NOTORNIS
is the journal of the Ornithological Society of New Zealand (Inc.)
Editor: E. W. Dawson,
P.O. Box 8009,
WELLINGTON.

VOLUME 21 PART 1 MARCH, 1974

MOA AND MAN IN NEW ZEALAND*

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ABSTRACT

Identifications of Moa bones from 25 North Island, 2 D'Urville Island, 38 South Island and 2 Stewart Island archaeological sites are tabulated.

In North Island sites the most widely represented genus is *Dinornis,* known from the north of the North Auckland peninsula to the Wellington area, followed in decreasing order of representation (though not necessarily of abundance at any one site) by *Pachyornis, Euryapteryx* and *Anomalopteryx.*

In South Island sites *Euryapteryx* is the predominant genus, followed in decreasing order of abundance by *Emeus, Dinornis, Pachyornis, Anomalopteryx* and *Megalapteryx. Dinornis,* common all along the South Island East Coast before the arrival of Man, is not known from archaeological sites on this coast north of Christchurch.

Man was probably responsible for the final extinction of at least the larger Moas, though natural causes may have contributed to a general decline in numbers.

The determination of Moa species, sometimes even of genera, from middens and other deposits associated with Man is often a long and wearisome process. The Moa-hunter Maori usually broke the bones, in order, presumably, to extract the marrow, or to utilise them for making tools and ornaments, so that the bones generally reach us as fragments. Skulls are seldom present (we know from finds at Shag River and Wairau Bar that it was usual to chop off the head and upper vertebrae and discard them before cooking the birds, and this may have happened miles from camp). In addition, the surface features of the bones have sometimes more or less disappeared through erosion. Moa, and other " Archaic " birds such as *Aptornis,* the big extinct Rail, and *Nesophalaris,* the extinct Coot, varied considerably in size and shape *within the species.* Added to this in the North Island

* The slightly revised. but not up-dated, text of a paper presented at the 39th ANZAAS Congress, Melbourne, 16-20 January 1967.

TABLE 1. Carbon fourteen age in years before 1950 (years B.P.) for archaeological sites containing Moa bone. (These figures have been brought up to date using the new half life value and have been corrected for secular variation following the Michael and Ralph method by B.G. McFadgen, pers. com. July 1973).

Archaeological Site Number	Site	Years B.P. (revised & corrected)	Approx. Date A.D.	Sample Reference No.
North Island				
N 40/3	Skipper's Midden, Opito	654 ± 50	1296	N.Z. 354
N 40/9	Sarah's Gully	621 ± 50	1329	N.Z. 357
N 40/9	Sarah's Gully	664 ± 50	1286	N.Z. 359
N 129/77	Ohawe	682 ± 59	1268	N.Z. 718
N 129/78	Te Rangatapu No.1	568 ± 56	1382	N.Z. 723
N 160/50	Paremata	547 ± 48	1403	N.Z. 510
South Island				
S 7/1	Heaphy River	573 ± 70	1377	N.Z. 509
S 29/7	Wairau Bar	824 ± 50	1126	N.Z. 50
S 29/7	Wairau Bar	922 ± 110	1028	Yale 204
S 84/76	Hamilton's, Redcliffs	1144 ± 65	806	N.Z. 438
S 84/77	Moabone Pt Cave, Redcliffs	660 ± 62	1290	N.Z. 437
S 136/1	Tai Rua, Otago	576 ± 32	1374	N.Z. 752
S 136/2	Teschemaker's, Ototara	561 ± 32	1389	N.Z. 560
S 140/2	Notornis Valley	347 ± 60	1603	N.Z. 51
S 143/1	Hawkesburn (early)	631 ± 60	1319	N.Z. 62
S 143/1	Hawkesburn (late)	446 ± 55	1504	N.Z. 59
S 146/2	Waimataitai	657 ± 30	1293	N.Z. 579
S 155/5	Shag River	795 ± 45	1155	N.Z. 605
S 155/5	Shag River	819 ± 56	1131	N.Z. 606
S 184/1	Pounawea (early)	631 ± 60	1319	N.Z. 57
S 184/1	Pounawea (late)	426 ± 60	1524	N.Z. 54
S 184/2	Hinahina	719 ± 75	1231	N.Z. 53
S 184/3	False Island	487 ± 60	1463	N.Z. 141
S 184/5	Papatowai (early)	744 ± 30	1206	N.Z. 134
S 184/5	Papatowai (mid.)	476 ± 50	1474	N.Z. 137
S 184/7	Tautuku	371 ± 80	1579	N.Z. 146

