Fossil Birds from Late Quaternary Deposits in New Caledonia

JEAN CHRISTOPHE BALOUET
and
STORRS L. OLSON

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ABSTRACT

Balouet, Jean Christophe, and Storrs L. Olson. Fossil Birds from Late Quaternary Deposits in New Caledonia. *Smithsonian Contributions to Zoology*, number 469, 38 pages, 16 figures, 13 tables, 1989.—Cave deposits in New Caledonia have produced fossils of 32 species of nonpasserine birds. Of these, 11 are extinct and known only as fossils. The giant galliform *Sylviornis neocaledoniae* is the only one of these to have been described previously. The following new species are described herein: *Accipiter efficax, Accipiter quartus, Megapodius molistructor, Caloenas canacorum, Gallicolumba longitarsus, Tyto? letocarti, Porphyrio kukwiedei, Rhynochetos orarius*. Two additional resident species, *Ninox* cf. *N. novaeseelandiae* and *Coenocorypha?* sp., and one migrant species, *Charadrius mongolus*, are new to the island. Five genera, *Megapodius, Caloenas, Gallicolumba, Ninox*, and *Coenocorypha?*, are new to the avifauna of New Caledonia. Abundant recent fossils of *Turnix* are smaller than *T. varia* from Australia or fossils from older deposits in New Caledonia. Several bones, including juveniles, of *Anas gracilis* are smaller than in a good series of skeletons from Australia and may represent an extinct resident population. Most of the fossils come from late Holocene deposits nearly or quite contemporaneous with the arrival of man in New Caledonia and most or all of the extinctions observed probably resulted from human disturbance.

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Fossil Birds from Late Quaternary Deposits in New Caledonia

Jean Christophe Balouet and Storrs L. Olson

Introduction

Through paleontological studies, there has been a great increase in recent years in our knowledge of prehistoric vertebrates from islands. In the Pacific, fossil remains of birds in particular have been instrumental in showing that man, especially prehistoric man, has been responsible for exterminating a very large proportion of the native faunas in the Hawaiian Islands (Olson and James, 1982), New Zealand (Cassells, 1984), the Cook Islands (Steadman, 1985), Henderson Island (Steadman and Olson, 1985), and Galapagos (Steadman, 1986). Without paleontological studies we cannot begin to know what the naturally occurring avifauna was on any island. It is also true that man-caused extinctions seem preferentially to remove the strangest and most bizarre members of a given fauna. Unfortunately, the species most specialized for insular conditions are also the most vulnerable to unnatural adversities. Since 1974, paleontological discoveries have shown that the fauna of New Caledonia was also much richer, with many more peculiar species than existed in the recent past.

Knowledge of the true nature of the former avifauna of New Caledonia is the more important because New Caledonia has the largest land area of any single island in the Pacific, apart from New Zealand (New Caledonian mainland, 16,750 km^2 [with Isle of Pines and Loyalties, 19,103 km^2]; North Island, New Zealand, 114,785 km^2; South Island, New Zealand, 153,318 km^2; Viti Levu, Fiji, 10,429 km^2; Vanua Levu, Fiji, 5556 km^2). Furthermore, man has been present in New Caledonia for a longer period of time than in other islands of Oceania that have been explored paleontologically. It will therefore be of interest to compare the timing and extent of man-caused extinctions on New Caledonia with data from elsewhere.

The present report is preliminary, the main purpose being to provide descriptions of new species and accounts of the nonpasserine taxa found as fossils to date. This work was largely completed prior to the collection in 1986 of an extensive series of skeletons of recent birds that will permit a much more accurate analysis of the fossil passerine fauna. Future studies will also treat additional fossils from Gilles Cave and elsewhere on New Caledonia, radiometric dating of bones, and more expanded treatment of the osteology and systematics of the remarkable extinct flightless bird *Sylviornis neocaledoniae*.

Fossil birds were first discovered fortuitously at the Kanumera site on the Isle of Pines in 1974 (Dubois, 1976). In 1978, Dr. P.V. Rich (Monash University, Melbourne) continued the recovery of fossils from Kanumera, collecting several hundred bones (Rich et al., 1981). Dr. François Poplin (Paris Museum) collected at the same locality in 1980 and brought back two tons of fossiliferous limestone breccia. Balouet discovered 11 new localities and collected more than 10,000 bones during 4 expeditions to New Caledonia (1980, 1981, 1983, 1984). On another expedition in August–September 1986, he discovered 3 additional sites and collected more material from Gilles Cave as well. The results of this last expedition are not covered in this report.

Fairly numerous passerine bones were obtained in the fossil deposits, mainly from the upper layers of Gilles Cave. At the time this research was undertaken we lacked sufficient comparative material to identify most of these fossils with any certainty. Since then we have obtained a fine comparative

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series, and analysis of the passerine fauna will be deferred until this can be prepared and consulted.

Prior to these expeditions, very little was known of the extinct fauna of New Caledonia. A supposed fossil tooth from Fern Hill (Diahot Valley, northern mainland) was originally considered by Filhol (1876) to belong to a rhinoceros but was later reinterpreted as a new species of marsupial in the Zygomaturinae, *Zygomaturus diahotensis* (Guerin et al., 1981). The origins of this fossil must be considered very dubious, however, as no further evidence of any mammals, except bats, to say nothing of such a large mammal as *Zygomaturus*, has emerged in New Caledonia (Balouet, 1984a:12). In the early part of this century, a few bones of a gigantic horned turtle, *Meiolania mackayi* (Anderson, 1925), were discovered on Walpole Island (Loyalty Archipelago). In 1954, a geologist of the Service des Mines, collected 4 bones on Tiga Island, also in the Loyalty group, that were referred to *Meiolania* sp. (Gaffney et al., 1984). Neither of these localities has been explored or excavated since.

Besides the three major localities described below, in 1980 Balouet found 4 bird bones of unknown age in a cave on Maré Island (Loyalty Archipelago) near Menaku. Of these, one belongs to the rail *Poliolimnas cinereus* Vieillot, one to a small dove, and the two others to passerines. These are the only fossil birds recorded from the Loyalty Islands.

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The New Caledonia Water and Forest Service provided major help in the field, which greatly increased the results of the various expeditions. We are also grateful to Yves Letocart, Francis Hannecart, Francis and Salomé Compin, and P.R. Millener, who contributed greatly to the success of the fieldwork. ORSTOM and the Musée de Nouméa also provided considerable scientific and material facilities. Other material aid to Balouet was offered by the Société de Nickel, the Musée de Nouméa, the Société Toucan, the Institut Pasteur (Paris and Nouméa), the Muséum National d'Histoire Naturelle de Paris, and the Laboratoire de Paléontologie des Vertébres et Paléontologie Humaine of the Université Paris VI.

Comparisons were made chiefly with skeletons from New Caledonia in the Muséum National d'Histoire Naturelle, Paris (MNHN) and with specimens in the U.S. National Museum collections (USNM) of the National Museum of Natural History, Smithsonian Institution, Washington, D.C. For lending, allowing access to, or providing information concerning additional comparative material of modern skeletons we are grateful to: Allison V. Andors and Mary LeCroy, American Museum of Natural History, New York (AMNH); Ann Jacobberger, Ned K. Johnson, and Barbara Stein, Museum of Vertebrate Zoology, University of California, Berkeley (MVZ); Alan Ziegler, Allen Allison, and Carla Kishinami, Bernice P. Bishop Museum, Honolulu (BPBM); David M. Niles, Delaware Museum of Natural History, Greenville (DMNH); J. A. Bartle, National Museum of New Zealand, Wellington (NMNZ); Rory O'Brien, National Museum of Victoria, Melbourne (NMV); Shane Parker, South Australian Museum, Adelaide (SAM); Glen E. Woolfenden, University of South Florida, Tampa (GEW); Eleanor Stickney, Peabody Museum of Natural History, Yale University, New Haven (YPM); Christian Erard, Paris Museum (MNHN), B.J. Gill, Auckland Museum (AM), Charles Meredith and P. V. Rich, Monash University; and J. Grant-Mackie, Auckland University.

J.P. Angle (Smithsonian Institution, SI) was instrumental in removing bones from study skins in order to provide comparative material when skeletons were not available. Frederick V. Grady (SI) sorted fossils from several hundred kilos of concentrate from Pindai Cave. Mary LeCroy kindly answered repeated requests for information on specimens in the AMNH collections. Photographs of specimens are by Claude Abrial, Paris University, and Victor E. Krantz, Smithsonian Institution.

All fossil specimens are deposited with the Muséum National d'Histoire Naturelle, Paris, for which the prefix MNHN may be assumed. The additional prefixes NCG, NCK, NCP reflect the island of origin (NC = New Caledonia) and the particular site (G = Gilles caves, K = Kanumera, P = Pindai).

History and Geology of the Fossil Localities

KANUMERA

This site, described previously by Poplin and Mourer-Chauviré (1985), is located in the southwestern corner of the Isle of Pines, a small (160 km^2) satellite island lying 50 km southeast of the New Caledonian mainland (Figure 1). Fossils were discovered here in 1974 by Dubois (1976), who was working on Melanesian traditions and learned of the presence of bone breccia at Ure, close to Kanumera Beach. A local legend explained the presence of these bones as being due to the fall of the god Kukwiede's nephews into the sink after being lured there by Kukwiede in revenge for certain transgressions.

Collections were made at Kanumera in 1978 by P.V. Rich, in 1980 by F. Poplin, and in 1981 by J.C. Balouet. Three adjacent localities besides that discovered initially were located by Poplin in 1980 and Balouet in 1981.

The geological history of these localities begins 180,000 years ago with the uplifting of the fringing limestone reef

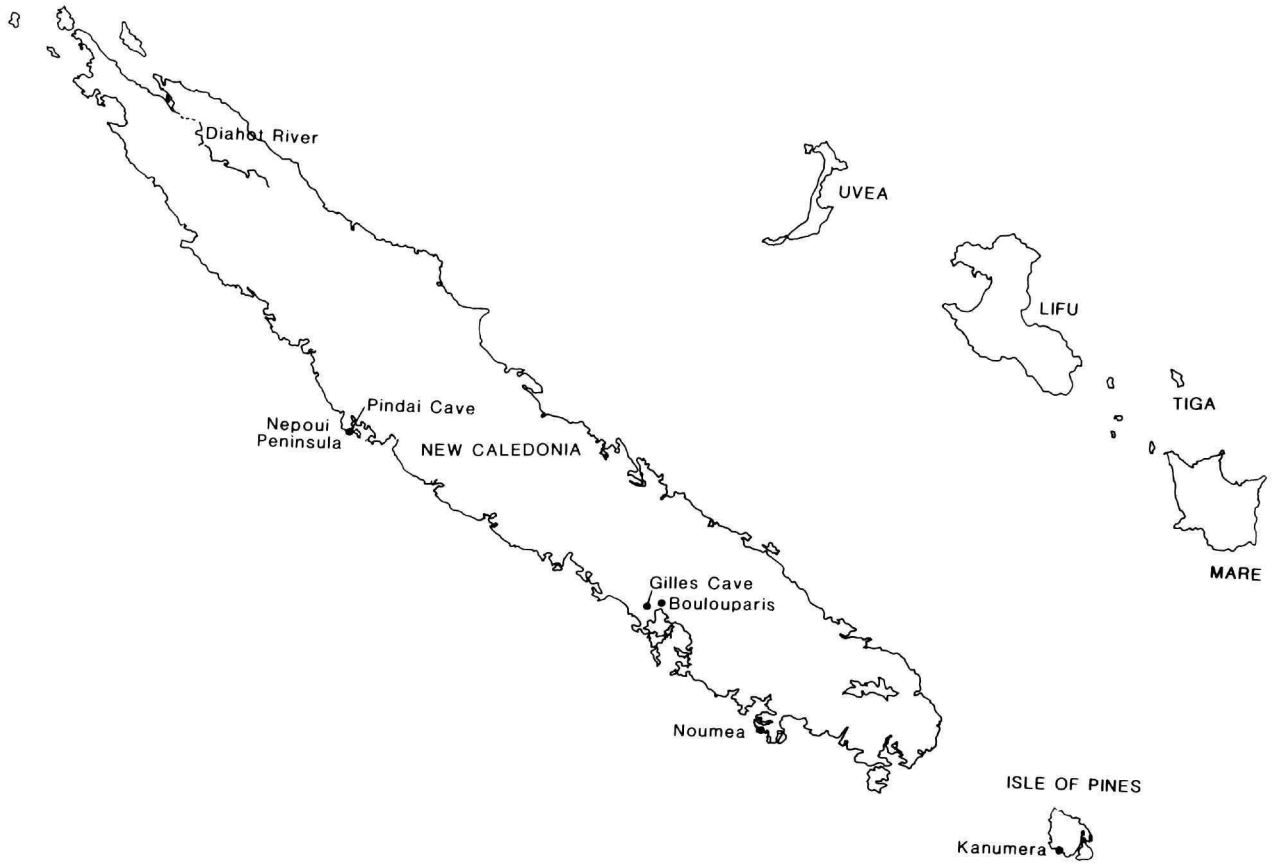

FIGURE 1.—Map of New Caledonia and the Loyalty Islands showing the location of fossil sites mentioned in the text.

(Launay and Recy, 1972; Paris, 1980). Subsequent solutional erosion formed more than 20 sinkholes up to 8 m deep, which then were filled by fragments of the eroded uplifted reef and bones of fallen animals, this breccia subsequently becoming cemented. Rockfall inside the sinkholes is presumably responsible for the severe fragmentation of the bones in the deposit. Marine erosion then cut transversely through the uplifted reef, exposing some of the brecciated sinks in cross section (see Poplin and Mourer-Chauviré, 1985, fig. 2).

Radiocarbon dating of collagen from bones of the extinct large bird *Sylviornis neocaledoniae* gave an age of 3450 ± 210 years BP for the Kanumera site (Poplin, et al., 1983). There are no human remains, artifacts, or rat bones associated with this site and its age is older than the most ancient evidence of man in New Caledonia (Green, 1979:33; Frimigacci, 1980), so it is likely that these deposits formed naturally.

Because of the conditions of preservation, and because there appear to have been no owls occupying these sinkholes, the avifauna of the Kanumera site is limited to 6 species, and is heavily biased towards large to very large birds (*Sylviornis*, *Tricholimnas*, *Rhynochetos*, *Porphyrio*, and *Megapodius*). All but the last of these were flightless. A single bone of *Turnix* provides the only record of a small bird. None of these species has ever been recorded historically from the Isle of Pines; 4 of them are extinct and known only from fossils, and the 2 others (*Tricholimnas* and *Turnix*) have been excessively rare on the New Caledonian mainland throughout the historic period and are on the verge of extinction.

The Isle of Pines has probably been separated from the New Caledonian mainland only for the past 10 to 20 thousand years. We have no evidence that any of the birds from the Isle of Pines had differentiated from those of the mainland, but the very fragmentary nature of the material makes comparisons difficult.

GILLES CAVES

The Gilles Caves are situated about 5 km WSW of Boulouparis, on the west coast of the mainland (Figure 1). Although one of these caves was known for more than 50 years to contain phosphatic deposits, their paleontological significance was discovered only on 15 September 1981 by Balouet. Collections were made at that time by Balouet and in 1983 by Balouet, P.R. Millener, and Y. Letocart. Material from more

extensive excavation by Balouet and Letocart in 1986 will be reported on separately.

The main cave at Gilles (the only one referred to in the species accounts) is the object of a phosphate mining grant. Its area is about 400 m^2 and the phosphate deposits, the result of the accumulation of bat and swift guano, reach depths of over 8 m.

Bones were recovered from two distinct levels. In the upper level, bones of rats were abundant and occurred to a depth of 1.3 m. Remains were identified by Francis Petter (Department of Mammalogy, MNHN) as belonging to *Rattus rattus* (rare), *R. exulans* (rare), and *R. norvegicus* (most abundant), with one jaw being referred to *Mus musculus*. These rodents are commensals of man and the deposits containing them must be assumed to postdate human occupation of the island. Bones from the upper layer at Gilles accumulated mainly as pellets of the barn owl *Tyto alba*. Most were obtained at the surface of the rockfalls near the two entrances of the cave and are obviously of recent age. The secondary entrance to the cave is probably relatively recent because human bones, along with some of *Sylviornis*, are wedged in among the huge boulders (several tons) that fell to form the entrance.

All of the birds from the upper level belong to species that are certainly known historically from the island, except *Sylviornis*, *Ninox*, and the extinct *Porphyrio*. Bones of the nearly, if not quite, extinct species *Turnix (varia) neocaledoniae* and *Tricholimnas lafresnayanus* are included, the former being the most abundant species represented except for *Tyto alba* and *Gallirallus philippensis*. None of the species of birds that were introduced by man in the 19th and 20th centuries have been identified in these deposits, however.

Rat bones are absent in the lower level deposits at Gilles Cave, which are therefore assumed to have been laid down prior to man's arrival. The sediments are red and ochre in color and very rich in lizard bones (geckos and skinks). This level has not been dated. Bones were obtained only from a small test pit and, apart from *Sylviornis* and lizard bones, include only 23 specimens. Of the 7 species of birds represented, 3 appear to have become extinct prehistorically (*Sylviornis*, *Tyto? letocarti*, and a snipe), and 2 are very rare historically (*Tricholimnas* and *Aegotheles savesi*, the latter known from only a single modern specimen). The most common species in the lower layer is *Sylviornis neocaledoniae*. The absence of *Rhynochetos* from the Gilles deposits is unexpected, as this is one of the more abundant birds at the other localities.

Two other caves near the main Gilles Cave were explored in 1983 and 1986. Bird remains from Grotte des Fours (Kiln Cave), so called for a lime kiln at the site, belong almost entirely to *Sylviornis neocaledoniae*. The few other bird bones (*Artamus leucorhynchus*, *Porphyrio porphyrio*, *Tyto alba*) were all obviously of very recent origin. Compin Cave, named after its discoverer, Francis Compin, yielded bones of *Tyto alba* and a vertebra and rib of *Sylviornis neocaledoniae*.

Pindai Caves

The Pindai Caves are located on the Nepoui Peninsula, on the west coast of the mainland, about 240 km NW of Nouméa (Figure 1). The caves are located 400 m from the sea, except Pindai II, which is only 20 m from the coast. The locality has previously been mentioned in the literature in connection with the recovery of specimens of the horned turtle *Meiolania* (Gaffney et al., 1984). Fossils were discovered here by Balouet on 3 July 1983, when a complete cranium of *Sylviornis* was found lying on the surface only 2 m from the entrance. Collections were made in 1983 by Balouet, P. R. Millener, Y. Letocart, and F. Hannecart; in 1984 by Balouet, Letocart, and L. Ginsburg, and in 1986 by Balouet.

The deposits in the main Pindai Cave probably accumulated at the bottom of an underground lake that formerly filled the cave. The sediments in the main part of the cave consist of phosphates and magnesic clay with several intercalated layers of gypsum (2–10 cm deep) that were deposited during dry periods when the cave was not flooded. Bone accumulations were found at two sites near lateral exits now filled by unstratified sediment. Bones occurred from the surface to depths of about 1.5 m, where excavation was discontinued. The concentration of bones was very high; more than 6000 bones were recovered in less than 3 cubic meters. Mollusk shells, such as *Arca*, *Ostrea*, and *Nautilus*, assumed to have been brought in by man, were fairly common through most of the deposit. Charcoal obtained at a depth of about 50 cm, in direct association with bones of *Sylviornis* and other extinct birds, gave a radiocarbon age of 1750 ± 70 years BP (Gif. 6341 [CNRS laboratory at Gif sur Yvette, France], Balouet, 1984a).

Sylviornis is the most abundant species of bird at this site. Of the 23 other species of birds, 8 are also extinct, and only 7 are still common. Four of the extinct species are known only from this site (*Caloenas*, *Gallicolumba*, and 2 species of *Accipiter*). More abundant than bird bones are those of bats (at least 4 species). Over 1000 bones of extinct reptiles, including a new family, genus, and species of primitive crocodilian, *Mekosuchus inexpectatus* (Balouet and Buffetaut, 1987), the horned turtle *Meiolania*, and a monitor lizard (*Varanus*), were also recovered (Balouet, 1984a).

