*Phelsuma* **21** (2013); 4-19

# Extinct birds of the Mascarenes and Seychelles - a review of the causes of extinction in the light of an important new publication on extinct birds

Anthony S. Cheke
139 Hurst St., Oxford OX4 1HE, UK
*anthony.cheke@dodobooks.com*

*Extinct birds* by Hume & Walters (2012) is the most comprehensive treatment of extinct avian species ever attempted, and the authors are to be congratulated on putting all this material in one place. However in relation to the well-documented Mascarenes there are numerous anomalies and discrepancies, and for the Seychelles some lesser but not unimportant omissions and errors. Only globally extinct species and subspecies are treated in the book, so lost local populations of taxa still extant elsewhere are not included. Since Hume &Walters (hereafter H&W) is so comprehensive, it will undoubtedly be data-mined for causes of extinction. It is therefore important that this record is not confused by erroneous interpretation.

It should be noted that H&W evidently went to press before Hume's treatise on Mascarene pigeons (2011) was published, so some species left undescribed in the book now have valid names.

**Mascarenes**

Although the putative, or in a few cases known, causes of extinction were explored in my ecological histories (Cheke 1987, Cheke & Hume 2008 [main text by ASC, hereafter C&H]), H&W published for many birds quite different suggested reasons, giving no supporting evidence or even sometimes, erroneously, citing C&H as source. Since the extinction history in the Mascarenes is so well documented, these islands provide a particularly forensic record of generally well-dated extinctions, which can be correlated with humans activities, introduction of alien species etc.

For Rodrigues in particular H&W have adduced a completely undocumented reason for several extinctions that took place between 1725 and 1761: "tortoise hunters who burned off the forest to collect giant tortoises" (*Cylindraspis* spp.) and/or the deforestation that is alleged to have accompanied this practice. In fact the handful of men living there for the sole purpose of collecting tortoises had no reason to clear forest, and there is no evidence they did so. Furthermore, the first documented case of a deliberate bush-fire was in 1761, when the birds in question were already extinct, and was apparently a one-off. Indiscriminate fire-raising (by disaffected slaves) did become a serious problem, but decades later, from 1795 onwards, once agricultural settlement started. While it probably contributed to the extinction of the tortoises, it was too late to have affected the birds. In any case hunting tortoises with fire would have been completely self-defeating, as they were needed alive to transport to Mauritius, and fire

would have simply killed them.

In many cases the extinction date can be correlated with particular invasive species arrivals (C&H). Many ground nesting birds, for instance, survived the arrival of rats *Rattus rattus* and pigs *Sus scrofa*, but rapidly succumbed when cats *Felis 'catus'* arrived. On both Mauritius and Réunion the first actual report of cats was after the birds declined or vanished, but in Réunion the cats were discussed precisely because they were blamed for extinctions. In Mauritius the first cat report was independent of extinction observations, but the fact that several ground-nesting birds disappeared shortly before the report is very strongly indicative. At the time the human population was barely in three figures, and the island had plenty of impenetrable forest and many wetlands/swamps, so overhunting is unlikely to have been a major factor for birds, though in Réunion the limited wetlands and larger human population would have made hunting a more important factor for waterbirds. Despite this more specific evidence, in most cases H&W simply vaguely mention 'introduced predators', or wrongly stress rats. Some predators such as Tenrecs *Tenrec ecaudatus*, House Shrews *Suncus murinus* and the Wolf Snake *Lycodon aulicus* will not have affected birds, and the arrival in Mauritius of the Small Indian Mongoose *Herpestes auropunctatus* in 1900 was too late to influence native species, but had a devastating effect on introduced gamebirds. Likewise the Wattle-necked Softshell Turtle *Palea steindachneri* was a late arrival in Mauritius (c.1920), but would no doubt have attacked the young of native waterbirds had they not already been long extinct.

The timing of forest destruction is also important, as blaming 'forest destruction' when only 5-10% of the lowland forest had in fact gone does not hold water. Although agricultural clearances started early, human populations were initially quite low, such that sufficient forest clearance to seriously affect bird populations only occurred in the late 18th century in Réunion and the early 19th on Mauritius. Apart possibly for the very dry west coast of Réunion which was already much altered by c.1725, 18th century and earlier extinctions will almost always have been due to other factors.

To help understand the timings of extinctions related to introduced predators, Table 1 gives dates when the various animals that attack birds were introduced on the three islands; only those animals which arrived when vulnerable native species still existed are included. Pigs, cats and rats all attack ground nesters and reptile eggs, while arboreal birds are targeted by monkeys and Ship Rats.

