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A NEW EXTINCT SPECIES OF GIANT PIGEON
(COLUMBIDAE: *DUCULA*) FROM ARCHEOLOGICAL
DEPOSITS ON WALLIS (UVEA) ISLAND,
SOUTH PACIFIC

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Abstract.—A new species of giant pigeon, *Ducula david*, is described from an archeological excavation on Uvea Island, Wallis group. The new species was contemporaneous with early Lapita culture. *Ducula david* is related to, but larger than, either *D. pacifica* or *D. galeata*. It was sympatric with *D. pacifica* and provides further evidence that more than one species of *Ducula* co-existed on small Pacific islands prior to the arrival of man, who was responsible for the extinction of larger species of *Ducula* throughout almost the entire Pacific.

The Wallis Islands, consisting of the large island of Uvea and some 22 much smaller satellites, lie in the South Pacific about 385 km northeast of Fiji and 300 km west of Samoa (13°12' to 13°24'S; 176°6' to 176°14'W). In the area between Fiji and Samoa, the Wallis group forms the northern point of a triangle with the Horn Islands (Futuna) to the southwest, and Niuafu'ou, a remote northern outlier of the Tonga group, to the southeast. The island of Uvea is 14 km long by 7.5 km wide, with an area of 95 km² and a maximum elevation of 142 m. The preceding is summarized from Stearns (1945) and Aubert de la Rüe (1963).

Excavations of Polynesian archeological sites on Uvea by Frimigacci, Siorat, and Vienne (see Appendix) have produced a few vertebrate remains, mainly of pig, sea turtles, and birds. Among the latter are bones belonging to an undescribed species of pigeon of the genus *Ducula*. The material described below is housed in the collections of the Département des Sciences Humaines, Office de la Recherche Scientifique et Technique Outre Mer (ORSTOM), Nouméa, New Caledonia.

Class Aves
Order Columbiformes
Family Columbidae
Genus *Ducula* Hodgson, 1836

The imperial pigeons (*Ducula*) can be distinguished from other large pigeons in the Pacific by the widely separated proximal foramina of the tarsometatarsus, the inner foramen being very large and separated from the inner side of the bone only by a thin ridge. Also, the inner cotyla is hooked anteriorly.

Ducula david, new species
Fig. 1

Holotype.—Right tarsometatarsus (MU 021 A/83 3335), lacking the hypotarsus and the distal end 1 cm below the facet for metatarsal I, internal cotyla damaged.

Type locality.—Utuleve (site WF-U-MU 21A of Frimigacci et al., see Appendix), west side of the island of Uvea, Wallis group, South Pacific.

