PRODIGIOUS BIRDS

Moas and moa-hunting in prehistoric New Zealand

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CONTENTS

ILLUSTRATIONS

TABLES

1

INTRODUCTION

The first Europeans to land in New Zealand, in 1769, came to determine whether the country coasted briefly by Tasman in 1642 was part of a great southern continent inhabited by people, plants and animals of appropriately rich diversity. This hypothesis, which Joseph Banks, the principal naturalist on the expedition and a self-confessed 'continent-monger' hoped to verify, sank irrecoverably in the wake of circumnavigation only six months later. New Zealand was proven to be an oceanic archipelago, and Banks was left to reflect, with some disappointment, that an observed 'scarcity of animals upon the land' (Banks 1770 in Morrell 1958:124) would probably stand the test of subsequent exploration.

In the event, he was quite right. New Zealand did have an unusually impoverished fauna of terrestrial vertebrates. The only mammals were two species of small bats (*Mystacina* spp.). There were also one genus of frogs (*Leiopelma* spp.), two families of lizards (Gekkonidae, Scincidae), one rhyncocephalian reptile (the tuatara, *Sphenodon punctatus*) and less than 80 species of land and freshwater birds. Amongst the latter, flightless species were unusually numerous, but Banks had not seen any and so missed the first portent of a remarkable discovery.

Evidence of the new birds did not come to light suddenly, and no living representatives of them were ever found, although the probability of their contemporary existence remained tantalisingly long in legitimate doubt. Yet even without that ultimate triumph, remains of them startled the Victorian world of natural history and sent a thrill of half-fearful excitement through the colonial community of European settlers.

The revelation of New Zealand's greatest faunal secret began to unfold more than 60 years after Banks' visit – curiously enough, in almost the same place where he had first stepped ashore. In the winter of 1834 the trading cutter *Emma*, badly damaged by storms off the East Coast of New Zealand, put in to Tolaga Bay for repairs. There, Joel Polack, its owner, was shown 'several large fossil ossifications' by the Maoris, who also mentioned that 'very large birds had existed' long ago, and had been exterminated by excessive hunting. Polack concluded that 'a species of emu, or a bird of the genus Struthio' had once lived in New Zealand. This shrewd deduction, which appeared in 1838 (Polack 1838I:303), is the earliest reference to the giant, flightless birds of New Zealand. Since Polack, however, had neither bones to show nor a name to report, it fell to others to bring these to notice.

The first bone to reach an osteological authority had actually been collected, between 1831 and 1836, by another East Coast trader, John Harris, but it was not until 1839 that the brilliant comparative anatomist, Richard Owen, saw the 'unpromising fragment' and deduced that it had belonged to a flightless bird, probably extinct, which had been heavier than an ostrich (Owen 1839, 1879aI:iv). He later named the bird *Dinornis Novae Zealandiae* (Owen 1843a), meaning the prodigious or surprising bird from New Zealand. Meanwhile, by virtue of further investigations amongst the East Coast Maoris, the bird was already becoming widely known by a Polynesian word 'moa', which meant, amongst other things, 'domestic fowl or chicken'.

Interest in moas

News of the moas (there soon proved to be a number of different kinds) had an immediate and sustained impact on natural scientists and public alike. The monstrous size of the large species attracted wide attention, in part, perhaps, because it was often substantially exaggerated (some early guesses had the tallest moa towering to 5 m in height, about twice the real maximum), and moa skeletons were enthusiastically reconstructed to conform with popular belief (Fig. 1.1). Nevertheless there were other very large, flightless birds still manifestly in existence such as the ostrich, emu, cassowaries and rheas, and others thought to be not long extinct such as the elephant birds of Madagascar, so size, as such, was not the issue which captured scientific attention.

Rather it was the fact that such large flightless birds came from one of the most isolated landmasses on earth; from a small archipelago located near the centre of the world's water hemisphere.

FIG. 1.1 An early attempt to reconstruct a moa skeleton. The anonymous collector has added numerous supernumerary vertebrae. (By courtesy of Hocken Library.)

