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## Expunging the 'Mascarene starling' *Necropsar leguati*: archives, morphology and molecules topple a myth

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Until relatively recently, species of birds known from unique specimens tended to be ignored, often being written off as dubious in one way or another. Because of the rapidity of extinction on islands, however, it is not at all unlikely that a species

could be collected and prepared as a museum specimen only once and then become extinct, leaving little or no other trace of its former existence. Careful study of the history of unique specimens and intensive scrutiny of the specimens themselves often leads to a species being fully restored, which has contributed significantly to our knowledge of biodiversity, zoogeography, and evolution (e.g. Graves & Olson 1987, James *et al.* 1989, Olson 1986a,b, Olson *et al.* 1989).

Less frequently, investigations of an unique holotype do not end in such positive results and specimens may turn out to be composites (Olson & Schifter 1989), hybrids (Olson & Violani 1996), or simply mislabelled and misidentified (Olson 1992). The subject of the present study, a supposed Mascarene starling, falls in the last category. This unfortunate relic was trebucheted into ornithological legend by Henry Ogg Forbes, director of the Liverpool Museum (Forbes 1898), in a six-page paper with a colour plate (Fig. 1), line drawing and table. At a time when ornithologists were routinely introducing new species of birds with a descriptions of only a sentence or two, such detail as Forbes advanced might now seem exemplary were it not for the fact that ultimately the entire result is seen to be a fiction.

This single specimen became the focus of one unfounded assumption after another, compounded by some over-vigorous imaginations and lack of any careful subsequent scientific scrutiny, which led to the development of what in hindsight can only be regarded as a myth. With the true identity of this specimen now at hand, its entire written history can be summed up as a banquet of codswallop.



Figure 1. The first published illustration of *Necropsar leguati*, from Forbes (1898)

## History

The specimen in question (Liverpool Museum D.1792; Figs. 2–3) was among a mixed lot purchased 10 August 1850 from the dealer Jules Verreaux by the 13th Earl of Derby, whose collection was transferred to the Liverpool Museum in 1851 (Fisher 2002). Its identity was still undetermined when the specimen, then a flat skin, surfaced in an inventory of the collection in 1897. The bird, which was essentially white and had been labelled only ‘Madagascar’ by the Maison Verreaux, had been placed among bulbuls of the genus *Hypsipetes* (Forbes 1898: 30), one Madagascan species of which is about the same size and of somewhat the same build. Thus the initial tentative placement of the specimen was among the bulbuls, Pycnonotidae. ‘That it had been left undetermined for so long a period is probably due to the fact of its being taken for an albino of some species of the above-named genus, or perhaps for a white starling’ (Forbes 1898: 30). The last phrase is a non sequitur—if it had been stored among bulbuls, what grounds would there be for assuming that anyone had previously taken it for a starling?

Forbes had evidently reached the conclusion beforehand that the specimen was a starling, and that it had come from the Mascarene islands, so his presentation was weighted heavily towards making the few available facts fit with his preconception. Madagascar is close to the Mascarenes, and the Mascarenes were known to have been the home of two species of starlings. One of these, *Fregilupus varius*, is known historically from the island of Réunion, where it became extinct in the middle of the 19th century (Fuller 2001). This was a showy bird, with large crest and white head and underparts, thus seemingly fitting with the whiteness of Forbes’ specimen. The other Mascarene starling is known from fossils from the island of Rodrigues and was named *Necropsar rodericanus* (H. H. Slater in Günther & Newton 1879: 427).

Forbes referred to an anonymous early account, first published by Newton (1875), concerning a bird with white and black plumage, the size of a Blackbird *Turdus merula*, that had been encountered on Islet au Mât (now called Île Gombrani) but not on the main island where the bones of *Necropsar rodericanus* were later found. This account was later attributed to one Tafforet, whose visit to Rodrigues took place in 1725 (Dupon, 1973, Cheke 1987). Île Gombrani is one of a number of small islets within the Rodrigues lagoon that would have provided refugia for the native birds that had been decimated by rats on the main island by 1725. Rats arrived as early as September 1601 during the visit of a Dutch fleet. All the islets are too small to have harboured endemic species and consequently Rodrigues would have had only one species of starling.

