

LONGEVITY IN THE RHINOCEROS AUKLET *CERORHINCA MONOCERATA* AND A COMPARISON WITH OTHER SPECIES OF ALCIDAE

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ABSTRACT

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The Rhinoceros Auklet *Cerorhinca monocerata* is an abundant and widely distributed North Pacific seabird. We describe noteworthy longevity records derived from banding operations (1984–1985 and 2008–2018) on several large breeding colonies in British Columbia, Canada. Of note was an individual banded as a nestling on the Lucy Islands in 1985 and recaptured as a breeding adult in 2016, 31 years later. Several other individuals banded in the mid 1980s survived into at least their late 20s. These longevity records for the Rhinoceros Auklet are close to the value predicted by the linear relationship between longevity and log body mass for the 15 species of Alcidae for which data are available.

Key words: banding, body mass, burrow nests, North Pacific, recapture, seabirds, survival

INTRODUCTION

The Rhinoceros Auklet *Cerorhinca monocerata* is an abundant, widely distributed seabird of the temperate North Pacific Ocean. It is misnamed, in that the species does not belong to the auklet clade (Aethiini). Rather, the genus *Cerorhinca* either is basal within the puffin clade (Fratereculini) or it forms a sister clade with *Fraterecula* (Smith & Clarke 2015). About 50 % of the global population of Rhinoceros Auklets (~750 000 pairs) breeds at colonies in British Columbia (BC), Canada (Gaston & Dechesne 1996), although that estimate may be closer to ~30 % if populations on Russia's Kuril Islands are as large as newer surveys indicate (375 000 pairs; Ushakova 2007). Birds breeding in the eastern Pacific Ocean average 475–525 g in mass, with little evidence of geographic variation, and only slight sexual dimorphism has been observed (males tend to be larger than females; Addison *et al.* 2008).

Rhinoceros Auklet nests are situated in cavities or, more often, earthen burrows that the birds excavate themselves and reuse from year to year (Richardson 1961). Adult birds are active on the colony mainly at night, and evolutionary consequences of their nocturnal habits include relatively slow offspring development and long breeding seasons (Hipfner *et al.* 2010): the single egg is incubated for ~45 days until hatch, and the nestling is provisioned for ~50–55 days until fledging (Summers & Drent 1979, Harfenist 1995). A generalist feeder (Bédard 1969), provisioning adults deliver bill-loads of small forage fish that are caught mainly in continental shelf waters within ~40–75 km of the breeding colony

(Domalik 2018, Wilkinson *et al.* 2018). The growth rates and survival of offspring vary markedly from year to year, in response to oceanographic conditions that affect the birds' prey base (Hedd *et al.* 2006, Thayer & Sydeman 2007, Borstad *et al.* 2011). Adult survival rates measured on Triangle Island, BC (UTM 09N 494480 5634395) averaged ~87 % per year with no detectable difference between males and females and no detectable effect of oceanographic variation (Morrison *et al.* 2011).

RESULTS AND DISCUSSION

On 10 July 2016, while working on the Lucy Islands, BC (UTM 09N 394673 6017550), we caught in a purse net a Rhinoceros Auklet that had been banded as a nestling by DFB on 15 July 1985 (band number 846-57235). When recaptured 31 years later, this bird was raising its own nestling in a burrow located ~225 m from its natal burrow on the largest island of the colony. The recaptured bird was most likely a female, given its bill depth of 15.9 mm. (For 17 females sexed using molecular methods, mean bill depth = 16.1 mm ± 0.5 [SD] and range = 14.7–17.0 mm. For 16 males, mean bill depth = 17.2 mm ± 0.7 [SD] and range = 16.1–18.5 mm (JMh unpubl. data).)

Nestling growth rate may be indicative of post-fledgling survival in some seabirds. In a close relative, the Tufted Puffin *Fraterecula cirrhata*, rapid growth to large size at fledging is associated with a higher probability of surviving to return to the colony in later years (Morrison *et al.* 2009). During 1985, a year in which growth

rates were generally fast owing to a strong year-class of Pacific sand lance *Ammodytes personatus* (Bertram *et al.* 1991, Bertram & Kaiser 1993), the rate at which the recaptured Rhinoceros Auklet gained mass as a nestling (8.2 g/d from 10 days old to 40 days old) was above the colony-wide average (7.1 g/d \pm 2.5 [SD]). We handled a total of 916 adults on the Lucy Islands from 2008 to 2018, and of the 166 hatch-year (HY) auklets banded in 1984 and 1985, this is the only one recaptured thus far. An additional 203 after-hatch-year (AHY) Rhinoceros Auklets were banded there in 1984 and 1985, but none has been recaptured in the recent program. The breeding population on the Lucy Islands was estimated at ~25 000 pairs in the 1980s (Rodway & Lemon 1991a) and there has been no overt change in population size since (Rodway & Lemon 2011, L. Wilson unpubl. data).

