

# Charles Immanuel Forsyth Major's expedition to Madagascar, 1894 to 1896: beginnings of modern systematic study of the island's mammalian fauna

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## Abstract

Charles Immanuel Forsyth Major (1843–1923) made the first synoptic systematic collection of mammals from Madagascar in the last decade of the 19th century. To reconstruct Major's obscurely known itinerary, we located 994 specimens that originated from his 1894–1896 expedition and determined their identification, dates and locality of collection, and current institutional repository. Fifty species were recovered from 26 localities centred in the Central Highlands and Eastern Humid Forest of east-central Madagascar. The geographic position of several type localities is refined and their coordinates estimated, and the type locality of one taxon (*Microgale pusilla* Major, 1896) is accordingly amended. Biographical details of the man, the biodiversity significance of his collections and the historical context of his discoveries are discussed.

**Keywords:** *History of collection, Madagascar, mammals, specimen localities, type specimens*

## Introduction

The current resurgence of systematic studies of Madagascar's mammals, as recently updated in Goodman and Benstead (2003), has underscored the historical importance of Charles Immanuel Forsyth Major's early expedition, 1894–1896, as a foundation for understanding the island's unique biodiversity. Unfortunately, Major's collecting sites, many of them now type localities, have proven difficult to locate with precision and confidence. Past studies have focused on single taxonomic groups, consequently treating only some of Major's localities and with varying success: e.g. Tattersall (1986) and Jenkins (1987) for prosimians; MacPhee (1987) for the shrew tenrecs, *Microgale*; Peterson et al. (1995) for Chiroptera; and Carleton and Schmidt (1990) for nesomyine rodents. To provide data critical for locating obscure collecting sites, map distributions and resolve taxonomic problems, we have attempted to locate all mammal specimens that have survived from Major's pioneering survey, to consolidate their locality records and to reconstruct his itinerary.

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*Relevance to current systematic research*

Major's expedition is renowned for the variety of collections produced, not only Recent mammals, sub-fossil lemurs and ratite birds but also other zoological, palaeontological and botanical specimens (Table I). Although over a century old, his collections remain crucial for the systematic study of Madagascar's Recent mammals for the following reasons.

1. All mammals were surveyed, the small mammals particularly thoroughly, providing the first comprehensive knowledge of the mammalian fauna inhabiting the eastern forests of Madagascar. Many of the collecting sites were visited at a time when pristine forest was still extensive and his specimens consequently indicate the formerly broader occurrence of certain species.
2. For the era of natural history exploration, the specimens were remarkably well documented in the field. Instead of the usually vague provenance given to material collected earlier in the 19th century (e.g. "western Madagascar"), Major recorded specific localities on the specimen tags and immediately afterwards (1897a) published an account of his expedition. Field labels were tied to individual specimens, including all their complementary parts (the skin, the skull, the skeleton) and many of these original collector's tags have remained attached to or affiliated with those specimens.
3. Specimens were obtained in series, permitting assessment of population and geographic variation. His single-site representation of certain small mammals—such as *Brachyuromys ramirohitra*, *Eliurus penicillatus* and *Microgale pusilla*—still constitute the best population samples of these species ever collected for the study of age, sex and individual variation.
4. Specimens were prepared in multiple ways: skins and skulls, skins with partial skeletons, full skeletons and a smaller number of bodies in alcohol. Major routinely recorded the nature of the preparation, along with sex, on his field labels. The condition of most specimens remains good to excellent.
5. Many of Major's specimens have been designated as primary types. In all, he described three new genera and 13 new species of Recent mammals shortly after the expedition (Major 1896a, 1896b) and his collections formed the basis for the description of another seven new species by other authors (Table II). All of the genera and most of the species described remain valid today. In addition, a new family (Nesopithecidae Major, 1896c) and genus (*Nesopithecus roberti* Major, 1896c) of sub-fossil lemurs were named, and three new species of frogs were described by Boulenger (1896a, 1896b).

Table I. Biological collections resulting from Major's 1894–1896 expedition to Madagascar, tallied as specimens received at the NHM and as specimens selected for acquisition by the NHM (data from Woodward 1897, 1898 and NHM archives).

Collections	Selected for NHM
<b>Recent</b>	
Mammals (>1600 skins, skulls, skeletons, and bodies in alcohol)	163
Birds (skeletons)	65
Amphibians and reptiles (bodies in alcohol)	155
Invertebrates	205
Plants	525
<b>Fossil</b>	
Mammals	24
Birds (ratites ca 2000; carinates ca 600)	248

Table II. Type localities and the 20 mammalian taxa (\* indicates new genus and species) described based on specimens collected during C. I. F. Major's expedition (field numbers and their current museum registration numbers are also given, since many early descriptions provided only the field number of the holotype).

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Ambohimombo (locality 3)
<i>Oryzoryctes gracilis</i> Major, 1896a; M184=BM(NH) 1897.9.1.78
<i>Microgale taiva</i> Major, 1896b; M154=BM(NH) 1897.9.1.112 and 1975.2233
<i>Fossa majori</i> Dollman, 1909; M167=BM(NH) 1897.9.1.115
<i>Eliurus majori</i> Thomas, 1895; M166=BM(NH) 1897.9.1.147
Ambositra (locality 5)
<i>Vespertilio matroka</i> Thomas and Schwann, 1905; M177=BM(NH) 1897.9.1.32
Antsirabe (locality 6)
<i>Oryzoryctes niger</i> Major, 1896a; M357=BM(NH) 1897.9.1.79
Ampitambe (locality 13)
<i>Microgale longirostris</i> Major, 1896a; M490=BM(NH) 1897.9.1.111
<i>Microgale thomasi</i> Major, 1896a; M581=BM(NH) 1897.9.1.108 and 1975.2226
* <i>Brachyuromys ramirohitra</i> Major, 1896a; M429=BM(NH) 1897.9.1.133
<i>Eliurus minor</i> Major, 1896b; M494=BM(NH) 1897.9.1.153 and 1958.3.4.3
<i>Eliurus penicillatus</i> Thomas, 1906; M602=BM(NH) 1897.9.1.149
* <i>Gymnuromys roberti</i> Major, 1896a; M446=BM(NH) 1897.9.1.140
Masindrary (locality 14)
* <i>Linnogale mergulus</i> Major, 1896a; M1024=BM(NH) 1897.9.1.113 and 1958.2.27.26
<i>Miniopterus manavi</i> Thomas, 1906; M453=BM(NH) 1897.9.1.37
<i>Miniopterus majori</i> Thomas, 1906; M457=BM(NH) 1897.9.1.38
Ankeramadinika (locality 16)
<i>Cheirogaleus sibreei</i> Major, 1896a; M839=BM(NH) 1897.9.1.160
Vinanitelo (locality 19)
<i>Microgale talazaci</i> Major, 1896a; M1293=BM(NH) 1897.9.1.107
<i>Eliurus tanala</i> Major, 1896b; M1358=BM(NH) 1897.9.1.154
Ambohimanana (locality 20)
<i>Microgale covani nigrescens</i> Elliot, 1905; M1349=FMNH 5644 (skin), FMNH 1349 (skull)
<i>Microgale pusilla</i> <sup>a</sup> Major, 1896b; M139=BM(NH) 1897.9.1.93

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See Figure 4 for localities.

