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HOPLODACTYLUS DELCOURTI (REPTILIA:GEKKONIDAE) AND THE *KAWEKAWEAU* OF MAORI FOLKLORE

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ABSTRACT.—The recent discovery of a giant gecko of unknown provenance in the collections of the Musée d'Histoire Naturelle de Marseille necessitated the employment of relatively unorthodox sources in order to attempt to establish its identity. A combination of morphological characteristics and anecdotal information from folkloric sources assisted in establishing the potential geographic locality of the new species. This determination indicated that an animal heretofore thought to be purely mythical, the ***kawekaweau*** of Maori folklore, is indeed a recognizable biological species.

INTRODUCTION

A hitherto unknown species of giant gecko was recently described (Bauer and Russell 1986) from a specimen rediscovered among the collections of the Musée d'Histoire Naturelle de Marseille, France. It has been in the collections for at least 117 years (Bauer and Russell 1986). The specimen has been assigned to the genus *Hoplodactylus*, a taxon of live-bearing geckos distributed throughout New Zealand but known from nowhere else. Strong anatomical evidence supports this placement of the new species—*Hoplodactylus delcourti*. Although no locality data are available for the specimen, we believe that anecdotal evidence, much of it dating from the last century, may be used to associate this giant gecko with the ***kawekaweau,*** a large reptile of Maori folklore (Bauer and Russell 1986). This therefore links the specimen with New Zealand. The evidence we present serves as an example of the value of native folkloric sources in certain aspects of zoological alpha systematics.

THE NEW ZEALAND GEKKONID FAUNA

The native New Zealand gekkonid fauna consists of two major lineages—the nocturnal "brown geckos" (genus *Hoplodactylus)* and the diurnal "green geckos" (genus *Naultinus).* (We consider *Heteropholis* Fischer 1883 to be subsumed within *Naultinus*—see Thomas [1982]). Both genera are members of the tribe Carphodactylini within the subfamily Diplodactylinae, a group restricted in its distribution to Australia, New Zealand

and New Caledonia (Fig. 1). Within this group, the New Zealand geckos have their closest affinities with the New Caledonian genera *Rhacodactylus*, *Bavayia* and *Eurydactylodes* (Bauer 1986). In particular, all share a similar arrangement of preanal pores on the venter and a strongly clawed first digit with scansorial pad. Although no uniquely derived characters support the monophyly of *Hoplodactylus* (Bauer 1986), digital characters and scalation allow members of this genus to be distinguished from other carphodactyline geckos.

HOPLODACTYLUS DELCOURTI, ITS AFFINITIES AND PROBABLE PROVENANCE

Hoplodactylus delcourti is distinguished from other members of the genus chiefly by its huge size (370 mm head and body length [SVL]). This makes the giant *Hoplodactylus* by far the largest known gecko species (Bauer and Russell 1986). It is 54% larger than the next largest species *(Rhacodactylus leachianus)* and more than 130% larger than the largest known individual of *Hoplodactylus duvaucelii* (Whitaker 1968), the next largest congener. The significance of and possible origins of such great size are discussed by Russell and Bauer (1986). Whether its point of origin was New Zealand or New Caledonia, *Hoplodactylus delcourti* represents a trend toward island gigantism that has been widely documented in reptiles (Mertens 1934; Carlquist 1974) as well as other vertebrates and invertebrates. New Caledonia, for example, is home to the second and fourth largest extant geckos in the world as well as to one of the largest skinks, a giant grasshopper and a huge flying fox. New Zealand, of course, is noted for the tallest bird, *Dinornis giganteus*, (Cracraft 1976), numerous large skinks and a group of large orthopterans ***(wetas).*** The causes of island gigantism are unclear.