there was a wide range of small forms, often little known to the systematist. Comparative material is scarce, and I expect we may have to unite some forms now regarded as "species." Individual bones, particularly tibio-tarsi, are very similar, e.g. the upper size range of *Emeus crassus* and the lower range of *Euryapteryx gravis,* or the upper size range of the latter and the lower range of *Pachyornis elephantopus.* Considering all these points identification difficulties become obvious.

However, the bones are occasionally whole, or in large pieces, and even small fragments sometimes have distinguishing features, so that with time and patience one can identify most of the material with complete confidence, and the remainder, at least to genus, with a reasonable degree of certainty.

Whether one can distinguish between subfossil or fossil bone and bone that was fresh or "green" when used, is often questioned. Subfossil bone from loess, usually but not always from swamps, and often from caves, is more or less heavily mineralised. From sandhills it is almost invariably light, unless it has been lying in very damp sand. The degree of mineralisation is a very unreliable criterion of age, e.g. two bones from different parts of a Moa-hunter site at Tai Rua, Otago, one of which was heavily mineralised, the other light, were both dated by the collagen content to B.P. 576± 32, exactly the same age. What is characteristic of bone that was fresh at the time of breaking is the way it fractures, and the appearance when cut or sawn. Mr Les Lockerbie and I have, independently, experimented and proved this. The difference is hard to describe, but can be demonstrated.

In Tables 2 and 3, I have included only those sites where I am satisfied that the bones were from contemporaneously killed birds. I have examined almost all of the bones included in the tables, the exceptions being bones from three sites, from two of which the determinations are by Dr John Yaldwyn; through his courtesy I was able to examine bones from two other sites in the National Museum, Wellington. The other exception is the collection of bones made by Mantell at Ohawe (Waingongoro). The tables list the results from 25 North Island sites (including Great Barrier Island), 2 D'Urville Island, 38 South Island and 2 Stewart Island sites, where Man used the Moa for food and often for artifacts.

I have omitted the important inland site of Poukawa, Hawkes Bay, because although Man undoubtedly killed several genera of Moa there, he was probably not what we usually understand by a Moa-hunter Maori, and the site is much too controversial to be discussed in this paper.

I have grouped 4 pairs of "species," *Emeus crassus* and "*E. huttoni,*" *Megalapteryx didinus* and "*M. hectori,*" because I believe in each case that only one true, but variable, species existed, and *Dinornis giganteus* and "*D. hercules.*" The latter is a bow-legged little-known variant and probably only a form of *giganteus.* The 4th grouping is of *Euryapteryx gravis* and *E. haasti,* which cannot be

TABLE 2. Moa species from North Island archaeological sites.

		Anomalopteryx didiformis	*Euryapteryx curtus*	*Euryapteryx exilis*	*Euryapteryx geranoides*	*Pachyornis septentrionalis*	*Pachyornis mappini*	*Dinornis gazella*	*Dinornis struthoides*	*Dinornis novaezealandiae*	*Dinornis giganteus* & *D. hercules*
NORTH AUCKLAND											
	Ocean Beach, Whangarei Heads		x		x						
N 7 on 870 from 930-950	Doubtless Bay, dune midden		x								
N 30/5	Haratonga, Great Barrier Island				x ?						
N 75/1	Tokoroa		x ?								
N 6/4	Houhora	2	80	103	6				7		4
COROMANDEL PENINSULA											
N 44/2	Tairua				x	x	x	?	x	x	x
N 46/47/17	Jolly's Midden, Manukau Heads										x
N 40/2	Parker's Midden, Opito (a)			x	x				x ?		
N 40/3	Skipper's Midden, Opito			xr					x		x
N 40/9	Sarah's Gully				?				x		x
N 40/6	Black's Midden, Mahinapua Bay			x	x						
	Whiritoa		x ?				x		x	x	

