Avifauna from the Teouma Lapita Site, Efate Island, Vanuatu, Including a New Genus and Species of Megapode[1]

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Abstract: The avifauna of the Teouma archaeological site on Efate in Vanuatu is described. It derives from the Lapita levels (3,000–2,800 ybp) and immediately overlying middens extending to ~2,500 ybp. A total of 30 bird species is represented in the 1,714 identified specimens. Twelve species are new records for the island, which, added to previous records, indicates that minimally 39 land birds exclusive of passerines were in the original avifauna. Three-fourths of the 12 newly recorded species appear to have become extinct by the end of Lapita times, 2,800 ybp. The avifauna is dominated by eight species of columbids (47.5% Minimum Number Individuals [MNI]) including a large extinct toothbilled pigeon, *Didunculus placopedetes* from Tonga, and a giant *Ducula* sp. cf. *D. goliath* from New Caledonia. Seabirds are rare despite the coastal location of the site. Fowl are important contributors to the Teouma avifauna, with the human-introduced Red Junglefowl *Gallus gallus* accounting for 15% MNI and present in all sampled layers. There are two species of megapodes (~10% of MNI), with the extant Vanuatu Megapode *Megapodius layardi* most abundant and represented at all levels in the deposits. A substantially larger extinct megapode, *Mwalau walterlinii*, n. gen., n. sp., is present only in the Lapita midden area, where it is relatively rare. This extinct species was larger than all extant megapodes but smaller than the extinct *Progura gallinacea* from Australia, with proportions most similar to those of *Alectura*, and was a volant bird. The remaining significant faunal component is rails, with four species present, of which *Porphyrio melanotus* was the most abundant. Rare but notable records include an undescribed large rail; a parrot, *Eclectus* sp. cf. *E. infectus;* a hornbill, *Rhyticeros* sp. cf. *R. plicatus;* and a coucal, *Centropus* sp. indet., all conservatively considered likely to be conspecific with known taxa elsewhere in Melanesia.

Numerous studies on the archipelagos and islands of the Pacific have revealed that whenever humans first arrived, they rapidly had severe impacts on the original avifaunas, resulting in the loss of a multitude of species (Balouet and Olson 1989; Steadman 1989*a*, 1993, 1995, 2006*a*; James and Olson 1991; Olson and James 1991; Worthy 2000, 2001;

[1] This research is part of Australian Research Council DECRA project DE130101133 (to T. H. Worthy), and DP0880789 to Stuart Bedford and Matthew Spriggs, "Persistence and Transformation in Ancestral Oceanic Society: The archaeology of the first 1500 years in the Vanuatu Archipelago" and DP110101415 to R. Grun, M. Spriggs, R. Atkinson, C. Falgueres, and B. Maureille "Understanding the Migrations of Prehistoric Populations through Direct Dating and Isotopic Tracking of their Mobility Patterns." Manuscript accepted 26 June 2014.

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Pacific Science (2015), vol. 69, no. 2:205–254
doi:10.2984/69.2.6

Worthy and Wragg 2003, 2008; Wragg and Worthy 2006; Karels et al. 2008). Because of the absence of suitable fossil deposits on many islands, often the only source of data for these extinctions is in the archaeological deposits of the first human colonizers, as detailed by Steadman (2006*a*). Often more than 50% of the original avian diversity became extinct, with endemic flightless and large species suffering the most losses (Steadman 2006*a*). In total, Steadman (2006a:409) estimated that between 820 and 1,960 species of birds have become extinct in the Pacific, with the uncertainty mainly due to how rails might be estimated. Estimates for rails ranged from 442 to 1,579 species, although only 74 were known (Steadman 2006*a*: table 10-12).

Located in the western Pacific (Figure 1), Vanuatu is a geologically young archipelago of 82 islands whose oldest rocks are 14 Ma but which has only been emergent in the last 2 Ma (Hamilton et al. 2010, and references therein). This young age and the rapid tectonic evolution of the region explains the absence of frogs (*Platymantis*) and elapid (*Ogmodon*) snakes that are present in Fiji (Hamilton et al. 2010). A majority of biota in Vanuatu is considered derived by dispersal from the Solomons to the north, and a distinct biotic break to the south, between Vanuatu and New Caledonia, has long been recognized (Gibbons 1985, Bauer 1988, Hamilton et al. 2010).

Vanuatu has a diverse avifauna of minimally 62 species of land birds, including six extinct taxa (Doughty et al. 1999, Steadman 2006*a*). The fauna has relatively low levels of endemism, with only 11 species, of which five are extinct, listed by Steadman (2006*a*). Nine species of pigeons compose the most notable component of this fauna. Four of these have a restricted distribution, with *Gallicolumba santaecrucis* also rare, *G. ferruginea* extinct historically, and *Ptilinopus tannensis* and *D. bakeri* endemic to Vanuatu and Santa Cruz Islands.

There have been relatively few investigations of paleodiversity of birds in Vanuatu, with just 601 bones from 42 species listed from 12 sites in the Torres Group and on Santo, Malakula, Efate, and Erromango (Steadman 2006*a*: table 5-12). Despite the very limited sampling, five extinct species were detected. However, these included no large or highly derived taxa such as have often been detected on better-studied islands such as Viti Levu or New Caledonia (Balouet and Olson 1989; Worthy 2000, 2001). Only two of the extinct taxa were rails, undescribed forms of *Gallirallus* and *Porzana*, but Steadman (2006*a*) predicted that minimally 36 flightless species in these genera could be present in the archipelago.

The first people colonized the Vanuatu/New Caledonia/Fiji region of the Southwest Pacific 3,100–3,000 yr ago and are characterized as bearers of the Lapita culture, whose distribution encompassed the Bismarck archipelago and coastal Papua in the west and Tonga and Samoa to the east. Beyond the main Solomons chain, in "Remote Oceania," the Lapita culture constitutes the initial human colonization of the island groups of Santa Cruz, Vanuatu, New Caledonia, Fiji, Tonga, Wallis and Futuna, and Samoa (Sand 1997, Clark and Anderson 2001, Galipaud and Swete-Kelly 2007). It is therefore sites formed by this cultural group that reflect the first human impacts on the natural faunas of islands in this region (see Steadman 2006*a*), and large samples from such sites can be expected to provide the best indication of original faunas on islands.

In this paper we present the single largest avifauna known from Melanesia. It derives from one of these Lapita sites, the formerly coastal Lapita cemetery and midden site at Teouma on the island of Efate, Vanuatu (Figure 1) (Bedford et al. 2006). Comprehensive radiocarbon dating of shell, bone, and charcoal samples from associated human burials and midden materials established the chronology for the site (Bedford et al. 2006, 2009, 2010). The earliest archaeological deposits, Layer 3, and the Area 2 extension and adjacent areas in the site, are dated approximately 3,000 calibrated yr before present (cal BP) and are associated with the oldest cemetery yet found in the Pacific islands (Bedford et al. 2006). Later midden deposits, which in places exceed 1 m depth and seal the cemetery, cannot date to later than 2,500 cal BP on the basis of pottery typology, which is well dated at other Efate sites (Bedford 2006). The site

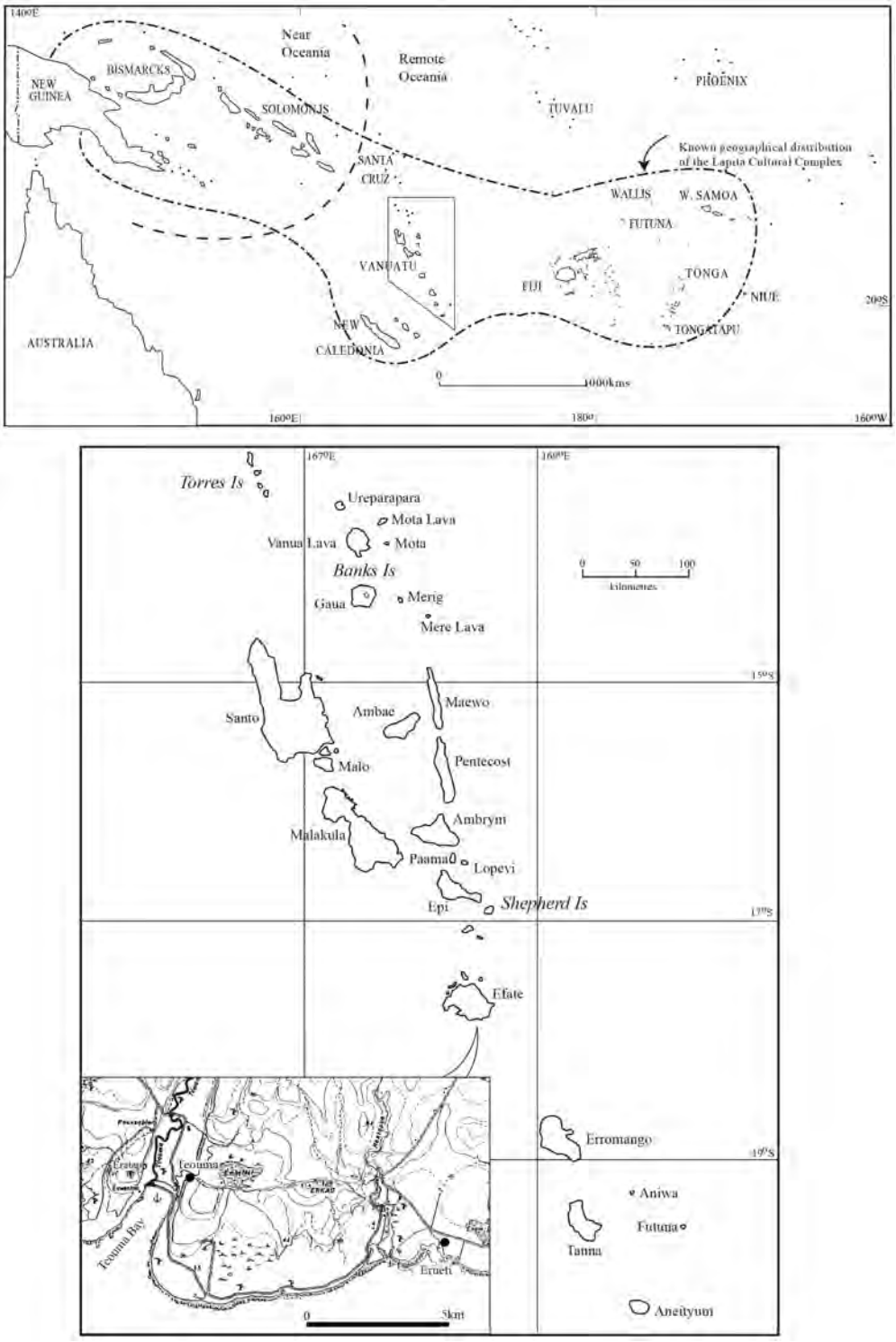

FIGURE 1. Location maps showing the location of Vanuatu in the Melanesian region of the Pacific (*above*) and the location of the Lapita site Teouma on Efate within Vanuatu (*below*).

is well stratified, with the bird bones most diverse and most abundant in the cemetery levels (Layer 3) and basal layers of the midden deposits (Layer 2) in which large terrestrial turtles (Meiolaniidae) were also abundant (White et al. 2010).

The purpose of this contribution is to report the avifauna from the Teouma site, which is the most extensively excavated first contact site between humans and the original fauna known for Vanuatu, to give insight into the composition of the original avifauna and place this in the context of other islands or archipelagos in Oceania.

MATERIALS AND METHODS

The Teouma Lapita site is located on the south coast of Efate Island, central Vanuatu. It was found in January 2004 following removal of some of the overlying black ash-rich soil (Layers 1 and 2) by quarrying. Excavations at Teouma were carried out over six field seasons of about 2 months each in 2004–2006 and 2008–2010 under the direction of M.S. and S.B. (Bedford et al. 2006, 2009, 2010; Spriggs and Bedford 2013). Excavations were by trowel, following natural stratigraphic layers, with most material from cultural layers either dry-sieved through 6 mm mesh, but mainly wet-sieved, through 2 mm mesh (Bedford et al. 2009). Some 451 m^2 were excavated in these six field seasons. The materials here were sorted by S.H. from all of the faunal remains, among which vertebrates were characterized by an abundance of fish, land turtle (?*Meiolania damelipi* [White et al. 2010]), fruit bat, and pig bones. Identification to taxon, element, and side was by T.H.W. after comparison with reference skeletal bird specimens. Measurements were made with dial calipers (Tesa) to 0.1 mm as follows: TL, maximum total length; PW, lateromedial proximal width; SW, lateromedial shaft width at midlength; SD, shaft depth at midlength, and DW, maximum distal width. Other specific measurements are identified as appropriate. In the material lists, the data are arranged as follows: catalogue number (excavation area, excavation unit, layer), element. We refer the reader to Bedford et al. (2009, 2010) and Spriggs and Bedford (2013) for details of the excavation.

Abbreviations

INSTITUTIONS: AM, Australian Museum, Sydney; ANWC, Australian National Wildlife Collection, Canberra; NMNZ, Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand; SAM, South Australia Museum; USNM, United States National Museum, Smithsonian Institution, Washington D.C., USA.

ELEMENTS: ant, anterior; cmc, carpometacarpus; cor, coracoid; cran pt, cranial part; hum, humerus; fem, femur; fib, fibula; fur, furcula; juv, juvenile; mand, mandible; pt, part; rad, radius; scap, scapula; stern, sternum; tib, tibiotarsus; tmt, tarsometatarsus; M, male; F, female; L, left; R, right. L and R preceded by p, s, or d indicate the proximal, shaft, or distal part of the element, respectively. MNI (minimum number of individuals) was determined for each taxon from the most frequent skeletal element (maximum of left or right side only) in the total sample from the site. We did not attempt to calculate MNI by layer but indicate for each species whether the samples came from the Lapita midden and cemetery (Layer 3 and the Area 2 extension) and/or the Post-Lapita midden layers (Layer 2 outside the Area 2 extension area). We provide the layer data in the specimen lists and note, when it is relevant, the distribution across layers. NISP, number of individual specimens.

Nomenclature and Comparative Material

We follow the nomenclature and taxonomic order in Dickinson and Remsen (2013). For anatomical terminology we follow Baumel and Witmer (1993), but for columbid coracoids we use the more detailed terminology of Worthy (2012).

The fossils were compared with skeletons of a wide range of bird species in the Australian Museum and South Australia Museum with additional comparisons of taxa from other institutions as necessary. Only the most relevant taxa are listed here, with only the

more important comparative specimens listed (that is, those representing taxa to which specimens are referred, or those with which there might be some confusion [e.g., for the megapodes and columbids given their numerical dominance in the assemblage]). The many more distantly related taxa that live in the geographic region and were examined are not listed (e.g., *Circus approximans*). Several taxa known from Vanuatu were not available for comparison (e.g., *Ducula bakeri*, *Ptilinopus tannensis*, *Macropygia mackinlayi*, and *Todiramphus farquhari*), although congeneric relatives that do live on Efate in Vanuatu were examined for all. This lack has compromised the resolution attainable for taxon identification but does not impact on the perceived diversity of the archaeological fauna. However, to acknowledge this and also problems of attaining certainty in specific identifications from fragmentary remains, we have employed a ranked set of assignments. Full rationales for the attributions are given in notes under the taxon accounts below and include a mix of geographic range and comments on the size of the bird in question (e.g., *D. bakeri* is known only from northern Vanuatu and not from Efate and is larger than *D. pacifica;* thus we refer the *Ducula* bones that do not differ from *D. pacifica* to this species, which is the only one known from Efate). Similarly, we do consider species that are known for adjacent geographic regions when the bones at hand do not differ from the only resident taxon on Efate (e.g., for *Columba*, *C. pallidiceps* from the Solomons was not considered because *C. vitiensis* is the resident taxon on Efate). We list specimens under a species-level heading only if we consider that they are identifiable by specific characters as belonging to that taxon. If a specimen is certainly of a genus, but not certainly of a given species, this is reflected by primary use of a genus name and then attribution of the species preceded by cf. (e.g., *Ptilinopus* sp. cf. *P. greyi*, which means that the specimens listed under such a heading are of the genus *Ptilinopus* and are similar to *P. greyi*). If the familial attribution is possible but a generic one is not, given the preserved features, but the size of the specimen allows tentative attribution to a species because of lack of known alternatives, then we list it with the following form: (e.g., "Columbid sp. ?*Chalcophaps indica*"). Last, we allocate specimens that are identifiable only to a family by size categories using the term "magn." from the Latin *magnitudino* to indicate the approximate size of the bones in question, to better capture the abundance of columbids in the overall assemblage.

Anatidae: *Anas superciliosa* (Pacific Black Duck). Megapodiidae: *Megapodius reinwardt* (Orange-footed Scrubfowl) ANWC O.22869; *Leipoa ocellata* (Malleefowl) SAM B.55458; *Aepypodius arfakianus* (Wattled Brush-turkey) ANWC O.26042; *Talegalla fuscirostris* (Black-billed Talegalla) ANWC O.3669; *T. jobiensis* (Brown-collared Talegalla) ANWC O.7567; *Alectura lathami* (Australian Brush-turkey) SAM B.46568. The fossil megapodes *Progura naracoortensis* van Tets, 1974, and *Progura gallinacea* De Vis, 1888, were also examined and comparisons of *Megavitiornis altirostris* made from data and images in Worthy (2000). Phasianidae: *Gallus gallus* (Red Junglefowl). Columbidae: *Columba leucomela* (White-headed Pigeon), AM O.60058, O.65054; *C. livia* (Rock Dove), AM O.66304, O.71393; *C. vitiensis* (White-throated Pigeon), AM O.7920, O.7921; *Macropygia amboinensis phasianella* (Brown Cuckoo-Dove), AM O.60060, O.70775, O.72437, SAM B.38504; *Alopecoenas beccarii* (Grey-breasted Quail Dove), ANWC 23490; *A. jobiensis* (White-breasted Ground Pigeon), AM O.64818, O.72023, S.345; *A. stairii* (Friendly Ground Dove), NMNZ S.38223; *Gallicolumba luzonica* (Luzon Bleeding-heart), AM S.345; *Caloenas nicobarica* (Nicobar Pigeon), AM O.65178, O.68969; *Didunculus strigirostris* (Tooth-billed Pigeon), AM O.303; *Chalcophaps indica* (Emerald Dove), AM O.56646, O.60006, O.71376, O.71568, S.706, S.746, SAM B.31777, B.37059; *Ducula bicolor* (Australian Pied Imperial-Pigeon), AM O.67627, O.68476; *D. pacifica* (Pacific Pigeon), AM O.7919; *D. spilorrhoa* (Torresian Imperial-Pigeon), AM O.64775; *D. whartoni* (Christmas Island Imperial-Pigeon), AM O.71708; *D. goliath* (New Caledonian Imperial-Pigeon), USNM 561560; *Ptilinopus magnificus* (Wompoo Fruit-Dove), AM O.64892, O.71715; *P. superbus* (Superb Fruit-

Dove), AM O.58248, O.60012, O.72295; *P. regina* (Rose-crowned Fruit-Dove), AM O.56962, O.71153, SAM B.46570; *P. greyii* (Grey's Fruit-Dove), AM S.633. CUCULIDAE: *Cuculus saturatus/C. optatus* (Oriental Cuckoo); *Centropus violaceus*, AM O.60593. RALLIDAE: *Porphyrio melanotus* (South-west Pacific Swamphen); *Gallirallus philippensis* (Banded Rail). ARDEIDAE: *Ardea modesta* (Eastern Great Egret); *Egretta sacra* (Eastern Reef Egret). THRESKIORNITHIDAE: *Threskiornis spinicollis* (Straw-necked Ibis); *Platalea flavipes* (Yellow-billed Spoonbill); *Platalea regia* (Royal Spoonbill). SULIDAE: *Sula leucogaster* (Brown Booby). ACCIPITRIDAE: *Accipiter fasciatus* (Brown Goshawk), AM O.73173. TYTONIDAE: *Tyto delicatula* (Australian Barn Owl). BUCEROTIDAE: *Rhyticeros* (*Aceros*) *plicatus* (Blyth's Hornbill). HALCYONIDAE: *Todiramphus chloris* (Collared Kingfisher); *Todiramphus pyrrhopygius* (Red-backed Kingfisher); *Todiramphus sanctus* (Sacred Kingfisher). PSITTACIDAE: *Eclectus roratus* (Eclectus Parrot); *Cacatua galerita* (Sulphur-crested Cockatoo).

SYSTEMATIC ACCOUNT

Note: For full lists of referred specimens for extant taxa, refer to Appendix; lists of specimens for all taxa that are extinct in Vanuatu are given in the main body of the text.

Order ANSERIFORMES
Family ANATIDAE
Genus *Anas* Linnaeus, 1758

Anas superciliosa J. F. Gmelin, 1789, Pacific Black Duck

MATERIAL: NISP = 14, MNI = 1.

NOTES: This widespread species in Melanesia and Polynesia occupies wetlands and coastal habitats and is common in archaeological faunas (Steadman 2006*a*). At Teouma, it generally occurs in Post-cemetery and Post-Lapita midden layers, with only one bone found from the Lapita cemetery layer.

Order GALLIFORMES
Family MEGAPODIIDAE

The following specimens are referred to Megapodiidae rather than Phasianidae, which is the only other galliform family naturally in Oceania, because they have the following combination of features derived in part from Steadman (1989*b*), Mourer-Chauviré (1992), and Worthy (2000). Tarsometatarsi (Figure 2*E–K*): 1, the eminentia intercotylaris is low and rounded and barely projects proximal to the area intercotylaris; 2, the shaft medial to the sulcus extensorius is very thin; 3, the distal half of the dorsal facies is convex, rather than flat or concave; 4, the fossa metatarsi I is large and deep with its articular facet projecting medial of the shaft. Coracoid (Figure 3*I–L*): 5, no processus procoracoideus; 6, the processus acrocoracoideus is robust and thick between the sulcus supracoracoideus and the impressio ligamentum acrocoracohumeralis (rather than compressed); 7, the processus acrocoracoideus is, in medial view, ovoid, craniosternally longer than dorsoventrally deep (in phasianids, it is deeper dorsoventrally than long, and lenticular in shape because the insertion for the ligamentum acrocoracoacromion is rotated farther sternally and overhangs the sulcus supracoracoideus to a greater extent, and at the same time it is positioned dorsal to, and often separated by a notch from the insertion of ligamentum acrocoraco-procoracoideum); 8, the medial margin of the sulcus supracoracoideus is thickened and rounded rather than compressed and ridgelike; 9, the medial margin of the sternal end that extends proximally from the angulus medialis is thickened and rounded rather than compressed with a ridge. Humerus (Figure 3*A–C*, *F–G*): 10, with crista bicipitalis more elongate and not so projecting ventrally; 11, the depressio insertii m. coracobrachialis caudalis (see Livezey and Zusi [2006], char. 1361), located on the dorsal side of the incisura capitis, indents the crista incisurae capitis distalis and abuts the midpoint of the caput humeri, rather than being separated from caput and bound dorsally by marked tuberculum; 12, the caudal shaft surface is compressed into a ridge (margo caudalis) in the area immediately distad of the crista bicipitalis (lacking in *Gallus*); and 13, the attachment of m. latissimus dorsi is located dorsad of the margo caudalis (rather than ventrad to the ridge as in all other galliforms (Mourer-Chauviré 1992).

Mwalau Worthy, Hawkins, Bedford & Spriggs, n. gen.
(Figures 2, 3)

TYPE SPECIES: *Mwalau walterlinii* Worthy, Hawkins, Bedford & Spriggs, n. sp.

DIAGNOSIS: As for the type and only species.

ETYMOLOGY: "mwalau" is the linguistic reconstruction for the name of megapode-like birds during the Lapita era, when this bird was first encountered and when it became extinct. It comes from the Proto-North Central Vanuatu language, a descendant subgroup of Oceanic Austronesian languages, and the ancestral language for the whole of North and central Vanuatu. Derived from mlau, the name for the incubator bird (megapode) in Efate. Pronounced "moi" (as in French) – lau (as in loud). This noun is treated as the nominative singular and the gender is masculine.

Mwalau walterlinii Worthy, Hawkins, Bedford & Spriggs, n. sp., Lini's Megapode
Figures 2, 3

HOLOTYPE: AM F.138791, L tarsometatarsus, lacking the cotyla lateralis, hypotarsus, and trochlea metatarsi II. Collected by M. Spriggs, S. Bedford, and S. Hawkins et al. on 8 July 2010.

DIAGNOSIS: A megapode distinguished from all other megapode genera by the following combination of character states of the tarsometatarsus: 1, sulcus extensorius deeper than in all except *Megavitiornis*, with two elongate parts to the tuberositas m. tibialis cranialis arising from the floor of the sulcus but not protruding dorsally above the adjacent shaft facies; 2, the dorsal facies mesad of the tuberositas m. tibialis cranialis is convex dorsally; 3, the fossa parahypotarsalis medialis is deep but not broadened proximally, and its medial profile is concave distal to the cotyla; 4, the impression for musculus abductor digiti IV forms a well-marked fossa opposite the fossa metatarsi I on the lateral side of the plantar facies over the distal 1/3 of shaft length, resulting in the shaft depth dorsally adjacent to it being reduced to about 1/3 of midshaft depth; 5, the dorsal facies of metatarsi IV adjacent to the foramen vasculare distale is convex and lacking any sulcus; 6, the area between the foramen vasculare distale and the incisura intertrochlearis lateralis, where it overlies the osseus bridge closing the canalis interosseus distalis, forms a notch relative to the surfaces on either side; 7, the groove dorsally in trochlea metatarsi III is parallel to the shaft axis; and 8, the tarsometatarsus is elongate and slender with proportions similar to that of *Alectura*.

In the genera *Macrocephalon*, *Alectura*, *Talegalla*, *Aepypodius*, *Eulipoa* (fide Steadman 1989*b*), *Megapodius*, *Progura*, and *Leipoa*, the tuberositas m. tibialis cranialis are dorsally prominent, especially in medial view; however, in this feature *Megavitiornis* shares with *Mwalau* a deeper sulcus extensorius in which the tuberositas m. tibialis cranialis is not dorsally protuberant (1). In *Megapodius*, *Progura*, and *Leipoa*, the dorsal facies mesad of tuberositas m. tibialis cranialis is flat or slightly concave dorsally (2). *Megapodius* and *Leipoa* are further differentiated by the fossa parahypotarsalis medialis being broadened proximally and having a convex medial profile distal to cotyla (3). The impression for musculus abductor digiti IV is relatively shallower in *Alectura*, *Talegalla*, *Aepypodius*, and *Megapodius* (4), and these same genera have a distinct sulcus laterally adjacent to the foramen vasculare distale (5). *Megapodius* is further differentiated by lacking a notch between the trochleae and dorsal to the canalis interosseus distalis (6), and most species in this genus, but not *M. reinwardt*, have the trochlea metatarsi III distolaterally oriented relative to the shaft axis (7). *Mwalau* was larger than all extant genera and had no reduction in any pectoral elements, so was probably a volant form. *Megavitiornis* of Fiji is further distinguished by its larger size, markedly broader tarsometatarsus in which the fossa parahypotarsalis lateralis is much reduced, and its flightless attributes including very reduced pectoral elements (Worthy 2000). In addition to the differences listed here, both species of *Progura* from the Quaternary of Australia, although probably volant because of their large pectoral elements, differ from *Mwalau* by larger size. The tarsometatarsi of *Progura naracoortensis*, although considerably shorter than those of *P. gallinacea*, were slightly longer, but

FIGURE 2. Skeletal elements of *Mwalau walterlinii*, n. gen., n. sp., from Teouma, Efate, Vanuatu. Proximal right tibiotarsus AM F.138796 in cranial (*A*), medial (*B*), caudal (*C*), and lateral (*D*) views; left tarsometatarsus, Holotype, AM F.138791 in dorsal (*E*) and plantar (*F*) views; proximal L tarsometatarsus AM F.138789 in plantar (*G*), medial (*H*), proximal (*I*), dorsal (*J*), and lateral (*K*) views (note that distal end is pathologically modified with loss of distal half in life); mandible tip AM F.138788 in lateral (*L*) and dorsal (*M*) views. Scale bars = 20 mm. Abbreviations: **cc**, crista cnemialis cranialis; **cf**, crista fibularis; **fpm**, fossa parahypotarsalis medialis; **iaIV**, impression for m. abductor digiti IV; **iil**, incisura intertrochlearis lateralis; **ilcm**, impressio ligamentum collateralis medialis; **mf**, fossa metatarsi I; **se**, sulcus extensorius; **ttc**, tuberositas m. tibialis cranialis; **TIII**, trochlea metatarsi III.