**Table 1**. Introduction dates of major bird predators in the Mascarenes

| | **Mauritius** | **Réunion** | **Rodrigues** |
|---|---|---|---|
| **Predator** | | | |
| Crab-eating Macaque *Macaca fascicularis* | 1602 | - | - |
| Pig *Sus scrofa* | 1606 | 1629 | c.1792 |
| Cat *Felis 'catus'* | ca.1685 | ca.1685 | c.1745 |
| Ship Rat *Rattus rattus* | pre-1598 | 1672-3 | pre-1691 |
| Norway Rat *R.norvegicus* | 1735 | 1735 | uncertain, pre-1874 |

The appendix table lists extinct Mascarene birds in the same sequence as in H&W, with the documented or inferred reasons for extinction compared to their version. Locally (but not globally) extinct birds are included for completeness (indicated by '*'), apart from two 'data deficient' seabirds in Rodrigues (Crested Tern *Sterna bergii* & Roseate Tern *S.dougallii*) one of which, and possibly both, made it into the 20th century.

In addition there are a few species included in H&W as known only from subfossils, without adequate observations in life, and hence it is unclear if they survived into human historical times:

- 'Réunion Pochard' *Aythya* sp., no reliable report alive, insufficient material (one bone) to establish identity, unclear if resident or vagrant, reason for extinction (if such it is) not known
- Mascarene Reed Cormorant *Phalacrocorax (africanus) nanus*, Mauritius: not recorded alive, reason for extinction not known (in the appendix for Réunion).
- Sauzier's Wood Rail *Dryolimnas* sp. [undescribed] is mentioned in passing (H&W:98). The first clear report of this bird in life has been discovered since H&W was published (Cheke 2013); the subfossil bones await description (C&H, H&W). Only reported once, in 1602, the species probably succumbed rapidly to rats &/or pigs.

A specific clarification is required in relation to the assignment of extinct pigeons from Rodrigues. On the basis of the very minimal material then available, Mourer *et al.* (1999) echoed Milne-Edwards (1874) in considering a subfossil sternum to differ generically from a tarsometatarsus, the former ('*Columba rodericana*') said by Mourer to resemble *Gallicolumba*, the latter assigned by both to *Streptopelia* (now *Nesoenas*) *picturata*. C&H followed Mourer's *et al.*'s diagnosis of two species, though Hume (2011) implied that this was dubious as "no characteristic skeletal elements, e.g. cranium or sternum, have yet to be found to substantiate" the occurrence of *picturata* there. He failed to explain that the reason to doubt its former occurrence was that he (Hume) had just re-assigned the element on which the assessment was based to the other, ex-*'Gallicolumba'*-type, species, *Columba* (now *Nesoenas*) *rodericana*! In the same paper he restored the number of Rodrigues pigeons to two by creating a new species *Alectroenas payendeei* based on previously undescribed material. Further confusion reigns because many previous authors had, somewhat arbitrarily, assigned some or all of the previously known- elements (i.e. *Nesoenas rodericana*) to the genus *Alectroenas* (discussion in Mourer *et al.* 1999 and Hume 2011) - the new *Alectroenas* is thus a quite different entity from the old '*Alectroenas*'.

**Seychelles**

The causation data for the three species extinctions in the Seychelles they include is largely accurate, but in two cases H&W missed the last occurrences, thus giving too early a bracketing date on the timing of extinction. They also entirely omitted

an important, well-attested, if not specifically identified extinction.

H&W missed some important data for the extinct Chestnut-Flanked white-eye *Zosterops semiflava*, and still treated it as a race of, or close to, the Mayotte species *Z.mayottensis,* This long-held view based on plumage similarity has been superceded by Warren *et al.*'s DNA phylogeny (2006) which showed they were unrelated and part of two quite different invasions of the western Indian Ocean. *Z.semiflava* was part of an early wave with Mascarene white-eyes and *Z.morouniensis* (upland Grande Comore) from Asia, while *mayottensis* derives from a later colonisation from Africa, together with the other Seychelles species *Z.modesta* and birds on Madagascar and lowland Comoros. H&W missed collections of the white-eye on Marianne in 1877 and 1892 (Lantz, Abbott), and Percival Wright's on Praslin (Oustalet 1878, Skerrett *et al.* 2001), and the contemporary attestation of occurrence also on La Digue and possibly Silhouette. The birds thus survived longer than H&W report, and succumbed to rats (absent on Marianne in 1867, Newton 1867) and deforestation around 1900, not 'between 1870 and 1900'; Gerlach (2007) noted that they were gone by 1908. 'Competition with introduced birds', H&W's third reason for extinction, is unsupported and unlikely.