As Owen (1879a1:iv) observed, all other large ratites were confined to continents, though some ranged to islands nearby. That initial interest was then amplified by the developing realisation that there were more kinds of moas than of any other ratites, and by the evidence that they had been, uniquely amongst birds, entirely wingless. It was an extraordinary puzzle. 'All analogy seemed against it' as Owen (1879b:273) remarked, and Oliver later (1949:1) suggested that New Zealand had been 'the locus of a grand experiment in evolution'.

Another matter of great interest was the question of whether any moas still lived (a claim which still attracts proponents). Owen had observed at once that the first bone he saw was quite unfossilised, and there were soon numerous stories in circulation asserting, successively, that Maoris had hunted moas within living memory, that some moas remained in remote mountain ranges and that European explorers had actually seen them. The earliest of the latter was the 'mechanic's tale' (Colenso 1846:90), told in 1842, about two Americans who ventured into the Marlborough mountains to a place that their Maori guide knew a moa to visit; 'presently they saw the monster majestically stalking down in search of food: they were, however, so petrified with horror at the sight as to be utterly unable to fire on him. Had they commenced the combat, it is, I think [said Colenso], highly doubtful how it might have terminated'. Excitement ran high for a time, and then subsided into a general optimism that moas might soon be 'seen striding among the emus and ostriches in the Regent's Park' (*The New Zealand Journal* (London) 30 March 1844).

This proved, if slowly, a vain hope, and interest in the period to which moas survived became transferred to the rapidly accumulating field evidence of Maori moa-hunting. In this, as in other respects, the story of moas was quite unusual. Other large ratites were hunted in modern times and their bones turned up occasionally in prehistoric middens, but only moas had been hunted on a scale sufficient to leave remains comparable with those of such classic examples of the big-game hunters' art as the bison kill sites on the high plains of North America. Furthermore, moa-hunting was so utterly unlike the subsistence activities of the historically known Maoris that the question was begged of whether it had occurred in a more remote antiquity than Maori accounts of it suggested and represented, perhaps, the tenure of a different people altogether.

These various considerations, fitted together, formed an exotic and compelling story. Archaic

birds, remarkable in size and diversity, had survived into modern times as the common prey of a lost race of Polynesian hunters at the very margins of human colonisation, and were possibly still to be found in some remote mountain valley. Moas became surrounded, consequently, by an aura of romance which so appealed to New Zealanders that the birds were, for much of the 19th century, as common a symbol in public imagery as the kiwi, which succeeded them, is today (Sinclair 1983). Even much later Buick (1931:2) could remark that of all the ratites, past and present, 'the Moa is indisputably the bird shrouded in the greatest mystery and steeped in the richest glamour'.

Behind the facade of popular romance, however, scholarship continued to quarry inexorably, if sometimes erratically, at the face of the early enigmas, and it is the progress of this research which forms the core of the present work.

Principal research themes

The early surprise at birds such as moas being discovered in an isolated oceanic archipelago, turned, not unexpectedly, into the main theme around which research on moas and moa-hunting has continued to centre. This can be stated, briefly, as an investigation of the consequences of island colonisation. Here was a large, temperate landmass of considerable environmental variety in nearly all respects, but it was an archipelago and it had a peculiarly impoverished fauna which, in particular, was utterly destitute of cursorial mammals. For flightless birds this was a uniquely inviting evolutionary canvas and much of the study of moas has dwelt, if not often very explicitly, on the consequences of that situation. It has concentrated, in particular, on the question of how many moas there were and how they were related to each other; an issue which is fundamental to other matters of island colonisation and adaptation such as how moas got to New Zealand and when, how they developed into different shapes and sizes and how these different types were distributed according to variations in the topography and vegetation.

The adaptation of moas to their unusual island environment has been the main theme in research on moa-hunting as well, especially since it has concentrated very substantially upon the question of extinction. Patterns of morphology and behaviour, developed in insular conditions, and which facilitated the evolution of moas, have been seen as subsequently rendering them peculiarly vulnerable to the entry of new and very capable predators – people in particular. Equilibrium patterns of behaviour which had been the most efficient strategies, such as low breeding rates, fatally depressed the resilience of moa populations under predation; the absence of other large land animals, which had reduced competition for moas, now narrowed prey choices and focussed the attention of predators upon them, and so on. It was, in addition, insular isolation which ensured the lateness of contact between moas and people, so that a traditional memory of the former reached, if barely, into the period of European colonisation.