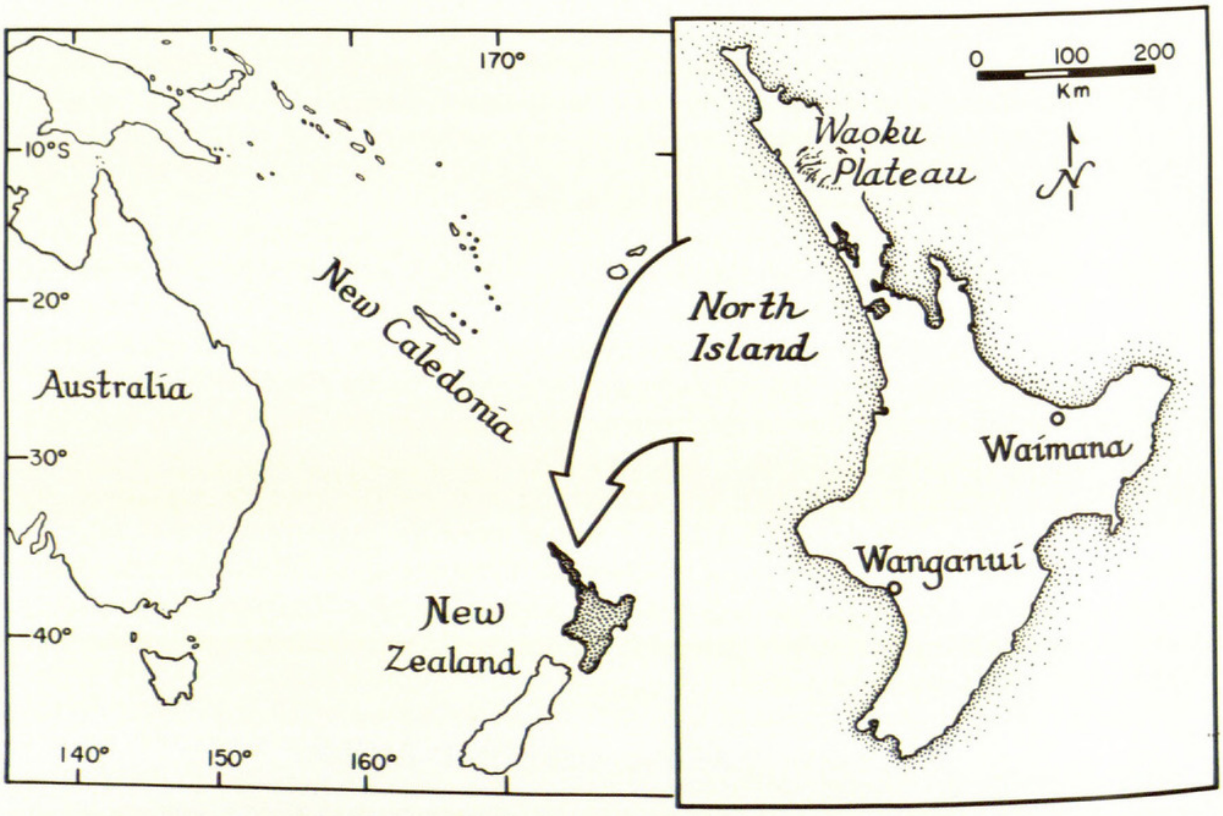

FIG. 1.—Distribution of the tribe Carphodactylini is restricted to Australia, New Zealand and New Caledonia (left map). The ***kawekaweau*** has been reported from Waimana (Mair 1873) and possibly from the Waoku Plateau (Walsh 1905) and Wanganui (Downes 1937), all on the North Island of New Zealand (right map).

