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A tale of two taonga: mutualistic research and management of heritage landscapes on Codfish Island (Whenua Hou), Aotearoa New Zealand

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ABSTRACT

Biological and cultural heritage features regularly coexist and overlap within landscapes, creating complex management challenges. Codfish Island (Whenua Hou), Aotearoa New Zealand, exemplifies such a landscape, containing cultural and biological taonga (treasures) of national and international importance. Here, the last breeding colony of the critically endangered Whenua Hou Diving Petrel (*Pelecanoides whenuahouensis*) exists within archaeological sites preserving a rich Māori history and the earliest documented European settlement in southern Aotearoa New Zealand. The proximity of the breeding habitat of an endangered species to significant cultural heritage previously led to competing stakeholder interests which limited research and effective management. We present a mutualistic approach to landscape management on Codfish Island, which has resulted in positive outcomes for archaeological research, cultural heritage management, biological research, and conservation management. Collaborations like this are applicable in other heritage rich landscapes. Our mutualistic approach also forms a foundation for future joint monitoring schemes and research, facilitating transparent and informed management of both tangible and intangible components of the landscape.

KEYWORDS

Archaeology; Codfish Island; conservation biology; heritage; taonga; *Pelecanoides whenuahouensis*

He pakiwaitara mō ngā taonga e rua: he rangahau, he whakahaerenga ngākau kotahi o ngā whenua tuku iho ki Whenua Hou, Aotearoa

Tuhinga whakarāpopoto

Rite tonu te nohotahi, te inakinaki o ngā āhua koiora tuku iho, me ngā āhua ahurea tuku iho ki ētahi whenua, e uaua rawa ai ngā wero o te whakahaere i aua whenua. Ka whakatauirahia e Whenua Hou, ki Aotearoa taua momo āhua i ngā taonga ahurea, me ngā taonga koiora e whai mana ana ā-motu, ā-ao o hoki. Ko te pūrei whakamutunga o tēnei momo kūaka, te Kūaka Whenua Hou (Whenua Hou Diving Petrel, *Pelecanoides whenuahouensis*) e korehāhā haere ana kei Whenua Hou, kei ngā wāhi huakanga e rokiroki ana i ngā kōrero rangatira o mua o te Māori me te nōhanga Pākehā tuatahi ki Aotearoa ki te tonga kua tuhia e ngā tumu kōrero. Nā te pātata o te whaitua oranga o tēnei momo

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manu e korehāhā haere ana ki tētahi wāhi tapu, tētahi wāhi taonga e pērā ana te tapu, i te tukituki ngā whaipānga, mea rawa ake, kua kore e taea te rangahau, te whakahaere tika i te wāhi nei kia eke ki te taumata e hiahiatia ana e aua whaipānga. Ko tā mātou, he tuku i tētahi ara ngākahu kotahi ki te whakahaere i te whenua ki Whenua Hou, he ara kua whai hua ngākaupai ki te rangahau whaipara tangata, he ara whakahaere ā-ahurea tuku iho he rangahau koiora, arā he whakahaerenga whakauka hoki. Ko ēnei ara mahi ngātahi, ngākau kotahi ki te rangahau, ki te whakahaere kaupapa hoki ka whai hua anō ai ki ērā atu horanuku haumako kua tukuna ihotia. Ko tā mātou aronga ngākau kotahi ka whakatakoto tūāpapa mō ētahi kaupapa ngātahi e pēnei tonu anō ana te āhua aroturuki, aro hoki ai ki te rangahau, ki te whakarite i te ara whakahaere e mārama ana, ā, e mātau ana i ngā āhuatanga tūturu, me ngā āhua waitara o te horanuku e haere ake nei.

Introduction

Cultural and biological values are often inseparably linked within landscapes (Holtorf and Ortman 2007), reflecting the mutual influences and legacies of both social and natural worlds (Lowenthal 2005). Overlapping components important to disparate research disciplines (e.g. culturally significant locations and aggregations of species), are present in most, if not all, landscapes (Szabó 2010). However, management of biological and cultural heritage is often compartmentalised. Throughout the twentieth century, the focus on landscapes as ecosystems prioritised biological heritage as a framework in which cultural heritage functioned (Olwig 2005). While academic critiques of this paradigm are now well established in the literature (e.g. Harrison 2015), mutualistic management of the multiple components of landscapes has often remained elusive (Larsen and Wijesuriya 2015).

The factors which threaten both biological and cultural heritage components within landscapes are comparable and often perceived and described within the same paradigm. Human encroachment is pervasive, and increasing worldwide (Holtorf and Ortman 2007; Ceballos et al. 2015; Ceballos, Ehrlich, and Dirso 2017). Anthropogenic overexploitation, habitat degradation, and climate change have not only driven species to extinction, but degraded or destroyed the physical fabric (archaeological record) of cultural heritage (Caughley 1994; Holtorf and Ortman 2007; Brook, Sodhi, and Bradshaw 2008; McCoy 2018). The ever-increasing impact of anthropogenic activities has led to a large number of conservation and heritage management initiatives (Hoffman et al. 2010; Henderson and Lingle 2018).

