

## SHORT NOTE

### First record of interbreeding between a Snares crested (*Eudyptes robustus*) and erect-crested penguin (*E. sclateri*)

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We observed a male Snares crested penguin (*Eudyptes robustus*) breeding with a female erect-crested penguin (*E. sclateri*) on North East Island, The Snares, New Zealand, early in the Snares crested penguin incubation stage (Fig. 1). This is the first record of these species interbreeding, despite their similar timing of breeding (Warham 1975) and observations of overlap in distribution. Erect-crested penguins are regular vagrants to The Snares (Miskelly *et al.* 2001) and Snares crested penguins are occasional vagrants to the Antipodes Islands (Tennyson *et al.* 2002). The impressive dispersal ability of both species is evident in records of each from the Falklands Islands in the southwest Atlantic Ocean (Napier 1968; Demongin *et al.* 2010; Morrison 2010). This is also the first record of a Snares crested penguin interbreeding with any other penguin species. In contrast, erect-crested penguins have previously been observed breeding with western (or southern, *E. chrysocome*) and eastern rockhopper (*E. filholi*) penguins on multiple occasions, and paired with a royal penguin (*E. schlegeli*) (Table 1).

There were c. 31,000 breeding pairs of Snares crested penguins in 2010 (BirdLife International 2012a), which are endemic to The Snares and are listed as Vulnerable by the IUCN (BirdLife International 2012a) and Naturally Uncommon by the New Zealand Department of Conservation (DOC; Robertson *et al.* 2013). Erect-crested penguins are also endemic to New Zealand's sub-Antarctic islands, breeding primarily on the Antipodes Islands (c. 40,000 pairs in 2011; Hiscock & Chilvers 2014) and Bounty Islands (c. 26,000 pairs in 2011; BirdLife International 2012b). A low number of erect-crested penguins may still breed on Disappointment Island of the Auckland Islands group, and a low number formerly bred on Campbell Island during the mid-20<sup>th</sup> century (Davis 2013). Although they have a larger population and breeding range, erect-crested penguin populations are undergoing a long-term decrease and are listed as Endangered by the IUCN (BirdLife International 2012b) and At Risk by DOC (Robertson *et al.* 2013).

The heterospecific pair was first observed guarding an empty nest on 30 September 2013 on the periphery of the "A3" colony during a census count. The pair's nest was still empty 9 October, but contained a small egg on 10 October, presumably the first-laid "A-egg". Our expedition departed 12 October before

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Fig. 1. Heterospecific pair of a male Snares crested penguin (left) standing over the egg of a female erect-crested penguin (right), 10 October 2013, North East Island, The Snares. Photo: K.W. Morrison

the second-laid “B-egg” was due to be laid, given the 2-egg clutch and 4 to 5 day laying interval typical of crested penguins (Warham 1975). Colin Miskelly and Alan Tennyson, from the Museum of New Zealand Te Papa Tongarewa, searched for the nest repeatedly from 2 to 11 December 2013 during the guard stage of chick-rearing, but the nest had likely failed as the erect-crested penguin was not resighted. The A3 colony contains c. 1,400 nests and is one of the largest Snares crested penguin colonies on the island. The colony is in dense *Olearia lyalli* forest and is located 250 m inland from the Biological Research Station (Warham 1974) and the nearest penguin landing site. Both the site and distance from the sea are typical of Snares crested penguin breeding colonies. In contrast, erect-crested penguin breeding colonies are typically in rocky areas adjacent to the coast (Warham 1975). We speculate that while searching for conspecifics the erect-crested penguin was attracted to the large number of penguins moving and courting inland, resulting in it breeding in the relatively large, sheltered A3 colony instead of the nearby small, more open colonies close to the coast.

The bill of adult male Snares crested penguins is larger than that of female adult Snares crested penguins (Warham 1974). We judged that the Snares crested penguin in the heterospecific pair we observed was a male because its bill appeared similar in size to the larger-billed bird in neighbouring pairs (Fig. 1). Using Vernier calipers we measured the single egg present to be 66.6 × 45.8 mm. Erect-crested penguin A-eggs average (± SD) 69.2 ± 3.8 mm × 46.4 ± 1.7 mm (Davis 2013), whereas Snares crested penguin A-eggs are of a similar length averaging 68.6 ± 2.4 mm, but of a greater width of 52.0 ± 1.7 (Massaro & Davis 2005). The narrower width of the A-egg from the mixed pair

supports our premise that the erect-crested penguin was a female.