The accumulation of bone at this site evidently did not involve deposition in owl pellets, as most smaller species of birds are absent, very few passerines having been recovered. Cave-inhabiting species, such as bats and swifts (*Collocalia*), are naturally abundant, and the presence of the remaining species is probably mainly due to entrapment or transportation by man.

Sediment excavated from the deposits was washed nearby with the cooperation of personnel from the Water and Forest Service of Nouméa and Kone. Large bones were removed in the field and the resulting concentrate was later picked for small bones at the Smithsonian Institution.

An adjacent cave contains a large underground lake with deep, treacherous accumulations of silt. Balouet obtained a

single femur of the endemic dove *Drepanoptila holosericea* in this lake.

Pindai Cave II is a small cave (5 m^2 and 50 cm high) that was found in 1983. Curiously, it contained only 7 human calvaria but no other human bones, 3 bones of the pigeon *Ducula goliath*, one of which, a sternum, had been butchered, and a complete pelvis of the flightless rail *Tricholimnas lafresnayanus*.

Systematic List

(Sequence of families generally follows that of Olson, 1985)

Order CUCULIFORMES
- Family CUCULIDAE
  - Genus *Urodynamis* Salvadori, 1880
    - *Urodynamis taitensis* (Sparrman, 1787)

Order FALCONIFORMES
- Family FALCONIDAE
  - Genus *Falco* Linnaeus, 1758
    - *Falco peregrinus* Tunstall, 1771
- Family ACCIPITRIDAE
  - Genus *Accipiter* Brisson, 1760
    - *Accipiter efficax*, new species
    - *Accipiter quartus*, new species

Order GALLIFORMES
- Family MEGAPODIIDAE
  - Genus *Megapodius* Gaimard, 1823
    - *Megapodius molistructor*, new species
- Family, Incertae Sedis
  - Genus *Sylviornis* Poplin, 1980
    - *Sylviornis neocaledoniae* Poplin, 1980

Order, Incertae Sedis
- Family TURNICIDAE
  - Genus *Turnix* Bonnaterre, 1791
    - *Turnix (varia) novaecaledoniae* Ogilvie-Grant, 1889

Order COLUMBIFORMES
- Family COLUMBIDAE
  - Genus *Ducula* Hodgson, 1836
    - *Ducula goliath* (Gray, 1859)
  - Genus *Drepanoptila* Bonaparte, 1855
    - *Drepanoptila holosericea* (Temminck, 1810)
  - Genus *Columba* Linnaeus, 1758
    - *Columba vitiensis* Quoy and Gaimard, 1830
  - Genus *Chalcophaps* Gould, 1843
    - *Chalcophaps indica* (Linnaeus, 1758)
  - Genus *Caloenas* Gray, 1840
    - *Caloenas canacorum*, new species
  - Genus *Gallicolumba* Heck, 1849
    - *Gallicolumba longitarsus*, new species

Order CORACIIFORMES
- Family HALCYONIDAE
  - Genus *Halcyon* Swainson, 1821
    - *Halcyon sancta* Vigors and Horsfield, 1827

Order STRIGIFORMES
- Family TYTONIDAE
  - Genus *Tyto* Billberg, 1828
    - *Tyto? letocarti*, new species
    - *Tyto alba* (Scopoli, 1769)
- Family STRIGIDAE
  - Genus *Ninox* Hodgson, 1837
    - *Ninox* cf. *N. novaeseelandiae* (Gmelin, 1788)
- Family AEGOTHELIDAE
  - Genus *Aegotheles* Vigors and Horsfield, 1826
    - *Aegotheles savesi* Layard and Layard, 1881

Order APODIFORMES
- Family APODIDAE
  - Genus *Collocalia* Gray, 1840
    - *Collocalia spodiopygia* (Peale, 1848)
    - *Collocalia esculenta* (Linnaeus, 1758)

Order GRUIFORMES
- Family RALLIDAE
  - Genus *Porzana* Vieillot, 1816
    - *Porzana tabuensis* (Gmelin, 1789)
  - Genus *Gallirallus* Lafresnaye, 1841
    - *Gallirallus philippensis* (Linnaeus, 1766)
  - Genus *Tricholimnas* Sharpe, 1893
    - *Tricholimnas lafresnayanus* (Verreaux and des Murs, 1860)
  - Genus *Gallinula* Brisson, 1760
    - *Gallinula* cf. *G. tenebrosa* Gould, 1846
  - Genus *Porphyrio* Brisson, 1760
    - *Porphyrio kukwiedei*, new species
    - *Porphyrio porphyrio* (Linnaeus, 1758)
- Family RHYNOCHETIDAE
  - Genus *Rhynochetos* Verreaux and des Murs, 1860
    - *Rhynochetos orarius*, new species

Order CHARADRIIFORMES
- Family CHARADRIIDAE
  - Genus *Charadrius* Linnaeus, 1758
    - *Charadrius mongolus* Pallas, 1876
  - Genus *Pluvialis* Brisson, 1760
    - *Pluvialis dominica* (Müller, 1776)
- Family SCOLOPACIDAE
  - Subfamily SCOLOPACINAE
    - Genus *Coenocorypha* Gray, 1855
      - *Coenocorypha?* species

Order ANSERIFORMES
- Family ANATIDAE
  - Genus *Anas* Linnaeus, 1758
    - *Anas gracilis*, subspecies indeterminate

Order PROCELLARIIFORMES
- Family PROCELLARIIDAE
  - Genus *Pterodroma* Bonaparte, 1856
    - *Pterodroma rostrata* (Peale, 1848)

Genus *Urodynamis* Salvadori, 1880

Urodynamis taitensis (Sparrman, 1787)

MATERIAL.—Pindai Cave: left tibiotarsus. Gilles Cave, upper level: right humerus.

MEASUREMENTS (mm).—Humerus: length, 37.8. Tibiotarsus: length, 54.0.

COMPARATIVE MATERIAL.—*Urodynamis taitensis*, 2 USNM.

STATUS.—Extant: migrant.

REMARKS.—This cuckoo breeds in New Zealand, winters in Polynesia, and occurs in New Caledonia as a migrant from May to September (Delacour, 1966:104).

Genus *Falco* Linnaeus, 1758

Falco peregrinus Tunstall, 1771

MATERIAL.—Pindai Cave: proximal end of left humerus, distal end of right humerus.

MEASUREMENTS (mm).—Humerus: distal width, 16.7.

COMPARATIVE MATERIAL.—*Falco peregrinus*, 12 USNM (all from North America).

STATUS.—Extant, uncommon resident, species widespread.

REMARKS.—The cosmopolitan Peregrine Falcon is a rare resident in New Caledonia today. This population has been referred to the subspecies *F. p. nesiotes* Mayr, of the New Hebrides, Loyalties, and Fiji, although this assignment was made in the absence of specimens from New Caledonia (Mayr, 1941; Stresemann and Amadon, 1979:423).

Genus *Accipiter* Brisson, 1760

Accipiter efficax, new species

FIGURE 2A,C,D

HOLOTYPE.—Left tarsometatarsus lacking proximal end and inner trochlea, NCP 1100, Institut de Paléontologie, Muséum National d'Histoire Naturelle, Paris (Figure 2A).

TYPE LOCALITY.—From apparently Holocene deposits in Pindai Cave, Nepoui Peninsula, west coast of New Caledonia; 21°20′S, 164°57′E.

MEASUREMENTS OF HOLOTYPE (mm).—Length as preserved, 63.4; estimated length, 78; greatest depth of shaft, 7.5; width and depth at proximal end of scar for hallux, 6.7 × 4.8; width through middle and outer trochleae, 10.7; depth of middle trochlea, 6.0.

PARATYPES.—Pindai Cave: complete right (NCP 1101) and scapular end of right (NCP 1102) coracoids, 2 incomplete left scapulae (NCP 1103, 1104), proximal end of left humerus (NCP 1105), 3 right (NCP 1106–1108) and 1 left (NCP 1109) ulnae, 2 right (NCP 1110, 1111) and 1 left (NCP 1112) carpometacarpi, proximal end of left tibiotarsus (NCP 1113), distal end of right tarsometatarsus (NCP 1114), 4 ungual phalanges (NCP 1115–1118).

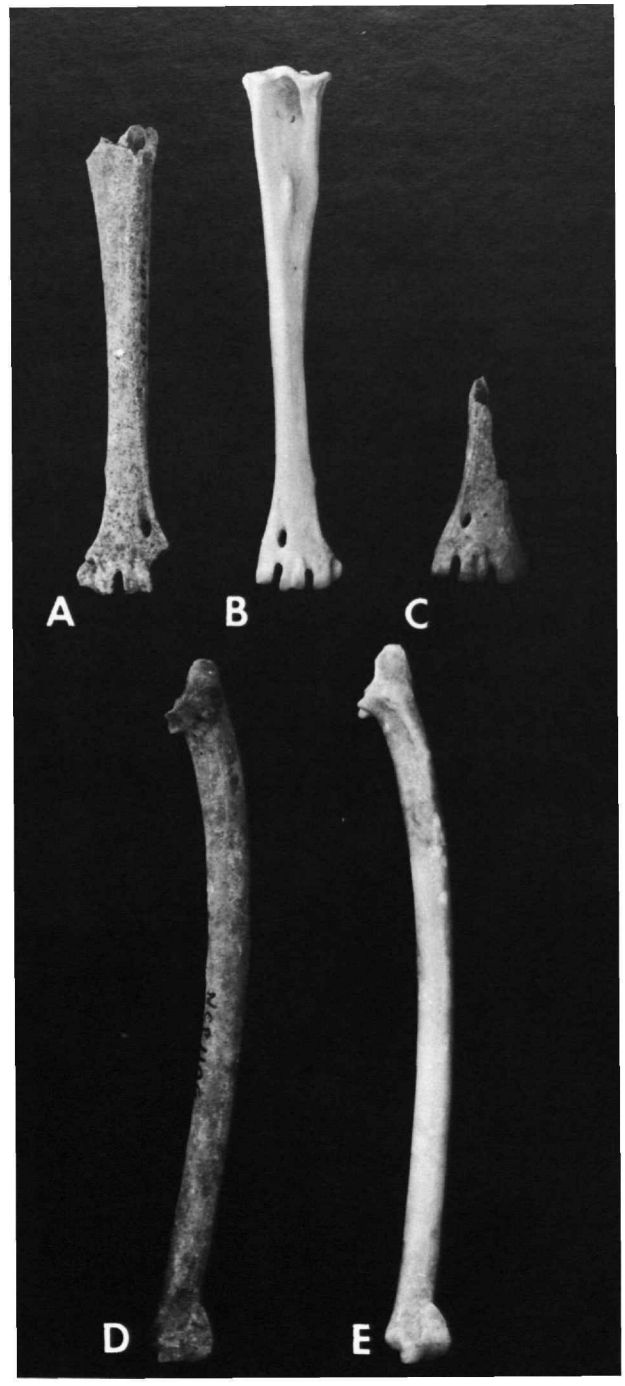

FIGURE 2.—*Accipiter efficax*, new species (A,C,D) compared with *A. meyerianus* (B,E). Tarsometatarsus in anterior view: A, holotype, NCP 1100; B, AMNH 532449. Distal end of tarsometatarsus in anterior view: C, NCP 1114. Right ulna in palmar view: D, NCP 1106; E, AMNH 532449. (Natural size.)

TABLE 1.—Measurements (mm) of *Accipiter efficax*, new species, compared with some larger species of *Accipiter* (dash indicates element not available).

Character	*A. efficax* paratypes	*A. fasciatus* (n = 6)		*A. gentilis* males (n = 6)		*A. gentilis* females (n = 4)		*A. meyerianus* male (n = 1)
		range	mean	range	mean	range	mean	
CORACOID								
Greatest length	43.4	34.5–40.0	37.9	48.3–52.5	50.6	49.8–52.2	51.1	–
ULNA								
Length	~95,100.8,101.3	76.8–91.7	85.5	103.3–110.6	107.3	112.5–113.8	113.1	102.7
CARPOMETACARPUS								
Length	51.0,51.1,52.2	41.9–49.9	46.4	56.8–59.8	58.4	58.6–63.0	60.8	–
TARSOMETATARSUS								
Distal width	14.2	9.0–11.9	10.5	12.2–14.1	13.0	14.0–14.8	14.5	12.6

MEASUREMENTS OF PARATYPES.—See Table 1.

COMPARATIVE MATERIAL.—*Accipiter f. fasciatus* (Vigors and Horsfield), 6 from Victoria and New South Wales, Australia: NMV W6657, male; NMV W9987, male; GEW 2682, male; NMV W3610, female; NMV B13091, unsexed; NMV B13444, unsexed. *Accipiter gentilis atricapillus* (Wilson) from eastern United States: 6 males, 4 females, USNM. *Accipiter meyerianus* (Sharpe), distal end of humerus, ulna, radius, and tarsometatarsus removed from skin, AMNH 532449, male from Seram Laut (Maar).

DIAGNOSIS.—An *Accipiter* of the *A. gentilis* group, recognizable by very large size (Table 1) and the proportionately short, very robust tarsometatarsus (Figure 2). Differs from *A. gentilis* (Linnaeus) in proportions, the elements of the wing and pectoral girdle being smaller but the tarsometatarsus and claws as large and robust as in that species. Also, the distal foramen of the tarsometatarsus is markedly smaller and the wing of the inner trochlea does not extend as far posteriorly. Compared with *A. meyerianus*, the ulna is more robust, with a heavier olecranon; the tarsometatarsus is also more robust, especially in lateral view, the distal end is more expanded, the distal foramen smaller, and the posterior face of the shaft more excavated and channel-like.

ETYMOLOGY.—Latin, *efficax* (powerful), from the large size and powerful nature of this group of hawks.

STATUS.—Extinct, endemic; known from fossils only.

REMARKS.—These bones come from a very large species of *Accipiter* that is distinct from *Accipiter fasciatus*, the larger of the two species of *Accipiter* found in New Caledonia today. The fossils are considerably larger than bones from the nominate Australian subspecies of *A. fasciatus*. The resident form on New Caledonia, *A. f. vigilax* (Wetmore), for which no skeletons were available, is reported to be smaller than Australian birds (Wattel, 1973:134). The large size and robust proportions of the tarsometatarsus, which is much more slender in *A. fasciatus*, indicate a goshawk of the *A. gentilis* group, the only member of which in Australasia is the rare monotypic species *A. meyerianus* of the Moluccas, New Guinea, New Britain, and Solomon Islands (Kolombangara and Guadalcanal).

Although Wattel (1973:184) places *A. buergersi* (Reichenow) of highland New Guinea with this group, Brown and Amadon (1968:463) would place it elsewhere because of the "very long middle toes, and relatively slender tarsi." No skeletons are available for this rare species, but the slender tarsi suggest that it is probably not closely related to *A. efficax*.

The paratypical coracoid lacks the procoracoid foramen, a condition that distinguishes the genus *Accipiter* from almost all other genera of Accipitridae except *Circus*, in which the procoracoid foramen is usually reduced or sometimes lost (Olson, 1988).

It is perplexing that *A. efficax* was fairly common in the Pindai deposits and that the only other fossils of *Accipiter* belong to a very small species that is also extinct, whereas the extant species *A. fasciatus* and *A. haplochrous* Sclater are absent as fossils. Evidently there were four species of *Accipiter* on New Caledonia in the recent past. Why two of these should have become extinct while two others survive is not clear.

Accipiter quartus, new species

FIGURE 3A,C,E

HOLOTYPE.—Left femur, NCP 990, Institut de Paléontologie, Muséum National d'Histoire Naturelle, Paris (Figure 3A).

TYPE LOCALITY.—From apparently Holocene deposits in Pindai Cave, Nepoui Peninsula, west coast of New Caledonia; 21°20′S, 164°57′E.

MEASUREMENTS OF HOLOTYPE.—See Table 2.

PARATYPES.—Pindai Cave: proximal (NCP 991) and distal (NCP 992) ends of left tibiotarsus, distal end of right tibiotarsus (NCP 993).

MEASUREMENTS OF PARATYPES.—See Table 2.

COMPARATIVE MATERIAL.—*Accipiter haplochrous*: DMNH 53876 female; USNM 561511–561518, 4 males and 4 females. *Accipiter cirrhocephalus* (Vieillot), 5 from Victoria, Australia, NMV B10346, B11666, W6745, W8574, W9876; one from New Guinea, YPM 8091, male. Of the 5 Australian specimens, 3 were unsexed and one was apparently missexed. On size, this series would appear to consist of 2 males and 3 females.

TABLE 2.—Measurements (mm) of *Accipiter quartus*, new species, compared with some other species of *Accipiter*.

Character	*A. quartus*[1]	*A. cirrhocephalus*				*A. haplochrous*			
		males (n = 3)		females (n = 3)		males (n = 4)		females (n = 5)	
		range	mean	range	mean	range	mean	range	mean
FEMUR									
Length	44.8	40.1–42.5	41.6	46.5–49.9	48.2	45.0–47.6	46.5	53.2–55.1	53.8
Proximal width	7.4	6.7–7.2	6.9	8.0–8.8	8.4	8.2–8.5	8.4	9.2–10.3	9.8
Distal width	7.9	7.0–7.4	7.2	8.0–9.2	8.7	8.4–9.1	8.8	10.5–11.3	10.8
TIBIOTARSUS									
Distal width	6.7, 6.8	5.5–5.9	5.7	6.9–7.5	7.2	7.1–7.4	7.2	8.7–9.0	8.8

[1]Measurements of femur from holotype only.

[2]Most individuals of *A. cirrhocephalus* were assigned to sex on the basis of size.

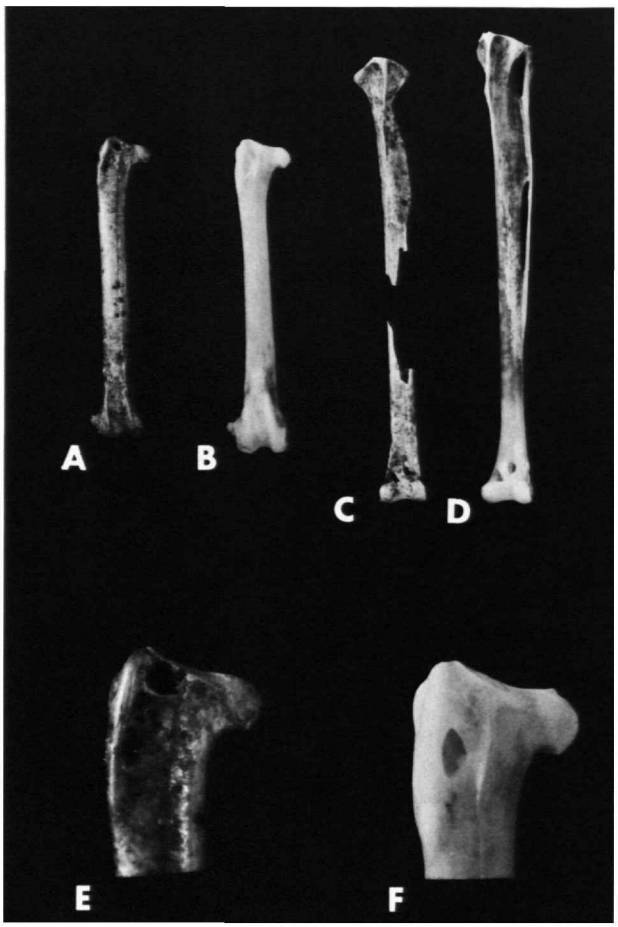

FIGURE 3.—*Accipiter quartus*, new species (A,C,E), compared with males (the smaller sex) of *A. haplochrous* (B,D,F). Femur: A,E, holotype, NCP 990; B,F, USNM 561514. Tibiotarsus in anterior view: C, proximal (NCP 991) and distal (NCP 992) ends; D, USNM 561515. (A–D, natural size; E,F, × 3.)

