MAXIMUM OBSERVED AGES OF GALÁPAGOS PENGUINS

GUSTAVO JIMÉNEZ-UZCÁTEGUI[1] & F. HERNÁN VARGAS[2]

[1]*Charles Darwin Research Station, Charles Darwin Foundation, Puerto Ayora, Galápagos, Ecuador (gustavo.jimenez@fcdarwin.org.ec)*
[2]*The Peregrine Fund, 5668 West Flying Hawk Lane, Boise, ID 83709, USA*

Received 15 January 2019, accepted 10 June 2019

ABSTRACT

JIMÉNEZ-UZCÁTEGUI, G. & VARGAS, F.H. 2019. Maximum observed ages of Galápagos Penguins. *Marine Ornithology* 47: 243–246.

A maximum age of at least 17.7 years was recorded for a Galápagos Penguin *Spheniscus mendiculus* on Isabela Island during studies up until 2018. This individual was first captured as an adult of at least two years of age, as indicated by its plumage. In addition, we present records of other penguins, not quite as old, that were first captured as chicks. Longevity is affected by many different factors, making it useful in the design of conservation strategies.

Key words: longevity, Galápagos Islands, penguins

INTRODUCTION

The Galápagos Penguin *Spheniscus mendiculus* (GAPE) is endemic to the Galápagos Islands (Harris 1973), breeding on Fernandina, Isabela, Floreana, and Santiago islands, and Marielas and Lougie islets (Vargas 2006). With restricted geographic distribution and a small, fluctuating population size, this species is listed as Endangered (IUCN 2018). The latest survey estimates the population at 1 900 individuals (Jiménez-Uzcátegui 2018), although the population fluctuates greatly with El Niño Southern Oscillation (ENSO) events (Vargas *et al*. 2006, 2007; Valle & Coulter 1987, Valle *et al*. 1987). The species faces several threats: introduced species such as cats *Felis catus* and rats *Rattus* spp. prey on chicks and eggs (Boersma 1977), and artisanal fishing causes mortality by entanglement (Crawford *et al.* 2017). Pollution (Jiménez-Uzcátegui *et al.* 2017), pathogens, and parasites put further pressure on its population (Merkel *et al*. 2007, Deem *et al*. 2010, Levin *et al.* 2013, Carrera *et al*. 2014).

The average life expectancy of the GAPE was estimated at 11 years (Boersma *et al.* 2013). Of the 17 species of penguins (Sphenisciformes) worldwide, the oldest recorded individual in the wild belongs to the Magellanic Penguin *Spheniscus magellanicus* species at 30 years old (Scolaro 1990), followed by the African Penguin *Spheniscus demersus* species at 27 years old (Whittington *et al.* 2000), the King Penguin *Aptenodypes patagonica* species at 26 years old (Flower 1938), and the Little Penguin *Eudyptula minor* species at 25.8 years old (Dann *et al*. 2005). For comparison, the longevity records of other Galápagos seabirds range from 40.8 years for the Waved Albatross (WAAL) *Phoebastria irrorata* to 17.2 years for the Flightless Cormorant (FLCO) *Phalacrocorax harrisi* (Jiménez-Uzcátegui *et al*. 2012, 2016).

METHODS

As part of the ecological monitoring program carried out from 2001 to 2018 by the Charles Darwin Foundation (CDF) with the Galápagos National Park Directorate (GNPD), a total of 1 822 penguins were marked with Passive Integrated Transponder (PIT) tags at the following locations: Caleta Iguana (0.97668°S, 91.44682°W), Puerto Pajas (0.75480°S, 91.37505°W), El Muñeco on Isabela Island (0.03058°N, 91.54682°W), and the Marielas Islets (0.59570°S, 91.08750°W).

Over the last eight years (2010–2018), 1 011 tagged penguins were recaptured. Data from 2015 to 2018 were used to estimate their maximum ages. Median and maximum ages were established for penguins tagged when they were chicks or adults. Median age was estimated with non-parametric statistics. The maximum age of penguins tagged as chicks was calculated as the time elapsed in years since the bird was tagged until the latest recapture. The maximum age of penguins tagged as adults was calculated as the time elapsed in years from when the bird was tagged to the time of the latest recapture, plus two years to account for the transition time from juvenile to adult plumage (Boersma 1977).

