Supplementary Information 1

1. Observations about legacy dates from Shag River Mouth

1.1. Marine reservoir offsets

As part of a PhD project testing the reliability of different shell taxa (Higham 1993), a range of shellfish were dated from Layer 4, including *Austrovenus stutchburyi* (cockle), *Paphies australis* (pipi), *Haliotis iris* (pāua), *Amphibola crenata* (mudsnail) and *Mytilus edulis* (blue mussel). A date on A*. crenata* was obtained to assess the error caused by the ingestion of sediment by this taxon and does not provide a reliable estimate of site occupation (Anderson *et al.* 1996). Petchey and Higham (2000, 147) reported an additional six fish bone gelatin and two tripeptide dates. However, tripeptide dates measured at the Oxford Radiocarbon Laboratory in the late 1990s were prone to contamination during processing and are no longer considered reliable (pers. comm. Tom Higham, 31/10/2019). Unfortunately, the current calibration methodology for marine and estuarine samples is relatively low precision, compared to the Southern Hemisphere calibration curve (Petchey and Schmid 2020). A comparison of calibration methodologies for different sample types by Bunbury et al. (2022) suggests that marine/estuarine calibrations for early sites tend to yield slightly older dates. This trend is also evident in the legacy SM/C:Dune chronology, where marine samples returned slightly older calibrated date ranges. We will not further evaluate the reliability of marine dates in this paper.

1.2. Bone dates

Previous evaluation of radiocarbon determinations of bone indicated significant variation caused by contamination, inadequate pretreatment, the use of sub-fossil bones in prehistory (see Petchey 1999), and variation in dietary ^{14}C in rat and aquatic bird taxa (Beavan and Sparks 1998; Higham *et al.* 2004, 2005). Petchey and Higham (2000) and Higham *et al.* (2004, 2005) give a detailed discussion of all legacy bone dates, which is not repeated here.

1.3. Mixed charcoal taxa

Most charcoal dates from the SM/C:Dune excavation are of mixed taxa (Supplementary Table 1), with Hoheria being dominant. Within this genus, many species are large shrubs or small trees and may have inbuilt age unless twigs are selected (see Anderson *et al.* 1996, footnote to Table 7.1). However, one species, *Plagianthus divaricatus* (Marsh Ribbonwood), a small divaricating shrub that grows along the edges of salt marshes, was considered the most likely source of the charcoal. This reduces the potential inbuilt age to <20 years. Regardless, the large sample sizes required for radiometric dating at that time introduce potential ambiguity in the dates (see Supplementary Table 3).

Supplementary Table 1. SM/C:Dune legacy dates (charcoal and moa eggshell only) – material and context information from Anderson *et al.* 1996.

Lab Number	CRA ± Error	Material / Element	Context	Comment
NZ-7758	580 ± 47	Charcoal: *Hoheria* (80%), *Olearia* (15%), *Pseudopanax* (2%), *Coprosma* (2%)	Layer 2, Square F3-4. Charcoal blackened sand rich in cultural material.	Mixed taxa. Near F.211, which cuts to the base of Layer 4.
NZ-7761	600 ± 50	Charcoal: *Hoheria* (37%), *Pittosporum* (23%), *Coprosma* (20%), *Myrsine australis* (10%), *Pseudopanax* (7%), *P. eugenioides* (3%)	Layer 4, Square E7. Dense shell midden filling a natural depression.	Mixed taxa. No intercutting between layers at this location.
NZ-7757	537 ± 44	Charcoal: *Hoheria*	Layer 5, Square D5.	From oven F.198; cuts through Layer 6.
NZ-7756	670 ± 47	Charcoal: *Hoheria* (95%), *Myrsine australis* (5%)	Layer 6, Square C6. Upper part of the layer.	Mixed taxa. From oven F.198; cuts through Layer 6.
Wk-2417	560 ± 40	Eggshell fragment (Moa)	Layer 6, Square E2/F2.	No intercutting; possibly associated with F.320 oven.
Wk-2416	600 ± 50	Eggshell fragment (Moa)	Layer 6 [5], Square E5. Black sand with numerous cooking scoops.	Original bag indicates Layer VI. No intercutting between layers at this location.
NZ-7755	646 ± 47	Charcoal: *Hoheria* (99%), *Hebe* (1%)	Layer 7, Square B7-8. Charcoal darkened sand.	No intercutting between layers at this location.
Wk-2589	630 ± 35	Charcoal: *Hoheria* (100%)	Layer 7, Square B4.	From oven F.302.
Wk-2604	570 ± 45	Eggshell fragment (Moa)	Layer 8, Square I3/I4. Trench 2. Yellow sand with patches of cultural material.	Little associated cultural evidence; likely redeposited material.
NZ-7771	660 ± 46	Charcoal: *Pseudowinteria colorata* (60%), *Leptospermum scoparium* (30%), *Pittosporum* (10%)	Layer 11, Square A6. Large in situ cooking pit in the NW corner.	Mixed taxa. From oven F.332.