Morphological features clearly place the animal in the genus *Hoplodactylus*, but this does not provide information about its origin. The morphology of the specimen limits the areas of possible origin, as it represents a member of a limited radiation of the tribe Carphodactylini in the southwest Pacific Ocean. One possibility is that the animal originated in the French island territory of New Caledonia. A New Caledonian origin would more easily explain the presence of the specimen in a French museum but would require that the genus *Hoplodactylus*, in the recent past, occurred in areas other than New Zealand. An alternative hypothesis, that of a New Zealand origin for *Hoplodactylus delcourti*, would be consistent with current ideas regarding the distribution of this genus, and would not be inconsistent with the history of many areas of the North Island. French explorers, scientists and settlers were quite active in the North Island, particularly in the area of the Bay of Islands (Hocken 1908; Wright 1950). While the museum in Marseille does not possess any other herpetological specimens from New Zealand, it does possess a number of old specimens from Australia and other areas in the Pacific. The dating of the acquisition of the specimen is problematic, but it is most likely that it was acquired between 1833 and 1869. No accessionary documentation of the museum survives from this period. The only New Caledonian material currently in the collection dates from the period 1902-1905 and represents donations from the Marseille Zoological Park, which had received a number of New Caledonian lizards and sea snakes from M. Bernier of the Muséum de Nouméa (Vayssière 1916).

REPTILES AND MAORI FOLKLORE

The contention that the specimen is from New Zealand is also supported by historical and anecdotal records from both Maori and ***pakeha*** (European) sources. Maori knowledge of natural history in New Zealand has been gained in their 900 year occupancy of these islands, but is tempered by common Polynesian conceptions and terminology of nature brought with them from their prior experiences in the islands of the central Pacific (McLintock 1966). There is considerable anecdotal material suggesting the existence of undescribed vertebrates in New Zealand. Of particular note is the case of the "New Zealand otter" (Watson 1960) which has never been resolved. Allusion to unknown reptiles of various sizes and attributes have also been made frequently in the local folklore and lizards, or lizard-like animals feature prominently in Maori art (Best 1923; Skinner 1964. See Fig. 2). Cook (1777) was the first European to record the Maori tales of giant reptiles and many authors have reiterated Maori claims of such beasts (Jameson 1842; Buller 1878; Gisborne 1888; Best 1909). Some of these animals, such as the ***taniwha,*** a giant reptile-like creature, have been summarily dismissed because of the great sizes credited to them. Yet, even in these claims there may be some veracity by way of the correlation of reports of large lizards with crocodiles or monitors (family Varanidae) encountered by the ancestors of the Maoris or collateral groups of Polynesians in other areas of the Pacific (Downes 1937). Lizard-like reptiles of a smaller size also figure prominently in Maori legend. Many of these tales can almost certainly be referred to the ***tuatara*** *(Sphenodon)*, but others seem to describe one or more different animals. The folk taxonomy of the Maori, like that of many peoples, seems to be quite exact (Best 1909), with most of the currently recognized taxa being identified by unique Maori names. Numerous early European workers provided partial listings of Maori names for local animals (e.g. Buller 1878, Downes 1937). Among the herpetofauna of New Zealand, it seems that only the leiopelmatid frogs and some of the more remotely distributed geckos of the South Island were completely unknown to the Maoris. Lumping of biological species also occurred among the skinks, but this is understandable given that modern herpetologists can only distinguish some of the morphologically similar *Leiolopisma* species on the basis of biochemical features (C. Daugherty, pers. comm.).

FIG. 2.—An example of Maori wood carving depicting a lizard-like animal (perhaps a gecko) with ***paua*** (abalone) eyes. This specimen is in the collections of the National Museum of New Zealand in Wellington.

Large lizards known to the Maori were the ***mokonui*** (Kerry-Nichols 1884; Best 1923), the ***kumi*** (Hector 1899) (believed by Hardy [1977] to be mythical), the ***ngarara*** (a 450 mm lizard from Kaiapoi in North Canterbury, Stack 1875) and the ***kaweau*** or ***kawekaweau*** reported from several areas of the North Island. All available reports of these lizards seem to be secondhand, and the characters attributed to the animals are often incongruous. In particular, the reference to the aquatic habits of the ***kawekaweau*** is surely inconsistent with all geckos and most of the known skinks of New Zealand. Indeed, many of the accounts of early settlers may refer to Australian agamid lizards (Hector 1899), such as *Physignathus lesueuri*, a large water-frequenting lizard.

