# LONGEVITY RECORDS FOR THE BROWN BOOBY *SULA LEUCOGASTER* AND FLESH-FOOTED SHEARWATER *ARDENNA CARNEIPES*

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**ABSTRACT**

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Longevity records for seabirds are vital to understanding population demography but are often limited due to the relatively short duration of many monitoring programs. Here, we present new longevity records for two seabird species: 32.2 years (Queensland, Australia) for the Brown Booby *Sula leucogaster* and 33.9 years (New Zealand) for the Flesh-footed Shearwater *Ardenna carneipes*, alongside existing longevity data. While these new records represent the oldest known birds to date, we suggest that they reflect typical adult lifespans of these species, i.e., 25–30 years, and reinforce the need for ongoing monitoring efforts.

**Key words:** *Ardenna carneipes*, banding, capture-mark-recapture, lifespan, seabirds, *Sula leucogaster*

## INTRODUCTION

Seabirds are regarded as reliable indicators of the condition of the marine environment (Furness & Camphuysen 1997). Understanding their demography by examining life-history traits such as fecundity, survival, and longevity are therefore crucial (Beadell *et al.* 2003). Here, we review existing longevity records for the Brown Booby *Sula leucogaster* and Flesh-footed Shearwater *Ardenna carneipes* worldwide and report new observations from Australia and New Zealand.

The Brown Booby's global population is estimated at 221 000–275 400 breeding pairs (conservation status: Least Concern; Schreiber & Norton 2020), with various breeding sites worldwide, including the Caribbean, the Gulf of Mexico, northern Australia, and the central and western Pacific (Birdlife International 2021). Adult survival is reportedly high (90% ± 1% (standard error)) and invariant, regardless of extreme weather related to El Niño (Beadell *et al.* 2003). However, studies suggest that populations have declined dramatically in some areas, e.g., the Indian Ocean and Southeast Asia, due to human-induced threats (Feare 1978, de Jong 2011). While average longevity has been projected to be 30 years (Simmons 1967) and possibly up to 50 years (Schreiber & Norton 2020), data are sparse, with the oldest known bird (prior to this study) being at least 26 years old (BBL 2020).

The Flesh-footed Shearwater breeds only within the Australasian region (Priddel *et al.* 2006), with a current global estimate of ~75 000 breeding pairs (Waugh *et al.* 2013, Lavers 2015). Average annual adult survival appears to vary significantly by region, from 63%–84% in Western Australia (Lavers *et al.* 2019b) to 76%–94% in northern New Zealand (Barbraud *et al.* 2014). Many populations are decreasing (Lavers 2015, Lavers *et al.* 2019a) as a result of pressures on land (e.g., invasive species) and at sea (e.g., fisheries by-catch; Reid *et al.* 2013). Consequently, the species was up-listed on the IUCN Red List in 2017, from Least Concern to Near Threatened (Birdlife International 2021). To date, there is minimal information on the longevity of this species (Marchant & Higgins 1990, Taylor 2013).

## METHODS AND RESULTS

On 16 August 2020, an adult female Brown Booby was re-sighted and photographed when it landed on a ship sailing from Saumarez Reef towards Hixson Cay, Coral Sea, Queensland (geographic coordinates: −21.636944, 153.759167). A metal band from the Australian Bird and Bat Banding Scheme (ABBBS) labelled with the number 121-32028 was on its right leg; it had been applied to an adult bird 30 years, 7 months, and 5 days prior at Frigate Cay, Swains Reef, Queensland (−21.741667, 152.416667) on 11 January 1990. The bird was located 138 km from where it had been banded. We report this observation alongside previous longevity records for this species (see 10 oldest birds in Table 1), which were obtained mainly from two sources: the Bird Banding Laboratory (BBL) and the ABBBS. The ages reported in Table 1 are based on BBL guidelines (see Appendix 1, available on the website; BBL 2020). Using our record as an example, which was banded as "After Second Year", the latest hatch month is assumed to be June, resulting in an estimated hatching date of June 1988 and a minimum age of 32.2 years.

On 25 October 2014, an adult Flesh-footed Shearwater of unknown sex was observed within the Ned's Beach colony on Lord Howe Island, New South Wales (−31.540833, 159.075833) during annual monitoring of the species. As the bird was missing its right eye, it was recaptured by hand to check for other injuries (none present). A metal band from the ABBBS labelled with the number 161-91086 was on its right leg; it had been applied to an adult bird 26 years, 7 months, and 18 days prior at the Ned's Beach colony (−31.518056, 159.068056) on 07 March 1988. The bird was found within 2 km

from where it had been banded. This observation is presented with additional longevity records for the species (Table 2), of which half were from the ABBBS and the rest were from an ongoing study in New Zealand (G. Taylor & P. Crowe pers. comm.). For birds banded as adults, the ages reported in Table 2 are the elapsed time between banding and recovery, plus four years (i.e., the minimum age of first breeding; JLL unpubl. data), giving our Flesh-footed Shearwater record the minimum age of 30.6 years.