The Seychelles Parakeet *Psittacula wardi* is quoted as having vanished 'between 1881 and 1906' through deforestation and persecution as a crop-pest, but although they cite a captive pair in 1883, they missed a specimen shot on Mahé in 1893 (Skerrett *et al.* 2001). The third full species extinction in Seychelles was the Aldabra Warbler *Nesillas aldabrana* last seen in 1983, probably due, as H&W say, to rats, although, as Gerlach (2007) pointed out, with such a limited range (a few hectares only) the extinction could be due to stochastic effects.

Perhaps the most enigmatic Seychelles extinction is omitted entirely by H&W, namely the 'poule bleu' of the early accounts of the granitic islands, discussed by Lionnet (1984a). This large blue waterhen was clearly, like the 'oiseau bleu' of Réunion, a *Porphyrio*, but as no specimens were collected and no bones have been found, its specific identity remains unclear; the same is true of the Réunion bird that H&W do however include, perhaps because it acquired a scientific name (see appendix). It was hunted, but it disappeared too rapidly after the islands were settled (1770) for that to have been the main cause, which was probably the introduction of Ship Rats by 1773, and cats by 1787 (Cheke 2010) - the bird was last reported in 1775.

The early accounts from the granitic Seychelles (e.g. Lionnet 1984b) also refer to a 'poule pintade', i.e., in contemporary island French usage, a spotted rail, possibly a *Gallirallus*, and a red-plumaged Fody long before *Foudia madagascariensis* was introduced - this may well (Cheke & Rocamora in prep.) have been a second endemic *Foudia*. Neither were reported again after the islands were settled and colonised by rats and cats.

A most significant local extinction in the Seychelles is Abbott's Booby *Papasula abbotti* from the island where it was discovered, Assumption; H&W mention the extinction but not its date. The birds were still present in 1908, but a settlement to extract guano was founded the same year, rapidly destroying the tree cover and hunting out the seabirds, which were gone by 1916, possibly as early as 1909 (Skerrett *et al.* 2001). See appendix for the loss of this species in the Mascarenes.

As H&W discuss extinct subspecies, they include the dilution and near-extinction, through hybridization, of the Seychelles race of the Malagasy Turtle Dove *Nesoenas picturata rostrata*, and the loss of the Amirante race *N.p.aldabrana,* but only in passing the disappearance of the populations on Astove and Assumption through hunting and habitat destruction[1]. The loss of the Assumption race of the White-throated Rail *Dryolimnas cuvieri abbotti* to rats and habitat loss is likewise covered, but not the elimination through habitat loss and over-hunting of populations of Comoro Blue Pigeon *Alectroenas sganzini* on Astove and Providence, Madagascar Coucal *Centropus madagascariensis* on Assumption and Cosmoledo or the Madagascar Bulbul *Hypsipetes madagascariensis* on Astove (Lionnet 1984a, Skerrett *et al.* 2001) - all three survive on Aldabra, as does its race *D.c.aldabranus* of the rail. A natural population of Barn Owls *Tyto alba* on Aldabra vanished mysteriously, last recorded in 1906 (Skerrett *et al.* 2001). Pink-backed Pelicans *Pelecanus rufescens* on St.Joseph were last reported in 1905 when the coconut plantations were still young and the workers still enchanted by the birds' antics, as described later by Dupont (1941, Lionnet 1984c), who writing in 1937, still thought they survived... Lionnet (1984c) and Skerrett *et al.* (2001) attributed their disappearance to human hunting or persecution.

**References**


Brisson, M.J. 1760. *Ornithologie*. 6 vols. Paris: J-B.Bauche.

Cheke, A.S. 1987a. An ecological history of the Mascarene Islands, with particular reference to extinctions and introductions of land vertebrates. Pp. 5-89 *in* Diamond (1987), q.v.

Cheke, A.S. & Hume Julian P. 2008. *Lost land of the Dodo: an ecological history of Mauritius, Réunion and Rodrigues*. London: Bloomsbury Publishing (A&C Black) & New Haven, Connecticut: Yale University Press. 464pp.

Cheke, A.[S.] 2010. The timing of arrival of humans and their commensal animals on Western Indian Ocean oceanic islands. *Phelsuma* 18: 38-69.