<sup>a</sup>Type locality as here emended; see locality 20.

### Historical background

Born in Glasgow on 15 August 1843, Major (Figure 1) was educated in Basle (Basel) and Zürich Universities, Switzerland and Göttingen University, “Germany”; he graduated in Medicine at Basle in 1868 and started his professional practice in Firenze (Florence), Italy. As with many 19-century doctors, however, natural history was an earnest avocation and he devoted much of his spare time to the study of fossil mammals, publishing his first paper on fossil primates in 1872. At the behest of the Italian government in 1877, Major collected fossil vertebrates from Calabria, Corsica, Sardinia, and Sicily. His interest in extinct vertebrates eventually surpassed his dedication to a medical career, which he ceased practising in 1886. Thereafter, he investigated the Recent and fossil fauna and flora of the islands of the Greek Archipelago and the mainland of Greece, making further important collections of fossil vertebrates, large parts of which were sent to the Collège Galliard at Lausanne and to the British Museum (Natural History) [subsequently renamed The Natural History Museum (NHM)] (Andrews 1923; Stehlin 1925). The latter contact fortuitously set the stage for the most important contributions of his career in natural history.

Beginning in 1893, Major worked on the Greek collections in the Geology Department of the NHM. While there, he also published several papers on the fossil and Recent

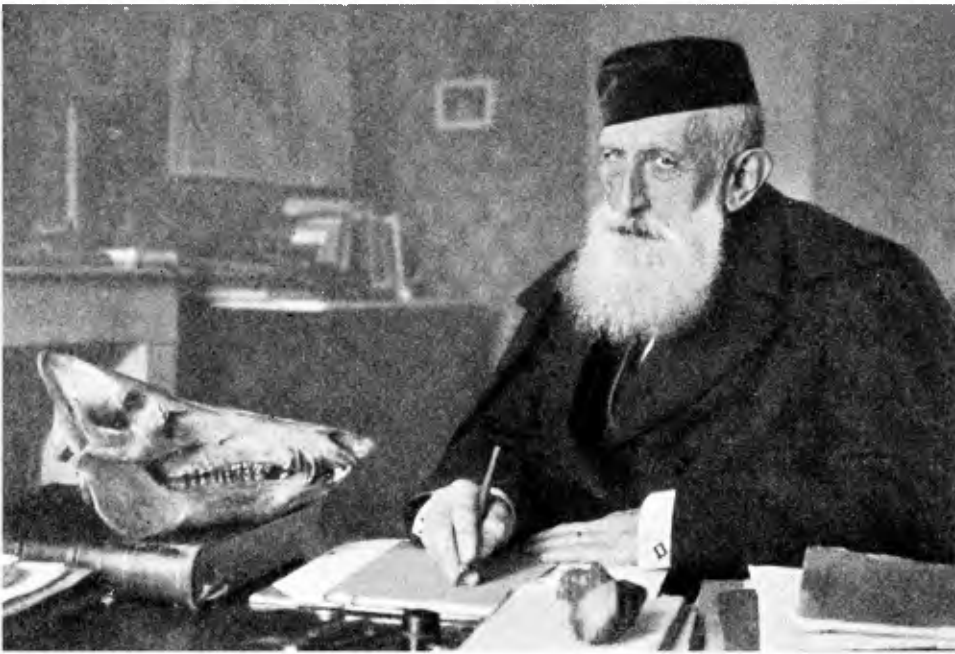


Figure 1. Photograph of Charles Immanuel Forsyth Major from Stehlin (1925).

lemur fauna of Madagascar, including the discovery of the new family Megaladapidae (Major 1893), genus and species of the extinct giant lemur *Megaladapis madagascariensis* (Major 1893), and five new species of the two Recent genera *Lepilemur* and *Cheirogaleus* (Major 1894a, 1894b, 1894c, 1894d). These taxonomic discoveries apparently kindled Major's specific interest in the living and extinct fauna of Madagascar and led to his eventful expedition to the island.

Major's fieldwork was financed principally by grants from The Royal Society. Additional private funding was supplied by the Honourable [Lionel] Walter Rothschild, F. Ducane Godman, Sir Henry Peek and others, including Major himself, plus equipment and incidental support from the NHM. The expedition, including the voyages to and from Britain, extended from embarkation on 15 July 1894 to return on 30 August 1896. For nearly 2 years, Major worked in the east-central portion of Madagascar and amassed large Recent and palaeontological collections, which were despatched to the NHM in 73 crates (Woodward 1897). His general account of the expedition was communicated to the Fellows of the prestigious Zoological Society of London on 1 December 1896, published in the Proceedings of the Society in the following spring (Major 1897a) and reproduced together with a popular account from *The Standard* newspaper of 8 January 1897 (Sibree 1897). The specimens resulting from the expedition immediately furnished the subject matter for numerous papers by Major and contemporary researchers, particularly Oldfield Thomas. Indeed, his collections are continually and widely referenced in systematic studies to the present day (Ellerman 1949; Petter 1961; Tattersall 1986; MacPhee 1987; Hill 1993; Carleton 1994; Peterson et al. 1995; Jenkins et al. 1996; Groves 2000).

Major (1897a, p 973) recounted that "at the end of my first stay at Ampitambé 804 specimens of Recent mammals had been collected: when I left Vinanitelo this figure had been more than doubled". These more than 1600 specimens are acknowledged to have

been received at the NHM (Woodward 1897), yet only 163 were initially selected for donation to the Museum, including all type specimens and representative skins and skeletons of each species (Woodward 1898). In accordance with the exchange practices at that time and, given the still nascent appreciation of locality series and analytical samples, so-called duplicate specimens were distributed to other interested institutions. Although the Royal Society technically owned the collection, Major, as the collector, undoubtedly had considerable influence over its dispersal. At least 46 specimens were donated to the Honourable Walter Rothschild, one of the expedition's sponsors (Hartert 1897), and these were later acquired by the NHM in the Rothschild bequest of 1939. Another portion of Major's specimens also subsequently returned to the NHM in 1974, in a donation from the Manchester Museum. Correspondence held by the Liverpool Museum tellingly indicates that Major's specimens were sold to that museum (18 specimens acquired 19 April 1898; see Largen 1985), so perhaps financial need was another factor spurring the wide subdivision of his collection. Another recipient was Guillaume Grandidier, who maintained a large private Madagascan collection that was itself dispersed among several institutions, notably the Muséum national d'Histoire naturelle, Paris and the Museum of Comparative Zoology, Harvard University (the latter in 1947; see Helgen and McFadden 2001). Carleton and Schmidt (1990), for example, recorded five European and three North American institutions that contain nesomyine rodents certainly originating from Major's 1894–1896 expedition.