Despite the fact that it had no black in the wings and tail, Forbes assumed that the mystery skin was the same species as in Tafforet’s anonymous account, and that this had to be different from *Fregilupus varius* because of its lack of a crest, among other things, and from *Necropsar rodericanus* because of the smaller tarsus. He therefore named the specimen from the Derby collection as a new species, *Necropsar leguati*, evidently not wishing to create a new genus for it.

Rothschild (1907: 6), disliking the idea of two starlings existing on Rodrigues, suggested that *N. leguati* was probably an albinistic example of 'the Mauritius species of *Necropsar*'. Mauritius is the only Mascarene island where no starling is otherwise known, and there is not yet a shred of evidence, historical or paleontological, that it ever harboured a starling. Hachisuka (1953), never one to let the lack of evidence stand in the way of naming new taxa, seized upon Rothschild's conjecture and proceeded to create a new genus *Orphanopsar*, with *N. leguati* as its type and only species, although the only difference from *N. rodericanus* that he mentioned was smaller size. Earlier Hachisuka (1937) had gone even further out of bounds in placing the bird observed on Islet au Mât in the Corvidae and naming it as a new genus and species of aberrant chough, *Testudophaga bicolor*, based only on Tafforet's description. This, however, has no relevance to the history of the type of *N. leguati*.

Greenway (1958) was very circumspect and conservative, suggesting that *N. leguati* might be a specimen of *N. rodericanus*, and he listed both in the synonymy of *Fregilupus varius*. Wagstaffe (1978) ventured the opinion that *N. leguati* was a valid species. In the influential Peters Check-list, Amadon (1962: 103) unquestioningly accepted *Necropsar leguati* as a valid species, giving its provenance as 'Met [sic] Islet, off Rodriguez', and suggesting that it was 'possibly identical with *N. rodericanus* Sclater'. This was the received wisdom at least as late as 1987 (Fuller 1987).

The first hint that things might not be as they seemed came from P. J. Morgan, Wagstaffe's successor as Keeper of Vertebrate Zoology at the Liverpool Museum (in Cheke 1987: 49), whose examination of the specimen of *N. leguati* suggested that it 'may not be a starling at all.' This proves to be the case.

### Plumage and morphology

As described by Forbes (1898: 34) the specimen of *Necropsar leguati* is 'white everywhere, except for a lighter or darker ferruginous wash on the external webs of the distal half of the primaries and secondaries, as also on the outer webs of the newly moulted, and on both webs of the unmoulted rectrices.' This was repeated verbatim by Hachisuka (1953: 204), as usual without attribution or quotes. In our examination of the specimen, however, it was obvious that the brownish portions of the remiges were asymmetrical from one side of the specimen to the other. Thus we agree completely with Morgan (in Cheke 1987: 49) that the darker portions of the flight feathers are due to 'discolouration'. This staining was evidently an ongoing process, because, as noted by Forbes, the older feathers of the tail are more heavily coloured than the freshly moulted ones, suggesting the bird may have been kept in captivity. In any case, the plumage is entirely white which, with the yellowish bill and feet, which were probably pink in life, leave no doubt that the specimen is an albino. As further evidence of this, the bases of the contour feathers are white, whereas they are dark, for example, in *Fregilupus varius* and *Cinlocerthia*.



Figure 2. X-radiographs of the skulls in skin specimens in lateral view. A, holotype of *Necropsar leguati* LIV D.1792; B, *Cincloerthia gutturalis* BMNH 1856.3.12.10 (Martinique); C, *Cincloerthia tremula pavida* BMNH 1840.5.13.11 (Nevis); D, *Cincloerthia macrorhyncha* BMNH 1894.12.24.2 (St Lucia); E, *Cincloerthia ruficauda tenebrosa* BMNH 1898.2.8.21 (St Vincent). Note not only the great similarity of *N. leguati* and *Cincloerthia*, but also the absence of the ossified posterior border of the nostril that characterises the Pycnonotidae, with which *N. leguati* was first associated.