While the severity and ubiquity of these threats make the preservation and management of both cultural and biological heritage highly desirable, overlapping components within the landscape have the potential to create stakeholder conflicts. Such conflicts may arise when cross-disciplinary communication is poor or perceptions of differences between biological and cultural research and management practices exist (e.g. generality vs. particularity, quantitative vs. qualitative research methods, targeted vs. broad publishing strategies, variances in scale, and the lack of a common vocabulary; Szabó 2010; Szabó and Hédl 2011). While research collaborations between disciplines have become more

frequent, most are focused primarily on beneficial outcomes for one discipline. For example, archaeological data frequently contribute to the reconstruction of historical species distributions (Cann, de Deckker, and Murray-Wallace 1991; Boessenkool et al. 2008; Rick and Lockwood 2012; Cole et al. 2018; Seersholm et al. 2018). Equally, biological analyses of aspects of archaeological records inform cultural chronologies (Jacomb et al. 2014), seasonal resource strategies (Bird et al. 2008; Denham 2008; Higham and Horn 2000), and models of prehistoric diet or population mobility (Denham 2008; Kinaston et al. 2013). However, mutualistic collaborations, resulting in beneficial outcomes for all disciplines involved, are less common. Here, we describe the resolution of a conflict between cultural and biological disciplines by applying a mutualistic approach that fused archaeology and conservation biology on Codfish Island (Whenua Hou), Aotearoa New Zealand, and consequently informed research and management of the island's landscape.

Study site

Codfish Island (Whenua Hou; pronounced 'fɛnua 'hou; meaning 'new land'), Aotearoa New Zealand, is the largest (13.92 km^2) of the islands around Stewart Island (Rakiura; Figure 1). Codfish Island is bounded by rocky cliffs and boulder beaches with one large (~1 km) sandy bay: the north-west-facing Sealers Bay (Waikoropūpū). Favourable conditions for human habitation in Sealers Bay are reflected in the distribution of archaeological sites (Tucker and Fischer 2018), which include evidence for intermittent pre-contact Māori occupation, and a short-lived post-contact Māori-Pākeha (Māori-European) settlement (Smith and Anderson 2009). The island was included in the 1864 Rakiura land purchase negotiated between the Crown and Ngāi Tahu and Ngāti Mamoe (tangata whenua; people of the land). In 1915, the Codfish Island Scenic

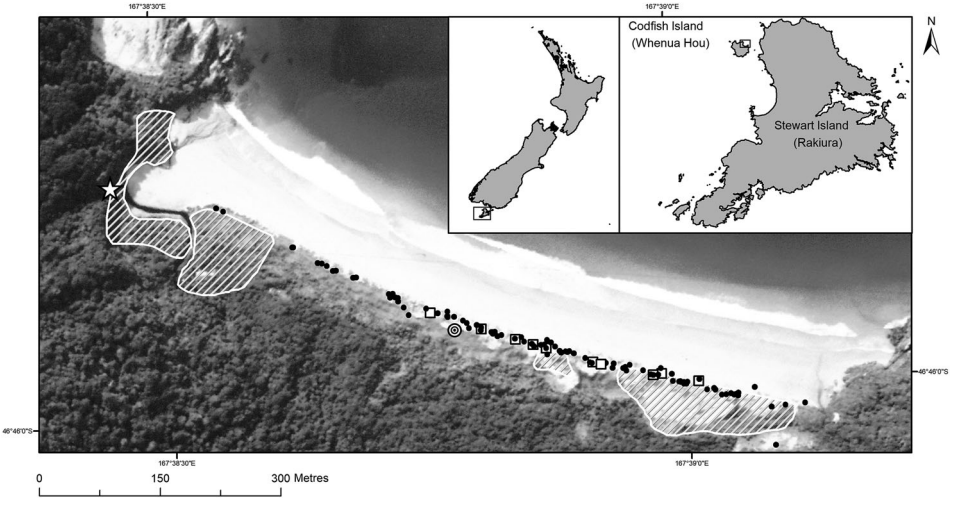

Figure 1. Archaeological sites (white-hashed areas; from left to right: D48/5, D48/31, D48/30, D48/21), including the site of the 2019 excavation (with star), in relation to Whenua Hou Diving Petrel burrows (black circles), nest boxes (white squares), and an acoustic attraction system (white target).