## DISCUSSION

Our Brown Booby age record (32.2 years) represents the oldest known living individual for the species and the only record over 30 years (Table 1). However, it is comparable to the previous expected longevity of the species, i.e., 25–30 years (Simmons 1967, Hennicke *et al.* 2012), and to the average lifespans reported for other sulids, such as the Masked Booby *Sula dactylatra* (25 years; BBL 2020), Abbott's Booby *Papasula abbotti* (30–35 years; Hennicke *et al.* 2012), and gannets (*Morus* spp., 25–33 years; Carey & Judge 2000). The 10 oldest birds (Table 1) are all female except one (and excluding three unknown sexes). Despite the small sample size, this is perhaps indicative of the relationship between body mass and longevity in birds (i.e., larger birds live longer; Lindstedt & Calder 1976), given the reverse sexual size dimorphism in Brown Boobies (i.e., females tend to be larger than males; Simmons 1967).

For the Flesh-footed Shearwater, the oldest known age according to the ABBBS database is 34.2 years (Table 2). However, this bird was recovered as a dried skeleton, so the precise time of death and its living age are unknown. Considering this, our record (30.6 years) is the oldest known living bird in Australia, although the New Zealand record is the oldest globally (33.9 years; G. Taylor pers. comm.). Combined with the remaining longevity records, we suggest the average lifespan of this species is at least 25–30 years. As sex determination for this species is difficult (Thalmann *et al.* 2007) and typically not recorded, the sex of each bird was not included in Table 2.

Records of birds over 30 years old for both species are rare. However, Schreiber & Norton (2020) suggest Brown Boobies may live up to 50 years, whereas shearwaters surpassing 30 years have been documented (40–50 years; Wasser & Sherman 2010, Fransson *et al.* 2017). There is thus a need to discern whether birds over the age of 30 years is an exception for these two species. While it is certainly plausible to continue depending on singular chance observations to resolve such uncertainties, consistent long-term monitoring is the more reliable alternative. That said, the lack of empirical data could very well be a by-product of intermittent banding and monitoring efforts. In Australia, for instance, banding of Brown Boobies commenced in 1960, peaked in the 1980s, and has significantly declined since; recovery records mirror banding trends (ABBBS 2020). As for the Flesh-footed Shearwater, intermittent banding has been conducted for over 30 years. An annual banding regime was initiated in Australia in 2011 (JLL pers. obs.), although one ongoing program does not make up for a collective lack of monitoring effort and data (for both species). It is also common for large-scale banding programs to be in operation for a period that is shorter than one lifespan of the birds investigated, particularly larger species (Lindstedt & Calder 1976).

**TABLE 1**
**Longevity records for the Brown Booby *Sula leucogaster* (10 oldest birds)**

| Banding region/location | Age at banding | Banding date | Encounter date | Sex | Status at encounter | Minimum age at encounter (years)[a] | Source[b] |
|---|---|---|---|---|---|---|---|
| Swains Reef, Queensland, Australia | After Second Year | Jan 1990 | Aug 2020 | F | Alive | 32.2 | This study |
| Fairfax Island, Queensland, Australia | Nestling | Mar 1967 | Aug 1995 | Unk | Alive | 28.4 | ABBBS |
| Oceania (including Hawaii & Philippines) | After Hatching Year | Oct 1964 | Jun–Sep 1989 | M | Alive | 26.0 | BBL |
| Raine Island, Queensland, Australia | Nestling | Dec 1984 | Dec 2009 | Unk | Alive | 25.5 | Hennicke *et al*. 2012 |
| Raine Island, Queensland, Australia | Hatching Year | Dec 1986 | Nov 2010 | F | Alive | 24.4 | Hennicke *et al*. 2012 |
| Oceania (including Hawaii & Philippines) | After Hatching Year | Jun 1963 | Jun 1986 | F | Alive | 24.0 | BBL |
| Oceania (including Hawaii & Philippines) | After Third Year | Jun 1973 | 1994[c] | F | Alive | 24.0 | BBL |
| Oceania (including Hawaii & Philippines) | After Hatching Year | Feb 1964 | Jan 1987 | F | Dead | 23.6 | BBL |
| Oceania (including Hawaii & Philippines) | Nestling | Jul 1966 | Sep 1989 | F | Dead | 23.2 | BBL |
| Raine Island, Queensland, Australia | After Hatching Year | Dec 1981 | 2003[c] | Unk | Alive | 23.0 | ABBBS |

