Invader or resident? Ancient DNA reveals rapid species turnover in New Zealand little penguins

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Supplementary material

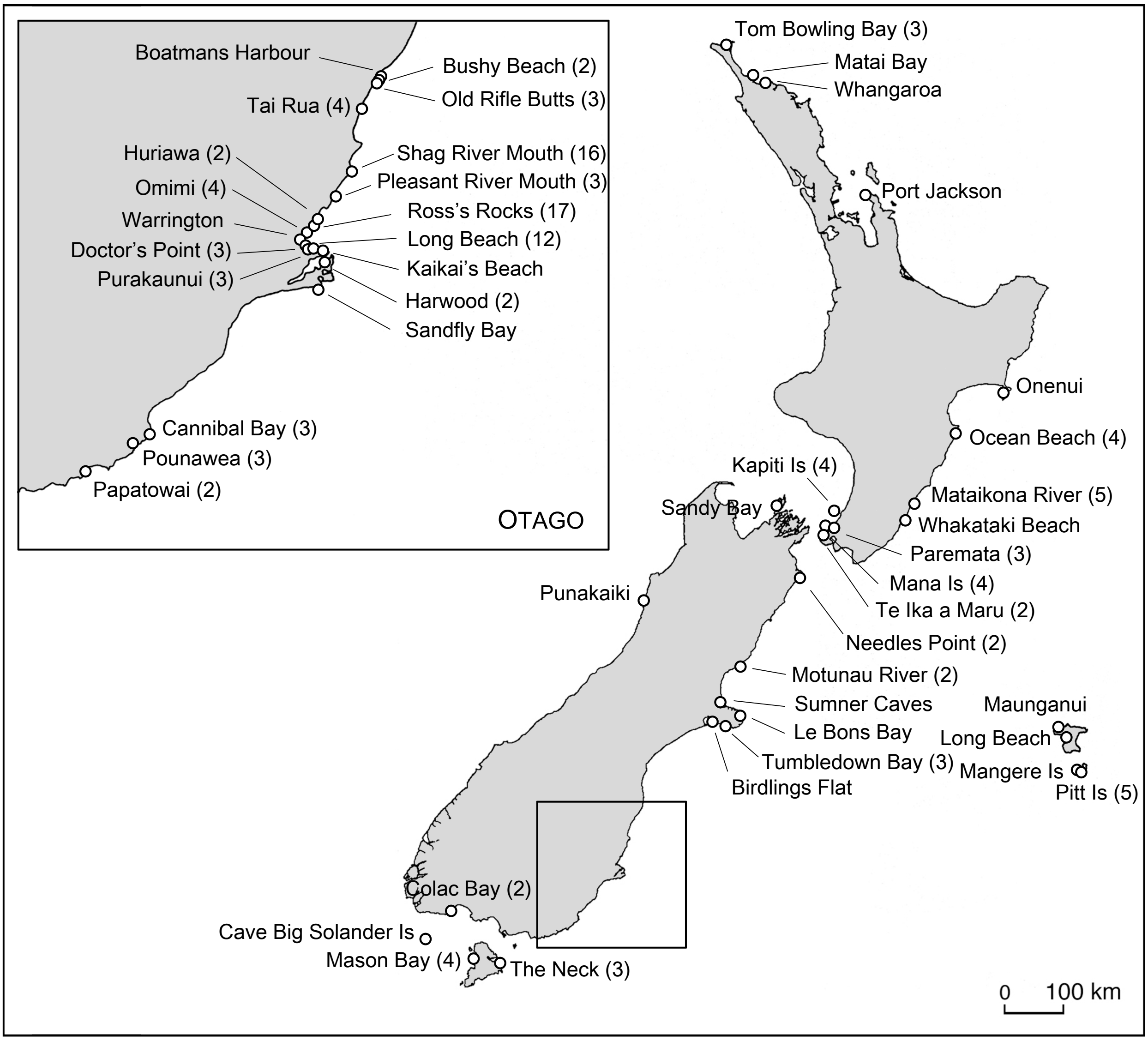

Figure S1. Geographic locations of New Zealand Holocene fossil and archaeological sites containing *Eudyptula* remains sampled in this study. Inset shows coastal Otago sites. Number of specimens available from a site is given in parentheses (if more than one).

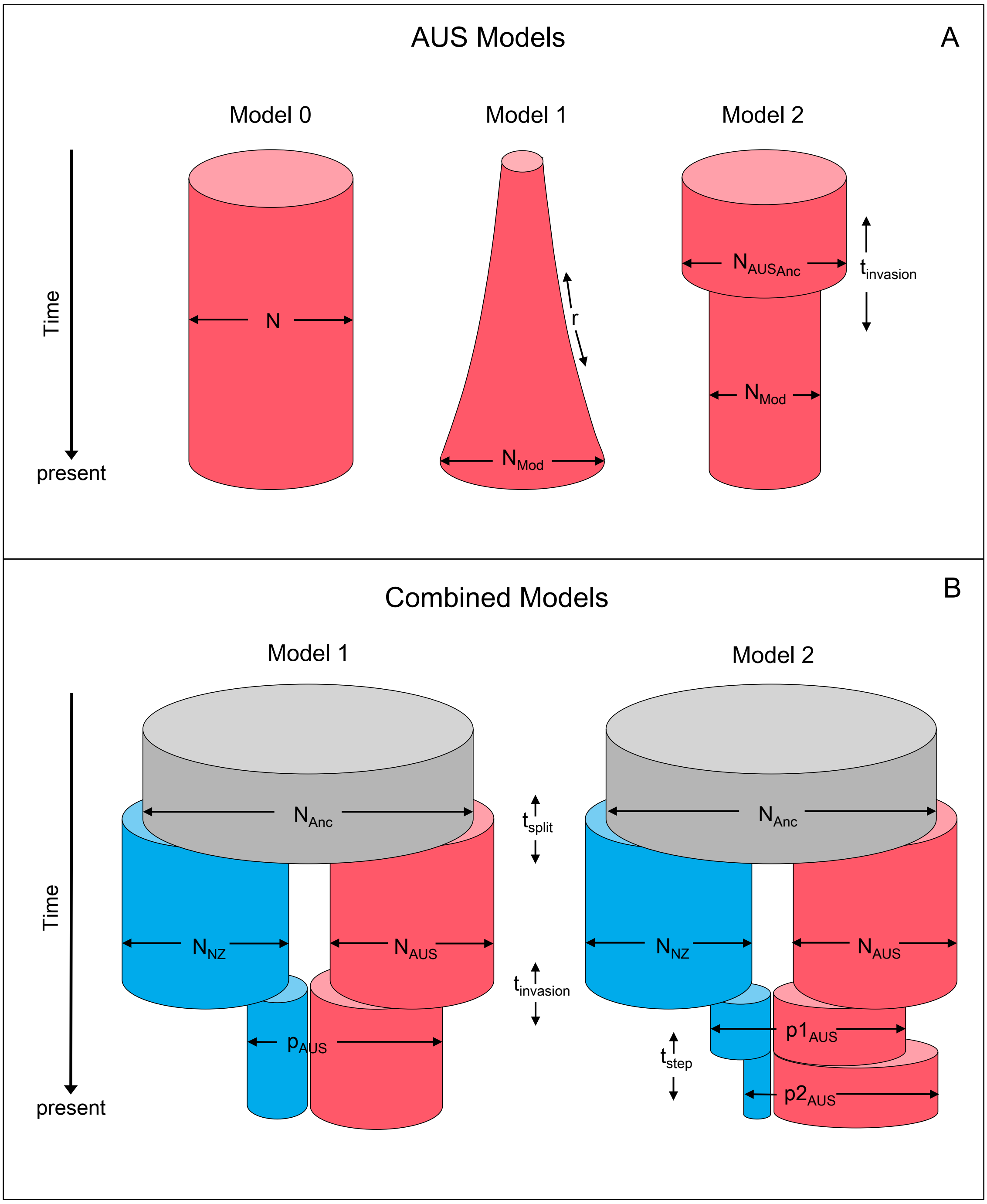

Figure S2. Demographic models for the *E. minor* (NZ, blue) and *E. novaehollandiae* (AUS, red) population in Otago analysed using a Bayesian serial coalescent approach. Cylinders represent demes, or panmictic populations of constant size; grey represents an undifferentiated ancestral population. Arrows indicate free parameters approximated with Approximate Bayesian Computation: Anc – ancestral population, AUS_{Anc} – ancestral Australian population, Mod – modern population, N – effective population size, r – population growth rate, p_{AUS} – proportion of *E. novaehollandiae* in the total population, $t_{invasion}$ – time of *E.novaehollandiae* invasion in Otago, t_{split}

– time of most recent common ancestor of *E. minor* and *E.novaehollandiae*, t_{step} – time of change in *E. novaehollandiae* population proportions (in secondary contact with *E. minor*). (A) Separate investigation of demographic history of *E. novaehollandiae* in Otago. AUS Model 0: constant population size; AUS Model 1: exponentially-increasing population since the founding event; AUS Model 2: a population constant since the founding event. (B) Combined Models using data of both species to approximate the time of invasion and rate of expansion of *E. novaehollandiae*. Combined Model 1: a single invasion that has maintained a constant proportion of the population since colonisation; Combined Model 2: an invasion followed by an expansion some time after colonisation.