Horizon and age.—Late Holocene archeological deposits, Bed VI^a, 0.80–0.85 m be-

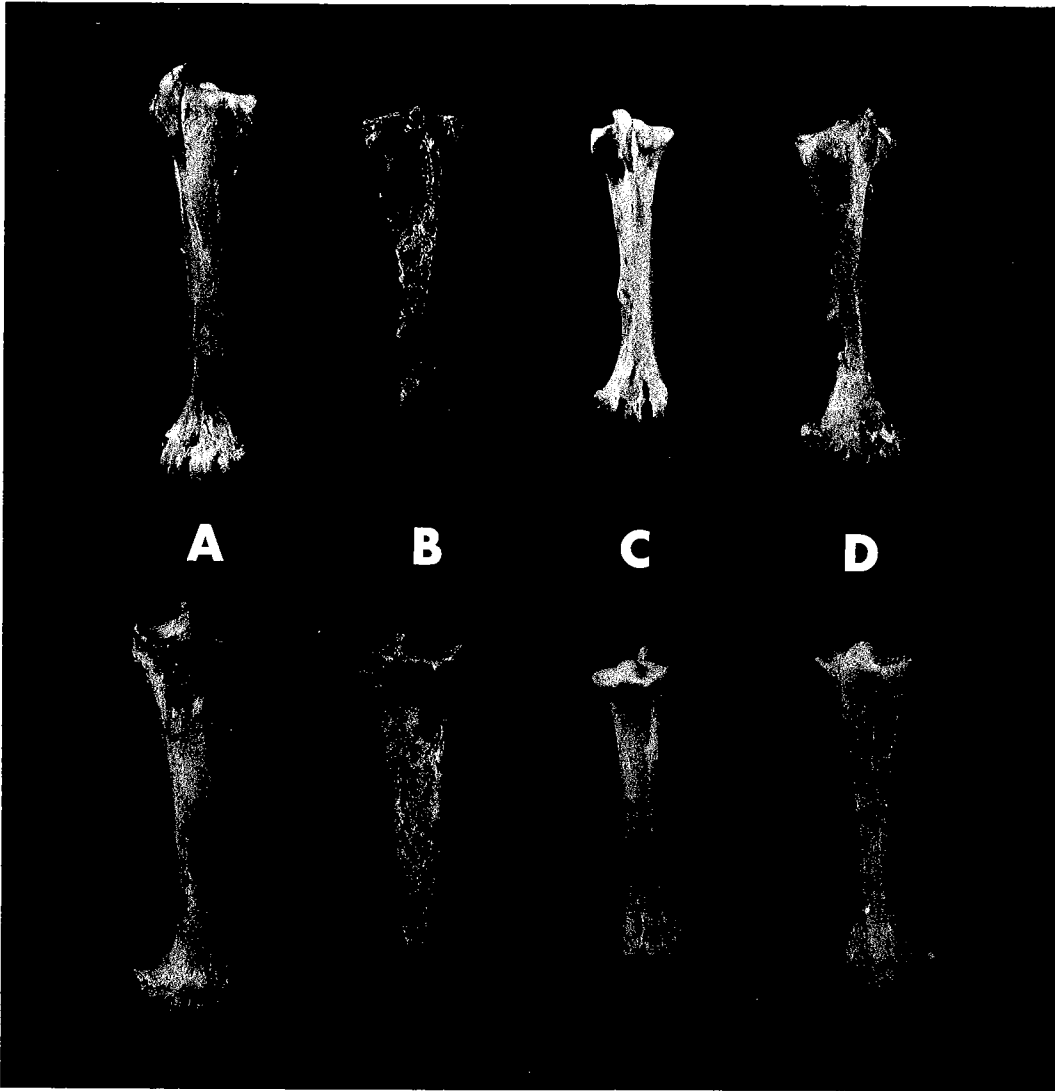


Fig. 1. Tarsometatarsi of *Ducula* in posterior (top row) and anterior (bottom row) views. A, *D. galeata*; B, *D. david*, new species, holotype; C, *D. pacifica*; D, *D. goliath*. 1.5 \times .

low surface, in association with Lapita ceramics of the Utuleve II type (see Appendix; Fig. 2). The radiocarbon age of the bed below that yielding the holotype is 2350–2550 YBP (Frimigacci, pers. comm.). Lapita culture appeared in Samoa and Tonga about 2500 to 3000 YBP and pottery manufacture is thought to have ceased there early in the Christian era (Green 1979, Davidson 1979). The bones of *D. david* were probably de-

posited between about 2000 and 2500 YBP (see Appendix).

Paratypes.—Fragment of a left coracoid (MU 021 A/83 4252) from the same locality as the holotype but from a lower level. Anterior portion of a left scapula (UMU 46 A A1 A2/83 1352) from the Malama Tagata site (see Appendix, Table 2).

Measurements of types.—See Table 1.