## Materials and methods

### *Specimens and specimen data*

We adopted a strategy similar to that used by Carleton and Schmidt (1990) for nesomyine rodents and correlated collector's numbers, collection dates and localities in order to reconstruct Major's itinerary. To collate this information, a database of specimens actually collected by Major, supplemented by records from archival sources in the NHM, was compiled in Corel Paradox 9. In all, 994 mammal records traceable to his expedition were located in the following 11 institutions, listed alphabetically according to the abbreviations used in the text and tables: BM(NH), registration prefix of The Natural History Museum, London; CUMZ, University Museum of Zoology, Cambridge; FMNH, The Field Museum of Natural History, Chicago; LMCM, Merseyside County Museums, Liverpool; MCZ, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts; MNHN, Muséum national d'Histoire naturelle, Paris; NHM, The Natural History Museum, London; NMW, Naturhistorisches Museum, Wien (Vienna); RMNH, Rijksmuseum van Natuurlijke Histoire, Leiden; USNM, National Museum of Natural History, Smithsonian Institution, Washington, DC (formerly United States National Museum); UZMC, Universitet Zoologisk Museum, Copenhagen; ZFM—Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn.

Original field labels served as the primary evidentiary source for verifying Major's specimens and capturing collections data. With minimal practice, his original tags became easily recognizable to us, given the distinctiveness of his script and the standard format he employed for documenting specimen information (Figure 2). From these labels, we routinely recorded the collector's sequential field number (usually prefaced with the letter M to denote mammal series); date of collection, usually designated as the day in arabic numerals, the month in roman numerals and the abbreviated year in arabic numerals (e.g.



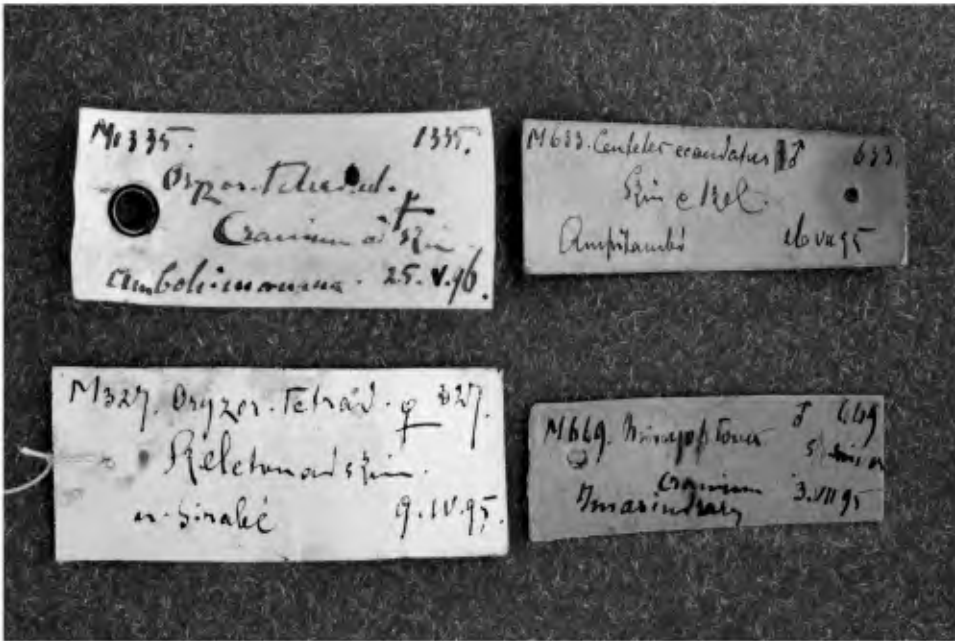


Figure 2. Examples of original specimen labels.

“3 III 95” is 3 March 1895); specimen preparation (whether a skin, skull, skeleton, or in alcohol); sex; locality (often abbreviated; e.g. Ampitambe f.[orest], Ambohima.[nana]); and field identification (regularly noted). Ancillary information was gleaned from the regrettably few surviving hand-written letters of Major, reports in the NHM and Royal Society Archives, and his systematic publications. The last source proved helpful for localizing certain place-names, since Major provided different landmarks and directional clues in citing his type localities. We presume, based on his periodic summaries of specimens collected, that Major maintained a field catalogue, but no such record or collector’s journal has been traced to date. Although his published summary (Major 1897a) provides a rough guide to some localities visited, it is regrettably inexplicit about the location of many of the main collection sites and fails to mention many that we authenticated from his specimen labels. In those infrequent cases where original labels were absent or the penmanship illegible, data were accepted from secondary sources, such as accession records, museum registers and recipient museum labels; in all such instances, the date of accession and associated material catalogued supplied strong circumstantial evidence for origination of the specimens from Major’s 1894–1896 expedition.

Bird skeletons collected on the expedition and housed at the NHM were also consulted and helped to refine localities and dates of visit (Table III). Their original collector’s labels bear much the same information as the mammal specimens, whether of collector’s number (prefixed with the letter A for avian series), date of collection, or locality. No attempt was made to incorporate precise data from the reptiles and amphibians, which were collected from fewer localities and none different from those documented for mammals. Because they were preserved in alcohol, many of these specimens lack original labels or have little data evident on those labels that remain. In contrast, the herbarium specimens in the NHM do have original information on localities and collection dates, so a similar compilation of

Table III. Collecting localities of C. I. F. Major, 1894–1896, approximately arranged by dates of visit and field number sequence.

Locality	Dates <sup>a</sup>	Documented field numbers <sup>b</sup>	No. of specimen records <sup>c</sup>	No. of species
1. Fianarantsoa	September 1894	M1–M12, M1150–M1163	27	7
2. Ivohimanitra	October to December 1894	M17–M32, M190–M217, M1578–M1580, A8–A13	29	9
3. Ambohimombo	November 1894 to 28 January 1895	M35, M43, M44, M54, M117–M176, M184–M189, M199, M203–M205, M227, M1168–M1174	68	19
4. Ambohimanga	–	M29	1	1
? Itsimatahodarana	21–29 November 1894	M40, M45–M50	7	2
5. Ambositra	30 November to 6 December 1894	M51–M115, M799, M801, M802	31 (of 39)	4 (of 6)
(2nd)	2–15 February 1895	M177–M179, M793	4 (of 39)	3 (of 6)
(4th)	8 April 1896	M1176, M1177	2 (of 39)	1 (of 6)
? Loharindra Cavern	December 1894	M183	9	2
6. Antsirabe	9 March to 31 May 1895	M230–M241, M256–M261, M267–M359, M364–M371, M387, M418, M1190–M1249, A25–A58, A135	142	8
(2nd)	September 1895 to January 1896	(Fossils only)		
7. Fasina	18 March to 10 April 1895	M244–M251, M310, M311, M320, M339	10	1
8. Andranobe	18 March to 15 May 1895	M262–M265, M363, M365, M367, M373–M417, A36	35	4
9. Andraikiba Lake	4–19 April 1895	A18, A20, A26		
(2nd)	24 February 1896	M805	1	1
10. Betafo	18 April 1895	M360	1	1
11. Tritriva	27 April, 7 June 1895	M368, A63, A142	1	1
12. Ivohitra	24 May 1895	M421	1	1
13. Ampitambe	23 June to 11 August 1895	M429–M450, M490–M788, A65–A140	132 (of 295)	22 (of 31)
(2nd)	6–28 March 1896	M806–M818, M840–M1087, A151–163	143 (of 295)	22 (of 31)
14. Masindry	3, 4 July 1895	M453–M526, M538–M541, M664–M670, M739–M744	56 (of 68)	2 (of 3)
(2nd)	18, 31 March 1896	M1024, M1082	2 (of 68)	1 (of 3)
15. Fandriana	24 March 1896	M1072	1	1
16. Ankeramadinika	10–21 January 1896	M820–M839	12	4
17. Angavo	11, 12 January 1896	M832, A200	1	1
? Ambataroa	12 January 1896	M830, M831	2	1
18. Ambohimandroso	23 April 1896	M1263–M1264	2	1
19. Vinanitelo	12 May to 6 June 1896	M1265–M1522, M1581–M1685, A171–A183	116	21
? Amboanara	24 May 1896	M1304, M1305, M1312	3	2
20. Ambohimanana	23–30 May 1896	M1316–M1453	65	7
21. Amboasary	4, 6 June 1896	M1509, M1511, M1517	3	3
22. Itaombelo	4, 6 June 1896	M1512, M1518, M1519	4	1
Totals	September 1894 to 6 June 1896	929	943	50

(For footnote see p1786)

data from the floral collection would undoubtedly complement the faunal investigation. Such a compilation is, however, beyond the scope of the current project.

