



Ref 1/1866
Darwin Initiative
Overseas Territories Challenge Fund
Final Report

This report should be completed and submitted within a month of agreed end date of project

Darwin Ref Number	EIDCF005
Darwin Project Title	Darwin Southern Sea Lion Programme
Country (ies)	Falkland Islands
Award holding Organisation	British Antarctic Survey
Partner Organisations	Falklands Conservation
Grant Value	£24,969
Start/end date	April 2010 – March 2011
Author(s), date	Alastair Baylis and Iain Staniland - 20 June 2011

1. Challenge Fund Background

One of the main hurdles facing conservation initiatives in the Falkland Islands is the lack of ecological data to inform decision makers and to direct initiatives. This is no-where more evident than for the Falklands population of southern sea lions (*Otaria flavescens*). This iconic apex predator has declined by an unprecedented 97%, from an estimated pup production of 80,000 in 1938 to 2,000 pups in 1995. Initial population declines were attributed to harvesting. Despite the cessation of sealing in the 1960's the population continued to decline into the 1990's. The most recent population census in 2003 indicated that while some colonies had increased, colonies at several sites remained stable or had declined. Currently, we lack the basic ecological information necessary to adequately conserve and protect the Falklands sea lion population or to identify and mitigate potential impediments to their recovery.

The southern sea lion is one of five sea lion species in the world. Sea lions form around one-third of species in the Otariidae family of seals (fur seals and sea lions). Over recent decades there has been growing concern over the status of all five sea lion species, with the decline or limited recovery of populations being attributed to negative influences from interactions with fishing activities and the effects of climate change. A recent review of the global status of pinnipeds, suggests that southern sea lions may qualify for Near Threatened status on the IUCN Red List (Kovacs et al. 2011). The Falklands sea lion population is a key conservation priority because intensive near shore fisheries have changed prey assemblages and overgrazing of tussock grass by stock has reduced breeding habitat. In addition, the southern sea lion is vulnerable to climatic anomalies such as El Nino events, which have decimated populations in Peru and Chile.

The lack of data on the ecology of Falklands marine predators is one of eight key knowledge gaps identified by the 'Falkland Islands State of the Environment Report 2008-2018' and is considered to be a major threat to the archipelagos' biodiversity. The growing Falklands human population, hydrocarbon exploration, intensive near shore fisheries and developing aquaculture, highlights the need for effective and coherent conservation initiatives.

In order to address key knowledge gaps, the British Antarctic Survey in partnership with Falklands Conservation initiated the **Darwin Southern Sea Lion Project**. The Challenge Fund project focused on developing a logistic and methodological framework, with the outlook of successfully implementing a main round funded project starting in 2012.

The aims of the project were to:

- Identify key sites that were readily accessible
- Establish methods for the capture and chemical immobilization of sea lions
- Preliminary deployment of GPS tags on lactating females at one main breeding colony
- Preliminary study on key prey species
- Assess the ability for traditional dietary methods (i.e. scat analysis) to reconstruct diet
- Generate local support and awareness via presentations
- Community involvement through tussac grass planting
- Enhance and further develop cooperation between UK and OT organizations
- Ensure that a resultant Darwin project would have a clear and viable exit strategy

2. Challenge Fund Activities

The achievements of our highly successful Challenge Fund Project were:

(i) Identified key breeding sites around the Falkland Islands. Assessed the feasibility of access to these sites (in terms of boating, vehicle access, capacity to camp and in terms of securing land owner support)

(ii) Established methods for the safe capture of sea lions

(iii) Deployed ten (10) satellite tags on lactating adult females at two (2) important breeding sites (only **one site originally planned** and GPS tags in combination with Time Depth Recorder (TDR) units)

(iv) Deployed satellite tags on six (6) juvenile sea lions from one site (**not originally planned**)

(v) Collected adult female scat samples from two breeding sites

(vi) Contributed to a local tussac grass planting project in October 2010 (key sea lion habitat)

(vii) Results have been disseminated through the Falklands Conservation newsletter, local newspaper, via the Falklands Conservation Facebook page and via the web: www.falklandsconservation.com

(viii) We are planning a community presentation and a conference presentation (Society of Marine Mammal Biology) in December 2011.