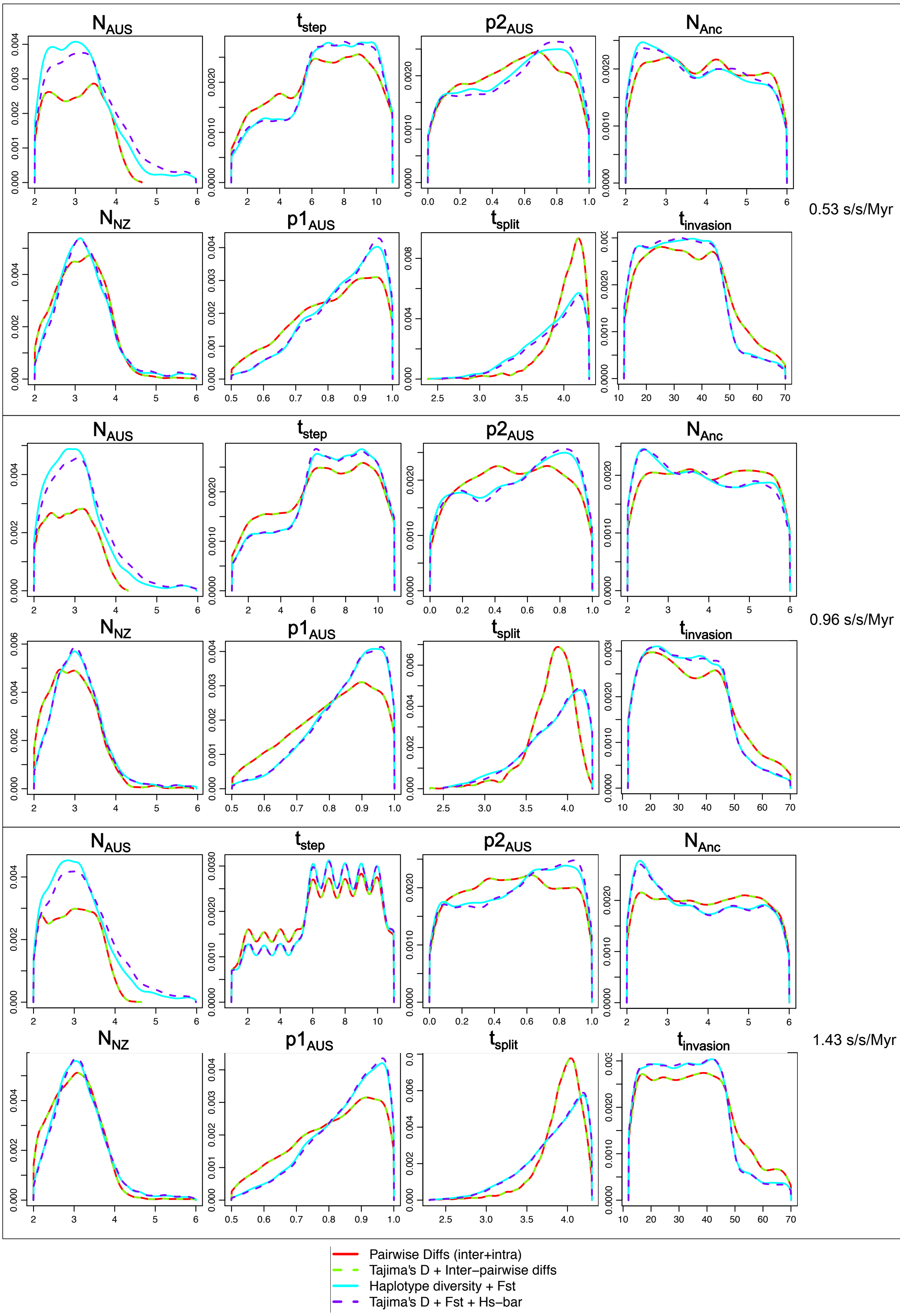

Figure S3. Posterior density distributions for Combined model 2 (Lo – 107bp). Models were run at three different mutation rates, given in substitutions/site/million years (s/s/Myr), and using different summary statistics. Anc – ancestral population, AUS – *E.novaehollandiae*, Hs-bar – mean inter-group diversity, Mod – modern population, N – effective population size, NZ – *E. minor*, Pairwise Diffs – pairwise differences, p_{AUS} – proportion of *E. novaehollandiae* in the total population, $t_{invasion}$ – time of *E.novaehollandiae* invasion in Otago, t_{split} – time of most recent common ancestor of *E. minor* and *E.novaehollandiae*, t_{step} – time of change in *E. novaehollandiae* population proportions N_{AUS}, N_{anc}, N_{NZ} and t_{split} are log-base 10-transformed.

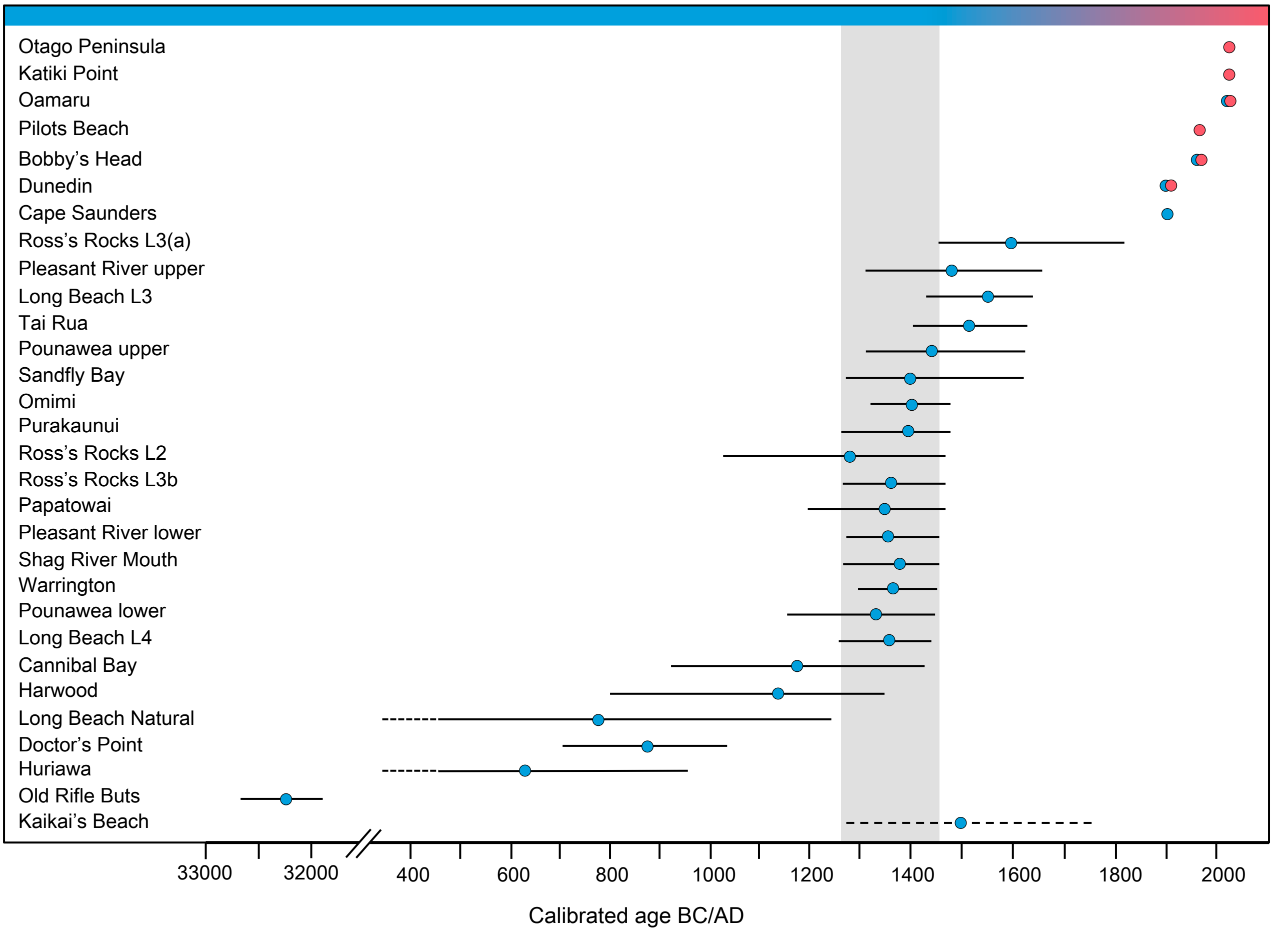

Figure S4. Calibrated ages of prehistoric, historic and modern Otago sample sites. Circles represent mean ages (years BC/AD) of sites and blue and red fillings indicated affiliation of samples from the particular site to *E. minor* and *E. novaehollandiae*, respectively. Horizontal bars represent calibrated age range of the particular site. Uncertain/unknown age ranges were drawn in long dashed lines. Age limits outside of the presented time frame are shown in short dashed lines. Human arrival and early settlement period are indicated by a vertical grey bar.

