark wild animals (e.g. Thomas et al. 1987; Schooley et al. 1993), but, to our knowledge, there was no previous experience of use of these devices on elephant seals.

The main advantage of passive transponders is the reduction of the risk of tag identification failure, while their obvious disadvantages are cost (about twenty times the cost of a plastic tag) and the need to get close to the animal and use a sensing device to read the code. Transponders were read in following seasons on yearling, juvenile individuals and adults, demonstrating that they are very effective marking devices, although they are best used as a back up of a main marking system, such as tagging.

1.4 Paint pellets

We sometimes use paint pellets (Nel-Spot, Nelson Paint Company), shoot by a CO2 gun, to mark specific females. Less than 5% of females are marked with pellets at any time. Paint pellets are a widespread marking method for sea lions (Campagna and Le Boeuf 1988). Although pellets marking produces a short-term disturbance, and in particular a reaction to the noise and to the sudden impact of the pellet, it permits to avoid the complicated and dangerous maneuvering needed to successfully mark core females in large harems. In fact a very short and limited disturbance is much more desirable than repeated tries with other methods. In five years of use of pellets we never observed a single case of pup abandonment or premature departure by females marked with paint pellets.

2) Weighing of pups and weanlings

Weighing of pups and weanlings is carried out without any form of chemical restrain. The pups are weighed using a simple canvas bag and a digital dynamometer, held up by two people. The weanlings are weighed using a weighing bag (a cotton sheet with straps cut out to fully enfold the weanling, held up by two horizontal aluminum poles connected by steel chains and springs to the dynamometer), held up by a half ton crane or an aluminum tripod, due to the heavy weight of weanlings (mean weight about 135 kg, but up to more than 200). In all cases, pups are restrained by hand and handling time is very short (Galimberti and Boitani 1999). Mean handling is 2’ 30” for pups (from the separation form the mother to the return to her), and 3’ 30” (single measure) or 5’ 30” (three consecutive measures, to calculate weighing error) for weanlings.

We weighed a pilot sample of 100 weanlings in 1996. Then, in 1998 and 1999, we weighed 179 pups at birth and 347 at weaning; 113 of the pups weighed at birth were weighed again at weaning. Weighing of pups after birth never resulted in physical damage of pup or abandonment by the mother. All weighed pups were successfully weaned. Weighing of weanlings also had no effect: every weighed individual resumed his previous activity (usually resting) a few minutes after being released.

3) Sampling of adults and weanlings

We collect skin samples from females, pup and putative fathers for genetic studies. The goal is to extract nuclear and mitochondrial DNA to estimate genetic paternity and to study genetic structure and gene flow among the populations of the South Georgia stock.

We started sampling in 1996. Collection of a full set of samples for paternity analysis requires two years: in the first one, breeding males and females are sampled, while in the following season pups are sampled, to determine fertilizations of the previous season. Until now, we collected a full set of samples for the 1996, 1997, 1998, and 1999 breeding season, while the 2000 is to be completed. The full sets of samples (1996-1999) comprise 3585 samples, from 453 males, 1075 females, and 2058 pups.

Samples are taken from the inter-digital web of the hind flippers of each animal using Dalton ear-notchers (Hoelzel et al. 1993), or from the back using a biopsy head (ø = 4 mm, Karesh et al. 1987) mounted on a pole to reach core females of large harems. Notchers and biopsy heads are carefully cleaned after each sample is taken. The samples are about 8-10 cube millimeters in size and 1-2 grams in weight.

The scars left by the ear-puncher and the small holes produced by the biopsy head are barely recognizable after few hours. We never observed any sign of infection due to skin sampling.

4) Stimulation for communication studies

To study male acoustic communication we use two different methods, recording of vocalizations in natural contest, and standardized recording with artificial stimulation. The stimulus is just one of the researcher who approaches the subject to elicit a vocal display. This method is very successful (Sanvito and Galimberti 2000), permitting to collect a large amount of recordings from most of the males when the recording conditions are optimal, something that rarely happens due to SLI weather. Although with this stimulation we add an extra-load to the time budget and breeding cost of the subject, the low frequency of stimulation of each individual make us confident that no long-term effect will result. To check this point, we are currently implementing a non-invasive blood collection method that, through hormone essays, should permit us to evaluate the human-induced stress on males.