Etymology.—In a genus with a species

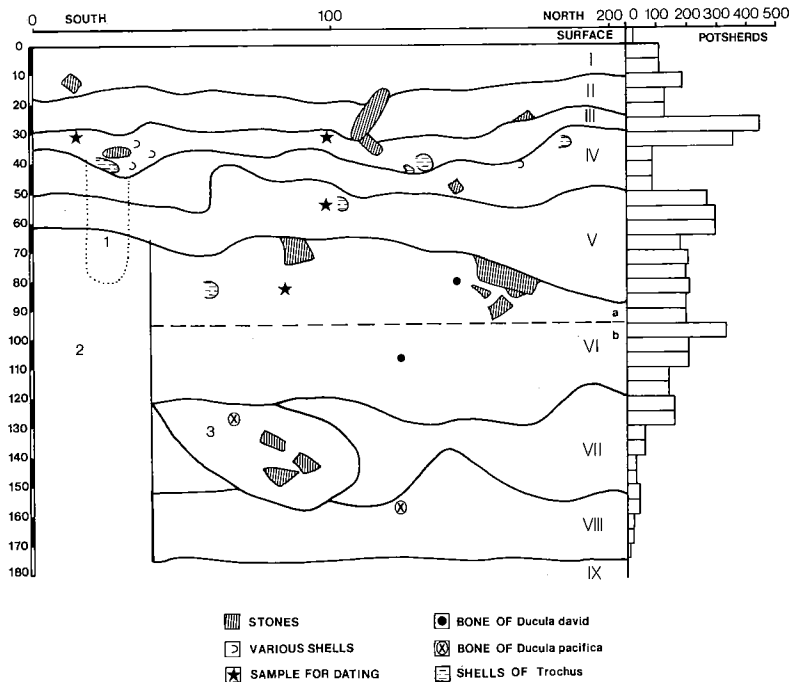


Fig. 2. Stratigraphic section of the excavation at Utuleve, Uvea, Site W-FU-MU 21A. The column on the left gives depth in cm. The column on the right shows the number of potsherds found in each 5 cm interval of the dig. Feature 1 is a post hole, feature 2 an unexcavated control column, and feature 3 a pit filling. *Trochus* is a large marine gastropod.

named *goliath*, it seems fitting to dedicate another species to David, whose name is invariably linked with the giant Philistine. In a reversal of the biblical fable, *Ducula david* was larger than *D. goliath* but perished, whereas the New Caledonian *D. goliath* is smaller and still survives.

Diagnosis.—A very large species of *Ducula*, with the tarsometatarsus larger and more robust than in either *D. goliath* or *D. galeata*. Tarsometatarsus with well developed proximal inner foramen, stout shaft, very well developed facet for metatarsal I, and proximal foramina widely separated; tubercle for tibialis anticus located on external edge of shaft.

Comparative material (skeletons) examined.—*Ducula goliath*, 1; *D. galeata*, limb bones removed from skin; *D. pacifica*, 3 + 3 partials; *D. aurorae*, 1; *D. oceanica*, 1; *D. pinon*, 2; *D. badia*, 3; *D. myristicivora*, 1 partial; *D. perspicillata*, 8; *D. radiata*, 1; *D.*

aenea, 17; *D. bicolor*, 7; *D. luctuosa*, 1; *D. spilorrhoea*, 1. All specimens in National Museum of Natural History, Smithsonian Institution, except *D. goliath*, Muséum National d'Histoire Naturelle, Paris.

Comparisons.—Among the species groups of *Ducula* recognized by Goodwin (1983), that containing *D. pacifica*, *D. oceanica*, *D. aurorae*, and *D. galeata* is very uniform in tarsometatarsal morphology. *Ducula david* shares with these species the same disposition of the muscular insertions anterior and posterior to the internal cotyla, both being triangular in shape and oriented at 45° to the long axis of the bone. *Ducula pacifica* is the most similar species in osteology to *D. david*. The proximal foramina of the tarsometatarsus are more widely separated in *D. david* than in any other species, and the metatarsal facet is much better developed, occupying half the width of the shaft.

Discussion.—Throughout the Pacific, the

Table 1.—Measurements (mm) of *Ducula david*, new species, compared with other large species of *Ducula*.

	<i>D. david</i>	<i>D. galeata</i>	<i>D. goliath</i>
Tarsometatarsus			
Distance between proximal end of metatarsal facet and internal cotyla	20.8	20.5	18.6
Proximal width	11.9	11.5	10.3
Depth of inner cotyla	6.3	5.3	4.2
Width of inner cotyla	5.3	4.2	3.8
Distance between proximal foramina	3.2	2.0	2.4
Width of shaft at metatarsal facet	6.2	4.8	5.1
Depth of shaft at metatarsal facet	3.9	3.5	3.3
Scapula			
Maximum diameter of glenoid facet	5.5	4.1	3.9
Maximum proximal width	11.9	8.9	8.6
Width of neck	4.8	3.1	3.1
Depth of neck	2.6	1.8	2.0
Coracoid			
Minimum diameter at mid-point	4.4	3.1	3.0
Maximum diameter at mid-point	4.8	3.3	3.2

very large forms of *Ducula* appear to have been especially vulnerable to extinction. The only historically known populations of pigeons of this size in Oceania are *D. goliath* in New Caledonia and *D. galeata* of Nuku Hiva, Marquesas. Recent discoveries in archeological and paleontological sites, as well as an account from Captain Cook's second voyage, have shown that *D. galeata*, or a closely similar form, occurred not only on other islands of the Marquesas (D. W. Steadman, in press), but on Henderson Island in the remote Pitcairn group (Steadman and Olson 1985), on Mangaia in the Cook group (Steadman 1985), and on Tahiti, in the Society group (Lysaght 1957). [Within *Ducula*, the specific name *Columba reinholdforsteri* Wagler, 1829, is probably a

senior synonym of *Serresius galeata* Bonaparte, 1855 (Lysaght 1957; Bruce et al. 1985; Olson and Steadman, in press).] *Ducula galeata* was therefore a widespread species that might be expected in deposits on many other islands as well.