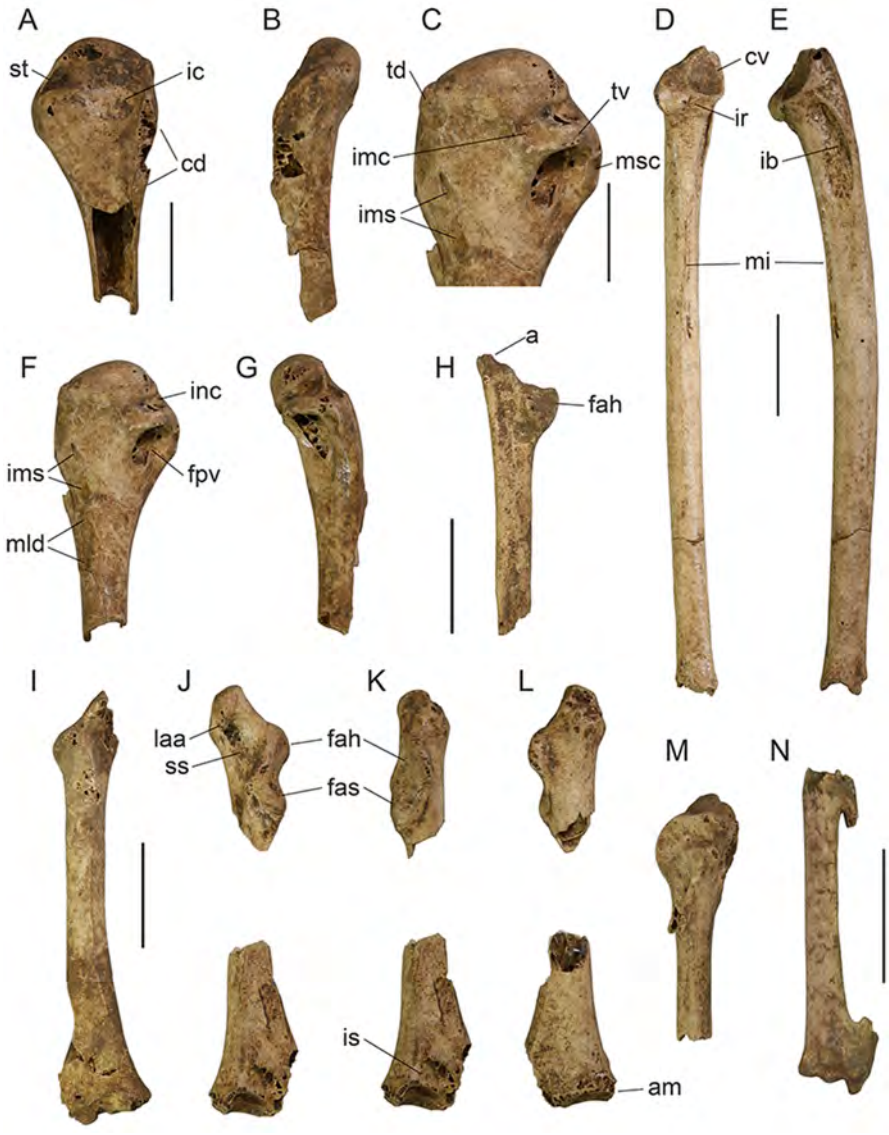

FIGURE 3. Pectoral elements of *Mwalau walterlinii*, n. gen., n. sp., from Teouma, Efate, Vanuatu. Proximal left humerus AM F.138794 in cranial (*A*), dorsal (*B*), caudal (*C*, *F*), and ventral (*G*) views; right ulna AM F.138793 in medial (*D*) and ventral (*E*) views; right scapula AM F.138778 in lateral view (*H*); L coracoid AM F.138777 in dorsal view (*I*); cranial and sternal parts right coracoid AM F.138787 in dorsal (*J*), lateral (for cranial part; dorsal for sternal part) (*K*), and ventral (*L*) views; proximal left carpometacarpus AM F.138772 in ventral view (*M*); shaft and distal end right carpometacarpus AM F.138775 in ventral view (*N*). Scale bars are 20 mm, except *C*, which is 10 mm. Abbreviations: **a**, acromion; **am**, angulus medialis; **cd**, crista deltopectoralis; **cv**, cotyla ventralis; **fah**, facies articularis humeralis; **fas**, facies articularis scapularis; **fpv**, fossa pneumotricipitalis ventralis; **ib**, impressio brachialis; **ic**, impressio coracobrachialis; **imc**, insertii musculi coracobrachialis caudalis; **ims**, impressio musculus supracoracoideus; **inc**, incisura capitis; **ir**, incisura radialis; **is**, impressio musculus sternocoracoidei; **laa**, insertion ligamentum acrocoraco-acromion; **mi**, margo interosseus; **mld**, attachment musculus latissimus dorsi; **msc**, insertion musculus scapulohumeralis caudalis; **ss**, sulcus musculus supracoracoidei; **st**, sulcus ligamentum transversus; **td**, tuberculum dorsale; **tv**, tuberculum ventrale.

more robust and relatively much broader both proximally and distally, than those of *Mwalau*.

ETYMOLOGY: Named after Vanuatu's first Prime Minister, the late Father Walter Lini (1942–1999), with permission of the family, to celebrate the independence of Vanuatu and for his crucial support of the Vanuatu Cultural Centre and his role in establishing a respect for traditional culture in Vanuatu.

TYPE LOCALITY: Teouma Site, Efate Island, Vanuatu.

STRATIGRAPHY/AGE: From excavation Area 2 extension, Unit D17, Layer 2; Lapita-age midden.

MEASUREMENTS OF HOLOTYPE (MM): Total length 102.1, midshaft width 8.6, midshaft depth 5.6, depth of trochlea metatarsi III 9.5.

PARATYPES: AM F.138787, (2 ext, C20, L2), 2 pts R cor; AM F.138789, (2 ext, D20, L2), pR tmt (NB: the distal part of this bone was lost pathologically); AM F.138792, (2 ext, D17, L2), s+pR ulna; AM F.138793, (2 ext, C16, L2), R ulna; AM F.138794, (2 ext, C16, L2), pL hum.

REFERRED MATERIAL: AM F.138780, (2, F10, L1), sL tmt; F.138768, (2 ext, A18, L3), pL rad; F.138769, (2 ext, B15, L2/3.1), pt L cor; F.138770, (2 ext, B15, L2/3.1), R MII.1; F.138771, (2 ext, B15, L2/3.1), sL fem; F.138772, (2 ext, A17, L3), pL cmc; F.138773, (2 ext, B19, L3.1), dL tib; F.138774, (2 ext, A17, L3.1), pt R scap; F.138775, (2 ext, B15, L2/3), R (-p) cmc; F.138777, (2 ext, B16, L3.1–3.2), L cor; F.138778, (2 ext, B16, L3.1–3.2), R scap; F.138779, (2 ext, B16, L3.1–3.2), pt mand; F.138776, (2 ext, B15, L3.2), dL rad; F.138781, (2 ext, C17, L3), mand tip; F.138782, (2 ext, C15, L2), sLdL tib, sLsRdR ulna, pt dL tmt, frag; F.138783, (2 ext, C19, L2), dL tib; F.138784, (2 ext, E15, L2), dL tmt; F.138785, 2 ext, I16, L3, sL ulna; F.138786, (2 ext, C17, L2), vert; F.138788, (2 ext, C20, L3), ant mand; F.138790, (2 ext, C19, L3), sL hum; F.138795, (2 ext, C16, L2), s tib, L scap; F.138796, (2 ext, C16, L2/3), pR tib; F.138797, (2 ext, C16, L2/3), R scap, pL tmt, cran pts LR cor; F.138798, (2 ext, G14, L2), R quad; F.138799, (2 ext, I12, L2), cran frag R cor; F.138800, (2 ext, E11, L3), d+sR tib; F.138801, (2 ext, A20, L2), dR tmt, s cmc; F.138802, (2 ext, G16, L2), cran pt L cor.

With type material, total NISP = 45, MNI = 3. All bones of this species are found in the Lapita midden layers at the site, in the Area 2 extension and adjacent squares of Area 2.

DESCRIPTION AND COMPARISON: In addition to the diagnostic features described here, *Mwalau walterlinii* has the following features.

Mandible: AM F.138779 includes the cotylae of the left side of the mandible: the retroarticular process and processus medialis are both broken from it as is the region anterior to the tuberculum pseudotemporale. The lateral side of the condylus lateralis is evenly rounded and robust. Height at the tuberculum pseudotemporale is 8.1 mm compared with 3.3 mm in *Leipoa ocellata* SAM B.11482. Two anterior mandibular symphyseal fragments (Figure 2*L–M:* AM F.138781 and F.138788) are present, whose measurements (AM F.138788, height of the os dentale immediately distal to the symphysis of 9.7 mm, symphyseal length 15.5 mm, width at caudal end of the symphysis 13.0 mm; AM F.138781, symphyseal length 16.2 mm, width at caudal end of the symphysis 14.0 mm) are of appropriate size for the caudal fragment AM F.138779.

Quadrate: AM F.138798 has a worn right quadrate with a height (capitulum to condylus lateralis) of 16 mm compared with 10.6 mm in *Leipoa ocellata* SAM B.11482. The medial foramen pneumaticum rostromediale (see Elzanowski and Stidham [2011]) is barely preceded by a groove on the processus oticus and penetrates the corpus below half of quadrate height. This foramen is continuous with the foramen pneumaticum basiorbitale, as shown by a solid rounded margin proximally beside which a sulcus opens both dorsally and ventrally, even though the caudal margin of the foramen was lost with part of the condylus medialis. In contrast, in *Leipoa*, *Alectura*, and *Megapodius* the foramen pneumaticum rostromediale is preceded dorsally by a marked groove and penetrates the corpus at about midheight and is separated dorsally from the foramen pneumaticum basiorbitale by an

osseous bridge over the underlying canal. Caudally there is no depressio caudomedialis below the capituli, nor a foramen, and it is similar to *Alectura* in this, whereas in *Leipoa* and *Megapodius* there is a marked dorsoventrally elongate depressio caudomedialis.

Humerus (Figure 3*A–C*, *F–G*): Only one proximal fragment and a shaft section are available to reveal humeral structure. In addition to familial diagnostic features 10–13, the impressio musculus supracoracoideus forms an oval scar (10.5 mm long by 5.0 mm wide) extending distocranially from a slightly dorsally prominent tuberculum dorsale. This impression is much more ovoid and, relative to the crista deltopectoralis, much shorter than it is in *Leipoa*, *Alectura*, *Megapodius*, or *Progura*. The insertii m. coracobrachialis caudalis forms a marked sulcus at the dorsal side of the incisura capitis as in all megapodes. The proximal rim of the fossa pneumotricipitalis ventralis projects caudally of the depressio insertii m. coracobrachialis caudalis forming a low tuberculum ventrale. The ventral rim of the crista bicipitalis has, at about the midproximodistal point of the fossa pneumotricipitalis ventralis, a large ovoid scar for the insertion of the m. scapulohumeralis caudalis (m. dorsalis scapulae) (see Hiroshige and Yoshikazu 2007), whose distal margin is elevated on the crista bicipitalis, as seen in other megapodes. The fossa pneumotricipitalis ventralis is shallow, highly pneumatic, and oval. The crista deltopectoralis is 28.5 mm long, but its height cannot be determined because its cranial margin is broken. A shallow and distally poorly emarginated impressio coracobrachialis extends adjacent to the proximal 1/3 of the crista and spreads over half the width of the cranial facies. The sulcus ligamentum transversus is about 10 mm long, broad adjacent to the caput, and narrowing ventrally, and unlike *Megapodius*, *Leipoa*, or *Alectura*, but as in *Progura*, does not extend to the ventral margin. Instead, the intumescentia humeri is connected via a curved facies 4 mm wide to the proximal side of the tuberculum ventrale. The attachment of m. latissimus dorsi is 15 mm long and is located immediately dorsad of the margo caudalis and because it is impressed helps create the margo caudalis. The margo caudalis is, however, weakly formed, less so than in *Leipoa* and *Progura*, due in part to the shaft ventral to it being inflated and convex, rather than flattened or slightly concave as it is in *Leipoa* and *Alectura*. Measurements: AM F.138794, PW = 26.4 mm; length to distal side of crista deltopectoralis 35 mm; craniocaudal depth caput 12.5 mm; AM F.138790, dorsoventral SW = 10.8 mm, craniocaudal SD = 8.8 mm.

Ulna (Figure 3*D–E*): The ulna AM F.138793 preserves near total length, as the preserved base of the tuberculum carpale indicates that just the length distad of this point is missing. A total length of between 135 and 137 mm is estimated for this specimen, PW = 14 mm, SW = 6.5 mm, SD = 8.8 mm. The length and the slender proportions of this bone indicate that this bird was volant. The impressio brachialis is deep and strongly emarginated caudally in both AM F.138793 and AM F.138792. This impressio is much deeper than it is in *Progura*, *Leipoa*, *Alectura*, and *Megapodius*. The incisura radialis is weakly formed, with the insertion points of m. biceps brachii forming an elongate and low tuberculum bicipitale ulnae extending from a distinct elevation adjacent to the cotyla ventralis across the cranial facies to a point immediately distad of the processus cotylaris dorsalis. The margo interosseus has a crest extending from the end of the impressio brachialis distally to about the nutrient foramen, as usual in megapodes. A total of nine low papillae remigales caudales is present. Distally, as revealed by a distal right ulna in AM F.138782, the condylus dorsalis ulnaris is shorter (9.6 mm) than wide (11.5 mm), resulting in a symmetrical and rounded distal profile, more so than in *Leipoa*.

Radius: Two fragments of radii are preserved. AM F.138776 shows the distal width to be 10 mm.

Distal Wing Elements: Two fragments of carpometacarpi (Figure 3*M–N*) (AM F.138772 and F.138775) indicate a total length of ca. 65 mm for this element and a shape very similar to that in *Leipoa*. A single proximal phalanx of the major digit (manual digit II.1) is missing its proximal articular surface but has an estimated length of 22 mm and width of 9.5 mm.

Coracoid (Figure 3*I–L*): The most informative coracoid remains are AM F.138777, with a near complete left element missing much of the acrocoracoid including the facies articularis clavicularis and, distally, the processus lateralis, and AM F.138787, with two parts of a right coracoid, cranially perfect but missing a section of shaft and the processus lateralis. In addition to points 5–9 described earlier under familial features, the following observations can be made. In overall form, the coracoid is like an enlarged version of that in *Alectura* although the narrowest shaft width is about midlength, not more cranial. Thus it has a more elongate shaft than that of *Leipoa* and is relatively much more gracile than the coracoid of *Progura*, which is only slightly longer.

At the cranial end, the acrocoracoid is deeper than lateromedially wide, and in medial view the facies articularis clavicularis is oval and craniosternally elongate. In *Leipoa*, *Alectura*, *Megapodius*, and especially *Progura*, the facies articularis clavicularis is broader dorsoventrally than long. The insertion for the ligamentum acrocoraco-acromion is prominent but only slightly overhangs the sulcus m. supracoracoidei, doing so to a much lesser extent than in *Leipoa*, *Alectura*, and *Megapodius*. *Progura* has a far greater development of the insertion for the ligamentum acrocoraco-acromion so that it greatly overhangs the sulcus. The facies articularis clavicularis is slightly convex and is only slightly notched along its sternoventrally angled sternal margin. The lack of a marked notch is because ventrally the insertion of ligamentum acrocoraco-procoracoideum is poorly developed and only slightly prominent medially of the shaft. The sulcus m. supracoracoidei is shallow and not excavated deeply against the facies articularis humeralis and contains a limited area of pneumatic foramina that penetrate the acrocoracoid below the insertion for the ligamentum acrocoraco-acromion. Similar pneumatism of the sulcus was not seen in *Leipoa*, *Progura*, and *Alectura;* however, pneumatic foramina were observed in *Megapodius*. The facies articularis humeralis is notably concave along its length and cranially forms a marked flange projecting mesad of the shaft. At its sternal end, the facies articularis humeralis is continuous with the facies articularis scapularis: the term cotyla is not pertinent because the articular facet is dorsally convex both across its breadth and along its length, not concave. It is aligned transversely at about 45 degrees to the shaft axis as is usual in galliforms. Craniomedially, this articular facet is elevated above and slightly overhangs the sulcus m. supracoracoidei.

The impressio m. sternocoracoidei is not appreciably deepened as typifies megapodes and contains pneumatic foramina near the facies articularis sternalis. The pneumatic foramen is small, however, relatively much smaller than in *Progura* coracoids. The facies articularis sternalis is like that on an enlarged *Alectura* coracoid, being craniosternally broad and bound cranially by a marked crest, with the dorsal facies continuous over a thickened end to a broad ventral facet. Measurements: AM F.138777, length angulus medialis to sternal side facies articularis scapularis 56.7 mm, length sternal side facies articularis scapularis to cranial side facies articularis humeralis 17.4 mm, depth at facies articularis scapularis 8.7 mm, SW = 7.2 mm, depth of sternal end 6.9 mm; AM F.138787, length sternal side facies articularis scapularis to end of acrocoracoid 27.6 mm, dorsoventral depth of acrocoracoid in medial view at right angles to ventral shaft facies 10.7 mm, length sternal side facies articularis scapularis to cranial side facies articularis humeralis 19.1 mm, depth at facies articularis scapularis 11.2 mm, depth of sternal end 7.9 mm.

Scapula (Figure 3*H*): The right scapula in AM F.138778 is the best-preserved example of this element, but it does not preserve the distal half, including all of the part bearing a crest on the margo dorsalis. Ventrally, on the costal facies there is a prominent tubercle as seen in *Alectura*. The facies articularis humeralis is ovoid and craniocaudally elongate, more so than in *Leipoa*. As in *Leipoa*, *Alectura*, and *Megapodius*, it has a large pneumatic foramen penetrating the corpus from the ventral margin just caudal to the facies articularis humeralis. The lateral facies dorsal to the facies articularis humeralis has a shallow sulcus

aligned along the collum. The acromion is more robust than in extant megapodes and like them is directed medially, but breakage of its tip precludes assessing the extent of the overhang of the medial facies.

Femur: The single femur fragment is a shaft: SW = 9.6 mm, SD = 9.2 mm.

Tibiotarsus (Figure 2*A–D*): The tibiotarsi of *Mwalau walterlinii* are represented by fragmentary remains in part due to their lightly constructed nature. One proximal fragment (AM F.138796) is missing the crista cnemialis lateralis but is otherwise complete. The crista cnemialis cranialis projects only ~2 mm above the area interarticularis and anteriorly about 7 mm, and it extends only a short distance distally along the shaft. The anterior profile of this crista is concave, unlike the more elongate and anteriorly convex crista in *Leipoa* and *Megapodius*. As in all megapodes, the impressio ligamentum collateralis medialis is marked and extends down the shaft opposite and overlapping distally about half the length of the crista fibularis. The incisura intercondylaris occupies about 1/3 of the distal width and is incised 4 mm below the anterior margin of the condylus lateralis. The epicondylus medialis is prominent medially in anterior view. The distal end is represented by three fragments of which AM F.138783 is the most complete. In combination, the shaft fragment in AM F.138782 and the proximal fragment AM F.138796 indicates a tibiotarsus proportioned similar to that in *Alectura*, that is, relatively elongate and about 145 mm long. Measurements: AM F.138773, SW = 8.9, DW = ca. 16.0, depth lateral condyle = 16.0 mm; AM F.138796, PW articular surface 16.5 mm, proximal depth from between cristae cnemialis to caudal side articular facies 21.0 mm, SW = 8.5; AM F.138783, DW = 16.2, depth medial condyle 16.9 mm, depth lateral condyle 16.4 mm; AM F.138782, DW = 16.4, SW = 7.8.

Tarsometatarsus (Figure 2*E–K*): The tarsometatarsus at ca. 102 mm long is longer than those of all megapodes except *Progura gallinacea* and *Megavitiornis altirostris*. Its proportions are most similar to those of *Alectura*, with *Aepypodius* having a noticeably more slender shaft and *Leipoa* being rather stouter. The facies articularis metatarsal I within fossa metatarsi I is ovoid in outline, as in *Leipoa* and *Megapodius*, but it is more circular in remaining taxa. The fossa supratrochlearis plantaris is broad and shallow, as in *Megapodius*, *Leipoa*, and *Progura*, but it is deeper or more concave in *Alectura*, *Talegalla*, and *Aepypodius* because they have greater plantar rotation of trochlea metatarsi II. The foramen vasculare distale is large, similar to the state in *Megapodius* and *Megavitiornis*, but it is relatively smaller in *Alectura*, *Talegalla*, *Aepypodius*, and *Progura*. No specimen preserves the hypotarsus.

In summary, *Mwalau walterlinii* was a larger megapode than any extant taxon but had proportions most similar to those of *Alectura*. Its relatively large pectoral elements and lightly built legs indicate that this bird could certainly fly as well as *Alectura*.

Genus *Megapodius* Gaimard, 1823

NOTES: Megapodes or scrubfowl of the genus *Megapodius* are widely distributed through Indonesia, Melanesia, and into western Polynesia and include a large number of taxa that have variously been treated as subspecies or species. Mayr (1938) subsumed many taxa into the *M. freycinet* complex, accepting just three *Megapodius* species, but White and Bruce (1986), followed and expanded by Jones et al. (1995), resurrected many taxa to specific status, so that now 13 species are recognized (Dickinson and Remsen 2013). Most of these species have a size range that broadly overlaps all others, except that of *M. pritchardi*, and differ mainly in small details of plumage (Jones et al. 1995). In Vanuatu, the genus is only represented by *M. layardi*, whose type locality is Efate, and which occurs on most islands in the northern and central part of the archipelago (Jones et al. 1995). Although we did not have access to this species, T.H.W. had direct access to skeletons of the very similar *M. reinwardt*, a species distributed from western Indonesia to northern Australia, and has examined material of *M. eremita*, *M. amissus*, and *M. alimentum* in the past. *Megapodius* is easily distinguished from other megapode genera by numerous features

listed earlier under the Diagnosis for *Mwalau walterlinii* and as listed in Worthy (2000). The only significant difference that could be detected between the Efate bones and those of *M. reinwardt* was that the trochlea metatarsi III is angled distolaterally, whereas in the latter species it is aligned parallel to the shaft axis. The Vanuatu bones are thus like those of *M. eremita*, *M. amissus*, and *M. alimentum*, which are the geographical proximate forms to the northwest and east of Vanuatu (see Worthy 2000: fig. 2). To the south of Vanuatu in New Caledonia, the tarsometatarsus of the extinct *M. molistructor* is larger than it is in all other *Megapodius* species (Balouet and Olson 1989, Worthy 2000), but the described bones of this species did not preserve the trochlea metatarsi III.

Megapodius layardi Tristram, 1879, Vanuatu Megapode

MATERIAL: NISP = 161, MNI = 15 (coracoid most abundant element).

Megapodius ?*layardi* Tristram, 1879, Vanuatu Megapode

MATERIAL: NISP = 8.

NOTES: Although the specimens were not compared directly with examples of *M. layardi*, they are very similar to *Megapodius reinwardt*, ANWC 22869, a specimen from Darwin in Australia. Summary data for tarsus length of *M. layardi* (mean 75.1 mm, range 69.0–80.2 mm) show that it overlaps broadly in size with *M. reinwardt*, which has tarsi lengths ranging from 63 to 78.8 mm, with mean lengths in northern Australian forms of 73–74 mm (Jones et al. 1995). The measurements for the Efate bones (Table 1) are within the range expected from the external measurements given by Jones et al. (1995) and do not encompass a variation outside of what would be expected for a single taxon. The fragmented nature of these specimens attributed to *Megapodius* ?*layardi* precludes a certain identification; however they match *Megapodius* bones better than *Gallus* bones.

Steadman (2006*a*:290–291, tables 5-12, 9-2) reported *Megapodius layardi* from archaeological sites on Malakula (Woplamplam, three bones) and Efate (Mangaasi, one bone) and an undescribed species (Species C, Arapus Site, Efate, one bone). The undescribed taxon was stated to be similar to, but larger than, *M. alimentum*. However, because this Fijian species is smaller than *M. reinwardt*, and *M. layardi* has a maximum size exceeding that of *M. reinwardt* (see Jones et al. 1995), it is likely that the Efate bone referred to "species C" by Steadman (2006*a*) may be just a larger example of *M. layardi*, because our larger sample gives no indication of a third taxon, and the new species described earlier is much larger than *M. alimentum*.

These specimens derive from both the Lapita midden area and the Post-Lapita midden. The species still occurs on Efate so an occurrence in the younger strata at the site is not unexpected.

Family PHASIANIDAE
Genus *Gallus* Brisson, 1760

Gallus gallus (Linnaeus, 1758), Red Junglefowl

MATERIAL: NISP = 305, MNI = 27 (by coracoids).

cf. *Gallus gallus* (Linnaeus, 1758), Red Junglefowl

MATERIAL: NISP = 34; these specimens do not add to the MNI for *Gallus*.

NOTES: This is a common species especially in later archaeological sites in Oceania. Specimens are found both in the Lapita midden area and in Post-Lapita midden deposits, showing the early spread of *Gallus* into Oceania.