Nomenclature of the Rodentia and of the Afrosoricida is based respectively on Musser and Carleton (forthcoming) and Bronner and Jenkins (forthcoming); nomenclature of the Chiroptera, Primates and Carnivora follows that of Wilson and Reeder (1993).

Maps were produced using the Distribution Mapping Software program DMAP (Morton 1993–2003).

#### *Cartographic sources and locality organization*

Many of Major's collecting sites, or his mid-1890s transliteration of those place-names, are unrecognizable according to present-day cartographic sources. Contemporary maps that were probably available to Major prior to his departure provided a picture of the state of geographic information at the turn of the century. These included Mullens (1875), Cowan (1882), Roblet (1885), Oliver (1886), Laillet and Suberbie (1889), and Grandidier (1893). Others, such as Laillet and Suberbie (1895) and Sibree (1896), were published contemporaneously with the expedition. Such period maps proved invaluable and were consulted extensively for estimating coordinates and for judging the correspondence of Major's locality spellings with current orthography. Longitudes on 19th-century French maps are marked as degrees East of the Paris meridian, rather than degrees East of the Greenwich meridian, which was the contemporary standard on British maps and is the current universal standard. Estimated degrees East of Paris are highlighted by enclosure in braces {}. In general, we accepted the coordinates supplied by the US Board of Geographic Names (USBGN) for Madagascar (1955, 1989) for plotting Major's collecting localities, where equivalence to current geographic names is certain or highly plausible. Those coordinates estimated from maps are preceded by "ca" (circa) to signify that their position is an approximation, in particular those extrapolated from the older historical maps.

The 26 annotated localities identified from Major's expedition are arranged broadly following his reconstructed itinerary (Table III; Figures 3 and 4). Indeterminate localities are unnumbered, but we have interspersed those among the main localities based on collection dates and field numbers. Organization of accounts is standardized as follows. The locality name is given in italicized font; its spelling observes the standard as given in the USBGN of Madagascar (1955, 1989) when feasible, with Major's original designation and variants provided in parentheses. The coordinates used to plot the italicized locality are supplied on the same line and the source of those coordinates indicated in parentheses. A "Geographic references" subheading includes maps, extracts from Major's papers and other publications that assisted our identification of collecting sites and verification of geographic coordinates. Major rarely provided information about habitat and altitude on his specimen tags. The latter datum is sometimes generally referenced in his later publications or was approximated by us from topographic maps. Corresponding vegetational zones are inferred from the altitudinal data as follows: 0–800 m, lowland or eastern rain forest; 800–1300 m, eastern moist montane forest; 1300–2300 m, eastern sclerophyllous montane forest; >1800–2000 m, montane thicket and grassland (White

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See Figure 4 for localities. <sup>a</sup>In the early months, Major did not always record the day of collection. <sup>b</sup>Field number ranges are indicated for large, apparently homogeneous, number series; not all intermediate numbers were necessarily located. Some bird specimens (A prefix) are also listed to enhance dates of visit. <sup>c</sup>Some specimens that may be reliably associated with a given locality lack dates or field numbers (e.g. field tag illegible or damaged).



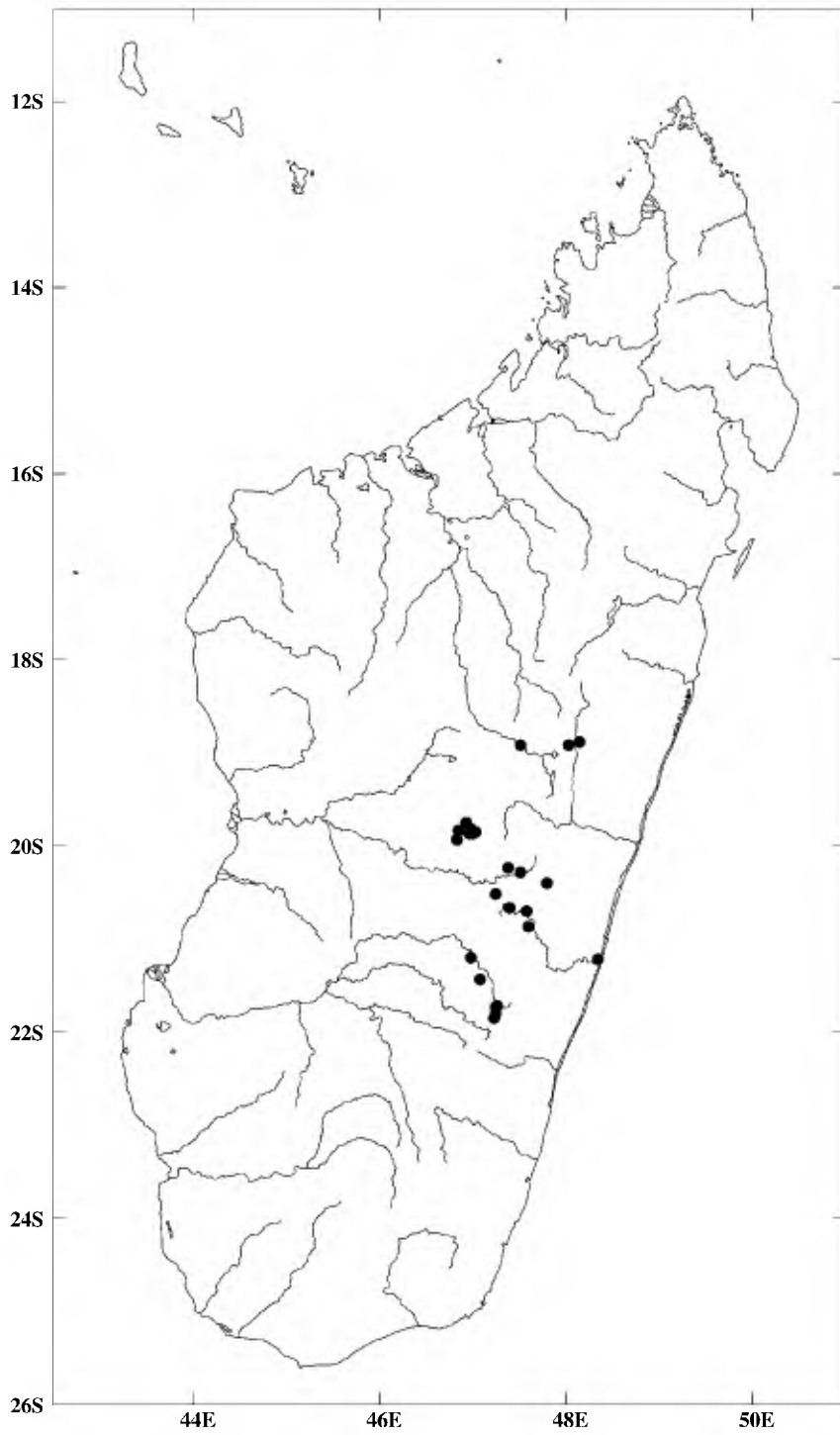


Figure 3. Map showing region of Madagascar visited by Major.

