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A NEW SPECIES OF SMALL FLIGHTLESS DUCK FROM AMSTERDAM ISLAND, SOUTHERN INDIAN OCEAN (ANATIDAE: *ANAS*)[1]

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Abstract. The islands of Amsterdam and St. Paul each appear to have been inhabited by endemic populations of ducks that were exterminated by humans or human-introduced mammals in the past two hundred years. The duck from St. Paul is known only from a historical account in 1793. Abundant bone remains of a duck from Amsterdam Island are described as a new species, *Anas marecula*. This was a small, teal-sized species with very reduced wings and pectoral girdle, so that it was certainly flightless. The short, pointed bill suggests a possible derivation of the species from an ancestor related to the widgeons formerly segregated in the genus *Mareca*.

Key words: Anas marecula; *new species; Amsterdam Island; St. Paul Island; flightlessness; paleontology; extinction.*

INTRODUCTION

The islands of Amsterdam and St. Paul in the southern Indian Ocean are isolated from the nearest point of mainland in Madagascar by a distance of some 2,500 km. The distance separating the islands themselves is 80 km, so that any species of vagrant land bird that colonized one of the islands may have colonized the other as well. We now know that such colonizations must have taken place from the fossil record and one account of an 18th century visitor. Unfortunately, because of the islands' strategic position between Africa and Australia, they were often visited by ships for supplies and later by whalers and sealers, who, through fires and the introduction of domesticated and commensal mammals, irrevocably altered the terrestrial ecosystems and caused the extermination of all land birds before they could be documented scientifically (Paulian 1960; Segonzac 1972; Jouventin 1994; Micol and Jouventin 1995).

That a sighting in 1696 of "two four-footed animals resembling a weasel and a fox" on Amsterdam may have been based on skulking rails and ducks as posited by Bourne et al. (1983) is equivocal at best. Of far greater interest, however, is the report of the explorer John Barrow, who was on St. Paul Island on 2 February 1793, where he mentioned the presence of "a small brown duck, not much larger than a thrush" that was "the favourite food of the five sealers living on the island" (quotes from Bourne et al. 1983).

Among numerous bones of seabirds collected on Amsterdam Island in 1955–1956, Jouanin and Paulian (1960) identified remains of a mummified rail that crumbled to dust, and two tarsometatarsi and an incomplete cranium of a very small duck supposedly about the size of a Garganey (*Anas querquedula*). These remains of land birds, they diffidently suggested, may have been derived from vagrants. Bourne et al. (1983)

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FIGURE 1. Lateral view of skulls of *Anas*, top to bottom: *A. querquedula*; *A. marecula*, new species, rostrum USNM 486686 (holotype), cranium 486687; *A. penelope*. Scale = 2 cm.

pointed out that vagrants were unlikely to have been sufficiently numerous to have fed five sealers and went on from the preceding evidence to speculate that there had been a "small dark endemic form of Garganey" on both Amsterdam and St. Paul Islands. Their suggestion of the affinities of this bird were predicated solely on small size and the fact that Garganey have been reported to stray to Madagascar and the Mascarenes.

Martinez (1987) collected thousands of bones of birds from various cavities and shelters in basaltic rocks on Amsterdam Island, most of which were of seabirds. Although no further remains of rails were encountered, bones of a very small duck were relatively common and were found in seven sites ranging from sea level to 500 m throughout most of the island's biotopes. All the major elements of the skeleton were represented and the number of individuals was not fewer than 33. Martinez (1987) presented measurements, preliminary comparisons of the Amsterdam duck, a Simpson diagram showing relative proportions of the limb elements, and photographs of some of the bones. He concluded that this was a very small species of *Anas*, with a fairly robust hindlimb for terrestrial locomotion, but very reduced wing and pectoral girdle suggesting weak powers of flight or even flightlessness. The impressions for salt glands were not well developed, indicating that the species was probably not coastal in habits, which accords with the occurrence of duck bones over much of the interior of the island. Although Martinez made allusions to resemblances to teal ("sarcelles"), he made no further refinement of the possible affinities of the Amsterdam duck, which has remained unnamed up to the present. The purpose of the present

FIGURE 2. Dorsal view of skulls of *Anas*, left to right: *A. penelope*; *A. marecula*, new species, rostrum USNM 486686 (holotype), cranium 486687; *A. querquedula*. Scale = 2 cm.