Figure 3. Specimens in ventral view: A, *Cincloerthia tremula pavida* BMNH 1840.5.13.11 (Nevis); B, *C. ruficauda tenebrosa* BMNH 1898.2.8.21 (St Vincent); C, *C. c. macrorhyncha* BMNH 1894.12.24.2 (St Lucia); D, holotype of *Necropsar leguati* LIV D.1792.

But an albino what? Surely it is not a starling. 'Its wings, however, are quite unlike those of any starling,' as Forbes (1898: 30) himself stated outright. He went on to amplify this further (p. 33): 'It possesses ten primaries, and of these the tenth, or outermost, is not the rudimentary or very reduced quill seen in the *Sturnidae* generally.' It is testimony to his willingness to delude himself that he could continue to rationalise that the bird was somehow nevertheless a starling.

The well-developed outer primary not only establishes that the specimen is not a starling, but also not a member of any of the so-called nine-primaried oscines. Likewise, the wing is not 'short, rounded, and 'concave' as attributed to most of the species of Timaliidae (Newton 1896: 963). The tarsal scutellation (inaccurately depicted by Forbes 1898) is not 'booted' as in the typical thrushes (Turdidae). Bill shape alone eliminates many other groups such as finches, shrikes and flycatching birds. Bulbuls (Pycnonotidae) may be absolutely ruled out by their tiny feet, bill shape and presence of filoplumes in the nape. Furthermore, X-radiographs of the holotype of *N. leguati* (Fig. 2) show that it did not have the posterior margin of the nostril ossified as in the Pycnonotidae (Olson 1990), thus eliminating the family with which the specimen had originally been associated while in Lord Derby's collection.

Through such a process of elimination we were finally led to make detailed comparisons with the species of Mimidae (mockingbirds and thrashers) and here the resemblances became much greater. In size, length and shape of bill, wing formula, and foot structure and scutellation, the holotype of *N. leguati* could be

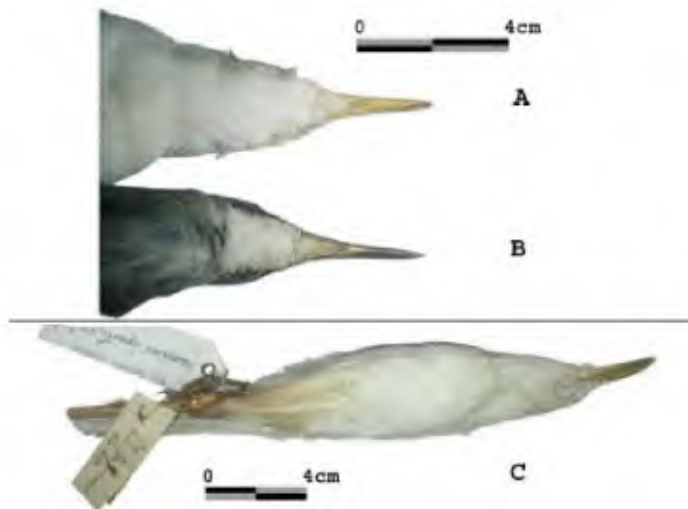


Figure 4. Close-up of ventral view of head (A, B) and lateral view (C) of entire specimen of A, C, holotype of *Necropsar leguati* LIV D.1792; B, *Cincloerthia macrorhyncha* BMNH 1894.12.24.2 (St Lucia).

matched only by the West Indian thrashers known as tremblers (*Cinlocerthia*) (Figs. 3–4).

The tremblers range throughout most of the Lesser Antilles, from Saba to St Vincent, with six recognised taxa that have usually been considered subspecies of Brown Trembler *C. ruficauda* (e.g. Davis & Miller 1960). However, in a more recent detailed analysis, Storer (1989) advocated recognition of two species, *C. gutturalis* for the populations from Martinique and St Lucia, and *C. ruficauda* for the remainder. Studies of DNA suggest that recognition of even more species may be warranted (see below).