Table S1. Pre-human Holocene fossil, archaeological and historic *Eudyptula* specimens used for ancient DNA analysis. Lineage NZ – *E. minor*, AUS – *E. novaehollandiae*. CR3/4 – 107bp fragments, CR3&4 – 107bp contigs, CR3 – 53bp fragment. Mean calibrated ages were calculated for Otago sites only by averaging all calibrated dates from a specific site. Dates are reported as years BC/AD and years BP (standardised to AD 2014). Deposit types are presented for all locations: fossil – before AD 1280; early – AD 1280-1450; middle – AD 1450-1650; historic – AD 1800-1970. Institutional abbreviations AIM: Auckland Institute and Museum, Auckland; CM: Canterbury Museum, Christchurch; JH: Jill Hamel collection, Dunedin; NMNZ: Museum of New Zealand Te Papa Tongarewa, Wellington; BA: Brian Allingham; OM: Otago Museum, Dunedin; OUA: University of Otago**,** Department of Anthropology and Archaeology, Dunedin. Mean calibrated ages were calculated by averaging across available dates from a site.

Sample Name	Museum Accession	Location	Lineage	Fragment	Element	Deposit type	Mean cal age (yrs BC/AD)	Mean cal age (yrs BP, 2014 AD)
Eumi_a14	CM Av21811	Tom Bowling Bay	NZ	CR3/4	femur	fossil	-	-
Eumi_a4	CM Av23513	Tom Bowling Bay	NZ	CR3/4	femur	fossil	-	-
Eumi_a78	CM Av22707	Tom Bowling Bay	-	-	femur	fossil	-	-
Eumi_a83	AIM 6836	Matai Bay	NZ	CR3	femur	fossil	-	-
Eumi_a90	AIM unregistered	Whangaroa	NZ	CR3&4	phalanx	fossil	-	-
Eumi_a84	AIM 14001	Port Jackson	NZ	CR3	femur	early	-	-
Eumi_a139	NMNZ N127/14	Onenui	-	-	femur	early	-	-
Eumi_a82	NMNZ S.38671.1	Ocean Beach	NZ	CR3&4	humerus	fossil/early	-	-
Eumi_a96	NMNZ S.39124.1	Ocean Beach	NZ	CR3&4	corocoid	fossil/early	-	-
Eumi_a97	NMNZ S.39110.1	Ocean Beach	NZ	CR3&4	humerus	fossil/early	-	-
Eumi_a98	NMNZ S.38617.1	Ocean Beach	NZ	CR3/4	humerus	fossil/early	-	-
Eumi_a85	NMNZ S.42176	Mataikona River	NZ	CR3&4	femur	fossil	-	-
Eumi_a93	NMNZ S.37894.1	Mataikona River	NZ	CR3&4	humerus	fossil	-	-
Eumi_a112	NMNZ S.45445.1	Mataikona River	-	-	humerus	fossil	-	-
Eumi_a113	NMNZ S.41865.1	Mataikona River	NZ	CR3&4	humerus	fossil	-	-
Eumi_a114	NMNZ S.41928.1	Mataikona River	-	-	humerus	fossil	-	-
Eumi_a115	NMNZ S.38442.1	Whakataki Beach	-	-	humerus	fossil	-	-
Eumi_a91	NMNZ unregistered	Centenial Inn	NZ	CR3&4	tibiotarsus	early	-	-

Sample Name	Museum Accession	Location	Lineage	Fragment	Element	Deposit type	Mean cal age (yrs BC/AD)	Mean cal age (yrs BP, 2014 AD)
Eumi_a105	NMNZ S.42081.1	Kapiti Is Cave	NZ	CR3	humerus	fossil/early	-	-
Eumi_a106	NMNZ S.42081.2	Kapiti Is Cave	-	-	humerus	fossil/early	-	-
Eumi_a107	NMNZ S.42081.3	Kapiti Is Cave	NZ	CR3	humerus	fossil/early	-	-
Eumi_a108	NMNZ S.42081.4	Kapiti Is Cave	-	-	humerus	fossil/early	-	-
Eumi_a92	NMNZ N160/50 old area1962	Paremata	NZ	CR3	humerus	early	-	-
Eumi_a94	NMNZ N160/50 old area1962	Paremata	NZ	CR3&4	humerus	early	-	-
Eumi_a95	NMNZ N160/50 1952	Paremata	NZ	CR3&4	coracoid	early	-	-
Eumi_a80	NMNZ R26/141 AB89	Mana Is	NZ	CR3&4	humerus	early, middle or historic	-	-
Eumi_a86	NMNZ R26/141 AB89	Mana Is	NZ	CR3	humerus	early, middle or historic	-	-
Eumi_a89	NMNZ R26/141 AB89	Mana Is	NZ	CR3	humerus	early, middle or historic	-	-
Eumi_a110	NMNZ R26/141 AB89	Mana Is	NZ	CR3&4	humerus	early, middle or historic	-	-
Eumi_a109	NMNZ 3N/4+5	Te Ika a Maru Bay	NZ	CR3&4	humerus	undated	-	-
Eumi_a111	NMNZ 3N/5 27/9 26/13	Te Ika a Maru Bay	NZ	CR3&4	humerus	undated	-	-
Eumi_a51	CM Av29684	Sandy Bay, D'Urville Is	NZ	CR3/4	femur	fossil	-	-
Eumi_a75	CM Av32061	Needles Point, Malborough	NZ	CR3&4	femur	fossil	-	-
Eumi_a23	CM Av26031	Needles Point, Malborough	NZ	CR3	femur	fossil	-	-
Eumi_a116	CM unregistered	Wtc Punakaiki	NZ	CR3&4	rib	fossil	-	-
Eumi_a12	CM Av30045	Motunau River	NZ	CR3/4	femur	fossil	-	-
Eumi_a19	CM Av30042	Motunau River	NZ	CR3/4	femur	fossil	-	-
Eumi_a11	CM Av27603	Long Beach (Chatham Is)	-	-	femur	fossil	-	-
Eumi_a21	CM Av30149	Maunganui	NZ	CR3/4	tibiotarsus	fossil	-	-
Eumi_a76	CM Av28348	Chatham Is	NZ	CR3/4	femur	fossil	-	-
Eumi_a77	CM Av27869	Chatham Is	NZ	CR3/4	femur	fossil	-	-
Eumi_a88	AIM 12069	Pitt Is	NZ	CR3	femur	fossil/early	-	-
Eumi_a79	AIM 12062	Pitt Is	NZ	CR3/4	femur	fossil/early	-	-
Eumi_a102	NMNZ S.45633.1	Pitt Is	-	-	humerus	fossil/early	-	-
Eumi_a103	NMNZ S.45366.2	Pitt Is	NZ	CR3	humerus	fossil/early	-	-
Eumi_a104	AIM 12071	Pitt Is	-	-	humerus	fossil/early	-	-
Eumi_a87	NMNZ S.36228.1	Mangere Is	-	-	humerus	fossil/early	-	-
Eumi_a24	CM Av16488	Birdlings Flat	NZ	CR3/4	femur	fossil/early	-	-
Eumi_a22	CM Av22394	Sumner Caves	NZ	CR3/4	femur	fossil/early	-	-
Eumi_a13	CM Av14610	Le Bons Bay	NZ	CR3/4	femur	early	-	-
Eumi_a17	CM Av9832	Tumbledown Bay	NZ	CR3&4	femur	early	-	-
Eumi_a123	BA TBS94/30B3Nth	TumbledownBay	NZ	CR3&4	humerus	early	-	-
Eumi_a124	BA TBS94/30BNWend	TumbledownBay	NZ	CR3&4	humerus	early	-	-