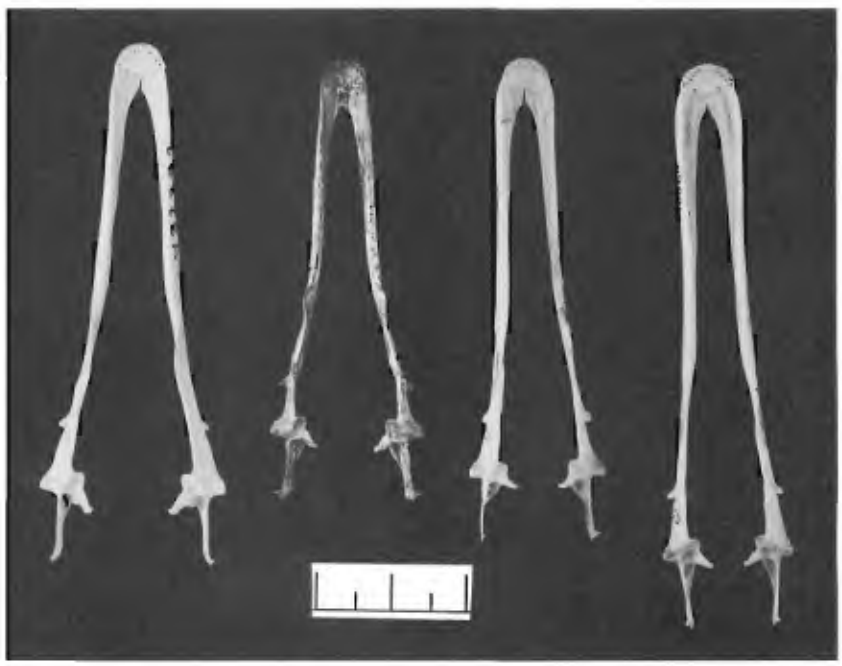

FIGURE 3. Dorsal view of mandibles of *Anas*, left to right: *A. penelope*; *A. marecula*, new species (USNM 486688); *A. hottentota*; *A. querquedula*. Scale = 2 cm.

