

# Translocation of reindeer from South Georgia to the Falkland Islands

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*Abstract:* This report describes the first translocation of reindeer *Rangifer tarandus* from South Georgia to the Falkland Islands, in the South Atlantic Ocean. Reindeer were introduced from Norway to the subantarctic island of South Georgia on three occasions in the early 1900s by Norwegian whalers, and today they exist as two discrete herds, numbering approximately 2600 individuals in total. Because of concerns over the impact on native vegetation, the long-term eradication of reindeer from South Georgia has recently been proposed. A translocation of reindeer to the Falkland Islands was undertaken in 2001 by the Falkland Island Government with two objectives: (1) to preserve the genetic resources of at least one of the South Georgia herds; and (2) to facilitate the diversification of the agricultural sector of the Falkland Islands by establishing a commercial reindeer herd. Techniques developed and used in North America for the successful relocation of large numbers of calves were adopted for the translocation. A total of 59 calves (26 females and 33 males) were successfully translocated from South Georgia to the Falklands Islands in 2001, and subsequently produced their first offspring in 2003. Good husbandry practices and an understanding of biology and behaviour are essential for the successful translocation of reindeer.

**Key words:** agriculture, Falkland Islands, habitat conservation, mammal population management, *Rangifer tarandus*, reindeer husbandry, relocation, South Georgia, subantarctic, translocation.

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## Introduction

South Georgia is an isolated subantarctic island located in the South Atlantic Ocean, between latitudes 53°58'S and 54°53'S and longitudes 34°47'W and 38°01'W. The mountainous island is approximately 170 km long and has a width that varies from 2 to 40 km. South Georgia is approximately 2000 km east of Tierra del Fuego and 1400 km south-east of the Falkland Islands (Fig. 1).

South Georgia has a subantarctic climate, dominated by cold, wet and windy conditions.

The mean temperature is 1.8 °C and annual rainfall is 1480 mm (Pasteur & Walton, 2006). During winter, extreme temperatures can vary between approximately -12 °C and 10 °C, whilst temperatures can exceed 15 °C in summer (Pasteur & Walton, 2006). During winter, snow cover usually lies down to sea level up to a depth of 1.0 to 1.5 m. Glaciers cover over half the land area of South Georgia.

On three occasions between 1911 and 1925, small numbers of reindeer (*Rangifer tarandus*)

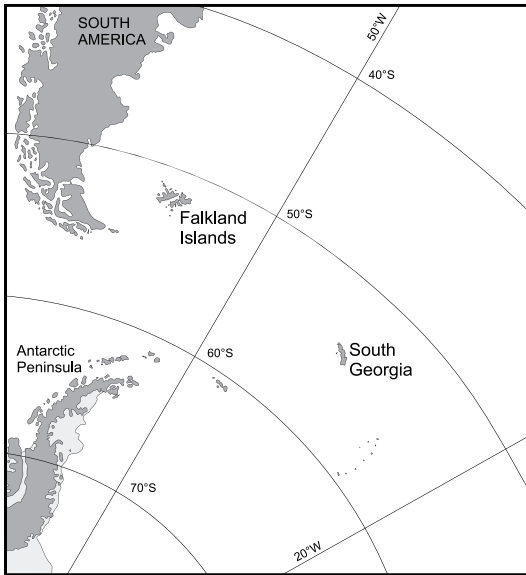


Fig. 1. Location of South Georgia and the Falkland Islands in the South Atlantic Ocean. Modified from Headland (1984).

from Norway were introduced to South Georgia by Norwegian whalers, presumably for the purpose of recreational hunting and providing an alternative source of fresh meat (Leader-Williams, 1988).

The first introduction occurred at Ocean Harbour in November 1911 by brothers C.A. and L.E. Larsen (Headland, 1984). Three male and 7 female reindeer sourced from Hemsedal in southern Norway were believed to have been introduced (hereafter referred to as the *Barff herd*), though there is some uncertainty in relation to the exact number and sex ratio (Leader-Williams, 1988, Lovatt, 2007). By 1958, the herd numbered approximately 3000 individuals (Leader-Williams, 1988). The most recent population estimation was approximately 1900 in 1976, including individuals grazing the expanded range at Royal Bay (Leader-Williams, 1988). A second introduction of 5 reindeer (2 male and 3 female) at Leith Harbour in Stromness Bay by Christian Salvesen's Company took place in 1912 (Headland, 1984). After increasing to approximately 20 animals, the