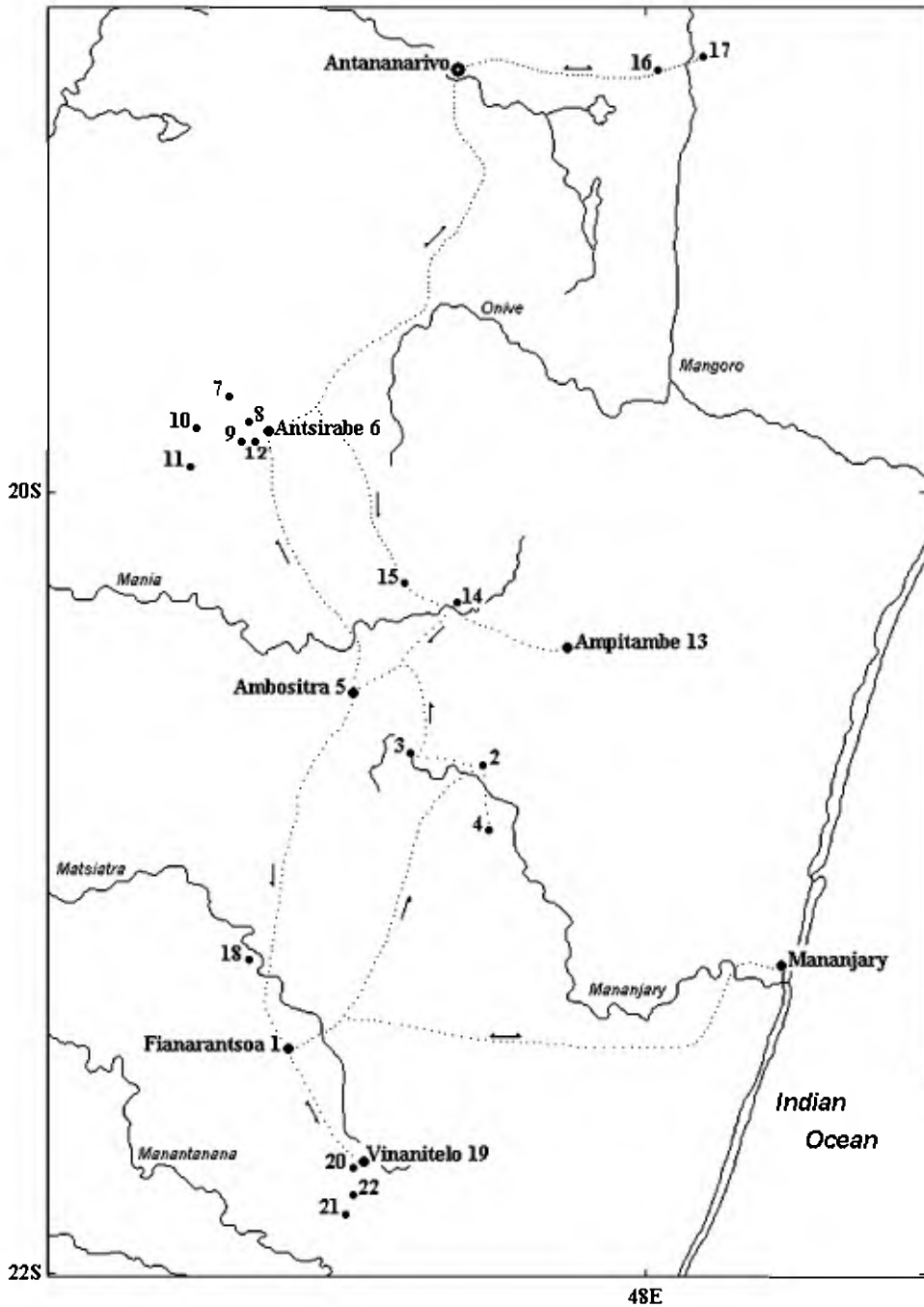


Figure 4. Itinerary of C. I. F. Major from August 1894 to July 1896. Map of the eastern region of Madagascar showing distribution of localities visited by Major. Numbered localities ● on the map correspond with those in the text and Table III; principal localities are shown thus ●. His probable route is indicated by dotted lines ..... and the direction of travel by arrows.

1986). The species documented from each locality convey something about the environment at the time of Major's visit and the "Specimens" subheading vouchers those species by museum registration number. Lastly, a "Remarks" subheading addresses miscellaneous topics particular to a given locality, such as problems associated with its modern identification, erroneous past interpretations of geographic placement and noteworthy details about the mammal fauna documented.

### Annotated gazetteer

*Locality 1: Fianarantsoa; 21°26'S, 47°05'E (USBGN)*

*Geographic references.* Major (1897a), "I arrived at Mananjary, on the east coast of Madagascar, at the end of August 1894 ... to travel first to Fianarantsoa, the capital of the Betsileo..."; marked on all historical and recent maps consulted.

*Habitat.* Grassy hills and plains (Cowan 1882).

*Altitude.* Ca 1000–1500 m (General Staff No. 4371 1943).

*Specimens.* *Setifer setosus*: BM(NH) 1897.9.1.57–58, 1939.1610–1612, 1948.279. *Tenrec ecaudatus*: BM(NH) 1939.1591–1592. *Suncus madagascariensis*: BM(NH) 1897.9.1.114. *Mormopterus jugularis*: BM(NH) 1966.6060–6061. *Pteropus rufus rufus*: BM(NH) 1897.9.1.29. *Avahi laniger*: BM(NH) 1939.1277. *Lepilemur microdon*: BM(NH) 1981.767.

*Remarks.* After his arrival at Mananjary in late August 1894, Major travelled inland to Fianarantsoa, a large town and the Provincial capital, where he arranged for field assistance and provisions for the later expedition. During this time, specimens were incidentally collected for several weeks in September, presumably mainly from the environs of the town. His first recorded specimen (M1) was a *Suncus madagascariensis*, presumably living as a human commensal. Forest-dwelling animals, such as the prosimians labelled from this locality, probably originated elsewhere and were brought to Major or perhaps purchased in the local market.