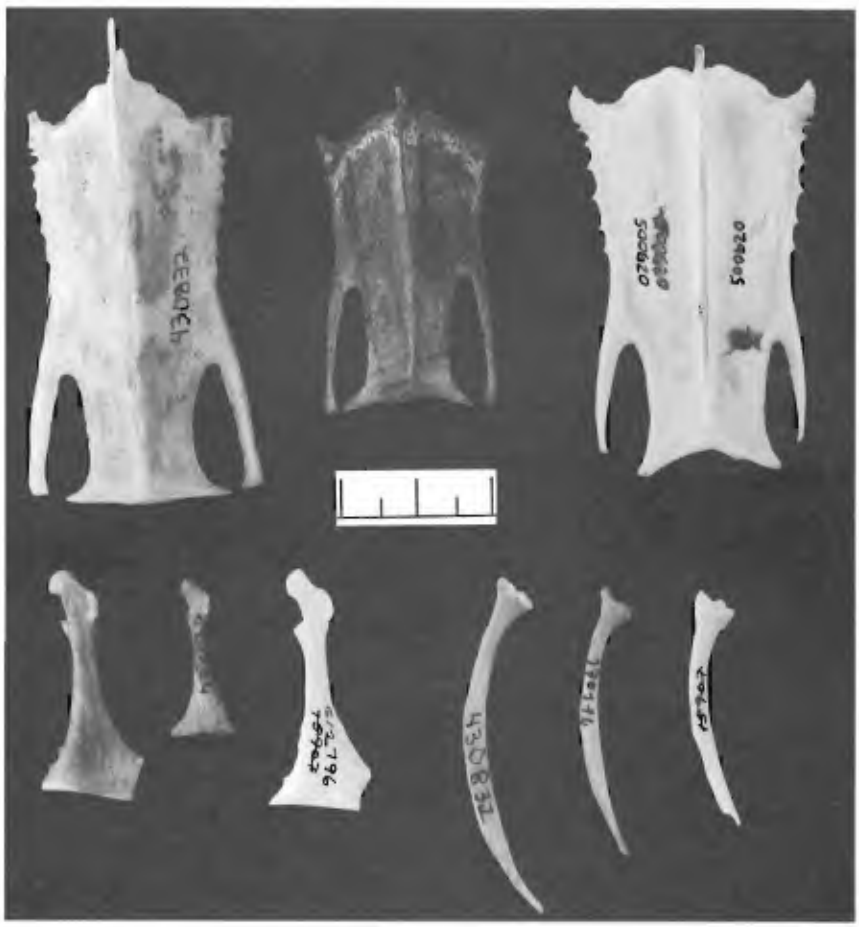

FIGURE 4. Ventral view of bones of pectoral girdle of *Anas* (top, sterna; bottom left, coracoids; bottom right, scapulae), left to right in each group: *A. hottentota*, *A. marecula*, new species (USNM 486690, 486695, 486696); *A. aucklandica*. Scale = 2 cm.

paper is to remedy this nomenclatural deficiency, as well as to speculate briefly on the affinities and economy of this curious, extinct duck.

SYSTEMATIC PALEONTOLOGY

Genus *Anas* Linnaeus, 1758

We agree with Martinez (1987) that the Amsterdam duck is referable to the widespread and diverse genus *Anas*. The only ducks that have successfully colonized and become adapted to terrestrial habitats on remote oceanic islands are members of the genus *Anas* (Lack 1970, Weller 1980), including the strange moa-nalos of the Hawaiian islands, which were thought possibly to be derivatives of *Anas* based on morphology (Olson and James 1991), a relationship confirmed by unpublished DNA data from the laboratory of R. Fleischer at the National Zoological Park.

Anas marecula, new species (Figs. 1–8)

Holotype. Complete rostrum (Figs. 1–2), vertebrate paleontological collections of the National Museum of Natural History, Smithsonian Institution, USNM 486686 (field number 150724).

Type locality. Amsterdam Island, Southern Indian Ocean. Collected by J. Martinez in November 1983.

Age. Holocene. Bones were collected at the surface in caves and fissures in rock. Although undated, the better-preserved of these specimens are probably no more than a few hundred years old.

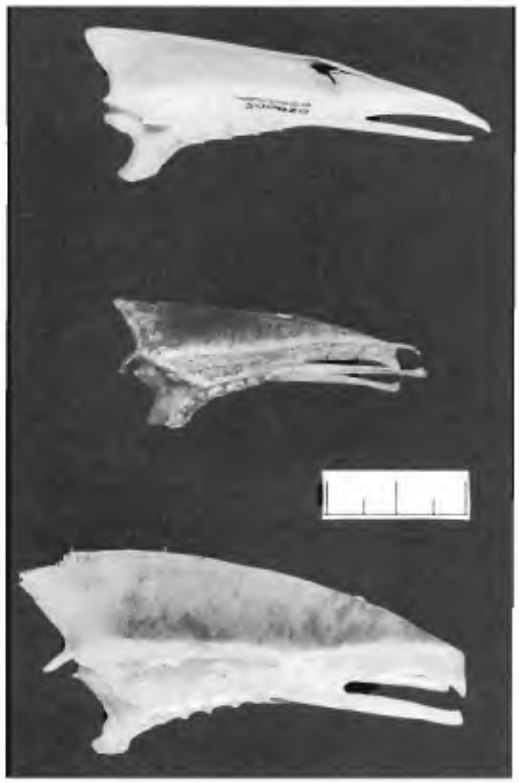

FIGURE 5. Lateral view of sterna of *Anas*, top to bottom: *A. aucklandica*, *A. marecula*, new species (USNM 486690); *A. hottentota*. Scale = 2 cm.

