**Supplementary Material**

Comprehensive evidence for subspecies designations in Cook’s Petrel *Pterodroma cookii* with implications for conservation management

MATT J. RAYNER, AYLA L. VAN LOENEN, LARA D. SHEPHERD, ILINA CUBRINOVSKA, R. PAUL SCOFIELD, ALAN J. D. TENNYSON, MICHAEL BUNCEand TAMMY E. STEEVES

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Table S1.Variable sites in the CO1 locus among modern, historic, and ancient samples of Cook’s Petrel. Little Barrier Island (LBI), Codfish Island (CDF), North Pacific (NP), South Pacific (SP), Buller (B), Christchurch (CHC), Featherston (F). Numbers refer to site positions relative to the 3’ end of the forward primer PCCO1F (Rayner et al. 2010a). Haplotype refers to haplotypes identified previously (H1, H2/3, and H5, Rayner et al., 2010a or AMNH 446060, AMNH 446061, AMNH 446068, Rayner et al., 2011) or those identified in this study (TES05, TP08). Variable sites were coded according to the IUPAC nucleotide base codes. Genbank Accession Numbers: MT454905 (TES02), MT454906 (TES05) and MT454907(TP08).

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| **Haplotype** | **Variable Sites** | | | | | | | | | **Sample Location** | | | | | | |
|  | **6** | **15** | **16** | **39** | **147** | **156** | **249** | **255** | **297** | **LBI** | **CDF** | **NP** | **SP** | **B** | **CHC** | **F** |
| H1/H4 | T | T | G | G | T | T | A | G | T | 38 |  | 5 |  |  |  |  |
| H2/H3 | . | . | . | A | . | . | . | . | . |  |  | 4 |  |  |  |  |
| H5 | . | . | . | . | . | C | . | . | . |  | 30 |  | 7 |  |  | 1 |
| AMNH 446060 | C | . | . | . | . | C | G | . | C |  |  |  | 1 |  |  |  |
| AMNH 446061 | . | . | . | . | C | C | . | . | . |  |  |  | 1 |  |  |  |
| AMNH 446068 | . | . | . | . | . | C | . | A | . |  |  |  | 1 |  |  |  |
| TES02 | . | . | . | . | . | C | . | . | . |  |  |  |  |  |  | 1 |
| TES05 | C | . | . | . | . | C | . | A | . |  |  |  |  |  | 1 |  |
| TP08 | A | A | C | . | . | C | . | . | . |  |  |  |  | 1 |  |  |
|  |  |  |  |  |  |  |  | Total | | 38 | 30 | 9 | 10 | 1 | 1 | 1 |

Table S2. Variable sites in the PAX locus among modern samples of Cook’s Petrel. Variable sites were coded according to the IUPAC nucleotide base codes. Numbers refer to site positions relative to the 3’ end of the forward primer PAX 20F (Kimball et al. 2009). Genbank Accession Numbers: MT454884-MT454904

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| **Haplotype** | **Variable Sites** | | | | | | | | | | | | | | | | | | | **Sample Location** | |
|  | **23** | **24** | **63** | **76** | **101** | **109** | **116** | **134** | **137** | **182** | **205** | **253** | **335** | **375** | **398** | **413** | **431** | **432** | **471** | **LBI** | **CDF** |
| PAX\_1 | C | C | A | T | A | C | A | C | T | T | G | C | T | C | G | C | T | T | T | 2 | 1 |
| PAX\_2 | G | . | . | . | T | . | G | . | . | . | A | T | . | . | A | A | . | . | . | 1 | 2 |
| PAX\_3 | . | . | . | . | . | . | G | . | . | . | . | . | . | . | . | . | . | . | . | 4 | 1 |
| PAX\_4 | G | . | . | . | . | . | G | . | . | G | . | . | . | . | . | . | . | . | G |  | 2 |
| PAX\_5 | G | . | . | . | . | . | G | . | . | . | . | . | . | . | . | . | . | . | . | 6 | 4 |
| PAX\_6 | G | . | . | . | T | . | G | . | . | . | A | T | . | . | A | A | . | . | G |  | 1 |
| PAX\_7 | G | . | . | . | . | . | G | . | C | . | . | . | . | . | . | . | . | . | . |  | 1 |
| PAX\_8 | G | . | . | . | . | . | G | . | . | . | . | . | . | . | . | . | . | G | . | 1 | 2 |
| PAX\_9 | G | . | . | . | . | . | G | . | . | . | A | T | . | . | A | . | . | . | . |  | 2 |
| PAX\_10 | G | . | . | . | T | . | G | . | . | . | A | T | . | T | A | . | . | . | . |  | 1 |
| PAX\_11 | G | . | . | . | . | . | G | . | . | . | . | T | . | . | . | . | . | . | . |  | 1 |
| PAX\_12 | G | . | . | C | . | . | G | . | . | G | . | . | . | T | . | . | . | . | . |  | 1 |
| PAX\_13 | G | T | . | . | . | . | G | . | . | G | . | . | G | . | . | . | . | . | . |  | 1 |
| PAX\_14 | . | T | . | . | . | . | G | . | . | G | . | . | . | . | . | . | . | . | . | 1 |  |
| PAX\_15 | G | . | . | . | . | . | G | . | . | . | . | . | . | . | . | . | . | . | G | 1 |  |
| PAX\_16 | G | . | . | . | . | . | G | . | . | G | . | . | . | . | . | . | . | . | . | 1 |  |
| PAX\_17 | G | . | G | . | . | . | G | . | . | . | . | . | G | . | . | . | G | . | . | 1 |  |
| PAX\_18 | . | T | . | . | . | . | G | T | . | G | . | . | . | . | . | . | . | . | . | 1 |  |
| PAX\_19 | G | . | . | . | . | . | G | . | . | . | A | T | . | . | A | A | . | . | . | 2 |  |
| PAX\_20 | G | . | . | . | . | G | G | . | . | . | . | . | . | . | . | . | . | . | . | 1 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Total | | | 22 | 20 |