*Locality 2: Ivohimanitra; ca 20°42'S, 47°35'E (Cowan 1882)*

*Geographic references.* Brockway (1876), recorded; Cowan (1882), ca 20°42'S, 47°35'E; Oliver (1886), ca 20°40'S, 47°30'E; Sibree (1896), mapped; Major (1896a, p 320) "... Ivohimanitra forest, in the country of the Tanala of Ambohimanga, Nov. 1894"; Major (1897a), "I decided to leave for ... a quiet corner in the forest of the Tanala, N E of Fianarantsoa. The collecting work in the forest extended from October 1894 to the beginning of February 1895, interrupted in December by a journey to the Betsileo town of Ambositra. The first six weeks ... we were encamped in the midst of the forest, near Ivohimanitra, at from 1000 to 1100 metres above the sea"; Tattersall (1986), mapped; MacPhee (1987), mapped; Jenkins (1987), ca 20°S, 47°E; Viette (1991), listed.

*Habitat.* Eastern moist montane forest.

*Altitude.* 1000–1100 m (Major 1897a); 900 m (Major 1899); 700 m (MacPhee 1987).

*Specimens.* *Microgale thomasi*: BM(NH) 1897.9.1.109, 1975.2228, 1994.354. *Setifer setosus*: BM(NH) 1939.1617, 1947.12.5.22, 1975.1964. *Tenrec ecaudatus*: BM(NH) 1994.249–250; LIVM A19.4.98.16. *Eptesicus matroka*: BM(NH) 1897.9.1.36, 1977.2687–2689; NMW 27455. *Avahi laniger*: NMW 935/B3507. *Eulemur rubriventer*: BM(NH) 1897.9.1.7–9, 1898.2.22.1, 1939.1273, 1981.705, 1981.715, 1995.R17–R18; FMNH 5651; NMW 934/B3518. *Microcebus rufus*: BM(NH) 1897.9.1.25. *Propithecus diadema edwardsi*: BM(NH) 1924.12.16.2. *Galidia elegans*: BM(NH) 1897.9.1.116.

*Remarks.* Following the trek inland to Fianarantsoa, Ivohimanitra represented Major's first extended collecting effort, spending about 6 weeks here from October to December 1894 (Major 1897a). Curiously, this locality is not found on recent maps or in the USBGN gazetteer, although it is mentioned in contemporary accounts and indicated on period maps. The map in Oliver (1886) indicates two trails between Fianarantsoa and Ambositra, one to the west being the most direct and a second one swinging to the east. Ivohimanitra is marked on this latter trail. Our coordinates, estimated from the maps of Cowan (1882) and Oliver (1886), place Ivohimanitra to the north-west of the modern position of Ambohimombo, as the latter is given by the USBGN (1955, 1989) and as sited on recent maps. The modern placement, however, contradicts information from Major's (1897a) own account and also that of Brockway (1876), who journeyed south-eastwards from Ambositra to Ambohimanga. At the end of the first day, Brockway stopped overnight at Ambohimombo and on the second day, after 4 hours travel through dense forest, arrived at Ivohimanitra, which he described as a town on the spur of a high mountain. The overlap in collecting dates (for November) and similarity in the lemur fauna indicate that Ivohimanitra and Ambohimombo were sufficiently close together for Major, or his team of assistants, to survey simultaneously (see next Remarks).

*Locality 3: Ambohimombo (Ambohimombo, Ambohimombo forest, Ambohi.); ca 20°40' S, 47°24' E (this study)*

*Geographic references.* Brockway (1876), recorded as Ambôhimômbo and a day's journey from Ambositra; Major (1896a, p 321), "...Ambohimombo forest, Nov. 1894"; Major (1896b, p 461–462), "The section of the Betsimisaraka tribe inhabiting the forest east of Betsileo are called Tanala by their neighbours. The name they give to themselves in the northern portion of this forest, in which Ambohimombo is situated, is Taiva ... Hab. Ambohimombo forest, Tanala Country, 19th Jan., 1895"; Major (1897a), "...a quiet corner in the forest of the Tanala, N E of Fianarantsoa ... The first six weeks ... we were encamped in the midst of the forest, near Ivohimanitra, at from 1000 to 1100 metres above the sea. The second stay was at Ambohimombo, a short day's journey NW from the latter place and some 400 metres higher up"; Major (1899, p 554), "... at Ambohimombo and Ivohimanitra, farther to the south, in the Tanala country (the Tanalas, 'foresters,' are part of the Betsimisaraka tribe)"; Geographical Section, General Staff No. 4243 (1941–43), Sheets 17 and 18, ca 20°44' S, 47°25' E; General Staff No. 4371 (1943), ca 20°43' S, 47°23' E; Morrison-Scott (1948), 20°40' S, 47°20' E; USBGN (1955, 1989), 20°43' S, 47°26' E; Tattersall (1986), mapped; Jenkins (1987), 20°43' S, 47°26' E; MacPhee (1987), 20°43' S, 47°26' E; Carleton and Schmidt (1990), *lapsus* as Ambohimombo 20°43' S, 47°23' E; Viette (1991), listed.

*Habitat.* Eastern sclerophyllous montane forest.

*Altitude.* 1350–1440 m, as marked on an original herbarium label; 1500–1600 m (Major 1897a); 1200 m (MacPhee 1987).

*Specimens.* *Hemicentetes semispinosus*: BM(NH) 1958.2.27.23–24, 1994.261–265, 1994.270–271, 1996.X35–X40; NMW B2728. *Microgale cowani*: BM(NH) 1994.340, 1996.X41. *Microgale dobsoni*: BM(NH) 1897.9.1.100, 1897.9.1.106; LIVM A19.4.98.19; MCZ 45038; USNM 154988; ZFMK 79.152–153. *Microgale gracilis*: BM(NH) 1897.9.1.78. *Microgale longicaudata*: BM(NH) 1994.352. *Microgale taiva*: BM(NH) 1897.9.1.112/1975.2233. *Setifer setosus*: BM(NH) 1975.1965; LIVM A19.4.98.17. *Tenrec ecaudatus*: BM(NH) 1897.9.1.54, 1994.242. *Eptesicus matroka*: BM(NH) 1897.9.1.35, 1966.6052; FMNH 5646. *Myotis goudoti*: BM(NH) 1897.9.1.47–48; MCZ 45116. *Avahi laniger*: FMNH 5654. *Eulemur rubriventer*: BM(NH) 1897.9.1.11; LIVM A19.4.98.11; NMW 890/B350? *Haplemur griseus*: BM(NH) 1897.9.1.12; FMNH 5652; NMW 902/B3505. *Lepilemur microdon*: BM(NH) 1958.3.4.7, 1981.759, 1984.1245. *Microcebus rufus*: LIVM A19.4.98.15. *Propithecus diadema*: BM(NH) 1958.3.4.4. *Propithecus diadema edwardsi*: BM(NH) 1939.1203–1206. *Fossa fossana*: BM(NH) 1897.9.1.115. *Eliurus majori*: BM(NH) 1897.9.1.147; MCZ 45929. *Nesomys rufus*: BM(NH) 1897.9.1.121, 1897.9.1.124, 1903.2.25.1–4, 1939.1895, 1958.2.28.4; USNM 154991.

*Remarks.* Major's field tags uniformly read "Ambohimitambo", but he had corrected the spelling to Ambohimitombo in his publications. Collecting dates confirm that he stayed at Ambohimitombo from November 1894 to the end of January 1895, interrupted by a week's visit to Ambositra (Table III). Although unmarked on contemporary maps, Brockway (1876) located Ambohimitombo as a good-sized village on the crown of a high hill, in forest and a day's journey south-east from Ambositra. These landmarks are consistent with the locality of the same name visited by Major.