TARANAKI											
	Rahotu Beach			x		x	x			x	
N 129/77	Ohawe (Buist)	x				x	x?	x		x	x
	Ohawe (Mantell)	x	x	x							
N 129/78	Te Rangatapu No.1 (Waingongoro)	x				x		x	x	x	
N 129/233	Te Rangatapu No.2 (Waingongoro)	x	x			x	x			x	
N 128/3	Kaupokonui	x		x	xr	x	x	x?			
HAWKES BAY											
	Limestone Rock-shelter, Puketitiri (a)			x?							
WELLINGTON											
N 160/50	Paremata (Sinclair) (b)	19	4	7		7		6			46
N 160/50	Paremata (Davidson) (b)	1	1	2		2		1+2?			17
	Akiteo										x
	Te Ika A Maru (c)					x?					?
N 164/2	Makara Beach (c)	x				x?					x
N 148/1	Foxton (d)					x					

TABLE 3. Moa species from D'Urville Island, South Island and Stewart Island archaeological sites.

D'URVILLE ISLAND, SOUTH ISLAND, STEWART ISLAND	D'URVILLE ISLAND: S 103/3 Greville Harbour (c)	D'URVILLE ISLAND: Omana, southern coast	NELSON - TAKAKA: S 14/1 Rotokura, Cable Bay	NELSON - TAKAKA: S 29/2 Tahunanui	NELSON - TAKAKA: S 9/13 Anapahi	NELSON - TAKAKA: S 7/1 Heaphy River
Megalapteryx didinus	x		x1			
Anomalopteryx didiformis			x	x	x	x
Emeus crassus & *E. huttoni*						
Euryapteryx new species						
Euryapteryx gravis & *E. haasti*				larger species not determined		
Pachyornis elephantopus						
Dinornis species		x				x ?
Dinornis torosus			x			
Dinornis robustus	x					
Dinornis maximus						

MARLBOROUGH											
S 49/46	Oliver's, Kaikoura						1*				
S 29/8	Marfell Beach, Lake Grassmere						14*		40*	1*	
S 29/5	Mussel Point, Lake Grassmere						1*		1*		
	Cape Campbell								1*		
S 29/7	Wairau Bar						*x* a		*x*	*x* r	1
CANTERBURY											
S 103/1	Wakanui Creek, Ashburton						1*				
	Hikurangi, Banks Peninsula						1*				
S 94/30	Midden D, Tumbledown Bay, Banks Peninsula								1		
S 84/76	Redcliffs, Sumner	1*				3*	69*		54*	3*	
S 84/77	Moabone Point Cave, Redcliffs	3					*x* a		*x*		
S 84/46	Bromley						*x*				
S 62/1	Domain Stream, Hurunui						1*				
SOUTHLAND - OTAGO											
S 184/5	Papatowai (= McLennan R. = Tahakopa R.)	5	4	3	2(e) 1	44	366	72	157	23	2(f)

Table 3 continued.

		Megalapteryx didinus	*Anomalopteryx didiformis*	*Emeus crassus* & *E. huttoni*	*Euryapteryx* new species	*Euryapteryx gravis* & *E. haasti*	*Pachyornis elephantopus*	*Dinornis* species	*Dinornis torosus*	*Dinornis robustus*	*Dinornis maximus*
SOUTHLAND-OTAGO											
S 184/1	Pounawea	3	3(g)	20	10	36	14				1
S 184/3	False Island (Owaka)			6	3	1					
	Kaka Point, Port Molyneux			3		3					
S 184/6	King's Rock							1(h)	1(h)	1	
S 140/2	Notornis Valley	1*									
	Long Island, Dusky Sound					1*(i)					
S 143/1	Hawkesburn (Inland Otago)		7			104	7				
S 164/1	Little Papanui			3		4					2
	Anderson's Landing			3		3					1
S 164/20	Long Beach			4							
S 164/17	Kaikai's Beach					1					
S 184/7	Tautuku									1*(j)	
	Pleasant River			x?		x		x1			

S 155/2	Pleasant River Mouth						x				
S 155/7	Seacliff		1(k)						1		
S 136/1	Tai Rua				xr	x	x				
S 155/5	Shag River (l) (Shag Point)	2	5			3	88		4		
S 136/2	Teschemakers, Ototara						x				
S 146/2	Waimataitai Mouth, Katiki					x	x		x		x?
S 128/1	Waitaki River			1		18	64		22		
S 109/9	Shepherd's Creek II, Waitaki River						x				x
STEWART ISLAND											
S 189/4	Old Neck							44			
S 189/1	Native Island						1*				

Footnotes to Tables 2 and 3.