DIAGNOSIS.—A small species of *Accipiter*, smaller than *A. haplochrous* (Table 2). The type material, which may be from a single individual, is smaller and decidedly less robust than the presumed females of *A. cirrhocephalus*, and larger and more robust than presumed males of that species. Although in length the holotype is only slightly smaller than the smallest male of *A. haplochrous*, it, along with the referred tibiotarsi, is decidedly more gracile than in that species (Figure 3). The head of the femur is proportionately smaller, the trochanter less expanded anteriorly, and the distal end is narrower, with a narrower rotular groove. The fibular crest of the tibiotarsus is relatively longer, and the distal end in distal view is decidedly shallower than in *A. haplochrous*. An apparently unique feature is the presence of two large pneumatic foramina in the anterior face of the trochanter, the larger of which is situated just under the articular surface of the neck. There are three smaller pinhole foramina between the two. Although there is some variation in the size and placement of these foramina in *Accipiter*, only a single large foramen is present, this being homologous with the more distal one seen in the holotype of *A. quartus*. No other species possessed the large proximal foramen of *A. quartus*.

ETYMOLOGY.—Latin, *quartus* (fourth), in reference to the fact that this is the fourth species of *Accipiter* to be found on New Caledonia.

STATUS.—Extinct, endemic; known from fossils only.

REMARKS.—Although the material is scant, *Accipiter quartus* is distinct from either of the two species of *Accipiter* known today on New Caledonia. The only species of *Accipiter* in the Australasian region in the same size range are *A. erythrauchen* Gray of the Moluccas, *A. brachyurus* (Ramsey) of New Britain, and *A. cirrhocephalus* (Vieillot) of Australia, New Guinea, and adjacent islands. No skeletal material is available for either of the first two species. *Accipiter quartus* may be derived from a stock similar to *A. cirrhocephalus*, or was at least its ecological equivalent.

Genus *Megapodius* Gaimard, 1823

The new species described below differs from other genera of megapodes and is similar to *Megapodius* (including *Eulipoa*) in the following characters: Scapula with better developed, more ventrally projecting acromion, narrower blade, and deep groove between glenoid facet and acromion (Figure 4D,E). Ulna with better developed ridge separating the cotylae (Figure 4F). Proximal end of tarsometatarsus more medially flared; attachment of M. tibialis anticus better developed and shaft medial to it very thin. Hypotarsus with the main calcaneal ridge extending farther posteriorly and also distally as a hook-like process; hypotarsal canal in the same antero-posterior line with main calcaneal ridge, not offset laterally (Figure 4C). The ungual phalanges are long and flattened ventrally, as typical for the family (Figure 4G).

Megapodius molistructor, new species

FIGURE 4

HOLOTYPE.—Left tarsometatarsus lacking outer and middle trochleae and part of the external cotyla, NCP 600, Institut de Paléontologie, Muséum National d'Histoire Naturelle, Paris (Figure 4A,B).

TYPE LOCALITY.—From apparently Holocene deposits in

FIGURE 4.—*Megapodius molistructor*, new species. Tarsometatarsus, holotype, NCP 600: A, anterior view; B, posterior view; C, proximal view. Scapula, NCP 601: D, dorsal view; E, ventral view. F, Proximal end of ulna in proximal view, NCP 604. G, Ungual phalanx in ventrolateral view, NCP 605. (A,B,D,E, natural size; C,F,G, × 2.)

TABLE 3.—Measurements (mm) of *Megapodius molistructor*, new species, compared with other species of Megapodiidae (n = 1, except *M. freycinet*, n = 12). Measurements of the ulna are from NCK 604, except those in parentheses, which are from NCP 604 and NCP 601, respectively; dash indicates element not available.

Character	*Megapodius molistructor*	*Megapodius freycinet* range	*Megapodius freycinet* mean	*Megapodius pritchardii*	*Megapodius wallacei*	*Leipoa ocellata*	*Alectura lathami*	*Macrocephalon maleo*	*Talegalla jobiensis*	*Aepypodius bruijnii*
SCAPULA										
Length	75.2	53.7–63.3	60.2	51.3	60.9	76.2	84.6	83.1	–	–
Maximum diameter of glenoid facet	7.4	5.4–6.8	5.9	4.4	5.3	7.2	6.5	8.6	–	–
Proximal width	15.1	9.8–11.9	10.9	8.6	10.3	15.4	14.8	15.2	–	–
ULNA										
Palmo-anconal proximal depth	– (10.4) (10.9)	7.4–8.3	7.9	6.5	7.4	10.3	10.7	12.1	10.3	10.4
Palmo-anconal distal depth	10.0	6.6–7.8	7.3	6.3	7.5	10.3	10.3	10.9	10.2	11.1
Minimum diameter of shaft at midpoint	5.0	3.6–4.0	3.7	3.0	3.3	5.1	5.4	5.3	5.1	5.1
Maximum diameter of shaft at midpoint	7.0	4.5–5.6	5.0	3.8	4.2	6.6	6.9	6.9	7.0	6.2
FEMUR										
Proximal depth	12.0	6.7–8.6	7.8	6.0	7.1	11.0	12.0	10.3	–	–
Minimum diameter at midpoint	7.8	5.1–6.6	5.9	4.4	4.7	8.2	10.3	7.1	–	–
Maximum diameter at midpoint	8.7	5.7–7.2	6.6	4.8	5.5	8.6	11.5	8.0	–	–
TARSOMETATARSUS										
Length from inner trochlea	79.1	59.9–74.5	69.3	56.4	60.2	74.2	89.2	84.8	85.4	109.0
Proximal width	~17	10.7–13.5	12.3	9.4	10.8	15.1	17.4	16.8	14.8	16.8
Proximal depth	16.8	10.3–14.1	12.7	9.2	11.0	14.7	14.2	14.2	13.1	14.7
Width at midpoint	8.0	4.5–6.2	5.6	4.0	4.4	6.5	7.1	6.7	6.6	7.0
Depth at midpoint	5.0	3.0–4.1	3.7	2.9	3.3	4.7	4.8	4.2	4.7	5.7

Pindai Cave, Nepoui Peninsula, west coast of New Caledonia; 21° 20′S, 164°57′E.

MEASUREMENTS OF HOLOTYPE (mm).—Length from intercotylar knob to inner trochlea, 79.1; length from intercotylar knob to distal foramen, 69.2; approximate depth through hypotarsus, 16.8; length of hypotarsus, 11.6; width and depth of shaft at midpoint, 8.0 × 5.0.

PARATYPES.—Pindai Cave: complete left scapula (NCP 601); anterior half of right scapula (NCP 602); proximal end of left ulna (NCP 603); fragment of right femur (NCP 604); ungual phalanx (NCP 605).

Kanumera: anterior end of right scapula (NCK 602); proximal end of right ulna (NCK 601); distal half of left ulna (NCK 604); distal end of left ulna (NCK 603); proximal half of right femur lacking head (NCK 600); ungual phalanges (NCK 605, 606, 607, 608).

MEASUREMENTS OF PARATYPES.—See Table 3.

COMPARATIVE MATERIAL.—*Megapodius freycinet* Gaimard, 36 USNM; *M. pritchardii* Gray, 3 USNM; *M. (Eulipoa* auct.) *wallacei* Gray, 1 USNM; *Leipoa ocellata* Gould, 1 USNM, 1 NMV; *Alectura lathami* Gray, 1 + 3 trunks USNM; *Talegalla jobiensis* Meyer, limb bones removed from skin USNM; *Aepypodius bruijnii* (Oustalet), limb bones removed from skin USNM; *Macrocephalon maleo* Müller, 1 USNM.

DIAGNOSIS.—Largest and most robust species of the genus (Table 3). The tarsometatarsus is extremely robust by comparison with other species of *Megapodius*, and the ulna differs in its stouter shaft, which resembles that in other genera more than *Megapodius*.

ETYMOLOGY.—Latin, *moles* (heap, pile), and *structor* (builder); from the most salient behavioral characteristic of the megapodes, which are also known as mound builders.

STATUS.—Extinct, endemic; known from fossils only.

REMARKS.—*Megapodius molistructor* is the only extinct fossil species of Megapodiidae to be described so far, except for two giant species of *Progura* from the Quaternary of Australia (van Tets, 1974). The fossils are not the first indication of a megapode from New Caledonia, however. Gray (1862:291) described a species supposedly from New Caledonia as *Megapodius? andersoni*, based on the manuscript notes of William Anderson, who mentioned a bird he called *Tetrao australis* and described only as "Fusca nigrique; pedibus

nudis." His use of the genus *Tetrao* (grouse) would certainly imply a galliform bird and the reference to the naked feet would presumably have been to contrast it with the true grouse, in which the feet are feathered.

Anderson, a ship's surgeon, had been a member of Captain James Cook's second voyage, the only one that went to New Caledonia. He was not assigned the duties of naturalist, however, until Cook's third and final voyage, during which Anderson died of consumption (Stresemann, 1950). We have not had the opportunity to undertake the historical research necessary to attempt to provide additional details for evaluating *Megapodius? andersoni*. The description is so brief and inconclusive by itself as to inspire little confidence. Given the great land area of New Caledonia and the large size of *M. molistructor*, there may once have been more than one species of megapode on the island. Therefore, even if we could be sure that Anderson had met with a megapode in New Caledonia, we could not be certain that this was of the same species as *M. molistructor*.

With extant populations of *Megapodius* in the New Hebrides (Vanuatu), Banks Islands, and Niuafou, between Fiji and Samoa, the absence of megapodes from New Caledonia, Fiji, Samoa, and other islands obviously within the dispersal capability of megapodes, should probably always have seemed unnatural. Lister (1911) noted these anomalies and attempted to explain them as being due to inter-island transport by the indigenous human inhabitants of the islands. This explanation is not concordant with species-level systematics or with the fact that megapodes do not adjust well to captivity. Furthermore, it does not explain the gaps in distribution.

Recently, however, archeological and paleontological studies have shown that megapodes were formerly present on islands where they no longer occur; e.g., Tikopia (Kirch and Yen, 1982:282), the Lakeba Group of Fiji (Gibbons and Clunie, 1986:69), the Santa Cruz group (material examined by Olson and D. W. Steadman), and Lifuka in the Tonga group (Steadman, in press b), in addition to New Caledonia. Furthermore, specimens of megapode eggs taken in the last century have been attributed to Hapai Island in the Tonga group, and to the Samoan Islands (Gray, 1862; Oates, 1901:17). There is even a somewhat apocryphal report of megapodes from the Kermadec Islands (Lister, 1911). These records have long since been forgotten. It is now evident, however, that many populations of megapodes have been eliminated by man within relatively recent time. Considering the vulnerability of megapodes, especially to egg predation, the mystery is why certain populations on small inhabited islands have been able to persist as long as they have. The Megapodiidae appear to be restricted in their dispersal northward into continental Asia by competitive exclusion by the Phasianidae (Olson, 1980). It now remains to be seen just how extensively distributed they were in the Pacific before the arrival of man.

Genus *Sylviornis* Poplin, 1980

Sylviornis neocaledoniae Poplin, 1980

MATERIAL.—Pindai Cave: 4263+ bones representing virtually all parts of the skeleton.

Gilles Cave, lower layers: 22 bones; upper layers: 55 bones.

Kiln Cave: 100+ bones.

Compin Cave: 1 vertebra.

Kanumera: 617+ bones (including material reported by Poplin and Mourer-Chauviré, 1985).

STATUS.—Extinct, endemic; known from fossils only.

REMARKS.—This gigantic flightless bird was first described as a ratite on the basis of some very fragmentary material from Kanumera (Poplin, 1980), the holotype being an incomplete toe bone still partially embedded in matrix. Additional material from Kanumera was interpreted as showing *Sylviornis* to be a galliform belonging to the Megapodiidae (Poplin et al., 1983; Poplin and Mourer-Chauviré, 1985).

Much more complete and better-preserved material from Pindai Cave includes elements of practically the entire skeleton, representing dozens of individuals. The osteology and relationships of *Sylviornis* will be treated in a monograph by Balouet to appear later. For the time being, we believe that a galliform relationship for *Sylviornis* appears reasonable, but the genus is so divergent that we question whether it should be included in the Megapodiidae.

Sylviornis is the most abundantly preserved bird in all of the fossil deposits, which suggests that, in spite of the somewhat raptorial looking beak, it could not have been a predator. A few bones of *Sylviornis* have been found in an archeological site at Nessadiou, near Bourail on the west coast (Balouet, 1984a:7), which, with the Holocene dates from Pindai Cave and Kanumera, shows that this highly peculiar species was once contemporary with man, who must be assumed to have caused its extinction (Balouet, 1987).

Genus *Turnix* Bonnaterre, 1791

Turnix (varia) novaecaledoniae Ogilvie-Grant, 1889

FIGURE 5

MATERIAL.—Pindai Cave: premaxillary and mandibular symphyses; anterior portion of sternum; right os coxae, left scapula; 2 right humeri.

Gilles Cave, lower layers: 2 left and 1 right coracoids; distal end of left tibiotarsus.

Gilles Cave, upper layers: cranium; pelvis; 4 sterna; furcula; 9 right and 12 left humeri; 4 right and 3 left ulnae; 7 right and 7 left femora; 16 right and 8 left tibiotarsi; 6 right and 4 left tarsometatarsi.

Kanumera: distal end of left tibiotarsus.

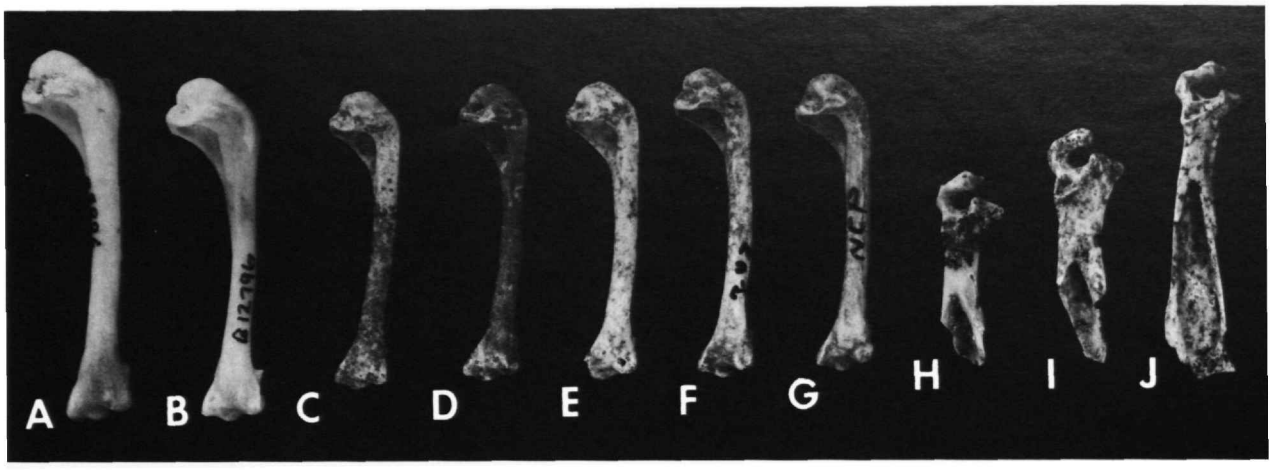

FIGURE 5.—Fossil and recent bones of *Turnix*: A–G, humeri in anconal view, × 1.5; H–J, coracoids in dorsal view, × 2. Note the larger size of modern *T. varia* from Australia (A,B) compared with fossils from the upper layers of Gilles Cave (C–F) and from Pindai Cave (G). On the other hand, fossils from the lower layer at Gilles Cave (H,I) are larger than those from the upper layer (J).

TABLE 4.—Measurements (mm) of fossil bones of *Turnix* from upper layer deposits of Gilles Cave compared with modern specimens of *T. varia* from Australia.

Character	Gilles Cave fossils			*T. varia*		
	n	range	mean	n	range	mean
CORACOID						
Length	2	23.5, 24.2	23.8	5	23.0–27.7	25.7
HUMERUS						
Length	13	28.2–31.1	29.0	5	31.6–35.3	33.9
Proximal width	18	6.4–7.4	6.8	5	7.3–8.8	8.0
Proximal depth	17	3.8–4.8	4.3	5	4.9–5.6	5.1
Distal width	14	4.8–5.7	5.2	5	5.4–6.3	5.9
Depth external condyle	13	2.8–3.5	3.1	5	3.5–4.2	3.8
FEMUR						
Length	6	27.5–32.5	30.5	6	30.2–34.1	32.3
Proximal width	9	5.0–6.0	5.6	6	5.5–6.4	5.9
Proximal depth	9	2.9–3.8	3.4	6	3.3–4.4	3.8
Distal width	9	4.6–5.7	5.1	6	5.2–5.8	5.4
Depth inner condyle	8	3.8–4.7	4.0	6	4.2–5.0	4.6
Depth outer condyle	8	3.0–4.3	3.7	6	4.0–4.7	4.2
TIBIOTARSUS						
Length	8	35.6–41.3	38.4	6	39.2–43.2	41.6
Length of fibular crest	10	7.6–10.9	9.3	6	7.0–9.2	8.1
Distal width	11	3.4–4.0	3.6	6	4.0–4.5	4.1
Depth inner condyle	8	3.2–3.8	3.5	6	3.9–4.1	4.0
Depth outer condyle	9	2.7–3.3	3.1	6	3.4–3.9	3.6
TARSOMETATARSUS						
Length	5	20.8–23.2	22.1	6	22.0–23.7	22.9
Proximal width	5	4.1–4.6	4.3	6	4.5–5.0	4.6
Proximal depth	5	3.5–4.2	3.9	6	3.6–4.5	4.1
Distal width	5	4.0–4.6	4.4	6	4.6–5.6	5.0
Distal depth	5	3.0–3.5	3.2	6	2.7–3.8	3.1

TABLE 5.—Measurements (mm) comparing fossils of *Turnix* from the upper and lower layers of Gilles Cave.

Character	Upper Layer n			Lower Layer n	
CORACOID					
Width at acrocoracoid	2	5.0, 5.3		2	5.2, 5.7
Depth at acrocoracoid	2	3.0, 3.0		3	3.2, 3.2, 3.3
Distance between head and sternocoracoidal depression	2	8.9, 9.6		3	10.0, 10.0, 10.5
Width below acrocoracoid	3	2.5, 2.6, 2.7		3	2.9, 3.0, 3.5
Depth below acrocoracoid	3	1.6, 1.6, 1.7		3	1.7, 1.9, 1.9
		range	mean		
TIBIOTARSUS					
Distal width	11	3.4–4.0	3.6	1	4.4
Depth inner condyle	8	3.2–3.8	3.5	1	4.1
Depth outer condyle	9	2.7–3.3	3.1	1	3.8

MEASUREMENTS.—See Tables 4 and 5.

COMPARATIVE MATERIAL.—*Turnix varia* (Latham), 1 USNM (pathological); 5 NMV (B8896, male; B8525, female; W5596, female; B8885, sex?; B12796, sex?).

STATUS.—Possibly extinct, endemic; extremely rare in collections, not taken or observed with certainty in this century.

REMARKS.—The button quail of New Caledonia has a curious and excessively obscure history. Under the species *Turnix varia*, an otherwise exclusively Australian species, Ogilvie-Grant (1889:474) mentioned a male specimen from New Caledonia that differed from typical *T. varia* "in having most of the *feathers of the rump, as well as those of the upper surface, almost entirely black* [emphasis in original], margined with whitish or buff. It is also a smaller bird ...." He did not name a new taxon at this point but in the index to that volume of *Ibis* (page 599) there is an entry for "*Turnix novae caledoniae*" that refers to the number of the page that included the above description. In a later publication, Ogilvie-Grant (1893:552) listed the specimen, again under *Turnix varia*, as being present in the collections of the British Museum (Natural History), repeated his previous description in a footnote, and called attention to the specimen's having been named in the index to the *Ibis*. The New Caledonian hemipode is now usually listed as *Turnix varia novaecaledoniae* Ogilvie-Grant and most authors have cited the 1893 publication as the original reference. This is incorrect, however; the name should date from its first appearance, as the index is consistently binomial and the entry is unambiguously linked with the text (ICZN, 1985: Article 11c iii).