Reserve was created (Howard 1940). During the 1960s, public access was restricted by permit and in 1987, the island was designated a Nature Reserve by the New Zealand Department of Conservation (Middleton 2007). Limited human disturbance, combined with a strong contemporary focus on biological conservation, has resulted in an exceptional species composition for twenty-first century Aotearoa New Zealand and the island hosts multiple endangered and critically endangered species (BirdLife International 2020).

Cultural treasures

Codfish Island is a cultural and archaeological repository of immense value. Tangata whenua refer to the island as a tūrangawaewae (place to stand), a taonga (treasure), and a kōhanga (nest) (Peat 2019). The earliest Māori occupation of the island has been dated between ~1200 and ~1400 AD (Smith and Anderson 2009). The island is traditionally significant for its role as a waypoint on the seasonal round of the titī (Sooty Shearwater; *Puffinus griseus*) harvest. While not one of the key Titī Islands (which lie further south), it was important for its geographical position and frequently used as a stopover (Middleton 2007). Periodic occupation by Pākeha sealing crews can be confirmed from 1808–1809 and shortly after this the island was nominated by a Ngāi Tahu chief as a place where Pākeha sealers could settle with their Māori wives. This action resulted in the first permanent bicultural settlement in Southern Aotearoa New Zealand, centred in Sealers Bay (Howard 1940; Middleton 2007). However, seal rookeries quickly declined, while other industries grew, encouraging the community to disperse. The Codfish Island settlement was abandoned around 1846 (Howard 1940; Middleton 2007) and the island remains uninhabited.

Albeit comparatively short, the rich history of Codfish Island has left considerable traces in the archaeological record. The New Zealand Archaeological Association Site Recording Scheme identifies nine archaeological sites on Codfish Island, four of which are in Sealers Bay (Smith and Anderson 2009; Tucker and Fischer 2018; Figure 1). These sites include the historical Sealers Bay settlement, which overlies the earliest evidence of Indigenous activity (D48/5), middens (i.e. habitation detritus and ovens; D48/30 and D48/31), and at least one urupā (Māori burial ground; D48/21) (Figure 1). Much of the archaeological material from both pre and post contact periods can be defined as taonga tūturu following the *Protected Objects Act 1975,* (2018 reprint, New Zealand Government 2018).

Biological treasures

Codfish Island hosts a remarkable community of globally threatened species, many of which have been formally recognised as taonga species in the *Ngāi Tahu Claims Settlement Act 1998* (BirdLife International 2020). Most prominently, the island holds the world's largest translocated population of the critically endangered Kākāpo (*Strigops habroptilus*) and a highly sophisticated management programme is in place to ensure the continued survival of this species (e.g. Elliott, Merton, and Jansen 2001; Sutherland 2002). The island also hosts a translocated 'backup' population of the endangered Campbell Island Teal (*Anas nesiotis*) (McClelland and Gummer 2006). The seabird community

on the island is of global importance and includes significant breeding colonies of endangered Yellow-eyed Penguins (*Megadyptes antipodes*), vulnerable Cook's Petrels (*Pterodroma cookii*), and near-threatened Mottled Petrels (*Pterodroma inexpectata*) (Taylor 2000a, 2000b; Rayner, Parker, and Imber 2008). All these taonga species have benefited considerably from a range of conservation management programmes, which included the eradication of all invasive predators (Taylor 2000a, 2000b; McClelland 2002; Middleton 2007; Rayner, Parker, and Imber 2008; Fischer et al. 2020).

One threatened taonga species is entirely restricted to Sealers Bay on Codfish Island: The critically endangered Whenua Hou Diving Petrel (*Pelecanoides whenuahouensis*, WHDP hereafter; Fischer et al. 2018a, 2020). Under the pressure of invasive predators, the WHDP has suffered multiple local extinctions throughout its historical distribution which included the southern South Island and the Subantarctic islands (Taylor 2000b; Holdaway, Jones, and Athfield 2003; Wood and Briden 2008; Wood 2016; Fischer et al. 2017a; Tennyson 2020). The WHDP breeding range is now restricted to Sealers Bay (<2 ha) where the breeding colony numbers only 194–208 adults (Figure 1; Fischer et al. 2018b; Fischer et al. 2020). Despite invasive predator eradications, the WHDP population on Codfish Island has exhibited a limited population recovery. The WHDP appears under pressure from storm-induced erosion of its breeding habitat and interspecific competition for burrows with Common Diving Petrels (*Pelecanoides urinatrix*; Fischer et al. 2017b, 2018b, 2020). Climate change will further exacerbate the dire status of the WHDP, as 30–50 per cent of the sandy coastlines in Aotearoa New Zealand and Australia are predicted to retreat >100 m by 2100 (Vousdoukas et al. 2020). Despite its presence on an island with well-resourced conservation management programmes, and its high threat status, many aspects of the WHDP's biology (e.g. offshore distribution, feeding ecology, and vital rates) remain virtually unknown, impeding future management strategies.