Cheke, A.S. 2013. A single comma in a manuscript alters Mauritius avian history. *Phelsuma* **21**: 1-3

Clark, G. 1859. A ramble round Mauritius with some excursions into the interior of that island; to which is added a familiar description of its fauna and some subjects of its flora. Pp.i-cxxxii *in* Palmer & Bradshaw, compilers, *The Mauritius Register: Historical, official & commercial, corrected to the 30th June 1859.* Port Louis: L.Channell.

Cossigny, J.F.Charpentier de. 1732-1755. [Treize lettres de Cossigny à Réaumur, ed. A.LaCroix]. *Rec. Trim. Doc. Trav. Inédits Servir Hist. Mascareignes Fr.* 4: 168-96, 205-82, 305-16 (1939-40).

Diamond, A.W.(ed.) 1987. *Studies of Mascarene Island birds.* Cambridge: Cambridge University Press. 458pp.

Dupont, R. 1941. Quelques notes au sujet de l'importance économique des oiseaux de mer dans les îles océaniques. *Trans. Roy. Soc. Arts Sci. Mauritius* C 10:2-11

1. - H&W also claim disappearance on Cosmoledo, but this population was rediscovered in 1982 (Skerrett *et al.* 2001).

Gerlach, J. (ed.) 2007. *Terrestrial and freshwater vertebrates of the Seychelles Islands.* Leiden: Backhuys Publishers. 154pp.

Hume, J.P. 2007. Reappraisal of the parrots (Aves: Psittacidae) from the Mascarene Islands, with comments on their ecology, morphology and affinities. *Zootaxa* 1513: 1-76.

Hume, J.P. 2011. Systematics, morphology, and ecology of pigeons and doves (Aves: Columbidae) of the Macarene Islands, with three new species. *Zootaxa* 3124: 1-62.

Hume, J.P. & Walters, M. 2012. *Extinct birds*. London: Bloomsbury Publishing (T & AD Poyser). 544pp.

Jones, C.G. 1987. The larger landbirds of Mauritius. Pp.208-300 in Diamond 1987, q.v.

Lionnet, [J.F.] G. 1984a. Extinct birds of the Seychelles. Pp.505-511 in D.R.Stoddart (ed) *Biogeography and ecology of the Seychelles Islands*. W.Junk, The Hague (*Monographiae Biologicae* vol.55).

Lionnet, [J.F.]G. 1984b. Observations d'histoire naturelle faites aux Seychelles en 1768 au cours de l'expédition Marion-Dufresne. *Mauritius Inst. Bull.* 10(1): 15-73.

Lionnet, [J.F.] G. 1984c. *Le monde des vertébrés des Seychelles.* ENDA, Port Louis, Mauritius. Document 26.

Mourer-Chauviré, C., Bour, R., Ribes, S. & Moutou, F. 1999. The avifauna of Réunion Island (Mascarene Islands) at the time of the arrival of the first Europeans. *Smithsonian Contrib. Paleobiol.* 89: 1-38.

Newton, E. 1867. On the land birds of the Seychelles archipelago. *Ibis* NS 3: 335-360.

Oustalet, E. 1878. Étude sur la faune ornithologique des îles Seychelles. *Bull. Soc. Philomath. Paris* (7)2: 161-206.

Skerrett, A., Bullock, I. & Disley, T. 2001. *Birds of Seychelles*. London: A.& C. Black (Croom Helm). 320pp.

Warren, B.H., Bermingham, E., Prys-Jones, R.P. & Thébaud, C. 2006. Immigration, species radiation and extinction in a highly diverse songbird lineage: white-eyes on Indian Ocean islands. *Molec. Ecol.* 15: 3769-3786.

**Appendix. Supposed causes of Mascarene extinctions compared.**

Abbreviations: C&H = Cheke & Hume (2008), H&W = Hume & Walters (2012). Preferred English names are given in bold; where two are shown, the first is from H&W followed by the usage in C&H, preferred by this author. Codes for Flight/Nest site: Flight ability: N = normal, WF = weak, F = flightless. Nest site: A = open nest in shrub/tree, C = cavity above ground (tree or cliff), G = open nest on ground, B = burrow or ground cavity p = presumed (i.e. inferred from relatives elsewhere)