Peak laying dates for Snares crested penguin A- and B-eggs were 28 September and 2 October on North East Island in 1972 (Warham 1974), and appeared very similar in 2013. The mixed-species nest was one of a low number of nests containing only an A-egg on 10 October 2013. The timing of laying of erect-crested penguins on the Antipodes Islands is similar, but slightly later than that of Snares crested penguins, averaging about 8 October and 12 October in 1998 for A- and B-eggs, respectively (Davis & Renner 2003). The erect-crested female in the heterospecific pair laid late relative to the Snares crested penguins, but on schedule for her own species on the Antipodes Islands. The maintenance of the presumed female’s typical timing of laying might be expected because although courtship activities within breeding colonies may accelerate and synchronise laying (Waas *et al.* 2000), the extent must be limited in crested penguins which all, except perhaps Fiordland crested penguins (*Eudyptes pachyrhynchus*), likely initiate egg formation at sea during their return migration to breeding colonies (Crossin *et al.* 2010).

Evolutionary theory predicts that more closely related species are more likely to interbreed because they are less likely to have evolved isolating mechanisms (Price 2008). In support of this theory, both penguin genera in which species are known to interbreed in the wild (*Eudyptes*; Table 1) and *Spheniscus* (Simeone *et al.* 2009) diverged and speciated more recently than the *Pygoscelis* and *Aptenodytes* penguins for which no wild heterospecific pairs or hybrids have been reported (Baker *et al.* 2006). The systematic affinities among extant *Eudyptes* taxa are not completely resolved. Baker *et al.* (2006) suggest

**Table 1.** Records of heterospecific pairs or hybrid crested (*Eudyptes* spp.) penguins. The species in higher abundance at the location (island-wide – some would be reversed if on a local colony basis) is listed first for each record. Occasions where the second-listed, less abundant species is a vagrant or breeds in very low numbers (< 50 pairs) are noted with an “\*”. Pairs not confirmed breeding are marked “+”.

Location	Species	Source
Falkland Islands	WR x EC*	Napier (1968), Morrison (2010)
Isla Noir	WR x MA	D. Oehler ( <i>pers. comm.</i> )
Staten Island	WR x MA*	A. Raya Rey ( <i>pers. comm.</i> )
Falkland Islands	WR x MA*	White and Clausen (2002), Morrison (2010)
South Georgia	MA x RO*	K. Reid in White and Clausen (2002)
Potentially multiple locations	MA x RO*	Marchant and Higgins (1990)
Marion Island	MA x ER	Woehler and Gilbert (1990)
Heard Island	MA x ER	Woehler and Gilbert (1990)
Campbell Island	ER x MA**	A. Tennyson in Seabrook-Davison (2013)
Campbell Island	ER x EC*	P. Moors in Hull and Wiltshire (1999)
Campbell Island	ER x RO*	Hull and Wiltshire (1999)
Macquarie Island	RO x EC**	Simpson (1985)
Macquarie Island	RO x ER	Simpson (1985), Hull and Wiltshire (1999)
Antipodes Islands	EC x ER	T. Greene in Morrison (2013)
Snares Islands	SC x EC*	This study

WR = Western rockhopper penguin (*Eudyptes chrysocome*), EC = Erect-crested penguin (*E. sclateri*), MA = Macaroni penguin (*E. chrysolophus*), RO = Royal penguin (*E. schlegeli*), ER = Eastern rockhopper penguin (*E. filholi*), SC = Snares crested penguin (*E. robustus*)

that the lineage leading to the erect-crested penguin diverged earliest, while Fiordland crested penguins and Snares crested penguins diverged most recently. In contrast, Ksepka (2006) and Ksepka and Ando (2011) suggest erect-crested, Snares crested, and Fiordland crested penguins shared a common ancestor with one another more recently than with other eudyptids. Regardless of the evolutionary time and genetic distance between them, most species of *Eudyptes* penguins have been documented interbreeding with one or more other congeneric species (Table 1). Only northern rockhopper penguins (*E. moseleyi*) and Fiordland crested penguins have not been recorded in any heterospecific pairing to date (Table 1). We suggest these 2 species are reproductively isolated because of their low-latitude breeding sites and early timing of breeding (Cuthbert 2013; Mattern 2013).

Almost all occurrences of *Eudyptes* species interbreeding have involved one of the closely related western and eastern rockhopper penguins (Table 1), for which separate species status has been argued (Banks *et al.* 2006), but is not yet recognised by the IUCN (BirdLife International 2012c). The only exceptions are the pair described in this study, and observations of macaroni (*E. chrysolophus*) and royal penguin pairs (Table 1), which are also closely related and sometimes argued to be subspecies (Christidis & Boles 2008). Woehler and Gilbert (1990) suggested

that rockhopper penguins may be more capable of forming heterospecific pairs than other eudyptids, but did not acknowledge that rockhopper penguins have the greatest opportunity to form mixed pairs. Western and eastern rockhopper penguins are the only species that breed sympatrically with any other eudyptid (Warham 1975), and together their circumpolar breeding range is larger than that of any other species and they are the second-most abundant crested penguin after macaroni penguins (BirdLife International 2012d; BirdLife International 2012c). Undoubtedly more interbreeding events among eudyptid penguins would be observed in New Zealand if breeding sites were more frequently systematically surveyed during the courtship or shared-incubation periods when both pair members are readily observed.

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