Conflict and cooperation

The remote location of Codfish Island, access restrictions associated with its status as a Nature Reserve on Public Conservation Land, and overlapping cultural and biological attributes, increased the potential for conflict between stakeholders focusing on individual landscape components. 'Heritage' is listed alongside 'species' and 'places' as one of three management foci for Public Conservation Land in Aotearoa New Zealand (Department of Conservation 2020), but 'heritage' has received less attention on Codfish Island. Following the *Ngāi Tahu Claims Settlement Act 1998*, the Whenua Hou Komiti was formed to strengthen descendant connections with the island and give tangata whenua a voice in management. The first formal archaeological survey and excavation was undertaken in 2007 as part of a wider cultural research programme (Smith and Anderson 2009). However, data restrictions, ongoing analyses, and grey literature reporting impaired the dissemination of information, and hindered the development of effective management. Despite historical and archaeological research (Middleton 2007; Smith and Anderson 2009), several ngā uri (descendants) visits, the installation of pouwhenua (traditional markers signifying the connection of tangata whenua to the land), and the publication of a book dedicated to the human connection with the island (Peat 2019), access to Codfish Island remained limited, almost exclusively, to biological scientists

(e.g. Sutherland 2002; Rayner, Parker, and Imber 2008; Fischer et al. 2018b, 2020). Consequently, newly identified archaeological sites were subject to erosion, dune movement, and vegetation encroachment, without regular monitoring and research (Tucker and Fischer 2018).

Conversely, the production of a conservation plan solely dedicated to cultural heritage and landscape components (Egerton 2016) inadvertently reinforced compartmental management. The tapu (sacred) nature of human remains within Māori culture and the presence of an urūpa has had ramifications for personnel movement within Sealers Bay. The lack of information on the biology of the WHDP can, at least in part, be ascribed to physical access restrictions caused by the presence of areas of high cultural value within the WHDP breeding colony (Figure 1; Taylor 2013). Even with island management focussed primarily on biological conservation, outdated cultural records, limited reporting, and access restrictions applied to sensitive cultural heritage have caused additional constraints to the management of this particular taonga species. In summary, heritage on Codfish Island has been largely perceived within a nature-culture dichotomy, with each type of heritage managed as a distinct, isolated unit rather than an integrated whole. In the absence of a mutualistic approach to research and management, compartmentalism results in competition for limited resources, inhibiting the objectives of all stakeholders (Harrison 2015; Larsen and Wijesuriya 2015).

Nonetheless, the potential for mutualistic research and heritage management on Codfish Island is high when the shared interests of stakeholders are identified. Statutory acknowledgement of tangata whenua connection with the island and the management framework mandated by the *Ngāi Tahu Claims Settlement Act 1998* have enabled the Whenua Hou Komiti to facilitate collaborative 'bridges' and promote a broader approach to heritage values. In our case, the primary areas of interest initially connecting stakeholders could be built upon to form relationships facilitating an integrated approach to cultural and biological heritage within a holistic landscape.

Mutualistic research and heritage management

We recognised the points of conflict inherent to compartmentalised management approaches (e.g. mutually exclusive access restrictions) and focussed on cross-disciplinary communication, discussing research objectives, management requirements, shortcomings, and impacts. With the support from the Whenua Hou Komiti, cross-disciplinary communication facilitated mutualistic research and heritage management and produced a range of positive outcomes for both cultural heritage and endangered species.

Our mutualistic approach to research enabled repeated joint monitoring of the Sealers Bay dune, WHDP burrow sites, and archaeological sites between 2017 and 2019. Our monitoring has documented the impacts of erosion and dune movement within Sealers Bay on cultural and biological heritage (Tucker 2017; Fischer et al. 2018b). High-quality, long-term data are crucial to identifying threats and guiding decision-making in both disciplines (Stephenson et al. 2017; Stephenson 2018). Cultural and biological taonga coexist within the same constrained environment, are exposed to the same conditions, influenced by the same processes, and consequently, face the same threats (i.e. erosion and climate change; Tucker 2017; Fischer et al. 2018b; McCoy 2018;

Vousdoukas et al. 2020). Joint monitoring regimes that disseminate information to all stakeholders and inform future cultural and biological management plans, are fundamental to preserving both types of heritage (Holtorf and Ortman 2007; McCoy 2018).

Further, we followed Sapir and Faust (2016) in employing animals as agents and facilitators of archaeological surveys and research. Specifically, in 2018, we systematically inspected the bioturbation (back-dirt hills) at all WHDP burrow entrances to investigate whether cultural material was being redeposited from nearby sub-surface archaeological sites. This approach allowed us to examine >100 sites within the foredunes without disturbing biological or cultural taonga (Figure 1). No cultural deposits were detected. The recorded absence of archaeological deposits at these specific points will be valuable for future management of the landscape.