Order COLUMBIFORMES
Family COLUMBIDAE

The columbid bones in the Efate assemblage can be separated into three broad size classes: small taxa (*Macropygia*, *Chalcophaps*, *Ptilinopus*, and *Gallicolumba*), median-sized taxa (*Columba vitiensis*, *Ducula pacifica*, and *Didunculus*), and large taxa (*Ducula* sp. cf. *D. goliath*). Some elements (e.g., the coracoid and tarsometatarsus) are more diagnostic of

TABLE 1

Summary Statistics of Measurements (mm) for Selected Elements of *Megapodius layardi* from Teouma, Efate

Tibia	TL	PW	SW	SD	DW	Depth Lateral Condyle	Depth Medial Condyle
Mean		13.1	6.4	5.4	11.8	9.9	10.7
Standard Deviation		0.55	0.53	0.44	0.32	0.41	0.56
Minimum	111.4	12.6	5.5	5.1	11.5	9.4	10.0
Maximum		13.7	7.4	6.3	12.3	10.4	11.2
Count	1	3	8	7	6	4	4

Tarsometatarsi	TL	PW	PD	SW	SD	DW
Mean	76.0	13.6	13.4	5.9	4.1	
Standard Deviation	3.15	0.32	0.72	0.38	0.31	
Minimum	73.0	13.3	12.7	5.2	3.7	14.8
Maximum	80.0	14.2	14.3	6.4	4.8	15.0
Count	4	6	4	20	18	2

Coracoid	Medial Length	Length Acrocoracoid-Cotyla Scapularis	Length Facies Humeralis-Cotyla Scapularis	SW	SD
Mean		15.8	11.1	4.5	4.5
Standard Deviation		0.75	0.58	0.33	0.39
Minimum	48.8	14.5	10.1	3.9	4.0
Maximum	49.6	17.1	12.1	5.1	5.1
Count	2	14	17	14	11

	Humerus SW	Humerus SD	Humerus DW	Cmc Length	Cmc PW
Mean	7.1	5.8			12.6
Standard Deviation	0.39	0.35			1.05
Minimum	6.7	5.5	15.0	47.8	11.95
Maximum	7.7	6.3	16.5		13.8
Count	6	6	2	1	3

Ulna	TL	PW	SW	SD	DW
Mean			4.2	5.5	
Standard Deviation			0.23	0.12	
Minimum	81.7	8.7	3.9	5.6	9.1
Maximum		9.1	4.5	5.7	
Count	1	2	6	6	1

Note: If less than three measurements were available, mean values are not presented.

columbid taxa, and given the abundance of coracoids in the assemblage these are most significant for determining MNI. Diagnostic characters of the coracoids are discussed in detail by Worthy (2012) for most genera. As detailed in Materials and Methods, taxa are referred with varying certainty to taxa.

Genus *Columba* Linnaeus, 1758

NOTES: This genus is represented by *Columba vitiensis* in Vanuatu, a species that is widely distributed from the Philippines through Melanesia east to Fiji and south to Lord Howe Island (Dickinson and Remsen 2013). In Vanuatu, an endemic form, *Columba v. leopoldi*, is recognized, and our referral of bones to this species followed comparisons with two reference specimens, AM O.7920 and O.7921, from Erromango Island in Vanuatu, which were a good match for the Teouma specimens.

Columba vitiensis Quoy & Gaimard, 1830, White-throated Pigeon

MATERIAL: NISP = 44, MNI = 7 (by coracoids).

Columbid sp. ?*Columba vitiensis*, White-throated Pigeon

MATERIAL: NISP = 26, potentially adds MNI of 4 to *Columba vitiensis*.

NOTES: In this fauna, *Columba vitiensis* can only be confused with the slightly larger *Ducula pacifica* or *Didunculus placopedetes* described later in this article because other columbids are either significantly smaller or, for *D. goliath*, larger. It is easily distinguished, however, on the major skeletal elements with features as described in Worthy (2001), Worthy and Wragg (2003, 2008), and Wragg and Worthy (2006). Significantly, the coracoid, a robust element that dictates the MNI in this sample, is easily identified by a combination of several features: in terminology of Worthy (2012), tuberculum A is large, abruptly and greatly overhangs the sulcus m. supracoracoidei, and is narrowly separated from the impressio ligamentum acrocoracoacromion (ilaa) on the dorsal side of the facies articularis clavicularis; the ilaa is weakly protuberant sternally and separated by a notch from the impressio ligamentum acrocoracoprocoracoideum ventrally, which forms a well-developed sternally directed projection over the sulcus m. supracoracoidei; the sulcus lacks pneumatic foramina; the processus procoracoideus arises over a relatively short length of the shaft and the sternal half of that length is relatively gracile. The tibiotarsus and especially the tarsometatarsus are relatively shorter than in *Ducula pacifica*, and the latter element has relatively closer and smaller foramina vascularia proximalia, with the lateral one being nearly closed. On the sternum, the spina interna rostri converges to a narrow tip, giving a triangular profile in ventral view, a useful feature because anterior sternal fragments are virtually all that have survived of sterni in the fauna. At Teouma specimens come from both the Lapita and Post-Lapita midden layers.

Genus *Macropygia* Swainson, 1837

Material was referred to *Macropygia* by general similarity of form and size compared with specimens of *M. amboinensis* (AM O.60066, SAM B.38504), and by presence of the following features: coracoid (using the terminology of Worthy [2012]) is more elongate than it is in *Chalcophaps* or *Ptilinopus;* the tuberculum A (not equivalent to tuberculum brachiale of Baumel and Witmer [1993], which is defined therein as for the attachment of the acrocoraco-acromial ligament) is much less inflated dorsally than it is in *Chalcophaps* and is very narrowly separated from the impressio ligamentum acrocoracoacromion (ilaa) without an intervening groove; the ilaa is dorsally protuberant; there is a marked notch between the ilaa and the impressio ligamentum acrocoracoprocoracoideum (ilap) on the sternal margin of the facies articularis clavicularis. The humerus lacks a caudal projection at the distal side of the caput humeri at the dorsal side of the incisura capitis.

Macropygia sp. ?*M. mackinlayi* E. P. Ramsay, 1878, Mackinlay's Cuckoo-Dove

MATERIAL: NISP = 9, MNI = 1.

NOTES: *Macropygia mackinlayi* is widespread in western Oceania, from the Admiralty Islands through the Solomons to Vanuatu (Dickinson and Remsen 2013).We did not have examples of this taxon available to us but were able to compare the fossils with Australian *M. amboinensis* (sometimes known as *M. phasianella*). *Macropygia mackinlayi* is a larger bird than either *Ptilinopus greyi*, the known *Gallicolumba* species on Vanuatu, or *Chalcophaps indica* but considerably smaller than the next largest taxon known to be present, *Columba vitiensis*, and so similarity to *M. amboinensis* and size was the basis for allocation of these specimens. Specimens are found both in the Lapita and Post-Lapita midden at Teouma.

Genus *Alopecoenas* Sharpe, 1899

NOTES: Following recent molecular analyses of the ground doves that revealed that the genus *Gallicolumba* sensu Dickinson (2003) was paraphyletic (Jønsson et al. 2011), it has been separated into *Gallicolumba* for the Bleeding-hearted doves and relatives and *Alo-*

pecoenas for the ground doves, including all those east of Papua New Guinea (Dickinson and Remsen 2013).

Several *Alopecoenas* species are found in Melanesia, with *A. jobiensis* and *A. beccarii* found from Papua New Guinea to the Solomons and *A. sanctaecrucis* in Santa Cruz Islands and Vanuatu (Dickinson and Remsen 2013). The following specimens were compared with *Alopecoenas jobiensis*, *A. beccarii*, *A. stairi*, and *Gallicolumba luzonica*. Material was referred to *Alopecoenas* by general similarity of form to the compared taxa, including the following features: coracoid (in terminology of Worthy [2012]): tuberculum A large, separated but not by a groove from ilaa on the facies articularis clavicularis; ilaa little prominent dorsally (less in *A. beccarii*), so facies articularis clavicularis is convex; sulcus m. supracoracoidei not pneumatic under facies articularis clavicularis, but a small pneumatic foramen penetrates the base of tuberculum A; ilap forms large sternally directed prominence, but this prominence is restricted to the ventral part of the facies, so the sulcus m. supracoracoidei merges smoothly with the facies articularis clavicularis at its middepth (i.e., there is no crest overhanging the sulcus running continuously from ilaa to ilap); the impressio m. sternocoracoidei is large and medially located and does not extend greatly laterally, being well separated from processus lateralis, where a distinct pneumatic sulcus is either small or absent. *Gallicolumba luzonica* lacks a foramen below tuberculum A and has a more pneumatized and larger pneumatic impressio m. sternocoracoidei.

Alopecoenas sp. undetermined ground dove

MATERIAL: NISP = 12, MNI = 6.

NOTES: All specimens indicate a bird similar in size to *A. stairi* as indicated by a large sample of that taxon from Vatulele in Fiji (Worthy and Anderson 2009, MNZ S38223) except for AM F.138275, which was from a rather larger bird. *Alopecoenas stairi* is on average a slightly larger bird than *A. sanctaecrucis* (data in Goodwin [1967]), thus all specimens except AM F.138275 probably derive from the same taxon, which is probably *A. sanctaecrucis* based on geographic expectation. All specimens were derived from the Lapita midden or cemetery.

Genus *Didunculus* Peale, 1848

NOTES: The tooth-billed pigeon *Didunculus strigirostris* is a large colorful pigeon, notable for its stout, hooked bill with a hooked gonys, that historically was restricted to the islands of Savai'i, Upolu, and Nu'utele in Western Samoa (Steadman 2006*a*, *c*). A second species, *Didunculus placopedetes* Steadman, 2006, is known from Late Holocene fossil deposits on 'Eua and Tongatapu in the Kingdom of Tonga (Steadman 2006*c*). The fossil species *Bountyphaps obsoleta* Worthy & Wragg, 2008, from Henderson Island was suggested after initial comparisons to be most closely related to *Didunculus* and *Caloenas* (see Worthy and Wragg [2008]) although it lacks major features of *Didunculus*, such as the elongate origin of the processus procoracoideus on the coracoid shaft. This distribution suggests that *Didunculus* and its near relatives once had a much broader distribution in the Pacific, in contrast to its current restricted distribution of one relict species in Samoa.

The Teouma material was compared with a wide range of columbids likely to be present in the region (see Nomenclature and Comparative Material) and identified as *Didunculus* after detailed comparisons with the skeletal specimen AM S.303 and skeletons of the similar-sized *Columba vitiensis* and *Ducula pacifica*. Detailed comparisons were also made with *Caloenas nicobarica* because a larger extinct form in this genus, *C. canacorum*, is known from New Caledonia and Tonga (Balouet and Olson 1989, Steadman 1989*b*) and so might be expected in Vanuatu (Steadman 2006*a*), and this genus is most similar along with *Bountyphaps* to *Didunculus* (Worthy and Wragg 2008). The Vanuatu bones listed here are differentiated from *Caloenas* and referred to *Didunculus* by the following traits shared with *D. strigirostris* adapted from and enlarged upon those given in Worthy (2001), Steadman (2006*c*), and Worthy and Wragg (2008).

Humerus (Figure 4*A–D*): The caudodistal part of the caput humeri exhibits a distinct elevation adjacent to the caudal exit of the incisura capitis (much lower in *Caloenas*);

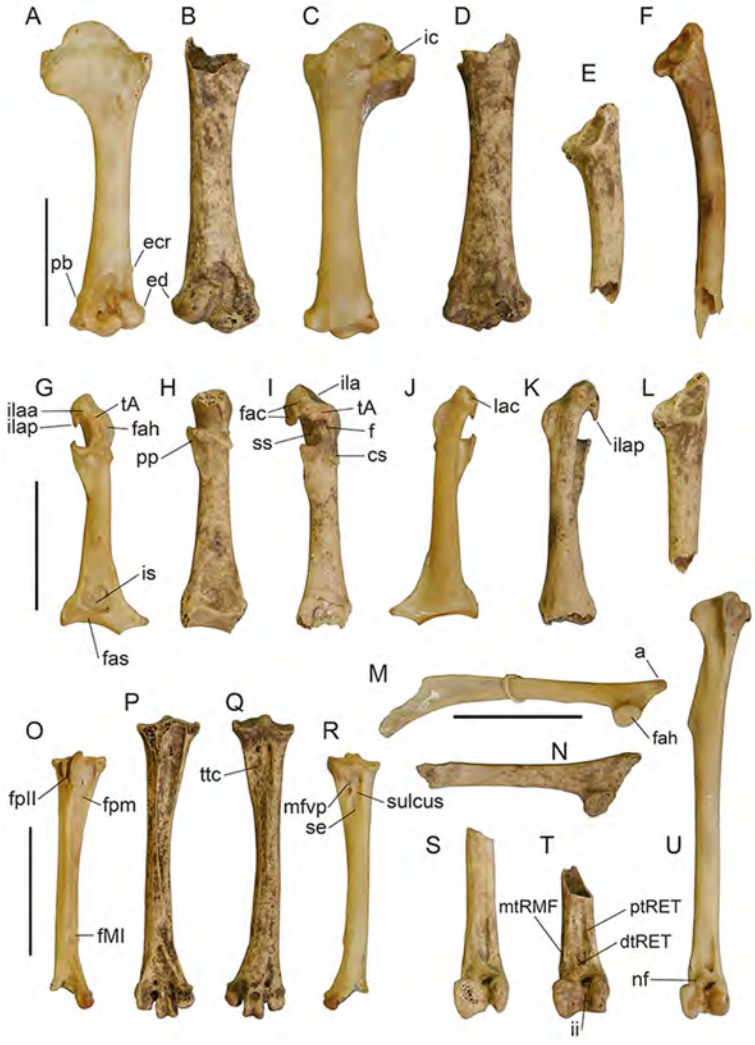

FIGURE 4. Selected bones of *Didunculus* species. *Didunculus strigirostris* AM S.303: left humerus in cranial (*A*) and caudal (*C*) views; right ulna in ventral view (*F*); right coracoid in dorsal (*G*) and ventral (*J*) views; right scapula in lateral view (*M*); left tarsometatarsus in plantar (*O*) and dorsal (*R*) views; right tibiotarsus in cranial view (*U*). *Didunculus placopedetes* from Teouma, Efate, Vanuatu: distal and shaft right humerus AM F.138742 in cranial (*B*) and caudal (*D*) views; proximal right ulna AM F.138751 in ventral (*E*) and medial (*L*) view; right coracoid AM F.138735 in dorsal view (*H*); right coracoid AM F138723 in dorsal (*I*) and ventral (*K*) views; right scapula AM F.138726 in lateral (*N*) view; left tarsometatarsus AM F.138761 in plantar (*P*) and dorsal (*Q*) views; distal right tibiotarsus AM F.138753 (*S*) and AM F.138733 (*T*) in cranial view. Scale bars are 20 mm. Abbreviations: **a**, acromion; **cs**, cotyla scapularis; **dtRET**, distal attachment retinaculum extensorium tibiotarsi; **ecr**, impression m. extensor carpi radialis; **ed**, epicondylaris dorsalis; **f**, fossa; **fac**, facies articularis clavicularis; **fah**, facies articularis humeralis; **fas**, facies articularis sternalis; **fpm**, fossa parahypotarsalis medialis; **fpII**, tendons for m. flexor perforatus digiti II and m. flexor perforans et perforatus digiti II; **fMI**, fossa metatarsi I; **ic**, incisura capitis; **ii**, incisura intercondylarus; **ila**, insertion for ligamentum acrocoraco-claviculare superficiale; **ilaa**, impressio ligamentum acrocoraco-acromion; **ilap**, impressio ligamentum acrocoraco-procoracoideum; **is**, impressio m. sternocoracoidei; **lac**, impressio lig. acrocoracohumeralis; **mfvp**, medial foramen vasculare proximale; **mtRMF**, tuberculum retinaculum m. fibularis medialis; **nf**, nutrient foramen; **pb**, attachment for pronator brevis; **pp**, processus procoracoideus; **ptRET**, proximal attachment retinaculum extensorium tibiotarsi; **se**, sulcus extensorius; **ss**, sulcus m. supracoracoidei; **tA**, tuberculum A; **ttc**, tuberculum m. tibialis cranialis.

the epicondylaris dorsalis projects markedly dorsally, creating an angular profile in cranial view (in *Caloenas*, much less so); the attachment of the pronator brevis overlaps in the proximodistal plane the facet of the tuberculum supracondylare ventrale but is more proximal in *Caloenas;* the impression of the ventral head of origin for m. extensor carpi radialis (see Worthy et al. 2011) is located proximad of the fossa m. brachialis unlike, for example, *Ducula* where it is distad of the proximal margin of the fossa brachialis.

Coracoids (Figure 4*G–K*): Here we follow the terminology of Worthy (2012). The processus procoracoideus has an elongate origin on the shaft (longer in *Goura*, but shorter in all other columbids); tuberculum A (not equivalent to the tuberculum brachiale of Baumel and Witmer [1993], which is defined therein as for the attachment of the acrocoraco-acromial ligament) is globular and not markedly undercut by the sulcus m. supracoracoidei (in *Caloenas*, it is elongate dorsomedially and greatly undercut by the sulcus); tuberculum A is close to the facies articularis clavicularis, rather than being well separated from it by a distinct groove, as in many columbids; the impressio ligamentum acrocoraco-acromion (ilaa), on the dorsal side of the facies articularis clavicularis, is linked by a crest on the sternal margin of that facies to the impressio ligamentum acrocoraco-procoracoideum (ilap), with the crest overhanging the sulcus m. supracoracoidei; the sulcus m. supracoracoidei is usually pneumatic under both ligament attachment sites, but sometimes foramina are present only ventrally; the sulcus m. supracoracoidei is secondarily deepened into a distinctive lateromedially narrow fossa extending from tuberculum A to the cotyla scapularis that undercuts the edge of the facies articularis humeralis (autapomorphy); there is a single undivided pit for the insertion for ligamentum acrocoraco-claviculare superficiale on the ventromedial tip of the proc. acrocoracoideus (see Worthy et al. 2009); the shaft is convex ventrally adjacent to the facies articularis humeralis; the impressio m. sternocoracoidei is large and extends close to the medial margin and is pneumatic, but a distinct laterally placed pneumatic sulcus is either small or absent (in *Caloenas*, the impressio is well separated from the medial margin, pneumatic medially, and has a distinct lateral pneumatic sulcus); the facies articularis sternalis are relatively narrow (craniosternally) with the ventral facet poorly developed (in *Caloenas*, the facets are both relatively broader and the ventral one is robust).

Scapulae (Figure 4*M–N*): The acromion is not pneumatic; the facies articularis humeralis has the dorsal margin distinctly elevated above the adjacent facies because of marked lateromedial thinness along the anterior scapular margin; there is a relatively deep depression on the costal surface of the acromion and a distinct larger depression located more ventrally at the level of the facies articularis humeralis.

Sternum: The spina interni rostri is subtriangular in ventral aspect, with a truncated tip that tends toward being bifid (in *Caloenas*, the tip narrows anteriorly; *Ducula* differs markedly with a broadly rectangular spina interni rostri); the pars cardiaca has a small pneumatic foramen on the midline flanked by larger pneumatic regions caudal to the pila coracoidea in poorly defined sulci (*Ducula* has a large medial foramen flanked by well-defined sulci).

Femora: The cranial facies adjacent to crista trochanteris lacks pneumatic foramina, unlike *Caloenas;* the linea intermuscularis caudalis extends from the condylus medialis proximolaterally across the shaft to pass laterad of the nutrient foramen (remains mesad of foramen in *Caloenas*).

Tibiotarsi (Figure 4*S–U*): Distally, the tuberculi retinaculi m. fibularis has two well-developed crests, the anterior (= medial) one (mtRMF) more crestlike and separated by a sulcus from the distal attachment of retinaculum extensorium tibiotarsi (dtRET) or tuberositas retinaculum extensoris lateralis; the well-developed mtRMF precludes the presence of a broad flat area laterad of the sulcus extensorius; the lateral attachment of retinaculum m. fibularis (ltRMF) is aligned parallel to the shaft axis rather than anterocaudally; the dtRET is elongate and extends

proximad of the pons supratendineus; the proximal attachment of the retinaculum extensorium tibiotarsi (ptRET), or tuberositas retinaculum extensoris medialis, is little separated proximally from the dtRET; the sulcus extensorius is not bound by a sharp crest laterally; there is a large nutrient foramen above the condylus lateralis (an autapomorphy of the genus).

Tarsometatarsus (Figure 4*O–R*): Overall elongate shape and proportions similar to those of *Didunculus strigirostris* and slightly more slender than those of *Caloenas*, but much more elongate than in *Ducula;* on the hypotarsus, the tendinal sulcus for m. flexor hallucis longus is bound laterally by a well-developed ridge along its whole length; the canal for the tendons for m. flexor perforatus digiti II and m. flexor perforans et perforatus digiti II is clearly grooved by each of the two tendons and is open plantarly; the foramen vasculare proximale laterale is much smaller than the foramen vasculare proximale mediale, a feature shared with *Caloenas*, although in this genus the medial foramen is relatively larger; sulcus extensorius broad proximally; the anterior facies distal to the impressiones retinaculi extensorii forms a broad, flat-bottomed sulcus that passes laterad of the tuberositas m. tibialis cranialis and is bound laterally by a low crest (in *Caloenas*, this area is convex); the sulcus for m. abductor digiti IV is relatively weakly formed and does not form a notch on the side of trochlea metatarsi IV distally; the fossa parahypotarsalis medialis ends distally proximal to the fossa metatarsi I (fossae abut in *Caloenas*).

Didunculus placopedetes Steadman, 2006, Tongan Tooth-billed Pigeon
Figure 4

MATERIAL: NISP = 62, MNI = 8 (by coracoids and scapulae), all from L2 or deeper.

AM F.138716, (4, 3 ext, L1/L2), dL fem; F.138717, (6, no square, L2), dR tmt; F.138719, (2, D3, L3), dL tmt; F.138720, (2, J8, L2/L3), dR tmt; F.138721, (2 ext, B11 East half, L1), cran pt L cor; F.138722, (2 ext, B16, L3.1), R scap; F.138723, (2 ext, A18, L3), R cor; F.138724, (2 ext, B13, L3.1), R scap; F.138725, (2 ext, B18, L3), L scap; F.138726, (2 ext, B17, L3.1), R scap; F.138727, (2 ext, A16, L3.1), R scap; F.138728, (2 ext, A17, L3), cran pt R cor; F.138729, (2 ext, A17, L3), L scap; F.138730, (2 ext, B14, L3.1), L scap; F.138731, (2 ext, B15, L2), dR tib; F.138732, (2 ext, A12, L3.2), LR scap, pR hum; F.138733, (2 ext, B12, L3.2), dR tib; F.138734, (2 ext, B16, L3.1–3.2), pt 1L2R cor, 1 phal; F.138735, (2 ext, B17, L3.2), R cor; F.138736, (3B, L2, L2), ant stern; F.138739, (2 ext, C14, L3), cran pt L cor, R scap, dR hum; F.138740, (2 ext, C15, L2), sL tmt, L scap, dR hum, pL fem, dR tib, stern pt R cor; F.138741, (2 ext, C19, L2), LR scap, 2 pts R cor, pL cmc; F.138742, (2 ext, C18, L2), s + d L hum; F.138744, (2 ext, C20, L2), cran pt R cor; F.138745, (2 ext, D20, L2), ant stern; F.138746, (2 ext, D20, L2), L scap, cran pt L cor; F.138747, (2 ext, H14, L2), L scap; F.138748, (2 ext, C16, L2), dR tmt, dR tib; F.138749, (2 ext, C16, L2/L3), cran pt L cor; F.138750, (2 ext, E13, L3), sR tmt; F.138751, (2 ext, E13, L2), pR ulna; F.138752, (2 ext, G15, L2), dL tmt; F.138753, (2 ext, B20, L2), dR tib, cran pt L cor; F.138754, (2 ext, J11, L2), stern end L cor; F.138755, (2 ext, C19, L2), LR cran pts cor, pt R cmc; F.138756, (2 ext, E18, L2), pL tmt; F.138757, (2 ext, D19, L2), pL tmt; F.138758, (2 ext, G26, L3), R tmt; F.138759, (2 ext, C16, L2), ant sternum; F.138760, (2 ext, C15, L2), ant sternum; F.138761, (2 ext, C15, L2), L tmt.

Columbid sp. ?*Didunculus placopedetes* Steadman, 2006, Tongan Tooth-billed Pigeon

MATERIAL: NISP = 10, addition of these would add 1 to the MNI for *D. placopedetes*.

AM F.138718, (2, C4, L3), dL ulna; F.138762, (2 ext, D16, L2), cran pt R cor; F.138763, (2 ext, E17, L3 to base), sL tib; F.138764, (2 ext, C13, L2), stern pt R cor; F.138737, (2 ext, C15, L?), stern end R cor; F.138738, (3A, 6.6, L3), pL rad; F.138765, (2 ext, C16, L2), sL fem, L scap; F.138766, (2 ext, F14, L2), stern end R cor; F.138767, (2 ext, D12, L3), ant stern.

NOTES: All but three of 72 specimens at Teouma come from the Lapita midden or

Lapita layers of the cemetery. The three bones that come from Post-Lapita midden layers may be in secondary deposition. The specimens identified as *Didunculus placopedetes* or ?*D. placopedetes* are significantly larger than those of *D. strigirostris* and are of similar size to and conform to the features described for *D. placopedetes* from Tonga (Tables 2a, 2b) (Steadman 2006*c*). It is significant that relatively complete specimens of the tarsometatarsus and distal tibiotarsus were not described for *D. placopedetes* from Tonga, and, because these are highly distinctive and diagnostic elements in columbids, this may have precluded perceiving differences between the Teouma and Tongan *Didunculus*. Because *D. placopedetes* was based on a holotype mandible and a range of mainly fragmentary postcranial bones, with diagnostic points limited to a few features of the coracoid, scapula, humerus, and tibiotarsus, we give a more detailed comparison with *D. strigirostris* to facilitate future identification of this bird. All elements of *D. placopedetes* are larger than those of *D. strigirostris*, but some differ qualitatively as follows.

The coracoid of *D. placopedetes* (Figure 4*H–I*, *K*) has a more rounded proc. acrocoracoideus over its cranial extremity between the pit for the insertion for ligamentum acrocoraco-claviculare superficiale and the impressio lig. acrocoracohumeralis, and the ventral facies adjacent to the medial rim of the facies articularis humeralis is convex ventrally, rather than relatively flattened. Sternally, the angulus medialis is more obtuse due to a more robust ridge extending further cranially, more than twice the craniosternal width of the facies articularis sternalis, and contributing to a more robust rounded ridge dorsally bounding the pneumatic fossa in the impressio m. sternocoracoidei. The scapulae of *D. placopedetes* (Figure 4*N*) differ further in that the dorsoventral depth of the facies artic. humeralis is greater than its anterocaudal length, as opposed to being slightly longer than deep. The referred sternal fragments have a relatively triangular and robust spina interna rostri that projects relatively farther past the sulcus artic. coracoideus and is not as noticeably bifid as it is in *D. strigirostris* AM S.303. The referred humeri (Figure 4*B*) and ulnae (Figure 4*E*) fragments differed only in their larger size from *D. strigirostris*. The most noticeable distinguishing character of the tibiotarsus (Figure 4*S–T*) is that the incisura intercondylaris is not as deeply excavated caudally, with its floor roughly at the same depth as the opening of the canalis extensorius, whereas in *D. strigirostris* the incisura floor lies far more caudal of that canal. On the tarsometatarsus (Figure 4*P–Q*) the sulcus extensorius is broader proximally, being deeply excavated along the medial side of the foramen vasculare proximalia medialis to the impressiones retinaculi extensori medialis. In *D. strigirostris*, the sulcus extensorius is not excavated mesad of the foramina vascularia proximalia medialis.