In discussing these and related issues this book is divided into two parts. Chapters 2 to 6 outline the discovery and biological nature of moas. In the second part, Chapters 7 to 10 outline the discovery and nature of moa-hunting sites and aspects of their archaeological evidence, while important questions arising from that evidence are considered in Chapters 11 to 13. Since a wide variety of issues and data – ranging from zoological taxonomy to use-damage on stone tools – are involved in these matters it may prove helpful to sketch, at the outset, the main questions which I tackle, some of the answers which I prefer and the order of dealing with these in the book.

How many kinds of moas were there?

The discovery of moas is described at greater length in Chapter 2. As an extended, piecemeal process marked by uncertain communications between antipodes, and intense rivalry between the main participants, it provides a useful introduction to the atmosphere in which interests in moas, which essentially meant in their systematics, were pursued during the first century of research.

Systematics, or taxonomy, concerns the arrangement of living things into classes which express degrees of relatedness, as in a family tree. In the case of extinct animals, the discrimination of relationships is necessarily inferential, and it requires a fine judgement of differences in size and shape between bones of the same anatomical element. Does a tibiotarsus which is 15 per cent longer than any others of the same shape require the establishment of a new species? Should all moas which had blunt beaks be classed together? These, and many other such questions, have been the consuming passion of moa research since the beginning.

Owen's investigations demonstrated that there were two broad groups of moas, but he could not find the characters with which to define them. Increasingly large samples of material compounded

the difficulty by appearing to indicate that moa limb bones, the main source of evidence, exhibited more or less continuous variation in size and shape. It was only with systematic research on moa crania, which began at the end of the 19th century, that the family and generic relationships of moas came to be sorted out. The number of species, however, remained as high as 24 to 28 until 1976 when Cracraft reduced it, by analogy with the amount of variation in kiwi bones, to 13. Subsequent minor revisions have reduced it further to 11. There are, however, several species, retained by some current workers, which I have also kept as a matter of convenience: *Euryapteryx gravis* and *Dinornis torosus*, although the case for doing so is becoming weaker. The historical development of moa systematics is discussed in Chapter 3 and the classification which is used here is shown in Table 1.1.

TABLE 1.1 The taxonomy of moas used in this book (see Chapter 3 for comment)

Order: Dinornithiformes	
Family: Anomalopterygidae	Family: Dinornithidae
Anomalopteryx didiformis	*Dinornis struthoides*
Megalapteryx didinus	*Dinornis torosus*
Emeus crassus	*Dinornis novaezealandiae*
Euryapteryx curtus	*Dinornis giganteus*
Euryapteryx geranoides	
Euryapteryx gravis	
Pachyornis mappini	
Pachyornis australis	
Pachyornis elephantopus	

How did moas get to New Zealand and develop?

Moas, and other ratites (so-called from their common possession of a flat breastbone), are more usefully defined as 'palaeognaths', a term referring to a fused, inflexible arrangement of bones in the roof of the mouth. This palatal condition seems to have been the original or primitive form in birds, but amongst the majority of birds, which later evolved the light, flexible, 'neognathous' palate, some subsequently reverted to the older form. The significance of this fact is that whereas it once seemed an inescapable conclusion that the southern hemisphere palaeognaths (emu, ostrich, cassowaries, rheas, moas, kiwis, etc.), were descended from an ancient stock of flightless birds on Gondwanaland, and became divided by continental drift, it is now possible that there is no such close relationship at all. Palaeognaths could have diverse origins, including as flying neognathous birds, and may have developed their similar features by convergent evolution. Unfortunately there is very little fossil evidence to assist in deciding the matter. No moa remains are more than a few million years old, whereas New Zealand was last separated from other landmasses more than 80 million years ago. I prefer the view that moa ancestors flew to New Zealand, but cannot claim strong grounds for it.