Our collaboration enabled biological research across three years within a culturally sensitive and little-known area. In 2017, custom-made nest boxes were installed underground within existing WHDP burrows (Figure 1; Fischer et al. 2018c). Supervision of the installation process ensured that the nest boxes did not disturb any cultural material. Subsequent maintenance of nest boxes in 2018 and 2019 was overseen in a similar manner. At least four WHDP chicks fledged from these nest boxes between 2017 and 2019. These nest boxes will prove invaluable for the future of the WHDP, as potential management strategies for the WHDP (i.e. translocations; Seddon et al. 2014) rely heavily on data obtained in this manner (Miskelly and Taylor 2004; Miskelly et al. 2009).

In late 2018, our collaboration also facilitated the first onsite management of the WHDP population by enabling the installation of an acoustics attraction system (Figure 1; Miskelly and Taylor 2004; Miskelly et al. 2009). This attraction system aimed to attract WHDPs to breeding sites within Sealers Bay that are more secure from storm damage (Fischer et al. 2018b). As with the nest boxes, the installation of the acoustic attraction system was expedited by onsite archaeological consultation to ensure cultural material was not disturbed.

Regular monitoring of archaeological sites allowed for assessments of their condition, the identification of threats to the archaeological material (Tucker 2017), and subsequent management of cultural heritage. We identified accelerated erosion as an immediate threat to the site of the historic Sealers Bay settlement and confirmed the archaeological and cultural significance of the deteriorating features (D48/5; Tucker and Fischer 2018; Tucker 2018). In consultation with the Whenua Hou Komiti this threat was managed by applying a temporary stabilisation of this particularly vulnerable site. This stabilisation ensured the preservation of the cultural material until a salvage excavation could be undertaken. In 2019, a significant excavation combined research and management (salvage) objectives and was participated in by all stakeholders. Our mutualistic approach has advanced archaeological research on Codfish Island, promoted a greater awareness of the island's human past, and stimulated continued development of heritage management protocols. Protocols guiding proactive management responses to future sea-level rise are crucial, not just on Codfish Island, but also worldwide (McCoy 2018; Vousdoukas et al. 2020).

Finally, our collaboration on Codfish Island has also created future opportunities for mutualistic landscape management further afield. As extreme weather events appear to be the major threat to WHDPs, a potential management strategy for this species could involve a translocation to a different island (Fischer et al. 2018b, 2020). Information

gathered by our joint monitoring as well as the research facilitated by the nest boxes will be crucial to implementing this management strategy (Miskelly and Taylor 2004; Miskelly et al. 2009). In the light of this potential management strategy, we extended our mutualistic research approach by conducting an investigation of potential translocation sites on Centre Island (Rarotoka; 38 km north of Codfish Island) where, similarly to Codfish Island, archaeological and biological features coexist. This investigation demonstrated the general applicability of mutualistic research and management beyond specific locations.

Conclusion

The preservation of landscapes requires mutualistic research and management (Larsen and Wijesuriya 2015). Various studies have underlined the importance of incorporating insights from multiple disciplines, in order to provide a holistic picture of landscapes through time and move beyond the compartmentalisation of heritage features (Szabó 2010; Szabó and Hédl 2011; Rick and Lockwood 2012; Harrison 2015). Our collaboration on Codfish Island provides a case study in which two disciplines (i.e. archaeology and conservation biology) have benefited from a mutualistic approach. An appreciation of all aspects within the landscape (in our case, unique archaeological remains and rare, endangered species) has been fundamental to the formation of our approach to research and management. Disclosure of objectives and requirements, negotiation of institutional processes, and data sharing facilitated mutual understanding and ultimately resulted in the informed participation of all stakeholders. Future integration of cultural and biological heritage management will ensure continued preservation of both tangible and intangible aspects of heritage within the landscape.

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References

Bird, R. B., D. W. Bird, B. F. Codding, C. H. Parker, and J. H. Jones. 2008. "The "Fire Stick Farming" Hypothesis: Australian Aboriginal Foraging Strategies, Biodiversity, and Anthropogenic Fire Mosaics." *Proceedings of the National Academy of Sciences* 105 (39): 14796–14801. doi:10.1073/pnas.0804757105.

BirdLife International. 2020. '*IUCN Red List for Birds*.' Species Factsheets. Accessed 20 May 2020. www.birdlife.org.

Boessenkool, S., J. J. Austin, T. H. Worthy, P. Scofield, A. Cooper, P. J. Seddon, and J. M. Water. 2008. "Relict or Colonizer? Extinction and Range Expansion of Penguins in Southern New Zealand." *Proceedings of the Royal Society B* 276 (1658): 815–821. doi:10.1098/rspb.2008.1246.

Brook, B. W., N. S. Sodhi, and C. J. A. Bradshaw. 2008. "Synergies among Extinction Drivers Under Global Change." *Trends in Ecology and Evolution* 23: 453–460. doi:10.1016/j.tree.2008.03.011.

