**Supplemental material:**

**Have burrowing petrels recovered on Marion Island two decades after cats were eradicated? Evidence from sub-Antarctic skua prey remains**

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**Estimating the abundance of burrowing petrel and penguin prey for sub-Antarctic skuas breeding at the Prince Edward Islands**

The approximate amount and density of prey available to sub-Antarctic skuas breeding on the Prince Edward Islands (Table IV) was calculated from breeding population estimates of summer-breeding burrowing petrels and penguins adapted from Cooper & Brown (1990), Ryan & Bester (2008), Crawford *et al*. (2009), Ryan *et al*. (2012) and unpublished data (Table S1). Burrowing petrel estimates for Prince Edward were inflated slightly from previous published estimates to reflect the 5–50-times greater burrow densities reported from that island by Schramm (1986). Masses of adult petrels were taken from Ryan & Bester (2008). Skuas target mainly penguin eggs and chicks, so available biomass was calculated as 1% of adult biomass (for the few adults eaten) + egg mass \* clutch size \* number of pairs + chick mass at 2 weeks \* hatching success \* number of pairs, using mass and breeding success data from Handrich (1989), Williams (1990a, 1990b), Cobley & Shears (1999), de Margerie *et al*. (2004), Poisbleau *et al*. (2008) and Crawford *et al*. (2009). The density of burrowing petrel prey at each island was calculated by dividing their biomass by the land area below 850 m estimated from a digital elevation model (Prince Edward Island is 850 m high, and no petrels breed above 850 m on Marion Island). The area of Marion Island below 850 m was taken to be 27 321 ha (adapted from Meiklejohn & Smith 2008). Comparative density estimates for penguins were made assuming most penguins breed below 100 m elevation: 6871 ha for Marion Island (Meiklejohn & Smith 2008) and 1750 ha for Prince Edward Island (Ryan *et al*. 2009).

**Table S1.** Approximate population estimates (number of breeding pairs) of summer-breeding penguins and burrowing petrels breeding at the Prince Edward Islands and the period (year) when the estimates were made.

Species Marion Island Prince Edward Island

Pairs Year Source\* Pairs Year Source\*

King penguin 65,000 2008 1 2,000 2008 1

Macaroni penguin 290,000 2008 1 12,000 2008 1

Rockhopper penguin 42,000 2008 1 38,000 2008 1

Salvin’s prion 100,000 1980s 2 500,000 1980s 2

Fairy prion 1,000 1980s 2 1,000 1980s 2

Blue petrel 50,000 1980s 2 200,000 1980s 2

White-chinned petrel 24,000 2009 3 12,000 2011 3

Soft-plumaged petrel 5,000 1980s 2 50,000 1980s 2

Kerguelen petrel 10,000 1980s 2 20,000 1980s 2

Common diving petrel 100 2015 4 20,000 1980s 2

South Georgian diving petrel 50 1980s 4 5,000 1980s 2

Black-bellied storm petrel 1980s 2 5,000 1980s 2

Grey-backed storm petrel 1980s 2 1,000 1980s 2

\*1Crawford *et al*. 2009; 2Cooper & Brown 1990 and Ryan & Bester 2008, modified based on burrow densities in Schramm 1986 for Prince Edward Island; 3Ryan *et al*. 2012; 4Percy FitzPatrick Institute unpublished data.

**References**

Cobley, N.D. & Shears, J.R. 1999. Breeding performance of gentoo penguins (*Pygoscelis papua*) at a colony exposed to high levels of human disturbance. *Polar Biology* **21**, 355–360.

Cooper, J. & Brown, C.R. 1990. Ornithological research at the sub-Antarctic Prince Edward Islands: a review of achievements. *South African Journal of Antarctic Research* **20,** 40–57.

Crawford, R.J.M., Whittington, P.A., Upfold, L., Ryan, P.G., Petersen, S.L., Dyer, B.M. & Cooper, J. 2009. Recent trends in numbers of four species of penguins at the Prince Edward Islands. *African Journal of Marine Science* **31**, 419–426.

De Margerie, E., Robin, J.P., Verrier, D., Cubo, J., Groscolas, R. & Castanet, J. 2004. Assessing a relationship between bone microstructure and growth rate: a fluorescent labelling study in the king penguin chick (*Aptenodytes patagonicus*). *Journal of Experimental Biology* **207**, 869–879.

Handrich, Y. 1989. Incubation water loss in king penguin egg. I. Change in egg and brood pouch parameters. *Physiological Zoology* **62**, 96–118.

Meiklejohn, K.I. & Smith, V.R. 2008. Surface areas of altitudinal zones on sub-Antarctic Marion Island. *Polar Biology* **31,** 259–261.

Poisbleau, M., Demongin, L., Strange, I.J., Otley, H. & Quillfeldt, P. 2008. Aspects of the breeding biology of the southern rockhopper penguin *Eudyptes c. chrysocome* and new consideration on the intrinsic capacity of the A-egg. *Polar Biology* **31**, 925–932.

Ryan, P.G. & Bester, M.N. 2008. Pelagic predators. *In* Chown, S.N. & Froneman, W., eds. *The Prince Edward Islands: land-sea interactions in a changing ecosystem*. Stellenbosch: Sun Media, 121–164.

Ryan, P.G., Whittington, P.A. & Crawford, R.J.M. 2009. A tale of two islands: contrasting fortunes for subantarctic skuas at the Prince Edward Islands. *African Journal of Marine Science* **31**, 431–437.

Ryan, P.G., Dilley, B. & Jones, M.G.W. 2012. The distribution and abundance of white-chinned petrels (*Procellaria aequinoctialis*) breeding at the sub-Antarctic Prince Edward Islands. *Polar Biology* **35**,1851–1859.

Schramm, M. 1986. Burrow densities and nest site preferences of petrels (Procellariidae) at the Prince Edward Islands. *Polar Biology* **6**, 63-79.

Williams, T.D. 1990a. Annual variation in breeding biology of gentoo penguins, *Pygoscelis papua*, at Bird Island, South Georgia. *Journal of Zoology, London* **222**, 247–258.

Williams, T.D. 1990b. Growth and survival in macaroni penguin, *Eudyptes chrysolophus*, A-and B-chicks: do females maximise investment in the large B-egg? *Oikos* **59**, 349–354.