The type specimen was not listed in the catalog of types in the British Museum (Warren, 1966); but, as a result of our inquiry, it was located in the general collection and has now been removed to the type series (D.W. Snow in litt. to Olson 27 May 1986). Verreaux and des Murs (1862) list *Turnix varius* [sic] as being included in the collection of birds from New Caledonia that they studied. The only other mention of a specimen from New Caledonia is a male listed by Sarasin (1913:54) as having been taken at Coné (=Kone) on 4 August 1911. Hannecart and Letocart (1983:11) consider *Turnix* to be very rare in New Caledonia, having been "reported near Touho and Népoui." Layard and Layard (1878:262) state:

> We have heard of an indigenous Quail on some of the grassy uplands, but have not yet seen a specimen. *T. varia* has been several times introduced from Australia; M. Marie may have come across one of these imported birds, and hence included it in his list [Marié, 1870]. Quails of some species were brought from Réunion in 1862, in the French frigate "Ibis," and turned out near Noumea. M. Jouan describes a Quail, "la même espèce qu'en Australie," as found on the uplands.

From this, and the great dearth of specimens, a considerable element of doubt has existed concerning the taxonomic validity of the *Turnix* of New Caledonia and its status as a native bird. The fossils from the lower layer of Gilles Cave establish that some form of *Turnix* was resident prior to the arrival of man. The number of specimens from the upper layer indicate that these birds were common during part of the period of human occupancy. The bones from the older layer are larger than those collected from the upper layer and on the surface of the cave (Figure 5, Table 5), and these younger specimens average considerably smaller than a series of modern *Turnix varia* from Australia (Table 4), thus conforming with Ogilvie-Grant's (1889) characterization of his New Caledonian specimen as a smaller bird. We do not know how to interpret these facts, except that it seems likely that there was a naturally occurring, endemic form of *Turnix* in New Caledonia.

Genus *Ducula* Hodgson, 1836

Ducula goliath (Gray, 1859)

MATERIAL.—Pindai II: right humerus, partial sternum, shaft of right ulna.

Gilles Cave, upper level: left scapula.

MEASUREMENTS (mm; those in parentheses are from the recent skeleton).—Sternum: length, >62.1 (62.5). Scapula: articular width, 11.7 (11.8). Humerus: length, 73.1 (69.7). Ulna: length, >75.5 (79.6).

COMPARATIVE MATERIAL.—*Ducula goliath*, 1 MNHN.

STATUS.—Extant, endemic: threatened, still hunted.

REMARKS.—The single individual from Pindai II was probably butchered, as the anterior part of the sternum has been cut, as by a blade. This species is no longer observed in the Pindai area.

Genus *Drepanoptila* Bonaparte, 1855

Drepanoptila holosericea (Temminck, 1810)

MATERIAL.—Pindai Cave: left femur.

MEASUREMENT (mm).—Femur: length, 41.1.

COMPARATIVE MATERIAL.—*Drepanoptila holosericea*, 1 MNHN.

STATUS.—Extant, endemic genus and species; threatened.

REMARKS.—The fossil was collected from sediments of an underground lake in the Pindai cave system and was the only bone thus obtained.

Genus *Columba* Linnaeus, 1758

Columba vitiensis Quoy and Gaimard, 1830

MATERIAL.—Pindai Cave: left ulna.

Gilles Cave, upper layer: fragmentary sternum and pelvis, 2 incomplete right humeri, right carpometacarpus.

MEASUREMENTS (mm).—Synsacrum: length, 46.0. Carpometacarpus: length, 36.1. Tibiotarsus: length, 54.1.

COMPARATIVE MATERIAL.—*Columba vitiensis*, 2 USNM (1 Fiji, 1 no locality).

STATUS.—Extant, resident: subspecies endemic to New Caledonia and Loyalties, species widespread.

REMARKS.—The fossil specimens are slightly larger than the two skeletons compared.

Genus *Chalcophaps* Gould, 1843

Chalcophaps indica (Linnaeus, 1758)

MATERIAL.—Gilles Cave, upper layer: right humerus.

MEASUREMENT (mm).— Length: 33.2.

COMPARATIVE MATERIAL.—*Chalcophaps indica*, 2 MNHN; USNM many.

STATUS.—Extant, resident; common in New Caledonia, species widespread.

Genus *Caloenas* Gray, 1840

The large fossil pigeon from New Caledonia described below was compared with 19 different genera of Columbidae and was found to be most similar to the large Australasian pigeons included in the genera *Goura*, *Didunculus*, and *Caloenas* (and presumably *Microgoura*, *Otidiphaps*, and *Trugon*, for which no skeletons were available). These differ significantly from other genera of Columbidae likely to occur on New Caledonia and are removed some distance from them in most classifications (e.g., Martin, 1904; Peters, 1937, Goodwin, 1983). The New Caledonian bird shares with the preceding three genera a well-developed, ventrally protruding glenoid facet of the coracoid. It also shares with *Caloenas* and *Goura* a very distinctive swollen area on the dorsomedial corner of the sternal end of the coracoid. It differs from *Didunculus* and *Goura* in that the procoracoid process does not taper gradually into the shaft and lacks an elongated ligamental scar where it joins the shaft. It differs further from *Didunculus* in that the insertion of M. coracoideus brachialis does not extend nearly the entire width of the dorsal surface of the sternal end of the coracoid, and the sternum lacks the distinct pit dorsal to the manubrium. The new pigeon differs further from *Goura* in that the brachial depression of the humerus is not as large and deep, the scar for the ligamentum collaterale dorsi is much more proximally situated, and the acromion of the scapula is shorter. In all of the above characters the new pigeon agrees exactly with *Caloenas*.

Caloenas canacorum, new species

FIGURE 6A,B,E,F,I,K

Caloenas canakorum [sic] Balouet, 1987:178 [nomen nudum].

HOLOTYPE.—Right coracoid, lacking only the tips of the procoracoid and the sternocoracoidal process, NCP 300, Institut de Paléontologie, Muséum National d'Histoire Naturelle, Paris (Figure 6C,D).

TYPE LOCALITY.—From apparently Holocene deposits in Pindai Cave, Nepoui Peninsula, west coast of New Caledonia. 21°20′S, 164°57′E.

MEASUREMENTS OF HOLOTYPE (mm).—Greatest length as preserved, 59.4; length with sternal end flat on calipers, 56.8; depth through head, 9.1; least width and depth of shaft at midpoint, 6.2 × 5.3; width of sternal end as preserved, 13.8.

PARATYPES.— Pindai Cave: fragment of sternum (NCP 304); left coracoid (NCP 301); fragment of right coracoid, probably from a juvenile individual (NCP 302); 2 proximal portions of left scapulae (NCP 306, 307); distal end of right humerus (NCP 303).

MEASUREMENTS OF PARATYPES (mm).—Coracoid NCP 301: greatest length as preserved, 59.0; length with sternal end flat on calipers, 56.9; depth through head, 7.2; least width and depth of shaft at midpoint, 6.1 × 5.0; width of sternal end as preserved, 13.7. Scapula NCP 306: width of anterior end, 15.0; width of blade at neck, 5.5. (See also Table 6.)

COMPARATIVE MATERIAL EXAMINED.—*Caloenas nicobarica* (Linnaeus), 21 USNM; *Goura cristata* (Pallas), 5 USNM; *G. scheepmakeri* (Finsch), 1 USNM; *G. victoria* (Fraser), 11 USNM; *Didunculus strigirostris* (Jardine), 1 USNM; 16 additional genera of pigeons in the USNM collections.

DIAGNOSIS.—Much larger (about 25%) than *Caloenas nicobarica* (Table 6), the only other species in the genus, with the proximal pneumatic foramina of the coracoid better developed.

ETYMOLOGY.—Latinized from *kanaka*, the name of the native Melanesian inhabitants of New Caledonia.

STATUS.—Extinct, endemic: known from fossils only.

REMARKS.—The living Nicobar Pigeon, *Caloenas nicobarica*, the only other member of the genus *Caloenas*, is a very distinctive terrestrial pigeon found (Peters, 1937:139) in

> the greater part of the Indo-Australasian region from the Nicobars and the Mergui Archipelago eastward over the Sunda Islands, Philippines, Celebes, Moluccas, Papuan Islands, New Guinea, Admiralty Islands, D'Entrecasteaux Archipelago, Trobriand Islands, and Louisades, to the Solomon Islands. Wherever found [it] occurs only on the small islands and on the islets off the larger land masses. Migrates between various groups of islands.

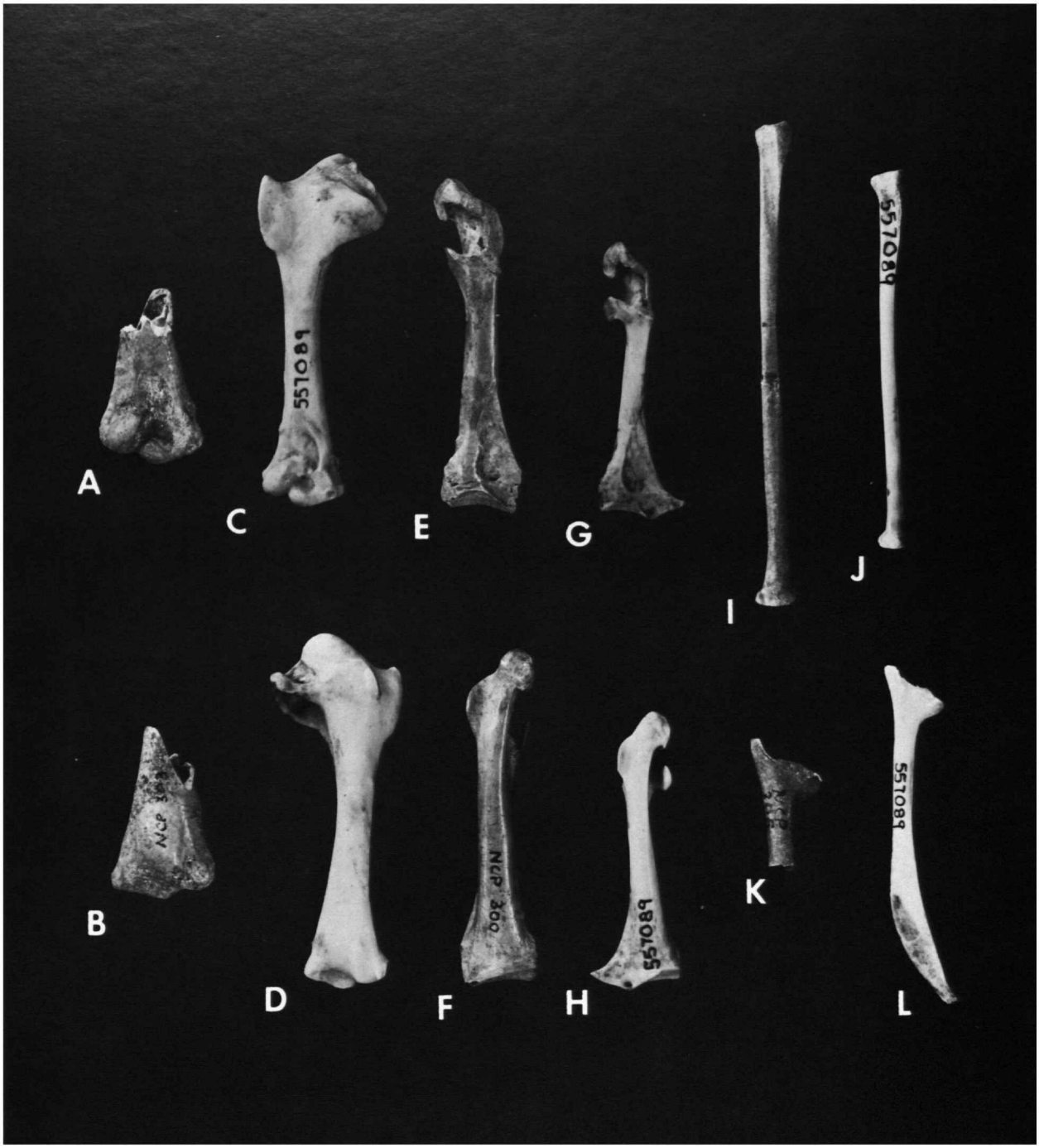

FIGURE 6.—*Caloenas canacorum*, new species (A,B: NCP 303; E,F: holotype, NCP 300; I: NCP 305; K: NCP 306), compared with the living species *C. nicobarica* (C,D,G,H,J,L; USNM 557089). Distal end of humerus: A,C, palmar view; B,D, anconal view. Coracoid: E,G, dorsal view; F,H, ventral view. Radius: I,J, in dorsal view. Scapula: K,L, in dorsal view. (Natural size.)

TABLE 6.—Measurements (mm) of *Caloenas canacorum*, new species, compared with some large pigeons.

Character	*Caloenas canacorum*[1]	*Didunculus strigirostris* (n = 1)	*Caloenas nicobarica* (n = 21) range	mean	*Goura victoria* (n = 11) mean	*Goura cristata* (n = 5) mean
CORACOID						
Length	59.4, 59.0	37.1	43.2–49.0	46.0	72.7	73.4
Shaft width	6.3, 6.2	3.8	4.0–4.3	4.2	7.5	7.3
Sternal facet width	13.3, 13.2	4.2	9.9–11.5	10.8	17.2	14.7
Sternal facet depth	5.1, 5.1	2.5	4.1–4.8	4.4	7.4	6.2
HUMERUS						
Distal width	18.6	12.0	12.5–13.4	13.1	22.0	22.2
Depth inner condyle	11.5	7.5	8.2–9.5	8.8	13.7	14.6
RADIUS						
Length	83.0	53.8	58.4–64.3	62.0	104.3	111.5

[1]*C. canacorum* measurements of coracoid from NCP 300 (holotype) and NCP 301, respectively; of humerus from NCP 304; of radius from NCP 303.

There is also an endemic subspecies, *C. n. pelewensis*, in the Palau Islands.

White and Bruce (1986:193) provide additional documentation for the wandering habits of this species and note that it is

> well known as a bird of islands rather than mainlands, but even in archipelagoes of small islands, it frequents only the smaller. In some parts of Wallacea it has not been recorded even on smaller islands, perhaps because they are too arid and lack forest, with which it is associated.

With such a distribution and nomadic habits, *Caloenas* would be a very likely candidate for colonizing New Caledonia and other islands in the Pacific, where the genus does not now occur. The estimated size of *Caloenas canacorum* is 38 cm from the bill to the tip of the tail. Being some 25% larger than *C. nicobarica*, it would have been a prime source of food for the early human inhabitants of New Caledonia. There is no indication of any reduction in flight capability in *C. canacorum*.

Genus *Gallicolumba* Heck, 1849

Gallicolumba is the only genus of Columbidae in Australasia and Oceania with the tarsometatarsus extremely elongated, as in the following species.

Gallicolumba longitarsus, new species

FIGURE 7C,D,G,H

Gallicolumba longitarsus Balouet, 1987:178 [nomen nudum].

HOLOTYPE.—Complete left tarsometatarsus, NCP 100, Institut de Paléontologie, Muséum National d'Histoire Naturelle, Paris (Figure 7G,H).

TYPE LOCALITY.—From apparently Holocene deposits in Pindai Cave, Nepoui Peninsula, west coast of New Caledonia. 21°20′S, 164°57′E.

MEASUREMENTS OF HOLOTYPE (mm).—Length, 51.6; proximal width, 8.1; proximal depth through hypotarsus, 8.1; width and depth at midpoint, 3.0 × 2.9; distal width, 7.9. (See also Table 7.)

PARATYPES.—Pindai Cave: complete left femur (NCP 101); proximal half of left femur (NCP 102); distal half of right tarsometatarsus (NCP 103); proximal fragment of left tar-

TABLE 7.—Measurements (mm) of *Gallicolumba longitarsus*, new species, compared with *G. tristigmata*, the largest extant species of the genus (dash indicates measurements not taken because of broken specimen).

Character	*G. longitarsus*[1]	*G. tristigmata* n	range	mean
CORACOID				
Maximum diameter of glenoid facet	5.2	4	4.0–4.1	4.1
Minimum diameter of shaft	3.3	4	2.7–3.2	3.0
FEMUR				
Length	45.4, –	4	39.5–42.7	41.5
Proximal width	9.4, 9.0	4	7.5–8.1	7.9
Proximal depth	5.8, 5.3	4	4.7–5.0	4.9
Minimum diameter of shaft	3.8, 3.8	4	3.0–3.2	3.1
Distal width	9.4, –	3	6.9–7.8	7.4
Depth of outer condyle	7.3, –	3	6.0–6.8	6.3
Depth of inner condyle	6.7, –	4	5.6–5.9	5.7
TARSOMETATARSUS				
Length	51.6, –	2	42.6, 47.1	44.9
Proximal width	8.1, –	2	7.2, 7.4	7.3
Proximal depth	8.1, –	2	7.1, 7.1	7.1
Width of shaft at midpoint	3.0, 2.7	2	2.9, 2.9	2.9
Distal width	7.9, 7.6	2	7.7, 7.9	7.8
Width of middle trochlea	2.7, 2.7	2	2.5, 2.5	2.5

[1]*G. longitarsus* measurements of femur from NCP 101 and NCP 102, respectively; of tarsometatarsus from NCP 100 and NCP 103, respectively.

sometatarsus (NCP 104); partial left coracoid (NCP 105).

MEASUREMENTS OF PARATYPES.—See Table 7.

COMPARATIVE MATERIAL.—*Gallicolumba luzonica* (Scopoli), 18 USNM; *G. criniger* (Pucheran), 2 USNM; *G. tristigmata* (Bonaparte), 2 (and 2 trunks) USNM; *G. stairi* (Gray), 1 trunk USNM; *G. rubescens* (Vieillot), 1 (and 2 trunks) USNM.

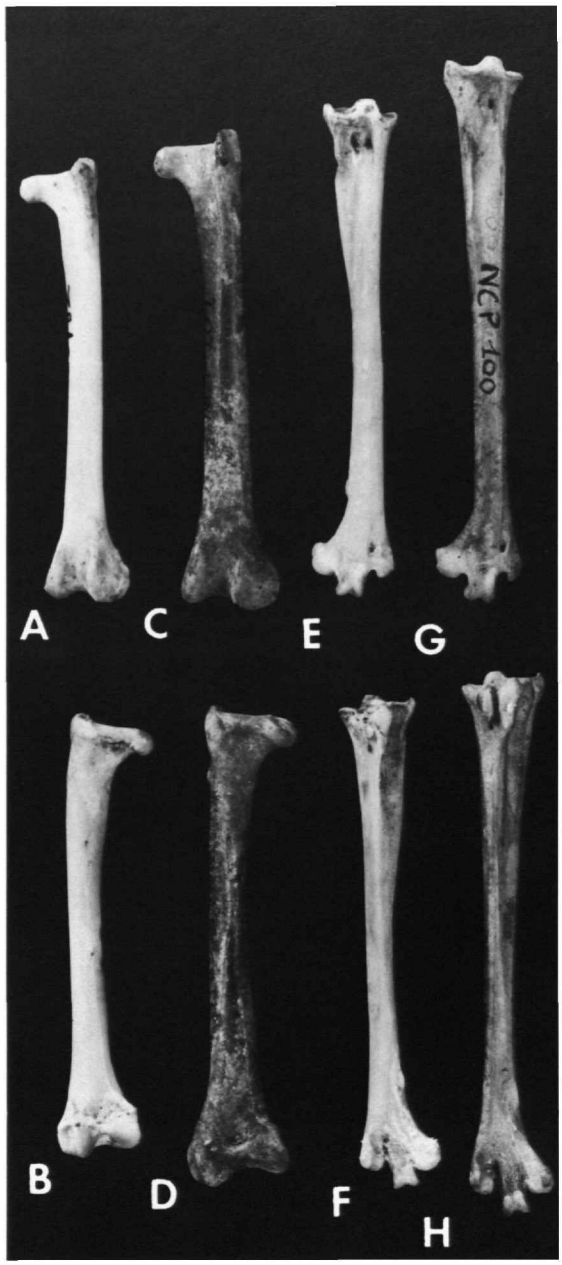

FIGURE 7.—*Gallicolumba longitarsus*, new species, (C,D: NCP 101; G,H: holotype, NCP 100), compared with *G. tristigmata* (A,B,E,F; USNM 226182), the largest living species of the genus. Femur: A,C, anterior view; B,D, posterior view. Tarsometatarsus: E,G, anterior view; F,H, posterior view. (× 1.5)

DIAGNOSIS.—Largest species of the genus yet known (Table 7). Femur with small but well developed pneumatic foramen on the anterior face of the trochanter, a feature lacking in all congeners. Inner side of the proximal half of the tarsometatarsus thicker than in other species of *Gallicolumba*.