(ix) Key research questions identified through the Challenge Fund Project provides the basis for a clear and viable exit strategy for a proposed main round funding project.

Results:

(i) Identified key breeding sites around the Falkland Islands and assessed access

The last population census of southern sea lions breeding on the Falkland Islands was conducted in 2003. Breeding colonies were found at 65 sites around East and West Falklands. The number of pups born across the 65 sites varied from 2 – 170.

As part of the scoping project, we identified key breeding sites that were relatively easy to access from mainland East Falklands. It was important to select sites that could be accessed from East Falklands via the Falklands Conservation zodiac (IRB) or via 4x4, as this was cost effective and meant that access to sites was not reliant on charter vessel availability or inhibited by costs. In addition, islands adjacent to mainland East Falklands (or within protected waters) were desirable as these sites afforded greater flexibility because they could be accessed independent of sea conditions. Suitable sites identified were Big Shag Island, Kelp Island, Port Harriet, Cape Dolphin, Turn Island, Tyssen Island, Blind Island and Mike's Island (Fig. 1). Of these breeding sites, we deployed satellite tags on lactating female sea lions from Big Shag Island and Kelp Islands, as these sites are thought to be among the largest sea lion breeding populations in the Falkland Islands (Fig.1).

In addition, we visited male haul out sites (i.e. non-breeding sites) that included Centre Island, Kidney Island and Cape Dolphin (Fig. 1). We deployed satellite tags on males at Cape Dolphin because of the easy access to this site (via 4x4) and the large number of juvenile males that frequent Cape Dolphin.

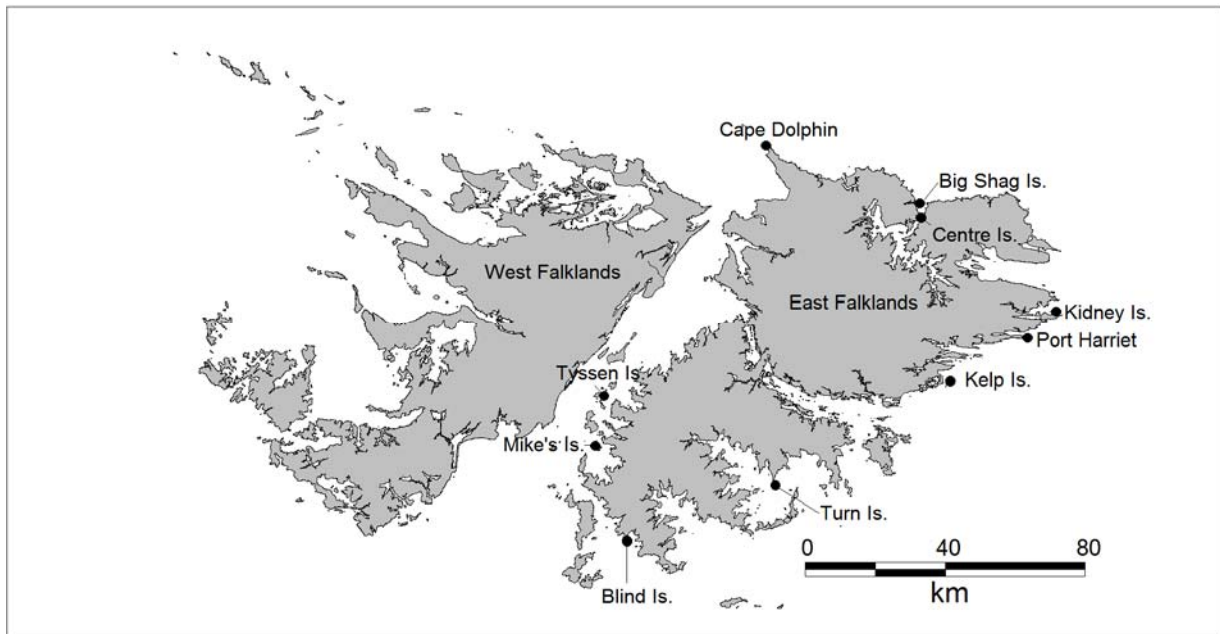


Fig.1. Distribution of selected southern sea lion breeding sites on East Falklands. Research was conducted at Big Shag Island, Cape Dolphin and Kelp Island.