Sample Name	Museum Accession	Location	Lineage	Fragment	Element	Deposit type	Mean cal age (yrs BC/AD)	Mean cal age (yrs BP, 2014 AD)
Eumi_a2	CM Av24902	Old Rifle Butts,Cape Wanbrow	NZ	CR3	femur	fossil	-	-
Eumi_a3	CM Av21256A	Boatsmans Harbour	-	-	femur	fossil	-	-
Eumi_a6	CM Av24930	Old Rifle Butts,Cape Wanbrow	NZ	CR3/4	tibiotarsus	fossil	32308 (BC)	34321
Eumi_a8	CM Av24920	Old Rifle Butts, Cape Wanbrow	NZ	CR3/4	tibiotarsus	fossil	32308 (BC)	34321
Eumi_a9	CM Av29869	Bushy Beach, Cape Wanbrow	-	-	femur	fossil	-	-
Eumi_a53	CM Av29692	Bushy Beach, Cape Wanbrow	-	-	femur	fossil	-	-
Eumi_a72	OUA 48/53 at 53/68, L. top5	Tai Rua	NZ	CR3/4	tibia	early/middle	1514	502
Eumi_a73	OUA 64/68, L.5	Tai Rua	NZ	CR3/4	tibia	early/middle	1514	502
Eumi_a140	OUA T.R. C/I/3-4	Tai Rua	NZ	CR3	coracoid	early/middle	1514	502
Eumi_a141	OUA T.R. 48/53 at 83/58 l5a	Tai Rua	NZ	CR3&4	femur	early/middle	1514	502
Eumi_a33	OUA SMC-L1-01	Shag River Mouth	NZ	CR3/4	femur	early	1383	632
Eumi_a34	OUA SMC-L2-02	Shag River Mouth	NZ	CR3/4	tibiotarsus	early	1383	632
Eumi_a35	OUA SMC-L2-03	Shag River Mouth	-	-	tibiotarsus	early	-	-
Eumi_a36	OUA SMC-L2-04	Shag River Mouth	-	-	tibiotarsus	early	-	-
Eumi_a37	OUA SMC-L6-05	Shag River Mouth	-	-	humerus	early	-	-
Eumi_a38	OUA SMC-L6-06	Shag River Mouth	-	-	humerus	early	-	-
Eumi_a39	OUA SMC-L6-07	Shag River Mouth	NZ	CR3&4	humerus	early	1383	632
Eumi_a40	OUA SMC-L6-08	Shag River Mouth	NZ	CR3/4	humerus	early	1383	632
Eumi_a41	OUA SMC-L7-09	Shag River Mouth	NZ	CR3/4	tibiotarsus	early	1383	632
Eumi_a42	OUA SMC-L7-10	Shag River Mouth	NZ	CR3&4	tibiotarsus	early	1383	632
Eumi_a43	OUA SMC-L7-11	Shag River Mouth	NZ	CR3/4	tibiotarsus	early	1383	632
Eumi_a44	OUA SMC-L9-12	Shag River Mouth	NZ	CR3/4	radius	early	1383	632
Eumi_a45	OUA SMC-L9-13	Shag River Mouth	NZ	CR3/4	ulna	early	1383	632
Eumi_a46	OUA SMC-L10-14	Shag River Mouth	NZ	CR3/4	ulna	early	1383	632
Eumi_a47	OUA SMC-L11-15	Shag River Mouth	-	-	tibiotarsus	early	-	-
Eumi_a48	OUA SMC-L-16	Shag River Mouth	NZ	CR3&4	fibula	early	1383	632
Eumi_a27	OUA PLRA2/503/BB1 L4	Pleasant River	NZ	CR3/4	humerus	early	1359	656
Eumi_a28	OUA PLR377/l4/BB2 L4	Pleasant River	NZ	CR3/4	humerus	early	1359	656
Eumi_a29	OUA PLR201/1	Pleasant River	NZ	CR3/4	ulna	middle	1509	507
Eumi_a69	OUA K13, upper terrace	Huriawa	NZ	CR3/4	coracoid	fossil	453	1563
Eumi_a70	OUA B/NW, mid terrace	Huriawa	NZ	CR3/4	tarsometatarsus	fossil	824	1176
Eumi_a66	OUA RR/D/2/II L.2 #4	Ross's Rocks	-	-	ulna	fossil/early	-	-
Eumi_a67	OUA RR/D/1/II L.2 #4	Ross's Rocks	NZ	CR3/4	-	fossil/early	1282	751
Eumi_a74	OUA RR/B/4/III L.2 #4	Ross's Rocks	NZ	CR3&4	-	fossil	1161	889
Eumi_a117	OUA RR/C/3/II/l3	Ross's Rocks	NZ	CR3/4	radius	middle/late	1595	421
Eumi_a128	OUA RR/C/3/III,L3b#4,1	Ross's Rocks	NZ	CR3/4	tibiotarsus	early	1369	645

Sample Name	Museum Accession	Location	Lineage	Fragment	Element	Deposit type	Mean cal age (yrs BC/AD)	Mean cal age (yrs BP, 2014 AD)
Eumi_a129	OUA RR/C/3/III,L3b#4,2	Ross's Rocks	NZ	CR3/4	tibiotarsus	early	1369	645
Eumi_a130	OUA RR/C/1/III,L3a#4	Ross's Rocks	NZ	CR3/4	tibiotarsus	middle	1595	421
Eumi_a131	OUA RR/C/3/IV,L3b#4a	Ross's Rocks	NZ	CR3/4	tibiotarsus	early	1369	645
Eumi_a132	OUA RR/C/3/IV,L3b#4b	Ross's Rocks	NZ	CR3/4	tibiotarsus	early	1369	645
Eumi_a133	OUA RR/A/4/II,L3#4	Ross's Rocks	NZ	CR3/4	femur	middle	1595	421
Eumi_a134	OUA RR/D/2/II,L2#4	Ross's Rocks	NZ	CR3/4	ulna	early/middle	1403	612
Eumi_a135	OUA RR/A/1/IV,L3	Ross's Rocks	NZ	CR3/4	tibiotarsus	middle	1595	421
Eumi_a136	OUA RR/A/3/IV,L3#4	Ross's Rocks	NZ	CR3/4	tibiotarsus	middle	1595	421
Eumi_a137	OUA RR/B/1/III,L3	Ross's Rocks	NZ	CR3/4	tibiotarsus	middle	1595	421
Eumi_a138	OUA RR/A/2/I, L3 #4	Ross's Rocks	NZ	CR3/4	humerus	middle	1595	421
Eumi_a145	OUA RR/C/3/II L3b #4	Ross's Rocks	NZ	CR3/4	femur	early	1369	645
Eumi_a146	OUA RR/C/3/II l3b #4	Ross's Rocks	NZ	CR3&4	femur	early	1369	645
Eumi_a71	OUA 39, Bay 3/6, 3c,	Omimi	-	-	coracoid	early/middle	-	-
Eumi_a125	OUA OMSq37-2A	Omimi	NZ	CR3&4	tibiotarsus	early/middle	1402	613
Eumi_a126	OUA OMSq8-2C	Omimi	NZ	CR3/4	humerus	early/middle	1402	613
Eumi_a127	OUA OMSq14-3C	Omimi	-	-	femur	early/middle	-	-
Eumi_a68	OUA Wgnt 5D, L2D2	Warrington	NZ	CR3/4	humerus	early	1368	647
Eumi_a142	BA I44/74 surface colln, 3/N	Doctors Point	NZ	CR3&4	tibiotarsus	fossil	882	1133
Eumi_a143	BA I44/74 surface at 91 excun	Doctors Point	NZ	CR3&4	tibiotarsus	fossil	882	1133
Eumi_a144	BA I44/74 eroded foreshore 91	Doctors Point	NZ	CR3	tibiotarsus	fossil	882	1133
Eumi_a30	OUA PK/B/3-L3	Purakaunui	-	-	femur	early/middle	-	-
Eumi_a31	OUA PK/C/4-L2	Purakaunui	NZ	CR3&4	tibiotarsus	early/middle	1393	622
Eumi_a32	OUA PK/C/3-L3	Purakaunui	-	-	femur	early/middle	-	-
Eumi_a5	CM Av17619	Long Beach (Otago)	NZ	CR3/4	tibiotarsus	fossil	784	1230
Eumi_a58	CM Av17619A	Long Beach (Otago)	NZ	CR3/4	humerus	fossil	784	1230
Eumi_a57	CM Av17619B	Long Beach (Otago)	NZ	CR3/4	humerus	fossil	784	1230
Eumi_a56	CM Av17619C	Long Beach (Otago)	NZ	CR3/4	humerus	fossil	784	1230
Eumi_a55	CM Av17619D	Long Beach (Otago)	NZ	CR3/4	humerus	fossil	784	1230
Eumi_a54	CM Av17619E	Long Beach (Otago)	NZ	CR3/4	humerus	fossil	875	1140
Eumi_a52	CM Av17619F	Long Beach (Otago)	NZ	CR3/4	humerus	fossil	784	1230
Eumi_a60	CM Av17619G	Long Beach (Otago)	NZ	CR3/4	tibiotarsus	fossil	835	1180
Eumi_a59	CM Av17619H	Long Beach (Otago)	NZ	CR3/4	tibiotarsus	fossil	784	1230
Eumi_a99	OM LB/D/C5/l4	Long Beach (Otago)	NZ	CR3&4	coracoid	early	1356	658
Eumi_a100	OM LB/D/4G/l3	Long Beach (Otago)	NZ	CR3&4	humerus	middle	1554	461
Eumi_a101	OM LB/D/2C/l3	Long Beach (Otago)	NZ	CR3&4	femur	early/middle	1524	492