Table S3.Variable sites in the *β-fibint7* locus among modern samples of Cook’s Petrel. Variable sites were coded according to the IUPAC nucleotide base codes. Numbers refer to site positions relative to the 3’ end of the forward primer FIB-B17Umodified (this study). Genbank Accession Numbers: MT454861-MT454883

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| **Haplotype** | **Variable Sites** | | | | | | | | | | | | **Sample Location** | |
|  | **35** | **39** | **131** | **148** | **258** | **293** | **374** | **401** | **427** | **437** | **444** | **465** | **LBI** | **CDF** |
| FIB\_1 | G | A | G | A | C | C | C | G | T | G | G | T | 1 | 8 |
| FIB\_2 | . | . | . | G | . | . | G | . | C | . | A | . | 11 | 3 |
| FIB\_3 | . | . | . | . | . | . | . | . | . | A | . | . |  | 2 |
| FIB\_4 | . | . | A | G | A | . | G | . | C | A | . | . | 3 | 2 |
| FIB\_5 | . | . | . | G | . | . | . | . | C | . | A | . |  | 1 |
| FIB\_6 | A | . | . | G | . | . | G | . | C | . | A | . |  | 5 |
| FIB\_7 | . | . | . | G | . | . | . | . | . | . | . | . | 1 | 1 |
| FIB\_8 | . | . | . | G | . | T | G | . | C | . | . | . | 1 |  |
| FIB\_9 | . | . | . | G | . | . | G | . | C | . | . | C | 1 |  |
| FIB\_10 | . | . | . | G | . | . | G | . | C | . | . | . | 1 |  |
| FIB\_11 | . | . | . | . | . | . | . | . | C | . | A | . | 1 |  |
| FIB\_12 | . | C | . | G | . | . | . | . | . | . | A | . | 1 |  |
| FIB\_13 | . | C | . | G | . | . | G | . | C | . | A | . | 1 |  |
| FIB\_14 | . | . | A | G | A | . | G | . | C | A | A | . | 1 |  |
| FIB\_15 | . | . | . | G | . | . | G | A | C | . | A | . | 1 |  |
|  |  |  |  |  |  |  |  |  |  | Total | | | 24 | 22 |

Table S4. Sample details for modern *Pterodroma cookii* samples unique to this study. All samples were processed at the University of Canterbury.

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| --- | --- |
| Sample | Sample location |
|
| MR69 | Codfish Is. |
| MR70 | Codfish Is. |
| MR71 | Codfish Is. |
| MR72 | Codfish Is. |
| MR75 | Codfish Is. |
| MR76 | Codfish Is. |
| MR77 | Codfish Is. |
| MR78 | Codfish Is. |
| MR79 | Codfish Is. |
| MR123 | Codfish Is. |
| MR124 | Codfish Is. |
| MR132 | Little Barrier Is. |
| MR133 | Little Barrier Is. |
| MR141 | Little Barrier Is. |
| MR142 | Little Barrier Is. |
| MR143 | Little Barrier Is. |
| MR144 | Little Barrier Is. |
| MR145 | Little Barrier Is. |
| MR146 | Little Barrier Is. |
| MR147 | Little Barrier Is. |
| MR148 | Little Barrier Is. |
| MR149 | Little Barrier Is. |
| MR150 | Little Barrier Is. |