| Species | Flight/ Nest site | Extinction date (from C&H) | Cause given in Hume & Walters (2012) [+ ASC comments] | Cause inferred by Cheke & Hume (2008) or (#) this paper |
|---|---|---|---|---|
| **Mauritius Sheldgoose** *Alopochen mauritiana* | N/pG | c.1695 [<1698] | "overhunting & perhaps predation of eggs by introduced predators" | Primarily cats, hunting secondary; survived rats & pigs |
| **Réunion Sheldgoose** *A.kervazoi* | N/pG | c.1700 [<1705] | "overhunting appears to be the primary cause" | Cats + over-hunting; survived rats & pigs |
| **Mascarene Teal** *Anas theodori*: Mauritius | N/pC | c.1700 | "overhunting appears to be the primary cause" | Primarily cats, hunting secondary; survived rats & pigs |
| **Mascarene Teal** *Anas theodori*: Réunion | N/pC | c.1700 [<1705] | "overhunting appears to be the primary cause" | Cats + over-hunting; survived rats & pigs |
| ***Réunion Black Petrel** *Pseudobulweria aterrima* & **Bourne's Petrel** *Pterodroma* sp.[2]: Rodrigues | N/B | 1726-1761 | [not included] | not specified; #survived rats, disappeared like so many other species, coincident with the arrival of cats |
| ***Greater Flamingo[3]** *Phoenicopterus roseus*: Mauritius | N/G | c.1770 | [not included] | not specified; last reported ca.1768 when only 3 remained - #almost certainly hunted out |

[2] These are combined as the only report was Tafforet's *fouquets de montagne* (Cheke 1987, C&H:48-9) - he did not describe the birds, which were evidently inland-nesting petrels. Bourne's Petrel remains *incertae sedis* due to Graham Cowles never having either described or released the subfossil specimens. *P.aterrima* survives, critically endangered, in Réunion (C&H).

[3] Flamingos on both islands apparently bred in small numbers but were supplemented by migrants from Madagascar; Feuilley in 1705 reported up to several thousand at times (Barré *et al.* 1996).

| | site | Extinction | Cause in Hume & Walters | Cause inferred |
|---|---|---|---|---|
| ***Greater Flamingo** *Phoenicopterus roseus*: Réunion | N/G | c.1710 | [not included] | as Boucher noted in 1710 - hunted out from the very limited available habitat |
| Réunion Ibis = **Réunion Solitaire** *Threskiornis solitaria* | ?WF/?G | c.1715 | "overhunting & the introduction of predators such as rats & cats are probable reasons for extinction" | Cats; no evidence it was much hunted in the heights once coastal birds had been eliminated; survived rats & pigs |
| **Mauritius Night-heron** *Nycticorax mauritianus* | N/?A | c.1700 | "Reasons for extinction are unknown but no doubt introduced predators such as cats & rats were primarily responsible" | Cats & possibly hunting; survived rats, pigs & monkeys |
| **Rodrigues Night-heron** *N.megacephala* | ?WF/?A | c.1750 | "severe deforestation & introduced predators" | Cats; survived rats; there was no deforestation at this time |
| **Réunion Night-heron** *N.duboisi* | N/?A | c.1700 [could be a bit later] | "the reason for its extinction is unknown, but it would have been subject to the same introduced predators as its relatives on Mauritius & Rodrigues" | Cats & probably hunting pressure |
| ***Dimorphic Egret** *Egretta dimorpha*: Mauritius | N/A | c.1725 | [not included] | Probably persecution on only known colony (Ile aux Aigrettes) |
| ***Dimorphic Egret** *Egretta dimorpha*: Réunion | N/A | c.1870 | [not included] | #Given long survival, cause of extinction obscure, likely to be hunting-related; could have been exterminated & recolonised |

| | site | Extinction | Cause in Hume & Walters | Cause inferred |
|---|---|---|---|---|
| ***Frigate-birds** *Fregata ariel* & ? *F.minor*: Mauritius | N/A | c.1640 | [not included] | direct hunting - the Dutch ate them; the sole nest-site was on the mainland near Dutch base settled in 1638; monkeys may have helped. |
| ***Frigate-birds** *Fregata ariel* & ? *F.minor*: Rodrigues | N/A | ?1860s | [not included] | not specified; #breeding ceased while there were still plenty of boobies *Sula sula* to kleptoparasitize. |
| ***Abbott's Booby** *Papasula abbotti*: Mauritius | N/A | c.1670 | "probably hunted to extinction" | Nested up trees on mainland; probably succumbed to monkeys, old birds persisting after rearing young became impossible |
| ***Abbott's Booby** *Papasula abbotti*: Rodrigues | N/A | c.1835 | "probably hunted to extinction" | not specified; #said by Pingré (1763) to be the only seabird worth eating and also the rarest, so probably hunted; last known birds caught for science in 1832 (C&H) |
| ***Red-footed Booby** *Sula sula*: Rodrigues | N/A | c.1880 | [not included] | Survived locals, but adults slaughtered & chicks decimated for down by British sailors in the 19thC! Last reported 1874. |
| **(Mascarene) Reed Cormorant** *Phalacrocorax (africanus) nanus*: Réunion [see text *re* Mauritius] | N/?G | c.1710 | [not specified, but quote included stating that it was not eaten except when very young] | Not a prime hunting target, but wetlands few & easily hunted out; survived rats & pigs, timing suggests cats. |