entire herd was killed in a snow-slide in 1918 (Headland, 1984). The third and final introduction at Husvik Harbour, in Stromness Bay, of 3 males and 4 females (hereafter referred to as the *Busen herd*) occurred in 1925 (Bonner, 1958). This population is believed to have increased to approximately 800 individuals (Leader-Williams, 1988; Moen & MacAlister, 1994). Leader-Williams (1988) suggested the source of these reindeer in Norway was unknown, however Lovatt (2007) has presented evidence that they originated from the same herd as the first introduction.

Only three other introductions of reindeer in the southern hemisphere are recorded. In the late 1940s, reindeer were released in southern Argentina, but were reported to be later exterminated (Long, 2003). In the mid 1950s, 10 reindeer were introduced from Sweden to Iles Kerguelen in the southern Indian Ocean, and by the 1970s, this population was estimated to total approximately 2000 individuals (Chapius *et al.*, 1994). In 1971, all but 1 of 8 animals shipped from South Georgia to Isla Navarino, Chile, died during the sea voyage (Headland, 1984).

Since the cessation in the 1960s of the whaling industry at South Georgia, reindeer have been killed for research purposes, particularly in the 1970s, and infrequently for food (McIntosh & Walton, 2000). Reindeer are currently protected under legislation of the Government of South Georgia and the South Sandwich Islands (GSGSSI) and a permit is required to kill them (McIntosh & Walton, 2000).

A glacial barrier has prevented interchange of reindeer between the two surviving South Georgia populations (Leader-Williams, 1988). The two herds occupy over 300 km<sup>2</sup> and although this is only about 20% of the snow-free area of the island, this is the most extensive and species-rich vegetated area (Leader-Williams *et al.*, 1989). The current retreat of glaciers may also permit range expansion in the

future (Leader-Williams *et al.*, 1989; Moen & MacAlister 1994). Because of concerns over the impact on the native vegetation, including over-grazing, soil erosion, loss of biodiversity in the plant communities and increased distribution of introduced plant species, the phased eradication of reindeer from South Georgia became policy of the SGSSI in 2000 (McIntosh & Walton, 2000). The eradication of the entire Busen herd is planned to be undertaken in the near future (Pasteur & Walton, 2006).

A translocation of reindeer from South Georgia to the Falkland Islands was proposed by the Falkland Islands Government (FIG) Department of Agriculture in 1999 for two purposes. Firstly, to conserve the unique genetic value of the South Georgia population prior to eradication. Secondly, to facilitate the diversification of the agricultural sector of the Falkland Islands, by establishing a commercial reindeer herd.

The subantarctic Falkland Islands have historically been reliant on sheep farming for wool production. Since the mid-1850s, sheep have been farmed under extensive conditions, grazing principally native pastures on the hilly, treeless land. The archipelago of the Falkland Islands comprises two main islands, East Falklands (approximately 5000 km<sup>2</sup>) and West Falklands (approximately 3500 km<sup>2</sup>), and some 700 smaller islands. The mean minimum and maximum temperatures respectively are 5.6 °C and 13.2 °C during summer and 0.2 °C and 4.2 °C during winter, and the mean annual rainfall at the capital Stanley (East Falklands) is 640 mm (Summers & McAdam, 1993).

Although the translocation of reindeer from South Georgia to the Falkland Islands has been considered several times in the past (Headland, 1984), it has never been attempted. Since the 1800s, reindeer have been successfully introduced to both continental areas and islands in the northern hemisphere (Long, 2003), and methods used have included overland herding,

trucking and air transport (Dieterich, 1990). Translocation of reindeer, particularly those taking days rather than a few hours, can however be fraught with difficulties if consideration is not given to reducing stress, providing appropriate feed and addressing general husbandry (Dieterich, 1990). For the translocation of reindeer from South Georgia to the Falkland Islands, it was proposed to adopt techniques developed and utilised by one of the authors (R. A. Dieterich) for the successful relocation of reindeer in North America.

This report describes the techniques used for the first translocation of reindeer calves from South Georgia to the Falkland Islands in 2001.

