

Untagged southern elephant seals at Marion Island: origin and demographic consequences

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2010



Declaration:

I,**Wessel Christiaan Oosthuizen**..... declare that the thesis/dissertation, which I hereby submit for the degree**MSc Zoology**..... at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

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Soli Deo Gloria

“Young bulls come up at the same time and are called Christmas Bulls. These leave the island at the latter end of January. The next season is March, when a few bulls come up and are called March Bulls. As the sea elephant has never been observed at any considerable distance from land, it is the opinion of the sealers that they lie in the root of the island, and it is imagined that they take in ballast for this purpose, as they have been observed on coming up to vomit a quantity of pebbles”.

Captain Thomas Raine, 1822. (In: Cumpston, J.S. 1968. Macquarie Island.)

UNTAGGED SOUTHERN ELEPHANT SEALS AT MARION ISLAND: ORIGIN AND DEMOGRAPHIC CONSEQUENCES

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At Marion Island in the southern Indian Ocean, nearly all southern elephant seal *Mirounga leonina* pups born annually (1983 - 2008) were marked with durable hind flipper tags in an ongoing mark-resight experiment. However, large numbers of untagged seals, either migrants from other sub-Antarctic islands where seals are not marked, or previously tagged Marion Island seals which suffered tag-loss, haul out at this locality.

The composition of the elephant seal population, expressed as numbers of tagged and untagged seals hauling out at Marion Island, correlates to different haulout phases and varies between age classes. Unmarked seals are most common (relative abundance) during the winter/mid-year haulout, followed by the moult and lastly the breeding season. The youngest age classes have the lowest proportion of tagged seals, and adult females the highest. These patterns suggest that the majority of unmarked seals hauling out at Marion Island are migrant seals, rather than seals native to Marion Island. The presence of large numbers of untagged seals during non-breeding haulouts may indicate that these seals forage in the region of Marion Island (rather than near their native island).

Although untagged seals are less abundant during the breeding season in comparison to the winter and moult haulouts, untagged adult female seals represent approximately half of the breeding population. As breeding dispersal of female elephant seals is considered to be a rare event, we calculated tag-loss rates for seals marked as weaned pups at Marion Island. Although tag-loss rates have been estimated before for seals double tagged in the inner interdigital webbing of the hind flippers (1983 - 1999), tag-loss rates were unknown for seals tagged in the outer interdigital webbing of the hind flippers (2000 - 2005). The slight alteration in tag-site had important consequences for tag-loss. Under the tag-loss independence assumption, double tag-loss of inner interdigital webbing tags remained below 1% in the first 5 years and increased monotonically as seals aged, with higher tag-loss in males. Changing the

tag-site to the outer interdigital webbing of the hind flippers resulted in increased and cohort dependent tag-loss, although the variation between cohorts was relatively low for any given age.

The higher relative abundance of juvenile untagged seals and investigation into tag-loss together suggested that the majority of unmarked seals at Marion Island must be non-native seals. Survey expeditions to Prince Edward Island, 19 km to the northeast of Marion Island and the only other island in the Prince Edward Islands archipelago allowed us to investigate movements of tagged elephant seals between Marion Island and Prince Edward Island. During the early moult season, in the summers of 2001, 2004 and 2008, 416 elephant seals were inspected for identification tags at Prince Edward Island. In total, 42 seals (10%) encountered had been tagged as weaned pups at Marion Island. The majority of the Marion Island-tagged seals were yearlings or subadults hauled out at Prince Edward Island for the annual moult. Marion Island individuals resighted at Prince Edward Island had lower overall capture probabilities (at Marion Island) than a random population sample, violating the 'homogeneity of capture' assumption. Part of a cohort of pups born at Prince Edward Island was tagged in 2004, and although some of these seals hauled out at Marion Island during the winter and moult, none of the surviving females bred at Marion Island in 2007 or 2008 (males had not reached maturity at this time).

The elephant seal population at Prince Edward Island numbers approximately 130 breeding females and is probably too small to contribute significant numbers of untagged seals to Marion Island. However, large(r) populations of unmarked elephant seals occur within the southern Indian Ocean, at Îles Kerguelen and Heard Island in particular, but also at Îles Crozet. From 1987 to 2002, 199 Îles Crozet individuals, or 11.63% of the tagged population there, were resighted at Marion Island. Resights of Îles Crozet seals at Marion Island peaked during the juvenile moult (45% of all haulouts) and autumn/winter mid-year haulout. Equal numbers of male and female seals were identified. The age frequency distribution of tagged Îles Crozet seals was strongly juvenile biased and seals aged 0 to 2 represent 66% of all resights of Îles Crozet individuals made. Îles Crozet females bred at Marion Island after initially immigrating to the population as juvenile seals (natal dispersal). Dispersing breeding females ($n = 22$, in 33 seasons) outnumbered dispersing breeding males ($n = 6$, in 16 seasons), but greater male-mediated gene flow was ultimately attained due to the polygynous mating system and some extremely successful males.

Insufficient marking of seals at Îles Kerguelen and Heard Island prevented quantitative assessment of intra-island movement from these islands to Marion Island using mark-resight techniques. However, satellite-relay data loggers deployed at Marion Island provided evidence of movement between Marion Island, Îles Crozet ($n = 6$) and Îles Kerguelen ($n = 3$). Two of the seals which migrated to Îles Crozet were born at Marion Island and returned to Marion Island subsequent to their haulout at Îles Crozet (temporary emigration). All other satellite-tracked seals were untagged subadult or adult males that are presumed to be non-native to Marion Island and probably hauled out there in the course of foraging migrations from Îles Crozet and Îles Kerguelen. A few of these adult males hauled out during the breeding season at Îles Crozet ($n = 2$) or Îles Kerguelen ($n = 2$), some returning to Marion Island afterwards for the moult haulout.

Realistic, long-term population models allow for additions or deletions to the population representing immigration, emigration and marker-loss, together with recruitment and mortality. Untagged seals hauling out at Marion Island appear to be primarily of foreign origin. Tag-loss for seals marked at Marion Island is low, but should be monitored as the time-series for outer-interdigital tags improve. Southern elephant seals in the southern Indian Ocean move between islands within the Kerguelen province despite the high site fidelity characteristic of this species. Immigration sufficiently modifies the population growth rate for the small southern elephant seal population at Marion Island and dispersal should ideally be considered when assessing vital rates for this and other southern Indian Ocean populations.

Keywords: demography, dispersal, inter-island movement, Kerguelen, long-term, Marion Island, marking, mark-recapture, migration, *Mirounga leonina*, movement, phocids, population, Prince Edward Islands, site fidelity, southern elephant seal, Southern Ocean, tag-loss, unmarked

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[†] JOHANN JAMNECK [1984.05.24 – 2009.10.04]

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PUBLISHED MANUSCRIPTS

(Emanating from this dissertation)

- Oosthuizen, W.C., Bester, M.N., de Bruyn, P.J.N. and Hofmeyr, G.J.G. 2009. Intra-archipelago moult dispersion of southern elephant seals at the Prince Edward Islands, southern Indian Ocean. *African Journal of Marine Science* 31: 457-462.
- Oosthuizen, W.C., de Bruyn, P.J.N., Bester, M.N. and Girondot, M. 2010. Cohort and tag-site-specific tag-loss rates in mark-recapture studies: a southern elephant seal cautionary case. *Marine Mammal Science* 26: 350-369.

Disclaimer

Each of the research chapters within this dissertation was structured with scientific journal publication in mind. Chapters are therefore concise and presented so as to be able to stand alone. I apologise for overlap and repetition.