(ii) Established methods for the safe capture of sea lions

Remote chemical immobilization is an established method used to facilitate the capture and restraint of seals and sea lions, particularly when working with large, dangerous or timid animals. Weighing 180 kg and reaching over two meters in length, juvenile male and adult female southern sea lions are large and difficult to safely restrain without the aid of anesthetics. The capture of sea lions using remote chemical immobilization has several benefits that include (i) minimizes capture stress (ii) minimizes the chance of injury to the animal during capture and physical restraint (iii) greatly reduces disturbance to surrounding animals (iv) maximizes handler safety.

Zoletil (a fixed ratio of Tiletamine (dissociative anesthetic) and Zolazepam (sedative) made by Virbac) has been successfully used to capture southern sea lions breeding in Argentina (Campagna *et al.* 2001). We have also used Zoletil to safely capture New Zealand fur seals (*Arctocephalus forsteri*), Antarctic fur seal males (*A. gazella*) and of particular relevance to the scoping project, endangered Australian sea lions (*Neophoca cinerea*). Building upon our experience, we developed remote chemical immobilization using Zoletil as the preferred capture method for southern sea lions breeding in the Falklands. Zoletil proved to be a safe, reliable and a fast acting anesthetic (10-15 min) with a wide safety margin.

We delivered Zoletil via a dart fired from a CO₂ tranquilizer gun (DanInject, JM Standard). This was a suitably flexible and highly effective way of administering Zoletil with minimal arousal of the target animal. Out of the 16 animals darted, five animals lifted their head but did not move, nine animals stood up briefly before lying back down and only two animals moved away (< 5 meters). Sea lions were selected on the basis of body condition and location (i.e. isolated and away from main groups of sea lions, a suitable distance from the shore line and in a location where cover was available to approach and observe the animal without being detected).

After the initial dose of Zoletil, anesthesia was maintained using isoflurane via a portable gas anesthetic machine. Satellite tags were attached to the guard hairs along the mid-dorsal line, approximately 3 inches from the shoulder blades, by using a flexible 2-part epoxy (Devcon 5-minute epoxy) (Fig.2). Deployment duration was 20 ± 4 minutes.



Fig.2. Adult female southern sea lion equipped with a SIRTRACK satellite tag in February 2011.

(iii) Deployed satellite tags on breeding females

Initially our project stated that we would use GPS tags in combination with TDR units. However both GPS tags and TDR units are archival and must be recovered in order to obtain data. Our initial choice of GPS and TDR units did not take into account that lactating females may not return to the site of deployment, thereby limiting our ability to recover GPS tags and TDR units (i.e. females move between multiple islands with their pups). In order to guarantee data and better understand whether females would move between islands, we deviated from our original proposal and purchased satellite tags only. The purchase of satellite tags was facilitated by small grants from JNCC and project AWARE. In total we purchased nine satellite tags. During February 2011 lactating sea lions from two important breeding colonies were equipped with satellite tags (instead of a single site as per Challenge Fund application). In total 10 tags were deployed on females (one tag was deployed twice) - six on adult females from Big Shag Island and four on adult females from the Kelp Islands. Of the nine satellite tags purchased, two tags failed (and were subsequently recovered). Prior to this research, satellite tracking in the Falklands had been undertaken on only four females in 1992 at one colony (see Thompson *et al.* 1998).