Measurements of holotype (mm). Length from naso-frontal hinge, 28.2; width at posterior margin of nostril, 11.2; depth at same point, 9.6; length of nostril, 7.4.

Paratypes. The paratypical series (USNM 486687–486708) consists of the additional specimens figured here (Figs. 1–8) plus a coracoid, furcula, and a second set of the seven long bones of the wing and leg. A larger series of paratypes, also deposited in the Smithsonian collections, has not yet been cataloged.

Measurements of paratypes (mm). Sternum, USNM 486690: length (not including manubrium), 38.4; width through posterior costal facets, 20.1; depth of carina from sternal plate, 9.2. See also Table 1.

Etymology. From the Latin diminutive of *Mareca*, the former genus of widgeons, which are now included in *Anas*. The name refers to the small size of the species and the resemblance of its short bill to that of widgeons.

Diagnosis. A very small, flightless species of *Anas* with a fairly robust hindlimb, but with the wing and pectoral girdle extremely reduced, the elements being absolutely smaller than in any other species of Anatidae except certain of the elements in the flightless moa-nalos of Hawaii (Olson and James 1991). The bill is relatively very short, with a pointed tip.

TABLE 1. Skeletal measurements (mm) of *Anas marecula*, new species.

Measurement	*n*	Range	Mean
Cranium			
Width	3	21.0–21.8	21.3
Length from naso-frontal hinge	2	40.2	
Pelvis			
Length of synsacrum	4	41.4–45.5	43.8
Width across antitrochanters	2	22.1–23.3	22.7
Preacetabular length (including acetabulum)	2	22.4–24.6	23.5
Postacetabular length	2	21.3–23.3	22.3
Coracoid length	3	21.4–22.5	21.9
Scapula length	3	34.5–37.9	35.8
Humerus length	6	40.5–45.2	42.0
Ulna length	5	33.2–38.4	35.2
Radius length	4	31.6–32.7	32.1
Carpometacarpus length	5	23.1–24.3	23.5
Femur length	14	31.4–35.1	33.2
Tibiotarsus length (including cnemial crest)	9	53.8–60.5	57.5
Tarsometatarsus length	20	27.7–32.0	29.5

Description. The Amsterdam Island duck cannot be confused with any other species of *Anas* because of its small size and extreme reduction of the wing and pectoral girdle. The only species that is similar in the latter respect is the flightless Auckland Island Teal *Anas aucklandica*, which is a considerably larger bird (Table 2).

The bill in *Anas marecula* is distinctive in being short and decidedly pointed at the tip. This contrasts markedly with the Garganey *Anas querquedula*, in which the bill is particularly elongate and rounded at the tip. The Pintail *A. acuta*, a species that has given rise to endemic forms on remote oceanic islands, also has an elongated bill. The species showing the greatest similarity to the Amsterdam Island Duck are the widgeons (*A. penelope*, *A. americana*, and *A. sibilatrix*) that were formerly separated in the genus *Mareca* (e.g., Peters 1931) but are now almost always included in *Anas* (e.g., Johnsgard 1979). In these species the bill is also short, with a pointed tip.