The fact that the holotype of *N. leguati* came from the French establishment of Maison Verreaux suggests the possibility of the specimen having originated in the French islands of Martinique or Guadeloupe. Colour comparisons, of course, are impossible because the specimen is an albino. The various taxa differ among themselves to some extent in size, but our measurements of the specimen of *N. leguati* compared with those in Storer (1989) were inconclusive, partly because there were so few specimens available from the French islands, especially Martinique. So only molecular analysis remained for a finer resolution of the identity of *N. leguati*.

### Provenance

As noted, the specimen of *Necropsar leguati* was received from Jules Verreaux and is labelled only 'Madagascar'. Forbes (1898: 30) suggested that because Verreaux had been to the Mascarene islands and had collected a specimen of the Réunion Starling *Fregilupus varius* that he had prepared as a skeleton, that he 'may have also secured' the bird in question during that visit. But then Forbes went on to remark that 'It is well known that M. Verreaux was often very inexact in the precise geographical data he inscribed on the labels of his specimen.' In fact, the unreliability of specimen labels emanating from Maison Verreaux is notorious in ornithology. 'The firm more than once sent out material completely mislabelled' and engaged in deliberately altering the identifications of birds' eggs to increase their market value (Mearns & Mearns 1988: 406). If it is allowed, as Forbes did, that the specimen in question could have come from somewhere other than Madagascar, then there is no basis for picking one locality over another without some sort of corroborating evidence.

We decided to look through some of the other specimens in the Liverpool Museum that came from Verreaux in the same purchase lot as the holotype of *N. leguati*, to see if any of them might shed some light on its provenance (this action being made easier by the existence of a specimen database which could be cross-referenced by date of purchase). We were not disappointed in our expectation of finding specimens with obviously erroneous locality information: a specimen of the North American Virginia Rail *Rallus limicola*, with 'Martinique' crossed out by Verreaux and 'Nle Zelande' (New Zealand) substituted; a *Ptilinopus* fruit dove

labelled 'Iles Marquises' annotated by David Holyoak as having an erroneous locality; a specimen of one of the South American subspecies of Southern Rough-winged Swallow *Stelgidopteryx ruficollis* labelled 'Jamaique'; etc.

But the real clincher came when examining a specimen identified as *Foudia madagascariensis* and labelled 'Madagascar'. *Foudia* is a genus of weaver finch (Ploceidae) confined to the south-west Indian Ocean islands. The supposed *Foudia* (D.3185) is a partial albino with the belly, mantle, rump and one rectrix white. The characteristic bill shape, rufous undertail-coverts and coloration of the remaining pigmented parts, however, establish beyond doubt that this is a specimen of the Lesser Antillean Bullfinch *Loxigilla noctis*.

The presence of another albinistic bird endemic to the Lesser Antilles labelled 'Madagascar' in the same purchase lot as the holotype of *Necropsar leguati* is too unlikely to be attributed to coincidence. Verreaux was obviously receiving specimens from the Lesser Antilles from someone, probably an aviculturist, with an affinity for albinos. To these Verreaux proceeded to give what may have been considered a more interesting and exotic provenance.

### Mitochondrial DNA

Our comparisons were greatly facilitated by the fact that mitochondrial DNA adenosine triphosphatase subunits 8 and 6 (ATP6/8) had already been sequenced for most relevant taxa of Antillean Mimidae (Hunt *et al.* 2001). Grey Trembler *Cinclocerthia gutturalis* of Martinique was not included in that study, however, for lack of fresh material. Therefore, we obtained samples from a skin specimen of *C. gutturalis* (USNM 75724) and from the holotype of *Necropsar leguati*. We also sequenced part of the mitochondrial cytochrome *b* gene (*Cytb*) from the same samples of *Cinclocerthia* and *Margarops (sensu lato)* as used in Hunt *et al.* (2001).