[a] Based on the Bird Banding Laboratory guidelines (see Appendix 1)
[b] ABBBS = Australian Bird and Bat Banding Service (ABBBS 2020), BBL = Bird Banding Laboratory (BBL 2020)
[c] Month unknown

**TABLE 2**
**Longevity records for the Flesh-footed Shearwater *Ardenna carneipes* (all existing data)**

| Banding region/location | Age at banding | Banding date | Encounter date | Status at encounter | Minimum age at encounter (years)[a] | Source[b] |
|---|---|---|---|---|---|---|
| Lord Howe Island, New South Wales, Australia | Adult | Feb 1963 | Apr 1993 | Dead[c] | 34.2 | ABBBS |
| Bethells Beach, New Zealand | Adult | Dec 1989 | Nov 2019 | Alive | 33.9 | G. Taylor pers. comm. |
| Lord Howe Island, New South Wales, Australia | Adult | Mar 1988 | Oct 2014 | Alive | 30.6 | This study |
| Motumahanga, Sugarloaf Islands, New Zealand | Adult | 1997[d] | Jan 2019 | Alive | 25.2 | P. Crowe pers. comm. |
| Lord Howe Island, New South Wales, Australia | Adult | Nov 1962 | Nov 1983 | Dead | 24.9 | ABBBS |
| Motumahanga, Sugarloaf Islands, New Zealand | Adult | Nov 1998 | Jan 2019 | Alive | 24.2 | G. Taylor pers. comm. |
| Lady Alice Island, New Zealand | Adult | Mar, Oct, Dec 2000 | Jan 2020 | Alive | 23.5 ($n$ = 24) | P. Crowe pers. comm. |
| Woody Island, Western Australia, Australia | Adult | Oct 1982 | Mar 2000 | Alive | 21.3 | ABBBS |
| Lord Howe Island, New South Wales, Australia | Adult | Mar 1988 | Apr 2005 | Alive | 21.1 | ABBBS |

[a] Elapsed time between banding and recovery, plus four years (see Methods)
[b] ABBBS = Australian Bird and Bat Banding Service (ABBBS 2020)
[c] Recovered as a skeleton (see Discussion)
[d] Month unknown

At present, there are various disincentives to long-term research. The current measure of scientific success (i.e., publication output and impact, which are often the top assessment criteria for job and funding acquisitions) hampers the generation of long-term datasets, since the execution and publication of relatively direct and short-lived studies are perceived as the quicker route to success (Hood & Sutherland 2020). Additionally, funding bodies are putting increasing priority on research they consider to be economically useful with a quick return (Birkhead 2014). In order to achieve real progress in the field of ecology and evolution, many fundamental questions will need to (and can only be) answered by examining the life histories of individuals that have been followed over their lifetimes (Mills *et al.* 2015). This further emphasizes the importance of monitoring programs with sufficiently long durations, particularly in seabird research.

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## REFERENCES

ABBBS (AUSTRALIAN BIRD AND BAT BANDING SCHEME) 2020. *ABBBS Database.* Canberra, Australia: Department of Agriculture, Water and the Environment.

BARBRAUD, C., BOOTH, A., TAYLOR, G.A. & WAUGH, S.M. 2014. Survivorship in Flesh-footed Shearwater *Puffinus carneipes* at two sites in northern New Zealand. *Marine Ornithology* 42: 91–97.

BEADELL, J.S., SCHREIBER, E.A., SCHREIBER, R.W., SCHENK, G.A. & DOHERTY, P.F., JR. 2003. Survival of Brown Boobies (*Sula leucogaster*) at Johnston Atoll: A long-term study. *The Auk* 120: 811–817.

BBL (BIRD BANDING LABORATORY) 2020. *Longevity Records of North American Birds.* Version 2019.2. Laurel, USA: Patuxent Wildlife Research Center, US Geological Survey. [Accessed online at https://www.pwrc.usgs.gov/BBL/longevity/Longevity_main.cfm.]

BIRDLIFE INTERNATIONAL 2021. *IUCN Red List for birds* (Species factsheet: *Ardenna carneipes* & *Sula leucogaster*). Cambridge, UK: BirdLife International. [Accessed online at http://www.birdlife.org/ on 15 November 2020.]

BIRKHEAD, T. 2014. Stormy outlook for long-term ecology studies. *Nature* 514: 405.

CAREY, J.R. & JUDGE, D.S. 2000. *Longevity Records: Life Spans of Mammals, Birds, Amphibians, Reptiles, and Fish.* Vol. 8 – Odense Monographs on Population Aging. Odense, Denmark: Odense University Press. [Available online at https://www.demogr.mpg.de/longevityrecords/.]