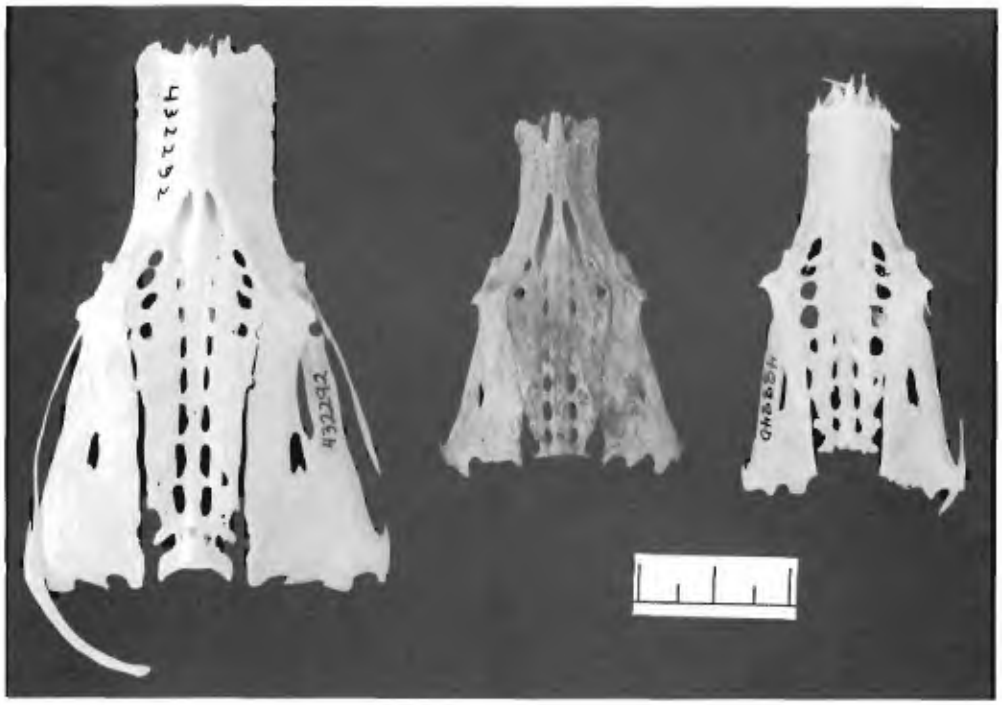

FIGURE 6. Dorsal view of pelves of *Anas*, left to right: *A. penelope*, *A. marecula*, new species (USNM 486689); *A. hottentota*. Scale = 2 cm.

The cranium in *A. marecula* is broad and very rounded and bulbous, contrasting strongly with the elongated cranium of *A. querquedula*. In lateral view, the frontal area slopes very steeply from the cranium to the naso-frontal hinge, the orbit appears reduced and the antorbital portion of the skull is shortened.

The mandibular symphysis of *A. marecula* is rather long, narrow, and squared at the tip, most closely resembling that in the widgeons, as opposed to the wider and more rounded symphysis in *A. querquedula* and most other species of *Anas*.

The sternum is very small, with a shallow, reduced carina with an acute apex; the manubrial spine is present, elongate, curved, and attenuated. The degree of reduction of the sternum and carina is comparable to that in *Anas aucklandica* and there can be little doubt that *A. marecula* was flightless. Other elements of the pectoral girdle and wing are comparably reduced, the shaft of the humerus being particularly thin, spindly, and weak, in contrast to the rather robust shaft in *A. aucklandica*.

The postacetabular portion of the pelvis is shorter, wider, and deeper than in typical species of *Anas*, and the hindlimb elements are robust, characteristics thought by Martinez (1987) to be adaptations for a more terrestrial existence.

DISCUSSION

The species in the large genus *Anas* are perplexingly homogeneous in postcranial osteology, so that identification of fossils is most often based on size differences (e.g., Bickart 1990). When species overlap in size, identification of isolated elements may not be possible. Vertebrates that colonize oceanic islands and evolve into endemic forms usually differ in size from their ancestral stock, insular gigantism and dwarfism being common phenomena. Thus, size is not a good clue to ancestry and the fact that *Anas marecula* is the size of a teal is not necessarily an indication that it evolved from teal-sized progenitors.

Feeding adaptations are likewise notoriously plastic, and the bill shape of *A. marecula* could perhaps have evolved in response to some environmental constraint of Amsterdam Island. Nevertheless, it is the only real morphological clue left to us to hypothesize the possible ancestry of the species. In this case, the Garganey (*A. quer-*

FIGURE 7. Major wing elements of *Anas* (humeri in anconal view, ulnae, radii, and carpometacarpi in ventral view), left to right: *A. hottentota, A. marecula,* new species (USNM 486691, 486692, 486693, 486694); *A. aucklandica.* Scale = 2 cm.

FIGURE 8. Anterior view of major hindlimb elements of *Anas,* left to right: *A. hottentota, A. marecula,* new species (USNM 486697, 486698, 486699); *A. aucklandica.* Scale = 2 cm.

quedula) would appear to be one of the least likely progenitors of the Amsterdam duck because of its very elongate bill that is slightly distally expanded, foreshadowing the even more specialized bill of the shovelers (formerly in the genus *Spatula*) to which the Garganey and other blue-winged teals have been presumed to be related (Delacour 1956).