In conclusion, we firmly believe that our method techniques cause either no disturbance or very short term disturbance to the animals. Moreover, our techniques are of minimal impact if compared with much more invasive procedures adopted by other research teams. These include repeated weighing of pups and adults, chemical restrain of pups and mothers, application of labeled water techniques, invasive biological sampling, implantation of instruments for physiological studies, implantation or gluing of devices and instruments for tracking at sea, experimental translocation (see Laws 1993 for general references).

Impact of the research on the study population

We have no evidences of any adverse effect of our research on the study population. Population size has been almost steady during 1989-2000 period (Galimberti and Boitani 1999; Galimberti in press), and, notwithstanding the very accurate monitoring (Galimberti and Sanvito 2001), there is no indication that our presence changed the dynamics of the population. The current lack of increase in population size seems to depend completely on the aquatic phase of the yearly cycle (Galimberti et al. 2001). Moreover, we have three direct indications of the good health of the population (Galimberti and Boitani 1999; Galimberti et al. 2001):

- female fecundity is close to 100% for the females coming to land to give birth (mean of 6 years = 97%), and reduces to 88% including females that skip breeding; these values are equal to or higher than other SES populations (McCann 1985)
- pup mortality is very low (mean of six years = 3.1%), among the lowest reported for any SES population (Galimberti and Boitani 1999)
- weight at weaning (mean = 136 kg), which is good index of the status of the population, is on the high side of the range observed in southern elephant seals (Burton et al. 1997)

Despite these clear evidences, we are always trying to improve our methodology and the evaluation of the impact of our research (e.g., Galimberti et al. submitted). For the future, we plan to evaluate the effect of disturbance on parental investment by

comparing weaning weight among areas with different level of disturbance, and to examine the effect of handling on individual stress by hormone essays.

Impact of the research on the local ecosystem

Our field work may in principle have a general adverse effect on the local ecosystem. This seems unlikely because the work is limited in space and time. Our study areas are the sandy beaches of the eastern tip of the island, where elephant seals breed. Our presence in the rest of the island is spotty and not invasive at all, we just carry out weekly counts of seals on the full island perimeter. Therefore, the most of our activity is carried out far away from the nesting sites of most bird species.

Moreover, our work is limited to the breeding season (September-November), well before the peak breeding of other species. Unfortunately, a full evaluation of the impact of the research on the local ecosystem requires time series on abundance and productivity of other species, which are almost completely lacking. Only the set up of regular monitoring of Sea Lion Island wildlife may permit a full understanding of the impact of our research and of other sources of human disturbance, including for example nature-oriented tourism and wildlife photography.

Presence in the field and impact on the other visitors

Our research team is very small (2-4 people in the past year, up to 6 people in the future), well below the mean size of analogous operations carried out on elephant seals breeding on sub-Antarctic islands. We occupy at any time a very small area of the island, therefore, our presence should not cause relevant disturbance to other visitors on the island. At any time, there is plenty of room for everybody on the island. A specific problem is represented by the use of cars. We currently have a small car (Lada Niva) on the island, and we hope to be able to get a second one in the next future. We changed the tires of the car accordingly to the request of David Gray, previous manager of the island, to reduce the soil erosion. The car is used to transport materials and, mostly, as shelter for behavioural observations.

We sometimes need to ask people to not get too close to the seals while we are doing behavioural observations. To collect good behavioural data the animals should obviously let undisturbed. We are not covering all harems at the same time, so people have usually just to move a few hundreds meters away to find another “free” harem. We usually refrain to ask people to keep their distance from seals while we are not observing them, except when we are handling or approaching animals for specific jobs (e.g., sound recording). This is asked to avoid any interference with our work that will eventually slow down operations, increase disturbance (seals are frequently scared when too many people surround them) and increase any risk for visitors (seals can be dangerous if approached without care).

Due to the Sea Lion Island weather, we need to use shelters to protect ourselves during behavioural observations, and to put water-poof containers on the beaches to store instruments. We are trying to use our car as shelter as much as possible, because it can be moved away from the beach when not needed. Unfortunately, the car alone is not enough to cover all our observation work. Therefore, in the past years, we have gradually built up small stone shelters in various

points of our study areas. They are made by stones found in place, they are temporary (and frequently destroyed in the winter), and they look integrated with the landscape. We are also used to set up a couple pallets towers in places were is not possible to build stone shelters. This towers are temporary, and are always removed at the end of the breeding season.

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