Cann, J. H., P. de Deckker, and C. V. Murray-Wallace. 1991. "Coastal Aboriginal Shell Middens and Their Palaeoenvironmental Significance, Robe Range, South Australia." *Transactions of the Royal Society of South Australia* 115 (4): 161–175.

Caughley, G. 1994. "Directions in Conservation Biology." *Journal of Animal Ecology* 63: 215–244. doi:10.2307/5542.

Ceballos, G., P. R. Ehrlich, A. D. Barnosky, A. Garcia, R. M. Pringle, and T. M. Palmer. 2015. "Accelerated Modern Human-Induced Species Losses: Entering the Sixth Mass Extinction." *Science Advances* 1: e1400253. doi:10.1126/sciadv.1400253.

Ceballos, G., P. R. Ehrlich, and R. Dirso. 2017. "Biological Annihilation via the Ongoing Sixth Mass Extinction Signalled by Vertebrate Population Losses and Declines." *Proceedings of the National Academy of Sciences* 114: E6089–E6096. doi:10.1073/pnas.1704949114.

Cole, T. L., J. M. Waters, L. D. Shepherd, N. J. Rawlence, L. Joseph, and J. R. Wood. 2018. "Ancient DNA Reveals That the 'Extinct' Hunter Island Penguin (*Tasidyptes hunteri*) is not a Distinct Taxon." *Zoological Journal of the Linnean Society* 182: 459–464. doi:10.1093/zoolinnean/zlx043.

Denham, T. 2008. "Traditional Forms of Plant Exploitation in Australia and New Guinea: The Search for Common Ground." *Vegetation History and Archaeobotany* 17: 245–248. doi:10.1007/s00334-007-0105-y.

Department of Conservation. 2020. "Our work." Accessed 26 May 2020. https://www.doc.govt.nz/our-work/https://www.doc.govt.nz/our-work/. doi:10.1016/S0006-3207(00)00191-9.

Egerton, R. 2016. *Codfish Island/Whenua Hou Conservation Plan: A plan to guide the management of historic and cultural heritage values*. Unpublished report.

Elliott, G. P., D. V. Merton, and P. W. Jansen. 2001. "Intensive Management of a Critically Endangered Species: The Kakapo." *Biological Conservation* 99: 121–133.

Fischer, J. H., J. Chambon, I. Debski I, J. A. Hiscock, R. Cole, G. A. Taylor, and H. U. Wittmer. 2018c. "Buffering Artificial Nest Boxes for Procellariiformes Breeding in Exposed Habitats: Investigating Effects on Temperature and Humidity." *Notornis* 65: 35–41.

Fischer, J. H., I. Debski, C. M. Miskelly, A. J. D. Tennyson, A. Fromant, J. Tessler, J. A. Hiscock, et al. 2018a. "Analyses of Phenotypic Differentiations between South Georgian Diving Petrel (*Pelecanoides georgicus*) Populations Reveal an Undescribed and Highly-Endangered Species From New Zealand." *PLoS ONE* 13: e0197766. doi:10.1371/journal.pone.0197766.

Fischer, J. H., I. Debski, G. A. Taylor, and H. U. Wittmer. 2017b. "Assessing the Suitability of non-Invasive Methods to Monitor Interspecific Interactions and Breeding Biology of the South Georgian Diving Petrel (*Pelecanoides georgicus*)." *Notornis* 64: 13–20.

Fischer, J. H., I. Debski, G. A. Taylor, and H. U. Wittmer. 2018b. "Nest-site Selection of South Georgia Diving-Petrels on Codfish Island (Whenua Hou), New Zealand: Implications for Conservation Management." *Bird Conservation International* 28: 216–227. doi:10.1017/S0959270917000041.

Fischer, J. H., F. O. Hjorsvarsdottir, J. A. Hiscock, I. Debski, G. A. Taylor, and H. U. Wittmer. 2017a. "Confirmation of the Extinction of South Georgian Diving Petrels (*Pelecanoides georgicus*) on Enderby Island." *Notornis* 64: 48–51.

Fischer, J. H., G. A. Taylor, R. Cole, I. Debski, D. P. Armstrong, and H. U. Wittmer. 2020. "Population Growth Estimates of a Threatened Seabird Indicate Necessity for Additional Management Following Invasive Predator Eradications." *Animal Conservation* 23: 94–103. doi:10.1111/acv.12516.

Harrison, R. 2015. "Beyond "Natural" and "Cultural" Heritage: Toward an Ontological Politics of Heritage in the Age of Anthropocene." *Heritage & Society* 8 (1): 24–42. doi:10.1179/2159032X15Z.00000000036.