In April 2000, a small piece of toe pad was sliced with a sterile scalpel from the specimen of *Necropsar leguati* at the Liverpool Museum (D.1792). The sample was placed in a sterile microfuge tube and returned to the ancient DNA laboratory in the Department of Biological Sciences at the University of Durham, where all subsequent molecular analyses of the sample were completed. In February 2001, a small piece of toe pad was sliced with a sterile scalpel from a specimen of *Cinclocerthia gutturalis* (USNM 75724 male, collected by F. A. Ober on Martinique). The sample was placed in a sterile microfuge tube and returned to the ancient DNA laboratory in the National Zoological Park, Smithsonian Institution, Washington DC, where all subsequent molecular analyses of the sample were completed.

Thus, DNA isolations of the two toe pad slices were conducted in separate laboratories on separate continents. Part of each sample was cut into smaller pieces using a sterile scalpel. DNA was isolated from the diced samples using an overnight DTT / SDS / Proteinase K digestion, followed by phenol-chloroform extraction and centrifugal dialysis concentration (Fleischer *et al.* 2000). From 2–4 ml of DNA extract were used in PCR amplifications of specific mtDNA regions for the



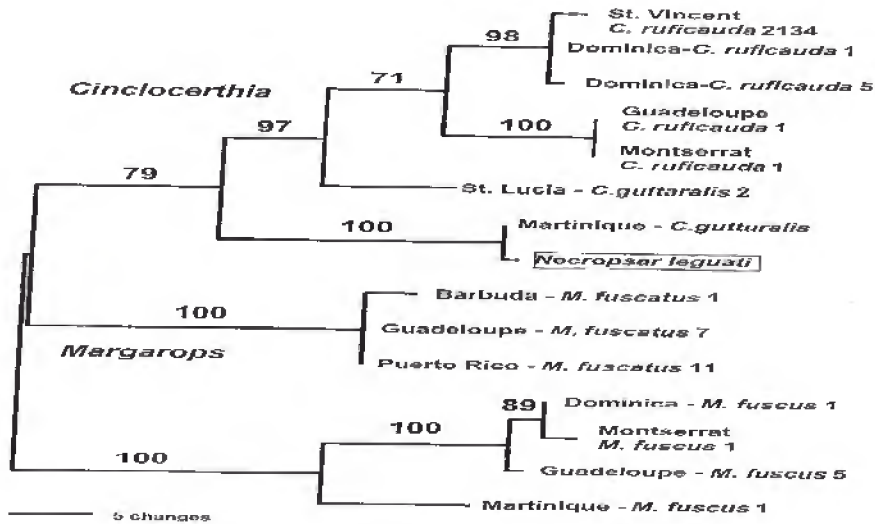


Figure 5. A phylogram of one of two most parsimonious trees found using a branch-and-bound search. The tree length is 135 steps. The numbers at each node are the percentage of 1,000 bootstrap replicates in which the particular node was found, if above 50%. Tree is based on 648 bp of Cytb and ATP8/6 sequence of two museum specimens (Martinique—*C. gutturalis* and *Necropsar leguati*) and Cytb sequences from this paper and ATP8,6 sequences from Hunt *et al.* (2001).

museum specimen samples. We targeted two mtDNA regions: Cytb and ATP8/6. A total of 332 bp of the Cytb region was amplified in two small pieces with primers Cytb1-anc and Cytb.X (112 bp of sequence) and Cytb2.RC and Cytb.wow (220 bp) (Dumbacher *et al.* 2003). Part of the ATP8/6 region was also amplified in two pieces totaling 350 bp with primers A6MNH and t-lys (192 bp; Dumbacher *et al.* 2003) and ATP6R (5'-AGGTGTCCTGCTGTGAGGTT-3') and ATP6L (5'-CCTAGCCTTCCCCCTATGAC-3') (158 bp). Additional *Cinclocerthia* and possible outgroup ATP8/6 sequences were obtained from Genbank, from a deposit by Hunt *et al.* (2001). Additional Cytb sequences were obtained using Cytb1-anc and Cytb.wow on a subsample of the fresh material from Hunt *et al.* (2001). PCR products were cycle sequenced and sized on an ABI automated DNA sequencer. Resulting sequence chromatograms were inspected to ensure correct nucleotide identification. Both strands were sequenced. Sequences were aligned in Sequencher (version 4.1.2; GeneCodes Corporation) to each other and to outgroup sequences.