The same was probably true of *D. david*. A very large pigeon has been reported from archeological deposits in the Lakeba Islands in the Fiji archipelago (Gibbons and Clunie 1986; specimens examined by Olson and D. W. Steadman), which, from its relative proximity to the Wallis group, might be referable to *D. david* or a closely allied form. From the island of Lifuka in the Tonga group, a species of *Ducula* even larger than *D. david* has been discovered in an archeological site (D. W. Steadman, pers. comm.).

The evidence of numerous extinct populations of large species of *Ducula* in archeological deposits shows that these birds persisted until the arrival of man, and their extinction is doubtless attributable to human influence. Whereas many man-caused extinctions of birds in the Pacific were due to habitat destruction or introduced predators (Olson and James 1984), the demise of the large species of *Ducula* was probably largely a result of direct overexploitation. For example, pigeon snaring was a very important facet of Tongan culture (McKern 1929, Gifford 1929) and the same is likely to have been true all through Polynesia.

The artificial, man-induced, pattern of distribution of pigeons in the Pacific has given rise to numerous erroneous systematic and biogeographic conclusions. Mayr (1940, 1942) has cited *D. galeata* as a classic case of allopatric speciation, as he supposed it to be only a representative of *D. pacifica* that evolved its manifestly divergent characters as a result of its great isolation in the Marquesas. Discounting the benefits of hindsight, it seems unbelievable that such a highly volant species as *D. galeata* would be confined to a single island and not be found elsewhere in the Marquesan archipelago. In any case, *D. galeata* was widely

Table 2.—Provenance of bones of *Ducula* and *Gallus* from archeological sites on Uvea, Wallis Islands.

Catalog	Bed	Depth	Pottery type	Species	Element
Site W-FU-MU 21A Utuleve					
3335	VI ^a	0.80–0.85 m	Utuleve II	<i>D. david</i> Holotype	Tarsometatarsus
4252	VI ^b	1.00–1.10 m	Utuleve I	<i>D. david</i> Paratype	Coracoid
5275	VIII	1.50–1.60 m	Utuleve I	<i>D. pacifica</i>	Coracoid
4950	VII	1.20–1.30 m	Utuleve I	<i>D. pacifica</i>	Coracoid
941	VI ^a	0.80–0.85 m	Utuleve II	<i>G. gallus</i>	Tibiotarsus
Site W-FU-MU 46-A Malama Tagata					
1352	8	1.40–1.43 m	Utuleve I	<i>D. david</i> Paratype	Scapula
1138	8	0.95–1.00 m	Utuleve I	<i>D. pacifica</i>	Scapula
1059	8	0.80–0.85 m	Utuleve II	<i>G. gallus</i>	Tibiotarsus

sympatric with smaller species of *Ducula* and is not merely a well-marked allospecies of *D. pacifica*. Modern concepts of biogeography and competitive exclusion have been used by Holyoak and Thibault (1978) to explain why the species of *Ducula* (and fruit-doves of the genus *Ptilinopus* as well) are allopatric throughout most of the Pacific. Paleontological and archeological evidence has now refuted these ideas by showing that two forms of *Ducula* occurred sympatrically over wide areas.

Ducula pacifica Gmelin, 1789

Material.—Two bones from the type locality of *D. david* and one other from the nearby Malama Tagata site (see Appendix, Table 2) do not differ in size or in morphology from bones of this widespread species.

Remarks.—*Ducula pacifica* occurs today in the Wallis group and has been recorded elsewhere from the Solomons east to Samoa, Tonga, and the Cook Islands.

Order Galliformes
Family Phasianidae
Genus *Gallus* Brisson, 1760
Gallus gallus Linnaeus, 1758

Material.—Two distal ends of tibiotarsi.

