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SHORT NOTE

When one pair is enough: determining the incubation period for tākoketai | black petrels (*Procellaria parkinsoni*)

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The incubation period for black petrels | tākoketai (*Procellaria parkinsoni*) has long been accepted as c. 57 days following research by Dr Mike Imber on Te Hauturu-o-Toi | Little Barrier Island and Great Barrier Island | Aotea, Hauraki Gulf | Tīkapa Moana between 1971 and 1983 (Imber 1987, Heather & Robertson 2005, Marchant & Higgins 1990). This incubation period was determined from only a single breeding pair on Te Hauturu-o-Toi – "*the only incubation period I timed was 56.5 days*" (Imber 1987, p27) – and may not be representative of the species as a whole.

The population of black petrels on Great Barrier Island has been monitored since 1995 (Bell et al. 2023) and over this period, data have been collected on the incubation period. Egg-laying and hatching dates from 110 breeding pairs recorded between 2001 and 2017 were used to determine the incubation period for black petrels: 42 to 71 days (mean ± SEM = 56.5 ± 0.4 days) (Table 1, Figure 1).

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Table 1. Incubation period for tākoketai | black petrels (*Procellaria parkinsoni*) on Great Barrier Island | Aotea, 2001-2017.

Breeding season	Number of breeding pairs	Range (days for egg incubation)	Mean (± SEM)
2001/02	15	52-71	57.7 ± 1.2
2002/03	10	42-59	51.1 ± 1.6
2003/04	5	45-61	52.8 ± 3.1
2007/08	5	66-71	67.8 ± 1.1
2008/09	8	53-58	55.9 ± 0.7
2009/10	10	52-59	55.5 ± 0.6
2010/11	2	49-55	52.0 ± 3.0
2012/13	30	49-64	56.8 ± 0.6
2013/14	9	54-58	56.6 ± 0.5
2014/15	5	54-63	57.4 ± 1.6
2015/16	6	53-59	56.3 ± 0.9
2016/17	5	56-67	58.2 ± 2.2
Total	110	42-71	56.5 ± 0.4

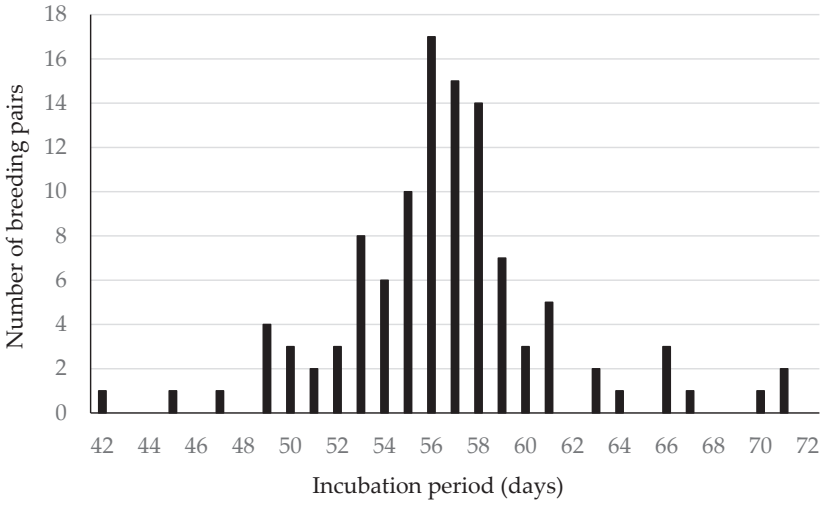

Figure 1. Incubation period for tākoketai/black petrels (*Procellaria parkinsoni*) on Great Barrier Island | Aotea, 2001-2017.

There are three incubation periods within the data set that are less than 49 days (42 days from one breeding pair in 2002/03, 45 days and 47 days from two breeding pairs in 2003/04) (Figure 1, Table 1) which is highly unusual for a large petrel such as black petrels (Warham 1990). These could be due to transcription errors in the dataset, an egg being missed during an earlier check, or a possible second egg in the chamber (i.e., one laid earlier than the other by a different female) which was missed on an earlier check. There are also three incubation periods within the dataset that are over 69 days (70 days from one breeding pair in 2001/02 and 71 days for two breeding pairs in 2007/08) (Figure 1, Table 1). However, petrels are known to leave eggs chilled for periods of time (in some cases up to ten days for black petrels) and these eggs can remain viable when cold (pers. obs., Warham 1990). If these six outlier instances are excluded, the mean incubation rate and standard error does not change (mean ± SEM = 56.5 ± 0.4 days) whereas if only the three shortest incubation periods are excluded, then the mean incubation rate (± SEM) is marginally higher at 56.9 ± 0.4 days.

The incubation period of black petrels is consistent with other *Procellaria* species (Marchant & Higgins 1990); karetai kauae mā/white-chinned petrel (*P. aequinoctialis*) ranges from 57 to 62 days (Mougin 1971, Hall 1987), tāiko | Westland petrel (*P. westlandica*) 51 to 68 days (Baker & Coleman 1977) and kuia | grey petrel (*P. cinerea)* 52 to 61 days (Barrat 1974).

Despite the data from Imber (1987) being derived from only one breeding pair, the analysis of this larger dataset confirms that the 57-day incubation period is accurate for black petrels.

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