Genus *Chalcophaps* Gould, 1843

NOTES: Material was referred to *Chalcophaps* by general similarity of form and size to compared specimens of *C. indica* including the following features: coracoid (in terminology of Worthy [2012]): a markedly dorsally protuberant tuberculum A that forms the most dorsal part of the acrocoracoid; tuberculum A narrowly separated from ilaa and not by a groove; facies articularis clavicularis dorsoventrally broader than craniosternally long and variably pneumatic; procoracoid short; ilaa and ilap not separated by a notch but linked by a dorsoventrally aligned crest. Humerus with a distinct caudal projection at distal side of the caput humeri adjacent to dorsal side of incisura capitis, and crista deltopectoralis starts proximally at a point distal to the sulcus ligamentum transversus. Specimens at Teouma come from both the Lapita and Post-Lapita midden areas.

Chalcophaps indica (Linnaeus, 1758), Emerald Dove

MATERIAL: NISP = 41, MNI = 14 (based on coracoids).

Columbid sp. cf. *Chalcophaps indica* (Linnaeus, 1758), Emerald Dove

TABLE 2a

Measurements (mm) of Coracoids, Scapulae, and Humeri of *Didunculus placopedetes* from Teouma, Efate, Vanuatu, Compared with Data from *D. strigirostris* AM S.303

Element	Taxon and Cat. No. AM	L	PW	SD Distal ldp	Min SW	DW	Max omal W	D cs-fah	L-omal side proc	L sc-acro	L sc-hf
Coracoids	*D. placopedetes* F.138723				4.3					13.7	9.8
	D. placopedetes F.138728									14.2	10
	D. placopedetes F.138735	est. 42.0			4.5				31.3		
	D. placopedetes F.138741									13.8	9.6
	D. placopedetes F.138744										10.7
	D. placopedetes F.138746										9.8
	D. placopedetes F.138749									13.4	9.6
	D. placopedetes F.138753				4.4						9.4
	D. placopedetes F.138762									13.5	9.6
	D. placopedetes[a]	41.8			4.2, 4.9				29.3, 30.2		8.8, 9.8
	D. strigirostris AM S.303	36.5			3.7				28.2	11.4	8.3
	D. strigirostris[a]	35.6, 38.0			3.6, 4.0				25.6, 28.1		7.4
Scapulae	*D. placopedetes* F.138722						12.3	8.3			
	D. placopedetes F.138726						12.5	8.8			
	D. placopedetes F.138730						11.7	8.2			
	D. placopedetes F.138741						12.3	8.5, 8.3			
	D. placopedetes F.138746						12.1	8.8			
	D. placopedetes[a]							8.1–9.1			
	D. strigirostris AM S.303						10.4	7.1			
	D. strigirostris[a]							7.1, 7.4			
Humeri	*D. placopedetes* F.138742			5.4	6.5	13.9					
	D. placopedetes F.138740			5.3	6.5	c.13.6					
	D. placopedetes[a]			5.3, 5.5							
	D. strigirostris AM S.303	49.6	15.4	4.6	5.4	12.0					
	D. strigirostris[a]			4.4, 4.8							

Abbreviations: L, length; PW, proximal width; SD distal ldp, shaft depth at distal end linea m. latissimi dorsi posterioris; Min SW, minimum shaft width; DW, distal width; Max omal W, maximum width between the acromion and the facies articularis humeralis; D cs-fah, depth collum scapulae to ventral side facies articularis humeralis; L-omal side proc, length to cranial/omal side of procoracoid where it abuts cotyla scapularis; L sc-acro, length cotyla scapularis to end of acrocoracoid; L sc-hf, length cotyla scapularis to top of facies articularis humeralis.

[a] Data for *D. placopedetes* and *D. strigirostris* from Steadman (2006*c*).

TABLE 2b

Measurements (mm) of Ulnae, Carpometacarpi, Femora, Tibiotarsi, and Tarsometatarsi of *Didunculus placopedetes* from Teouma, Efate, Vanuatu Compared with Data from *D. strigirostris* AM S.303

Element	Taxon and Cat. No. AM	L	PW	Min SW	mtSW	SDmt	DW	Dlc	Dmc
Ulnae	*D. placopedetes* F.138718			4.1			8.6		
	D. placopedetes F.138751		8.1						
	D. strigirostris AM S.303	59.3	7.5	3.6			6.6		
Carpometacarpi	*D. placopedetes* F.138741		12.0						
	D. strigirostris AM S.303	33.7	9.2						
Femora	*D. placopedetes* F.138716			4.6					
	D. strigirostris AM S.303	48.2	9.1	4.1			8.6		
Tibiotarsi	*D. placopedetes* F.138733						8.6	8.3	9
	D. placopedetes F.138748						7.9	8.1	8.9
	D. placopedetes F.138753			4.5			8.4	8.2	
	D. strigirostris AM S.303	67.2	7.9	3.8			7.4	7.1	7.9
Tarsometatarsi	*D. placopedetes* F.138717				4.7	3.4			
	D. placopedetes F.138719			4	4.8	3			
	D. placopedetes F.138720						8.8		
	D. placopedetes F.138748				4.2				
	D. placopedetes F.138758	Est. 47.6		3.6	4.3	3.1			
	D. placopedetes F.138761	42.6	9.7	3.8	4.5		9.4		
	D. placopedetes[a]			5.2		3.4			
	D. strigirostris AM S.303		8.6	3.4	3.8	2.6			
	D. strigirostris[a]			3.1–3.4		2.4–2.7			

Abbreviations: L, length; PW, proximal width; Min SW, minimum shaft width; mtSW, shaft width at metatarsal facet; SDmt, shaft depth at metatarsal facet; DW, distal width; Dlc, depth condylus lateralis; Dmc, depth condylus medialis. Est. means this is the estimated value allowing for a minor bit of breakage.

[a] Data for *D. placopedetes* and *D. strigirostris* from Steadman (2006*c*).

MATERIAL: NISP = 8; addition of these specimens does not affect MNI for the species.

Genus *Ducula* Hodgson, 1836

NOTES: This genus is widely distributed from India and Asia, through the Philippines and Melanesia where it has greatest diversity, to Polynesia (Dickinson and Remsen 2013). An endemic species, *Ducula bakeri*, is known from the Banks Islands, Espiritu Santo, Ambae, Maewo, Pentecost, and Ambrym, all in northern Vanuatu. Otherwise, only the widely distributed *Ducula pacifica*, known from islands off Papua New Guinea east to American Samoa, occurs in Vanuatu and is the only *Ducula* in southern islands in the archipelago including Efate.

Ducula species are medium to large pigeons easily distinguished on most limb bones from similar-sized columbids as described, for example, by Worthy (2001), Worthy and Wragg (2003, 2008), and Wragg and Worthy (2006). One of the most diagnostic elements is the coracoid; because its survival is enhanced by its relative robustness compared with other elements, it provides the MNI in these samples, and so its characteristic features are summarized here.

Distinguishing features of the coracoid in *Ducula* are as follows: the sulcus m. supracoracoidei is apneumatic; the tuberculum A (following terminology of Worthy [2012]) is large, abuts the facies articularis humeralis, importantly does not abruptly overhang the sulcus m. supracoracoidei, and is widely separated from the insertion for the ligamentum acrocoraco-acromion acrocoracoid (ilaa); the latter tuberculum has little projection over the sulcus m. supracoracoidei; the facies articularis clavicularis, as it extends ventrally from this tuberculum, is flattened and, on its ventral side, extends as a large sternally directed projection for the insertion for the ligamentum acrocoraco-procoracoideum (ilap);

ilaa and ilap are not connected by a crest that overhangs the sulcus m. supracoracoidei; sternally the impressio m. sternocoracoidei extends close to the medial margin and has a large pneumatic foramen penetrating toward the angulus medialis; the facies articularis sternalis dorsalis is broad, especially medially, and a crest extends cranially from the angulus medialis enclosing a distinct flattened area dorsally between it and the impressio and the facies articularis sternalis.

Ducula pacifica (J. F. Gmelin, 1789), Pacific Imperial Pigeon

MATERIAL: NISP = 146, MNI = 23 (by coracoids).

Ducula sp. cf. *D. pacifica* (J. F. Gmelin, 1789), Pacific Imperial Pigeon

MATERIAL: NISP = 54; addition of these specimens to those certainly identified as *D. pacifica* raises the MNI (based on coracoids) to 26.

Columbid sp. magn. *Ducula pacifica* (J. F. Gmelin, 1789), Pacific Imperial Pigeon

MATERIAL: NISP = 102, MNI = 9 (by coracoids).

NOTES: Specimens attributed to *Ducula pacifica* at Teouma come from both the Lapita and Post-Lapita midden deposits.

Ducula sp. cf. *D. goliath* (G. R. Gray, 1859), New Caledonian Imperial Pigeon

MATERIAL: NISP = 34, MNI = 6.

AM F.138624, (3, 4.2, L2/3), dR hum; F.138625, (2, H9, L3), L scap; F.138628, (2 ext, A18, L3), L scap; F.138629, (2 ext, B17, L3.1), L cor; F.138630, (2 ext, B17, L3.1), L scap; F.138631, (2 ext, A19, L3.2), cran pt L cor; F.138632, (2 ext, A17, L3.1), cran pt R cor; F.138637, (2 ext, C18, L2), sL tmt, dLpL rad; F.138638, (2 ext, C13, L3), L scap; F.138639, (2 ext, D20, L2), ant stern; F.138640, (2 ext, D17, L2), sR tib; F.138641, (2 ext, C16, L2/3), cran pt L cor; F.138642, (2 ext, E13, L3), R cor; F.138643, (2 ext, B20, L2), dR ulna, cran + stern pts L cor; F.138644, (2 ext, C19, L2), L cor, dL tmt; F.138645, (2 ext, C21, L3 to base), L cor, L scap; F.138646, (2 ext, D19, L3 to base), sL tmt, phal I.1; F.138647, (3B ext, 4.13, L3), sR tmt; F.138626, (3A, 1.3, 2/3, L2), pts R rad; F.138627, (3A, 1.7, L2), pR rad; F.138633, (2 ext, B16, L3.1–3.2), pLpR rad.

Columbid sp. magn. *Ducula goliath* (G. R. Gray, 1859), New Caledonian Imperial Pigeon

MATERIAL: NISP = 21; addition of these specimens does not alter MNI for "*goliath*."

AM F.138634, (2 ext, B15, L2), sL ulna; F.138635, (2 ext, A17, L3.2), sL cor; F.138648, (2 ext, C20, L3), 2dR ulnae; F.138649, (2 ext, C16, L2), 2 ant stern, pR fem, sR tmt; F.138650, (Trench 3, A11, L3), ant stern; F.138651, (2 ext, C15, L3), stern pt R cor; F.138652, (2 ext, J14, L3), syn; F.138653, (2 ext, J14, L3), sR tmt; F.138654, (2 ext, H20, L2), pR tib; F.138636, (3B, 2.8, L2/3), phal R1.1; F.138655, (2 ext, D15, L2), metatarsal, phal I.1; F.138656, (2 ext, D15, L2), 5 phal, 1 frag.

NOTES: The material was compared with the elements in a specimen of *Ducula goliath* (USNM 561560) from New Caledonia and was found to have the characteristic features of *Ducula*, were of a similar size to the *D. goliath* specimen, and differed in no discernible way. The specimens listed only as a columbid the size of *D. goliath* were fragmentary to the extent that, although they could be identified as columbid, they lacked any distinguishing features of *Ducula* and so were referred only to a columbid species the size of *D. goliath*. However, no other species of similar large size is known from the fauna. *Ducula goliath* is not previously known from Vanuatu and is considered a taxon endemic to New Caledonia. This species is the largest in the genus and volant, so it is quite possible that its former range included the adjacent islands in Vanuatu. Whether the Vanuatu bones were the same taxon or a very similar form cannot be established here, but the bones indicate minimally the extirpation of a population of very large imperial pigeon from Vanuatu, if not

the extinction of a species. All bones came from the Lapita midden or Lapita cemetery levels at Teouma, with the exception of two specimens out of the 55 found in the Post-Lapita midden.

Genus *Ptilinopus* Swainson, 1825

NOTES: Material was referred to *Ptilinopus* by general similarity of form and size to compared specimens of *Ptilinopus* and especially to *P. greyi*, AM S.633, including the following features: coracoid (in terminology of Worthy [2012]): tuberculum A separated by distinct groove from ilaa; ilaa more dorsally protuberant than tuberculum A; ilaa more offset cranially from ilap than in *Chalcophaps*, so that in medial view the facies articularis clavicularis is longer craniosternally than dorsoventrally wide; ilaa and ilap linked by a cranially slanted slightly arched crest lacking a noticeable notch; pneumatic foramina present under facies articularis clavicularis; and processus procoracoideus short. In Vanuatu, two *Ptilinopus* species are found, the endemic *P. tannensis*, and *P. greyi*, which has a larger distribution in the Solomons, Santa Cruz Islands, Vanuatu, New Caledonia, and Loyalty Islands (Dickinson and Remsen 2013). Skeletal material of *P. tannensis* was not available to us, but it is a larger bird than *P. greyi* (see Goodwin [1967]). Specimens were found in both the Lapita and Post-Lapita midden layers.

Ptilinopus sp. cf. *P. greyi* Bonaparte, 1857, Red-bellied Fruit-Dove

MATERIAL: NISP = 16, MNI = 4.

Columbid sp. ?*Ptilinopus greyi* Bonaparte, 1857, Red-bellied Fruit-Dove

MATERIAL: NISP = 1.

NOTES: The small size of this carpometacarpus makes it likely that it is from *P. greyi*.

Small columbid indeterminate

MATERIAL: NISP = 72.

NOTES: Small columbid specimens that were too fragmentary or worn or of nondiagnostic parts were found in both the Lapita and Post-Lapita midden layers.

Order CUCULIFORMES
Family CUCULIDAE
Genus *Cuculus* Linnaeus, 1758

Cuculus optatus Gould, 1845, Oriental Cuckoo

MATERIAL: NISP = 2, MNI = 1.

NOTES: *Cuculus optatus* breeds in the Northern Hemisphere from Northeast Europe to North and East Asia and winters in Indonesia, Philippines, Papua New Guinea, and islands east to the Solomons and south to Australia (Higgins 1999). These specimens were a good match in both size and morphology for AM O.64568, a specimen of *C. optatus* from New South Wales in Australia. Both specimens were from Layer 1. The bones do not match in form or in size those of any of the three resident or regular visiting cuckoos of Vanuatu: *Cacomantis flabelliformis*, Fan-tailed Cuckoo; *Chrysococcyx lucidus*, Shining Bronze Cuckoo; and *Eudynamis taitensis*, Long-tailed Koel (Mayr 1945, Steadman 2006*a*, Van Perlo 2011). Both specimens came from Layer 1 of Area 7C, which postdates 2,500 ybp, and they could even represent a modern visitor.

Genus *Centropus* Illiger, 1811

Centropus sp. indet., Indeterminate Coucal
Figure 5*A–D*

MATERIAL: NISP = 1, MNI = 1.

AM F.138818, (2 ext, C16, L3), a complete R tib.

MEASUREMENTS: TL = 107.0 mm, PW = 12.1 mm, SW = 6.3 mm, DW = 12.9 mm.

NOTES: *Centropus* is not known historically nor from prehistoric populations from anywhere in Vanuatu (Steadman 2006*a*). The various *Centropus* species, or coucals, are large birds distributed from Africa through Asia and the Philippines to Papua New Guinea and the Solomon Islands. *Centropus violaceus*, from New Britain and New Ireland of Papua

FIGURE 5. Left tibiotarsus AM F.138818 of *Centropus* sp. indet. from Teouma, Efate Island, Vanuatu, in cranial (*A*), medial (*B*), caudal (*C*), and lateral (*D*) views, shown with *Centropus violaceus* AM O.60593 in cranial view (*E*). Distal left tibiotarsus of large indeterminate rallid AM F.138822 from Teouma, Efate Island, in cranial view (*F*). This bone indicates a fossil rail nearly twice as large as *P. melanotus* from Efate. Scale bars = 20 mm.

New Guinea, and *C. milo* from the Solomon Islands, at 60–68 cm long and about 500 g weight, are among the largest species (del Hoyo et al. 1997). *Centropus milo* is alone in the group in feeding mainly on the ground and is weakly flying (del Hoyo et al. 1997), so is expected to have larger leg bones than *C. violaceus*. The tibiotarsus of *Centropus violaceus*, AM O.60593 is longer but more slender than the specimen from Vanuatu (total length = 117.6 mm, PW = ca. 13 mm, SW = 6.4 mm, DW = 11.9 mm). Specimens of *C. milo* were not available for comparison, but the stout nature of the Vanuatu tibiotarsus raises the possibility that it is either *C. milo* or a related form. The single bone (Figure 5*A–D*) came from the Lapita midden at Teouma. This discovery extends the distribution of *Centropus* out beyond the Solomon Islands.

Order GRUIFORMES
Family RALLIDAE
Genus *Hypotaenidia* Reichenbach, 1853

Hypotaenidia philippensis (Linnaeus, 1766), Buff-banded Rail

MATERIAL: NISP = 64, MNI = 8.

NOTES: All these specimens are considered to belong to a taxon in the *Hypotaenidia philippensis* complex (= *Gallirallus philippensis*, sensu Kirchman [2012]), a species listed with 22 subspecies in Dickinson and Remsen (2013). The subspecies living on Vanuatu is *H. p. sethsmithi*, which ranges over Fiji, Tuvalu, New Caledonia, and the Loyalty Islands. Material of this taxon was not available to us, but the bones are all slightly larger than those of the Australian form *H. p. mellori* with which they were compared, as expected from data given in Kirchman and Steadman (2005). The Teouma specimens come from both the Lapita and Post-Lapita midden layers.

Genus *Porphyrio* Brisson, 1760

Porphyrio melanotus Temminck, 1820, South-west Pacific Swamphen

MATERIAL: NISP = 222, MNI = 18 (by tmt).

Rallid sp. cf. *Porphyrio melanotus*, South-west Pacific Swamphen

MATERIAL: NISP = 22; these do not affect the MNI estimated earlier.

NOTES: Teouma specimens come from both Lapita and Post-Lapita midden layers. This species is still abundant in Teouma.

Large rail, sp. and gen. indet.
Figure 5*F*

MATERIAL: NISP = 1, MNI = 1.
AM F.138822, (deep pit, SW corner), dL tib.

MEASUREMENTS: SW = 8.5 mm, DW at proximal side of pons supratendineus 12.2 mm, preserved length 79.5 mm.

NOTES: This specimen includes the shaft from a point distal to the nutrient foramen to the distal side of the pons supratendineus, including about half the length of the condylus lateralis (Figure 5*F*). It is much larger than other rallid bones from Efate. All of the condylus medialis and most of the condylus lateralis is missing. A crest marking the intermuscular line that extends proximally from the medial margin of the sulcus extensorius forms a prominent convex medial anterior margin. Because the lateral margin of the sulcus ex-

tensorius extends proximolaterally around the shaft to the posterior facies, the shaft has a marked twisted appearance. The pons supratendineus is complete and, like *Porphyrio*, has its distal margin aligned across the shaft. Although worn, at the lateral side of the pons a low buttress for the eminentia intercotylaris arises dorsally from the incisura intercondylaris and is of similar robustness to that in *Porphyrio*, not a prominent tuberosity as seen in birds with long tarsi (e.g., *Threskiornis*). Laterad of the pons and extending to a level slightly proximad of the pons is a triangular tuberosity that is the tuberositas retinaculum extensoris lateralis (lateral attachment for lig. transversum) and is of similar proportions to that seen in *Porphyrio*. The tuberositas retinaculum extensoris medialis is a crest 7 mm long slightly overhanging the sulcus extensorius that ends about 2 mm proximal to the pons. The sulcus extensorius is broad and, at the midlength point of the latter tuberositas, extends to the lateral margin just above the sulcus m. fibularis. The sulcus m. fibularis is broad, faces more anteriorly than laterally, and extends distally, passing laterad of the tuberositas retinaculum extensoris lateralis onto the lateral facies of condylus lateralis.

AM F.138822 differs markedly from galliforms in, for example, its broad sulcus extensorius, the anteriorly facing sulcus m. fibularis, and the relatively proximal location of the tuberositas retinaculum extensoris lateralis. Threskiornithids have a much narrower medially located canalis extensorius. Anatids have a more centrally located and deeper sulcus extensorius, with a quite different form of the sulcus m. fibularis. In all these features, this bone is a good match for rallids and is interpreted as probably from a giant form of *Porphyrio*. It is of similar size to *Porphyrio mantelli* from the North Island of New Zealand, and thus is almost twice as large as *P. melanotus*, the largest rail otherwise known from Efate. Steadman et al. (1999) and Steadman (2006*a*) listed large extinct and undescribed *Porphyrio* species from New Ireland and Buka, and a large extinct form, *P. kukwiedei*, is known from New Caledonia (Balouet and Olson 1989). AM F.138822 is slightly larger than *P. kukwiedei*, and it likely represents another example of this radiation of large *Porphyrio* species. However, more material is required to facilitate its description. The Teouma specimen was in secondary deposition and was therefore not attributable to layer.

Genus *Porzana* Vieillot, 1816

Porzana tabuensis (Gmelin, 1789), Spotless Crake

MATERIAL: NISP = 5, MNI = 1.

NOTES: All Teouma specimens were from the Post-Lapita midden. The species is still common in Vanuatu.

Order Procellariiformes
Family Procellariidae
Genus *Pseudobulweria* Mathews, 1936

?*Pseudobulweria rostrata* (Peale, 1848), Tahiti Petrel

MATERIAL: NISP = 1, MNI = 1.

NOTES: The single Teouma specimen, a humeral shaft of appropriate size and robustness for this taxon, was from the Post-Lapita midden. This species is probably breeding in the Vanuatu group (Dutson 2012).

Genus *Puffinus* Brisson, 1760

Puffinus sp. cf. *P. bailloni* Bonaparte, 1857, Tropical Shearwater

MATERIAL: NISP = 1, MNI = 1.

MEASUREMENTS: Maximum distal width 5.4 mm, condylus dorsalis ulnae width 4.5 mm.

NOTES: This specimen was identified as *Puffinus* by its overall morphology and to this species by size, and it notably differs from similar-sized *Pterodroma* by the rather flat caudal face to the condylus dorsalis ulnae and the shaft being somewhat angular just proximad of the condyle. This single Teouma specimen was from the Post-Lapita midden. The subspecies *P. b. gunax* is probably breeding in the Vanuatu group (Dutson 2012).

?*Puffinus pacificus* (Gmelin, 1789), Wedge-tailed Shearwater

MATERIAL: NISP = 1, MNI = 1.
NOTES: The single Teouma specimen was from the Post-Lapita midden. This species is abundant on rat-free islands of the Vanuatu group (Dutson 2012).

Order PELECANIFORMES
Family ARDEIDAE
Genus *Ardea* Linnaeus, 1758

Ardea alba modesta J. E. Gray, 1831, White Heron/Eastern Great Egret

MATERIAL: NISP = 3, MNI = 1.
NOTES: *Ardea alba* is a cosmopolitan species, with the subspecies *A. a. modesta* distributed from Asia to Australasia (Dickinson and Remsen 2013). It is a rare vagrant to Bougainville in the Solomons and New Caledonia, so although not recorded from Vanuatu (Marchant and Higgins 1990, Doughty et al. 1999) it would be expected in coastal locations in Vanuatu. The Teouma specimens were found both from the Post-Lapita midden and in secondary deposition unattributable to layer.

Family THRESKIORNITHIDAE
Genus *Threskiornis* Gray, 1842

Threskiornis sp. cf. *T. molucca* (Cuvier, 1829), Australian White Ibis

MATERIAL: NISP = 3, MNI = 1.
MEASUREMENTS: See Table 3.

NOTES: The threskiornithids *Threskiornis* and *Platalea* have very similar postcranial skeletons, as predictable from their sister-group relationship (Chesser et al. 2010, De Pietri 2013), especially for the elements represented in the Teouma fauna, and either might occur in coastal locations on Efate. The Teouma specimens are referred to *Threskiornis* because they have the following features: Femur: 1, in medial view, the condylus medialis has a more rounded and symmetrical profile, whereas in *Platalea flavipes* (SAM B.11553, 24310) and *P. regia* (SAM B.10978, 310845, 32464, 49463, 51174) the condyle is angular with a shorter surface articulating with the tibiotarsus and a longer surface roughly at right angles to the last more dorsally; 2, the impressio tuber. m. gastrocnemialis lateralis is less elevated from the adjacent facies and is not buttressed laterodorsally, rather than being more elevated and buttressed laterodorsally in *Platalea;* 3, the proximal end of the crista tibiofibularis is in line with the proximal margin of the condylus medialis, whereas it projects more proximally in *Platalea;* and although lacking in AM F.138821, the depressio epicondylaris lateralis extends as a definite impressed scar toward the proximal side of the condylus medialis, whereas it is restricted to a shallow small circular fossa in *Platalea*. The tibiotarsus has a well-marked buttress for the eminentia intercotylaris, the incisura intercondylaris is enlarged proximally both medially and laterally, reducing

TABLE 3

Measurements (mm) of *Threskiornis* Species and Teouma Bones

	Cat. No.[a]	F TL	F PW	F SW	F DW	T TL	T fcL	T SW	T DW	Sc PW
T. spinicollis	B.11518	75.0	17.1	6.7	18.1	141.4	122.0	7.2	14.5	—
T. spinicollis	B.48351	71.4	17.9	7.0	16.5	140.0	122.4	7.3	13.5	15.3
T. spinicollis	O.59348	72.0	15.1	7.0	16.1	136.0	115.0	7.2	12.9	14.9
T. spinicollis	O.64771	66.3	13.2	6.4	15.6	123.9	107.6	7.0	12.1	14.1
T. molucca	O.59303	74.6	16.9	7.4	17.2	149.0	127.0	7.2	13.6	16.2
T. molucca	O.64724	74.9	15.2	6.9	16.4	148.7	131.0	7.2	13.2	14.3
T. molucca	O.70723	71.4	16.8	7.4	16.9	142.5	123.0	7.0	14.0	14.5
T. molucca	O.65112	71.0	16.5	7.1	16.6	136.0	114.6	7.6	13.0	14.9
Teouma	F.138819, F.138821	79.4	16.7	7.5	18.0	—	131.2	7.8	13.7	16.9

Abbreviations: Femora, F; tibiotarsi, T; T fcL, tibiotarsus length from proximal side crista fibularis to condylus lateralis; ScPW, scapular width from acromion to facies articularis humeralis; other abbreviations in Materials and Methods.
[a] Cat. No. is catalogue number, with B. numbers in SAM, or O. numbers in AM.

the widths of the adjacent condyles, and the canalis extensorius is narrow and placed well medially, as typical of threskiornithids. AM F.138819 is referred to *Threskiornis* because it has a low, rather than prominent, epicondylus medialis and is relatively shorter than tibiotarsi of *Platalea*. Scapulae of *Platalea* and *Threskiornis* are very similar, but in *Threskiornis* the acromion projects less anteriorly of a line linking the facies articularis humeralis and the tuberculum coracoideum, the dorsal profile of the facies articularis clavicularis/acromion is rounded rather than distinctly angular, and on the costal facies a single intermuscular line parallels the dorsal margin extending from the collum scapulae toward the acromion, whereas in *Platalea* this line divides, with the more caudal one diverging ventrally from the dorsal margin, thus partly defining a secondary sulcus on the costal side of the acromion.