Sample Name	Museum Accession	Location	Lineage	Fragment	Element	Deposit type	Mean cal age (yrs BC/AD)	Mean cal age (yrs BP, 2014 AD)
Eumi_a61	CM Av13740	Kaikai's Beach	NZ	CR3/4	femur	any	-	-
Eumi_a118	JH I44/344,114	Harwood	NZ	CR3/4	humerus	fossil	1184	831
Eumi_a119	JH I44/344,10	Harwood	NZ	CR3/4	humerus	fossil	1184	831
Eumi_a25	OUA S2E4	Sandfly Bay	NZ	CR3/4	tibiotarsus	early	1396	618
Eumi_a49	CM Av34414A	Cannibal Bay	NZ	CR3/4	femur	fossil/early	1188	826
Eumi_a65	CM Av34414B	Cannibal Bay	NZ	CR3/4	femur	fossil/early	1188	826
Eumi_a64	CM Av34414C	Cannibal Bay	NZ	CR3/4	femur	fossil/early	1188	826
Eumi_a62	CM Av36176	Pounawea	-	-	tibiotarsus	early	-	-
Eumi_a63	CM Av34057	Pounawea	NZ	CR3/4	femur	early	1329	686
Eumi_a20	CM Av32874	Pounawea	-	-	femur	early	-	-
Eumi_a7	CM Av34572	Papatowai	NZ	CR3/4	femur	early	1343	672
Eumi_a26	OUA PPT5/BB3	Papatowai	NZ	CR3/4	humerus	early	1343	672
Eumi_a15	Landcare Research Collection	Colac Bay	NZ	CR3/4	humerus	fossil/early	-	-
Eumi_a16	Landcare Research Collection	Colac Bay	NZ	CR3/4	humerus	fossil/early	-	-
Eumi_a50	CM Av27269	Cave, Big Solander Is	NZ	CR3/4	tibiotarsus	fossil	-	-
Eumi_a1	CM Av14837	Mason Bay, Stw Is	NZ	CR3/4	femur	fossil	-	-
Eumi_a18	CM Av26146	Mason Bay, Stw Is	NZ	CR3/4	femur	fossil	-	-
Eumi_a10	CM Av26156	Mason Bay, Stw Is	NZ	CR3/4	femur	fossil	-	-
Eumi_a81	NMNZ S.36151.1	Mason Bay, Stw Is	NZ	CR3/4	femur	fossil	-	-
Eumi_a120	CM ONGPS37 unregistered	Old Neck, Stw Is	-	-	humerus	fossil/early	-	-
Eumi_a121	CM ONGSP41 unregistered	Old Neck, Stw Is	NZ	CR3&4	coracoid	fossil/early	-	-
Eumi_a122	CM ONGPS42 unregistered	Old Neck, Stw Is	NZ	CR3&4	coracoid	fossil/early		
Eumi_hi1	NMNZ OR.015386	Pilots Beach	AUS	CR3/4	skin toe pad	historic	1969	45
Eumi_hi2	NMNZ OR.015387	Pilots Beach	AUS	CR3/4	skin toe pad	historic	1969	45
Eumi_hi3	NMNZ OR.015388	Pilots Beach	AUS	CR3/4	skin toe pad	historic	1969	45
Eumi_hi4	NMNZ OR.015389	Pilots Beach	AUS	CR3/4	skin toe pad	historic	1969	45
Eumi_hi5	NMNZ OR.015390	Bobby's Head (Palmerston)	AUS	CR3/4	skin toe pad	historic	1969	45
Eumi_hi6	NMNZ OR.015391	Bobby's Head (Palmerston)	NZ	CR3/4	skin toe pad	historic	1969	45
Eumi_hi7	NMNZ OR.7210b	Cape Saunders	NZ	CR3&4	egg shell	historic	1906	108
Eumi_hi8	OM AV059	Otago/Dunedin	NZ	CR3	skin feathers	historic	1905	109
Eumi_hi9	OM AV060	Otago/Dunedin	AUS	CR3&4	skin feathers	historic	before 1915	99

Table S2. Proxy dates for Holocene fossil and archaeological sites containing *Eudyptula* remains. Radiocarbon dates were calibrated in OxCal v4.2 [13] using either the ShCal13 [14] or the Marine13 calibration curve [15] with a local ΔR value of -41±39 [16]. Median ages were calculated for each date (yrs BC/AD and yrs BP, present = AD 1950) and all median ages for one site were then averaged to obtain one mean calibrated age per site. Mean calibrated ages for a site were then standardised to AD 2014. Calibrated age ranges represent minimum and maximum calibrated age observed for a site. RCDB – New Zealand Radiocarbon Database.

Location	**Layer**	**Cal age range (yr BC/AD)**	**Mean cal age (yr BC/AD)**	**Mean cal age (yrs BP, AD 2014)**	**Material**	**Source**
Cape Wanbrow	natural	32661-31955 (BC)	32308 (BC)	34321	Marine bird	this study
Tai Rua	L5-6	1406-1621	1514	502	Marine shell	[1]
Shag River	all layers	1270-1459	1383	632	Charcoal, moa bone, Moa egg shell, marine bird	[2-3]
Pleasant River	upper	1320-1660	1509	507	Charcoal, marine shell	[4]
	lower	1291-1450	1359	656	Charcoal	[4]
Huriawa	upper & mid terrace	320-947	639	1370	Marine bird	this study
Ross Rocks	L3	1450-1797	1595	421	Marine shell	[5]; RCDB
	L3b	1273-1465	1369	645	Marine shell	[5]; RCDB
	L2	1019-1482	1282	751	Marine bird	this study
Omimi		1312-1492	1402	613	Fish bone	[6]
Warrington	AreaB, L1/1a	1316-1522	1397	617	Marine shell	RCDB
	5D, L2D2	1295-1440	1368	647	Marine bird	this study
	AreaB, L2/2b	1197-1421	1303	711	Marine shell	RCDB
Doctors Pt.		701-1034	882	1133	Marine bird	[7]
Purakaunui	North L2, South L2a	1272-1505	1393	622	Marine shell	[8-9]; RCDB
Long Beach	Natural	195-1246	793	1230	Marine bird	this study; [3, 7]
	LB/D/4G-L3	1426-1649	1539	476	Marine bird	this study
	OM U4C/l4	1266-1440	1356	658	Marine bird	[3]
Harwood		831-1385	1184	831	Marine bird	[3, 7]
Sandfly Bay	all areas	1288-1612	1396	618	Charcoal	[5]
Cannibal Bay	natural	915-1430	1188	826	Marine bird	[7]
Pounawea	upper	1311-1615	1431	584	Marine shell	[10]
	lower	1164-1450	1329	686	Moa bone	[10-11]; RCDB
Papatowai	all layers	1192-1476	1343	672	Moa bone, charcoal, marine shell	[5-12]; RCDB

Table S3. Parameter and 5% and 95% confidence estimates, and prior distributions for AUS and Combined models using long (Lo – 107bp) and short (Sh – 53bp) sequence fragments. Models were run at three different mutation rates, given in substitutions/site/million years (s/s/Myr), and using different summary statistics. Estimates of time are in units of generation time (8.75yr) before present (AD 2014). Anc – ancestral population, AUS – *E.novaehollandiae*, D – Tajima's D, Inter-PairDiffs – pairwise inter-specific differences, H – Haplotype diversity, $\overline{H_s}$ – mean inter-group diversity, Mdn – Median, MLE –Maximum Likelihood Estimate, Mod – modern population, N – effective population size, NZ – *E. minor*, p_{AUS} – proportion of *E. novaehollandiae* in the total population, PairDiff – pairwise inter- and intra-specific differences, r – population growth rate, $t_{invasion}$ – time of *E.novaehollandiae* invasion in Otago, t_{split} – time of most recent common ancestor of *E. minor* and *E.novaehollandiae*, t_{step} – time of change in *E. novaehollandiae* population proportions, U - uniform.