Although a small town approximating their description is marked on maps dating from 1943, some uncertainty surrounds the equivalence of this post-1943 locality to the one identified by Brockway and Major in the latter 19th century. Plotted according to the USBGN (1955, 1989) coordinates, the post-1943 Ambohimitombo falls to the south-east of Ivohimanitra, at a lower altitude, in contrast to the position of the latter site as estimated from historical maps (Cowan 1882; Oliver 1886). Major (1897a) stated and Brockway (1876) implied that Ambohimitombo was north-west of Ivohimanitra (see previous entry); furthermore, in his discussion of *Eulemur* captures, Major (1899) clearly indicated that Ivohimanitra was the lower site, situated some 400 m in altitude below Ambohimitombo. The positions of some villages certainly do change over time, such that the Ambohimitombo of Brockway's and Major's era may have been differently situated relative to the modern town of the same name. Another explanation for the discrepancy is that Cowan (1882) and Oliver (1886) inaccurately mapped the location of Ivohimanitra. We judge this unlikely, firstly, because Oliver (1886) explicitly stated that Ivohimanitra was one of the few non-migratory towns in the northern part of the Tanala region and secondly, because of the concurrence between these 1880s maps and both Brockway's (1876) and Major's (1897a, 1899) coeval accounts of geographic disposition and altitude. The coordinates supplied by Morrison-Scott (1948) position Ambohimitombo north-west of the modern town of the same name and incidentally also north-west of Ivohimanitra as depicted by Cowan (1882) and Oliver (1886). Although the source of Morrison-Scott's coordinates is unknown, their latitude (20°40'S) appears probable to us. Their longitude (47°20'E), however, plots Ambohimitombo within a lightly populated region on Cowan's (1882) map; this is improbably far to the west and an unlikely locale for the many forest-dwelling mammals that Major obtained. The coordinates we provide (ca 20°40'S, 47°24'E,



as interpolated from Cowan and Oliver) place Ambohimombo to the north-west of Ivohimanitra and close to the eastern Fianarantsoa–Ambositra track that runs parallel to Ivohimanitra (as shown by Oliver).

Major's survey in the vicinity of Ambohimombo yielded a relatively high species richness, especially for Tenrecidae and Primates, although surprisingly few rodent taxa were recovered considering the altitude and montane forest setting. Four new species were ultimately described from specimens collected at this locality (Table II). The specimen of the rare *Microgale gracilis* was found at only one other site, Ankeramadinika (see below).

*Locality 4: Ambohimanga; 20°52'S, 47°36'E (USBGN)*

*Geographic references.* Brockway (1876), recorded; Mullens (1875), ca 20°50'S, 47°52'E; Cowan (1882), ca 20°52'S, 47°36'E; Oliver (1886), ca 20°52'S, 47°36'E; Sibree (1896), mapped; Geographical Section, General Staff No. 4243 (1941–43), Sheets 17 and 18, ca 20°52'S, 47°36'E; General Staff No. 4371 (1943), ca 20°52'S, 47°36'E.

*Habitat.* Large areas cleared for cultivation, with isolated forest and abundant bamboo between Ivohimanitra and Ambohimanga, “the forest capital” (Brockway 1876); countryside with forest patches (Cowan 1882).

*Altitude.* Ca 500 m (General Staff No. 4371 1943).

*Specimens.* *Hapalemur griseus griseus*: BM(NH) 1958.3.4.5.

*Remarks.* The Ambohimanga on the single label recorded from this locality plausibly corresponds to the well-known town referred to as the “first capital” (of the Tanala country) on Cowan's map (1882). Major (1897a) escorted his first collection from Ivohimanitra to Ambohimanga, where he intended to use the local Norwegian Lutheran Mission for the first return shipment of his specimens to the coast and onwards to London. Because of the war, however, he was obliged to carry what he could back to Ivohimanitra, leaving part of his “things” at the Missionary Station; whether these “things” included only field gear or also specimens is unclear. Apparently, only a single specimen of *Hapalemur griseus* plus a few reptiles were collected at this locality, which, according to Brockway (1876), was a short journey but a great descent from Ivohimanitra.

*Itsimatahodarana (Hsimatabodalamia?) (near Ambositra); not located*

*Specimens.* *Hemicentetes nigriceps*: BM(NH) 1939.1603, 1939.1605. *Hemicentetes semispinosus*: BM(NH) 1939.1606, 1939.1608–1609; LIVM A19.4.98.18.

*Remarks.* Major's cursive flair makes this locality's spelling illegible; Itsimatahodarana is our best interpretation. As such or similar variants in spelling, the locality has not been traced, but according to correspondence from Major (Hartert 1897) and one specimen label, Itsimatahodarana is near Ambositra and their proximity is corroborated by the collection dates (Table III). He presumably visited this site during his passage from the Ivohimanitra–Ambohimombo region to Ambositra, where he arranged the first return shipment of specimens to London.

*Locality 5: Ambositra; 20°31'S, 47°15'E (USBGN)*

*Geographic references.* Major (1897a), "...interrupted in December by a journey to the Betsileo town of Ambositra. The Betsileo town of Ambositra, on the central plateau ... In the intervals ... some good collecting work was carried on at Ambositra as well"; marked on all historical and recent maps.

*Habitat.* "Exposed treeless country around Ambositra" (Brockway 1876); "grassy hills and plains" (Cowan 1882).

*Altitude.* Ca 1500–2000 m (General Staff No. 4371 1943).

*Specimens.* *Hemicentetes nigriceps*: BM(NH) 1939.1604; CUMZ E.5445.A; NMW 1298. *Hemicentetes semispinosus*: BM(NH) 1994.273. *Setifer setosus*: BM(NH) 1897.12.2.5, 1897.9.1.60, 1939.1613–1615, 1947.12.5.13, 1948.266–278, 1975.1962, 1975.1963, 1994.255, 1994.257–258; CUMZ E.5450.B; NMW 1300, 7198; USNM 122488, 122489. *Tenrec ecaudatus*: BM(NH) 1958.2.27.25. *Eptesicus matroka*: BM(NH) 1897.9.1.32, 1897.9.1.34, 1989.160; MCZ 45115. *Miniopterus majori*: BM(NH) 1977.2692.

*Remarks.* After the social unrest encountered in Ambohimanga, Major used Ambositra as his principal logistical base for packing and despatching specimens and for contacting the British consulate in Antananarivo. As interpolated from specimen dates and his expedition summary (1897a), he visited the town on at least four occasions for such activities: (1) early December 1894, during his fieldwork at Ivohimanitra and Ambohimombo and following his failure to secure help at Ambohimanga; (2) February and March 1895, at the completion of collecting at Ambohimombo and before proceeding for the first time to Antsirabe (locality 6); (3) probably late August 1895, after his first visit to Ampitambe (locality 13) and prior to his second session at Antsirabe; and (4) April 1896, after his second period at Ampitambe and before embarking on the final leg of his expedition to Vinanitelo (locality 19). Miscellaneous tenrecs and bats are documented for the layovers in December 1894, February 1895 and April 1896, presumably collected on an opportunistic basis and in and around the town.