RESULTS

Median and maximum ages of penguins tagged as chicks

The oldest penguin that was tagged as a chick and recaptured was 14.2 years old (Table 1). The last recapture of this penguin was on 24 July 2018 at Caleta Iguana. This male was marked with PIT-tag 053-770-030 as a chick on 15 May 2004 by HV and was recaptured in 2010, 2012, 2013, 2015, 2016, 2017, and 2018 by GJU at the same location. The next oldest penguin was 13.11 years old (Table 1). It was last recaptured on 27 July 2018 at El Muñeco (Isabela Island) by GJU. This male was tagged by HV as a chick on 09 August 2004 with PIT-tag 053-260-894 and was recaptured in 2005 and 2018 at the same location. The maximum age of penguins tagged as chicks in 2015, 2016, and 2017 was 12 years old (Fig. 1). In 2018, 17 penguins were recaptured and 142 individuals captured for first time. The median age of these 17 birds was 2.7 years old (SE ± 1.14).

Median and maximum ages of penguins tagged as adults

The oldest GAPE was recaptured on 08 November 2016 on Caleta Iguana (Isabela Island). It was a female penguin tagged as an adult by HV on 01 April 2001, a capture-recapture interval of 15.7 years.

At the time of tagging, with PIT-tag 041-858-870, this bird had adult plumage, suggesting that the penguin was at least two years of age. Therefore, the individual was estimated to be 17.7 years of age in November 2016, the oldest age recorded for GAPE (Table 1, Fig. 2). This individual was recaptured in the same colony at Caleta Iguana in 2004, 2005 (when it was recorded breeding), 2015, and 2016 by GJU. The maximum age of penguins tagged as adults in 2015, 2017, and 2018 was 17, 13, and 12 years, respectively (Fig. 1). In 2016, a total of 68 GAPE were recaptured, and 45 were captured for first time. The median age of these 68 individuals tagged as adults was 5.4 years (SE ± 0.4; Fig. 2).

DISCUSSION

It is known that animal longevity is related to genetic, environmental, evolutionary, and physiological factors (Harvey & Purvis 1999). The three oldest penguins, listed in Table 1, were born after the last strong ENSO event of 1997–1998. Warm-ENSO events are known to cause population crashes of penguins (Vargas *et al*. 2007), which might affect their age structure. Over the past 20 years, warm-ENSO events in the Galápagos Islands have been weak, but were associated with reduced breeding success (Jiménez-Uzcátegui *et al*. 2019). Introduced species in the study area, such as cats and rats, could also affect age structure because they prey on chicks and eggs. Interestingly, the highest survival rates of penguins occur in areas where the Galápagos National Park controls these exotic predators. Penguins are subject to additional threats, but these threats have minimal effects on penguin mortality. Regardless, it is important to study and control these factors (Jiménez-Uzcátegui *et al*. 2019).

Lacking large mammalian predators, Galápagos birds are expected to live longer than their counterpart mainland species. On the other hand, GAPE and other marine birds face extreme climatic variations due to El Niño (Valle *et al*. 1987, Vargas *et al*. 2006, Jiménez-Uzcátegui *et al*. 2019), which puts them under extreme stress due to food shortages. GAPE are also not the only species that

TABLE 1
Maximum observed ages of Galápagos Penguins, Galápagos Archipelago

Identification		Tagging			Re-capture		Age (years)	
PIT-tag	Sex[a]	Date	Age[b]	Location	Date	Location	Actual	Maximum
041-858-870	F[c]	01 Apr 2001	A	Caleta Iguana	08 Nov 2016	Caleta Iguana	15.7	17.7
053-770-030	M[c]	15 May 2004	C	Caleta Iguana	24 Jul 2018	Caleta Iguana	14.2	-
053-260-894	M[d]	09 Aug 2004	C	El Muñeco	27 Jul 2018	El Muñeco	13.11	-

[a] F: Female, M: Male.
[b] A: Adult, C: Chick.
[c] Sexed by morphological measurements (Capello & Boersma 2018).
[d] Sexed by molecular techniques.