Although a ‘snap-shot’, results from our Challenge Fund Project redefined our understanding of sea lion foraging habitat. Lactating females showed two modes of foraging with (i) overnight trips confined to waters close the colony and (ii) trips lasting several days involving distances of over 100km to shelf break waters. The more distant trips will bring sea lions into conflict with commercial fishing activities and into areas of hydrocarbon exploration. The overnight trips are likely to overlap with areas of interest to aquaculture leading to negative interactions (Fig.3).

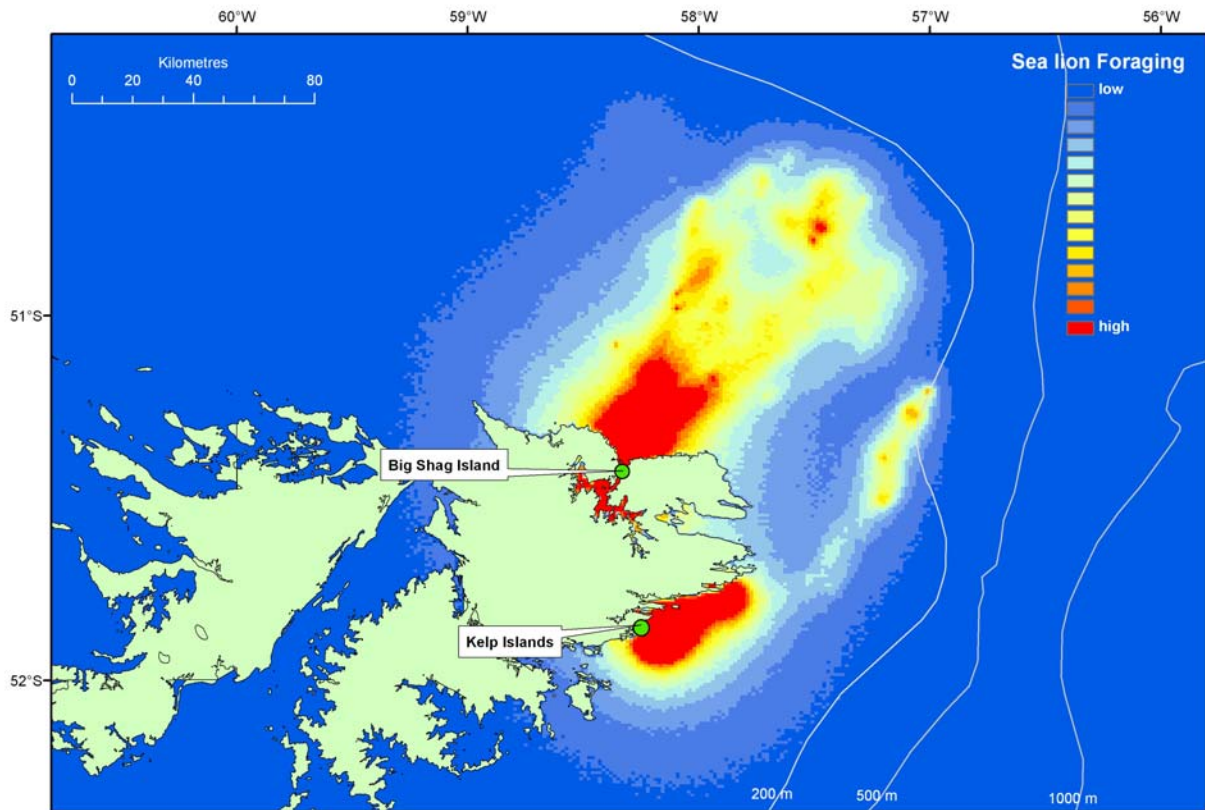


Fig 3. Initial results showing the distribution of foraging effort of adult female southern sea lions. Foraging effort was derived using Bayesian analysis.