| | site | Extinction | Cause in Hume & Walters | Cause inferred |
|---|---|---|---|---|
| Réunion Rail = **Réunion Wood Rail** *Dryolimnas augusti* | ?F/G | 1675-1705 | "it disappeared due to overhunting & predation by introduced mammals, particularly rats & cats" | Hunting pressure would have been minimal, and *D.cuvieri* on Aldabra copes with rats; it survived rats & pigs for decades, so cats are the most likely culprit. |
| Mauritius Red Rail = **Red Hen** *Aphanapteryx bonasia* | F/G | c.1695 | "appeared to be able to survive the onslaughts of human occupation & associated animals including monkey, pigs & rats ... but the introduction of cats proved disastrous" | [as left] |
| Rodrigues Rail = **Leguat's Rail** *Erythromachus leguati* | F/G | c.1750 | "rapid disappearance between 1726 & 1761 suggests that introduced cats were the main culprits, but severe deforestation by tortoise hunters from 1735 who burned off the forest to collect giant tortoises ... may also have contributed significantly" | Cats, helped by direct hunting; survived rats; there was no deforestation at this time |
| Réunion Blue Gallinule= **Oiseau Bleu** *Porphyrio 'caerulescens* [4] | WF/G | c.1720 [not "the end of the 17th century"] | "primarily due to over-hunting, but the accidental introduction of rats in 1676 would also have made the eggs & chicks extremely vulnerable" | Was hunted, but remote habitat makes this unlikely as final cause of extinction; survived rats & pigs, so timing suggests cats the most likely cause |

[4] No subfossils have been found of this bird, so its specific identity remains unclear, and *P.(porphyrio) madagascariensis* is not ruled out; there was an equivalent, and equally unidentified, form in the Seychelles (Lionnet 1984a; see text).

| | site | Extinction | Cause in Hume & Walters | Cause inferred |
|---|---|---|---|---|
| **Mascarene Coot** *Fulica newtoni*: Mauritius | N/G | c.1700 | "both populations were presumably exterminated through over-hunting & introduced predators" | Not a prime hunting target; survived rats & pigs, timing suggests cats. |
| **Mascarene Coot** *Fulica newtoni*: Réunion | N/G | c.1700 [<1705] | "both populations were presumably exterminated through over-hunting & introduced predators" | Not a prime hunting target, but wetlands few & easily hunted out; survived rats & pigs, timing suggests cats. |
| **Dodo** *Raphus cucullatus* | F/G | c.1640s on mainland, 1662 on offshore islet; some claim 1680s [disputed] | "direct hunting ... was almost certainly not the primary cause. The introduction of Black Rats *Rattus rattus*, pigs, goats & perhaps monkeys, all [of] which would have been direct threats to eggs & chicks ... are the likely culprits» | Survivors on Ile d'Ambre killed by sailors in 1662; mainland birds survived rats, but pigs, abundant by the 1620s & reported to raid tortoise eggs, are probable main cause, aided by hunting. |
| **Rodrigues Solitaire** *Pezophaps solitarius*[5] | F/G | c.1760(-65?) [not soon after 1733] | [unclear and selective account, but tortoise hunters burning vegetation appear to be blamed; 1755 account missed] | Cats blamed by locals, but Cossigny (1732-55) in 1755 added hunting, as bird was good to eat - probably cats prevented survivors breeding. |
| **Mauritius Wood Pigeon** *Columba thiriouxi* [see Hume 2011] | N/?A?C | [unknown] | "over-hunting, predation from Black Rats *Rattus rattus* & severe deforestation» [in fact no unequivocal evidence it was ever seen by humans, but early accounts do not fully describe all pigeons] | [not included; subfossils not described at the time of publication] |