1.4. Moa eggshell

Higham (1994) compared dates of moa eggshell to those of moa bone collagen and charcoal from the SM/C:Dune. Based on consistency with dates from other sample types, he concluded that eggshell was a reliable dating material because it underwent minimal post-deposition contamination and because midden evidence suggested the eggs were mainly collected for consumption. However, this comparison was low-precision and overlooked the possibility that moa eggs may have had additional intrinsic value that led to longer-term storage or heirloom effects. Moreover, more recent studies have found that eggshell can be too old due to the ingestion of geological carbonates (Vogel *et al.* 2001), a consideration that must be kept in mind when dating eggshell. Several moa eggshell AMS dates, obtained in 2016 from Layers 11 and 2, are statistically distinguishable ($\chi 22{:}0.05 = 8.76<5.99$). However, at least two of the samples were broadly associated with features that cut down below Layer 8. Because their CRAs were much older than samples from Layers 4 to 6 upper and a charcoal sample from Layer 2 (NZ-7758), the logical assumption is that residual material has been brought to the surface.

2. Observations about legacy dates from Kokohuia

2.1. Reservoir offsets

Schmidt (1996a) obtained twenty dates from rocky and estuarine shellfish. Calcareous sediments are found to the north of the site, and a small spring emerges nearby (Taylor 1993, 3). In comparable locations, hardwater effects (i.e., the introduction of ancient carbon via limestone in the shells) have been found to complicate ^{14}C age interpretation (e.g., Hogg *et al.* [1998]; see Petchey *et al.* [2018] for complexities caused by tidal currents and onshore drift). Schmidt (1996a) couldn't identify any hardwater effect in the shell dates from the site, but further investigation is needed along with consideration of possible temporal changes in the marine ^{14}C reservoir (Petchey and Schmid 2020). Hardwater and temporal changes in the marine reservoir could also affect *Rattus exulans* bone dates (Higham *et al.* 2004). Both legacy shell and bone dates are excluded from further analysis in this paper.

2.2. Mixed charcoal taxa

Schmidt (1996a) considered all samples selected for dating to be "short-lived" charcoal and pūriri seeds. Matching the Waikato Radiocarbon laboratory records with the anthracology report suggests that some of the seeds were mixed with identified charcoal to maximise sample weights for standard radiometric dating (Supplementary Table 2). Unfortunately, no record remains of exactly which dates contain charcoal or seed material. This mixing is problematic because only longer-lived taxa (>100 years) are likely to have been removed from the ^{14}C samples, as was typical at the time (cf., McFadgen *et al.* 1994). Given the dominance of broadleaf taxa at the site (shrubs produced only 1/3 of the charcoal), there is a high probability of moderate inbuilt age material being included in some dates.

2.3. Context

Taylor (1993) provides some information on the excavation, but it was never formally written up, and the available field notebooks housed at the Auckland University Anthropology Department are incomplete. We could not find any excavation plan for the Area 3 midden, and Leach *et al.* (1997) published the only cross-section available for the site from Square I12. However, all samples dated by Schmidt (1996a) came from the same few squares (I-J/11-12) and were deliberately taken from each layer to test marine reservoir change; therefore, this section (Figure 8) is likely to be a good approximation of the sequence at this location.