Threskiornis is represented by two species in the Australian region. *Threskiornis spinicollis* is found in Australia, Norfolk Island, Lord Howe Island, and is vagrant to Papua New Guinea (Marchant and Higgins 1990). *Threskiornis molucca* is found in the Moluccas, the Lesser Sunda Islands, Papua New Guinea, Australia, and a dwarf form occurs on Rennell Island in the Solomon Islands (Marchant and Higgins 1990). Lowe and Richards (1991) found that *T. molucca* exhibited size variation in a latitudinal cline, with larger individuals in the south, but had relatively few data. Marchant and Higgins (1990) showed that *T. molucca* is larger than *T. spinicollis* (mean male weights of 2,005.9 g versus 1,465 g). The limited number of skeletons available to us indicated that most measurements of femora and tibiotarsi were broadly overlapping, but they suggest that tibiotarsi of *T. molucca* were a little more elongate. The fossil femur was slightly larger and more robust than in the compared skeletons (Table 3) but morphologically was otherwise very similar to both species. However the tibiotarsus was similar in size and in proportions to larger *T. molucca* and longer than any compared *T. spinicollis*, so it is likely that the Teouma bones can be referred to *T. molucca* based on their large size, and this is more probable given the wider distribution of that species. All three Teouma specimens came from the Lapita midden area.

Family SULIDAE
Genus *Sula* Brisson, 1760

Sula leucogaster (Boddaert, 1783), Brown Booby

MATERIAL: NISP = 8, MNI = 2.

NOTES: This is a common and widespread bird in Oceania. Seven of the eight Teouma specimens came from the Post-Lapita midden layer, with one coming from the Lapita midden area.

Order ACCIPITRIFORMES
Family ACCIPITRIDAE
Genus *Accipiter* Brisson, 1760

Accipiter fasciatus (Vigors & Horsfield, 1827), Brown Goshawk

MATERIAL: NISP = 21, MNI = 2.

NOTES: The genus *Accipiter* is widespread in Oceania from the Bismarcks to Tonga, with numbers of extinct populations or taxa (Steadman 2006*a*). In Vanuatu, *Accipiter fasciatus vigilax* is known from Tanna and Aneityum and as an extirpated population from Efate (Steadman 2006*a*, Dickinson and Remsen 2013). The feathers were a traditional item of trade from Aneityum to Tanna (Inglis 1890:136). Inglis claimed that at the time it was not present on Tanna. The specimens listed here confirm that this species survived on Efate into the early period of human colonization. They were found in both the Lapita and Post-Lapita midden areas.

Order STRIGIFORMES
Family TYTONIDAE
Genus *Tyto* Billberg, 1828

Tyto delicatula (Gould, 1837), Australian Barn Owl

MATERIAL: NISP = 14, MNI = 2.

NOTES: Usually referred to as *Tyto alba* (e.g., Steadman [2006*a*]), the recent *Checklist of Birds of the World* (Dickinson and Remsen 2013) has separated out populations in Aus-

tralia, Melanesia, and Oceania as *T. delicatula*. This species is widely distributed in the Pacific, although in Fiji and more eastern locations it is likely that the species colonized only after humans did (Worthy and Anderson 2009). The specimens from Teouma derive from both the Lapita and Post-Lapita midden layers, suggesting a possible prehuman distribution in Vanuatu.

Order Bucerotiformes
Family Bucerotidae
Genus *Rhyticeros* Reichenbach, 1849

Rhyticeros (= *Aceros*) sp. cf. *R. plicatus* (J. R. Forster, 1781), Papuan Hornbill
Figure 6

MATERIAL: NISP = 9, MNI = 2.
AM F.138803, (2, G1, L3), sL tmt; F.138804, (2 ext, B15, L2/3.1), R scap; F.138805, (2 ext, A17, L3.1), sternal pt L cor; F.138806, (2 ext, B18, 3.3, L1), sR tmt; F.138807, (2 ext, C18, L2), cran pt R cor; F.138808, (2 ext, C16, L2/3), L scap; F.138809, (2 ext, D15, L2), R cor; F.138810, (2 ext, A20, L2), pL ulna; F.138811, (2 ext, C20, L3), L quad.

FIGURE 6. Selected bones of *Rhyticeros* (= *Aceros*) sp. cf. *R. plicatus* from Teouma, Efate Island, Vanuatu. Right coracoid AM F.138809 in dorsal (*A*) and medial (*B*) views; shaft right tarsometatarsus AM F.138806 in dorsal (*C*) and plantar (*D*) views; left scapula AM F.138808 in lateral view (*E*); left quadrate AM F.138811 in lateral (*F*), caudal (*G*), and mediocaudal (*H*) views. Scale bars = 20 mm.

MEASUREMENTS: AM F138803, tmt least shaft width 6.1 mm. AM F.138804, scapular width acromion–facies articularis humeralis 12.1 mm. AM F.138806, tmt least shaft width 5.5 mm. AM F.138807, cor length cotyla scapularis–acrocoracoid above the facies articularis humeralis 13.8 mm, minimum shaft width 4.5 mm. AM F.138808, scapular width acromion–facies articularis humeralis 13.0 mm. AM F.138809, cor length medial angle–acrocoracoid 38.6 mm, length cotyla scapularis–acrocoracoid above the facies articularis humeralis 14.5 mm, minimum shaft width 4.9 mm. AM F.138811, quadrate height capitulum squamosum–condylus lateralis 14.5 mm.

NOTES: These specimens were compared with *Rhyticeros plicatus* AM O.1263 from New Britain in the Bismarck Archipelago and were a good match in morphology but were a bit smaller. Measurements (mm) AM O.1263: tarsometatarsus TL = 51.5, PW = 16.2, least SW = 6.3, DW = 15.8; coracoid medial length = 49.4, least SW = 5.6, sternal width 16.4. Given the large size of this species, the slight difference in size of the fossils compared with the single modern representative, and the absence of any qualitative features whereby they could be distinguished, there is no suggestion that two taxa may be involved. This species has several subspecies over a modern range of the Maluku Islands (Moluccas) in Indonesia, Papua New Guinea, Bismarck Archipelago, and the Solomon Islands (Dickinson and Remsen 2013), so an occurrence in Vanuatu is predictable (Mayr 1945, Steadman 2006*a*:159, 367) and here confirmed. However, we caution accepting that a population was resident on Efate because the Lapita people were very mobile seafarers (Kirch 2000) and perhaps could have transported the few birds represented by these remains from an island with a resident population of *Rhyticeros* (for example, from the Solomons). All of the Teouma specimens came from the Lapita midden area or Lapita cemetery layers. Steadman (2006*a*) listed an

TABLE 4

Summary Statistics of Measurements (mm) for *Todiramphus sanctus* (SAM B.49187, 48530, 49168, 55217, 55961, 55487) Compared with Measurements for AM F.138980 and *T. chloris* (AM O.64570)

Measurement	Hum L	Hum PW	Hum SW	Hum DW	Fem L	Fem PW	Fem SW
Mean	30.20	6.37	2.25	5.37	18.62	3.63	1.49
Standard Deviation	0.75	0.19	0.10	0.21	0.36	0.19	0.10
Minimum	29.0	6.1	2.1	5.1	18.1	3.4	1.4
Maximum	31.0	6.6	2.4	5.6	19.1	3.9	1.7
Count	6	6	6	6	6	6	6
AM O.64570	35.4	7.5	2.6	6.5	22.4	4.7	1.9
AM F.138980	32.2	6.8	2.3	5.9	Est. 20.0	4.0	1.7

Note: Est. is the estimated value allowing for minor breakage.

undescribed species smaller than *R. plicatus* from Lifu in the Loyalty Islands based on two pedal phalanges, but this needs to be assessed within an appreciation of the size range of individuals of the various subspecies in western Oceania.

Order Coraciiformes
Family Alcedinidae: Halcyoninae
Genus *Todiramphus* Lesson, 1827

Todiramphus sp. cf. *T. chloris* (Boddaert, 1783), Collared Kingfisher

MATERIAL: NISP = 6, MNI = 3.

MEASUREMENTS: All humeri are of similar size, but only AM F.138980 affords meaningful measurements (Table 4).

NOTES: Vanuatu has two species of resident kingfisher: *Todiramphus farquhari*, Chestnut-bellied Kingfisher, that primarily lives in forest and is endemic to Espiritu Santo, Malo, and Malekula, and *T. chloris*, primarily in coastal habitats (Steadman 2006*a*, Van Perlo 2011). However, *T. sanctus*, Sacred Kingfisher, is a winter visitor to the Bismarck Archipelago and the Solomon Islands (Mayr 1945) so would perhaps be expected in Vanuatu. The fossil bones are larger than those of *T. sanctus* and close in size to those of *T. chloris* (Table 4), so are tentatively referred to this resident taxon, which would be expected in the coastal environment of Teouma on Efate. Specimens come from both the Lapita and Post-Lapita midden layers.

Family Psittacidae

Indeterminate species, magn. *Charmosyna palmarum* (Gmelin, 1788), Palm Lorikeet

MATERIAL: NISP = 7, MNI = 3.

NOTES: *Charmosyna* is a genus of small lories with species from the Bismarcks through the Solomons to New Caledonia and Fiji (Steadman 2006*a*). The species *C. palmarum* is endemic to Vanuatu. No reference material was available, but the few listed fragments are of appropriate size for it, with the only other parrot taxa known from Vanuatu, *Trichoglossus* and *Eclectus* (Steadman 2006*a*), being far larger birds. All Teouma specimens come from the Lapita midden area or Lapita cemetery layers.

Genus *Eclectus* Wagler, 1832

Eclectus sp. cf. *E. infectus* Steadman, 2006*b*

MATERIAL: NISP = 4, MNI = 1.

AM F.138812, (2 ext, C17, L3), dR fem; F.138813, (2 ext, D15, L2), stern end L cor; F.138814, (2 ext, C18, L3), stern end R cor; F.138815, (2 ext, B16, L3.1–3.2), pL ulna.

MEASUREMENTS (MM): AM F.138812, DW = 12.3 mm, depth of medial condyle 8.3, SW = 4.9 mm. AM F.138814, sternal width 12.4. AM F.138815, PW = 9.3.

NOTES: Two genera of large parrots potentially might occur in Vanuatu. *Cacatua* has a widespread presence, with *C. galerita*, Sulphur-crested Cockatoo, on New Britain

and nearby islands (Higgins 1999); *C. ducorpsii*, Solomon Islands Corella, endemic to the Solomons; and specifically indeterminate specimens reported from New Caledonia (Steadman 2006*a*). *Eclectus roratus*, Eclectus Parrot, is a wide-ranging polytypic species with at least nine subspecies, of which *E. r. solomonensis* (Rothschild & Hartert, 1901) from Lihir Island, Bougainville, and the Solomons comes closest to Vanuatu (Dickinson and Remsen 2013). This subspecies also occurs on the Admiralty Islands, New Britain, and Witu Islands (Dickinson and Remsen 2013), although these populations have in the past been distinguished as *E. roratus goodmani* Hartert, 1901 (e.g., Higgins 1999). An extinct form, *Eclectus infectus*, was described on specimens from Tonga and from Malakula in Vanuatu (Steadman 2006*b*). The specimens from Teouma were compared with *Eclectus roratus* SAM B.5047, 21926–928, 37527, and various *Cacatua* species. They are larger than those of extant *E. roratus* and within the size of *C. galerita* (e.g., SAM B. 45764, 47268). The distal femur AM F.138812 shares two features with *Eclectus:* 1, it has a marked sulcus immediately proximal to the trochlea fibularis for reception of the fibula during maximum rotation of the leg, resulting in the articular surface abutting the tuber. m. gastrocnemialis lateralis on its proximal margin; and 2, the distal end of the impressio tuber. m. gastrocnemialis lateralis is not projecting laterally of the trochlea. In contrast, in *Cacatua galerita* the articular surface is restricted to the trochlea fibularis; there is no articulation into a deep fossa, or "fibular stop," proximal to the trochlea fibularis; the tuber. m. gastrocnemialis lateralis is separated from the trochlea; and its distal end projects laterally of the trochlea.

However, they are just slightly larger than the described bones of *E. infectus* and share the diagnostic characters of that species, notably the less-protuberant tuberculum ligamentum collateralis ventralis and processus cotylaris dorsalis on the ulna and with the condylus medialis in the axial plane of the femur (Steadman 2006*b*). These bones are thus provisionally assigned to *E. infectus*. All Teouma specimens come from the Lapita midden area or Lapita cemetery layers. As for the hornbill bones, the rarity of these *Eclectus* bones could be explained by their being brought as prized captive birds from, for example, the Solomons, rather than that they represent a resident *Eclectus* population in Vanuatu. The rarity of parrot bones in the deposit is unexpected because of the adundance of this group in the forests today. It is possible that the abundant columbids and fowl made it unnecessary to hunt parrots, which are probably more difficult to catch.

Order Passeriformes

A total of 94 passerine bones is present in the sample, all catalogued into the AM collection. Several taxa are represented, but no attempt was made to identify them because suitable comparative material was not available. At least 19 taxa are currently extant in Vanuatu (Steadman 2006*a*) that might be represented among the fossils.

The data presented here for each taxon are summarized in Table 5, wherein along with its status, whether locally extinct or globally extinct, MNI values are converted to percentage of the total calculated MNI for the fauna and these summed by family so that their relative importance can be better appreciated.

DISCUSSION

Summary of the Fauna

Steadman (2006*a*) reported 28 species of land birds, not counting the 19 passerines, either extant or extirpated from Efate. Of these, it is likely that the *Megapodius* undescribed species C was a large example of *M. layardi*, rather than the new taxon *Mwalau* described here, whose bones would not be considered similar to *M. alimentum* in size (see discussion under genus *Megapodius*). We report a total of 30 bird species from the Teouma archaeological site on Efate, in Vanuatu (Table 5). Of these, 12 are new records for the island, which added to the 27 land birds reported by Steadman (2006*a*) total minimally 39 land birds exclusive of passerines in the original avifauna

(Table 6). Of the 12 new records, eight appear limited to the early Lapita layers at the site, with a further species represented by a single specimen found only in secondary deposition and of indeterminate age. Up to three-fourths of the new records therefore appear to have become extinct by the end of Lapita times, explaining their absence from Steadman's largely Post-Lapita collections.

The avifauna is dominated by eight species of columbids (47.5% MNI) that included five of the six columbids previously recorded from Efate: only *Ptilinopus tannensis* escaped detection in our samples. Minimally, three taxa were recorded from Efate for the first time. With the exception of a few bones, all three taxa were found only in Lapita layers at the site and may have become locally extinct by ca. 2,800 ybp. One of these, *Didunculus placopedetes*, is globally extinct, and *Ducula* sp. cf. *D. goliath* survives only in New Caledonia. The 12 bones identified as *Alopecoenas* sp. possibly represent two species, and although no ground dove is extant on Efate today, *Alopecoenas* (= *Gallicolumba*) *santaecrucis* and *A. ferruginea* are known from Santo and Tanna in Vanuatu, respectively (Steadman 2006*a*). It is probable that the absence of ground doves through most of Vanuatu is a result of human-induced extirpations, as has been demonstrated in numerous places across the Pacific (Steadman 2006*a*). Fowl are important contributors to the Teouma fauna, with the human-introduced Red Junglefowl accounting for 15% MNI and present in all sampled layers. Megapodes, with about 10% of MNI, are represented by two species, with the smaller Vanuatu Megapode most abundant, represented at all levels in the deposits and still extant today. A substantially larger extinct megapode, *Mwalau walterlinii*, n. gen., n. sp., is present only in the Lapita midden area, where it is relatively rare. The remaining significant faunal component is rails, with four species present, of which *Porphyrio melanotus* was the most abundant.

Only four of the 30 species were seabirds, three procellariids and one sulid, where paucity is also paralleled in the specimen frequency, because these taxa accounted for only 11 bones of the 1,714 identified specimens. This low frequency of seabird bones has been found elsewhere in Melanesia (e.g., for six archaeological sites in New Ireland, Bismarck Archipelago; and in Kilu Cave on Buka in the northern Solomon Islands), but often in archaeological sites seabirds dominate archaeological faunas (e.g., Mussau in the Bismarck Archipelago and Tikopia and Anuta in the Santa Cruz Group, Solomon Islands [Steadman 2006*a*]). The few data previously available for Vanuatu (Steadman 2006*a:* table 5-12) also suggested that seabirds were of minimal biological significance in archaeological sites, but in Polynesia, seabird taxa can often be abundant in such sites (Steadman 2006*a:* tables 15-2, 15-3).

Nine of the 30 species from Teouma are extinct, with four, *Mwalau walterlinii*, *Didunculus placopedetes*, an undescribed large rail, and *Eclectus* sp. cf. *E. infectus*, globally extinct. Three others, *Rhyticeros* sp. cf. *R. plicatus*, *Centropus* sp. indet., and *Ducula* sp. cf. *D. goliath*, are conservatively considered likely to be conspecific with known taxa elsewhere in Melanesia but may upon discovery of more complete material be shown to be undescribed taxa. The remaining locally extinct taxa, *Accipiter fasciatus* and one or two species of *Alopecoenas*, are or probably are known from elsewhere. These extinct taxa, *Accipiter* excluded, are represented by relatively few bones in the fauna, all of which are from the earliest Lapita midden area or from Lapita cemetery levels elsewhere on site. This observation is important to consider in the context of the site to the human colonization history of Efate. The Post-Lapita middens sampled at Teouma are minimally 100–200 yr younger than the Lapita cemetery they overlie, which has been dated approximately 3,000 ybp (Bedford 2006, Bedford et al. 2006, White et al. 2010). The cemetery is thus coeval with the colonization of the Vanuatu/New Caledonia/Fiji region 3,000 yr ago by the Lapita culture (Sand 1997, Clark and Anderson 2001, Galipaud and Swete-Kelly 2007). Therefore the Post-Lapita midden, with a date range of perhaps 2,800–2,500 calendar ybp, does not sample the period of initial human contact with the Vanuatu fauna, and so it is likely that the most human-susceptible

TABLE 5

Summary List of the Species Present and Their Representation in the Avifauna Based on 1,714 Identified Bones from Teouma

Family	Species	Common Name	Status[a]	NISP[b]	MNI[c]	% MNI	Fam. % MNI
Anatidae	*Anas superciliosa*	Pacific Black Duck		14	1	0.6	0.6
Megapodiidae	*Mwalau walterlinii*, n. gen., n. sp.	Lini's Megapode	E	45	3	1.7	9.9
	Megapodius layardi	Vanuatu Megapode		161	15	8.3	
	Megapodius ?*layardi*	? Vanuatu Megapode		8	0	0.0	
Phasianidae	*Gallus gallus*	Red Junglefowl		305	27	14.9	14.9
	cf. *Gallus gallus*	cf. Red Junglefowl		34	0	0.0	
Columbidae	*Columba vitiensis*	White-throated Pigeon		44	7	3.9	47.5
	Columbid sp. ?*Columba vitiensis*	? White-throated Pigeon		26	4	2.2	
	Macropygia sp. ?*M. mackinlayi*	? Mackinlay's Cuckoo-Dove		9	1	0.6	
	Alopecoenas sp.	Undetermined ground dove	Le	12	6	3.3	
	Didunculus placopedetes	Tongan Tooth-billed Pigeon	E	62	8	4.4	
	Columbid sp. cf. *Didunculus placopedetes*	cf. Tongan Tooth-billed Pigeon	E	10	1	0.6	
	Chalcophaps indica	Emerald Dove		41	14	7.7	
	Columbid sp. cf. *Chalcophaps indica*	cf. Emerald Dove		8	0	0.0	
	Ducula pacifica	Pacific Imperial Pigeon		146	23	12.7	
	Ducula sp. cf. *D. pacifica*	cf. Pacific Imperial Pigeon		54	3	1.7	
	Columbid sp. magn. *Ducula pacifica*	Columbid size of Pacific Imperial Pigeon		102	9	5.0	
	Ducula sp. cf. *D. goliath*	cf. New Caledonian Imperial Pigeon	Le	34	6	3.3	
	Columbid sp. magn. *Ducula goliath*	Columbid size of New Caledonian Imperial Pigeon	Le	21	0	0.0	
	Ptilinopus sp. cf. *P. greyi*	cf. Red-bellied Fruit-Dove		16	4	2.2	
	Columbid sp. cf. *Ptilinopus greyi*	Columbid cf. Red-bellied Fruit-Dove		1	0	0.0	
	Small columbid indeterminate	Small pigeon indet.		72	0	0.0	
Cuculidae	*Cuculus optatus*	Oriental Cuckoo		2	1	0.6	1.1
	Centropus sp. indet.	Indeterminate Coucal	Le	1	1	0.6	
Rallidae	*Hypotaenidia philippensis*	Buff-banded Rail		64	8	4.4	15.5
	Porphyrio melanotus	South-west Pacific Swamphen		222	18	9.9	
	Rallid sp. cf. *Porphyrio melanotus*	cf. South-west Pacific Swamphen		22	0	0.0	
	Large rail, sp. and gen indet.	Extinct large rail	E	1	1	0.6	
	Porzana tabuensis	Spotless Crake		5	1	0.6	
Procellariidae	?*Pseudobulweria rostrata*	? Tahiti Petrel		1	1	0.6	1.7
	Puffinus sp. cf. *P. bailloni*	cf. Tropical Shearwater		1	1	0.6	
	?*Puffinus pacificus*	? Wedge-tailed Shearwater		1	1	0.6	
Ardeidae	*Ardea alba*	White Heron/Eastern Great Egret		3	1	0.6	0.6
Threskiornithidae	*Threskiornis* sp. cf. *T. molucca*	Australian White Ibis		3	1	0.6	0.6
Sulidae	*Sula leucogaster*	Brown Booby		8	2	1.1	1.1

Accipitridae	*Accipiter fasciatus*	Brown Goshawk	Le	21	2	1.1	1.1
Tytonidae	*Tyto delicatula*	Australian Barn Owl		14	2	1.1	1.1
Bucerotidae	*Rhyticeros* (= *Aceros*) sp. cf. *R. plicatus*	Hornbill, cf. Papuan Hornbill	Le	9	2	1.1	1.1
Alcedinidae	*Todiramphus* sp. cf. *T. chloris*	Collared Kingfisher		6	3	1.7	1.7
Psittacidae	Indet. species, magn. *Charmosyna palmarum*	Small parrot size of Palm Lorikeet		7	3	1.7	2.2
	Eclectus sp. cf. *E. infectus*	Eclectus species	Le	4	1	0.6	
Passeriformes	Passerines indet.	Undetermined songbirds		94		0.0	
Totals				1,714	182	100	100

[a] E, extinct; Le, locally extinct but extant elsewhere.
[b] Number of individual specimens.
[c] Minimum number of individuals; but for specimens tentatively identified to a taxon already listed, only the additional MNI is indicated so that the total of the combined sample is not inflated.

taxa had already been severely impacted and some already driven extinct. This scenario explains the extreme rarity, limited to the Lapita midden area or in secondary deposition, of the large probably flightless rail and the other large birds, especially *Mwalau walterlinii*, *Rhyticeros* sp. cf. *R. plicatus*, and *Centropus* sp. indet., which, although volant, have ground-dwelling habits. The large, but volant and arboreal taxa *Didunculus placopedetes* and *Ducula* sp. cf. *D. goliath* by habit would have not been as susceptible to predation, and their extinction may have taken place over a longer period.

Given the Teouma fauna, the question could be asked as to whether there ever have been any truly large flightless birds such as *Sylviornis* from New Caledonia or *Megavitiornis* and *Natunaornis* from Viti Levu? The geologically young age of emergent land in Vanuatu, ca. 2 Ma as against ca. 37 Ma for New Caledonia and perhaps 16 Ma for Viti Levu (Chase 1971, Rodda 1994, Grandcolas et al. 2008, Neall and Trewick 2008, Murienne 2009, Hamilton et al. 2010) allows minimal time for such divergent forms to evolve. In contrast to such flightless avian taxa, endemic meiolaniid turtles in Vanuatu, Viti Levu, and New Caledonia are presumed to be able to readily disperse across the ocean (White et al. 2010). Therefore the former existence of truly aberrant avian forms such as found in Fiji and New Caledonia seems improbable.

Mwalau walterlinii *and the Diversity of Megapodes*

The description of the new species *Mwalau walterlinii* from Vanuatu increases the known number of megapode genera existing in the Holocene to 10: *Macrocephalon*, *Talegalla*, *Aepypodius*, and *Eulipoa* in the Indonesia–New Guinea region; *Progura*, *Leipoa*, and *Alectura* in Australia; the extinct *Megavitiornis* in Fiji; and *Megapodius*, widely distributed across all these regions and farther east into Oceania (Jones et al. 1995). The giant flightless *Sylviornis* from New Caledonia was generally considered also to be a megapode, but based on the autapomorphic structure of its skull it

TABLE 6

List of Nonpasserine Birds Recorded from Efate Based on Steadman's (2006*a:* tables 5-11, 15-1) Lists of Modern and Prehistorically Known Land Bird and Seabird Taxa and Those Recorded from Teouma

Family	Species	Common Name	Steadman (2006*a*)	Teouma	Age[a]
Anatidae	*Anas superciliosa*	Pacific Black Duck	Y	Y	Post-L
	Anas gibberifrons	Gray Teal	Y		
	Aythya australis	Hardhead	Y		
Megapodiidae	*Mwalau walterlinii*, n. gen., n. sp.	Lini's Megapode	?Y	Y	Lapita
	Megapodius layardi	Vanuatu Megapode	Y	Y	L and Post-L
Phasianidae	*Gallus gallus*	Red Junglefowl		Y	L and Post-L
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe	Y		
Columbidae	*Columba vitiensis*	White-throated Pigeon	Y	Y	L and Post-L
	Macropygia mackinlayi	Mackinlay's Cuckoo-Dove	Y	?Y	L and Post-L
	Alopecoenas sp.	Undetermined ground dove		Y	Lapita
	Didunculus placopedetes	Tongan Tooth-billed Pigeon		Y	Lapita
	Chalcophaps indica	Emerald Dove	Y	Y	L and Post-L
	Ducula pacifica	Pacific Imperial Pigeon	Y	Y	L and Post-L
	Ducula sp. cf. *D. goliath*	cf. New Caledonian Imperial Pigeon		Y	Lapita
	Ptilinopus tannensis	Tanna Fruit Dove	Y		
	Ptilinopus greyi	Red-bellied Fruit-Dove	Y	Y	L and Post-L
Apodidae	*Collocalia esculenta*	Glossy Swiftlet	Y		
	Aerodramus spodiopygius	White-rumped Swiftlet	Y		
	Aerodramus vanikorensis	Uniform Swiftlet	Y		
Cuculidae	*Cuculus optatus*	Oriental Cuckoo		Y	<2,500 ybp
	Centropus sp. indet.	Indeterminate Coucal		Y	Lapita
	Cacomantis flabelliformis	Fan-tailed Cuckoo	Y		
	Chrysococcyx lucidus	Shining Bronze Cuckoo	Y		
Rallidae	*Hypotaenidia philippensis*	Buff-banded Rail	Y	Y	L and Post-L
	Porphyrio melanotus	South-west Pacific Swamphen	Y	Y	L and Post-L
	Large rail, sp. and gen. indet.	Extinct large rail		Y	Indet.
	Porzana tabuensis	Spotless Crake	Y	Y	Post-L
Procellariidae	?*Pseudobulweria rostrata*	? Tahiti Petrel		Y	Post-L
	Puffinus cf. *P. assimilis*	cf. Little Shearwater		Y	Lapita
	?*Puffinus pacificus*	? Wedge-tailed Shearwater		Y	Lapita
Ardeidae	*Ardea alba*	White Heron/Eastern Great Egret		Y	Post-L
	Egretta sacra	Pacific Reef Egret	Y		
Threskiornithidae	*Threskiornis* sp. cf. *T. molucca*	Australian White Ibis		Y	Lapita
Sulidae	*Sula leucogaster*	Brown Booby		Y	L and Post-L
	Papasula abbotti	Abbott's Booby	Y		
Accipitridae	*Accipiter fasciatus*	Brown Goshawk	Y	Y	L and Post-L
	Circus approximans	Swamp Harrier	Y		
Tytonidae	*Tyto delicatula*	Australian Barn Owl	Y	Y	L and Post-L
Bucerotidae	*Rhyticeros* (= *Aceros*) cf. *R. plicatus*	Hornbill, cf. Papuan Hornbill		Y	Lapita
Alcedinidae	*Todiramphus chloris*	Collared Kingfisher	Y	Y	L and Post-L
Falconidae	*Falco peregrinus*	Peregrine Falcon	Y		
Psittacidae	*Charmosyna palmarum*	Palm Lorikeet	Y	?Y	Lapita
	Trichoglossus haematodus	Rainbow Lorikeet	Y		
	Eclectus sp. cf. *E. infectus*	Eclectus species		Y	Lapita
Species count land birds only			27	26	

Note: Steadman (2006*a*) listed 19 passerines in addition to the fauna listed here.