The strikingly short, pointed bill of *A. marecula* suggests a possible ancestry among the widgeons ("*Mareca*"). Many endemic waterfowl of remote oceanic islands are descended from highly migratory Palearctic species (Weller 1980), such as the pintails of the Kerguelen Islands and Crozet Islands (*Anas acuta eatoni* and *A. a. drygalskii*), and the Washington Island Gadwall (*Anas strepera couesi*), each of which is smaller than its mainland progenitor. Widgeons are as likely potential colonizers of islands as other waterfowl that are known to have established insular populations. The Eurasian Widgeon *Anas penelope*

TABLE 2. Size comparison of long bones of *Anas marecula*, new species (means from Table 1) and selected species of *Anas* and *Nettapus* (included to show how these smallest of waterfowl rank among other small ducks). Measurements are total lengths of long bones from a single female individual (male in *A. capensis*) and rounded to the nearest millimeter; measurements of *A. laysanensis* are means of 15–17 individuals; those for *A. aucklandica* are from 11 to 15 individuals from data in Livezey (1990). In polytypic species the nominate form was selected. Species are arranged by increasing femur length. CMC = carpometacarpus, FEM = femur, HUM = humerus, TAR = tarsometatarsus, TIB = tibiotarsus, ULN = ulna.

Species	FEM	TIB	TAR	HUM	ULN	CMC
N. auritus	27	48	24	50	44	29
N. coromandelicus	30	50	25	57	48	32
A. crecca	31	56	29	55	48	29
A. hottentota	32	54	28	56	47	32
N. pulchellus	32	55	26	59	51	35
***A. marecula*, n. sp.**	**33**	**57**	**29**	**42**	**35**	**23**
A. cyanoptera	34	58	31	62	52	37
A. querquedula	35	58	31	66	57	39
A. gracilis	36	63	33	69	59	41
A. versicolor	38	64	34	70	57	41
A. castanea	38	67	37	70	60	42
A. erythrorhynchus	39	66	35	73	64	44
A. capensis	39	70	37	70	63	43
A. laysanensis	41	67	35	71	62	39
A. aucklandica	43	70	34	52	39	28
A. penelope	42	74	38	76	65	47
A. acuta	45	75	41	86	77	55

migrates into Africa, India, and Sri Lanka and wanders widely in the New World, West Indies, and as far as Hawaii (Johnsgard 1979). The Southern Widgeon *A. sibilatrix* has occurred in the Falkland Islands, and Weller (1980) mentions sight reports of vagrants from South Georgia and the South Orkneys. Either of these species might be potential colonizers of Amsterdam Island.

Livezey (1990:639) remarked that "*Anas aucklandica* is the only anatid in which loss of flight was coincident with a derived decrease in body size." To this must now be added *A. marecula*, which Livezey (1993) determined was flightless based on the measurements given by Martinez (1987). Both are inhabitants of small, subantarctic islands and certainly or probably subsisted mainly on invertebrate prey. Other flightless insular waterfowl have evolved increased body size, such as *Cnemiornis* of New Zealand and the moa-nalos in the Hawaiian Islands (Olson and James 1991), but these were presumably or certainly herbivores and inhabited larger, more temperate islands.

The identity of the small duck that Barrow observed on St. Paul Island in 1793 cannot be determined in the absence of bone remains. That it may have been the product of the same invasion that gave rise to *A. marecula* of Amsterdam Island would not be an unreasonable assumption. If the St. Paul duck were flightless it would necessarily have evolved its flightless adaptations independently of the Amsterdam duck, so that the resulting taxa would be unlikely to be morphologically identical, even if they did have a common ancestor. If the St. Paul duck was not flightless then it was certainly different from the Amsterdam duck. Thus, no justification exists for referring the St. Paul duck to the same species as that of Amsterdam Island and its status will have to remain undetermined until such time as its bones are discovered.

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