### **Material and methods**

The feasibility of translocating reindeer from one of the two South Georgia herds was assessed in February 2000 by the authors. This included visiting South Georgia, locating potential sites for the construction of temporary handling facilities and assessing biological parameters, such as body condition and size of calves. Animals of the Busen herd were determined to be the most amenable to herding, based on field observations and mock herding, and a suitable site was identified for the construction of handling facilities. This site was located on a flood plain on the southern side of the abandoned Husvik whaling station (54°11'S, 36°43'W), on Stromness Bay. Intact infrastructure at the abandoned whaling station was also available to provide accommodation for a field party and storage of equipment and supplies.

In early January 2001 a field party of eleven personnel arrived at the chosen site. The field party included three veterinarians, one with extensive reindeer experience, and was supported by an ocean-going yacht. A circular corral of approximately 25 m diameter was constructed using prefabricated aluminium panels that were approximately 3 m long and 2 m high.

Guyed with fencing wire to steel stakes, the open panels were lined internally with hessian to create a visual barrier. Two ‘wing’ fences leading to the main corral were constructed using a combination of wire netting and fencing wire, and strips of plastic sheeting were tied to this fencing as bunting to create the impression of a physical barrier to the reindeer. Two pens adjoining the corral were constructed. One pen of 6 m diameter opened directly off the main corral, and was connected to a ‘chute’ that was V-shaped in cross-section and lined with timber panels. The second pen, for holding calves, also adjoined the main corral. Both these pens were also constructed with prefabricated aluminium panels, but were lined with timber panels to a height of 2.5 m. These two pens were later merged to provide an enlarged area for holding captive calves. Shelters and bedding material were provided for the captive calves.

Following the construction of holding facilities, herding was commenced on foot. This was usually undertaken by six people working in pairs, using geographical features to assist in the movement of reindeer. Once the reindeer were within the proximity of the corral, four to five additional personnel assisted with the final drive of animals to the ‘wing’ fences and into the corral.

Once in the corral, the reindeer were permitted to settle before being moved into holding pens. As animals were then moved through the chute individually, calves were caught manually by two people, and the adult and yearling animals released. On the day of capture, the sex of the calves was determined, a sequentially numbered plastic ear-tag was applied, and fenbendazole (*Panacur*<sup>™</sup> 10% Suspension, Intervet UK Ltd, Milton Keynes, Buckinghamshire, UK) and a multi-strain pro-biotic paste (*Protexin*<sup>™</sup> Paste For Horses, Probiotics International Ltd, Stoke-sub-Hamdon, Somerset, UK) were administered orally. The eyes of captive calves were also examined, flushed with 0.9% saline and if deemed necessary, treated with topical chloramphenicol ointment (*Chloromycetin*<sup>™</sup>, Parke Davis Research Laboratories, Eastleigh, Hampshire, UK) if dust or other foreign material were present.

Captive calves were fed twice daily with custom manufactured feed pellets (W. & H. Marriages & Sons Ltd, Chelmsford, Essex, UK) and a powdered, multi-strain pro-biotic (*Protexin*<sup>™</sup> Soluble For All Animals, Probiotics International Ltd, Stoke-sub-Hamdon, Somerset, UK). Two formulations of pellets, referred hereafter to as *Diet A* and *Diet B* (Table 1), were fed in combination. The pellets were similar in composition to commercial reindeer rations

Table 1. Dietary analysis of pelletised feed and powdered milk replacer used for the translocation. Information provided by the manufacturer of pelletised feed (W. & H. Marriages & Sons Ltd, Chelmsford, Essex, UK) and commercial sheep milk replacer (SCA Nutrition Ltd, Thirsk, North Yorkshire, UK).

| Component   | Diet A<br>(pellet) | Diet B<br>(pellet) | Commercial milk<br>replacer |
|-------------|--------------------|--------------------|-----------------------------|
| Protein (%) | 16                 | 26                 | 22                          |
| Fat (%)     | 3.5                | 4.5                | 24                          |
| Fibre (%)   | 16                 | 3                  | 0.05                        |
| Ash (%)     | 7.75               | 7.67               | 6.80                        |
| P (%)       | 0.7                | 0.45               | Not available               |
| Ca (%)      | 1.00-1.25          | 1.0                | Not available               |

Table 2. Date (2001) and location where calves were observed and captured on South Georgia.