Model	Summary statistic	Parameter	MLE	Mdn	5%	95%	MLE	Mdn	5%	95%	MLE	Mdn	5%	95%	Prior
			0.53 (s/s/Myr)				0.96 (s/s/Myr)				0.96 (s/s/Myr)				
AUS0	PairDiffs	$log_{10}N$	3.22	3.17	2.50	3.68	3.01	2.94	2.31	3.46	2.80	2.78	2.21	3.29	U(2,6)
	D+Inter-PairDiffs	$log_{10}N$	3.22	3.17	2.50	3.68	3.01	2.94	2.31	3.46	2.80	2.78	2.21	3.29	U(2,6)
	H+Fst	$log_{10}N$	3.24	3.12	2.18	3.74	3.04	2.92	2.17	3.54	2.84	2.80	2.16	3.39	U(2,6)
	D+Fst+Hs	$log_{10}N$	3.47	3.24	2.29	3.84	3.08	3.02	2.24	3.65	3.06	2.87	2.17	3.46	U(2,6)
AUS1	PairDiffs	$log_{10}N_{mod}$	3.45	3.93	2.76	5.71	3.17	3.72	2.54	5.70	4.26	4.53	3.83	5.77	U(2,6)
		$log_{10}(-r)$	-2.44	-2.74	-4.61	-1.89	-2.14	-2.46	-4.58	-1.60	-3.33	-3.72	-4.81	-3.07	U(-5,0)
	D+Inter-PairPiffs	$log_{10}N_{mod}$	3.45	3.93	2.76	5.71	3.17	3.72	2.54	5.70	3.00	3.70	2.46	5.70	U(2,6)
		$log_{10}(-r)$	-2.44	-2.74	-4.61	-1.89	-2.14	-2.46	-4.58	-1.60	-1.96	-2.22	-4.52	-1.44	U(-5,0)
	H+Fst	$log_{10}N_{mod}$	3.43	3.55	2.37	5.50	3.16	3.31	2.28	5.47	2.89	3.24	2.26	5.49	U(2,6)
		$log_{10}(-r)$	-2.38	-2.80	-4.61	-1.73	-2.13	-2.63	-4.67	-1.51	-1.94	-2.43	-4.64	-1.37	U(-5,0)
	D+Fst+Hs	$log_{10}N_{mod}$	3.47	3.63	2.47	5.46	3.27	3.40	2.33	5.39	3.04	3.32	2.32	5.42	U(2,6)
		$log_{10}(-r)$	-2.53	-2.93	-4.67	-1.82	-2.23	-2.71	-4.66	-1.56	-2.01	-2.49	-4.64	-1.40	U(-5,0)
AUS2	PairDiffs	$log_{10}N_{mod}$	3.15	3.17	2.45	3.71	3.27	3.16	2.48	3.72	2.71	2.73	2.18	3.29	U(2,6)
		$log_{10}N_{anc}$	5.52	4.09	2.34	5.75	3.88	4.00	2.30	5.74	5.49	4.09	2.30	5.75	U(2,6)
		$t_{invasion}$	38.72	32.49	16.40	47.44	45.18	31.94	16.46	47.78	24.58	32.58	16.85	47.69	U(14,50)
	D+Inter-PairDiffs	$log_{10}N_{mod}$	3.15	3.17	2.45	3.71	2.96	2.92	2.29	3.46	2.71	2.73	2.18	3.29	U(2,6)
		$log_{10}N_{anc}$	5.52	4.09	2.34	5.75	4.96	4.07	2.32	5.74	5.49	4.09	2.30	5.75	U(2,6)
		$t_{invasion}$	38.72	32.49	16.40	47.44	36.68	32.51	16.58	47.65	24.58	32.58	16.85	47.69	U(14,50)
	H+Fst	$log_{10}N_{mod}$	3.32	3.26	2.34	5.10	2.97	3.04	2.23	4.96	2.92	2.88	2.18	5.01	U(2,6)
		$log_{10}N_{anc}$	2.27	3.65	2.15	5.69	2.28	3.68	2.15	5.69	2.25	3.76	2.15	5.71	U(2,6)
		$t_{invasion}$	41.32	33.83	16.65	47.84	45.68	33.14	16.60	47.89	45.54	33.50	16.92	47.86	U(14,50)
	D+Fst+Hs	$log_{10}N_{mod}$	3.43	3.31	2.40	4.52	3.12	3.08	2.26	4.51	2.97	2.92	2.22	4.40	U(2,6)
		$log_{10}N_{anc}$	2.33	3.85	2.20	5.72	2.30	3.89	2.19	5.72	2.30	3.93	2.20	5.71	U(2,6)
		$t_{invasion}$	42.16	33.13	16.37	47.65	37.38	33.07	16.68	47.88	45.96	33.53	16.83	47.95	U(14,50)
Comb1 Lo	PairDiffs	$log_{10}N_{AUS}$	3.70	3.44	2.22	4.27	3.52	3.16	2.17	3.96	3.65	3.85	2.25	5.71	U(2,6)
		$log_{10}N_{NZ}$	3.36	3.53	2.25	5.53	2.99	3.36	2.22	5.52	3.25	3.90	2.25	5.73	U(2,6)
		$log_{10}N_{anc}$	2.50	3.49	2.19	5.69	2.54	3.53	2.20	5.64	2.40	3.99	2.25	5.75	U(2,6)
		$t_{invasion}$	23.56	43.18	16.45	166.73	32.74	43.58	16.84	167.24	35.68	99.71	22.64	187.50	U(12,200)
		p_{AUS}	0.90	0.65	0.16	0.96	0.66	0.63	0.15	0.95	0.74	0.52	0.07	0.94	U(0,1)
		$log_{10}t_{split}$	3.96	3.86	2.70	4.23	3.70	3.64	2.60	4.11	3.87	3.74	2.51	4.89	U(2.3,4.3)
	D+Inter-	$log_{10}N_{AUS}$	3.70	3.44	2.22	4.27	3.52	3.16	2.17	3.96	3.65	3.85	2.25	5.71	U(2,6)