Remarks.—These bones of domestic fowl, a species imported to the island by Polynesians, show significant variation in size

(UMU 46 A, A1–A2 /83 1059—distal width 12.1 mm, distal depth 13.5; UMU 24 A 83 941—distal width 10.3, distal depth 10.8).

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Appendix

Preliminary Report on Archeological Sites on Wallis (Uvea)
Island Yielding Bones of Pigeons (*Ducula*)D. Frimigacci, C. Sand, J. P. Siorat, and B. Vienne
(translated and edited by Storrs L. Olson)

The site yielding bones of *Ducula david* (designated WF-U-MU 21A) is located at Utuleve, at about the midpoint of the western side of the island of Uvea. The entire archeological sequence of the island was exposed in this excavation. In the eight beds that were recognized (Fig. 2) are ceramics that correspond to three distinct levels: Utuleve I, the oldest, and Utuleve II and III, all three belonging to the same cultural unit, the Lapita. The superficial soil at the site was covered with wild yams and with numerous potsherds strewn about. The description of the different beds follows, with color designations from the Munsell soil color chart in parentheses.

Bed I.—Black humic soil (7.5 YR 3/2) heavily disturbed by agricultural activity.

Bed II.—Black sandy clay (7.5 YR 3/2) invariably culturally altered. Pottery and food remains more abundant than in Bed I.

Bed III.—Dark sandy soil (10 YR 3/1) spared by farmers. This is an archeological filling composed of large shells, most often burnt, hearth stones, and a great number of potsherds. A post hole is contemporaneous with this level (Feature 1 in Fig. 2).

Bed IV.—Light sandy soil (10 YR 3/3) with some burnt shells representing the base of Bed III.

Bed V.—Gray sandy soil (10 YR 3/2) in which the pottery is different from the overlying beds. Numerous shells present. This bed is an archeological filling with a very great density of remains at the surface. A control column was left in place below this bed (Feature 2 in Fig. 2).

Bed VI^a.—Deep ochraceous sandy soil with food remains and hearth stones. First appearance of potsherds with stamped impressions.

Bed VI^b.—Light ochraceous sandy soil (10 YR 3/3), the difference in color from VI^a being most noticeable on the west face. Elsewhere the color of Bed VI is uniformly light ochre. The greatest concentration of pottery is found at the surface of Bed VI^b and the first dotted and geometric Lapita decorations appear here.

Bed VII.—Brown sandy soil (10 YR 6/4) in which was found a pit filling of black sediment rich in pottery and food remains (Feature 3 in Fig. 2).

Bed VIII.—Very light sandy dune soil (10 YR 7/4), without anthropic coloration, in which some potsherds still occur.

Bed IX.—Consolidated beach sand consisting of coarse shell fragments, archeologically sterile.

One bone of *Ducula david* and one of *D. pacifica* were recovered from a site (WF-U-MU-O46-A) at the stone monument of Malama Tagata, also in the Utuleve region. The same three cultural levels (Utuleve I, II and III) as in the preceding site were present here. The bones come from a low level (ca. 1.5 m below surface; Table 2) in a dark sandy clay layer (Bed 8) resting immediately above a basalt monument.

The pigeon bones from the preceding two sites came from levels containing ancient Lapita pottery. At site WF-U-MU 21A, Utuleve III pottery occurred in beds I to IV. This most recent ceramic type is undecorated and is found throughout Uvea. Utuleve II pottery appears in beds V and VI^a. This is much finer than the preceding, with rare decorations confined to the borders. The same pottery, which goes back to the first centuries BC, is found at Futuna (Kirch 1976; Frimigacci, Siorat, and Vienne, in prep.), and is comparable to that from the Singatoka site on Fiji dating to the same epoch. Utuleve I pottery, which is even more ancient, with dentate stamped (*pointillé*) decorations, appears in beds VI^b to VIII. The same ceramic sequence (Utuleve I, II, III) is revealed at Futuna (Frimigacci, Siorat, and Vienne, in prep.).

The stratigraphic position of the bones shows that these pigeons coexisted with the first human occupants of Uvea. The extinction of *Ducula david* may have taken place in the first centuries AD. The Polynesians attached considerable significance to pigeons. Tongan nobles used to construct "pigeon mounds," called *sia heulupe*, from which they evidently snared pigeons (McKern 1929).

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