(iv) Deployed satellite tags on juvenile males

Our original proposal stated that we would only deploy tags on lactating females. Several satellite tags failed after a short period of deployment (as described above). These tags were replaced under warranty and additional tags provided. This presented the opportunity for us to expand our project to include juveniles. In total, four satellite tags were deployed on juvenile males and two satellite tags were deployed on juvenile females in early May 2011. This additional work extended our initial planned end date and delayed analysis. An example of a juvenile male foraging trip is presented in Fig. 4. The tags are expected to continue to transmit location information until August 2011. A summary of juvenile foraging locations will be provided to the Darwin Initiative at a later date.



Fig 4. Example of a juvenile male foraging track (green dot is start location, red dot is end location)

(v) Collected female scats for diet analysis

A total of 200 scat samples were opportunistically collected in February and March. Although a snapshot, the diet study is the most comprehensive study on the diet of Falklands’ sea lions to date. Samples will be sorted in July-August 2011, but initial results indicate that scats contain hard parts (fish ear bones and squid beaks) and these will be used to reconstruct sea lion diet. A summary of sea lion diet will be provided to the Darwin Initiative at a later date.

3. Outcome & Impact of Challenge Fund

(a) The OT Challenge Fund provided the foundation for a southern sea lion main project through:

- Accessible capture sites identified
- Remote chemical immobilisation developed as a safe and reliable means of capturing sea lions
- Confirmed that the collection of scats is a cost effective means of reconstructing sea lion diet
- Additional key research identified, providing a clear exit strategy
- Land owner support attained and local interest has been generated

In addition, the Challenge Fund has provided Falklands Conservation (with the support of the British Antarctic Survey) with the capacity to undertake marine mammal research - specifically by providing the capital for Falklands Conservation to invest in key equipment. The project also provided the opportunity to build regional collaborations with researchers currently working on Chilean and Uruguay populations of sea lions. These collaborations are necessary for the development of our proposed main round funded project.

(b) The Southern sea lion remains one of the least studied pinniped (seals, sea lions, walrus) despite their wide distribution along the coast and offshore islands of South America (Argentina, Chile, Falkland Islands, Peru, Uruguay). Because of the paucity of information on southern sea lions, we again highlight that the **Darwin Southern Sea Lion Challenge Fund Project** focused on developing a logistic and rigorous methodological framework, with the outlook of successfully implementing a main round funded project starting in 2012. Unexpected difficulties encountered were:

- (i) Satellite tags failed after 20 days of deployment. Tags were replaced under warranty by the manufacturer. The replacement of satellite tags provided the opportunity to expand our project and deploy tags on juveniles. This additional work extended our initial planned end date and delayed analysis. Results from the juvenile tracking will be available after August 2011.
- (ii) Sea lions molt annually to replace old and worn out fur. We were eager to avoid deploying tags on molting animals because tags would fall off with molting hair. Only anecdotal information was available on the timing of molt, so planning our field work (to avoid molting animals) was initially difficult. We established that adult female sea lions molt between March - June, and that juveniles molt earlier than females, having completed their molt by the end of April.

(c) Our highly successful OT Challenge Fund Project (although a 'snap-shot') redefined our understanding of foraging habitat. Both lactating females and juvenile males travelled further than anticipated (120 km and 300 km respectively from mainland Falklands, to Patagonian shelf-break waters), in areas associated with commercial fishing and hydrocarbon exploration. Therefore, the potential for interactions with commercial operations is greater than previously believed and warrants further investigation. In addition, our Challenge Fund Project also revealed that females are larger in size than that reported for females from South America. This raises compelling questions regarding the genetic connectivity between the Falklands population and mainland South America and the genetic diversity of the Falklands population. The genetic diversity of the Falklands population of sea lions and genetic connectivity with mainland South American populations needs to be explored further as these results will influence the conservation status of the Falklands population of sea lions.

In summary, the Darwin Southern Sea Lion Challenge Fund Project identified key sites that are accessible, developed methods to reliably and safely capture southern sea lions, highlighted key knowledge gaps that require additional research and clarified a clear and viable exit strategy for a main round funded project. As such, we feel we are now in a position to apply for full Darwin initiative funding.