ETYMOLOGY.—Latin, *longus* (long), and *tarsus* (foot), in reference to the very slender, elongate tarsometatarsus of this species. The name is used as a noun in apposition.

STATUS.—Extinct, endemic; known from fossils only.

REMARKS.—*Gallicolumba tristigmata* of Celebes (Sulawesi) is the largest extant species of the genus, yet is considerably smaller than *G. longitarsus* (Table 7).

Two extinct species of *Gallicolumba*, named only on the basis of early paintings and descriptions, are sufficiently close geographically to New Caledonia to merit further consideration. One of these was from Norfolk Island, to which the name *Gallicolumba? norfolciensis* (Latham) has been applied (Hindwood, 1965; Goodwin, 1983:231). Two fossil bones assigned to this species by Meredith (1985) indicate that the Norfolk Island bird is decidedly smaller than *G. longitarsus* (distal width of tarsometatarsus 6.3 mm, as opposed to 7.6 and 7.9 mm).

Gallicolumba ferruginea (Wagler) was described and illustrated from Tanna Island in the New Hebrides on Cook's second voyage (Greenway, 1958:300). Mayr (in Peters, 1937:136, footnote) questioned the locality because no such bird occurs on Tanna today (which, of course, means nothing) and suggested that the bird may have come from Tonga. His desire to believe this was probably reinforced by the fact that *G. ferruginea* may be an earlier name for the species he had then recently named from the Santa Cruz Islands as *G. sanctaecrucis* (Mayr, 1935) and that was later reported on Espiritu Santo in the New Hebrides (Mayr, 1945:183). Stresemann (1950) and Greenway (1958) gave cogent reasons for accepting Tanna as the type locality of *G. ferruginea*. Because this bird was supposedly only slightly larger than *G. erythroptera*, and because *G. sanctaecrucis* is also a rather small *Gallicolumba*, neither of these can be the same as the very large New Caledonian bird.

The "quite remarkable" (Mayr, 1936:4) distribution of *Gallicolumba* in the Pacific is surely due almost entirely to man-caused extinctions. In addition to *G. longitarsus*, the fossil record now shows that a medium-size species of *Gallicolumba* occurred on Mangaia, the first record of the genus for the Cook Islands (Steadman, 1985). Also, remains of another very large, extinct species have been found in archeological sites in the Marquesas, Society, and Cook islands (Steadman, in press a). Any unusual patterns of distribution in this genus are highly suspect.

Genus *Halcyon* Swainson, 1821

Halcyon sancta Vigors and Horsfield, 1827

MATERIAL.—Gilles Cave, upper layer: 2 right humeri.

MEASUREMENT (mm).—Humerus: length, 29.3.

COMPARATIVE MATERIAL.—*Halcyon sancta*, 14 USNM.

STATUS.—Extant, endemic subspecies of widespread species; fairly common in open country, scarcer in forests.

Genus *Tyto* Billberg, 1828

The following new species most closely resembles *Tyto* as opposed to the Strigidae in the following characters. Femur: absence of a deeply excavated popliteal fossa that sharply delimits the posterolateral border of the inner condyle; head proportionately small. Coracoid: pneumatic foramina on the head absent; procoracoid process expanded; dorsomedial sternal facet more strongly projecting dorsally, but short, extending only half the width of sternal end. The fossil form shows no similarity to *Phodilus* (which has a much larger head of the femur and a strangely reduced acrocoracoid area) except in the wide rotular groove. Although clearly referable to the Tytonidae, as opposed to the Strigidae, this species is so different from the species of *Tyto* for which skeletons are available, that it might eventually be placed in another genus. Comparison is desired with *Tyto tenebricosa* (Gould), a highly distinctive species of Australia and New Guinea, but unfortunately no skeletons of it have been preserved.

Tyto? letocarti, new species

FIGURE 8A,B,D

Tyto letocarti Balouet, 1987:178 [nomen nudum].

HOLOTYPE.—Complete adult left femur, NCG 1000, Institut de Paléontologie, Muséum National d'Histoire Naturelle, Paris (Figure 8A,B).

TYPE LOCALITY.—Lower layer (antedating the arrival of man and *Rattus*) of the deposits at Gilles Cave, 5 km WSW of Boulouparis, west coast of New Caledonia. 21°53′ 23″S, 166°00′ 15″E.

MEASUREMENTS OF HOLOTYPE.—See Table 8.

PARATYPES.—Gilles Cave, lower layers: 2 thoracic vertebrae (NCG 1001, 1002); left coracoid, with sternocoracoidal process broken (NCG 1003); left scapula with end of blade and acromion missing (NCG 1004); shaft of left humerus (NCG

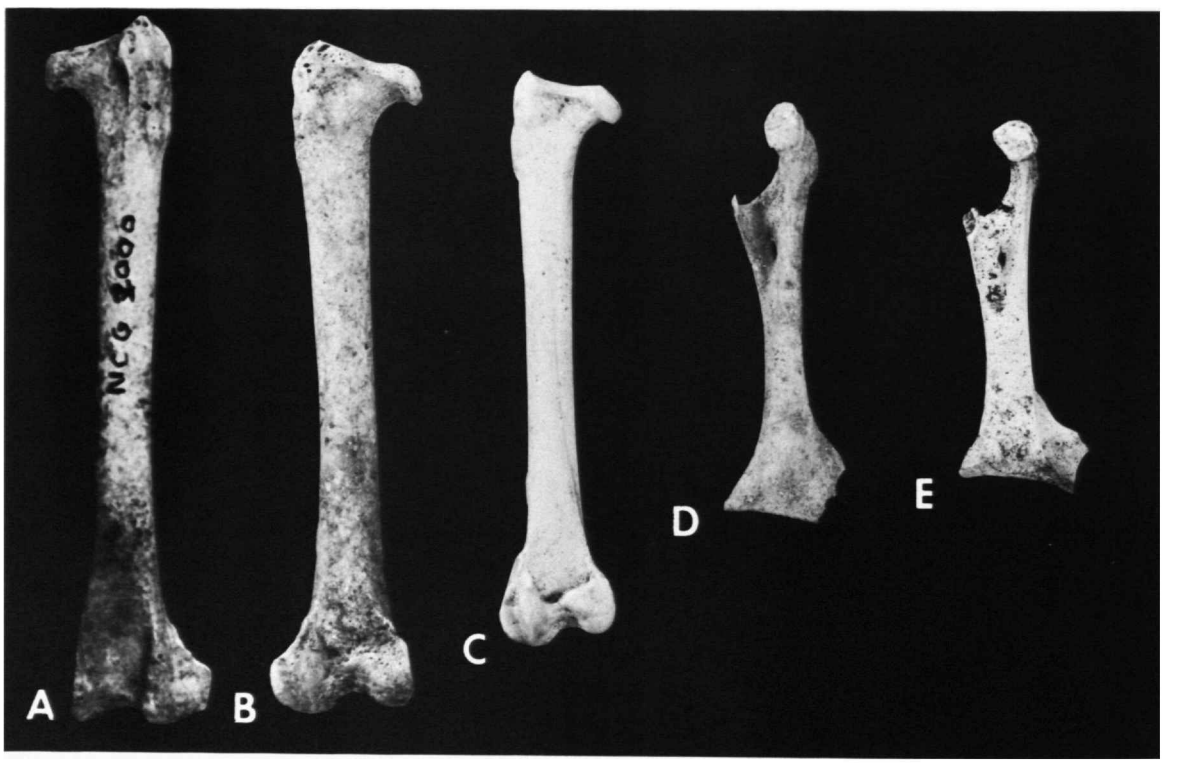

FIGURE 8.—*Tyto? letocarti*, new species (A,B: holotype, NCG 1000; D: NCG 1003), compared with bones of *T. alba* from the upper layer of Gilles Cave (C,E). Femur: A, anterior view; B,C, posterior view. Coracoid: D,E, ventral view. (B–E, × 1.5; A somewhat larger.)

TABLE 8.—Measurements (mm) of *Tyto? letocarti*, new species, compared with other species of *Tyto*.

Character	*T.? letocarti*[1]	*T. alba* (n = 11)		*T. longimembris* (n = 2)		*T. novaehollandiae* (n = 2)	
		range	mean	range	mean	range	mean
SCAPULA							
Proximal width	8.0	7.2–8.4	7.6	10.6, 11.0	10.8	9.6, 11.4	10.5
CORACOID							
Length	38.5	32.0–33.8	33.1	39.8, 40.2	40.0	39.4, 43.4	41.4
Width of shaft at midpoint	4.0	4.2–4.6	4.3	5.1, 5.2	5.2	4.9, 5.0	5.0
Depth of shaft at midpoint	2.4	2.1–2.7	2.3	2.7, 2.9	2.8	3.0, 3.6	3.3
FEMUR							
Length	62.6	49.1–53.9	51.4	60.3, 62.5	61.4	61.8, 67.1	64.4
Proximal width	12.0	8.9–10.7	9.9	10.5, 11.0	10.8	12.0, 13.7	12.8
Proximal depth	7.5	5.5–6.3	6.0	6.8, 8.0	7.3	7.1, 9.1	8.1
Shaft width at midpoint	5.3	3.5–4.2	3.9	4.3, 4.5	4.4	5.4, 6.5	6.0
Distal width	12.9	9.5–10.9	10.4	11.1, 12.2	11.6	12.5, 14.2	13.4
Depth inner condyle	8.9	6.5–7.2	6.9	7.7, 8.3	8.0	8.7, 10.1	9.4
Depth outer condyle	10.5	7.8–9.0	8.3	10.3, 10.7	10.5	11.0, 12.5	11.8

[1]*T.? letocarti* measurements of femur from NCG 1000 (holotype).

1005); distal half of juvenile left femur (NCG 1006).

MEASUREMENTS OF PARATYPES (mm).—Coracoid: length with sternal end flat on calipers, 38.5; width and depth of shaft at midpoint, 4.0 × 2.4. Scapula: proximal width, 8.1. Humerus: width and depth of shaft at approximate midpoint, 5.4 × 4.6. (See also Table 8.)

COMPARATIVE MATERIAL.—*Tyto alba* (Scopoli), many from North America, 2 Africa, 2 Thailand, 1 Fiji, 1 Australia, all USNM; *T. glaucops* (Kaup), 3 USNM; *T. novaehollandiae* (Stevens), 2 NMV, 2 partial SAM; *T. longimembris* (Jerdon), 1 MVZ, 1 + 1 partial SAM; *Phodilus badius* (Horsfield), 1 USNM.

DIAGNOSIS.—Femur similar in size to that of *Tyto longimembris* but head smaller, shaft somewhat more robust, rotular groove very much wider, the ridges of the condyles not extending as far proximally, distal end more expanded. The coracoid is proportionately smaller and the shaft is much more slender. The furcular facet is much more pronounced and rotated more ventrally. The scapula has the blade straighter and narrower, with the proximal end much narrower as well.

ETYMOLOGY.—Named after Yves Letocart of the Water and Forest Service in Nouméa, who has been very active in the preservation of New Caledonian birds and who took part in prospecting for and collecting fossil birds.

STATUS.—Extinct, endemic; known from fossils only.

REMARKS.—The six bones recovered in the lower layers of Gilles Cave belong to one juvenile individual and probably only one adult individual, as all the bones were recovered very close to one another, in association with abundant lizard bones (Gekkonidae and Scincidae), and bones of *Sylviornis neocaledoniae*, *Turnix varia*, *Aegotheles savesi*, and *Tricholimnas lafresnayanus*.

Tyto alba (Scopoli, 1769)

MATERIAL.—Pindai Cave: right tarsometatarsus, left carpometacarpus, 2 coracoids (juvenile).

Gilles Cave, upper layer: 2 crania, quadrate, premaxilla, sternum, 5 scapulae, furcula, 13 coracoids, 20 humeri, 16 ulna, 5 radii, 5 metacarpi, 2 carpometacarpi, 34 femora, 24 tibiotarsi, 24 tarsometatarsi.

MEASUREMENTS (mm).—Pindai: length of tarsometatarsus, 62.2; length of carpometacarpus, 44.6.

Gilles (measurements are means): cranium width, 36.9; quadrate height, 10.3; premaxilla length, 26.4; length of keel of sternum, 30.5; length of furcula, 35.3; length of scapula, 40.9; length of coracoid, 35.0; length of humerus, 86.3; length of ulna, 97.8; length of carpometacarpus, 44.7; length of pelvis, 54.3; length of femur, 52.0; length of tibiotarsus, 92.3; length of tarsometatarsus, 62.7.

COMPARATIVE MATERIAL.—See *Tyto? letocarti*, new species.

STATUS.—Extant, cosmopolitan species; common.

REMARKS.—These birds are responsible for the accumulation of most of the vertebrate remains in the upper layer at Gilles Cave. Although birds from New Caledonia and the Loyalty Islands were once stated by Mayr (1936) not to differ from the Polynesian form *T. a. lulu* (Peale), he later (Mayr,

1945:162) recognized them under the name *T. a. lifuensis* Brasil, evidently following Amadon (1942). If valid, this race seems to be poorly differentiated.

It is appropriate to review here the literature concerning the possible occurrence of a second living species of *Tyto* in New Caledonia. The first such attribution was in Marié's list of the avifauna of New Caledonia (Marié, 1870; reprinted in Layard and Layard, 1877), which included *Strix castanops* (= *Tyto novaehollandiae*) in addition to *Strix delicatula* (= *Tyto alba*). According to Sarasin (1913:11), this record had its origin in a specimen among a collection from Lifu, Loyalty Islands, in the old Colonial Museum in Nouméa that was reported by Layard and Layard (1878:252) as follows.

> Strix castanops, Gould.
> We have not met with this species; but in the collection, *though not from Lifu* [emphasis in original], is a bird that bears evidence on its label as having been killed somewhere in New Caledonia, which accords in description and in all its measurements with *Strix novae-hollandiae*, Stephens, as given by Gould ('Handb. birds of Austr.' i. p.65); and as such we, without doubt, consider it. This is another addition to the list.

In a subsequent paper on the birds of the Loyalties, they made the following remarks concerning this specimen (Layard and Layard, 1880:223).

> Strix novae-hollandiae, Steph.
> In the Lifu collection alluded to in a previous paper, appeared a solitary specimen of this bird. From the "make-up" of the skin, having restuffed it, we are now sure it is a genuine Lifu production, though at first we doubted it.

Presumably for this reason, there is no mention of this species in their subsequent accounting of the avifauna of mainland New Caledonia (Layard and Layard, 1882), although it was later listed from New Caledonia on their authority by Sharpe (1899:301) and Wiglesworth (1891:4). Sarasin (1913:11) considered the record to be due to a labelling error and suggested that that the species be stricken from the fauna of New Caledonia and the Loyalties. He also noted that Oustalet (1879) had been unable to locate a New Caledonian specimen in the British Museum nor in the museums in Paris and Leiden.

Unfortunately, the collection from Lifu was poorly preserved to begin with and was not properly maintained afterwards (Mees and Fisher, 1986), making it seem unlikely that the original specimen would have survived, whatever its provenance. Amadon (1942:14), however, called attention to an ancient mounted specimen of *Tyto longimembris* from the Verreaux collection in the American Museum of Natural History (AMNH 9669) that was labeled "2572. *Strix castanops* Gould ... *Strix Novae Hollandiae* Steph. Nouvelle Caledonie." He suggested that this might have been the same specimen as seen by the Layards that was somehow later acquired by Verreaux. This, along with another specimen of *T. longimembris* in the British Museum labeled only "*Strix novaehollandiae* N C," which Mathews (1916:401) took to mean New Caledonia, Amadon considered sufficient evidence to include *T. longimembris* in the New Caledonian fauna. In this opinion, he was followed by Mayr (1945:162), Schodde and Mason (1980:88), and Hannecart and Letocart (1983:84). New Caledonia was not included in the range of *Tyto longimembris* by Mathews (1927), Peters (1940), or Burton (1973), however. Warner (1947:158) says of *T. longimembris:*

> Only a very few specimens of the Grass Owl were collected on New Caledonia during the early years of the last century. Since none has been taken or recorded during the succeeding seventy years, I believe it is now entirely extinct on the island. None of the local residents know more than one owl.

In Australia, *T. longimembris* has a scattered distribution and may be irruptive and highly nomadic (Schodde and Mason, 1980:84; Blakers et al., 1984:311). Mees (1964:49) has remarked on the curious fact that Australian birds do not seem to differ from those of India, whereas there is a distinctive subspecies in the highlands of New Guinea, and others in the Philippines and Formosa. The specimen evidence for the occurrence of *Tyto longimembris* in New Caledonia is far from satisfactory, which, given the apparent nomadic propensities of the species, makes it dubious that there ever was a resident population on New Caledonia.

Genus *Ninox* Hodgson, 1837

Ninox cf. *N. novaeseelandiae* (Gmelin, 1788)

FIGURE 9B,D

MATERIAL.—Pindai Cave: left femur (NCP 662), left tibiotarsus (NCP 660), distal end of right tibiotarsus (NCP 661).

Gilles Cave, upper layer: proximal half of right ulna.

MEASUREMENTS.—See Table 9.

TABLE 9.—Measurements (mm) of fossil specimens of *Ninox* sp. from New Caledonia, compared with *N. novaeseelandiae* (1 unsexed, New Zealand) and *N. boobook* (1 female, Australia) (measurements of the tibiotarsus are from NCP 660, except those in parentheses, which are from NCP 661).

Character	*Ninox* sp.	*N. novaeseelandiae*	*N. boobook*
FEMUR			
Length	37.2	37.7	53.3
Proximal width	7.6	7.4	10.4
Proximal depth	4.5	4.4	6.0
Diameter of head	3.0	3.0	4.5
Diameter of shaft	3.1	3.1	4.0
Distal width	7.4	7.4	10.4
Depth of inner condyle	4.4	5.0	6.0
Depth of outer condyle	5.7	5.8	7.9
TIBIOTARSUS			
Length	60.0	60.3	85.6
Proximal width	6.4	6.0	9.8
Proximal depth	7.2	7.8	10.3
Distal width	6.7 (6.9)	6.5	9.2
Depth of inner condyle	5.5 (5.5)	5.3	7.7
Depth of outer condyle	5.0	5.2	7.3
Minimum diameter of shaft	2.8	2.8	4.3

COMPARATIVE MATERIAL.—*Ninox novaeseelandiae*, 1 USNM; *N. boobook* (Latham), 1 USNM; *N. scutulata* (Raffles), 2 USNM.

STATUS.—Extinct?; known in New Caledonia only from fossils.

REMARKS.—These bones are from a small strigid owl that is much smaller than a specimen of *N. boobook* from Australia, which is sometimes considered as conspecific with *N. novaeseelandiae*. No differences could be detected between the fossils and a single New Zealand specimen of *N. novaeseelandiae*. The ulna from Gilles Cave is large compared to the single unsexed New Zealand specimen but this can perhaps be attributed to sexual dimorphism.

