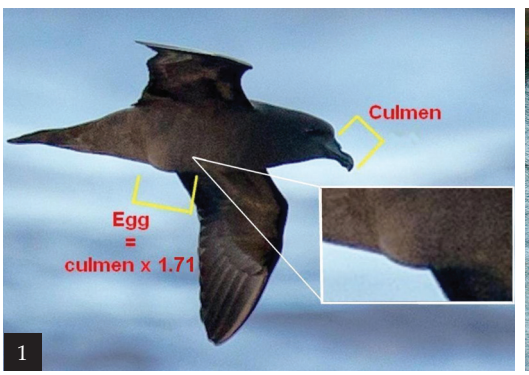
Response to 'Gravid female birds cannot be determined by visual inspection'

We did consider if the lump in the photograph of Mascarene Petrel *Pseudobulweria aterrima* (Shirihai *et al.* 2014: 220) could be a tumour, cyst, abnormal growth, internal injury, even debris of some sort attached to the body. We felt that it represented a fully developed egg for the following reasons.

Eggs are disproportionately large in petrels, all effort being put into the single-egg clutch. The egg of a storm petrel, for example, can represent 30% of an adult female's mass, while a radiograph of a female Bonin Petrel *Pterodroma hypoleuca* (Warham 1990: 281) shows the egg can be 50% the length of the body. Egg size in Mascarene Petrel is unknown, but Villard *et al*. (2006) published dimensions for the closely related Tahiti Petrel *P. rostrata*. The culmen length to egg length ratio in that species is 1:1.71 (using mean measurements of females from New Caledonia, south Pacific) and assuming this ratio to be the same for Mascarene Petrel, the egg would sit where the lump is visible (Fig. 1). The position of the 'bump' is correct when also considering the locations of the cloaca and uterus in the long body of *Pseudobulweria* (Fig. 1). Dissection of two congeneric species, Beck's *P. becki* and Fiji Petrel *P. macgillivrayi* (Figs. 2–3), confirm this.

In the hand, we have found that several species of petrels can show the obvious outline of an egg and this produces a distinct 'bump'. A female Providence Petrel *Pterodroma solandri* captured on Lord Howe Island in late May 2004 on its arrival from the sea had a visible 'bump' of similar shape and the same location, though seemingly even larger than



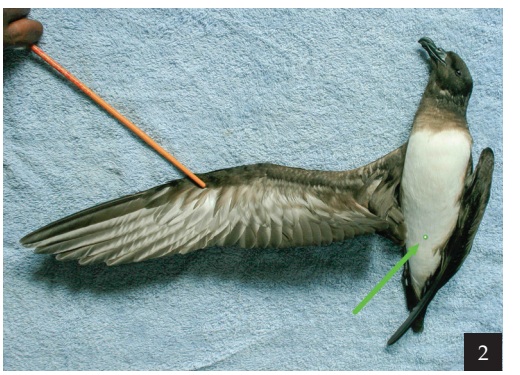


Figure 1. Mascarene Petrel *Pseudobulweria aterrima*, off Réunion, December 2012, with what we believe to be a large egg in the uterus; swollen area located just above the cloaca. Graphics show likely ratio of culmen:egg (*cf*. Villard *et al*. 2006 for measurements) (Hadoram Shirihai, © Tubenoses Project)

Figures 2–3 (facing page). Two *Pseudobulweria* petrels (left, Beck's *P. becki* and right, Fiji Petrel *P. macgillivrayi*) that were subsequently dissected; the green dots indicate the approximate location of the cloaca in each case. In *Pseudobulweria*, the cloaca is more forward than expected, due to the long body and tail (Hadoram Shirihai, © Tubenoses Project)

that of the Mascarene Petrel photographed (HS pers. obs). Equally, a female Cape Petrel *Daption capense* handled by VB (Adélie Land, December 1985) showed a similar 'egg bump'. However, neither of these birds was seen in flight, so we cannot describe the bump in aerial profile.

The extraordinary breeding biology of petrels must also be considered. We believe this photograph fortuitously captured a Mascarene Petrel returning to its colony from the pre-laying exodus (a period at sea following mating and during which the egg develops). On arrival most females move quickly to their burrows to lay the by-now fully-formed egg, thus their timetable is very different to the vast majority of birds; the single egg is laid the same night that they return (Warham 1990; VB pers. obs.), unlike most birds that sit on, or stay around, their nests day and night for a duration of *c*.24 hours, permitting time for an egg to travel the reproductive tract.

We have observed illness and deformity in wild birds, as well as tumours and growths in cagebirds, though none has shown any abnormality like this. In cagebirds, however, such deformations, including bumps in the abdomen, can change in shape and size as survival is potentially longer for birds in care. Thus, comparing caged with wild birds, petrels specifically, is not convincing. We remain convinced the bump shown by the Mascarene Petrel was an egg based on the information presented above, but accept that this cannot be conclusively proven.

References:

Shirihai, H., Pym, T., San Román, M. & Bretagnolle, V. 2014. The Critically Endangered Mascarene Petrel *Pseudobulweria aterrima*: identification and behaviour at sea, historical discovery of breeding sites, and breeding ecology on Réunion, Indian Ocean. *Bull. Brit. Orn. Cl.* 134: 194–223.

Villard, P., Dano, S. & Bretagnolle, V. 2006. Morphometrics and the breeding biology of the Tahiti Petrel *Pseudobulweria rostrata*. *Ibis* 148: 285–291.

Warham, J. 1990. *The petrels: their ecology and breeding systems.* Academic Press, London.

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