[5] This is the species long thought to have been a sort of dodo - see e.g. C&H:30-31, H&W:377-8

| | site | Extinction | Cause in Hume & Walters | Cause inferred |
|---|---|---|---|---|
| **Réunion Pink Pigeon** *Nesoenas duboisi* | N/pA | c.1700 [<1703] | "The arrival of the Black Rat ... appears to have been a major factor (C&H)" [misquote!] | Cats were clearly blamed by authors in 1703 & 1705 for the very recent demise of *ramiers* (? this species) & slaty pigeons (below); they survived rats for at least 25 years. |
| **Rodrigues Turtle Dove** *N. rodericana*[6] [see Hume 2011] | N/pA | 1726-1761 | "Leguat ... noted presence of rats ... and it seems they exterminated the ... dove" | Rats confined the birds to breeding on offshore islets before 1691; either rats reached the islets(#), or the very tame birds were killed by cats c.1750. |
| **Mauritius Turtle Dove** *N.cicur*[7] [see Hume 2011] | N/pA | [unknown] | "disappeared by around 1730 as a result of over-hunting, predation from introduced mammals & severe deforestation" [in fact, no unequivocal report of it alive, possibly due to conflation with other pigeons] | [as then considered conspecific with Malagasy Turtle Dove *N.picturata*, still present, extinction cause not discussed; though extinction & re-introduction accepted as plausible] |
| Mauritius Blue Pigeon = **Pigeon Hollandais** *Alectroenas nitidissima* | N/pA | c.1835 ['1837' misquoted from C&H] | "survived humans & introduced predators for over two centuries, so it was almost certainly deforestation that caused its extinction" | Notoriously good to eat and easy to kill, this pigeon would have become very vulnerable to hunting once habitat was severely reduced, as deforestation accelerated from 1810 onwards |

[6] Inadequate material previously available had been referred by Mourer *et al*. (1999) in part to an undescribed genus near *Gallicolumba*, and in part to *Nesoenas picturata*, and thus thought to involve two species; echoed by C&H (see text).

| | site | Extinction | Cause in Hume & Walters | Cause inferred |
|---|---|---|---|---|
| **Réunion Blue Pigeon** *Alectroenas* sp. [no subfossils yet found] | N/pA | <1703 | "probably disappeared by around 1700 due to over-hunting & predation by introduced rats" | Definitely did not survive cats (see *N.duboisi* above), but Dubois's 'slaty pigeon' may have been *N.picturata* [see C&H & Hume 2011:15[8]], so the only firm report was in 1619 - extinction ascribed to cats in C&H |
| **Rodrigues Blue Pigeon** *Alectroenas payandeei* [see Hume 2011][9] | N/pA | [unknown] | ? extinct before 1691, probably due to rats [in fact no evidence this species was ever seen by humans] | [not described when C&H published] |
| **Thirioux's Grey Parrot** *Psittacula bensoni*: Mauritius | N/pC | 1760s | "slash & burn forest clearance ... no doubt had a serious effect on tree-cavity nesting species" | not specified; #this bird was prized for the table, and lowland forest clearance would have reduced nesting possibilities & increased threat from hunting. |
| **Thirioux's Grey Parrot** *P.bensoni*: Réunion | N/pC | ?1730s | "regularly hunted for food, but also appears to have been persecuted for damage to crops" | not specified; #as above. |
| Rodrigues Ring-necked Parakeet = **Rodrigues Parakeet** *P.exsul* | N/pC | 1876 | "a devastating series of cyclones ... perhaps wiped out the last few survivors (Cheke 1987)" | as left, #but prior rarefaction probably due to deforestation and loss of holes to breed in. |

[7] Formerly though to be a local population of *N.picturata*, e.g. Mourer et al. (1999), C&H.

[8] Subfossil small *Nesoenas* bones on Réunion were referred to *Nesoenas picturata* by Mourer et al. (1999), echoed more tentatively by Hume (2011), but it is unclear whether the birds survived throughout, or died out and were re-introduced. Dubois's mention of ramiers and tourterelles "like those in Europe" is too vague to be useful, and may have simply been another informant's account of the two pigeons he had just described (slaty and reddish, treated as *Alectroenas* sp. & the larger *Nesoenas duboisi*); the same problem applies to his parrot account.