We obtained a total of 682 bp of mtDNA sequence from *Necropsar leguati* and the Martinique specimen of *Cinclocerthia gutturalis*: 332 of Cytb, 350 of ATP6/8 (Genbank accession numbers pending). The sequences were aligned with each other. The Cytb sequences were identical except for a few ambiguous bases in the

specimen of *C. gutturalis*. The ATP8 and 6 sequences were identical between the two specimens, but for a single nucleotide substitution. This low level of sequence divergence strongly indicates that the two specimens are from the same species. We aligned the two museum specimen sequences to the ATP6/8 sequences from Hunt *et al.* (2001) and to the *Cytb* sequences.

We conducted four different types of phylogenetic analyses on the dataset to reconstruct phylogenetic trees from the sequences: parsimony, neighbour-joining (using a Kimura 2-parameter distance), and maximum likelihood using PAUP\* 4.0b10 (Swofford 2002), and a Bayesian analysis using Mr. Bayes 3.0 (Huelsenbeck & Ronquist 2001). We show here one maximum parsimony tree with associated bootstrap values on the nodes (Fig. 5), but note that in all trees produced by any criterion, the specimen of *Necropsar leguati* is a clear and close sister lineage to the specimen of *C. gutturalis* from Martinique. The clade is basal to a *C. ruficauda*/*C. gutturalis* clade, and this is nested within a clade of other Caribbean mimids, including Scaly-breasted Thrasher *Margarops fuscus* and Pearly-eyed Thrasher *M. fuscatus*. Thus, based on both the sequence comparison and the phylogenetic analysis it appears that the holotype of *Necropsar leguati* is an example of *C. gutturalis sensu stricto*, which is known historically only from Martinique.

On the basis of the DNA analysis, one could justify recognising as many as four species of *Cinlocerthia*: *C. tremula* (Lafresnaye 1843) from Guadeloupe, with a subspecies *C. t. pavidia* Ridgway (1904, type locality St Kitts) from most of the Lesser Antilles north of Guadeloupe; *C. ruficauda* (Gould 1836) of Dominica, with a subspecies *C. r. tenebrosa* Ridgway (1904) from St Vincent; *C. gutturalis* (Lafresnaye 1843) from Martinique; and *C. macrorhyncha* Sclater (1866) from St Lucia. The distribution of the two basal taxa, *C. gutturalis* and *C. macrorhyncha*, scattered among the seemingly more derived forms, does not match expectation based on linear colonisation of the Lesser Antilles and suggests a rather old split. Such a conclusion requires corroboration from other sources such as nuclear DNA, morphology, and perhaps call and behaviour. Regardless, *Necropsar leguati* clearly belongs with *Cinlocerthia gutturalis*.

## Conclusions

On the basis of morphology and the history of the specimen, the holotype of *Necropsar leguati* Forbes, 1898, a supposed Mascarene starling, is shown instead to be a mislabelled albino West Indian trembler of the genus *Cinlocerthia*. Studies of mitochondrial DNA identify the specimen with the distinctive basal taxon from Martinique *C. gutturalis*. These conclusions have the following consequences:

1. *Necropsar leguati* Forbes, 1898, becomes a junior subjective synonym of *Ramphocinclus gutturalis* Lafresnaye, 1843 = *Cinlocerthia gutturalis*.
2. *Orphanopsar* Hachisuka, 1953, becomes a junior subjective synonym of *Cinlocerthia* Gray, 1840.

### 3. *Necropsar leguati* must now be entirely expunged from the avifauna of the Mascarene islands.

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## The type locality of the Hadedda Ibis *Bostrychia hagedash* (Latham)

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*Bostrychia hagedash* was described as *Tantalus Hagedash* by Latham (1790), with type locality Cape of Good Hope (*Caput B. Spei*), very likely from a specimen shot in September 1775 and briefly described by Sparrman (1783, p.293 in the original, pp.280–281 in the English translation). This is not specifically stated in Latham's type description, but the only reference (undated) given therein is to Sparrman's book. The page numbers match the English translation by George Forester (1785).