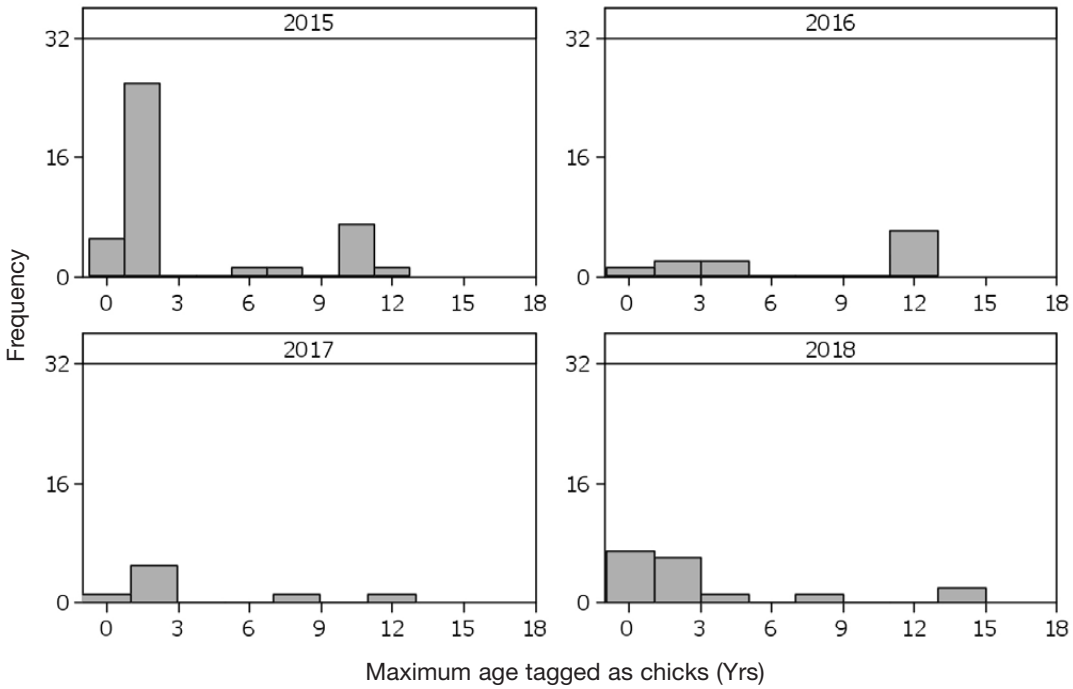

Fig. 1. Distribution of maximum ages of Galápagos Penguins that were tagged as chicks and recaptured between 2015 and 2018. The oldest penguins were recaptured in 2018.