[a] Age lists whether the specimens come from Lapita and/or Post-Lapita contexts.

was recently transferred to its own family Sylviornithidae by Mourer-Chauviré and Balouet (2005). *Sylviornis*, however, is likely to be closely related to megapodes and adds to the diversity of these birds and further attests to the Sahul-Melanesian region as the center of diversity if not the origin of megapodes. The discovery of *Mwalau* in Vanuatu is thus not altogether unexpected given its intermediate location between Fiji and New Caledonia. The observed distribution of generic diversity also makes it likely that there is undiscovered generic diversity of megapodes in the poorly know fossil avifaunas of the Solomons, because of their greater proximity to New Guinea.

Mwalau walterlinii was a larger megapode than all extant taxa, although it was smaller than the *Progura* species from Australia. It had proportions most similar to those of *Alectura*, and its relatively large pectoral elements and lightly built legs indicate that this bird could probably fly as well as *Alectura*. The mixture of osteological features described earlier currently precludes identifying the nearest relative of *Mwalau*, and a phylogenetic analysis to determine this is outside the scope of this paper. Some of the osteological features, such as the lack of dorsal elevation of the tuberositas m. tibialis cranialis shared only with *Megavitiornis* and a proximally narrow fossa parahypotarsalis medialis, may relate to the digging or mound-building ability of *Mwalau*. The dorsal prominence of the tuberositas m. tibialis cranialis in megapodes is probably related to strong flexion of the tarsus during the raking motion associated with mound building. Similarly, the relatively larger fossa parahypotarsalis medialis of *Megapodius* and *Leipoa*, which build some of the larger mounds compared to most megapodes, appears to allow a stronger extension of the tarsus in these taxa. These preliminary observations suggest that *Mwalau* was not such a specialist mound-building bird as other megapodes. Despite the abundance of bones of megapodes in the deposit, including those of chicks, no eggshell was recovered, although it is likely that eggs would have been harvested.

Columbid Biogeography and a Melanesian-Tongan Link

As noted by Steadman (2006*a*) and Hamilton et al. (2010) the majority of birds found in Vanuatu, especially columbids, are widespread, with most shared with the Solomons or areas of Melanesia to the west such as the Bismarks. Only 12 of the 62 taxa of land and freshwater birds Steadman (2006*a*) listed for Vanuatu were considered endemic, three of which were columbids (i.e., *Ptilinopus tannensis*, *Ducula bakeri*, and *Gallicolumba ferruginea*). The addition of *Ducula goliath* to the Vanuatu fauna is the first example of a bird with a range restricted to Vanuatu and New Caledonia (data from Steadman 2006*a*). Only three other bird species, in the widespread genera *Aythya*, *Circus*, and *Artamus*, have distributions in both areas, but all range over a much greater geographic area including into Australia. This lack of overlap between the faunas of Vanuatu and New Caledonia contributes to the biotic break long recognized between these landmasses (Gibbons 1985, Bauer 1988, Hamilton et al. 2010). However, the presence of *D. goliath* in Vanuatu invites consideration of the range of *Ducula* within Vanuatu, because although *D. pacifica* is widespread, the endemic *D. bakeri* is restricted to the northern half of the archipelago, reaching only as far south as Malakula and Ambrym. The numerous *Ducula* bones recovered from Teouma on Efate had a narrow size range consistent with that for *D. pacifica* and did not provide evidence of a slightly larger taxon such as *D. bakeri*. The absence of *D. bakeri* in islands south of its historical range defies explanation in the current context. However, the presence of *Ducula* sp. cf. *D. goliath* on Efate in the recent past could have generated a mechanism to create this distribution. Competition from the combined presence of one medium and one large *Ducula* species on Efate, and presumably other southern islands of Vanuatu, could have excluded *D. bakeri* from this area. Without a more extensive fossil record this hypothesis cannot be tested, and nor can the temporal extent of this distribution be assessed, which could inform of whether *D.*

goliath is a recent colonist whose presence has excluded *D. bakeri*. However, if it is a valid reason, there should be no bones of *Ducula* cf. *D. goliath* within the range of *D. bakeri*.

A biotic break, termed Cheeseman's Line, has been identified in Vanuatu, dividing the archipelago between Efate and Erromango (Hamilton et al. 2010), which places Efate with all more northern islands. It was based on diverse data for plants, invertebrates, and vertebrates, particularly squamates. However, it is notable that *D. bakeri* was used to support the split even though it is absent from Efate and all islands between it and Malakula and Ambrym, so perhaps the faunal transition zone is broader than a single line and differs in detail by taxa.

Three avifaunal links between Tonga and either New Caledonia or southern Vanuatu have been identified based on extinct taxa. The large fossil pigeon *Caloenas canacorum* from New Caledonia was reported from Lifuka, Ha'ano, and Ha'afeva in Tonga (Steadman 1989*b*, 2006*a*) based on fragmentary remains attributed to *Caloenas* that were of similar large size to the extinct New Caledonian species. The large extinct scrubfowl *Megapodius molistructor* from New Caledonia was also reported from rare fragmentary bones from Lifuku and Faleloa in Tonga (Steadman 1989*b*, 2006*a;* Steadman et al. 2002), again, based largely on their large size. *Eclectus infectus*, established for fossils from Tonga, was also tentatively recorded from Vanuatu (Steadman 2006*b*) based on a few fragmentary bones of conformable size. However, there are widespread populations of various subspecies of *E. roratus* in Melanesia (Dickinson and Remsen 2013) for which mean average size of birds has not been established to our knowledge. So the possibility that the Vanuatu bones represent another large form of *Eclectus roratus* cannot be discounted.

To these taxa with a New Caledonian/Vanuatu-Tonga link we can now add *Didunculus placopedetes* described originally from 'Eua and Tongatapu in Tonga (Steadman 2006*c*). About 100 bones from Teouma allow a robust attribution to *Didunculus* and reveal no differences from the described bones of *D. placopedetes* from Tonga, and so perhaps offer the strongest evidence yet of conspecific populations with this distribution. In each instance this extinct connection comprised the largest taxa in their respective groups (that is, scrubfowl *Megapodius*, *Eclectus* parrots, *Caloenas* pigeons, and now *Didunculus* pigeons).

To these taxa could be considered addition of the suite of large *Ducula* species, with *Ducula goliath* in New Caledonia and *D. galeata* of the Marquesas, the only remaining extant forms. Populations of these two giant fruit pigeons were formerly linked by several similar-sized forms: *Ducula* cf. *D. goliath* from Vanuatu (data herein), *D. lakeba* from the Lau Group and perhaps another from Viti Levu in Fiji (Worthy 2001), *D. david* from Wallis Island (Balouet and Olson 1987), *D. harrisoni* from Henderson Island (Wragg and Worthy 2006), and undescribed forms in Tonga (Steadman 2006*a*) and Mangareva (Worthy and Tennyson 2004). Unlike the foregoing taxa, this suite of *Ducula* species appears to represent an allopatric radiation of large fruit pigeons, with different taxa on each archipelago.

None of the taxa with a New Caledonian/Vanuatu-Tongan distribution have yet been recorded in Fiji, including the Lau Group. It is possible that competitive exclusion, or the "founder-takes-all" density-dependent principle (Waters et al. 2013), explains the absence of these taxa in the Fiji archipelago. In Fiji, there is a rich and comparatively ancient avifauna with diverse columbids (one *Columba*, five *Ptilinopus*, three including one extinct *Ducula*, one *Gallicolumba* and *Natunaornis* [a giant terrestrial form]), two relatively large endemic *Megapodius* species and a very large flightless endemic megapode *Megavitiornis*, and large endemic *Prosopeia* parrots (Worthy 2000, 2001; Steadman 2006*a*). According to the "founder-takes-all" principle, this suite of taxa would be expected to have formed a buffer precluding colonization by dispersalist taxa with similar niche requirements. Knowing the direction of the dispersal events that led to this distribution pattern is important for predicting other taxa that may show similar patterns or the presence of other populations. Although such dispersing taxa could have originated in the Tongan archi-

pelago facilitated by the dominant east-to-west trade winds, the greatest diversity of *Megapodius*, the only extant species of *Caloenas* (although the poorly known and extinct *C. maculata* may derive from Tahiti [Gibbs et al. 2001]), and many populations of *Eclectus* lie at the western end of this range, so it is more probable (see Steadman 2006*a*) that all these taxa dispersed from west to east.

ACKNOWLEDGMENTS

We thank Walter Boles (AM) and Philippa Horton (SAM) for access to skeletal material, and Yong Yi (AM) for facilitating cataloguing of the material. We thank Jackie Nguyen for measuring *Centropus* and *T. chloris* bones at the AM and Nic Thieberger for advice on etymology of Vanuatuan words. Grant Gully (Flinders University) helped with photography.

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Appendix

Complete List of Specimens Referred to Extant Taxa from Teouma, Efate, Vanuatu

Family Anatidae
Genus *Anas* Linnaeus, 1758
Anas superciliosa J. F. Gmelin, 1789, Pacific Black Duck
am F.138826, (3A, 1.3, L2), pL ulna; F.138827, (3A, 1.3, L2/3), pt L cmc; F.138828, (3A, 1.3, L2/3), L scap; F.138829, (3A, 1.3, L2/3), dR fem; F.138830, (3A, 1.3, L2/3), L cor; F.138887, (3B, 1.9–4.9, L2), d + sL ulna; F.838930, (Mound 2b), pR cmc, sternal pt R cor; F.138931, (3A, 7.5, L2), ant and pt side stern; F.138932, (3A, 7.3, L2), R tmt, dR tib; F.138973, (3B, 7.11, L3), pt fur; F.138985, (2 ext, C + D20, L1), R scap.

Family Megapodiidae
Genus *Megapodius* Gaimard, 1823
Megapodius layardi Tristram, 1879, Vanuatu Megapode
am F.137643, (deep pit, SW corner), fur; F.137646, (4, 1, L2), sR tib; F.137647, (deep pit, central), juvenile synsacrum; F.137649, (deep pit, central), sR tmt; F.137650, (3A, 6.1, L2), sR tmt; F.137653, (2 ext, B11, L3), R scap; F.137654, (2, D10, L2/L3), dL tmt; F.137655, (2, G2, L3), pR tmt; F.137657, (2, K1/L1, L2/L3), cran pt R cor; F.137658, (2, C10, L1), sL tmt; F.137659, (2, K1/L1, L2/L3), R scap; F.137660, (2, H1, L1), p + sL tmt; F.137661, (2, J9, L3), notarium; F.137662, (2, I3, L2), pt L cmc; F.137664, (2, I9, 2/L3), juv L tmt; F.137665, (2, K1/L1, L2/L3), sL tmt; F.137666, (3B, 1.7, L2/L3), L MII.1; F.137667, (2 ext, B13, L3.1), sR tmt; F.137668, (2 ext, A16, L3.1), sR fem; F.137669, (6B, 7, L2), L ulna; F.137670, (2 ext, A18, L2), pR tib; F.137671, (3B, 2.3, L2), R tmt; F.137672, (3B, General South half, L2/L3), stern; F.137673, (2 ext, A17, L3.1), pL fem; F.137674, (3B, General South half, L2/L3), dR tib; F.137675, (6B, 6, L3), L cmc; F.137676, (3B, General South half, L2/L3), pR fem; F.137677, (2 ext, B14, L3.1), sL tib; F.137678, (2 ext, B13, L3.1), dR tib; F.137679, (3B, 1.8, L2), dR tib; F.137680, (6B, 6, L3), R hum; F.137681, (3B, 4.8, L2), R tmt; F.137682, (3B, 3.7, L2), sL ulna; F.137683, (2 ext, B14, L3.1), pt R cor juv; F.137684, (2 ext, B19, L3.1), sL hum; F.137685, (3B, 2.3, L2), ant stern; F.137686, (3B, 3.7, L2), dL tmt; F.137688, (3B, 3.7, L2), sL hum; F.137689, (3B, 1.5, L2), notarium; F.137690, (3B, 5.6, L2), ant stern; F.137691, (2 ext, B16, L3.1), dR tib; F.137692, (2 ext, A16, L3.1), sR fem; F.137693, (2 ext, B15, 2/L3.1), ant. stern; F.137694, (2 ext, A18, L3), R cor; F.137695, (3B, 5.5/5.6, L2), dL tmt; F.137696, (3B, 2.7, L2), sR ulna; F.137697, (2 ext, A16, L2 disturbed), sR tib; F.137698, (3B, 1.4, L2), R scap; F.137699, (2 ext, B16, L3.1–3.2), p + sR tib, L cor, dL tmt; F.137700, (3B, 6.6, L2), L scap; F.137701, (3B, 2.6, L3), sR ulna; F.137702, (3B, 5.7, L2), pL tmt; F.137703, (3B, 3.7, L2/L3), dR cmc; F.137704, (3B,

5.7, L2), cran pt R cor; F.137705, (2 ext, B13, L3.2), cran pt L cor; F.137706, (2 ext, A17, L3.2), dR fem; F.137707, (3B, 1.7, L3), sR hum; F.137708, (3B, 6.6, L3), dL hum; F.137709, (2 ext, A17, L3.3), pR fem; F.137710, (3B, 6.5, L2), sR cor, sL tmt; F.137711, (2 ext, B16, L3), s + dL tib; F.137712, (3B, 1.9–4.9, L2), ungual phal; F.137713, (2 ext, B14, L3.1), ungual phal; F.137714, (Mound 2b), dL hum; F.137715, (3A, 6.8, L3), L cor; F.137716, (3A, 4.6, L3), R scap; F.137717, (3A, 5.3, L2), cran pt L cor; F.137718, (3A, 2.8, L2), cran pt R cor, pL cmc; F.137720, (3A, 4.6, L2), L cor; F.137721, (3A, 5.9, L2), cran pt L cor; F.137722, (Mound L2), juv L tmt; F.137724, (3A, 0.7, L2), R hum (-ends); F.137725, (3A, 7.7, L2), L tib; F.137726, (3A, 6.7, L2), ungual phal; F.137727, (2 ext, D16, L2), L tib, pR tmt, cran pt R cor; F.137728, (2 ext, C16, L2/3), ant stern L scap; F.137729, (2 ext, C17, L3), 1L2R cor; F.137730, (2 ext, E15, L3 to base), dR tib; F.137731, (2 ext, E15, L2), dL tmt; F.137732, (2 ext, C17, L2), L ulna; F.137733, (2 ext, E16, L2), cran pt L cor; F.137734, (2 ext, D17, L2), R hum, 2L2R scap; F.137735, (2 ext, C19, L2), L scap; F.137736, (2 ext, C15, L2), cran pt L cor, L scap, pt sR tmt; F.137737, (2 ext, C20, L2), pL dL tib; F.137738, (2 ext, G16, L2), L tmt, L scap; F.137739, (2 ext, I16, L2), R tmt, metatarsal; F.137740, (2, R3, L3), sL ulna; F.137741, (2 ext, C18, L2), cran pt L cor; F.137742, (2 ext, F16, L3), sR ulna; F.137743, (2 ext, C16, L2), L scap, 1L1 cran pt L cor, R tib; F.137744, (2 ext, G18, L2), p + sL tmt; F.137745, (Trench 3, A12, L2), L cmc; F.137746, (2 ext, I15, L2), pL ulna; F.137747, (2 ext, D18, L2), cran pt L cor; F.137748, (2 ext, A20, L2), sL tmt; F.137749, (2 ext, F19, L2), dR tmt; F.137750, (2 ext, G17, L2), dR tmt juv; F.137751a, (3B ext, 5.12–6.12 5.13–6.13, L2/L3), cran pt R cor; F.137751b, (4.1, L2 (post-Lapita), sR ulna; F.137752a, (2 ext, E14, L2), cran + stern pts L cor; F.137752b, (3A, 1.8, L3), ungual phal; F.137753, (2 ext, D17, L3), pR ulna; F.137754, (2 ext, C19, L2), cran pt R cor; F.137755, (2 ext, D20, L3), pL dL tmt, metatarsal, 11 phalanges; F.137756, (2 ext, G19, L2), sR tmt; F.137757, (Quarry edge, N6, L3), dL tmt; F.137758, (2 ext, B20, L2), dL tmt; F.137759, (2 ext, H15, L2), cran pt R cor; F.137760, (2 ext, D20, L2), pR tmt; F.137761, (3B ext, 1.12–6.12 1.13–6.13, cleaning), dR tmt; F.137762, (2 ext, J18, L2), 2 pts L cmc; F.137763, (2 ext, I15, L2), dR tmt; F.137764, (2 ext, H13, L2), pL cmc, cran pt L cor; F.137765, (2 ext, D19, L2), cran pt R cor; F.137766, (3B ext, 3.12–3.13 4.12–4.13, 2 to L3), cran pt R cor; F.137767, (2 ext, C18, L3), stern end L cor; F.137768, (2 ext, I16, L2), ungual phal; F.137769, (3A, 2.9, L2), sLsR ulna; F.137770, (2 ext, J17, L2), ungual phal; F.137771, (2 ext, C18, L2), ungual phal.

Megapodius ?*layardi* Tristram, 1879, Vanuatu Megapode

AM F.137644, (3A, 1.5, L2), juv R ilium; F.137645, (3A, 1.3, L2/L3), sL fem; F.137648, (4, 3 ext, L1/L2), dR hum; F.137656, (2, H5, L2), dR rad; F.137663, (2, J1, L2), dR tib; F.137687, (3B, 5.6, L2), sR tmt; F.137719, (3A, 5.2, L3), R scap; F.137723, (Mound 2), dR rad.

Family Phasianidae

Genus *Gallus* Brisson, 1760

Gallus gallus (Linnaeus, 1758), Red Junglefowl

AM F.137958, (3A, 1.7, L2), L fem; F.137960, (3A, 1.3, L2), ant stern; F.137961, (deep pit, NE corner), R hum; F.137962, (deep pit, NE corner), R ulna + frag; F.137963, (deep pit, NE corner), R cor; F.137964, (deep pit, NE corner), L hum; F.137965, (deep pit, NE corner), R tmt; F.137966, (deep pit, NE corner), dR tib; F.137967, (deep pit, NE corner), pt fur; F.137968, (deep pit, NE corner), R cmc; F.137969, (deep pit, NE corner), L tmt; F.137970, (deep pit, NE corner), L cor; F.137972, (4, 3 ext, L1/L2), pL hum; F.137973, (deep pit, NE corner), cran pt L cor; F.137974, (deep pit, NE corner), dL ulna; F.137975, (3A, 5.1, L3), pL ulna; F.137976, (4, 3, L2), cran pt R cor; F.137977, (3, 1.1, L2), cran pt L cor; F.137978, (deep pit, NE corner), pR tib; F.137979, (Loc 1, 1, sandy soil), dL tib; F.137982, (3A, 1.4, L3), dR hum; F.137983, (3A, 1.4, L3), pL tib; F.137984, (deep pit, central), cran pt L cor; F.137985, (deep pit, NE corner), pL cmc; F.137986, (3A, 2.1, L3), L fem; F.137988, (3A, 2.1, L3), pL tmt; F.137989, (4, 1, L2), dL tmt; F.137991, (3B, 7.4 ext, L2), L cmc; F.137992, (deep pit, central), pR tmt; F.137993, (deep pit, central), pR tmt; F.137994, (3, 7.2, L2), s + pR tib; F.137995, (3A, 0.2, L3), sR tib; F.137996, (4, 1, L2), L hum; F.137997, (2, H5, L3), sR tib; F.137998, (2, H4, L1), L cor; F.138000, (2, J1, L2), dR tmt; F.138001, (2, J2, L1), pt L tmt; F.138002, (2, H4, L1), dL tmt; F.138003, (2, J1, L2), pR tmt; F.138004, (2, J9, L3), R cor; F.138005, (2, G8, L2), dR tib; F.138006, (2, G8, L2), pL tib; F.138007, (2, H2, L2), pR tmt; F.138008, (2, H1, L3), stern; F.138009, (2, I3, L2), dR tib; F.138010, (2, J9, L3), dR ulna; F.138011, (2, J9, L3), R cmc; F.138012, (2, J9, L3), pt L cmc; F.138013, (2, J9, L3), R hum; F.138014, (2, J9, L3), sL tmt; F.138017, (2, H5, L2), L cor; F.138018, (2, I7, L2), L hum; F.138020, (2, K1/L1, L3), pL cmc; F.138021, (2, K1/L1, L3), pR tib; F.138022, (2, K1/L1, L3), frag; F.138023, (2, K1/L1, L3), dR tib; F.138024, (2, K1/L1, L2), dL tib; F.138025, (2, I3, L2), pL tmt; F.138029, (2, C4, L2), dL tib; F.138030, (2, E5, L2/L3), dL tib; F.138033, (2, ?, L1), pL hum; F.138034, (2, H10, L1), L scap; F.138035, (2, C9, L2), R cor; F.138038, (2, H1, L3), pR tmt; F.138040, (2, I2, L2), pR hum; F.138042, (2, J4, L1), pt R cor; F.138043, (2, I8, L2), dR hum; F.138044, (2, B8, L2), cran pt R cor; F.138045, (2, I1, L3), sL tmt; F.138046, (2, I4, L1), pt R cor; F.138047, (2, I4, L1), pL tmt; F.138048, (2, H6, L3), pL hum; F.138049, (2, H6, L3), dL tmt; F.138050, (2, H6, L3), R cmc; F.138051, (2, H6, L3), R fem; F.138052, (2, J3, L2), dR hum; F.138053, (2, C8, L2/L3), pL tib; F.138054, (2, J1, L3), cran pt L cor; F.138056, (2, G7, L2), dR ulna; F.138057, (2, G7, L2), cran pt R cor; F.138058, (2, I9, L1), cran pt L cor; F.138059, (2 ext, A12, L2/L3), pR tmt; F.138060, (2, J9, L3), sR tmt; F.138061, (2, I10, L1), pR tmt; F.138062, (2, J1, L3), pR ulna; F.138063, (2, J1, L3), pL fem; F.138066, (2, K1/L1, L2/L3), cran pt R cor; F.138067, (2, J6, L1), sR tmt; F.138068, (2, D5, L2), dR ulna; F.138069, (2, G10, L1), pt R