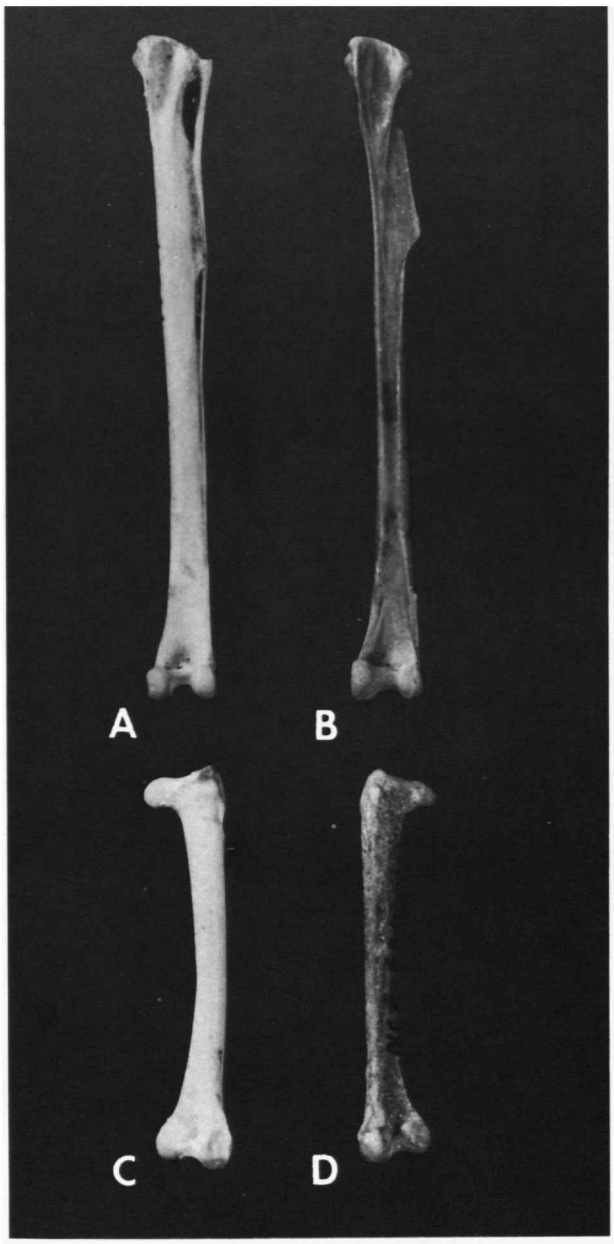

FIGURE 9.—*Ninox* cf. *N. novaeseelandiae* from Pindai Cave (B: NCP 661; D: NCP 662) compared with living *N. novaeseelandiae* from New Zealand (A,C; USNM 18287): A,B, tibiotarsus, anterior view; C,D, femur, posterior view. (× 1.5.)

Ninox novaeseelandiae, in the restricted sense, occurs at present in New Zealand, with an extinct population, sometimes considered a full species, *N. undulata* (Latham), being known from Norfolk Island (Schodde et al., 1983:55; Meredith, 1985). No strigid owls of any kind have ever been reported from New Caledonia. The fact that two other nocturnal birds are known from New Caledonia only from single specimens (*Aegotheles savesi* and *Eurostopodus exul* Mayr, 1944) is doubtless an indication of how poorly the island has been searched for night birds. Thus, this owl might possibly still exist in the island.

Genus *Aegotheles* Vigors and Horsfield, 1826

Aegotheles savesi Layard and Layard, 1881

MATERIAL.—Gilles Cave, lower layer: 2 left humeri (NCG 1007, 1008), left tarsometatarsus lacking proximal end (NCG 1009).

MEASUREMENTS (mm).—Humerus: length, 36.3, 37.7; shaft width at midpoint, 3.1, 3.3; distal width, 8.0; 8.2. Tarsometatarsus: estimated length, 35; shaft width at midpoint, 2.1; distal width, 5.5.

COMPARATIVE MATERIAL.—*Aegotheles savesi*, X-radiographs of the holotype, Liverpool Museum T16101; *A. cristatus* (White), 1 USNM, 1 NMV; *A. crinifrons* (Bonaparte), 1 USNM; *A. albertisi* Sclater, 2 YPM; *A. insignis* Salvadori, 1 YPM.

STATUS.—Extinct?, endemic; known only from the holotype taken in 1880 and the fossils mentioned here.

REMARKS.—This highly distinctive endemic species has been much misunderstood since Mayr (1945:162) published a fictitious description of it and wrongly suggested that it was probably only a geographical representative of the Australian species *A. cristatus*. Apart from the bones reported here, the species is still known only from the unique type, a skin in the Merseyside County Museums, Liverpool. Restudy of this specimen (Olson, Balouet, and Fisher, in press), including X-radiographs, shows that it is among the largest species in the family, with an elongated tarsometatarsus and reduced wing elements, thus tending towards the characters of the larger "*Megaegotheles*" *novaezealandiae* Scarlett, known from Quaternary deposits in New Zealand.

Genus *Collocalia* Gray, 1840

Collocalia spodiopygia (Peale, 1848)

MATERIAL.—Pindai Cave: 20 fragments of sternum; 13 right and 12 left coracoids; 15 right and 15 left humeri; 29 right and

31 left ulnae; 28 right and 29 left carpometacarpi; 8 first phalanges of the major alar digit, one second phalanx of the major alar digit, right femur.

MEASUREMENTS (mm).—For each element, the ranges of the lengths for 10 fossils are given, followed by the mean (in parentheses). Humerus: 6.1–6.5 (6.3). Ulna (without olecranon): 9.4–9.9 (9.6). Carpometacarpus: 11.1–11.8 (11.3).

COMPARATIVE MATERIAL.—*Collocalia spodiopygia*, 11 USNM (New Caledonia).

STATUS.—Extant, widespread species; common.

REMARKS.—This is the larger of the two species of *Collocalia* that inhabit New Caledonia. It also appears to be more abundant at lower elevations and habitually nests in caves, so it is not surprising that this species is the more abundant one in the Pindai site. *Collocalia esculenta*, on the other hand, is more common at higher elevations and more frequently nests in holes in trees and rocks (Warner, 1947:164).

Collocalia esculenta (Linnaeus, 1758)

MATERIAL.—Pindai Cave: 2 left humeri, 1 left ulna.

MEASUREMENTS (mm).—Humerus: length, 5.3, 5.5. Ulna: length without olecranon, 8.1.

COMPARATIVE MATERIAL.—*Collocalia esculenta*, 2 USNM (New Caledonia).

STATUS.—Extant, widespread species, common.

REMARKS.—These bones are markedly smaller than the fossils assigned to the preceding species.

Genus *Porzana* Vieillot, 1816

Porzana tabuensis (Gmelin, 1789)

MATERIAL.—Gilles Cave, upper layer: right and left femora, 2 right and 1 left tarsometatarsi.

MEASUREMENTS (mm).—Femur: length, 27.7, 29.0; tarsometatarsus: length, 24.6.

COMPARATIVE MATERIAL.—*Porzana tabuensis*, 1 USNM.

STATUS.—Extant, resident; species widespread.

REMARKS.—This small rail is widespread in Australia and Oceania. Hannecart and Letocart (1983:65) remark that it is now found in New Caledonia mainly on the east coast; the fossil occurrence suggests that the birds may have been more generally distributed in the recent past.

Genus *Gallirallus* Lafresnaye, 1841

Gallirallus philippensis (Linnaeus, 1766)

MATERIAL.—Pindai Cave: right femur; left tibiotarsus, left tarsometatarsus.

Gilles Cave, upper layer: right and left coracoids; 3 complete and 1 fragmentary right humeri; 3 fragmentary left humeri; 6 complete and 5 fragmentary right femora; 6 complete and 6 fragmentary left femora; 4 complete and 13 fragmentary right tibiotarsi; 4 complete and 11 fragmentary left tibiotarsi; 12 complete and 3 fragmentary right tarsometatarsi; 3 complete and 3 fragmentary left tarsometatarsi.

MEASUREMENTS (mm; means in parentheses).—Coracoid: length, 22.0, 21.8. Humerus: length, 43.1. Femur: length, 42.2–49.8 (45.7; n = 12). Tibiotarsus: length, 59.7–69.5 (62.9; n = 8). Tarsometatarsus: length, 37.2–41.1 (38.8; n = 7).

COMPARATIVE MATERIAL.—*Gallirallus philippensis*, 1 USNM (Philippines), 2 MNHN (New Caledonia).

STATUS.—Extant, common in New Caledonia; species widespread.

REMARKS.—This species is one of the most abundant in the upper layer of Gilles Cave. Its absence in the older deposits might suggest that this species is a recent colonizer of New Caledonia (see also *Porphyrio porphyrio*).

Of the 13 individuals represented by right tarsometatarsi, 11 are juveniles, indicating good breeding populations in the vicinity, and probably differential predation on young birds.

Genus *Tricholimnas* Sharpe, 1893

Tricholimnas lafresnayanus (Verreaux and des Murs, 1860)

FIGURE 10

MATERIAL.—Pindai Cave: a juvenile skull (tentatively referred), tip of rostrum, right mandibular articulation, right quadrate, 2 sterna, right coracoid, right ulna, left carpometacarpus, right femur, left tibiotarsus, right tarsometatarsus.

Pindai II: 1 complete pelvis.

Gilles Cave, lower layer: tip of rostrum, left coracoid, proximal end of right humerus.

Gilles Cave, upper layer: distal end of right tarsometatarsus.

Kanumera: 238 very fragmentary bones including rostrum, mandibles, quadrates, scapulae, coracoids, humeri, carpometacarpi, femora, tibiotarsi, fibulae, tarsometatarsi, and vertebrae. Additional collections from Kanumera contain much good material of this species that is not included here (Rich et al., 1981).

MEASUREMENTS (mm; from Pindai Cave specimens only).—Cranium: length, 35.7; maximum width, 22.2; minimum width, 11.1. Mandible: width of articular facet, 7.0; depth of articular facet, 6.6. Quadrate: height, 10.7; depth from orbital process, 10.7. Sternum: maximum width, 24.5; minimum width, 10.7. Coracoid: width at sternal end, 7.8. Ulna: length, 45.3. Carpometacarpus: length, 35.0. Pelvis: length, 66.6; preacetabular portion, 36; length of synsacrum, 57.2; maximum width, 31.6. Femur: length, 70.8; proximal width, 14.8; proximal depth, 12.5; width of shaft at midpoint, 6.4; distal width, 14.3; depth of inner condyle, 10.0; depth of outer condyle, 13.0. Tibiotarsus: distal width, 10.4; depth of inner condyle, 10.7; depth of outer condyle, 10.9. Tarsometatarsus: length, 62.7; proximal width, 10.2; proximal depth, 9.8; width of shaft at midpoint, 4.3; distal width, 10.7; distal depth, 7.4.

COMPARATIVE MATERIAL.—A tibiotarsus and tarsometatar-

sus found in the Paris Museum (MNHN) among the old Alphonse Milne-Edwards comparative collection; evidently removed from a skin.

STATUS.—Extant?, endemic species; extremely rare if not extinct.

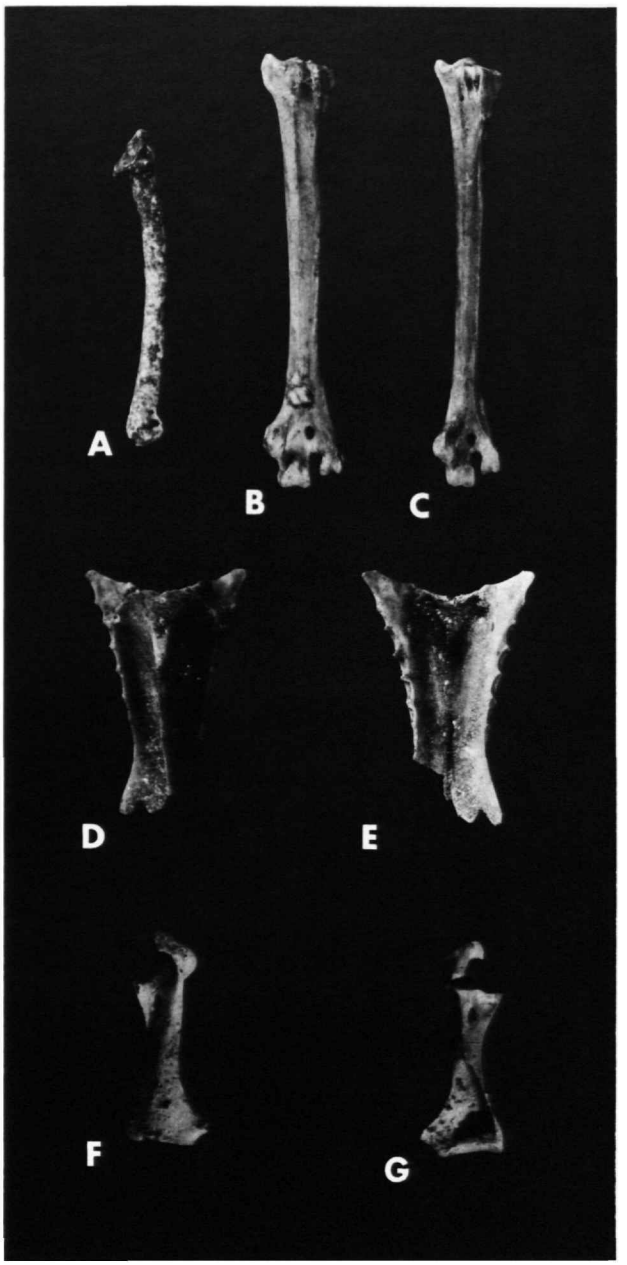

FIGURE 10.—Fossils of *Tricholimnas lafresnayanus* from Pindai Cave (A,C,D,E) and Kanumera (F,G) and a modern specimen (B) found in MNHN. Ulna: A, palmar view. Tarsometatarsus: B,C, posterior view. Sternum: D, ventral view; E, dorsal view. Coracoid: F, ventral view; G, dorsal view. (Natural size.)

REMARKS.—Fullagar et al. (1982) report that at least 17 specimens of this large flightless rail have been collected, of which 15 still exist. The species is extremely rare, with only one sight record having been reported recently (Balouet, 1987). The two sterna from Pindai have the carina much reduced, showing that this species is flightless or nearly so, which has doubtless contributed to its depletion by man and introduced predators.

Genus *Gallinula* Brisson, 1760

Gallinula cf. *G. tenebrosa* Gould, 1846

MATERIAL.—Pindai Cave: complete right humerus (NCP 500); proximal end of left ulna (NCP 502); incomplete distal end of left tibiotarsus (NCP 501).

MEASUREMENTS (mm; those in parentheses are from a male *G. tenebrosa*, USNM 492462).—Humerus (NCP 500): length, 67.0 (66.5); proximal width, 13.9 (13.8); distal width, 10.3 (9.8); distal depth, 6.0 (5.7). Ulna (NCP 502): width of proximal end, 7.0 (6.9); depth of proximal end, 6.1 (5.9).

COMPARATIVE MATERIAL.—*Gallinula tenebrosa*, 1 USNM.

STATUS.—Extant, uncommon; taxonomic status of extant and fossil populations uncertain.

REMARKS.—The fossil humerus shows only slight differences from the modern Australian specimen of this species, notably, the more expanded bicipital surface, more protruding bicipital crest, more reduced and shallower tricipital fossa, and larger capital groove. The ulna is almost identical in size to the Australian form, although it has a deep depression between the olecranon and internal cotyla and a well-developed foramen between the olecranon and external cotyla. The tibiotarsus is too damaged for detailed comparison, but it is the same size as that of Australian *G. tenebrosa*.

This species was unknown in New Caledonia until a small population (about 10 individuals observed) was discovered by Hannecart and Letocart (1980:99), who collected three specimens and forwarded them to Dr. Christian Erard at the Museum National d'Histoire Naturelle, where they still await analysis. It remains to be determined whether the extant population represents a recent recolonization of New Caledonia from Australia or is a remnant of the possibly endemic population that was present when the fossils were deposited.

Genus *Porphyrio* Brisson, 1760

The following two species are referable to the genus *Porphyrio* by the deep, heavily fused premaxillary symphysis and the very thin medial side of the shaft of the tarsometatarsus.

Porphyrio kukwiedei, new species

FIGURES 11A-C,E,G; 12C,D; 13C,D

Porphyrio kukwiedei Balouet, 1987:178 [nomen nudum].

HOLOTYPE.—Left tarsometatarsus lacking a medial piece of the shaft, NCP 410, Institut de Paléontologie, Muséum

National d'Histoire Naturelle, Paris (Figure 12C,D).

TYPE LOCALITY.—From apparently Holocene deposits in Pindai Cave, Nepoui Peninsula, west coast of New Caledonia; 21°20′S, 164°57′E.

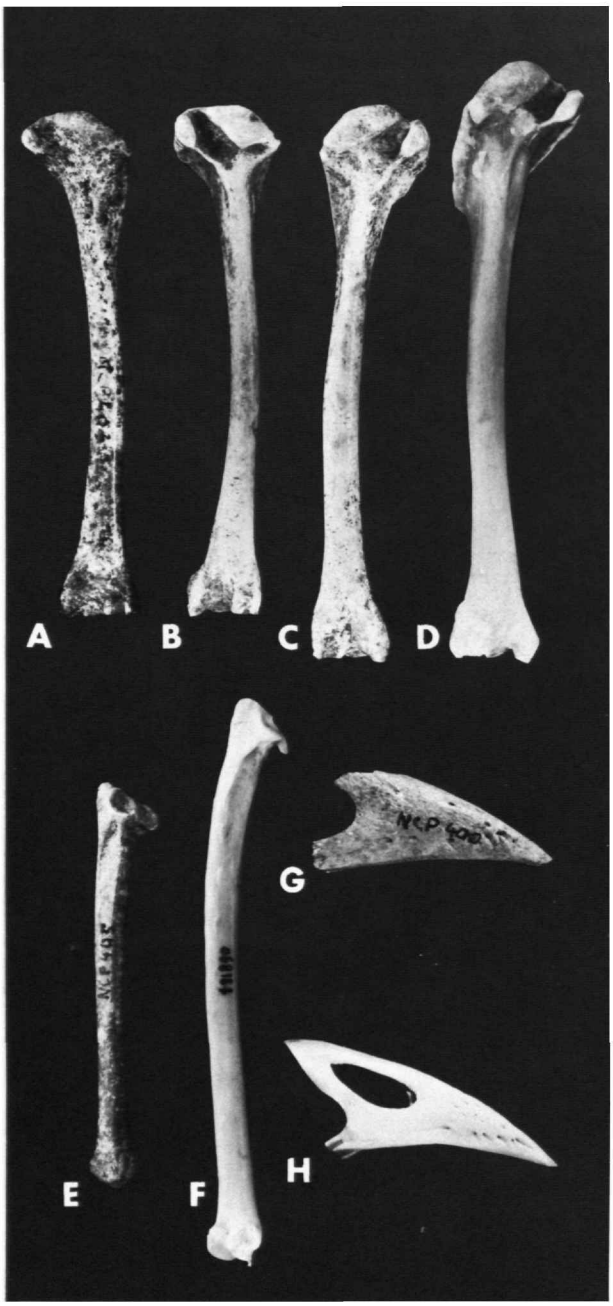

FIGURE 11.—*Porphyrio kukwiedei*, new species (A: NCP 403 "female"; B: NCP 402 "female"; C: NCP 401, "male" E: NCP 405; G: NCP 400), compared with *P. porphyrio* (D,F,H: USNM 491890). Humeri: A–D, in anconal view. Ulna: E,F, in palmar view. Premaxilla: G,H, lateral view. (Natural size.)

MEASUREMENTS OF HOLOTYPE (mm).—Length, 108.6; proximal width, 19.6; depth through hypotarsus, 19.7; length of calcaneal ridge, 13.9; width and depth of shaft at midpoint, 8.6 × 6.2; distal width, 19.7; width and depth of middle trochlea, 7.5 × 8.7.

PARATYPES.—Pindai Cave: anterior portion of premaxilla (NCP 400); tip of premaxilla (NCP 422); right mandibular articulation (NCP 408); right quadrate (NCP 409); dorsal vertebrae (NCP 423, 424, 425); anterior half of left scapula (NCP 407); "male" left humerus (NCP 401); "female" right humeri (NCP 402, 403); left humerus lacking proximal end (NCP 404); left ulna (NCP 405); "female" left tibiotarsus (NCP 01); proximal end of left tibiotarsus (NCP 421).

Gilles Cave, upper layer: "male" proximal end of right tarsometatarsus lacking medial half (NCG 01).