	PairDiffs	$\log_{10}N_{NZ}$	3.36	3.53	2.25	5.53	2.99	3.36	2.22	5.52	3.25	3.90	2.25	5.73	U(2,6)
		$\log_{10}N_{anc}$	2.50	3.49	2.19	5.69	2.54	3.53	2.20	5.64	2.40	3.99	2.25	5.75	U(2,6)
		$t_{invasion}$	23.56	43.18	16.45	166.73	32.74	43.58	16.84	167.24	35.68	99.71	22.64	187.50	U(12,200)
		p_{AUS}	0.90	0.65	0.16	0.96	0.66	0.63	0.15	0.95	0.74	0.52	0.07	0.94	U(0,1)
		$\log_{10}t_{split}$	3.96	3.86	2.70	4.23	3.70	3.64	2.60	4.11	3.87	3.74	2.51	4.89	U(2.3,4.3)
	H+Fst	$\log_{10}N_{AUS}$	2.51	3.30	2.17	5.58	2.58	3.31	2.17	5.54	3.11	3.96	2.26	5.75	U(2,6)
		$\log_{10}N_{NZ}$	2.72	3.20	2.19	5.38	2.82	3.08	2.18	5.22	3.42	3.90	2.25	5.74	U(2,6)
		$\log_{10}N_{anc}$	2.25	3.42	2.11	5.64	2.27	3.41	2.12	5.65	2.62	3.95	2.25	5.74	U(2,6)
		$t_{invasion}$	21.31	33.97	15.29	120.63	41.92	34.36	15.35	122.87	62.85	100.60	23.61	188.07	U(12,200)
		p_{AUS}	0.93	0.81	0.31	0.98	0.93	0.81	0.31	0.98	0.90	0.52	0.07	0.94	U(0,1)
		$\log_{10}t_{split}$	4.13	3.72	2.68	4.23	4.11	3.73	2.71	4.23	4.19	3.74	2.51	4.89	U(2.3,4.3)
	D+Fst+Hs	$\log_{10}N_{AUS}$	2.57	3.38	2.18	5.62	2.59	3.37	2.18	5.59	3.92	3.94	2.25	5.74	U(2,6)
		$\log_{10}N_{NZ}$	2.78	3.22	2.20	5.41	2.79	3.09	2.18	5.24	3.17	3.96	2.27	5.74	U(2,6)
		$\log_{10}N_{anc}$	2.25	3.43	2.11	5.65	2.28	3.48	2.13	5.66	2.63	3.96	2.25	5.74	U(2,6)
		$t_{invasion}$	20.94	33.93	15.26	118.68	41.81	34.00	15.26	102.56	41.56	101.00	23.13	187.70	U(12,200)
		p_{AUS}	0.93	0.81	0.33	0.98	0.94	0.82	0.34	0.98	0.89	0.52	0.07	0.94	U(0,1)
		$\log_{10}t_{split}$	4.12	3.72	2.69	4.23	4.11	3.74	2.73	4.23	4.08	3.75	2.51	4.89	U(2.3,4.3)
Comb2 Lo	PairDiffs	$\log_{10}N_{AUS}$	3.46	3.09	2.15	4.03	3.19	2.92	2.13	3.76	3.03	2.98	2.13	3.86	U(2,6)
		$\log_{10}N_{NZ}$	3.35	3.16	2.22	4.10	2.64	2.93	2.16	3.89	3.08	3.03	2.17	3.93	U(2,6)
		$\log_{10}N_{anc}$	3.08	3.95	2.26	5.73	3.53	4.00	2.27	5.74	2.35	3.98	2.23	5.73	U(2,6)
		t_{step}	8.88	6.75	1.97	10.41	9.06	6.81	1.95	10.43	9.00	6.95	1.95	10.41	U(12,200)
		$p1_{AUS}$	0.95	0.83	0.58	0.98	0.90	0.83	0.58	0.98	0.92	0.83	0.58	0.98	U(0,1)
		$t_{invasion}$	25.42	34.30	15.29	59.84	20.55	33.04	14.84	59.86	38.79	34.32	14.92	60.63	U(12,200)
		$p2_{AUS}$	0.68	0.54	0.08	0.93	0.72	0.52	0.08	0.93	0.63	0.51	0.08	0.94	U(0,1)
		$\log_{10}t_{split}$	4.17	4.07	3.50	4.27	3.88	3.84	3.27	4.14	4.04	3.96	3.38	4.23	U(2.3,4.3)
	D+Inter-PairDiffs	$\log_{10}N_{AUS}$	3.46	3.09	2.15	4.03	3.19	2.92	2.13	3.76	3.03	2.98	2.13	3.86	U(2,6)
		$\log_{10}N_{NZ}$	3.35	3.16	2.22	4.10	2.64	2.93	2.16	3.89	3.08	3.03	2.17	3.93	U(2,6)
		$\log_{10}N_{anc}$	3.08	3.95	2.26	5.73	3.53	4.00	2.27	5.74	2.35	3.98	2.23	5.73	U(2,6)
		t_{step}	8.88	6.75	1.97	10.41	9.06	6.81	1.95	10.43	9.00	6.95	1.95	10.41	U(12,200)
		$p1_{AUS}$	0.95	0.83	0.58	0.98	0.90	0.83	0.58	0.98	0.92	0.83	0.58	0.98	U(0,1)
		$t_{invasion}$	25.42	34.30	15.29	59.84	20.55	33.04	14.84	59.86	38.79	34.32	14.92	60.63	U(12,200)
		$p2_{AUS}$	0.68	0.54	0.08	0.93	0.72	0.52	0.08	0.93	0.63	0.51	0.08	0.94	U(0,1)
		$\log_{10}t_{split}$	4.17	4.07	3.50	4.27	3.88	3.84	3.27	4.14	4.04	3.96	3.38	4.23	U(2.3,4.3)
	H+Fst	$\log_{10}N_{AUS}$	3.00	3.06	2.16	4.49	2.85	2.95	2.16	4.23	2.85	3.02	2.17	4.41	U(2,6)
		$\log_{10}N_{NZ}$	3.12	3.16	2.30	4.31	2.99	3.04	2.26	4.11	3.04	3.09	2.28	4.24	U(2,6)
		$\log_{10}N_{anc}$	2.42	3.80	2.21	5.70	2.39	3.83	2.21	5.73	2.32	3.79	2.19	5.72	U(2,6)
		t_{step}	9.68	7.23	2.20	10.46	8.98	7.17	2.14	10.45	7.01	7.22	2.07	10.43	U(12,200)
		$p1_{AUS}$	0.95	0.86	0.63	0.98	0.94	0.87	0.64	0.98	0.96	0.87	0.64	0.98	U(0,1)
		$t_{invasion}$	36.53	32.72	14.79	55.90	22.25	32.18	14.87	54.82	41.74	32.44	14.73	55.53	U(12,200)
		$p2_{AUS}$	0.81	0.57	0.08	0.94	0.83	0.56	0.07	0.94	0.84	0.56	0.07	0.94	U(0,1)
		$\log_{10}t_{split}$	4.18	3.92	3.19	4.26	4.15	3.89	3.04	4.25	4.19	3.91	3.09	4.25	U(2.3,4.3)
	D+Fst+Hs	$\log_{10}N_{AUS}$	3.18	3.19	2.19	4.86	3.08	3.04	2.18	4.44	3.05	3.12	2.18	4.66	U(2,6)
		$\log_{10}N_{NZ}$	3.11	3.20	2.31	4.40	3.01	3.04	2.26	4.10	3.05	3.11	2.29	4.27	U(2,6)
		$\log_{10}N_{anc}$	2.43	3.85	2.22	5.70	2.42	3.82	2.21	5.71	2.32	3.79	2.19	5.72	U(2,6)
		t_{step}	8.00	7.19	2.14	10.45	6.19	7.15	2.16	10.46	7.01	7.21	2.05	10.43	U(12,200)
		$p1_{AUS}$	0.96	0.87	0.63	0.98	0.96	0.87	0.64	0.98	0.97	0.87	0.64	0.98	U(0,1)
		$t_{invasion}$	32.11	32.47	14.78	55.34	21.23	32.24	14.91	54.91	41.62	32.32	14.73	54.95	U(12,200)
		$p2_{AUS}$	0.80	0.59	0.08	0.94	0.83	0.57	0.08	0.94	0.89	0.57	0.07	0.95	U(0,1)
		$\log_{10}t_{split}$	4.18	3.94	3.23	4.26	4.16	3.90	3.12	4.25	4.20	3.91	3.12	4.26	U(2.3,4.3)
Comb1 Sh	PairDiffs	$\log_{10}N_{AUS}$	3.89	3.54	2.22	4.38	3.61	3.34	2.20	4.12	3.47	3.21	2.18	3.95	U(2,6)
		$\log_{10}N_{NZ}$	3.65	3.70	2.29	5.58	3.46	3.65	2.29	5.63	3.25	3.55	2.24	5.64	U(2,6)
		$\log_{10}N_{anc}$	2.67	3.73	2.24	5.70	2.65	3.70	2.24	5.71	2.71	3.80	2.24	5.73	U(2,6)
		$t_{invasion}$	33.11	53.12	17.95	181.44	33.84	56.97	18.14	179.91	30.91	60.00	18.41	182.47	U(12,200)
		p_{AUS}	0.67	0.58	0.10	0.94	0.76	0.55	0.09	0.93	0.66	0.54	0.09	0.94	U(0,1)
		$\log_{10}t_{split}$	4.10	3.98	2.67	4.53	3.78	3.68	2.63	4.25	3.58	3.50	2.57	4.07	U(2.3,4.3)
	D+Inter-PairPiffs	$\log_{10}N_{AUS}$	3.89	3.54	2.22	4.38	3.61	3.34	2.20	4.12	3.47	3.21	2.18	3.95	U(2,6)
		$\log_{10}N_{NZ}$	3.65	3.70	2.29	5.58	3.46	3.65	2.29	5.63	3.25	3.55	2.24	5.64	U(2,6)
		$\log_{10}N_{anc}$	2.67	3.73	2.24	5.70	2.65	3.70	2.24	5.71	2.71	3.80	2.24	5.73	U(2,6)
		$t_{invasion}$	33.11	53.12	17.95	181.44	33.84	56.97	18.14	179.91	30.91	60.00	18.41	182.47	U(12,200)
		p_{AUS}	0.67	0.58	0.10	0.94	0.76	0.55	0.09	0.93	0.66	0.54	0.09	0.94	U(0,1)
		$\log_{10}t_{split}$	4.10	3.98	2.67	4.53	3.78	3.68	2.63	4.25	3.58	3.50	2.57	4.07	U(2.3,4.3)
	H+Fst	$\log_{10}N_{AUS}$	3.47	3.64	2.23	5.56	3.42	3.48	2.21	5.52	3.11	3.45	2.21	5.54	U(2,6)
		$\log_{10}N_{NZ}$	3.57	3.57	2.35	5.34	3.25	3.48	2.34	5.34	3.08	3.36	2.28	5.23	U(2,6)
		$\log_{10}N_{anc}$	2.25	3.18	2.11	5.65	2.27	3.27	2.11	5.68	2.22	3.29	2.11	5.66	U(2,6)