Similarly it is possible only to speculate about the development of different kinds of moas in New Zealand, by reference to major environmental events which might have encouraged evolution within an ancestral stock: the Oligocene reduction of the landmass to an archipelago; uplift of the Southern Alps; fluctuations of climate during the Pleistocene; the subsequent formation of Cook and Foveaux Straits, and so on. All that can be said is that the modern moa species existed by about 25,000 years ago, and that no remains belonging to other species have yet been described.

But although we know very little about the speciation process, we do have some evidence of the way in which species were distributed in the late Holocene environment. Comparison of species distributions through time in a changing environment, where deposits from both Pleistocene and Holocene can be found in the same area, and comparison of species distributions with the broad variation of late Holocene vegetation patterns, both point to the same conclusion: a different suite of species occupied humid forests than those that occupied dry forest, scrub or open ground. The smaller *Dinornis* species and *Anomalopteryx* occupied the former habitats, while *Dinornis giganteus* and all the remaining moas occupied the latter habitats. Amongst the latter, there was also some variation in species with altitude.

All these matters are canvassed in Chapter 4.

How did moas differ in morphology and ecology?

Opinions have varied considerably over the years about how 'the moa' might have appeared in life, and it is only quite recently that the idea of obvious morphological variation has begun to inform artistic reconstructions (Fig. 1.2). This is quite strange considering the early, and enduring, belief that moas belonged to two quite different groups. It is now commonly expressed as a division into two families: Dinornithidae and Anomalopterygidae. Dinornithids were tall, comparatively slender

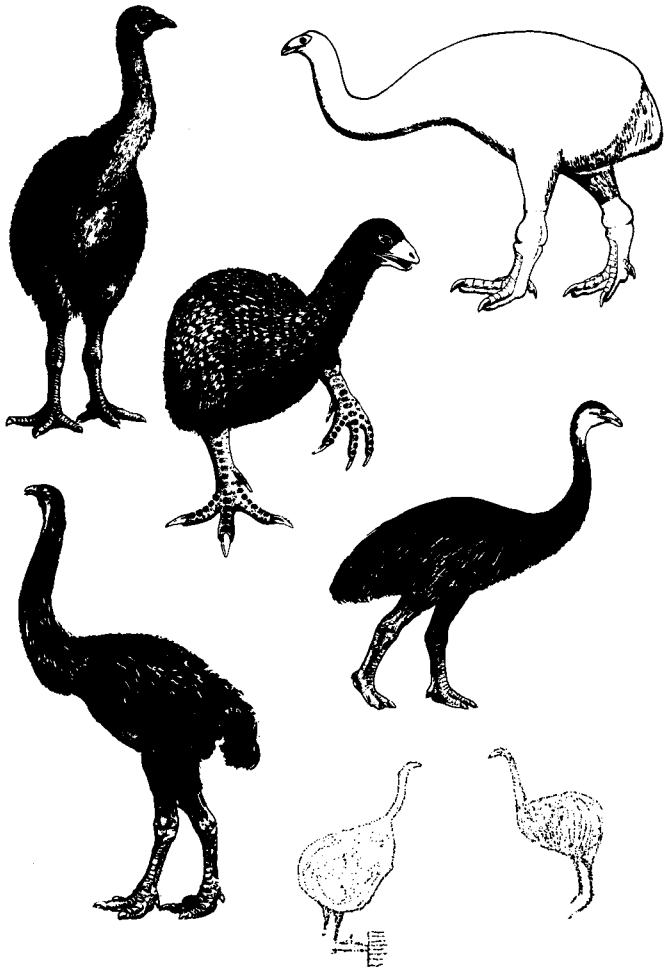

FIG. 1.2 Previous images of moas: *Dinornis* (*Palapteryx* in Hochstetter 1867:176), top left; *Dinornis maximus* according to Augusta and Burian (n. d., pl. 41), bottom left, and Temple and Gaskin (1985, frontispiece), centre right; medium-sized moa, top right and smaller moa, centre left (in McCulloch 1982:7, cover); probable pre-European drawings of moas in Craigmore Shelter, bottom right (Kreuzer and Dunn 1982:176).