Kanumera: axis vertebra (NCK 03); right coracoid lacking ends (NCK 104); left humerus lacking ventral tubercle and distal end (NCK 400); proximal and distal ends of right humerus (NCK 402, 403); proximal end of left ulna (NCK 420); proximal end of right carpometacarpus (NCK 405); "male" distal end of right tibiotarsus (NCK 01); proximal part of left tibiotarsus (NCK 02); 2 proximal ends of left fibulae (NCK 401, 406); shaft of right tarsometatarsus (NCK 407).

MEASUREMENTS OF PARATYPES.—See Table 10.

COMPARATIVE MATERIAL.—*Porphyrio porphyrio*, sensu lato, 3 males and 4 females USNM (all zoo birds except one from Thailand), 1 MNHN (New Caledonia); *Porphyrio mantelli* (Owen), 1 MNHN.

DIAGNOSIS.—A very large, flightless species of *Porphyrio*, about 25% larger than *P. porphyrio* in most elements (Table 10). Premaxillary symphysis not as heavy and deep as in *P. mantelli*. Wings reduced; ulna absolutely shorter than in *P. porphyrio* or *P. mantelli*; humeri short, with the palmar rotation of the pectoral crest typical of flightless birds, bicipital surface reduced. Tibiotarsus with a notch between the inner and outer cnemial crests, with the latter coming in at a right angle rather than sloping. Tarsometatarsus much more robust than in *P. porphyrio*, trochleae more divergent. Tarsometatarsus longer and not nearly as robust as in *P. mantelli*, with the medial side of proximal half of tarsometatarsus still reduced to a thin ridge, as in *P. porphyrio*, whereas this has become secondarily thickened in *P. mantelli*.

ETYMOLOGY.—*Kukwiede* is the name of a divinity associated with a local legend that led to the discovery of the bone deposits at Kanumera on the Isle of Pines (Dubois, 1976). Although much has been made of this "legend" (Rich et al. 1981; Poplin and Mourer-Chauviré, 1985), with its reference to large extinct birds, it is believed to be of very recent origin (Balouet, 1984a:41).

STATUS.—Extinct, endemic: known from fossils only.

REMARKS.—The presence of a large species of *Porphyrio* in New Caledonia was first detected in 1980 when sorting out smaller bones from the Kanumera site. When more numerous and diagnostic remains were subsequently collected in Pindai and Gilles Cave, it was first thought (Balouet, 1984a:41) that

TABLE 10.—Measurements (mm) of *Porphyrio kukwiedei*, new species, compared with other species of *Porphyrio*.

Character	*P. kukwiedei*[1]	*P. porphyrio* females (n = 4) range	mean	males (n = 4) range	mean	*P. mantelli* sex? (n = 1)
PREMAXILLA						
Distance from nostril to tip	30.2	17.8–20.2	19.2	23.3–26.1	24.7	34.1
MANDIBLE						
Width of articular region	10.8	8.8–9.2	9.0	9.5–11.3	10.7	10.8
Height at coronoid process	12.1	9.2–9.7	9.4	12.2–13.5	12.7	20.2
QUADRATE						
Height	17.2	9.7–10.0	9.9	12.2–13.5	12.7	16.4
Width of otic process	7.6	4.4–4.7	4.6	5.1–5.3	5.2	8.1
Length of orbital process from posterior side	18.1	9.5–10.4	10.0	12.4–12.9	12.5	20.4
Maximum width of articular facet	12.5	7.3–7.8	7.5	8.3–8.7	8.6	11.8
AXIS						
Maximum length	21.0	10.3–11.5	10.8	12.9–13.4	13.2	20.5
Length of centrum	11.3	6.5–7.3	6.9	7.6–8.5	8.1	11.5
SCAPULA						
Maximum diameter of glenoid facet	7.7	5.2–5.8	5.6	6.3–7.0	6.6	5.3
Minimum diameter of glenoid facet	4.5	3.8–4.2	4.0	3.8–5.0	4.7	4.6
Proximal width	11.9	9.7–10.0	9.8	11.3–12.3	11.8	12.3
Depth at glenoid facet	4.1	2.8–3.5	3.2	4.1–5.3	4.5	4.3
HUMERUS						
Length	80.4, 74.0, 74.0, 61.9	63.9–71.7	68.4	84.4–86.6	85.4	83.0
Proximal width	16.5, 16.4, 15.4, –	14.9–15.5	15.2	16.3–18.5	17.6	20.1
Distal width	11.5, 11.1, 10.9, 11.3	10.4–11.4	11.0	12.9–13.7	13.4	13.8
Distal depth	8.0, 7.0, 6.7, 6.4	6.2–6.8	6.5	7.7–8.1	7.9	7.7
Minimum shaft diameter	4.8, 4.5, 4.3, 4.0	3.9–4.1	4.0	5.2–5.4	5.3	4.9
ULNA						
Length	59.1	66.4–68.8	66.5	68.1–69.9	68.9	70.4
Proximal maximum diameter	10.3	9.2–10.0	9.5	10.9–11.8	11.3	11.2
Minimum diameter of shaft	3.4	3.4–3.6	3.5	4.2–4.6	4.4	4.3
Diameter of outer condyle	7.2	6.6–6.9	6.8	7.8–8.2	8.0	7.8
TIBIOTARSUS						
Length	65.0, –	121.3–133.0	127.5	131.4–141.6	140.2	150.8
Distal width	17.5, 18.3	9.2–9.7	9.5	11.5–12.0	11.8	17.6
Depth of inner condyle	17.3, 19.3	9.6–10.0	9.8	12.0–12.7	12.4	17.0
Depth of outer condyle	16.4, 17.0	9.1–9.3	9.3	10.9–11.3	11.2	15.6
Anterior width of inner condyle	3.8, 5.0	2.3–2.6	2.5	2.9–3.3	3.1	4.1
Anterior width of outer condyle	6.4, 6.9	3.4–3.9	3.6	4.4–4.7	4.6	6.3
FIBULA						
Proximal width	11.9	6.9–7.1	7.0	8.7–9.0	8.8	12.4
Proximal depth	4.4	1.9–2.0	1.9	2.4–3.0	2.6	4.4
TARSOMETATARSUS						
Length	–, 109.5	81.4–89.8	86.9	94.9–101.1	98.5	91.6
Height of main calcaneal ridge	16.5, 13.9	9.7–9.9	9.8	13.4–14.1	13.8	15.4
Proximal width	–, 19.4	10.1–10.7	10.4	12.7–13.4	12.9	17.6
Proximal depth	–, 14.3	10.6–10.9	10.7	12.4–13.5	13.0	13.6
Distal width	–, 19.7	10.8–11.3	11.0	13.2–13.9	13.6	19.4

[1]*P. kukwiedei* measurements of humeri from NCP 401, 402, 403, 404, respectively; of tibiotarsi from NCP 01 and NCK 01, respectively; of tarsometatarsus from NCG 01 (proximal end only) and NCP 410, respectively.

FIGURE 12.—Anterior (A,C,E) and posterior (B,D,F) views of tibiotarsi of *Porphyrio*. A,B, *P. mantelli*, MNHN uncataloged (ex NMNZ 14965); C,D, *P. kukwiedei*, new species, NCP 01; E,F, *P. porphyrio*, USNM 321151. (Natural size.)

this species should be referred to the genus *Notornis*, which is often used for the flightless Takahe (*P. mantelli*) of New Zealand. Some authors, however, would not recognize *Notornis* (e.g., Mayr, 1949:4) and attribute its differences from typical *Porphyrio* mainly to adaptations for flightlessness (Olson, 1973:409, 1977a:371). Further study of the New Caledonian material, augmented by the discovery of a rostrum, shows *Porphyrio kukwiedei* to be more similar to *P. porphyrio* than to *P. mantelli* in any case.

The marked sexual dimorphism in size seen in many species of Rallidae (e.g., *Fulica americana*, see Engels, 1938) is also apparent in *Porphyrio kukwiedei*. We have tentatively identified some of the elements in the paratypical series to sex (see "Paratypes"), with larger individuals assumed to be males.

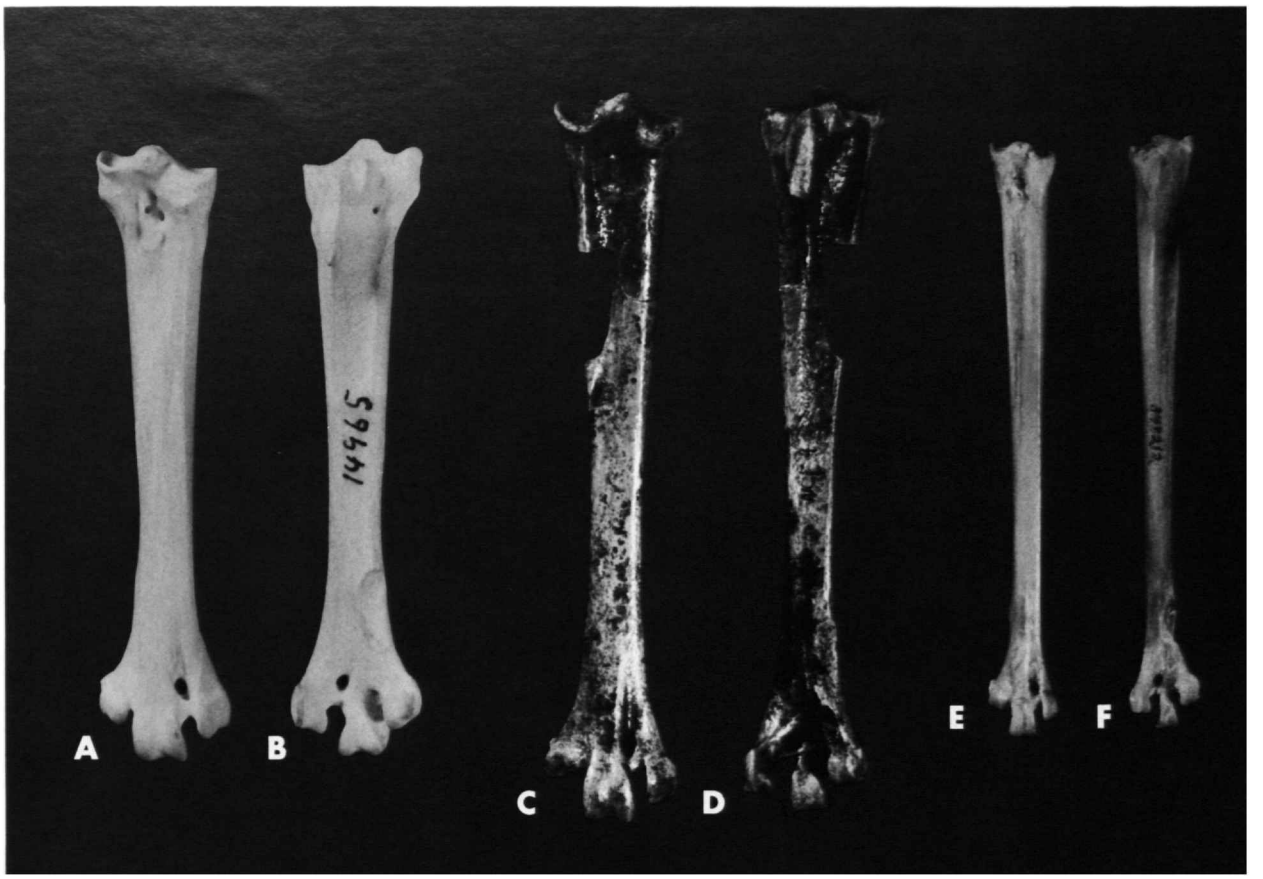

FIGURE 13.—Anterior (A,C,E) and posterior (B,D,F) views of tarsometatarsi of *Porphyrio*. A,B, *P. mantelli*, MNHN uncataloged (ex NMNZ 14965); C,D, *P. kukwiedei*, new species, holotype NCP 410; E,F, *P. porphyrio*, USNM 343212. (Natural size.)

An interesting passage in Verreaux and des Murs (1860:438) concerning *Tricholimnas lafresnayanus* suggests that *Porphyrio kukwiedei* or some other large bird may have persisted into the historic period.

> Nouvelle Calédonie, où il est nommé, par les indigènes, *N'dino*, camp de Morari. Il vit dans les lieux marécageux, et arriverait, dit la note, *à la taille du Dindon*! Est-ce la même espèce, ou bien y en aurait-il une autre qui attendrait cette dimension?

A bird the size of a turkey (*Meleagris*) might conceivably apply to either *Porphyrio kukwiedei* or *Megapodius molistructor*, although if it frequented marshy places, the former would seem more likely.

Porphyrio porphyrio (Linnaeus, 1758)

MATERIAL.—Pindai Cave: 2 rostra, 1 right and 2 left os coxae, 1 right and 2 left coracoids, 1 right humerus, right carpometacarpus, 2 right and 1 left femora; shaft of right femur; distal portion of right tibiotarsus; proximal half of right tibiotarsus. All but the femoral shaft are from juveniles.

MEASUREMENTS.—All the specimens are too poorly ossified for meaningful measurements.

COMPARATIVE MATERIAL.—See *Porphyrio kukwiedei*, new species.

STATUS.—Extant, common: species widespread.

REMARKS.—This species was found only in Pindai Cave. Its absence in deposits antedating the arrival of man (Gilles lower layer and Kanumera) suggests that the colonization of New Caledonia by *P. porphyrio* may have been very recent, following the extinction of *P. kukwiedei*. The New Caledonian population had once been recognized as a distinct subspecies, *P. p. caledonicus* Sarasin, but Mayr (1949:23) found individual variation in Melanesian birds to be so great as to necessitate merging all previously recognized subspecies, from the Admiralties to Samoa, under the name *P. p. samoensis* Peale. This race itself is only poorly differentiated from *P. p. melanopterus* Bonaparte of New Guinea and the Moluccas. The New Caledonian fossil record tends to corroborate that of New Zealand (Millener, 1981:773) in suggesting that the volant

forms of Rallidae such as *Porphyrio porphyrio*, *Gallirallus philippensis*, and *Porzana tabuensis*, now so widespread in Oceania, have probably dispersed only recently in the Pacific in the wake of pervasive extinction of endemic flightless rails.

Genus *Rhynochetos* Verreaux and des Murs, 1860

Rhynochetos orarius, new species

FIGURES 14B,D,F,G; 15B,D,F,H,J

Rhynochetus [sic] *jubatus*.—Balouet, 1987:178.

HOLOTYPE.—Right tibiotarsus, NCP 700, Institut de Paléontologie, Muséum National d'Histoire Naturelle, Paris (Figure 14D).

TYPE LOCALITY.—From apparently Holocene deposits in Pindai Cave, Nepoui Peninsula, west coast of New Caledonia. 21°20′S, 164°57′E.

MEASUREMENTS OF HOLOTYPE (mm).—Length from cnemial crest, 153.5; length from proximal articular surface, 148.9; width of proximal articular surface, 15.4; width and depth of

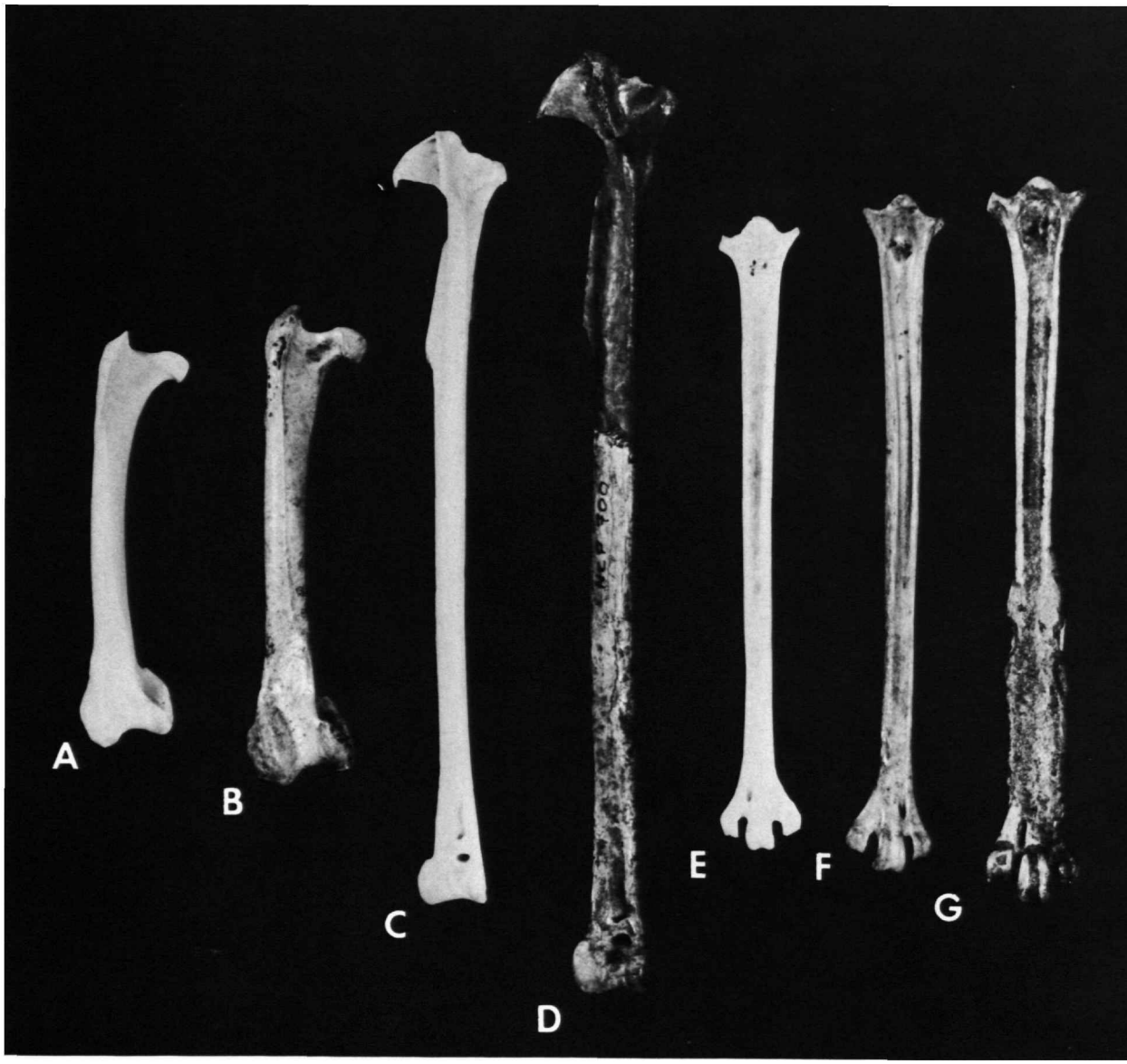

FIGURE 14.—Hindlimb elements of *Rhinochetos orarius*, new species (B;D: holotype, NCP 700; F;G), compared with the living species *R. jubatus* (A,C,E; MNHN uncataloged). Femur: A,B, anterior view. Tibiotarsus: C,D, anterior view. Tarsometatarsus: E,F, anterior view; G, pathological specimen, anterior view. (Natural size.)

shaft at midpoint, 8.0 × 6.5; distal width, 13.3; depth of inner condyle, 13.2; depth of outer condyle, 12.3.

PARATYPES.—Pindai Cave: 8 fragments of rostra (NCP 930–937); mandible lacking left ramus (NCP 965); 5 mandibular symphyses (NCP 972–976); 6 portions of mandibular rami (NCP 966–971); 8 right and 7 left mandibular articulations (NCP 950–964); 3 complete and 3 incomplete crania (NCP 800–805); 2 right and 2 left maxillopalatines (NCP 900–903); 3 right and 2 left quadrates (NCP 880–884); 5 pterygoids (NCP 941–945); right jugal (NCP 940); notarium (NCP 980); 40 vertebrae (unnumbered); 10 sternal fragments (NCP 810–819); 4 right and 4 left portions of pelves (NCP 760–767); 3 right complete, 1 right scapular end, 6 left complete, 1 scapular end, and 1 sternal ends of coracoids (NCP 770–781); 2 incomplete furculae (NCP 875, 876); 6 right and 3 left scapulae (NCP 830–838); 3 complete right, 1 proximal right, 6 complete left, 1 proximal left, and 2 distal left humeri (NCP 840–852); 2 left radii (NCP 870, 871); 6 complete right,

FIGURE 15.—Forelimb elements and mandible of *Rhinochetos orarius*, new species (B,D,F,H,J), compared with the living species *R. jubatus* (A,C,E,G,I; MNHN uncataloged). Humerus: A,B, palmar view. Ulna: C,D, palmar view. Carpometacarpus; E,F, palmar view. Coracoid: G,H, ventral view. Mandible: I,J, lateral view. (Natural size.)