4. Lessons

The Darwin Southern Sea Lion Project ultimately highlights that southern sea lion foraging effort overlaps with commercial operations (e.g. fisheries and hydrocarbon exploration). It is now imperative to assess the degree of interaction between sea lions and commercial operations and redress key knowledge gaps identified by the Darwin Southern Sea Lion Challenge Fund Project.

In addition, our scoping project identified that sea lions foraged in at least two discrete habitats, and that animals from different colonies foraged in different areas (i.e. colony specific foraging areas). This implies any potential threats to the Falklands sea lion population varies according to colony location. Tracking should be expanded (see key research below) to elucidate whether multiple management units need to be established.

The key research required includes:

- (i) Assess the current population status and determine the current population trend (last census was in 2003 and indicated some populations had declined)
- (ii) DNA analysis to determine the genetic diversity of the Falklands population and to elucidate levels of genetic connectivity between the Falklands population and mainland South America
- (iii) Determine whether a population bottleneck has led to a loss of genetic diversity that is limiting the recovery of the Falkland Islands population
- (iv) Given our scoping project was limited to two breeding sites on East Falklands we recommend that a main round project would need to include additional sites around east Falklands and importantly, key breeding populations from west Falklands (e.g. Steeple Jason Islet). In

- addition we highlight that adult females generally returned to the site of deployment and therefore it would be possible to deploy and reliably recover tags
- (v) A seasonal component needs to be incorporated into future tracking and dietary work in order to capture any seasonal variation in diet and/or foraging movements.

5. Project Expenditure

Item	Budget for whole project*	Actual Expenditure	Variance** as a %	Comments
Travel Costs				
Subsistence costs				
Overhead costs				
Operating + Capital Costs				
Capital Costs				
Other				
Salaries (specify by individual)				
TOTAL				

* please indicate which document you refer to if other than your project application or annual grant offer letter

** please explain any variance of +/- >10%

6. Other comments not covered elsewhere

References

- Campagna C, Werner R, Karesh W, Rosa Marin R, and others (2001). Movements and location at sea of South American sea lions (*Otaria flavescens*). *Journal of Zoology*, London 257: 205-220.
- Kovacs K.M, Aguilar A, Auriolles A, Burkanov V, and others (2011). Global threats to pinnipeds. *Marine Mammal Science*. DOI: 10.1111/j.1748-7692.2011.00479.x
- Thompson D, Duck C.D, McConnell B.J, Garrett J. (1998). Foraging behavior and diet of lactating female southern sea lions (*Otaria flavescens*) in the Falkland Islands. *Journal of Zoology*, London 246: 135-146.

Darwin Challenge Fund Reporting Guidelines

All Darwin projects are required to report on the work they have undertaken with Darwin funds and this offers you the opportunity to report on your achievements and lessons learnt and on any other issues you would like to raise. Your report should show how you have progressed against the activities outlined in your application, or clearly explain any changes and the reasons why these changes were necessary.

You are expected to prepare the report in conjunction with your partners and you are expected to submit a Final Report within 1 month of completion of the agreed dates for the award (max 6 pages excluding annexes).

We will acknowledge and read all reports submitted, but will only contact you about your report if there are specific concerns.

If you have any additional queries about reporting, please feel free to email or call on 0131 440 5181.

Checklist for submission

	Check
Is the report less than 5MB? If so, please email to Darwin-Projects@ltsi.co.uk putting the project reference number in the Subject line.	✓
Is your report more than 5MB? If so, please advise Darwin-Projects@ltsi.co.uk that the report will be sent by post on CD, putting the project reference number in the Subject line.	NA
Have you included means of verification? You need not submit every project document, but the main outputs and a selection of the others would strengthen the report.	✓
Do you have hard copies of material you want to submit with the report? If so, please make this clear in the covering email and ensure all material is marked with the project number.	NA
Have you involved your partners in preparation of the report and named the main contributors	✓
Have you completed the Project Expenditure table fully?	✓
Do not include claim forms or other communications with this report.	