ANECDOTAL SOURCES IN RELATION TO A NEW ZEALAND ORIGIN

A number of the descriptions of the lizards of Maori legend offer corroborating evidence as to the identity and origin of *Hoplodactylus delcourti*. The most valuable information comes from Mair (1873) who commented on "the existence of a large forest lizard, called by the Maoris ***kaweau***". (The spelling and pronunciation of this term varies among Maori tribal dialects—Best 1909.) He continues, "In 1870 an Urewera chief

killed one under the loose bark of a dead ***rata,*** in the Waimana Valley [Fig. 1], he described it to me as being about two feet long and as thick as a man's wrist; color brown, striped longitudinally with dull red". This description, one of the few to provide morphological information about giant lizards, matches extremely well the size and color of the specimen at Marseille, and the position of the lizard under bark is not inconsistent with the known daytime retreats of other large geckos. Buller (1895) stated that the ***kawekaweau*** was semi-arboreal and existed in the deep forests of the North Island at least until the 1860s. He also commented on the striking "banded" pattern of the animal. Best (1909, 1923) referred to the ***kawekaweau*** as being the size of a small ***tuatara,*** reddish in color, and to its retreats as being the holes of trees. This again is a likely gekkonid hiding place and is supported by the known retreats of giant geckos of the related genus *Rhacodactylus* (Meier 1979).

Kerry-Nichols (1884) claimed that a large lizard ***(ngarara*** in the ethnotaxonomic generic sense) was known to local Maoris to inhabit the caves and rock piles of the North Island. Walsh (1905) remarked on an unnamed large lizard, with both arboreal and aquatic habits from the Waoku Plateau (Fig. 1), between the Hokianga and Kaipara districts, the remains of which washed down the Waima Creek around 1870. Finally, Jameson (1842) referred to a large lizard resembling the chameleon. It is noteworthy that in New Caledonia, home of the previously largest known geckos *(Rhacodactylus),* the local name for large geckos is "cameleons", distinguishing them from the small house geckos *(Hemidactylus* and *Lepidodactylus)* which are known as "margouillats". It seems that large geckos are frequently confused with chameleons in areas where chameleons do not occur. This is probably because some species in each family change color, or perhaps because of the prominence of the eyes and relatively slow movements of the animals.

Hardy (1977) suggested that the skink *Leiolopisma gracilicorpus,* might be identifiable as the ***kawekaweau.*** However, the only known specimen of this species has a length of 97 mm and is thus far smaller than the legendary ***kawekaweau.*** Further, the specimen is completely bleached, so that a correlation with the color pattern described in the early accounts is not possible. Given the existence of a specimen matching features of color and morphology as reported by early New Zealanders, we feel that the new species of giant gecko may indeed be the basis for the legendary ***kawekaweau.***

POTENTIAL AGENTS OF EXTINCTION IN HISTORICAL TIMES

Although the lack of material and records would indicate that *Hoplodactylus delcourti* has become extinct, this is by no means certain. There remain in the North Island extensive areas of relatively undisturbed land which might harbor remaining populations. These include areas containing ***kauri*** forests as well as rock outcrops, two of the possible habitats of the ***kawekaweau.*** It is certainly no less likely that this animal still survives than it is that the much larger thylacine *(Thylacinus cynocephalus)* of Tasmania is extant. A number of vertebrate species long thought extinct have been "rediscovered" in the recent past. These include the Chaco peccary *(Catagonus* c.f. *wagneri)* (Wetzel *et al.* 1975), Leadbeater's possum *(Gymnobelideus leadbeateri)* and New Zealand's own ***takahe*** *(Notornis mantelli).* The ***takahe*** (witness the Maori name) as well as at least some species of Moa were present as distinct entities in Maori folk taxonomy. Although most, if not all, the species of Moa had become extinct by the time Europeans had begun to anthropologically document Maori culture, knowledge of the existence of these giant birds had been maintained by oral tradition in at least some tribes (Andrews 1986). Even more noteworthy are recently discovered vertebrates about which nothing was previously known. Two of the smaller, but nonetheless spectacular congeners of *H. delcourti, H. rakiurae* Thomas 1981 and *H. kahutarae* Whitaker 1984 have only recently been discovered in remote parts of New Zealand. It is just possible that a 370 mm SVL gecko