Table S5. Sample details of historic and ancient *Pterodroma cookii* samples. Museum abbreviations: CM - Canterbury Museum, NMNZ - Museum of New Zealand Te Papa Tongarewa, NHM – Natural History Museum, London. NI = North Island, SI = South Island. Samples were processed at UC = University of Canterbury, MU = Murdoch University or NMNZ. 1Holotype specimen of *P. cookii* (Gray, 1843). 1Bird of unknown provenance.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sample | Museum Registration Number | Processing Lab | Sample location | Sample type | Approximate age [reference] | SNP |
|
| TES02 | CM AV15888 | MU/UC | Pigeon Bush #1 Cave, Featherston, South Wairarapa, NI | Bone | Late Pleistocene to Holocene pre-human [1, 5] | C |
| TES03 | CM AV15888G | UC | Pigeon Bush #1 Cave, Featherston, South Wairarapa, NI | Bone | Late Pleistocene to Holocene pre-human [1, 5] | C |
| TES04 | CM AV27186 | UC | Porthole Cave, Mahoenui, NI | Bone | Holocene pre-human [1] | C |
| TES051 | CM AV458 | MU/UC | Fendalton School, Christchurch, SI | Toepad | European-era (1932) | C |
| TES06 | NHM 1842.9.28.14 | MU | Mangaoraka Stream, Taranaki, NI | Toepad | European-era (c.1839) | T |
| TES07 | CM AV23576 | UC | Cairn's Tomo, Buller, SI | Bone | Holocene pre-human [2] | C |
| TES08 | CM AV15888J | UC | Pigeon Bush #1 Cave, Featherston, South Wairarapa, NI | Bone | Late Pleistocene to Holocene pre-human [1, 5] | T |
| TES09 | CM AV15888I | UC | Pigeon Bush #1 Cave, Featherston, South Wairarapa, NI | Bone | Late Pleistocene to Holocene pre-human [1, 5] | C |
| TES10 | CM AV18325 | MU/UC | Bushface Caves #3 Cave, Patoka, Hawke's Bay, NI | Bone | Late Pleistocene to Holocene pre-human [1, 5] | C |
| TES11 | CM AV23576 | UC | Cairn's Tomo, Punakaiki, Buller, West Coast | Bone | Late Pleistocene to Holocene pre-human [3] | C |
| TES12 | CM AV18581 | UC | Te Waka Caves #1 Cave, Te Waka, Hawke's Bay, NI | Bone | Late Pleistocene to Holocene pre-human [4] | C |
| TES13 | CM AV18325 | UC | Bushface Caves #3 Cave, Patoka, Hawke's Bay, NI | Bone | Late Pleistocene to Holocene pre-human [1, 5] | C |
| TES14 | CM AV18325 | UC | Bushface Caves #3 Cave, Patoka, Hawke's Bay, NI | Bone | Late Pleistocene to Holocene pre-human [1, 5] | C |
| TES15 | CM AV25927 | UC | Makuri Cemetery, Tararua, NI | Bone | Holocene pre-human [1] | T |
| TES17 | CM AV18801 | UC | Lost World limestone cave, Waitomo, NI | Bone | Holocene pre-human [8] | T |
| TES18 | CM AV28209 | UC | Limestone Pothole, Waipuna, Rangitikei, NI | Bone | Holocene pre-human [1] | C |
| TES19 | CM AV27183 | UC | Porthole Cave, Mahoenui, NI | Bone | Holocene pre-human [1] | T |
| TES21 | CM AV25023 | UC | Bluegum Cave, Waitomo, NI | Bone | Holocene pre-human [1] | C |
| TP01 | NMNZ S.001063 | NMNZ | Swiss Cheese Cave, Waitomo, NI | Bone | Late Pleistocene to Holocene pre-human [7] | T |
| TP04 | NMNZ S.024468 | NMNZ | Coonoor Cave, Wairarapa, NI | Bone | Holocene pre-human [5] | C |
| TP05 | NMNZ S.35757 | NMNZ | Bushface Caves #1 Cave, Patoka, Hawke's Bay, NI | Bone | Late Pleistocene to Holocene pre-human [1, 5] | C |
| TP07 | NMNZ S.38200 | NMNZ | Megamania Cave, Gunner River, Tasman, SI | Bone | Late Pleistocene to Holocene pre-human [6] | C |
| TP08 | NMNZ S.23616 | NMNZ | Kids Cave (Four Mile River), Buller, SI | Bone | Late Pleistocene [3] | C |

Millener, P. R. (1981). The Quaternary avifauna of New Zealand. Unpublished PhD thesis, University of Auckland, New Zealand.

Worthy, T. H. and Holdaway, R. N. (2012a) Quaternary fossil faunas from caves in the Punakaiki area, west coast, South Island, New Zealand. *J. Roy. Soc. New Zealand* 23: 147-254.

Worthy T. H. and Zhao, J. X. (2003) A late Pleistocene predator accumulated avifauna from Kids Cave, West Coast, South Island, New Zealand. *Alcheringa: An Australasian J. Palaeontol*. 30: 389-408.

Worthy, T. H., Holdaway, R. N., Alloway, B. V., Jone, J., Winn, J. and Turner, D. (2002) A rich Pleistocene-Holocene avifaunal sequence from Te Waka #1: terrestrial fossil vertebrate faunas from inland Hawke's Bay, North Island, New Zealand. *Tuhinga* 13: 1-38.

Worthy, T. H. (2005) *Fossil deposits in Megamania Cave, Gunner River, South Island, New Zealand*. Wellington: Department of Conservation.

Beauchamp, A. J. and Worthy, T. H. (2010) Decline in distribution of the takahe *Porphyrio* (= *Notornis*) *mantelli*: a re-examination. J. Roy. Soc. New Zealand 18: 103-118.

Worthy, T. H. (2010b) Osteological observations on the larger species of the skink *Cyclodina* and the subfossil occurrence of these and the gecko *Hoplodactylus duvaucelii* in the North Island, New Zealand. *New Zealand J. Zool.* 14: 219-22