| Date (2001) | Area                                  | No. calves observed | No. calves captured |
|-------------|---------------------------------------|---------------------|---------------------|
| 14 Jan      | Carlita Bay and Olsen Valley          | 38                  | 38                  |
| 16 Jan      | Busen (Lewin) Peninsula (north coast) | 12                  | 8                   |
| 20-21 Jan   | Cape Saunders                         | 12                  | 0                   |
| 22 Jan      | Leith Harbour                         | 4                   | 0                   |
| 22 Jan      | Stromness Harbour                     | 15                  | 13                  |
| 26 Jan      | Fortuna Bay (east coast)              | 8                   | 0                   |
| 27 Jan      | Olsen Valley                          | 8                   | 8                   |
| 29 Jan      | Jason Harbour                         | 1                   | 0                   |
| Total       |                                       | 98                  | 67                  |

used in North America for maintenance (Diet A) and growth (Diet B). Pellets were fed in V-shaped timber troughs, with approximately 0.3 m of linear trough per calf. Suitable lichens were not available on South Georgia for feeding to calves.

Powdered sheep milk replacer (*Lambkin Ewe Milk Replacer*, SCA Nutrition Ltd, Thirsk, North Yorkshire, UK) was reconstituted with water and fed twice daily in plastic tubs, and fresh water was available at all times. Calves were weaned from milk onto water prior to departure from South Georgia.

The behaviour of calves was observed at least twice daily to monitor their adjustment to captivity. Depending on the date of capture, calves were held at Husvik for a period of 8 to 20 days prior to departure from South Georgia. Several calves at a time were transferred to the ship in a custom designed transfer crate carried in a flat bottomed boat. The M/V *Sigma*, a 60 m long modified fishing trawler, was used for the voyage to the Falkland Islands. Calves were held in pens on the trawl deck of the ship. The pens had been constructed using prefabricated steel panels, originally designed for the air transport of sheep, arranged on a raised timber platform to ensure that pens remained dry. The trawl deck of the ship was completely

enclosed except at the stern and this provided both good ventilation and adequate shelter from the weather. Each pen had a floor dimension of 3 m by 2 m, and a maximum of 10 calves were held per pen. This provided sufficient space to enable all animals in a pen to be recumbent simultaneously. A thick layer of hay on the plywood floor was provided for bedding. The pelletised feed (combination of Diet A and

Diet B) was fed to the calves twice daily during the voyage and fresh water was available at all times.

Following a three day sea voyage from South Georgia, the calves were discharged on 9 February 2001 at Stanley on East Falklands via the transfer crate to an open-top truck trailer. A two hour road journey was then undertaken to the FIG Department of Agriculture research farm. At the time of unloading from the truck, 15 ml of anti-sera for *Actinomyces pyogenes*, *Pasteurella haemolytica*, *P. multocida* and *Salmonella typhimurium* (*Polyserum*<sup>TM</sup> Grand Laboratories, Inc, Freeman, South Dakota, USA) and 10 ml of anti-sera for *Clostridium perfringens* (*Clostratox*<sup>TM</sup> BCD, Grand Laboratories, Inc, Freeman, South Dakota, USA) were administered to all calves by subcutaneous injection. The calves were released into an area of pasture enclosed by a deer-proof fence.

A necropsy was performed by a veterinarian on all calves that died during the translocation.

## Results

Herding of reindeer to the abandoned whaling station at Husvik took place between 14 and 27 January 2001. Of 98 calves observed during the herding, a total of 67 (68%) were successfully herded and captured from coast-

line of Stromness Harbour, the north coast of the Busen (Lewin) Peninsula and the Olsen Valley / Carlita Bay area (Table 2). Reindeer could not be herded from several other sites (Table 2).

Calves were estimated to be approximately 10 to 12 weeks of age at the time of capture, based on their size and the assumption that they were born in November of the previous year (Bonner, 1958). Calves were held in captivity at Husvik for 8 to 20 days, depending on the day of capture. Calves become settled within a day or two of capture, to the extent that personnel could move slowly amongst them in the holding pens. Sudden movements or loud noises did spook the calves, irrespective of how long they had been held for.