Supplementary Table 2. Legacy terrestrial dates from Kokohuia, Area 3 "lower midden" (from Schmidt 1996a)

Lab Number	CRA ± Error	Material / Element	Context	Comment
Wk-3695	330 ± 45	Charcoal: identified*	Layer II	
Wk-4484	380 ± 40	*Vitex lucens* (Pūriri) seeds	Layer II	
Wk-4485	340 ± 40	*Vitex lucens* (Pūriri) seeds	Layer II	
Wk-4486	410 ± 40	*Vitex lucens* (Pūriri) seeds	Layer II	
Wk-4487	380 ± 40	*Vitex lucens* (Pūriri) seeds	Layer II	
Wk-3703	410 ± 40	Charcoal: identified*	Layer III	
Wk-4540	360 ± 40	*Vitex lucens* (Pūriri) seeds	Layer III	
Wk-4541	350 ± 40	*Vitex lucens* (Pūriri) seeds	Layer III	
Wk-3718	384 ± 41	Charcoal: identified*	Layer IV	Context: as per Schmidt (1996a); Nims (2022), attributed this sample to Layer V.
Wk-3711	366 ± 40	Charcoal: identified*	Layer IV	
Wk-4482	449 ± 41	Charcoal: identified*	Layer IV	Likely a mix of charcoal and pūriri seeds#
Wk-4483	494 ± 40	Charcoal: identified*	Layer IV	Likely a mix of charcoal and pūriri seeds#
Wk-4542	433 ± 40	Charcoal: identified*	Layer IV	Likely a mix of charcoal and pūriri seeds#
Wk-3719	443 ± 42	Charcoal: identified*	Layer V/Va	
Wk-3720	492 ± 41	Charcoal: identified*	Layer V/Va	
Wk-3721	505 ± 45	Charcoal: identified*	Layer V/Va	
Wk-4543	484 ± 42	Charcoal: identified*	Layer V/Va	Likely a mix of charcoal and pūriri seeds#
Wk-4544	407 ± 41	Charcoal: identified*	Layer V/Va	Likely a mix of charcoal and pūriri seeds#

While Pūriri seeds represent one-season growth, the addition of charcoal from shorter-lived taxa could provide material with 20 – 80 years of inbuilt age.

* Identified taxon not specified by Schmidt (1996a).

^Schmidt (1996a) combined V and Va. V was sterile.

Supplementary Table 3. Common taxa used for New Zealand archaeological dating and estimated inbuilt age

Species (Scientific, Common and Māori names)	**Growth Characteristics and Ecological Context**	**Inbuilt Age Contribution (if not a twig)**	**Reference**
Hebe / *Veronica* (Hebe / Koromiko)	Rapid-growth shrubs; lifespan ~ 15 – 30 yrs. Open habitats, coastal bluffs, riverbeds, and recently cleared sites.	Low. Rarely >25 years.	Wardle (1991)
Plagianthus divaricatus (Marsh Ribbonwood / Mākaka)	Small, salt-marsh shrub; lifespan ~ 10 – 20 years. Estuarine; found on the margins of salt marshes and tidal mudflats.	Low.	Salmon (1992)
Coprosma (e.g., *C. robusta /* Karamū)	Shrub to small tree; lifespan ~ 30 – 60 years. Regenerated scrub and open forest edges.	Low to Moderate. Fast-growing.	Poole and Adams (1994)
Olearia (Tree Daisy / Akiraho)	Shrub to small tree; lifespan ~ 40 – 80 years. Diverse habitats from coastal cliffs to sub-alpine scrub.	Low.	Salmon (1992); Wardle (1991)
Leptospermum scoparium (Mānuka / Tea Tree)	Shrub to small tree; lifespan ~ 30 – 80 yrs. Disturbed areas, wetlands, and poor soils. Dense wood that survives well.	Moderate.	Wardle (1991)
Pseudopanax (e.g., Five-finger / Whauwhaupaku)	Trees; lifespan ~ 40 – 70 years. Regenerating forest, scrubland, and disturbed soils.	Moderate.	Wardle (1991)
# *Hoheria* (Lacebark / Houhere)	Fast-growing; lifespan ~ 50 – 100 years. Prominent in lowland forest margins and river terraces.	Moderate.	McGlone, *et al.* (1994)
Pittosporum (e.g., Kohuhu / Tarata)	Small trees; lifespan ~ 80+ years. Forest understory and secondary growth; coastal and inland sites.	Moderate.	Salmon (1992)
Myrsine australis (Mapou / Red Matipo)	Small, slow-growing tree; lifespan ~ 80+ years. Secondary forest and margins. Higher wood density.	Moderate. Preserves well.	Wardle (1991)
Plagianthus regius (Ribbonwood / Houi /mānatu)	Tree; lifespan ~ 70 – 100+ years. Fertile alluvial flats and lowland river terraces; secondary forest growth.	Moderate to High.	Salmon (1992)

Unlikely in many archaeological contexts on the margins of salt marshes and tidal mudflats. In these locations, *P. divaricatus* is more common.