		$t_{invasion}$	38.27	32.51	14.97	76.38	41.65	33.27	15.26	82.79	43.39	33.41	15.15	83.44	U(12,200)
		p_{AUS}	0.92	0.79	0.35	0.97	0.92	0.81	0.35	0.98	0.94	0.81	0.36	0.98	U(0,1)
		$log_{10}t_{split}$	4.80	4.38	3.04	4.97	4.56	4.27	2.93	4.96	4.83	4.26	2.93	4.96	U(2.3,4.3)
	D+Fst+Hs	$log_{10}N_{AUS}$	3.67	3.72	2.24	5.60	3.42	3.52	2.21	5.57	3.09	3.49	2.22	5.56	U(2,6)
		$log_{10}N_{NZ}$	3.57	3.60	2.37	5.40	3.22	3.49	2.35	5.37	3.07	3.35	2.28	5.25	U(2,6)
		$log_{10}N_{anc}$	2.25	3.24	2.11	5.65	2.28	3.37	2.12	5.70	2.22	3.36	2.11	5.67	U(2,6)
		$t_{invasion}$	38.98	32.66	15.05	73.24	40.97	33.13	15.25	70.94	43.39	33.17	15.10	74.85	U(12,200)
		p_{AUS}	0.93	0.80	0.36	0.98	0.93	0.82	0.38	0.98	0.94	0.82	0.38	0.98	U(0,1)
		$log_{10}t_{split}$	4.82	4.40	3.07	4.98	4.80	4.28	3.00	4.96	4.83	4.27	2.98	4.96	U(2.3,4.3)
Comb2 Sh	PairDiffs	$log_{10}N_{AUS}$	3.63	3.27	2.17	4.20	3.36	2.99	2.13	3.85	3.14	2.87	2.12	3.71	U(2,6)
		$log_{10}N_{NZ}$	3.34	3.33	2.23	4.78	3.31	3.13	2.20	4.35	3.00	3.01	2.16	4.28	U(2,6)
		$log_{10}N_{anc}$	2.50	3.96	2.25	5.75	2.59	3.94	2.26	5.74	2.73	3.98	2.26	5.75	U(2,6)
		t_{step}	6.83	6.69	1.88	10.40	6.22	6.71	1.87	10.43	9.00	6.73	1.90	10.37	U(12,200)
		$p1_{AUS}$	0.95	0.83	0.58	0.98	0.95	0.82	0.58	0.98	0.95	0.82	0.57	0.98	U(0,1)
		$t_{invasion}$	32.45	35.44	15.22	61.13	22.25	33.71	14.94	59.99	25.20	34.61	14.98	61.27	U(12,200)
		$p2_{AUS}$	0.39	0.48	0.07	0.92	0.50	0.48	0.07	0.92	0.40	0.48	0.07	0.92	U(0,1)
		$log_{10}t_{split}$	4.22	4.05	3.35	4.27	4.00	3.88	3.24	4.20	3.77	3.73	3.09	4.08	U(2.3,4.3)
	D+Inter-PairDiffs	$log_{10}N_{AUS}$	3.63	3.27	2.17	4.20	3.36	2.99	2.13	3.85	3.14	2.87	2.12	3.71	U(2,6)
		$log_{10}N_{NZ}$	3.34	3.33	2.23	4.78	3.31	3.13	2.20	4.35	3.00	3.01	2.16	4.28	U(2,6)
		$log_{10}N_{anc}$	2.50	3.96	2.25	5.75	2.59	3.94	2.26	5.74	2.73	3.98	2.26	5.75	U(2,6)
		t_{step}	6.83	6.69	1.88	10.40	6.22	6.71	1.87	10.43	9.00	6.73	1.90	10.37	U(12,200)
		$p1_{AUS}$	0.95	0.83	0.58	0.98	0.95	0.82	0.58	0.98	0.95	0.82	0.57	0.98	U(0,1)
		$t_{invasion}$	32.45	35.44	15.22	61.13	22.25	33.71	14.94	59.99	25.20	34.61	14.98	61.27	U(12,200)
		$p2_{AUS}$	0.39	0.48	0.07	0.92	0.50	0.48	0.07	0.92	0.40	0.48	0.07	0.92	U(0,1)
		$log_{10}t_{split}$	4.22	4.05	3.35	4.27	4.00	3.88	3.24	4.20	3.77	3.73	3.09	4.08	U(2.3,4.3)
	H+Fst	$log_{10}N_{AUS}$	2.87	3.13	2.17	4.87	3.07	3.08	2.18	4.76	2.75	2.97	2.15	4.57	U(2,6)
		$log_{10}N_{NZ}$	3.28	3.38	2.38	5.13	3.14	3.22	2.31	4.71	3.23	3.17	2.30	4.55	U(2,6)
		$log_{10}N_{anc}$	2.39	3.72	2.18	5.72	2.35	3.67	2.17	5.68	2.25	3.68	2.16	5.71	U(2,6)
		t_{step}	9.00	7.06	2.09	10.42	6.21	7.05	2.10	10.44	6.99	7.16	2.07	10.44	U(12,200)
		$p1_{AUS}$	0.95	0.87	0.64	0.98	0.96	0.86	0.63	0.98	0.97	0.87	0.64	0.99	U(0,1)
		$t_{invasion}$	35.17	33.26	14.94	56.56	21.68	32.32	14.68	58.00	27.24	32.42	14.78	56.56	U(12,200)
		$p2_{AUS}$	0.58	0.50	0.07	0.91	0.53	0.47	0.06	0.91	0.59	0.49	0.06	0.92	U(0,1)
		$log_{10}t_{split}$	4.18	3.91	3.17	4.25	4.14	3.87	3.05	4.25	4.19	3.86	3.00	4.25	U(2.3,4.3)
	D+Fst+Hs	$log_{10}N_{AUS}$	2.99	3.27	2.20	5.15	2.75	3.18	2.20	4.99	2.83	3.05	2.17	4.83	U(2,6)
		$log_{10}N_{NZ}$	3.29	3.41	2.40	5.19	3.15	3.24	2.33	4.83	3.20	3.18	2.31	4.59	U(2,6)
		$log_{10}N_{anc}$	2.41	3.67	2.19	5.72	2.35	3.67	2.18	5.68	2.26	3.65	2.16	5.70	U(2,6)
		t_{step}	9.00	7.09	2.07	10.44	6.21	7.06	2.14	10.45	8.00	7.13	2.06	10.45	U(12,200)
		$p1_{AUS}$	0.96	0.88	0.65	0.98	0.96	0.87	0.64	0.99	0.97	0.88	0.65	0.99	U(0,1)
		$t_{invasion}$	35.05	33.04	14.97	55.83	18.63	32.20	14.74	57.19	27.01	32.21	14.80	55.92	U(12,200)
		$p2_{AUS}$	0.60	0.51	0.07	0.92	0.52	0.49	0.07	0.92	0.66	0.51	0.06	0.92	U(0,1)
		$log_{10}t_{split}$	4.20	3.93	3.25	4.26	4.13	3.88	3.10	4.25	4.19	3.87	3.05	4.25	U(2.3,4.3)

Table S4. Statistical support for the maximally credible version of the AUS and Combined models for different mutation rates given in substitutions/site/million years (s/s/Myr). Supported models are highlighted in grey. Lo – long sequence fragments (107 bp); Sh – short sequence fragments (53 bp).

Model	Parameters	AICc	Weight	Support	Beaumont
AUS Models					
0.53 s/s/Myr					
0	1	6.0529	1.0000	0.9970	0.5690
1	2	25.4008	0.0001	0.0001	0.4110
2	3	17.6917	0.0030	0.0030	0.0200
0.96 s/s/Myr					
0	1	5.8721	1.0000	0.7650	0.5050
1	2	28.5094	0.0000	0.0000	0.2610
2	3	8.2329	0.3072	0.2350	0.2340
1.43 s/s/Myr					
0	1	55.9110	1.0000	1.0000	0.8930
1	2	326.7821	0.0000	0.0000	0.0330
2	3	133.1493	0.0000	0.0000	0.0740
Combined Models (Lo)					
0.53 s/s/Myr					
1	5	30.1583	0.0045	0.0045	0.1610
2	7	19.3423	1.0000	0.9955	0.8390
0.96 s/s/Myr					
1	5	23.0278	0.0150	0.0148	0.3570
2	7	14.6344	1.0000	0.9852	0.6430
1.43 s/s/Myr					
1	5	21.3038	0.0179	0.0175	0.1310
2	7	13.2526	1.0000	0.9825	0.8690
Combined Models (Sh)					
0.53 s/s/Myr					
1	5	26.0710	0.0060	0.0060	0.1060
2	7	15.8400	1.0000	0.9940	0.8940
0.96 s/s/Myr					
1	5	18.2819	1.0000	0.5289	0.0750
2	7	18.5131	0.8908	0.4711	0.9250
1.43 s/s/Myr					
1	5	24.1061	0.0884	0.0812	0.0050
2	7	19.2543	1.0000	0.9188	0.9950

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