cor; F.138070, (2, J6, L1), sR tib; F.138084, (2 ext, A18, L2), sL tib; F.138085, (2 ext, B15, L2/L3.1), sR tmt; F.138086, (3B, 1.2, L2), sR fem; F.138087, (3B, 4.6, L2), dR tib; F.138088, (2 ext, A18, L2.1), pR cmc; F.138090, (3B, 3.7, L2), pt R cor; F.138091, (2 ext, A18, L3.1), R cor; F.138092, (3B, 6.7, L2), cran pt R cor; F.138093, (2 ext, B15, L2/L3.1), dL fem; F.138095, (2 ext, B19, L3.1), dL tib; F.138096, (3B, 3.3, L3), pR fem; F.138097, (3B, 3.6, L2), sR tmt; F.138100, (3B, General North, L1), dR tib; F.138101, (3B, 2.7, L2), cran pt L cor; F.138102, (3B, 2.7, L2), dL tib; F.138103, (2 ext, B14, L2), R cor; F.138104, (3B, 2.4, L2), cran pt L cor; F.138105, (3B, 2.4, L2), sR hum; F.138106, (3B, 4.6, L3), stern; F.138107, (4B, no square, L1), pR fem; F.138108, (2 ext, B19, L2), dR tmt; F.138109, (3B, 2.5, L3), stern pt R cor, s tib, pt fur; F.138110, (3B, 4.1, L2/L3), pR tib, ?dR tib; F.138111, (3B, 1.9–4.9, L2), dL tib; F.138112, (B47 fill, L3), L tib, L cor; F.138113, (3B, 3.1, L3), cran pt R cor; F.138114, (3B, 4.2, L2), dL tib; F.138115, (3B, 5.8, L2), p + sR tmt; F.138116, (3B, 6.6, L3), sL fem; F.138117, (B40 fill, 3 1.2, L3), 2/1L fem, L scap; F.138118, (3B, 2.1, L3), pL hum; F.138119, (3B, 6.7, L3), R cor, pR ulna; F.138120, (7C, no square, L1–3), sL tmt, pR hum, 2 frags; F.138121, (3, 2.1, L3), pL tib; F.138122, (3B, 2.1, L3), dL tib, L fib; F.138124, (3B, 1.6, L3), dR tib; F.138125, (3B, 3.2, L3), 1pL1pR ulna, sL fem, dR rad; F.138126, (3B, 1.9–4.9, L2), R scap; F.138127, (2 ext, B17, L3.2), pR rad; F.138128, (Mound 2a), dL fem; F.138129, (3A, 6.9, L3), dR tib, L scap, L MII.1; F.138130, (3A, 5.6, L2), L cor; F.138131, (3A, 6.3, L2), dR tib, ant pel; F.138132, (3A, 6.8, L3), cran pt R cor; F.138133, (3A, 3.8, L3), pR hum; F.138134, (3A, 4.5, L2), L fem, pL tib, L fib; F.138135, (3A, 2.3, L2), 2R cor, R cmc; F.138136, (3A, 5.6, L2), L ulna; F.138137, (3A, 2.9, L2), L tmt; F.138138, (3A, 6.8, L2), L scap; F.138139, (3A, 2.8, L2), R cmc; F.138140, (3A, 3.5, L2), 2L cran pt cor; F.138141, (3A, 2.3, L2), dR rad; F.138142, (3A, 7.9, L3), L(-d) tmt; F.138143, (3A, general SW, L1), pL fem; F.138144, (3A, 3.3, L2), sR tmt; F.138145, (3A, 6.4, L2), R scap; F.138146, (7C, 15, L1), pR tmt; F.138147, (7C, 6, L1), sput tmt; F.138148, (7C, 6, L1), dR hum; F.138149, (3A, general NE, L1), pL tib; F.138150, (3A, 3.9, L2), ant stern; F.138151, (3A, 2.8, L2), L cor; F.138152, (3A, 4.4, L2), dL tmt; F.138153, (7C, 10, L1), pL tmt; F.138154, (7C, 12, L1), dL tmt; F.138155, (7C, 10, L1), dR fem; F.138156, (3A, 7.9, L2), sR tmt; F.138157, (7C, 13, L1), dL tmt; F.138158, (3A, 2.7, L2), pR rad; F.138159, (3B, 1.10/2.10/3.10/1.11/2.11/3.11, L2), pL fem; F.138160, (3B, 1.10/2.10/3.10/1.11/2.11/3.11, L2/L3), 1R1dR tmt; F.138161, (Mound 2), dL tmt; F.138162, (3A, 6.8, L2), dL ulna; F.138164, (3B, 4.10, L3), dL fem; F.138165, (3B, 3.10, L2), pL fem; F.138166, (3A, 5.4, L3), L hum, L cor, L tmt; F.138167, (3B, 3.10, L2/L3), pL hum, cran pt R cor; F.138168, (3B, 6.9, L3), L cor, sR tmt; F.138169, (3B, 4.10, L3), dL hum; F.138170, (3B, 7.7, L3), sR ulna, pt dR tmt; F.138171, (quarry edge, M1, L3), prox rad; F.138172, (3B, 2.11, L3), cran pt R cor; F.138173, (3B, L2, L3), s + dR fem, cran pt R cor; F.138174, (3B, 6.9, L2/L3), 2 pts L tmt, 2 pts pL tib, R scap, dR fem, L hum, 2 vert, 2 frags; F.138176, (3A, 0.7, L2), dR fem; F.138178, (3B, 6.11, L3), L fib, sR ulna, pR fem; F.138180, (3B, 4.10, L2/L3), pL hum, dR fem; F.138182, (3B, 5.10, L3), R scap; F.138183, (3A, 5.6, L2), dR tib; F.138184, (3A, 5.6, L1), 2 pts sR tib; F.138185, (3A, 4.2, L3), sR tib; F.138186, (3B, 4.10, L2), sR tib; F.138187, (3B, 4.11/5.11/4.10/5.10, L1), sR ulna; F.138188, (3A, 0.3, L3), L scap, cran pt R cor; F.138189, (Mound 2), 2 pts L tib; F.138190, (3B, 5.10, L3), sR tib; F.138191, (3B ext, 1.12, L3), spur off tmt; F.138192, (2 ext, E14, L2), dR cmc, s tmt; F.138193, (2 ext, I16, L2), dL tmt, R scap; F.138194, (2 ext, C + D 15 + 16, L1), sL fem; F.138195, (trench 3, A12, L3), dL tib; F.138196, (2 ext, Q + H / ? + 12, L1), dR tib; F.138198, (2 ext, E20, L2), sL fem; F.138199, (2 ext, J17, L2), R scap; F.138200, (quarry edge, N4, L2), sR fem, 2 pts mand; F.138201, (2 ext, C + D 13 + 14, L1), dR tmt, sR ulna; F.138202, (2 ext, F16, L2), sR cor; F.138203, (3B ext, 5.12, L3), sR tmt; F.138204, (2 ext, J15, L2), pL cmc, R scap, cran pt L cor; F.138206, (2 ext, F16, L2), L cor, L scap, pR hum; F.138207, (2 ext, C18, L2), cran pt L cor; F.138208, (2 ext, D17, L2), R cor, 2dR tib, ant stern; F.138209, (2 ext, E16, L2), dL hum; F.138210, (trench 3, A12, L2), pR fem, L scap; F.138211, (2 ext, G14, L2), 2 pts R tib, L scap, fur; F.138212, (quarry edge, N4 (cutout-K), L2/L3), sR tib; F.138213, (2 ext, D12, L2), dR tmt; F.138214, (2 ext, E20, L2), cran pt L cor; F.138215, (2 ext, I14, L2), dR tmt; F.138216, (2 ext, J12, L2), R cor; F.138217, (2 ext, A20, L2), L(-p) fem, sLsR hum; F.138218, (2 ext, F12, L2), cran pt R cor; F.138219, (2 ext, G–H 19–20, L1), R scap; F.138220, (2 ext, J13, L2), dR tib; F.138221, (2 ext, D16, L2), pL hum; F.138222, (2 ext, D15, L2), sR tmt; F.138223, (2 ext, C14, L2), dR tib, cran pt L stern pt L cor, dLdR rad, pL rad, pt fur, sL tmt; F.138224, (2 ext, D17, L2), L scap; F.138225, (3B ext, 4.12, L3), pR tib; F.138226, (2 ext, E16, L2), RMII.1; F.138227, (2 ext, D12, L3), R cmc; F.138228, (2 ext, D20, L2), stern pt R cor; F.138229, (2 ext, D12, L2), L tmt, cran pt R cor; F.138230, (2 ext, F19, L2), pR tmt; F.138231, (2 ext, H15, L2), dL fem; F.138232, (2 ext, H13, L2), pRsR spur tmt; F.138233, (quarry edge, N3, L3?), L ulna; F.138234, (2 ext, C12, L2), pR tib; F.138235, (2 ext, I15, L3), pL fem; F.138236, (2 ext, G12, L2), sL tmt spur; F.138237, (3A, 2.11–2.12, L2), cran pt L cor.

cf. *Gallus gallus* (Linnaeus, 1758), Red Junglefowl

AM F.137959, (deep pit, SW corner), L ulna; F.137971, (3A, 1.3, L4), sL fem; F.137980, (3B, 7.3, L2), dL ulna; F.137981, (3A, 1.1, L2), R scap; F.137987, (3A, 2.1, L3), dR fem; F.137990, (3A, 1.1, L2), R m.II.1; F.137999, (2, J6, L2), dL tmt; F.138015, (2 ext, C11, L1/L2), pt L tmt; F.138016, (2, G6, L2), dR fem; F.138026, (2, E4, L3), stern; F.138027, (2, E1, L2), pR fem; F.138028, (2, F8, L2), pL fem; F.138031, (2, H8, L2/L3), sL tmt; F.138032, (2, I7, L2/L3), L cor; F.138036, (2, F4, L2), L scap; F.138037, (2, C8, L2/L3), pR rad; F.138039, (2, C9, L2), dR ulna;

F.138041, (2, H1, L2), stern; F.138055, (2, F6, L3), dL cmc; F.138059, (2, J4, L2), dR rad; F.138064, (2, K1/L1, L2/L3), pL cmc; F.138065, (2, K1/L1, L2/L3), dL tmt; F.138094, (3B, 6.7, L2), dL rad; F.138098, (2 ext, A19, L3.2), sL fem; F.138099, (6B, L1), dR ulna; F.138123, (2 ext, B16, L3), R fib; F.138163, (3A, 6.4, L2), sR fem; F.138175, (3B, 3.10, L3), d pt s R tib; F.138177, (3A, 0.5, L2), juv R tib (-ends); F.138197, (3B ext, 5.12, L3), R fib, cerv vert.

Family Columbidae

Genus *Columba* Linnaeus, 1758

Columba vitiensis Quoy & Gaimard, 1830, White-throated Pigeon

AM F.138252, (3A, 1, L2/3), R cor; F.138253, (4, 3, L3), dR ulna; F.138285, (2, J4, L3), pL hum; F.138286, (2, J2, L1), cran pt L cor; F.138287, (2, B10, L2/3), pR tmt; F.138344, (2 ext, A18, L2), L scap; F.138345, (2 ext, B18, L3), L cmc; F.138346, (3B, 5.5/5.6, L2), stern; F.138347, (3B, 2.5, L2), R fem; F.138348, (3B, 3.2, L2/L3), stern; F.138349, (3B, 4.5, L2), L scap; F.138350, (3B, 3, L2), d + sL ulna; F.138351, (2 ext, A17, L3.2), R tib; F.138352, (3B, 4, L3), cran pt R cor; F.138353, (2 ext, B18, L2), cran pt L cor; F.138354, (3B, 4.7, L2), sL tmt; F.138459, (3A, 6.2, L2), L tmt; F.138460, (3A, 6.6, L2), sR tib; F.138461, (3A, 4.5, L2), R scap; F.138462, (3A, 2.7, L2), L scap; F.138463, (3A, 7.8, L2), juv dL ulna; F.138464, (3A, 6.7, L2), R tmt, p + sR tib; F.138465, (3A, 2.8, L2), 2R cmc; F.138466, (7C, 10, burial fill), cran pt R cor; F.138467, (3A, 4.6, L2), ant stern; F.138468, (3A, 5.3, L2), dR tmt; F.138469, (3A, 5.8, L2), stern pt L cor; F.138525, (3B,10/2.10/3.10/1.11/2.11/3.11, L2–L3), sR tib; F.138526, (3A, 7.8, L2), sL tmt; F.138527, (3A, 5.5, L2), R scap; F.138528, (3B, 3.11, L3), R cor; F.138529, (3A, 4.5, L3), cran pt R cor; F.138530, (3A, 0.6, L3), 2 pts R cor; F.138610, (2 ext, C14, L3), dL rad; F.138611, (2 ext, C16, L3), L scap; F.138612, (2 ext, C20, L2), R cor, dR fem; F.138613, (2 ext, D16, L2), L tmt; F.138614, (2 ext, B20, L2), dL rad; F.138615, (3B ext, 4.12, L3), R scap; F.138743, (2 ext, C16, L3), pt L hum.

Columbid sp. ?*Columba vitiensis* White-throated Pigeon

AM F.138254, (3A, 1.3, L2), dR fem; F.138255, (3A, 6.1, L2), R fem; F.138284, (2, I10, L2/L3), pL rad; F.138355, (2 ext, B13, L3.1), stern; F.138356, (3B, 5.5/5.6, L2), R cor; F.138357, (2 ext, B19, L3.1), pR tmt; F.138358, 6B, L1), pt R cor; F.138359, (3B, 5.7, L2/L3), stern; F.138360, (2 ext, A16, L2 disturbed), pt R cor; F.138361, (3B, 6.7–6.8, L2), pL ulna; F.138362, (3B, 2.2, L2), pR rad; F.138470, (3A, 2.4, L2), pL fem; F.138471, (7C, 15, L1), pR rad; F.138472, (3A, 6.8, L2), pR rad; F.138531, (3A, 7.4, L3), sL tib; F.138616, (2 ext, C17, L3), 2 pts L, 1 cran pt L cor, L scap; F.138617, (2 ext, C18, L2), pL fem; F.138618, (3B ext, 3.12, L3), L ulna; F.138619, (2 ext, C21, L3 to base), sL tib; F.138620, (2 ext, H11, L3), ant stern; F.138621, (2 ext, E16, L2), dL ulna; F.138622, (trench 3, A11, L2), R cor; F.138623, (2 ext, E20, L2), sL cor.

Macropygia sp. ?*M. mackinlayi* E. P. Ramsay, 1878, Mackinlay's Cuckoo-Dove

AM F.138276, (2 ext, B11 east half, L1), pL tmt; F.138321, (2 ext, A16, L3.1), dR tib; F.138322, (3B, 6.6, L2), R tmt (length 24.4 mm, vs 25.64 mm in *M. amboinensis* AM O.60006); F.138323, (2 ext, B13, L3.2), dL tib; F.138324, (3B, 1.8, L2), R hum; F.138564, (2 ext, C19, L3), pL ulna; F.138563, (2 ext, C19, L2), dR ulna, cran + stern pts L cor; F.138565, (2 ext, C15, L3), 1 ant stern.

Genus *Alopecoenas* Sharpe, 1899

Alopecoenas sp. undetermined ground dove

AM F.138239, (3A, 1.7, L3), L cor (medial length est. 26.5 mm, cotyla scapularis-acrocoracoid 8.5 mm); F.138275, (2 ext, B11, L3), cran pt R cor (cotyla scapularis-acrocoracoid 13.2 mm); F.138315, (2 ext, B16, L3.1–3.2), L cor (medial length est. 28.4 mm, cotyla scapularis-acrocoracoid 8.0 mm); F.138452, (3A, 7.2, L2), L cor (medial length est. 28.4 mm, cotyla scapularis-acrocoracoid 8.1 mm); F.138566, (2 ext, C19, L2), cran pt R cor (cotyla scapularis-acrocoracoid 7.7 mm); F.138567, (2 ext, C15, L2), stern pts LR cor, L scap, 2 cran pts L cor (cotyla scapularis-acrocoracoid 8.5 and ca. 8.5 mm); F.138568, (2 ext, H13, L2), L cor (medial length est. 26.3 mm, cotyla scapularis-acrocoracoid 7.8 mm); F.138569, (2 ext, C16, L2/L3), dL tmt.

Genus *Chalcophaps* Gould, 1843

Chalcophaps indica (Linnaeus, 1758), Emerald Dove

AM F.138249, (3A, 1.6, L2), L cor; F.138250, (3A, 1, L2/L3), dR tmt; F.138251, (3A, 1.4, L2), cran pt L cor; F.138273, (2, H5, L2), L tmt; F.138274, (2, G1/G2, L3), pL hum; F.138333, (2 ext, A18, L2), L cor; F.138334, (2 ext, B17, L3.1), pL hum; F.138335, (3B, 2.3, L3), L cor; F.138336, (2 ext, A17, L3.1), pt L cor; F.138337, (3B, 3.5, L2), cran pt R cor; F.138338, (3B, 3.5, L2), R cor; F.138339, (3B, 3.7, L2/L3), stern; F.138340, (3B, 4.5, L2), cran pt L cor; F.138341, (3, 2.1, L3), ant stern; F.138342, (3, 1.1, L2/L3), ant stern; F.138434, (3A, 6.2, L2), R cor; F.138435, (3A, 7.5, L2), cran pt L cor; F.138436, (3A, 3.6?, L3), R hum; F.138437, (3A, 5.4, L2), L cor, L scap; F.138438, (3A, 6.7, L2), dR tmt; F.138439, (3A, 5.5, L2), L cor; F138440, (3A, 2.4, L2), L cor; F.138516, (3A, 5.5, L2), L hum; F.138570, (2 ext, C20, L2), R cor; F.138571, (2 ext, C14, L3), R cor; F.138572, (2 ext, C11, L2), cran pt R cor; F.138573, (2 ext, C20, L3), L cor; F.138574, (2 ext, C16, L2/L3), LR cor, LR scap; F.138575, (2 ext, D20, L3), R cor, ?pL hum; F.138576, (2 ext, C20, L2), cran pt R cor; F.138577, (2 ext, C20, L2), 2 pts L cor; F.138578, (2 ext, B20, L2), cran pt R cor, 1pR tib; F.138579, (2 ext, D14, L3), cran pt L cor; F.138580, (2 ext, C13, L3), pL hum.

Columbid sp. cf. *Chalcophaps indica* (Linnaeus, 1758), Emerald Dove

AM F.138343, (3B, 3.8, L3), dR tmt; F.138441, (3A, 7.9, L2), pL ulna; F.138442, (3A, 5.6, L2), pL tmt; F.138443, (3A, 6.7, L2), pL tmt; F.138444, (3A, 4.6, L2), dL tmt; F.138445, (?, ?, ?), R tmt; F.138581, (2

ext, I11, L2/L3), ant stern; F.138582, (2 ext, C18, L2), L scap.

Genus *Ducula* Hodgson, 1836

Ducula pacifica (J. F. Gmelin, 1789), Pacific Imperial Pigeon

AM F.138262, (3A, 0.1, L2), sR hum; F.138263, (deep pit, NE corner), R cor; F.138264, (3A, 1.5, L3), L cor; F.138265, (3A, 4.1, L2), L scap; F.138266, (3A, 4.1, L2), L cor; F.138267, (3A, 1.1, L2), dR ulna; F.138268, (3A, 5.1, L2/L3), stern; F.138269, (3A, 1.4, L3), L scap; F.138270, (3A, 1.6, L2), L scap; F.138271, (deep pit, central), R cor; F.138272, (deep pit, central), dL fem; F.138301, (2, J3, L2), cran pt R cor; F.138302, (2 ext, I18, L1), stern; F.138303, (2, K1/L1, L2), stern; F.138304, (2, I4, L1), pL fem; F.138305, (2, I4, L1), dL fem; F.138306, (2, J3, L2), L cor; F.138307, (2, I1, L3), L cor; F.138308, (2, I9, L1), dL fem; F.138309, (2, H3, L1), pR tmt; F.138386, (3B, 2.8, L2), pL fem; F.138387, (3B, 3.7, L3), R tmt; F.138388, (2 ext, A18, L2), dL cmc; F.138389, (3B, 3.6, L2), L ulna; F.138390, (2 ext, B18, L3), pR fem; F.138391, (2 ext, B17, L3.1), dL ulna; F.138392, (2 ext, B15, L2/L3.1), L cor; F.138393, (3B, 5.5/5.6, L2), stern; F.138394, (3B, 2.3, L2), L fem; F.138395, (3B, 4.6, L2), pL hum; F.138396, (2 ext, A16, L3.1), dR ulna; F.138397, (2 ext, A16, L3.1), pR cmc; F.138398, (3B, 1.5, L2), pL tmt; F.138399, (3B, 3.7, L2), dL tib; F.138400, (3B, 3.7, L2), L cor; F.138401, (3B, 2.5, L2), pR tmt; F.138402, (3B, 2.2, L2), R cor; F.138403, (6B, 9, L3), R scap; F.138404, (3B, 2.3, L2), pR tmt; F.138405, (3B, 3.4, L3), dR rad; F.138406, (3B, general north, L1), stern; F.138407, (3B, 4.8, L2), L fem; F.138408, (3B, 4.8, L2), R scap; F.138409, (3B, 4.8, L2), cran pt L cor; F.138410, (2 ext, A17, L3.1), cran pt L cor; F.138411, (3B, 4.7, L2), L tmt; F.138412, (3B, 4.7, L2), dL tib; F.138413, (3B, 4.7, L2), R cor; F.138414, (3B, 3.7, L2/L3), L cor; F.138415, (3B, 1.6, L2), cran pt L cor; F.138416, (3B, 1.6, L2), pL tib; F.138417, (3B, 6.6, L2), cran pt R cor; F.138418, (2 ext, A17, L2), pL tmt; F.138419, (3B, 4.6, L3), L scap; F.138420, (3B, 1.3, L2), R hum, R scap; F.138421, (3B, 3.2, L3), R scap; F.138422, (3B, 2.5, L3), R cor; F.138423, (2 ext, B16, L3.1–L3.2), 2R cor, R scap, pR tmt; F.138424, (3B, 1.9–4.9, L2), p + dR ulna, R scap; F.138425, (6B, 3, L3), d + sL tib; F.138426, (8A, no square, L4), dR hum; F.138427, (2 ext, B18, L2), R cor; F.138428, (3B, 1.8, L2), ant stern; F.138429, (3B, 5.8, L2), ant stern; F.138430, (3B, 3.2, L3), R cor; F.138431, (3B, 4.7, L2), L tmt; F.138432, (3B, 4.2, L2), pL rad; F.138473, (Mound 2b), R cor, ant stern; F.138474, (3A, 4.9, L2), cran pt L cor; F.138475, (3A, 6.3, L2), L cor; F.138476, (3A, 3.3, L2), L cmc; F.138477, (3A, 4.3, L2), dL ulna; F.138478, (3A, 4.4, L3), L cor; F.138479, (3A, 2.4, L2), L tib; F.138480, (3A, 7.9, L2), L cor; F.138481, (3A, 7.4, L2), cran pt L cor, stern pt R cor; F.138482, (3A, 6.5, L2), R scap; F.138483, (3A, 7.2, L2), cran pt L cor, dR ulna; F.138484, (3A, 6.9, L2), L scap; F.138485, (3A, 3.3, L2), R scap; F.138486, (3A, 6.7, L2), R scap, dR ulna; F.138487, (3A, 3.4, L2), cran pt R cor; F.138488, (3A, 4.6, L2), L scap; F.138489, (3A, 4.8, L2), cran pt R cor; F.138490, (7C, 6, L1), dL tib; F.138491, (3A, 4.6, L2), L cor; F.138492, (3A, 2.5, L2), pL hum; F.138493, (3A, 3.2, L2), 2 pts R cor, ant stern; F.138494, (3A, 3.5, L2), L cmc; F.138495, (3A, 4.6, L2), L scap; F.138496, (3A, 5.3, L2), R hum; F.138497, (3A, 5.8, L2), R scap; F.138544, (3B, 1.10/2.10/3.10/1.11/2.11/3.11, L2), L scap; F.138545, (Mound 2), sR tmt; F.138546, (3A, 0.5, L2), R cor; F.138547, (3B, 6.9/7.9/7.7/7.8, L2), L scap, sR cmc; F.138548, (3A, 6.6, L3), R tmt; F.138549, (3B, 3.10/3.9, L3), R cor; F.138550, (3A, 4.4, L2), dL hum; F.138551, (3A, 7.7, L3), ant stern; F.138657, (2 ext, H12, L2), sR ulna; F.138658, (2 ext, C18, L2), L fem, pL tib, L fib; F.138659, (2 ext, C17, L3), cran pt L cor; F.138660, (2 ext, H15, L2), cran pt R cor; F.138661, (2 ext, C17, L2), L cor; F.138662, (2 ext, C15, L2), d + s L tib; F.138663, (2 ext, C17, L2), s + dR hum, L scap; F.138664, (Trench3, A12, L2), pL tmt, stern pt L cor; F.138665, (2 ext, J16, L2), R tmt; F.138666, (2 ext, B20, L2), dL rad, cran pt R cor, L scap; F.138667, (2 ext, D14, L2), dR fem; F.138668, (2 ext, C20, L2), R cor; F.138669, (3A, 1.10/1.11, L2), ant stern, cran pt L cor; F.138670, (3B ext, 6.12, L3), dR rad; F.138671, (quarry edge, K6, L2), R hum, ant stern; F.138672, (2 ext, C20, L2), dL fem; F.138673, (2 ext, G17, L3), R tmt; F.138674, (2 ext, H15, L2), cran pt R cor; F.138675, (2 ext, I16, L2), cran pt L cor; F.138676, (2 ext, H20, L2), dR tib; F.138677, (3B ext, 1.12–2.12/1.13–2.13, L2/L3), L cor; F.138678, (2 ext, H13, L2), L scap; F.138679, (2 ext, H15, L2), cran pt R cor; F.138680, (3B ext, 3.12–3.13/4.12–4.13, L2 to L3), L cor; F.138681, (3B ext, 5.12–5.10, L2), R cor.

Ducula sp. cf. *D. pacifica* (J. F. Gmelin, 1789), Pacific Imperial Pigeon

AM F.138261, (4, 3, L3), stern + frag; F.138288, (2, I5, L2), pR tmt; F.138289, (2, K1/L1, L2), cran pt R cor; F.138363, (2 ext, B15, L2/L3.1), dL tmt; F.138364, (3B, 4.7, L2), s hum; F.138365, (2 ext, B19, L2), sR hum; F.138366, (3B, 1.4, L2), dR cmc; F.138367, (3B, 2.2, L3), stern pt R cor, s tib, pt fur; F.138368, (2 ext, B15, L3.2), dR rad; F.138369, (3B, 1.3, L2), sR hum, L scap; F.138433, (3B, 2.7, L2), cran pt L cor; F.138508, (3A, 3.9, L2), R scap; F.138509, (3A, 7.5, L2), sR tib; F.138510, (3A, 2.9, L2), sL tib; F.138511, (7C, 10, burial fill), R cor; F.138512, (3A, 3.3, L2), stern pt L cor; F.138513, (7C, 6, pit feature), L tmt, cran pt L cor, stern pt R cor, metatarsal; F.138514, (3A, 7.6, L2), sL ulna, pR cmc; F.138682, (2 ext, D14, L2), cran pt R cor, pR fem; F.138683, (2 ext, D17, L2), R scap, dL tmt, cran pt R cor; F.138684, (2 ext, C16, L2), pR tmt; F.138685, (2 ext, C16, L2/L3), pL tib, dL rad; F.138686, (2 ext, B20, L2), sL fem, sR hum, sR tmt, R scap, 2 ant stern, pR cor; F.138687, (2 ext, D17, L2), R scap; F.138688, (2 ext, D19, L2), s + dL p + sL tmt; F.138689, (2 ext, F13, L2), R scap, stern pt R cor; F.138690, (3A, 2.11–2.12, L2), L fem, pL tib, L fib; F.138691, (2 ext, C19, L2), stern pt L cor; F.138692, (quarry edge, N5, L2), L ramus mand;

F.138543, (3B, 3.10, L2), sL tib; F.138383, (3B, 5.7, L2), sR hum; F.138693, (3B ext, 1.12–6.12, collapse), ant stern.