There are three other noteworthy records of Rhinoceros Auklets banded on BC colonies in the 1980s and encountered in recent years. In the first instance, a probable female (bill depth = 16.2 mm) banded as an AHY (846-57168) on Pine Island (UTM 09N 589302 5647888) in July 1985 was recaptured there in 2009, 24 years later. In 1985, 82 Rhinoceros Auklets (27 AHY and 55 HY) were banded on Pine Island. In the second instance, a near-certain female (bill depth = 14.4 mm) banded as an AHY (785-61002) on Pine Island in July 1986 was recaptured there in 2008, 22 years later. In 1986, 100 birds (25 AHY and 75 HY) were banded on Pine Island, which supported ~89 000 pairs in the 1980s (Rodway & Lemon 1991b). We handled 1097 adults on Pine Island from 2008 to 2018. In the third instance, a bird of unknown sex that was banded as an AHY (785-57806) on Triangle Island in July 1984 was found dead on a beach in Oregon, USA, in September 2010, 26 years later. In 1984, 117 Rhinoceros Auklets (49 AHY and 68 HY) were banded on Triangle Island, which supported ~41 000 pairs in the 1980s (Rodway *et al.* 1990). If we assume that these three birds were breeding when banded (they were carrying bill-loads of fish, presumably destined for nestlings) and that the minimum age at first breeding in the Rhinoceros Auklet is four or five years old (similar to the Atlantic Puffin *Fratercula arctica*, a close relative of similar size; Petersen 1976, Harris 1981), then the three were at least 26–30 years old when re-encountered. While this is mathematically improbable for a species with an annual adult survival rate of ~87 % (Morrison *et al.* 2011), it appears that it is not uncommon for some individuals of this species to survive into their late 20s and 30s.

To put these observations in perspective, we compiled longevity records for species belonging to the family Alcidae from the EURING (Fransson *et al.* 2017) and North American Bird Banding Laboratory (BBL; USGS 2017) databases. We obtained data for 15 of the 23 species in the family, and we excluded the BBL longevity record of just six years for the Tufted Puffin, a large auk (~725 g) with an adult survival rate more than 90 % (Morrison *et al.* 2011) that has not been the subject of large banding programs. For all 15 species, the maximum (oldest) longevity records were derived from individuals banded as AHYs (thus, of unknown age). We replaced the BBL records with recently published records for two species, the Ancient Murrelet *Synthliboramphus antiquus* (Shoji & Gaston 2008) and Cassin's Auklet *Ptychoramphus aleuticus* (Johns *et al.* 2017). We also substituted an unpublished record for the Thick-billed Murre *Uria lomvia*, based on an individual banded as a HY on Coats Island, Nunavut, Canada, in 1981 and encountered in 2018, alive and breeding (K. Elliott pers. comm.). Based on these records, our longevity record of 31 years for the Rhinoceros Auklet is very close to the value predicted from the

linear relationship between longevity and log body mass for other species of Alcidae (Fig. 1). Positive relationships of a similar nature have been reported in other seabird taxa, such as the procellariiforms (Ainley *et al.* 2001).

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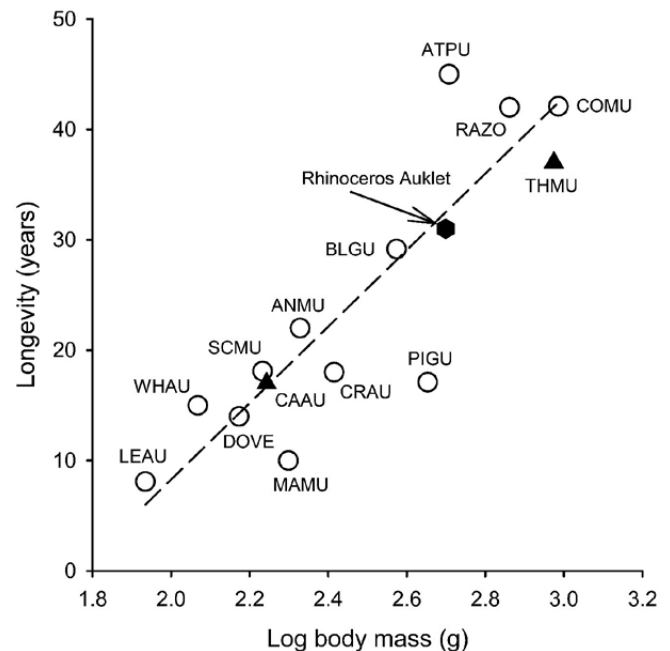


Fig. 1. Maximum longevity records in relation to body mass in the Alcidae. See text for sources for longevity records. Note that there is much interspecific variability in the quality of the data, largely related to abundance and the number of birds banded (e.g., both high in Atlantic Puffin, both much lower in Marbled Murrelet *Brachyramphus marmoratus*). Body masses are from Gaston & Jones (1998), using values for birds of unknown/combined sexes and the largest sample size reported. Filled symbols indicate known-age birds banded as HYs; open symbols indicate birds banded as AHYs. The formula for the linear relationship is $y = -56.9 + 32.9x$ ($R^2 = 0.76$, $F_{1,12} = 37.83$, $P < 0.001$). Species codes: COMU = Common Murre *Uria aalge*; THMU = Thick-billed Murre; RAZO = Razorbill *Alca torda*; DOVE = Dovekie (Little Auk) *Alle alle*; BLGU = Black Guillemot *Cepphus grille*; PIGU = Pigeon Guillemot *Cepphus columba*; MAMU = Marbled Murrelet; SCMU = Scripp's Murrelet *Synthliboramphus scrippsi*; ANMU = Ancient Murrelet; CAAU = Cassin's Auklet; CRAU = Crested Auklet *Aethia cristatella*; LEAU = Least Auklet *Aethia pusilla*; WHAU = Whiskered Auklet *Aethia pygmaea*; ATPU = Atlantic Puffin.

transport to field sites. We worked under Animal Care, Banding, and Migratory Birds permits from ECCC, and under permits from BC Parks and the Metlakatla, Tlatlasikwala, and Quatsino First Nations to work on the Lucy Islands, Pine Island, and Triangle Island. Alan Burger and an anonymous reviewer provided valuable suggestions to improve our paper.

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