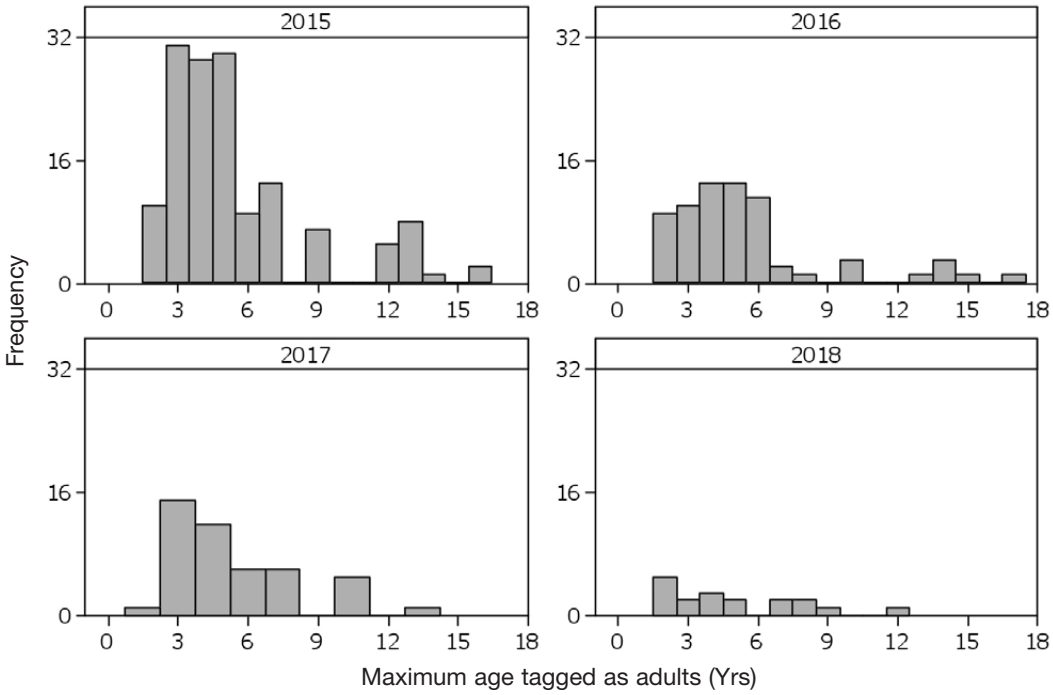

Fig. 2. Distribution of maximum observed ages of Galápagos Penguins that were tagged as adults (age at least 2 years) and recaptured between 2015 and 2018. The oldest penguin (17.7 years old) was recaptured in 2016.

deal with ENSO. Further investigation of the longevity of GAPE and other marine birds, including increased sample sizes of tagged individuals, is essential for devising conservation strategies.

ACKNOWLEDGEMENTS

We would like to thank our donors: the Galápagos Conservation Trust, the Truell Charitable Foundation, the Leona M. and Harry B. Helmsley Charitable Trust, Lindblad – National Geographic, the Penguin Fund of Japan, and the Peregrine Fund. We also thank Mr. Seishi Sakamoto for his financial support of the Galápagos Penguin, Flightless Cormorant, and Waved Albatross Project at CDF. We are grateful to our collaborators and more than 80 assistants and volunteers who helped in the research from 2009 to 2018, including Manuel Masaquisa, Franklin Gil, Wilman Valle, Carolina García, and Freddy Villalva. We thank Sarah Brooks and Dana Lind for the English revision. This paper was improved by comments from anonymous reviewers. We thank to the Galápagos National Park Directorate for grating research authorizations and permissions (PC-34-19, PC-05-18, PC-10-17, PC-51-16, PC-35-15). We thank to the Charles Darwin Research Station for the process to obtaining the authorizations and permissions. This publication is contribution number 2274 of the Charles Darwin Foundation for the Galápagos Islands.

REFERENCES

BOERSMA, P.D. 1977. An ecological and behavioral study of the Galápagos penguin. *Living Bird* 15: 43–93.

BOERSMA, P.D., STEINFURTH, A., MERLEN, G., JIMÉNEZ-UZCÁTEGUI, G., VARGAS, F.H. & P.G. PARKER. 2013. Galápagos penguin (*Spheniscus mendiculus*). In: GARCÍA BORBOROGLU, P. & BOERSMA, P.D. (Eds.) *Penguins: Natural History and Conservation*. Seattle, WA: University of Washington Press, pp. 285–302.

CRAWFORD, R., ELLENBERG, U., FRERE, E. ET AL. 2017. Tangled and drowned: A global review of penguin bycatch in fisheries. *Endangered Species Research* 34: 373–396.

CAPELLO, C.D. & BOERSMA, P.D. 2018. Sexing Galápagos penguins *Spheniscus mendiculus* by morphological measurements. *Endangered Species Research* 35: 169–173.

CARRERA-JÁTIVA, P., RODRÍGUEZ-HIDALGO, R., SEVILLA, C. & JIMÉNEZ-UZCÁTEGUI, G. 2014. Gastrointestinal parasites in the Galápagos penguin *Spheniscus mendiculus* and the flightless cormorant *Phalacrocorax harrisi* in the Galápagos Islands. *Marine Ornithology* 42: 77–80.

DANN, P.M., CARRON, M., CHAMBERS, B. ET AL. 2005. Longevity in Little penguins *Eudyptula Minor*. *Marine Ornithology* 33: 71–72.

DEEM, S.L., MERKEL, J., BALLWEBER, L., VARGAS, F.H., CRUZ, M. & PARKER, P.G. 2010. Exposure to *Toxoplasma gondii* in Galápagos Penguins (*Spheniscus mendiculus*) and Flightless Cormorants (*Phalacrocorax harrisi*) in the Galápagos Islands, Ecuador. *Journal of Wildlife Diseases* 46: 1005–1011.

FLOWER, M.S.S. 1938. The duration of life in animals - IV. Birds: special notes by orders and families, in *Proceedings of the Zoological Society of London.* London, UK: The Zoological Society of London, pp. 195–235.