Columbid sp. magn. *Ducula pacifica* (Gmelin, 1789), Pacific Imperial Pigeon

AM F.138240, (3, 2.2, L2), ant stern; F.138241, (3, 5.2, L3), sR ulna; F.138256, (6, no square, L2), L scap; F.138257, (3A, 4.1, L2), R M.II.1; F.138258, (3A, 6.1, L3), cran pt R cor; F.138259, (3A, 5.1, L2/L3), pt R cmc; F.138260, (4, 1, L2), dL rad; F.138292, (2, H5, L3), dR rad; F.138293, (2, H8, L3), pt L cmc; F.138294, (2, H9, L1), pL fem; F.138295, (2, G7, L2/L3), pt L cor; F.138296, (2, I4, L1), sR tmt; F.138297, (2, G5, L2/L3), cran pt L cor; F.138298, (2, I1, L3), L scap; F.138299, (2, G2, L3), cran pt R cor; F.138290, (2, G5, L2), sR hum; F.138291, (2, G5, L2), stern; F.138300, (2, G5, L2), stern; F.138370, (2 ext, A16, L3.1), L scap; F.138371, (2 ext, A16, L3.1), L scap; F.138372, (2 ext, A16, L3.1), L scap; F.138373, (2 ext, A17, L3), L scap; F.138374, (2 ext, B19, L3.1), L cor; F.138375, (2 ext, B16, L2), dR rad; F.138376, (3B, 3.8, L2), L scap; F.138377, (3, 1.1, L3), ant stern; F.138378, (3B, 4.9, L2), dR hum; F.138379, (3B, 4.8, L3), 2 notarium; F.138380, (3B, 4.9, L3), 2 pts 1L cor; F.138381, (2 ext, B16, L3), pR tib; F.138382, (3B, 2.2, L2), stern; F.138384, (3B, 1.2, L3), cran pt L cor; F.138385, (3B, 4.7, L3), L quad; F.138498, (Mound 2a), L cor (very worn); F.138499, (3A, 7.9, L2), dL rad; F.138500, (3A, 3.9, L2), pL fem; F.138501, (3A, 2.7, L3), L scap; F.138502, (3A, 3.6, L2), R scap; F.138503, (3A, 7.9, L2), pts LR cor, dR rad; F.138504, (3A, 3.8, L2), sR tib; F.138505, (7C, 6, L1), pR fem, stern pt L cor, 2dR ulna; F.138506, (3A, 3.3, L2), dR rad, R scap, stern pt R cor; F.138507, (3A, 4.8, L2), sR hum; F.138515, (3A, 5.5, L2), sL tib; F.138532, (3B, 1.10/2.10/3.10/1.11/2.11/3.11, L2–3), R scap, stern end R cor, pR ulna; F.138533, (3B, 6.9/7.9/7.7/7.8, L2), R scap, dL cmc; F.138534, (3A, 7.1, L2), L cmc (-p); F.138535, (3A, 5.4, L3), sR hum; F.138536, (3B, 3.10, L2/L3), 2 pt sR hum; F.138537, (3A, 0.5, L2), sL cmc; F.138538, (3B, 6.1, L3), cran pt R cor; F.138539, (3A, 5.7, L2), pL rad; F.138540, (3A, 6.6, L2), sL hum; F.138541, (Mound 2), dR rad; F.138542, (3B, L2, L2), dL rad; F.138609, (quarry edge, H6, L2), pt L cor; F.138694, (2 ext, H14, L2), sR hum; F.138695, (quarry edge, J6, L2), L rad, pts LR cor; F.138696, (2 ext, C20, L2), juv L fem; F.138697, (quarry edge, J5, L2), sL tib; F.138698, (2 ext, F16, L2), R scap; F.138699, (2 ext, C13, L3), L scap, cran and stern pts 2 R cor; F.138700, (2 ext, C20, L2), pt R cor, sR hum; F.138701, (2 ext, C20, L3), pL fem, dR ulna, stern pt L cor; F.138702, (3B ext, 5.12, L3), sL tib; F.138703, (2 ext, D16, L2), dR rad; F.138704, (2 ext, E17, L3 to base), sL tmt; F.138705, (2 ext, D18, L2), pR tib, sL cor; F.138706, (2 ext, E20, L2), L Manus II.1; F.138707, (quarry edge, N4, L2), sR ulna; F.138708, (2 ext, B20, L2), 2dL cmc, 2 pts L cor, dR tmt, R scap; F.138709, (2 ext, D13, L2), sL tib; F.138710, (2 ext, F14, L2), ant stern; F.138711, (2 ext, C14, L2), pL cmc, R scap, cran pt L cor; F.138712, (2 ext, H20, L2), ant stern; F.138713, (3B ext, 1.12, L3), sR hum; F.138714, (3A, 1.10/1.11, L2), sR tib; F.138715, (2 ext, C15, L2), L scap.

Genus *Ptilinopus* Swainson, 1825

Ptilinopus sp. cf. *P. greyi* Bonaparte, 1857, Red-bellied Fruit-Dove

AM F.138.316, (3B, 4.6, L2), L tmt; F.138317, (3B, 5.6, L2), L ulna; F.138318, (3B, 3.5, L2), L cor; F.138319, (3B, 1.4, L2/L3), ant stern; F.138320, (3B, 5.8, L2), dL ulna, frag; F.138453, (3A, 3.4, L2), L tmt; F.138454, (3A, 6.3, L2), L tmt (-d); F.138455, (3A, 2.9, L2), L tmt; F.138456, (3A, 4.7, L2), dL ulna; F.138457, (3A, 6.9, L2), R cor; F.138458, (7C, 6, L1), R cor; F.138560, (2 ext, C15, L2), dR tmt; F.138561, (2 ext, C18, L2), cran pt L cor, L scap, ant stern, pt sR tmt; F.138562, (2 ext, D14, L3), cran pt R cor.

Columbid sp. ?*Ptilinopus greyi* Bonaparte, 1857, Red-bellied Fruit-Dove

AM F.138517, (3A, 7.7, L3), R cmc.

Small columbid indeterminate

AM F.138242, (3A, 1.3, L2), L cor; F.138243, (3A, 1.6, L2), pL fem; F.138244, (3A, 1.9, L2), pR ulna; F.138245, (3A, 1.9, L2), pR fem; F.138246, (3A, 1.3, L3), dL hum; F.138247, (4, 3, L2), cran pt R cor; F.138248, (3A, 6.1, L2), dL hum; F.138279, (2, B11, L3), dL hum; F.138280, (2, G1/G2, L3), R cmc; F.138281, (2, J5, L2), dR ulna; F.138282, (2, J10, L3), pL fem; F.138283, (2, A11, L2/L3), pt R tmt; F.138325, (2 ext, B15, L2/L3), R scap; F.138326, (3B, 2.1, L2), L cor; F.138327, (3B, 2.2, L2), pR tib; F.138328, (2 ext, B19, L3.1), L cor; F.138329, (3B, 5.7, L2), L cor; F.138330, (3B, 5.7, L2), dR rad; F.138331, (2 ext, B18, L2), stern pt R cor, pR tib, dL ulna; F.138332, (3B, 2.7, L2), stern pt L cor; F.138446, (3A, 6.9, L3), pR fem; F.138447, (3A, 2.8, L2), L MII.1; F.138448, (3A, 3.8, L2), pL ulna; F.138449, (3A, 6.9, L2), pL tib; F.138450, (3A, 4.6, L2), ant stern; F.138451, (3A, 4.6, L2), pL fem; F.138518, (3A, 5.5, L3), ant stern; F.138519, (3B, 4.10/4.11/5.10/5.11, L2), stern pt R cor; F.138520, (3B, 3.11, L3), stern pt R cor; F.138521, (3B, L2, L3), cran pt L cor; F.138522, (3A, 7.1, L2), L cor; F.138523, (3A, 0.7, L2), R scap; F.138524, (3A, 4.4, L3), ant stern; F.138583, (2 ext, J17, L2), pL tib; F.138584, (2 ext, C17, L3), R scap; F.138585, (2 ext, D18, L3), R scap, sL cor; F.138586, (2 ext, C14, L3), cran pt L cor; F.138587, (2 ext, C19, L2), R scap, dR ulna, stern pt L cor, dL tmt; F.138588, (2 ext, C13, L3), R scap; F.138589, (2 ext, D17, L2), L scap; F.138590, (2 ext, C16, L2), R scap; F.138591, (2 ext, D15, L3 to base), stern pt R cor; F.138592, (2 ext, A20, L2), d + sL ulna; F.138593, (2 ext, J17, L3 to base), pt R cor; F.138594, (2 ext, B20, L2), R scap, stern pt L cor; F.138595, (2 ext, C15, L2), stern pt L cor; F.138596, (2 ext, I12, L3), pt dR hum, ant stern; F.138597, (2 ext, C21, L2), L scap; F.138598, (2 ext, C19, L2), cran + stern pts L cor; F.138599, (3A, 1.10/1.11, L2), L cor; F.138600,

(2 ext, C15, L3), 2L scap, stern pt L cor; F.138601, (2 ext, D12, L3), pL fem; F.138602, (2 ext, E20, L2), dR hum, ant stern; F.138603, (2 ext, D19, L2), dL hum; F.138604, (3B ext, 1.12–2.12 1.13–2.13, L2/L3), pR hum; F.138605, (2 ext, D19, L2), cran pt R cor, ant stern; F.138606, (2 ext, D14, L3), L cor, L scap; F.138607, (3B ext, 2.12, L3), stern pt L cor; F.138608, (3B ext, 6.13, L3), L scap.

Family Cuculidae

Cuculus optatus Gould, 1845, Oriental Cuckoo

am F.138920, (7C, 6, pit feature), cranial pt L cor; F.138921, (7C, 13, L1), pR cmc, sternal pt R cor.

Family Rallidae

Hypotaenidia philippensis (Linnaeus, 1766), Buff-banded Rail

am F.138839, (3A, 1.6, L2), dL tmt; F.138840, (3A, 1.2, L2), pL fem; F.138841, (deep pit, NE corner), dL tmt; F.138842, (deep pit, SW corner), dL fem; F.138843, (deep pit, SW corner), dL tmt; F.138844, (deep pit, SW corner), dL ulna; F.138845, (3A, 0.2, L2), R cmc; F.138846, (3, 1.1, L2), R tmt; F.138862, (2, E1, L2), L cmc; F.138863, (2, A4, L1), sL tmt; F.138864, (2, H3, L1), pR tib; F.138873, (3B, 1.2, L2), dR tib; F.138874, (3B, 4.6, L2), L cmc; F.138875, (3B, 5.6, L2), dR tmt; F.138876, (3B, 5.6, L2), pL tib; F.138877, (3B, 2.1, L2), dL ulna; F.138878, (3B, 3.2, L2/L3), dR tmt; F.138879, (3B, 2.2, L2), dR tmt; F.138880, (3B, 2.3, L2), dR fem; F.138881, (3B, 2.4, L2), R ulna, dR hum, R cmc; F.138882, (3B, 1.4, L2), R (-p) fem, dL ulna; F.138883, (3B, 1.9–4.9, L2), L tib; F.138884, (3B, 2.1, L3), sR cor; F.138885, (3, 2.1, L2), pL tib; F.138933, (Mound 2a), dR tib; F.138934, (3A, 6.6, L2), dL tmt; F.138935, (3A, 2.3, L2), L tmt; F.138936, (3A, 2.3, L2), pL ulna; F.138937, (3A, 3.8, L3), ant stern; F.138938, (3A, 2.4, L2), R cor; F.138939, (3A, 2.2, L2), dR tib; F.138940, (3A, 6.4, L2), dR tib; F.138941, (3A, 6.7, L2), d + sL fem; F.138942, (3A, 2.2, L2), L cor; F.138943, (3A, 4.4, L2), pL fem; F.138944, (3A, 5.3, L2), dR tmt, p + sR hum; F.138945, (3A, 5.8, L2), dR tib; F.138974, (3B, 1.10/2.10/3.10/1.11/2.11/3.11, L2), pL fem; F.138975, (3B, 3.10, L2), dR tmt; F.138976, (3B, 0.6, L2), dL tmt; F.138977, (3B, 6.9/7.9/7.7/7.8, L2), R cor; F.138978, (3B, 1.11, L3), pR tmt; F.138979, (3B, 2.10, L3), dR tmt; F.138991, (2 ext, C15, L2), sR tmt; F.138992, (2 ext, C16, L2), pR hum; F.138994, (2 ext, C13, L2), dR tmt; F.138995, (2 ext, D11, L2), pR tmt; F.138996, (2 ext, H12, L3), pR fem; F.138997, (2 ext, E15, L2), cran pt L cor; F.138998, (2 ext, D13, L2), pR tib; F.138999, (quarry edge, M6, L2), L cor, 2 pts R hum, pL ulna; F.139000, (2 ext, C21, L2), pL tmt; F.139001, (quarry edge, N5, L2), sR tib; F.139002, (3A, 1.10/1.11, L2), pL tib, cran pt L cor; F.139003, (2 ext, H18, L2), L tmt (3 pieces); F.139004, (2 ext, J18, L2), L cor; F.139005, (2 ext, G18, L3), R hum; F.139006, (2 ext, G–H 17–18, L1), dR fem, dL ulna.

Porphyrio melanotus Temminck, 1820, South-west Pacific Swamphen

am F.137772, (3A, 4.1, L2), dR ulna; F.137773, (3A, 1.8, L3), dL tmt; F.137774, (deep pit, NE corner), dL tmt + frag; F.137775, (4, 3 ext, L1/L2), ant mand; F.137776, (3A, 1.4, L2/L3), dR tmt; F.137777, (3A, 1.4, L2/L3), pR tmt; F.137778, (3A, 1.7, L2), L fem; F.137779, (4, 1, L2), dR tmt; F.137781, (3A, 0.3, L2), pL tmt; F.137782, (3A, 0.3, L2), sR hum; F.137784, (4, 1, L2), sR tib; F.137786, (3A, 1.1, L2), dR fem; F.137787, (3A, 1.1, L2), dL tib; F.137789, (3A, 5.1, L2/L3), sR tib; F.137790, (3A, 1.4, L3), s tib; F.137791, (deep pit, central), sR tib; F.137792, (3, 7.7, L2), R cor; F.137793, (4, 1, L2), sR tib; F.137795, (4, 1, L2), dL tib; F.137796, (3A, 2.1, L2), L cor; F.137797, (deep pit, central), cran pt L cor; F.137798, (deep pit, central), R cor; F.137799, (3, 7.2, L2), L scap; F.137800, (3A, 2.1, L2/L3), dR tib; F.137801, (4, 1, L2), sR fem; F.137802, (4, 1, L2), mand; F.137803, (4, 2, L2), dR hum; F.137804, (4, 3, L3), dR tmt; F.137806, (4, 3, L2), R tmt; F.137807, (4, 1, L2), sL tib; F.137808, (3A, 5.1, L2), sR hum, pR rad; F.137809, (3A, 1.1, L2/L3), sR hum; F.137810, (2, J2, L1), pR hum, sR fem; F.137811, (2, H2, L3), L cor; F.137812, (2, H8, L2), L scap; F.137813, (2, I3, L2), pR tib; F.137814, (2, I5, L2), sR tib; F.137815, (2, G9, L2), pL tmt; F.137816, (2, H5, L2), dR tmt; F.137818, (2, E1, L2), ant stern; F.137819, (2, D9, L2), dL fem; F.137820, (2, F6, L3), cran pt L cor; F.137821, (2, J4, L2), pR hum; F.137822, (2, E10, L1), pL fem; F.137823, (2, A9, L3), sL tib; F.137824, (6B, 2, L3), frag; F.137825, (2b ext, A19, L1), pR tib; F.137826, (3B, 3.6, L2), L scap; F.137828, (3B, 5.5/5.6, L2), dR tmt; F.137829, (3B, 5.5/5.6, L2), L cmc; F.137830, (3B, 5.5/5.6, L2), pL tmt; F.137831, (3B, 5.5/5.6, L2), pR hum; F.137832, (3B, 5.5/5.6, L2), dR hum; F.137833, (3B, 2.3, L2), L cor; F.137834, (3B, 2.3, L2), L cor; F.137835, (3B, 2.3, L2), dL tmt; F.137836, (3B, 4.6, L2), pL hum; F.137837, (3B, 5.6, L2), pL tib; F.137839, (3B, 1.2, L2), pR tib; F.137841, (3B, 2.1, L2), R tmt; F.137842, (3B, 2.1, L2), pL tib; F.137843, (3B, 2.1, L2), cran pt R cor; F.137844, (6B, 9, L3), pt L cor; F.137845, (3B, 3.2, L2/L3), L cor; F.137846, (3B, 3.2, L2/L3), dL tmt; F.137847, (3B, 2.2, L2), L cor; F.137849, (3B, 2.2, L2), sL fem; F.137850, (3B, 6.7, L2), cran pt L cor; F.137851, (6B,1–6, L1), R scap; F.137852, (3B, 2.7, L2), dR tib; F.137853, (3B, 5.6, L2), dL tib; F.137853, (3B, 5.6, L2), sL tib; F.137854, (3, 1.1, L2), dR ulna; F.137855, (2 ext, B17, L2), juv pL hum; F.137856, (3B, 3.5, L2), L scap; F.137858, (2 ext, B15, L2), R cor; F.137859, (3B, 1.3, L2), pL tib; F.137861, (B47 fill, 3), pt R cor, ant stern; F.137862, (2 ext, B17, L3.2), dL tib; F.137863, (3B, 1.3, L2), R tmt (-p), sL hum; F.137864, (3B, 4.2, L2), dR tib; F.137865, (Mound 2b), p + sL, sL tmt, dL ulna; F.137866, (Mound 2a), L cor, sL tib, pR ulna; F.137867, (Mound 2a), sR hum; F.137868, (Mound 2a), dR tmt; F.137869, (Mound 2a), pR tib, sL hum; F.137870, (Mound 2a), L(-d) ulna, dRdL tib; F.137871, (3A, 6.2, L2), sL hum; F.137872, (3A, 3.9, L2), sR hum; F.137873, (3A, 4.6, L2), dR tmt; F.137874, (3A, 4.4, L3), dLpL tmt; F.137876, (3A, 7.4, L2), dR tmt, 2 ptsL ulna, pt tib; F.137877, (3A, 3.7, L2), cran pt L cor; F.137878, (3A, 2.3?, L2), L cor

(-acrocoracoid); F.137879, (3A, 7.5, L2), L scap; F.137880, (3A, 2.3, L2), L scap; F.137881, (3A, 5.6, L2), L cor; F.137882, (3A, 2.4, L2), p + sL tmt; F.137883, (3A, 5.7, L2), 2 ptsR tib (-p, -d); F.137884, (3A, 6.6, L2), dL rad; F.137885, (3A, 2.8, L2), R cor; F.137886, (3A, 6.2, L2), 3 pts sR tib, pR fem; F.137887, (3A, 7.3, L2), sL tmt, dR ulna; F.137888, (3A, 7.3, L2), pR tib (2 pts); F.137889, (3A, 7.5, L2), R cor; F.137890, (3A, 6.5, L2), sL tmt; F.137891, (3A, 5.4, L2), pt mand; F.137892, (3A, 5.4, L2), R cor; F.137893, (3A, general SW, L1), stern pt L cor; F.137894, (3A, 3.4, L2), 1dR1d + sR tmt; F.137895, (3A, 3.3, L2), pL hum; F.137896, (3A, 6.7, L2), L cor; F.137897, (3A, SE general, L1), juv pL tmt; F.137898, (quarry, deep pit), s + dL fem, 2 ptsL tib; F.137899, (3A, 2.2, L2), dR tmt; F.137900, (7C, 15, L1), cran pt R cor; F.137901, (3A, 4.8, L2), cran ptsLR cor; F.137902, (3A, 6.9, L2), R cor; F.137903, (7C, 6, L1), 2R scap, R MII.1; F.137904, (3A, 6.7, L2), pR tmt; F.137905, (3A, 4.3, L2), dR tib; F.137906, (7C, 3, L3), L tmt; F.137907, (3A, 4.8, L2), pL tmt; F.137908, (7C, 18, L1), dL tmt; F.137909, (3A, 5.9, L2), sR hum, d + sR fem; F.137910, (3A, 7.7, L2), dL tib, phal; F.137911, (3A, 3.7, L2), dR tib; F.137912, (Mound 2b), sL tmt; F.137913, (3A, 3.3, L2), pR rad; F.137914, (3A, 6.3, L2), sL hum, sL ulna; F.137915, (Mound 2a), sL hum; F.137916, (Mound 2), sL tib, ant mand, sLsR hum, dLdR tib, R cor; F.137918, (Mound 2), ant mand; F.137919, (3A, 6.4, L2), dL tib; F.137920, (quarry edge, M1/M2/N1, L2), cran pt L cor, dL rad; F.137921, (3A, 6.7, L2), R(-p) tmt; F.137922, (3A, 7.4, L2), R cor; F.137923, (3A, 7.1, L2), pL tmt; F.137924, (3A, 7.8, L3), pL hum; F.137925, (3A, 7.6, L3), sLsR tmt; F.137926, (3B, 5.11, L2/L3), ant mand; F.137928, (Mound 2), dR tib, sR hum; F.137929, (3A, 0.6, L2), sL ulna, L scap; F.137930, (quarry edge, L6, L2), R scap; F.137931, (2 ext, J20, L2), R scap; F.137933, (quarry edge, L7, L2), dL tmt, pR hum, vert; F.137934, (3B ext, 3.12/3.13/4.12/4.13, L2), dR tmt; F.137936, (2 ext, F16, L2), dL tib; F.137937, (2 ext, C13, L3), dL ulna; F.137938, (2 ext, E16, L2), mand tip, dR tib; F.137939, (2 ext, E15, L2), dR tmt; F.137940, (quarry edge, I4, L2), pL tib; F.137941, (Trench 3, A12, L2), dL tib, 2 pts dR hum; F.137942, (2 ext, I15, L2), dL tmt, dL rad; F.137943, (2 ext, G14, L2), pR ulna; F.137944, (2 ext, G + H 19 + 20, L1), pR ulna, L scap; F.137945, (2 ext, F19, L2), dR tib, sL hum; F.137946, (2 ext, B20, L2), pt mand; F.137947, (2 ext, C–D 15–16, L1), stern end L cor; F.137948, (2 ext, I–J 13–14, L1), dL tmt; F.137949, (3A, 2.10–2.11, L2), dL tmt; F.137951, (3A, 1.10/1.11, L2), 2 pts sR tib, R tmt; F.137952, (2 ext, G19, L2), L scap; F.137954, (quarry edge, L5, L2), dL tmt; F.137955, (2 ext, D19, L2), dL tib; F.137956, (2 ext, G13, L3 to base), dL hum; F.137957, (3A, 1.10/1.11, L2), dL tib; F.138019, (2, I5, L2), pt L tmt.

Rallid sp. cf. *Porphyrio melanotus* South-west Pacific Swamphen
AM F.137780, (deep pit, SW corner), sL tib; F.137783, (3A, 1.9, L2), dL hum; F.137785, (4, 1, L2), sR fem; F.137788, (Loc 1, 1, sandy soil), sR tmt; F.137794, (4, 1, L2), sR tib; F.137805, (3A, 5.1, L2), sR tib; F.137817, (2, H5, L2), ant stern; F.137827, (3B, 1.2, L2), pt R cor; F.137838, (2 ext, A16, L3.1), sL tib; F.137840, (3B, 2.5, L2), sL tib; F.137848, (3B, 2.2, L2), ant stern; F.137857, (3B, 4.5, L2), sL tib; F.137860, (2 ext, B17, L1), sL hum; F.137875, (3A, 2.8, L3), mand tip; F.137917, (3B, 4.10/4.11/5.10/5.11, L2), pR rad; F.137927, (3A, 6.3, L2), sL tib; F.137932, (2 ext, C16, L2), dL tmt; F.137935, (2 ext, E + F 20, L1), sL hum; F.137950, (2 ext, A20, L3), sL fem, dL ulna, stern pt L cor; F.137953, (2 ext, C16, L2), sL tib.

Genus *Porzana* Vieillot, 1816
Porzana tabuensis (Gmelin, 1789), Spotless Crake
AM F.138927, (3A, 4.3, L2), sLR hum; F.138928, (3A, 5.7, L2), dR tib; F.138929, (3A, 4.2, L2), dL tmt; F.138993, (Trench 3, A12, L2), pL tmt.

Family Procellariidae
Genus *Pseudobulweria* Mathews, 1936
?*Pseudobulweria rostrata* (Peale, 1848), Tahiti Petrel
AM F.138970, (3A, 6.6, L2), sR hum.

Genus *Puffinus* Brisson, 1760
Puffinus sp. cf. *P. bailloni* Bonaparte, 1857, Tropical Shearwater
AM F.138990, dR ulna (2 ext, I15, L2).

?*Puffinus pacificus* (Gmelin, 1789), Wedge-tailed Shearwater
AM F.138888, (2 ext, A16, L3.3), pL tib.

Family Ardeidae
Genus *Ardea* Linnaeus, 1758
Ardea alba modesta J. E. Gray, 1831, White Heron/Eastern Great Egret
AM F.138816, juv dL tmt, (3a, Unit 1.6, L2); F.138817, R cor, R scap (Mound 2a).

Family Threskiornithidae
Genus *Threskiornis* Gray, 1842
Threskiornis sp. cf. *T. molucca* (Cuvier, 1829), Australian White Ibis
AM F.138819, (2 ext, A18, L3), L tib (-p); R femur; F.138820, (2 ext, C18, L2), L scap; F.138821, (2 ext, H14, L2).

Family Sulidae
Genus *Sula* Brisson, 1760
Sula leucogaster (Boddaert, 1783), Brown Booby
AM F.138890, (3B, 4.8, L2), dL rad; F.138924, (3A, 2.3, L2), dL rad; F.138925, (3A, 3.5, L2), dR rad; F.138926, (3A, 3.7, L2), p + dR hum, R cor, R scap; F.138982, (2 ext, H13, L2), dR rad.

Family Accipitridae
Genus *Accipiter* Brisson, 1760
Accipiter fasciatus (Vigors & Horsfield, 1827), Brown Goshawk
AM F.138831, (4, 3 ext, L1/L2), pL tmt; F.138832, (3A, 0.1, L2), pL fem; F.138833, (3A, 0.1, L2), pL tib;

F.138834, (3A, 0.1, L2), pL tmt; F.138835, (deep pit, SW corner), R scap; F.136836, (3A, 1.9, L2), pR ulna; F.138837, (3A, 1.9, L2), R MII.1; F.138838, (3A, 0.1, L2), dL tib; F.138872, (2 ext, B11, L3), ungual phal II.3; F.138898, (3B, 2.1, L2), sR hum; F.138899, (3B, 1.1, L2/L3), dR tmt; F.138900, (3, 1.1, L2), dL ulna; F.138901, (3B, 4.1–5.1, L2 disturbed), L scap; F.138902, (B34 fill, L3), dR tib; F.138922, (3A, 2.8, L2), R cor, R scap, R cmc; F.138923, (3A, 7.9, L2), L cmc; F.138981, (quarry edge, J5, L2), sL tmt; F.138903 2158, (2 ext, B17, L3.1), ungual phal ?III.4; F.138904, (3B, 2.1, L3), ungual phal II.3.

Family Tytonidae
Genus Tyto Billberg, 1828
Tyto delicatula (Gould, 1837), Australian Barn Owl
am F.138123, (4, 3, L2), R cmc; F.138866, (2, H4, L3), pR tib; F.138868, (2, G8, L3), dR tmt; F.138870, (2, H3, L3), dL rad; F.138871, (2, J4, L2), L cor; F.138891, (2 ext, B17, L3.1), dR ulna; F.138892, (2 ext, A18, L2.1), L tmt; F.138893, (2 ext, A18, L2.1), dL fem; F.138894, (2 ext, A18, L2.1), dL tib; F.138895, (2 ext, A18, L2.1), dR tib; F.138896, (3B, 2.3, L2), cran pt R cor; F.138897, (3B, 5.5, L3), R cmc; F.138984, (2 ext, J19, L2), pt L cor; F.138983, (2 ext, E20, L2), dR tib.

Family Alcedinidae: Halcyoninae
Genus *Todiramphus* Lesson, 1827
Todiramphus sp. cf. *T. chloris* (Boddaert, 1783), Collared Kingfisher
am F.138824 (3A, 6.1, L2/L3), dR ulna; F.138825 (4, 1, L2), R hum; F.138919 (7C, 3, L3), R hum; F.138980 (quarry edge, M4, L3), R hum, LsR fem.

Family Psittacidae
Indeterminate species, magn. *Charmosyna palmarum* (Gmelin, 1788), Palm Lorikeet
am F.138886, (3B, 1.4, L3), R ulna, dR hum, R cmc; F.138986, (2 ext, C16, L2), pR ulna; F.138987, (2 ext, F13, L3), sternal pt L cor; F.138988, (3B ext, 1.13, L3), stern pt R cor; F.138989, (2 ext, C13, L3), pR ulna.