(a) *Dinornis*, but not certainly *D. struthoides*; (b) There was much more fragmentary material from Paremata which was un-identifiable; (c) Determinations by John Yaldwyn, *Dinornis hercules* at Makara and *Megalapteryx hectori* rather than *M. didinus* at Greville Harbour; (d) Other genera were present at Foxton but I have not seen them; (e) 2 sub-adult bones either *D. robustus* or *D. torosus*; (f) Shaft fragments of tibio-tarsi, probably *Megalapteryx*, but possibly *Anomalapteryx*; (g) Determinations as *Anomalapteryx* not quite certain; (h) *Dinornis maximus* or *D. robustus*; (i) 2 fragments of tibio-tarsi, one of femur. Probably of a 'haunch' taken to the site from elsewhere, e.g. Southland; (j) Associated femur, tibio-tarsus and tarso-metatarsus found in position of articulation; (k) Part of pelvis of *Dinornis*, probably *D. robustus*; (l) There are many more bones from Shag River which I have not seen.

TABLE 4. Sites at which Moa bone is present but has not been identified.

NORTH ISLAND

Various places at Tokerau Beach, Doubtless Bay, and Tom Bowling Bay, Northland, contain Moa bones and are probably eroded midden judging by the artifacts also found, but being in sand dunes the association is not certain.

Motutapu, Auckland, under the Rangitoto ash-shower of about A.D. 1200 (bone and eggshell).

Near Whangamata, Coromandel Peninsula.

Hotwater Beach, Coromandel Peninsula, two adjacent middens.

Robinson's site, near Hawera, Taranaki.

Near Arawhata Stream, Wairarapa, weathered out of sand with other midden material. Primary association with Man probable but unproved.

SOUTH ISLAND

S 111/1 Dashing Rocks, Timaru, Canterbury.

S 146/6 Matakaea, Otago.

separated unless the bills are present, and which I consider were subspecies.

With many of the South Island and a few of the North Island collections, I have counted the total number of identifiable bones or pieces of bone of each species, and have thus arrived at the proportions between each kind of Moa present. An "x" in the Tables indicates that the species is present at the site, an "a" indicates that it is abundant while an "r" indicates that it is rare. Where a figure is marked *, I have estimated the minimum number of *individuals* in the site.

In a few cases, either the proportion of the midden examined was very small, or I have not seen all the bones from the site, and cannot be sure I have a representative sample. Shag River is an example. It is a very large site, but I have handled comparatively few bones from it.

The greater part of the material consists of leg-bones, with a few skulls, pelves, vertebrae, etc. I have very occasionally included identifications of eggshell of *Euryapteryx gravis* and *Megalapteryx didinus*, the only kinds of which I can be certain.

The predominant genus in the South Island, present in 26 of the sites, and in some cases, e.g. Papatowai, Pounawea, Hawkesburn, and Wairau Bar, far more abundant than any other, is *Euryapteryx*. *Emeus* is present in 19 sites (and probably in 1 other), *Pachyornis* in 8, *Anomalopteryx* in 9, and a probable 10th, *Megalapteryx* in 5, and possibly in a 6th. *Dinornis* is not common, and no *Dinornis* of any of the three South Island species has been recorded further north, on the East Coast, than Redcliffs, near Christchurch, where it is very rare. In Moa-hunter times, the genus was more frequently found in Otago and Southland than elsewhere, but even there was uncommon. 15 *Dinornis* bones at Papatowai, as against 366 *Euryapteryx* illustrate the point. *Dinornis* is known sparsely from 14 South Island Moa-hunter sites, but before the arrival of Man was common all along the South Island East Coast, and, for example, is found well *below* the Moa-hunter stratum at Marfell Beach, Marlborough, but never in, or above the human occupation.