TABLE 11.—Measurements (mm) of fossil specimens of *Rhynochetos orarius*, new species, compared with the extant species *R. jubatus* (dash indicates no measurement available).

Character	*Rhynochetos jubatus*			*Rhynochetos orarius*					
				Pindai			Kanumera		
	n	range	mean	n	range	mean	n	range	mean
CRANIUM									
Length	3	50.9–53.2	51.8	3	55.5–56.7	55.9	–	–	–
Maximum width	3	40.1–43.5	41.8	3	44.2–47.3	45.8	–	–	–
Interorbital bridge width	2	17.1, 18.0	17.5	3	19.0–26.0	21.8	–	–	–
MANDIBLE									
Length	4	88.9–90.4	89.5	1	106.3		–	–	–
Width of articulation	4	14.2–15.6	14.9	14	15.4–18.0	16.8	–	–	–
QUADRATE									
Height	3	14.2–15.0	14.6	5	15.6–17.4	16.4	3	15.7–16.1	15.9
CORACOID									
Length	17	32.7–44.4	38.0	8	41.0–45.3	43.7	1	44.1	
Width of sternal facet	12	10.5–12.4	11.4	10	10.8–13.3	12.4	1	12.6	
HUMERUS									
Length	10	62.1–67.0	64.0	9	65.7–74.0	70.2	–	–	–
Proximal width	6	15.0–15.4	15.2	9	15.7–17.6	16.7	–	–	–
Minimum diameter of shaft	6	4.2–4.8	4.4	11	4.6–5.6	5.2	1	5.1	
Distal width	6	12.5–14.1	13.3	14	14.0–15.9	15.0	2	14.3, 15.5	14.9
Distal depth	6	7.0–7.9	7.5	14	7.9–9.2	8.5	3	7.5–8.7	8.2
ULNA									
Length	12	60.5–68.0	64.3	9	67.8–75.5	73.6	–	–	–
CARPOMETACARPUS									
Length	12	31.4–37.6	34.5	6	39.1–41.0	39.9	1	36.0	
FEMUR									
Length	18	66.3–69.6	67.9	6	72.7–79.1	74.7	–	–	–
Proximal width	12	14.2–16.3	15.0	4	16.9–18.1	17.3	–	–	–
Proximal depth	12	8.2–9.2	8.6	4	10.2–11.2	10.5	–	–	–
Minimum shaft diameter	13	5.1–5.9	5.3	6	6.0–6.6	6.3	1	6.3	
Distal width	12	14.2–15.6	15.0	5	16.8–17.4	17.1	1	17.4	
Depth of inner condyle	12	9.0–10.5	9.7	4	10.2–11.6	10.5	–	–	–
Depth of outer condyle	12	12.0–12.9	12.5	5	13.1–15.5	14.2	–	–	–
TIBIOTARSUS									
Length	11	123.7–137.4	129.7	6	142.1–153.6	146.2	–	–	–
Maximum diameter of shaft	7	5.6–6.0	5.9	10	6.3–8.1	7.2	–	–	–
Minimum diameter of shaft	7	4.9–5.3	5.0	10	5.3–6.3	5.9	–	–	–
Distal width	7	11.8–12.6	11.9	11	11.8–13.2	12.5	2	12.1, 12.3	12.2
Depth of inner condyle	7	10.5–11.8	10.8	11	12.1–13.7	12.8	2	12.4, 12.5	12.4
Depth of outer condyle	7	10.1–10.6	10.4	11	11.0–12.3	11.6	2	11.5, 11.9	11.7
TARSOMETATARSUS									
Length	13	101.0–112.4	106.5	2	110.4, 117.5	113.9	–	–	–
Proximal width	9	13.3–14.3	13.7	10	13.9–16.0	15.3	2	14.3, 14.9	14.6
Proximal depth	9	11.1–12.2	11.7	9	11.9–14.4	11.7	2	11.5, 11.7	11.6
Width at middle of shaft	9	4.1–5.2	4.7	7	5.7–6.1	5.9	2	5.8, 6.4	6.1
Distal width	9	12.6–13.7	13.2	5	14.3–16.0	15.1	–	–	–

3 proximal right, 2 distal right, 5 complete left, and 2 proximal left ulnae (NCP 910–927); 3 complete right, 3 complete left, and 2 proximal left carpometacarpi (NCP 860–867); 2 complete right, 3 complete left, 1 proximal left, and 2 distal left femora (NCP 730–737); 4 complete right, 5 proximal right, 5 distal right, 1 complete left, 3 proximal left, and 4 distal left tibiotarsi (NCP 701–722); 2 left fibulae (NCP 890, 891); 1 complete right, 4 proximal right, 3 distal right, 1 complete left, 3 proximal left, and 2 distal left tarsometatarsi (NCP 740–753).

Kanumera: 56 bones, all very fragmentary except a single left coracoid (NCK 306) and a left carpometacarpus (NCK 341) and including also 2 rostra, 3 quadrates, mandibular ramus, 17 vertebrae, 5 coracoids, 5 scapulae, 4 humeri, 3 ulnae, 3 radii, 5 carpometacarpi, 6 femora, 8 tibiotarsi, fibula, and 6 tarsometatarsi.

MEASUREMENTS OF PARATYPES.—See Table 11.

COMPARATIVE MATERIAL.—Measurements of various specimens of *Rhynochetos jubatus* Verreaux and des Murs have

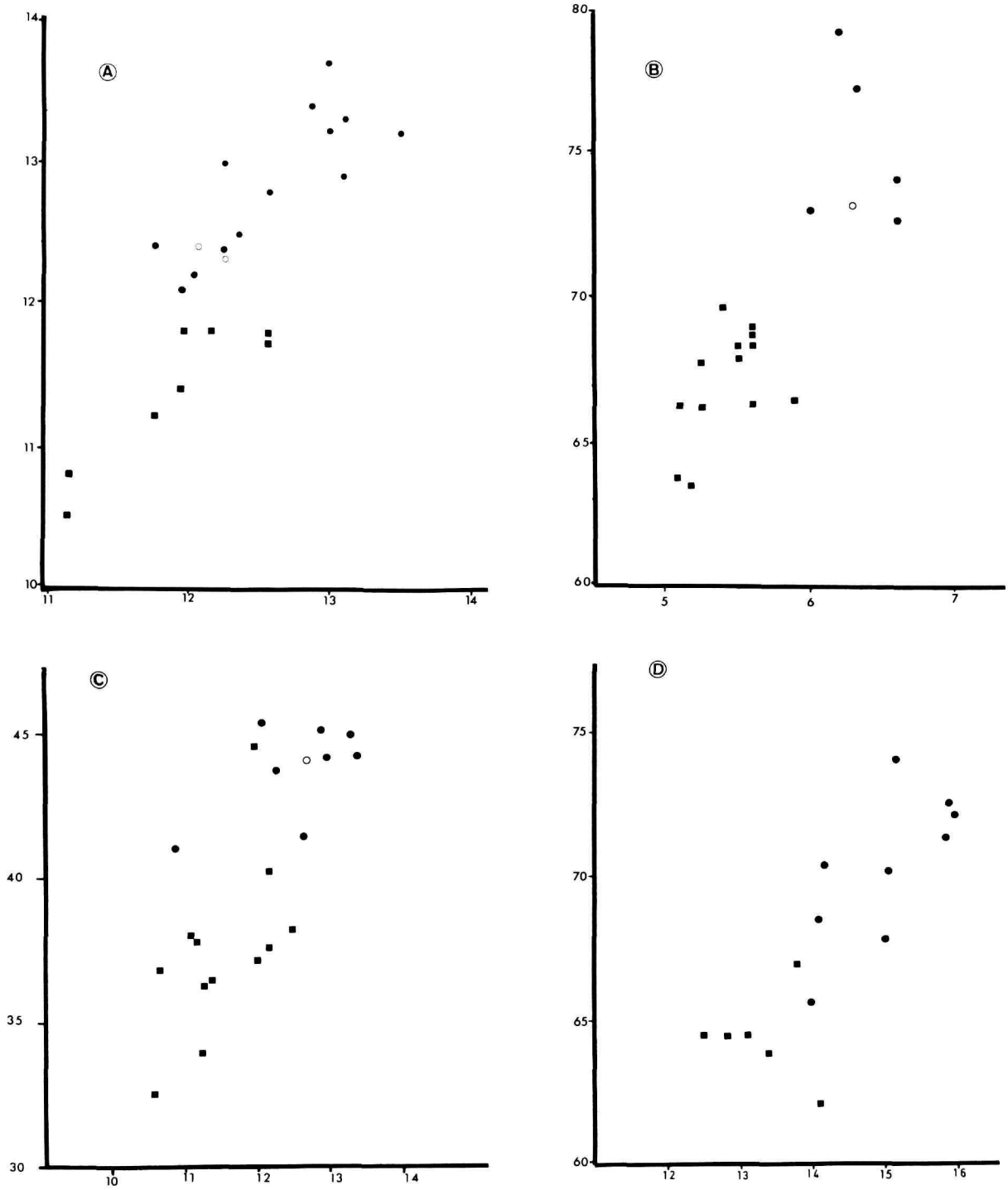

FIGURE 16.—Scatter diagrams showing differences in proportions between *Rhinochetos orarius*, new species (solid circles = Pindai Cave; open circles = Kanumera) and the living species *R. jubatus* (solid squares): A, distal width of tibiotarsus/depth of inner condyle; B, length of femur/diameter of shaft; C, length of coracoid/width of sternal facet; D, length of humerus/distal width. (Measurements are in mm.)

been accumulated by Balouet as opportunities presented themselves, including 7 individuals measured as they were prepared in the field prior to their dispersal to several museums. Many of the skeletons in collections are of highly pathological captive birds from which few measurements were possible. These factors account for the considerable variation in numbers of specimens of *R. jubatus* given for the various measurements in Table 11. Specimens measured include 2 MNHN (plus 2 in the Department of Comparative Anatomy, MNHN), 3 (and 2 trunks) USNM, 2 AM, 2 NMNZ, 3 in the collection of Y. Letocart, and length measurements of long bones from 3 AMNH.

DIAGNOSIS.—A large species of kagu with average measurements 15% greater than the extant *R. jubatus*. There is no overlap in measurements in the hindlimb elements between modern and fossil specimens and only very rare overlap in the measurements of the forelimb. (This overlap could be real or due to pathological conditions that are very frequent in modern zoo specimens and not uncommon in wild ones as well.) The general proportions of the different bones are very similar in the two species, but in *R. orarius* the tibiotarsi have the inner condyle deeper than the width of the distal end (Figure 16A) and the tarsometatarsi have a deeper anterior groove that extends nearly to the distal foramen, whereas this groove is less pronounced and restricted to the proximal half of the bone in *R. jubatus*.

ETYMOLOGY.—Latin, *orarius* (of the coast) from *ora* (edge, border, coast), from the presumed lowland distribution of the species, as opposed to *R. jubatus*.

STATUS.—Extinct, endemic; known only from fossils.

REMARKS.—Although the material of this kagu was found in 1980 and has been mentioned several times since (Balouet, 1984a; 1984b; 1987), no firm systematic conclusions had been possible because of insufficient comparative material. With additional specimens of *R. jubatus* it is seen that there is no overlap in most measurements with the fossils from Pindai and Kanumera (Table 11; Figure 16). Therefore, unless we postulate that all kagus have become much smaller within only a few centuries, which seems highly unlikely, then the fossils must represent a form that is taxonomically distinct from *R. jubatus*.

Both fossil sites from which kagu bones were recovered (the absence of *Rhynochetos* in the Gilles deposits is remarkable and inexplicable) are from lowland areas at or near the seacoast. Kagus were probably eliminated from the lowland areas of New Caledonia long before the first specimens were collected and described in 1860. Probably all modern specimens have come from inland localities at considerably higher elevations than the fossil sites. We therefore suggest that *R. orarius* and *R. jubatus* were lowland and highland forms, respectively. Whether they ever existed sympatrically or whether they formed intergrades, can presumably only be determined by finding fossil sites at higher elevations.

Genus *Charadrius* Linnaeus, 1758

Charadrius mongolus Pallas, 1876

MATERIAL.—Gilles Cave, upper layer; right and left humeri.

MEASUREMENTS (mm).—Humerus: length, 32.0, 32.1.

COMPARATIVE MATERIAL.—*Charadrius leschenaultii* Lesson, 1 USNM; *C. mongolus*, 5 USNM, *C. asiaticus* Pallas, 2 USNM; *C. hiaticula* Linnaeus, 3 USNM.

STATUS.—Extant, Palearctic migrant; first record for New Caledonia.

REMARKS.—The fossils agree perfectly in size and osteology with the modern species *C. mongolus*, whereas they are smaller than in *C. leschenaultii* (length of humerus, 37.2) or *C. asiaticus* but larger than in *C. hiaticula*. Only three species of Charadriidae have been reported historically from New Caledonia, all being Palearctic migrants (Hannecart and Letocart, 1983): *Charadrius leschenaultii* (only five occurrences recorded), *Pluvialis squatarola* (Linnaeus) and *P. dominica* Müller. *Charadrius mongolus* breeds in Asia and winters in the Australasian region. It doubtless occurs in New Caledonia at least as a vagrant, and the fact that it has never previously been recorded there only reflects the need for more ornithological work in the island.

Genus *Pluvialis* Brisson, 1760

Pluvialis dominica (Müller, 1776)

MATERIAL.—Gilles Cave, upper layer: right humerus, right ulna, right and left femora, left tarsometatarsus.

MEASUREMENTS (mm).—Humerus: length, 45.2. Ulna: length, 46.4. Femur: length, 32.5, 33.5. Tarsometatarsus: length, 44.6.

COMPARATIVE MATERIAL.—*Pluvialis dominica*, 32 USNM, 1 MNHN.

STATUS.—Extant, Palearctic migrant; common.

Genus *Coenocorypha* Gray, 1855

Coenocorypha? species

MATERIAL.—Gilles Cave, lower layer: right humerus lacking most of the ends, proximal end of left humerus, scapular end of right coracoid.

MEASUREMENTS.—No standard measurements possible.

COMPARATIVE MATERIAL.—*Tringa brevipes* (Vieillot), 6 USNM; *Capella megala* (Swinhoe), 1 USNM; *C. stenura* (Bonaparte), 3 USNM; *Coenocorypha a. aucklandica* (Gray), 1 NMNZ; *C. a. pusilla* (Buller), 1 NMNZ.

STATUS.—Extinct, endemic?: known only from fossils.

REMARKS.—These bones come frnom a scolopacid the size of *Tringa brevipes*, the only scolopacid in this size range known from New Caledonia. *Tringa brevipes* is a palearctic migrant that is confined to seacoasts, whereas Gilles Cave is 7 km inland. The fossils are very different from *Tringa*,

however, and clearly belong to a snipe-like bird in the subfamily Scolopacinae. Several Palearctic species of *Capella* migrate to the Australasian region but none has ever been recorded from New Caledonia. Furthermore the fossils are so different from *Capella megala* and *C. stenura* that they cannot be referred to that genus. The resemblances are closer to the peculiar snipes of the genus *Coenocorypha*, which are endemic to the New Zealand region, although the New Caledonian bird was much larger. We are deferring description of this species in the hopes of obtaining more complete material of it at a future date. Nevertheless, it appears to represent another extinct endemic element in the New Caledonian avifauna.

Genus *Anas* Linnaeus, 1758

Anas gracilis subspecies indeterminate

MATERIAL.—Pindai Cave: cranium, 1 right and 2 left coracoids, 2 left scapulae, 3 right humeri, 2 left carpometacarpi, incomplete pelvis, right femur, 2 left tibiotarsi, right and left tarsometatarsi.

MEASUREMENTS.—See Table 12.

COMPARATIVE MATERIAL.—*Anas gracilis* Buller, 16 MVZ; *Anas gibberifrons* Miller, 1 USNM; *Anas chlorotis* Gray, 4 NMNZ; *Anas castanea* (Eyton), 1 USNM.

STATUS.—Extant: now fairly common in New Caledonia but taxonomic status of extant and fossil populations uncertain.

REMARKS.—These bones, from a small teal-sized duck, agree in all details except size with a series of skeletons of *Anas gracilis* from Australia. The elements are all smaller and more gracile than in *A.* (*aucklandica*) *chlorotis* (Table 12), with the basitemporal plate of the cranium much narrower, the postorbital process more slender, and the antorbital region proportionately shorter. As noted by Olson (1977b), the bones in the Australian species *Anas castanea* are also more robust than in *A. gracilis*.

We follow Parker et al. (1985) in recognizing *Anas gracilis* of Australia, New Guinea, and New Zealand as distinct from *Anas gibberifrons*. The material from Pindai includes 2 left tibiotarsi and a humerus that are incompletely ossified and are clearly from juvenile individuals, thus indicating a breeding population at the time of deposition. The only small ducks reported from New Caledonia are *Anas gracilis* and *Anas chlorotis*, the latter being a supposedly sedentary New Zealand species known in New Caledonia only by a sight record of a single individual that appeared three years in succession at a pond with both wild and captive ducks (Delacour, 1965). The present status of *Anas gracilis* in New Caledonia is not clear. Delacour (1966:42) regarded the species as having been present in the last century, only to disappear until relatively recently, when a supposed influx from Australia repopulated the island. Hannecart and Letocart (1980:100) state that the "species appears to nest on our territory only occasionally; it comes to us in migratory waves from Australia."

The bones from Pindai indicate a local breeding population that was smaller than the birds from the Australian mainland (Table 12). All of the wing and pectoral elements are smaller, the cranium is smaller than in all but 3 females, and the interorbital width smaller than in all but one individual of those compared. The tarsometatarsi fall within the range of females of *A. gracilis* in length but are smaller in proximal width than in all but 2 individuals. Any historically taken skins of *A. gracilis*, particularly those taken in the last century, should be scrutinized to see if a smaller endemic subspecies can be discerned. The only mention of such a specimen that we have encountered is of a female taken in 1865 that at least at one

TABLE 12.—Measurements (mm) of New Caledonian fossils of *Anas gracilis* compared with *A. g. gracilis* from Australia and *A. chlorotis* of New Zealand (2 males and 2 females).

Character	*A. gracilis* (fossil)	*A. g. gracilis* females (n = 7) range	mean	males (n = 9) range	mean	*A. chlorotis* (n = 4) range	mean
CRANIUM							
From nasofrontal hinge	46.9	45.8–47.6	46.9	47.5–51.0	49.7	48.5–50.5	49.6
INTERORBITAL BRIDGE							
Width	6.6	6.2–7.5	7.0	6.7–8.9	8.0	8.5–10.2	9.2
CORACOID							
Greatest length	36.2, 37.1, 37.4	38.3–41.1	39.7	41.8–45.4	43.1	40.8–41.8	41.3
HUMERUS							
Length	63.8, 65.0	65.8–72.1	68.2	70.2–75.1	72.3	71.2–74.6	72.6
CARPOMETACARPUS							
Length	38.6, 39.3	40.6–42.5	41.6	43.3–46.5	44.8	41.9–48.4	44.1
FEMUR							
Length	37.9	37.6–40.5	38.5	38.5–42.5	40.4	43.5–45.1	44.1
TARSOMETATARSUS							
Length	35.3, 36.3	33.7–37.1	35.3	34.4–37.9	36.9	40.5–41.8	41.1
Proximal width	3.4, 3.6	3.4–3.7	3.5	3.3–3.9	3.6	4.0–4.2	4.1