with nocturnal habits, isolated and hidden retreats, and low population density might go unnoticed in New Zealand today.

Whether now extinct or not, *Hoplodactylus delcourti* has not occurred in large numbers for at least a century. Two human factors may be suggested to have contributed to this decline. The first is the degradation of primary habitat through the destruction of native forests. A second is the introduction and spread of introduced mammals by both the Maori and later ***pakeha*** settlers of New Zealand. Stack (1875) suggested rats were responsible for the disappearance of a 450 mm ***ngarara*** from the Waimakariri River Valley, while Buller (1895) cited feral pigs as being the most destructive predators of the ***kawekaweau.*** Taylor (1868) and Kirk (1895) add cats to the list of introduced enemies of reptiles.

Rats have long been regarded as being severely damaging to populations of native reptiles in New Zealand. The effect of rats on the ***tuatara*** has been extensively documented (Crook 1973a, 1973b, 1975; Newman 1983). Although it is currently unclear whether the main factor involved is predation, competition or degradation of habitat, it is known that islands supporting the ***kiore*** *(Rattus exulans)* have fewer juvenile ***tuataras*** and poorer adult recruitment than do similar islands without rats. Whitaker (1973, 1978; Bull and Whitaker 1975) documented that the presence of rats decreases both lizard population size and species diversity on offshore islands. His assumption was that the primary danger posed by rats is predation, especially on young lizards. This view is supported by empirical evidence showing that rats do ingest lizards (Bettesworth 1972; Bettesworth and Anderson 1972; Whitaker 1978). Whitaker (1978) drew conclusions about vulnerability which are pertinent to *Hoplodactylus delcourti:* a) nocturnal species are more susceptible to rats than are diurnal species, and b) larger species are more vulnerable than are smaller ones. In the former case activity time corresponds with peak rat activity, and in the latter animals are unable to use hiding places inaccessible to rats. These conclusions clearly place the ***kawekaweau*** at very high risk.

While no certainty can be attached to the origin of the giant gecko, a body of evidence from historical and ethnographic sources suggests that the species did or does inhabit parts of the North Island. The likelihood of the evolution of such a gigantic form in New Zealand is supported by the preponderance of large species of a variety of taxonomic groups (ratites, scincids, orthopterans, etc.).

ANECDOTAL SOURCES AND THEIR UTILITY IN ALPHA SYSTEMATICS

Common local animals, as well as rarer but more spectacular ones, are strongly associated with the art, folklore and traditions of most cultures. As shown by Maori folklore and legend, as recorded by European chroinclers, the knowledge of native peoples about the fauna may be of value to systematic zoologists. In this particular case the attributes of a relatively rare animal were still known to Maoris who had never seen the animal alive. This is probably due in part to the large size of the ***kawekaweau,*** but also to the fact that mythical powers had been associated with the animal and it therefore took on more symbolic significance. Best (1909:236; 1923:331) stated that it represented the souls of dead forbears of any person who saw it and indicated it was time for that individual to join these ancestors in the spirit world.

Some generalities may be outlined for the use of such anecdotal native evidence in the examination of systematic questions. To the zoologist many native references seem implausible because they attribute biologically incorrect (or impossible) characteristics to animals. In the case of the ***taniwha*** (Downes 1937), virtually all of the attributes of the beast are entirely mythical. The combination of plausible features with mythical ones may, however, imply that the animal in question is based in fact.