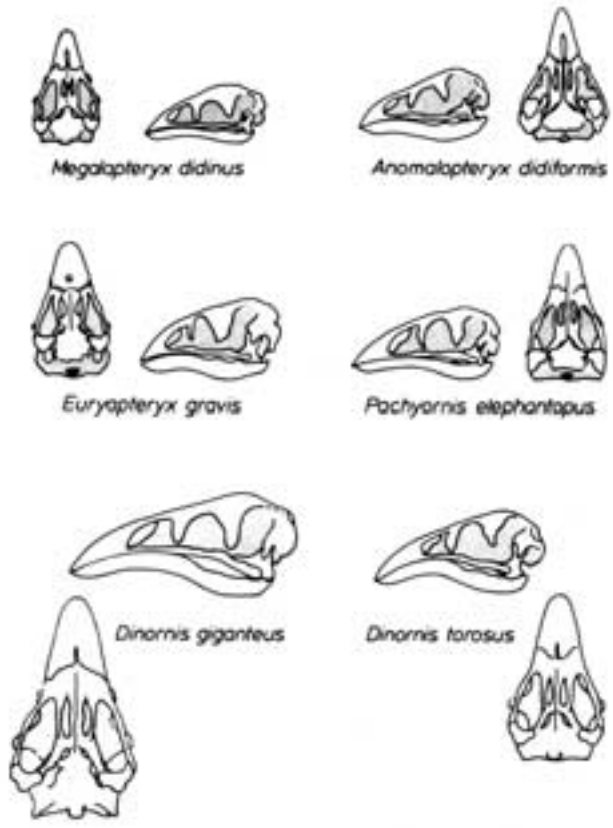

FIG. 1.3 Outlines of cranial morphology in moas, side and palatal views. Note variations in size, and in length and shape of beak (minus keratinous sheath, which seldom survives).

birds with long lower legs, flat, wide skulls and relatively long, downcurved beaks. It was species of this family which, mounted in museums as massive frames of peat-black bones, promoted the impression that moas, in general, had looked like giraffes from which the front legs had been lopped (Kennedy 1876:201). Anomalopterygids were much more variable. The small genera, *Anomalopteryx* and *Megalapteryx*, contained rather gracile birds with limb bones similar, in some ways, to those of *Dinornis*, but the larger genera contained heavy, robust birds with short, stout limbs. Beak forms were variable, and included the sharp *Pachyornis* and blunt *Euryapteryx* forms (Fig. 1.3).

Moas ranged in weight from about 20 kg to more than 200 kg. Stature is a more problematical matter. If any birds stood with legs and necks extended to a more or less vertical position they would have reached about 3.5 m in height. Recent evidence indicates, however, that moas as a whole stood with their leg bones arranged into a reversed-Z position, as amongst birds in general, and that they held their necks in the looped manner common amongst other large flightless birds (Fig. 1.4). This would have reduced the range of stature amongst moas to about 0.5 to 2 m (Chapter 5).

Do Maori stories about moas provide reliable evidence?

The short answer here is 'no'. The numerous purported Maori accounts of moa biology, ecology and behaviour (also hunting, Chapter 11), which were published between about 1870 and 1930 were described bluntly, but accurately, by Elsdon Best