HARRIS, M.P. 1973. The Galápagos Avifauna. *The Condor* 75: 265–278.

HARVEY, P.H. & PURVIS, A. 1999. Understanding the ecological and evolutionary reasons for life history variation: mammals as a case study. In: MCGLADE, J. (Ed.). *Advanced Ecological Theory: Principles and Applications.* Oxford, UK: Blackwell Science. pp. 232–248.

INTERNATIONAL UNION FOR CONSERVATION OF NATURE (IUCN) 2018. *The IUCN Red List of Threatened Species.* Version 2018.1. [Accessed online at http://www.iucnredlist.org on 08 August 2018.]

JIMÉNEZ-UZCÁTEGUI, G. 2018. *Monitoreo del Pingüino de Galápagos y Cormorán no volador 2018*. Informe técnico de avances para la Fundación Charles Darwin y Dirección Parque Nacional Galápagos. Puerto Ayora, Ecuador: Fundación Charles Darwin, Parque Nacional Galápagos.

JIMÉNEZ-UZCÁTEGUI, G., HARRIS, M.P., SEVILLA, C. & K.P. HUYVAERT. 2016. Longevity records for the Waved Albatross *Phoebastria irrorata. Marine Ornithology* 40: 133–134.

JIMÉNEZ-UZCÁTEGUI, G., VALLE, C.A. & F.H. VARGAS. 2012. Longevity records of Flightless Cormorant *Phalacrocorax harrisi. Marine Ornithology* 40: 127–128.

JIMÉNEZ-UZCÁTEGUI, G., VINUEZA, R.L., URBINA, A.S. ET AL. 2017. Lead and cadmium levels in Galapagos Penguin Spheniscus mendiculus, Flightless Cormorant *Phalacrocorax harrisi* and Waved Albatross *Phoebastria irrorata. Marine Ornithology* 45: 159–163.

JIMÉNEZ-UZCÁTEGUI, G., WIEDENFELD, D., VALLE, C.A. ET AL. 2019. Threats and vision for the conservation of Galapágos birds. *The Open Ornithology Journal* 12: 1–15.

LEVIN, I.I, ZWIERS, P., DEEM, S. ET AL. 2013. Multiple lineages of avian malaria parasites (Plasmodium) in the Galápagos Islands and evidence for arrival via migratory birds. *Conservation Biology* 27: 1366–1377.

MERKEL, J., JONES, H.I, WHITEMAN, N.K. ET AL. 2007. Microfilariae in Galápagos Penguins (*Spheniscus mendiculus*) and Flightless Cormorants (*Phalacrocorax harrisi*): Genetics, morphology and prevalence. *Journal of Parasitology* 93: 495–503.

SCOLARO, J.A. 1990. On a longevity record of the Magellanic penguin. *Journal of Field Ornithology* 61: 377–484.

VALLE, C.A. & COULTER, M.C. 1987. Present status of the Flightless Cormorant, Galápagos Penguin and Greater Flamingo populations in the Galápagos Islands, Ecuador, after the 1982–1983 El Niño. *The Condor* 89: 276–281.

VALLE, C.A., CRUZ, F., CRUZ, J.B., MERLEN, G. & COULTER, M.C. 1987. The impact of the 1982-83 El Niño-Southern Oscillation on seabirds in the Galápagos Islands, Ecuador. *Journal of the Geophysical Research* 92: 437–444.

VARGAS, F.H. 2006. *The Ecology of Small Populations of Birds in a Changing Climate*. PhD dissertation. Oxford, UK: University of Oxford.

VARGAS, F.H., HARRISON, S., REA, S. & MACDONALD, D.W. 2006. Biological effects of El Niño on the Galápagos penguin. *Biological Conservation* 127: 107–114.

VARGAS, F.H., LACY, R.C., JOHNSON, P.J. ET AL. 2007. Modelling the effects of El Niño on the persistence of small populations: The Galápagos penguin as a case study. *Biological Conservation* 137: 138–148.

WHITTINGTON, P.A., DYER, B.M. & KLAGES, N.T. 2000. Maximum longevities of African Penguins *Spheniscus demersus* based on banding records. *Marine Ornithology* 28: 81–82.