Features such as size are particularly likely to be exaggerated. Consequently, reports of animals of relatively small size or rather unspectacular appearance are also more likely to be referrable to living creatures. Unfortunately, rare animals such as the ***kawekaweau,*** had seldom been seen by those describing them. Thus these animals are generally reported as occuring "several villages away" and to have been seen by "a relative" or "acquaintance". Thus again, the fact that some of the Maoris responsible for the claims reported to the ***pakeha,*** whose reports are cited herein, actually saw the animals themselves, near their own villages and in the recent past, adds credibility to the factual basis of the animal in question.

The scientific identification of animals largely from folkloric sources is rare, but such an instance is applicable in the case of *Hoplodactylus delcourti*. In such instances there must always remain a degree of uncertainty of identification. Nonetheless, the reciprocal illumination of the fields of zoology and ethnology holds great potential for uncovering useful information. Greenwell (1985) has reviewed the categorization of cryptozoological evidence and has provided an operational classificatory system for documenting cases. The current case falls somewhere between Greenwell's (1985) categories III and IV. Here we have a taxon represented by a partial specimen and "known" only from anecdotal sources. It is precisely these sources that have aided in its identification.

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The salmonid family encompasses salmon, trout, char, huchen, and grayling. In the proposed homeland of speakers of Proto-Indo-European (PIE)—the Eastern Pontic to Western Kirghiz Steppes in the USSR, north of the Black and Caspian Seas—only one salmonid species occurs, ***Salmo trutta,*** with its two morpha, the large anadromous "salmontrout" and the smaller non-anadromous "brook trout." According to Diebold, PIE most likely encoded lexically only two salmonid fish, these being the two types found to the exclusion of all other salmonids in the proposed PIE homeland. This, then, is the evidence supporting the hypothesis placing PIE speakers in the above-mentioned geographical region.

As speakers of Indo-European (IE) languages spread from their homeland through Europe, Western Asia, and the Indian subcontinent, they encountered numerous unfamiliar species of salmonid. Diebold's short book is chiefly concerned with how previously unknown salmonid species were named, and in particular with nomenclature innovated or borrowed for species of the genus ***Hucho*** (huchen).

There are no surprises here. Indo-Europeans have used strategies for naming huchen which are commonly employed by peoples everywhere in labeling newly encountered entities: direct borrowing, description, metaphor, calque, etc. The importance of Diebold's nomenclatural inquiry is that it reveals that *all* terms for huchen in recorded IE languages have been either borrowed or innovated, suggesting that it is unlikely that PIE had a label for any huchen species. According to the author, the same is also true of all IE terms for salmon, char, and grayling, although he does not present detailed documentation for these claims as he does for huchen names. In brief, Diebold makes an excellent but, as he himself cautions, nondefinitive case for a PIE fish lexicon which referentially identified morpha of only one salmonid species, ***Salmo trutta.***

Students of folk biological classification can profit from Diebold's discussion of relatively recent changes in some IE folk taxonomies treating salmonid fish. For example, both huchen ***(Hucho hucho)*** and several species of char (genus ***Salvelinus)*** are lumped together in the Czech folk genus *siven*. Each member of this grouping is binomially labeled: *siven dunajský* ***(Hucho hucho),*** *siven americký* ***(Salvelinus fontinalis),*** *siven alpský* ***(Salvelinus alpinus),*** and so on. Diebold notes that there is an older Czech term for ***Hucho hucho,*** the monomial *hlavatice,* which was used to differentiate lexically huchen from all other salmonids. The inclusion of huchen in *siven* and its binomial designation, then, are relatively recent developments.

Diebold argues that this development in Czech may be related to a "transient Linnaean misclassification" made by 19th century biosystematists. Members of the genera ***Hucho*** and ***Salvelinus*** are perceptually very similar and this no doubt motivated an earlier