[9] H&W correctly say "it was not mentioned by Leguat in 1691-3 or Tafforet in 1725-6" - so the bird may already have been extinct. Alternatively the visitors may possibly have conflated the two pigeon species; they gave no clear descriptions, though the ones most familiar to Leguat (Hume 2007:20) were granivorous, hence *Nesoenas* not *Alectroenas*.

| | site | Extinction | Cause in Hume & Walters | Cause inferred |
|---|---|---|---|---|
| Réunion Ring-necked Parakeet = ***Echo Parakeet** *Psittacula eques* [as island endemic species in H&W][10] | N/C | ?1750s [<1760] | [not specified] | not specified; #as *P.bensoni*, but the Paris specimen collected c.1750. |
| Mascarene Parrot = **Mascarin** *Mascarinus mascarinus*: Réunion | N/pC | ?1780s [living birds in Paris in 1784] | [not specified] | not specified, and bird not hunted for food, so, as it survived rats & cats #perhaps lowland forest loss deprived it of nest-sites |
| **Rodrigues Parrot** *Necropsittacus rodericanus* | N/pC | ?1770s [v.rare in 1761] | "presumably disappeared due to forest clearance, over-hunting & probable rat predation of eggs & chicks" | Confined, as were pigeons, to nesting on lagoon islets by rats before 1691, either rats reached the islets(#), or the birds were gradually killed off by cats. |
| Réunion Parrot = **Dubois's Parrot** ?*Psittacula borbonicus* [in H&W as ?*Necropsittacus borbonicus*][11] | N/pC | ?1670s | [not specified] | not specified, #but not reported again after rats arrived, so may have been vulnerable like *N.rodericanus*. |

[10] Best considered conspecific with the extant form on Mauritius; no surviving specimen, but good 18thC illustrations, all probably from the same specimen first described by Brisson (1760). H&W's mention of three specimens was based on my speculative statement (Cheke 1987, Hume 2007) that three specimens reached Paris for three different illustrations; in hindsight this was a dubious assumption - in fact they were probably all the same one (C&H:316, note 226). The idea in H&W that the Edinburgh specimen might have been the one used for the *Planches Enluminées* (attributed by Hume 2007 wrongly to Jones 1987) is nonsense - the bird was collected between 1801 and 1810 by Mathieu, almost certainly in Mauritius (Jones 1987, C&H).

[11] This bird is known from only one description, and lacks subfossils - some authors (see H&W) have suggested it may have been a feral population of some escaped imported pet parrot.

| | site | Extinction | Cause in Hume & Walters | Cause inferred |
|---|---|---|---|---|
| Broad-billed Parrot = **Raven Parrot** *Lophopsittacus mauritianus* | ?WF/ ?C?B | ?1670s [<1695] | "probably disappeared as a result of hunting, deforestation & nest predation by introduced monkeys & rats" | nest-robbing by monkeys, old birds surviving long after reproduction had ceased; deforestation was minimal at the time, and no-one reported hunting this species. |
| **Mauritius Lizard-owl** *Mascarenotus sauzieri* | N/pC | c.1840 [<1859] | "probably due to an increase in deforestation ... had survived alongside introduced predators for centuries" | as left + deforestation removing nest sites & near extinction of forest skinks (putative prey). Desjardins in 1837 (in C&H[12]) also invoked "the large number of poachers who roam the woods that remain" |
| **Réunion Lizard-owl** *M.grucheti* | N/pC | [unknown; H&W suggest "some time in the 1700s"] | "severe deforestation" | not specified as absolutely no data [#this species was never observed alive, so may not have been around in human times, or could have succumbed before 1700 to rats; probably disappeared long before any severe deforestation] |
| **Rodrigues Lizard-owl** *M.murivorus* | N/pC | 1726-1761 | "probably as a result of severe deforestation caused by tortoise hunters burning off the vegetation" | timing suggests cats; survived rats; there was no deforestation, and prey was still abundant. |
| **Rodrigues Bulbul** *Hypsipetes* sp. [undescribed] | N/A | [unknown] | [not included] | Not reported by visitors, may have been exterminated by rats before Leguat arrived in 1691 |

[12] Wrongly cited as a quote from Clark (1859) in H&W

| | site | Extinction | Cause in Hume & Walters | Cause inferred |
|---|---|---|---|---|
| Réunion Crested Starling = **Hoopoe Starling** *Fregilupus varius* | N/pC | 1850s [<1860] | disease or parasite, aided by replacement of coffee by sugar, and deforestation of the 'cirques' | as left |
| **Rodrigues Starling** *Necropsar rodericanus* | N/pC | 1726-1761 | "the islets provided the only refuge, but when rats eventually colonised them, the bird's fate was sealed" | confined by rats to islets by 1726; cats blamed, but #rat colonisation of islets perhaps more likely (cf. pigeons). |
| **Réunion Fody** *Foudia delloni* | N/A | ?1675-80 | "likely that the population crashed once these vermin [Ship Rats] had become established" | as left; the only observations precede the arrival of rats. |