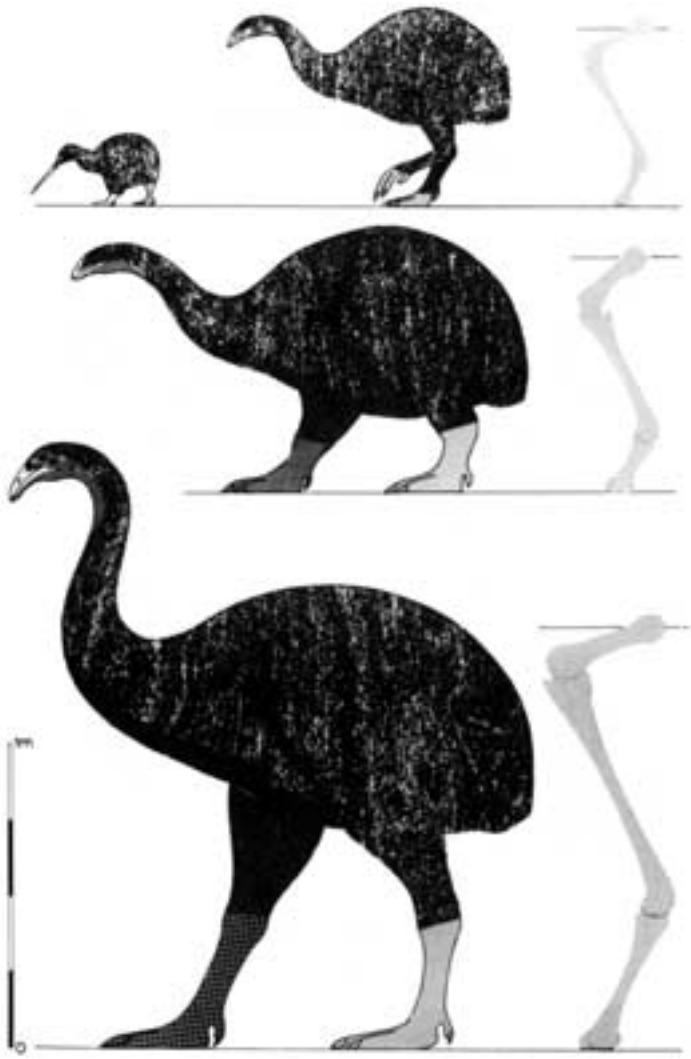

FIG. 1.4 Some examples of moas as they may have appeared in life: *Megalapteryx didinus* and, for comparison, Brown kiwi (*Apteryx australis*), top; *Euryapteryx gravis*, centre; *Dinornis giganteus*, bottom. To right, are the leg bones shown in mean positions of rotation as determined by Worthy (pers. comm.).

(1942:182), as 'a remarkable quantity of puerile data'. He objected, as other scholars have done, to the general anonymity of the alleged informants or the circumstances of transmission, and to the frequent obvious flaws, such as descriptions of moa wings. In addition, it is clear that many Maoris, if indeed they were much implicated in these tales at all, were quite familiar with the appearance and habits of emus and other large ratites from as early as the 1860s, in some cases from the 1840s. There may be some pure metal of genuine pre-European recollection about moas in these stories but it is now impossible to extract it from the dross.

Another, and perhaps more serious, difficulty lies in the use of the word 'moa'. It was first recorded in connection with a giant bird in 1838 when Colenso (1846:81) heard it as the name of a mythological creature of part-avian, part-human characteristics which lived in a cave on the East Coast and was guarded by giant reptiles. Whether this 'moa', the relics which came to be known as moa bones and the birds identified as *Dinornis* were all held to be manifestations of the same entity, in the original Maori perception, is open to question. Furthermore, early Maori phrases or sayings which include the word 'moa' are peculiarly non-specific in terms of such obvious features of moas as their remarkable size. Conversely, the word can often be plausibly traced to a Polynesian phrase or saying where it clearly refers to the domestic fowl. There have been various attempts to get around this longstanding problem by putting forward other words alleged to have been genuine Maori names for moas; none are at all convincing. These and related issues are discussed further in Chapter 6.

Who were the moa-hunters?

Chapter 7 opens the section on moa-hunting with an historical survey of the long and often contentious debate about the identity of the moa-hunters. This canvassed three main sources of uncertainty: stratigraphical evidence of the age of moa-hunting, a problem which arose with the first discovery of moa-hunting remains at Waingongoro, south Taranaki, in 1843; the contents, and their cultural implications, of the moa-hunters' artefactual assemblage, a lightning rod of dissent erected by Haast in 1871; and the credibility of certain Maori traditions, brought to light in the early 20th century, which alleged a non-Polynesian ancestry of the moa-hunters. A substantial consensus on these matters, not achieved until the 1950s, was that the moa-hunters were exclusively east Polynesian by ancestry (and Maori by retrospective ascription), and had arrived about 1200 years ago, bringing with them a distinctive aceramic, neolithic material culture.

The most persuasive arguments in reaching this conclusion had come from comparative analysis of artefactual styles, but when Duff (1956a) attempted to capitalise on that research by proposing a formal nomenclature for the assemblages he raised another problem of identification altogether. For the early assemblage Duff revived Haast's term 'Moa-hunter' which, by implication, inverted the proposition that people who hunted moas had a certain kind of material culture. In fact, whichever