DE JONG, G.D.C. 2011. Current status of the seabird colony on Suanggi Island, Banda Sea. *Kukila* 15: 93–99.

FEARE, C.J. 1978. The decline of booby (Sulidae) populations in the western Indian Ocean. *Biological Conservation* 14: 295–305.

FRANSSON, T., JANSSON, L., KOLEHMAINEN, T., KROON, C. & WENNINGER, T. 2017. *EURING list of longevity records for European birds. Stockholm*, Sweden: Swedish Museum of Natural History, EURING.

FURNESS, R.W. & CAMPHUYSEN, C.J. 1997. Seabirds as monitors of the marine environment. *ICES Journal of Marine Science* 54: 726–737.

HENNICKE, J.C., KING, B., DRYNAN, D., HARDY, L.J., STOKES, A. & TAYLOR, S. 2012. New life-span records of the Brown Booby *Sula leucogaster. Marine Ornithology* 40: 125–126.

HOOD, A.S.C. & SUTHERLAND, W.J. 2020. The data-index: an author-level metric that values impactful data and incentivises data sharing. *bioRxiv*. doi:10.1101/2020.10.20.344226

LAVERS, J.L. 2015. Population status and threats to Flesh-footed Shearwaters (*Puffinus carneipes*) in South and Western Australia. *ICES Journal of Marine Science* 72: 316–327.

LAVERS, J.L., HUTTON, I. & BOND, A.L. 2019a. Changes in technology and imperfect detection of nest contents impedes reliable estimates of population trends in burrowing seabirds. *Global Ecology and Conservation* 17: e00579.

LAVERS, J.L., LISOVSKI, S. & BOND, A.L. 2019b. Preliminary survival and movement data for a declining population of Flesh-footed Shearwater *Ardenna carneipes* in Western Australia provides insights into marine threats. *Bird Conservation International* 29: 327–337.

LINDSTEDT, S.L. & CALDER, W.A. 1976. Body size and longevity in birds. *The Condor* 78: 91–94.

MARCHANT, S. & HIGGINS, P.J. 1990. *Handbook of Australian, New Zealand & Antarctic Birds.* Vol. 1 - Ratites to Ducks. Melbourne, Australia: Oxford University Press.

MILLS, J.A., TEPLITSKY, C., ARROYO, B. ET AL. 2015. Archiving primary data: Solutions for long-term studies. *Trends in Ecology & Evolution* 30: 581–589.

PRIDDEL, D., CARLILE, N., FULLAGAR, P., HUTTON, I. & O'NEILL, L. 2006. Decline in the distribution and abundance of Flesh-footed Shearwaters (*Puffinus carneipes*) on Lord Howe Island, Australia. *Biological Conservation* 128: 412–424.

REID, T., HINDELL, M., LAVERS, J.L. & WILCOX, C. 2013. Re-examining mortality sources and population trends in a declining seabird: using Bayesian methods to incorporate existing information and new data. *PLoS One* 8: e58230.

SCHREIBER, E.A. & NORTON, R.L. 2020. Brown Booby (*Sula leucogaster*), version 1.0. In: BILLERMAN, S.M. (Ed.) *Birds of the World*. Ithaca, USA: Cornell Lab of Ornithology.

SIMMONS, K.E.L. 1967. Ecological adaptations in the life history of the Brown Booby on Ascension Island. *Living Bird* 6: 187–212.

TAYLOR, G.A. 2013. Flesh-footed Shearwater. In: MISKELLY, C.M. (Ed.) *New Zealand Birds Online.* New Zealand: Museum of New Zealand Te Papa Tongarewa, Ornithological Society of New Zealand, New Zealand Department of Conservation. [Accessed online at http://nzbirdsonline.org.nz/species/flesh-footed-shearwater on 22 November 2020.]

THALMANN, S., BAKER, G.B., HINDELL, M., DOUBLE, M.C. & GALES, R. 2007. Using biometrie measurements to determine gender of Flesh-footed Shearwaters, and their application as a tool in long-line by-catch management and ecological field studies. *Emu - Austral Ornithology* 107: 231–238.

WASSER, D.E. & SHERMAN, P.W. 2010. Avian longevities and their interpretation under evolutionary theories of senescence. *Journal of Zoology* 280: 103–155.

WAUGH, S.M., TENNYSON, A.J.D., TAYLOR, G.A. & WILSON, K.-J. 2013. Population sizes of shearwaters (*Puffinus* spp.) breeding in New Zealand, with recommendations for monitoring. *Tuhinga* 24: 159–204.