Fig. 2 depicts the mean daily amount of feed offered. As it was rare to have any feed remaining in the troughs after any meal, this amount was considered to be equivalent to mean daily intake. Approximately 0.1 kg of milk powder per calf, reconstituted with water, was also provided twice daily. Calves were offered pellets and milk from the first day in captivity; most appeared to commence feeding on the same day. Pellets were gradually introduced as shown in Fig. 2. By the time of departure from South Georgia, calves had a daily intake of approximately 2.4 kg, with the higher protein formulation (Diet B) comprising approximately 20% (0.5 kg) of the diet (Fig. 2). The mean daily intake of pellets remained constant during the sea voyage.

A total of 8 (11%) of calves died whilst held in captivity at Husvik, between 4 and 18 days

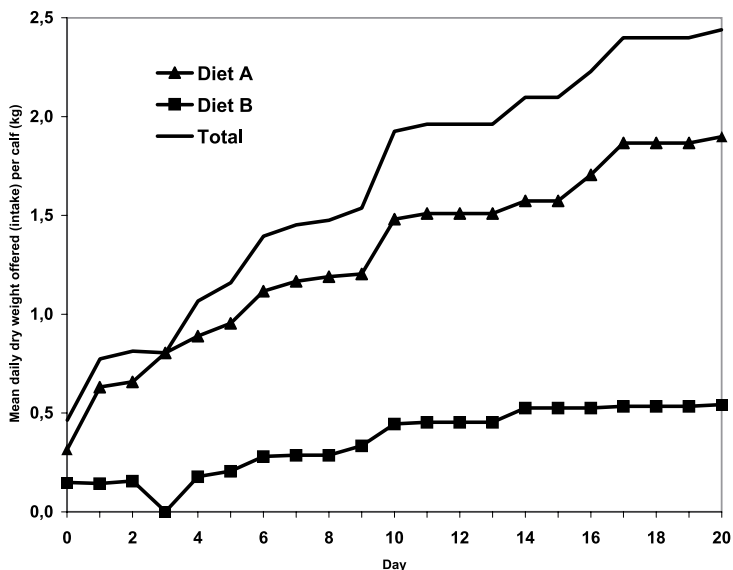


Fig. 2. Mean daily amount offered by dry weight (kg) of Diet A and Diet B pellets to calves during captivity on South Georgia. This is regarded as equivalent to mean daily intake (see text). Day zero refers to the day when the first calves were captured (13 January 2001) and Day 20 is the day prior to departure from South Georgia.

post-capture (mean 8.5 days). A necropsy was performed in each case (Table 3). The necropsy findings based on gross examination included sand impaction of the abomasum, hair impaction of the rumen and evidence of starvation. No evidence of ruminal acidosis was recorded in any of the dead calves. The cause of death generally appeared to be associated with poor adaptation to the dietary change.

A total of 59 calves (26 females and 33 males) were transported to the Falkland Islands from South Georgia. No mortalities occurred during the three day sea voyage. Although calves were observed to be in sternal or lateral recumbency for most of the voyage, sea conditions did not prevent calves from standing in the pens to feed, urinate or defaecate.

### Discussion

This report documents the first translocation of free-ranging reindeer of the South Georgia population to the Falkland Islands. By modify-

Table 3. Gross *post-mortem* findings for captive calves that died in captivity at South Georgia during January and February 2001.

| Sex    | Days in captivity prior to death | Gross post-mortem findings              |
|--------|----------------------------------|---|
| Male   | 4                                | Empty rumen/abomasum; undersized animal |
| Female | 4                                | No fat reserves                         |
| Female | 7                                | No fat reserves                         |
| Male   | 7                                | No fat reserves; possible enteritis     |
| Female | 8                                | Hair impaction of rumen                 |
| Male   | 8                                | No significant findings                 |
| Male   | 12                               | Sand impaction of abomasum              |
| Male   | 18                               | Sand impaction of abomasum              |

ing techniques originally developed for translocation of reindeer in North America to suit the subantarctic South Georgia environment, as well as taking into consideration the natural biology of the animals, we were able to herd and capture reindeer, hold them in captivity for up to 20 days and then ship them approximately 1400 km across open ocean with relatively few mortalities.