In the North Island, the *Dinornis* picture is very different. It was the predominant genus at Opito and Sarah's Gully, and present in all but one of the other Coromandel sites, it was comparatively common at Ohawe and Rangatapu (Waingongoro) in Taranaki, the second most common genus at Paremata, Wellington, and present in 17 of the 25 North Island sites so far investigated. At the recently excavated and most important North Island site, Houhora in North Auckland, the proportion of *Dinornis* bones was only 13 to 189 of *Euryapteryx,* but of the very many one-piece fish-hooks found there, many must have been made of *Dinornis* bone, thus raising the proportions considerably. I have not had time to study the multitude of small pieces of Moa bone from Houhora but doubt if they would much alter the general picture.

Of the other North Island Moa, *Pachyornis mappini* is present in 10, and probably 2 other sites, *Pachyornis septentrionalis* in 4 and a probable 5th, *Euryapteryx geranoides* in 10, and probably 3 more, *Euryapteryx exilis* in 5, *Euryapteryx curtus* in 8, with 2 more probable. Paremata, incidentally, contained a cut shaft section of a femur of *Euryapteryx gravis,* quite likely an importation from the South Island. *Anomalopteryx didiformis* is represented in 6, and probably in 7, North Island sites.

I have concluded, from a study of the proportionate distribution in various swamps or former lakes as well as in human sites, that the various " flocks " of Moa did not usually range widely. In the case of human sites I have allowed for the possibility that preference for one kind of Moa rather than another *may* have affected the selection. We still have insufficient dates to compare swamps and human sites, but two examples will illustrate the point. Glenmark Swamp and Pyramid Valley swamp, Canterbury, are 10 miles apart. At Glenmark all six South Island genera of Moa were recovered, at Pyramid Valley only the 4 larger genera. Marfell Beach and Wairau Bar Moa-hunter

sites in Marlborough are only 15 miles from each other. At Marfell Beach from the bones recovered I have estimated a minimum of 14 individuals of *Euryapteryx,* as against 40 of *Emeus.* At Wairau Bar the picture is reversed. *Euryapteryx* is overwhelmingly abundant, *Emeus* scarce. There is no reason to assume a big difference in age between Wairau Bar and Marfell Beach sites.

The chief emphasis of this paper is on the problem of identification of the Moa found in human association. I can deal only briefly with the question of the role of Man in their extermination and not at all with the reverse, the effect of Moa upon Man.

The reasons for the extinction of the Moa are controversial. My present opinion is that, in the South Island *Dinornis* and probably *Emeus* and *Pachyornis* were less in number when Man arrived (more than a thousand years ago) than they had been some centuries before, probably because the last climatic optimum for their flourishing (c. 6000 years ago) had passed (there seem to have been several such optima in their long history) and Man finished them off, taking several centuries to do so. By about 600 to 800 years ago *Euryapteryx* was still plentiful on Stewart Island and the South Island East Coast, but Man the destroyer eventually killed the last of this genus too by about 300 to 400 years ago. *Anomalopteryx* very probably still existed, at least in the Nelson-Takaka area, until less than 200 years ago. In my opinion *Megalapteryx* was probably alive in the Southern West Coast area until late last century, and there is a *very* slim chance that this little Moa may still exist in the wilds of Fiordland. In the central part of the North Island, the volcanic ash-showers must have had a good deal to do with lessening the numbers of the various species, although the late Bill Hartree and I found, in the hills of Hawkes Bay, ample evidence of re-colonization between the various eruptive periods. In both islands Man was still killing Moa 400-500 years ago, and must be held responsible for the extermination of at least the 4 larger genera.

In this short paper, it is not possible to do more than summarise, in three tables, the mass of evidence on which these conclusions are based. I will end by thanking Dr Roger Duff, the Director of the Canterbury Museum, for his encouragement of my studies, the Directors of Otago, National and Auckland Museums for the opportunity, always freely given, to examine material in their respective collections, and to express my great indebtedness to many archaeologist friends without whom this paper would have been impossible. I am especially indebted to Dr John Yaldwyn, National Museum of New Zealand, who revised my original manuscript and prepared it for publication. My thanks are also due to Mrs Rose-Marie Thompson and Miss Elaine Bardsley, DSIR, Wellington, who typed and arranged the tables.

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