Henderson, J., and A. M. Lingle. 2018. "Preventive Conservation in Archaeological Sites." *The Encyclopaedia of Archaeological Sciences*, doi:10.1002/9781119188230.saseas0476.

Higham, T., and P. L. Horn. 2000. "Seasonal Dating Using Fish Otoliths: Results From Shag River Mouth Site, New Zealand." *Journal of Archaeological Science* 27: 439–448. doi:10.1006/jasc.1999.0473.

Hoffman, M., C. Hilton-Taylor, A. Angulo, M. Bohm, T. M. Brooks, S. H. M. Butchart, K. E. Carpenter, J. Chanson, B. Collen, N. A. Cox. 2010. "The Impact of Conservation on the Status of the World's Vertebrates." *Science* 330: 1503–1509. doi:10.1126/science.1194442.

Holdaway, R. N., M. D. Jones, and N. R. B. Athfield. 2003. "Establishment and Extinction of a Population of South Georgian Diving Petrel (*Pelecanoides georgicus*) at Mason Bay, Steward Island, New Zealand, During the Late Holocene." *Journal of the Royal Society of New Zealand* 33: 601–622. doi:10.1080/03014223.2003.9517748.

Holtorf, C., and O. Ortman. 2007. "Endangerment and Conservation Ethos in Natural and Cultural Heritage: The Case of Zoos and Archaeological Sites." *International Journal of Heritage Studies* 14: 74–90. doi:10.1080/13527250701712380.

Howard, B. 1940. *Rakiura: A History of Stewart Island, New Zealand*. Dunedin: AH and W Reed.

Jacomb, C., R. N. Holdaway, M. E. Allentoft, M. Bunce, C. L. Oskam, R. Walter, and E. Brooks. 2014. "High Precision Dating and Ancient DNA Profiling of moa (Aves: Dinornithiformes) Eggshell Documents a Complex Feature at Wairau Bar and Refines the Chronology of New Zealand Settlement by Polynesians." *Journal of Archaeological Science* 50: 24–30. doi:10.1016/j.jas.2014.05.023.

Kinaston, R. L., R. K. Walter, C. Jacomb, E. Brooks, N. Tayles, S. E. Halcrow, C. Stirling, et al. 2013. "The First New Zealanders: Patterns of Diet and Mobility Revealed through Isotope Analysis." *PLoS ONE* 8 (5): e64580. doi:10.1371/journal.pone.0064580.

Larsen, P. B., and G. Wijesuriya. 2015. "Nature-Culture Interlinkages in World Heritage: Bridging the Gap." *World Heritage Review* 75: 4–15.

Lowenthal, D. 2005. "Natural and Cultural Heritage." *International Journal of Heritage Studies* 2: 81–92. doi:10.1080/13527250500037088.

McClelland, P. J. 2002. "Eradication of Pacific Rats (*Rattus exulans*) from Whenua Hou Nature Reserve (Codfish Island), Putauhinu and Rarotoka Islands, New Zealand." *Turning the Tide: The Eradication of Invasive Species* 27: 173–181.

McClelland, P., and H. Gummer. 2006. "Reintroduction of the Critically Endangered Campbell Island Teal *Anas Nesiotis* to Campbell Island, New Zealand." *Conservation Evidence* 3: 61–63.

McCoy, M. D. 2018. "The Race to Document Archaeological Sites Ahead of Rising Sea Levels: Recent Applications of Geospatial Technologies in the Archaeology of Polynesia." *Sustainability* 10: 185. doi:10.3390/su10010185.

Middleton, A. 2007. *Two Hundred Years on Codfish Island (Whenuahou)*. Invercargill: Department of Conservation.

Miskelly, C. M., and G. A. Taylor. 2004. "Establishment of a Colony of Common Diving Petrels (*Pelecanoides Urinatrix*) by Chick Transfers and Acoustic Attraction." *Emu* 104: 205–211. doi:10.1071/MU03062.

Miskelly, C. M., G. A. Taylor, H. Gummer, and R. Williams. 2009. "Translocations of Eight Species of Burrow-Nesting Seabirds (Genera *Pterodroma*, *Pelecanoides*, *Pachyptila* and *Puffinus*: Family Procellaridae)." *Biological Conservation* 142: 1965–1980. doi:10.1016/j.biocon.2009.03.027.

New Zealand Government. 2018. *Protected Objects Act* 1975, reprint as at 1 October 2018. New Zealand Legislation. http://www.legislation.govt.nz/act/public/1975/0041/latest/DLM432116.html.

Olwig, K. R. 2005. "Introduction: The Nature of Cultural Heritage, an d the Culture of Natural Heritage – Northern Perspectives on a Contested Patrimony." *International Journal of Heritage Studies* 2: 3–7. doi:10.1080/13527250500036742.

Peat, N. 2019. *Whenua Hou, A New Land: The Story of Codfish Island*. Invercargill: Department of Conservation in association with the Whenua Hou Committee.