The experience gained from this translocation with respect to herding, husbandry and transportation will be useful if future translocations or related management activities are undertaken on South Georgia. As good husbandry practices and an understanding of biology and behaviour are believed to play an important role in the success of reindeer translocations (Dieterich, 1990), we firstly ensured there was an appropriate level of expertise within the field team. This was achieved by including on the field team three veterinarians (one with extensive experience in reindeer health, biology and translocation), a ruminant nutritionist and two experienced livestock farmers. We chose to translocate calves instead of adults because of the higher survival rates experienced in North America by one of the authors (R. Dieterich), the ease of handling and rapid adaptation to a new diet. By translocating calves, a larger number of animals

could also be fitted into the limited space on-board the ship. Because of the remote and isolated location of South Georgia and the absence of an airfield, shipping the reindeer by sea was the only method available for transporting them to the Falkland Islands.

Although the diet we provided was a compromise between food source availability, time constraints and cost, the majority of calves adapted to it readily.

The authors were well aware of the high protein level of Diet B which arose due to issues associated with the commercial production of the feed. However this did not appear to have any negative impacts. The amount of Diet B offered to calves was closely monitored at all times, and field personnel ensured that the pellets were evenly mixed with the lower protein pellets at feeding time. Lichens are an ideal dietary change starter, but appropriate species were not available on South Georgia. Monitoring body mass of calves would have been a useful tool for feeding management, but this was not undertaken as we did not wish to subject animals to additional handling stress.

All herding activities on South Georgia were undertaken on foot as the GSGSSI prohibited the use of motorised vehicles, horses and dogs. Further, to charter and transport a helicopter by ship to South Georgia would have been cost prohibitive and potentially problematic due to weather conditions. The geography in some locations, for example long valleys with steep sides, combined with the use of temporary fencing, made herding on foot feasible. Difficulties were experienced herding reindeer from some areas, including Cape Saunders, Leith Harbour and Fortuna Bay; the authors believe that even with additional personnel, it may have been impossible in these areas. The

use of a helicopter may have been the only way that animals could have been herded from these areas.

The cause of death of calves during the translocation appeared to be principally associated with poor adaptation to dietary change. This was consistent with translocations in North America where 5 to 10% of reindeer do not adapt to captivity and a commercial diet (Dieterich, 1990). Severe weather may have been a complicating factor on South Georgia, although attempts were made to mitigate this by providing roofed shelters and bedding material for calves in the holding pens.

The reindeer translocated to the Falkland Islands were first bred in 2003 and 15 females produced 11 calves under extensive grazing conditions (S. Pointing, *pers. comm.*). The reindeer were privatised in 2004 when the breeding herd was moved to West Falklands and 12 castrated males went to an island off West Falklands. Body condition of the breeding herd became poor and some mortality occurred following the move. Unsuitable range and parasitism may have been implicated, but the definitive cause of death could not be determined for these mortalities (S. Pointing, *pers. comm.*).

The breeding herd was again relocated in 2006 on West Falklands, following which body condition significantly improved and breeding continued (S. Pointing, *pers. comm.*).

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Permission to capture and export reindeer from South Georgia was granted by The Commissioner for South Georgia and the South Sandwich Islands. Permission to import reindeer to the Falkland Islands was granted by the Falkland Islands Government.



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Flytting av rein fra Sør-Georgia til Falklandsøyene

*Abstract in Norwegian / Sammendrag:* Artikkelen beskriver den første overføring av rein *Rangifer tarandus* fra Sør-Georgia til Falklandsøyene i søratlanteren. Tamrein fra Norge ble flyttet til den subarktiske øya Sør-Georgia ved tre anledninger i perioden 1911 til 1925 i forbindelse med den norske hvalfangsten der. I dag består bestanden av rundt regnet 2600 dyr fordelt på to geografisk atskilte flokker. Av hensyn til den naturlige vegetasjonen på øya er det forslag om å på sikt utrydde reinbestanden på øya. Regjeringen på Falklandsøyene foretok en første overføring av rein fra Sør-Georgia i 2001 ut fra en målsetting om å 1) bevare genetiske ressurser fra minst en av de to reinflokkene, og 2) øke mulighetene innenfor landbrukssektoren på Falklandsøyene ved å etablere en kommersiell reinflokk der. Overføringen ble utført med metoder som hadde vist seg formålstjenlige ved flytting og nylokalisering av kalver i Nord-Amerika. Totalt ble 59 kalver overført i 2001 derav 26 hunndyr. De overførte reinene produserte kalver i 2003. God driftspraksis og biologisk og atferdsmessig forståelse var viktig for en vellykket overføring.