Rayner, M. J., K. A. Parker, and M. J. Imber. 2008. "Population Census of Cook's Petrel *Pterodroma Cookii* Breeding on Codfish Island (New Zealand) and the Global Conservation Status of the Species." *Bird Conservation International* 18: 211–218. doi:10.1017/S095927090800021X.

Rick, T. C., and R. Lockwood. 2012. "Integrating Paleobiology, Archaeology, and History to Inform Biological Conservation." *Conservation Biology* 27: 45–54. doi:10.1111/j.1523-1739.2012.01920.x.

Sapir, Y., and A. Faust. 2016. "Utilizing Mole-rat Activity for Archaeological Survey: A Case Study and Proposal." *Advances in Archaeological Practice* 4: 55–70. doi:10.7183/2326-3768.4.1.55.

Seddon, P. J., C. J. Griffiths, P. J. Soorae, and D. P. Armstrong. 2014. "Reversing Defaunation: Restoring Species in a Changing World." *Science* 345: 406–412. doi:10.1126/science.1251818.

Seersholm, F. V., T. L. Cole, A. Grealy, N. J. Rawlence, K. Greig, M. Knapp, M. Stat, et al. 2018. "Subsistence Practices, Past Biodiversity, and Anthropogenic Impacts Revealed by New Zealand-Wide Ancient DNA Survey." *Proceedings of the National Academy of Sciences* 115 (30): 7771–7776. doi:10.1077/pnas.1803573115.

Smith, I. W. G., and A. J. Anderson. 2009. "An Archaeological Sequence for Codfish Island (Whenua Hou), Southland, New Zealand." *New Zealand Journal of Archaeology* 30: 5–21.

Stephenson, P. J. 2018. "A Global Effort to Improve Species Monitoring for Conservation." *Oryx* 52: 412–413. doi:10.1017/S0030605318000509.

Stephenson, P. J., T. Brooks, S. Butchart, E. Fegraus, G. Geller, R. Hoft, J. Hutton, N. Kingston, B. Long, and L. McRae. 2017. "Priorities for big Biodiversity Data." *Frontiers in Ecology and the Environment* 15: 124–125. doi:10.1002/fee.1473.

Sutherland, W. J. 2002. "Conservation Biology: Science, Sex and the Kakapo." *Nature* 419: 265–266. doi:10.1038/419265a.

Szabó, P. 2010. "Why History Matters in Ecology: An Interdisciplinary Perspective." *Environmental Conservation* 37: 380–387. doi:10.1017/S0376892910000718.

Szabó, P., and R. Hédl. 2011. "Advancing the Integration of History and Ecology for Conservation." *Conservation Biology* 25: 680–687. doi:10.1111/j.1523-1739.2011.01710.x.

Taylor, G. A. 2000a. *Action Plan for Seabird Conservation in New Zealand. Part A: Threatened Seabirds*. Wellington: Department of Conservation.

Taylor, G. A. 2000b. *Action Plan for Seabird Conservation in New Zealand. Part B: Non-Threatened Seabirds*. Wellington: Department of Conservation.

Taylor, G. A. 2013. "South Georgian Diving Petrel." In *New Zealand Birds Online*, edited by C. M. Miskelly. www.nzbirdsonline.org.nz.

Tennyson, A. J. D. 2020. "Holocene Bird Bones Found at the Subantarctic Auckland Islands." *Notornis* 67: 269–294.

Tucker, B. 2017. *Archaeological monitoring report Codfish Island (Whenua Hou): 16–20 September* 2017. Unpublished report. www.heritage.org.nz/protecting-heritage/archaeology/digital-library.

Tucker, B. 2018. *Archaeological Assessment of D48/5 Sealers Bay Camp, Codfish Island/Whenua Hou*. Report to Heritage New Zealand Pouhere Taonga.

Tucker, B., and J. H. Fischer. 2018. "Codfish Island/Whenua Hou – A Decade On." *Archaeology in New Zealand* 61: 34–47.

Vousdoukas, M. I., R. Ranasinghe, L. Mentaschi, T. A. Plomaritis, P. Athanasiou, A. Luijendijk, and L. Feyen. 2020. "Sandy Coastlines Under Threat of Erosion." *Nature Climate Change* 10: 260–263. doi:10.1038/s41558-020-0697-0.

Wood, J. R. 2016. "Spatial Distribution of Late Holocene Bird Bones in the Mason Bay Dune System, Stewart Island, New Zealand." *Journal of the Royal Society of New Zealand* 46: 103–116. doi:10.1080/03036758.2016.1149497.

Wood, J. R., and S. Briden. 2008. "South Georgian Diving Petrel (*Pelecanoides georgicus*) Bones From a Maori Midden in Otago Peninsula, New Zealand." *Notornis* 55: 46–47.