*Loharindra Cavern (near Ambositra); not located*

*Specimens.* *Miniopterus manavi*: BM(NH) 1966.6047–6050. *Myotis goudoti*: BM(NH) 1966.6042–6046.

*Remarks.* The original specimen label of the *Miniopterus* (Loharindra Cavern, near Ambositra) and collecting dates place this cavern near Ambositra.

*Locality 6: Antsirabe (Sirabé, near Sirabe); 19°51'S, 47°02'E (USBGN)*

*Geographic references.* Marked on all maps consulted; Major (1896a, p 322), "Marshes near Sirabè"; Major (1896b, p 462), "Fossil [*Microgale pusilla*] in the Children's Cave, near Sirabè (Vakinankaratra)"; Major (1897a), "Finally in March, I left Ambositra for Sirabé ... so I had to content myself for the beginning with the exploration of a small cave, and ... collecting the recent fauna of the neighbourhood .... The cavern yielded some bird-remains and egg-shells of *Æpyornis*, but chiefly small mammals ... I subsequently found still existing in different parts of

the forest most of the new Mammals discovered in the cave [and] ... in the beginning of September 1895 ... I returned to Sirabé and searched ... [for fossils]"; Major (1897b, p 697), "Fossil [*Brachyuromys ramirohitra*] ... in the Children's Cave, Sirabé".

*Habitat.* Major (1897a) mentioned collecting in nearby marshland and caves, presumably with no or little forest since Antsirabe was a well-established population centre by the 1890s.

*Altitude.* 1500 m (MacPhee 1987; General Staff No. 4371 1943).

*Specimens.* *Hemicentetes semispinosus*: BM(NH) 1994.272; FMNH 5634; ZFMK 79.149. *Microgale cowani*: BM(NH) 1897.9.1.80, 1947.12.5.3, 1975.2213–2217. *Oryzorictes tetradactylus*: BM(NH) 1897.9.1.67–69, 1897.9.1.79, 1897.12.2.7, 1939.1636–1639, 1947.12.5.1, 1974.558, 1975.2163–2171, 1975.2173–2188, 1994.283; FMNH 5640; CUMZ E.5453.B–C; LIVM A19.4.98.22; MCZ 12430; MNHN 1897.520. *Setifer setosus*: BM(NH) 1897.9.1.59, 1939.1618–1619, 1947.12.5.15, 1975.1966–1972, 1979.147. *Tenrec ecaudatus*: BM(NH) 1939.1593, 1994.248. *Suncus madagascariensis*: FMNH 5649. *Miniopterus fraterculus*: BM(NH) 1977.2717–2718. *Fossa fossana*: BM(NH) 1947.12.5.49, 1958.3.4.14–17, 1958.3.4.19, 1958.3.4.21.

*Remarks.* This long-established locality is marked on contemporary maps as Sirabé but as Antsirabe on more modern maps and in gazetteers (see Remarks under Andranobe, locality 8, on the Malagasy usage of "An"). Major twice stayed at Antsirabe for extended bouts of collecting: the first time from 9 March to 31 May 1895 (Table III); the second visit from September 1895 probably to December 1895; a period in which he concentrated on fossil prospecting and apparently obtained no Recent material (none confirmed in our searches). During his prolonged intervals at Antsirabe, Major seemed to devote some time to tidy record-keeping of his Recent mammal collection, as evidenced by out-of-sequence numbers assigned to specimens that had been collected at earlier localities and dates (such as those collected from Ambositra—M799 and M801 in December 1894 and M793 in February 1895). These are skins with skulls or full skeletons, which he could dry and stabilize until time materialized for preparation. The "small cave" and "Children's Cave" that Major variously referenced (1896a, 1896b, 1897a, 1897b) are probably one and the same, which is in the district of Vakinankaratra near Antsirabe. MacPhee (1987) used the name Lavajaza, which in Malagasy translates as the Children's Cave. Antsirabe served as Major's base of operation during brief visits to nearby places (see localities 7–12).

In spite of the extended periods spent in and around Antsirabe, Major collected few Recent specimens. A notable exception is *Suncus madagascariensis*, one of two species of the lipotyphlan family Soricidae found in Madagascar; the specific status and hence endemism of the form is uncertain (Hutterer 1993), although Goodman (2003) lists it as indigenous to Madagascar. The Children's Cave, however, produced significant collections of subfossil small mammals, in particular material of the new species *Microgale pusilla* (Major, 1896b) and *Brachyuromys ramirohitra* (Major, 1896a), both of which he later collected at more southern forest localities and eventually described (Table II). These occurrences indicate either that the cave region was forested at some period in the near past or that forested areas were within the range of predatory birds such as owls. The several forest-dwelling *Fossa* documented from Antsirabe also suggest the persistence of suitable forest in the vicinity at the time of his expedition, although the possibility that they originated from elsewhere and were simply acquired by Major during his stay may not be discounted.

*Locality 7: Fasina (Ifasina, Ifasina near Sirabé); ca 19°45'S, 46°56'E (Geographical Section, General Staff No. 4243 1941–43, Sheets 17 and 18)*

*Geographic references.* Mullens (1875), Ifasina ca 19°45'S, 47°05'E; Roblet (1885), Fasina ca 19°45'S, {44°42'E}; Grandidier in Oliver (1886), Fasina, Geographical Section, General Staff No. 4243 (1941–43, Sheets 17 and 18), ca 19°45'S, 46°56'E.

*Habitat.* Unknown, but probably either eastern sclerophyllous montane forest or montane thicket and grassland.

*Altitude.* Ca 1800–>2000 m, as estimated from map references.

*Specimens.* *Oryzorictes tetradactylus*: BM(NH) 1898.3.8.1–4, 1975.2159–2162, 1994.285–286.

*Remarks.* Major rendered the locality as “near Sirabé” on some specimen labels and their physical closeness is corroborated by some collection dates that include specimens from both places.

*Locality 8: Andranobe (Ranobe); 19°49'S, 46°59'E (USBGN)*

*Geographic references.* Oliver (1886), as Andranobe L., ca 19°49'S, 46°59'E; Geographical Section, General Staff No. 4243 (1941–43), Sheets 17 and 18, Lake Andranobe, ca 19°49'S, 46°59'E; USBGN (1955), Lake Andranobe, 19°49'S, 46°59'E; Viette (1991), listed as both forêt d'Andranobe and Lac Andranobe.

*Habitat.* Unknown. The fauna recorded indicates a range of habitats, including marshes and wetlands (several species of waterbird and *Oryzorictes tetradactylus*), forest edge and disturbed areas (*Viverricula indica*) and relatively intact forest (*Fossa*).

*Altitude.* Ca 1500–2000 m (General Staff No. 4371 1943).

*Specimens.* *Microgale cowani*: BM(NH) 1897.9.1.81, 1947.12.5.25, 1994.333, 1994.338–339, 1994.341–347. *Oryzorictes tetradactylus*: BM(NH) 1897.9.1.66, 1939.1641, 1975.2189–2199, 1994.365; FMNH 5637; MNHN 1897–521. *Fossa fossana*: BM(NH) 1947.12.5.14, 1958.3.4.12–13, 1958.3.4.20. *Viverricula indica*: BM(NH) 1958.3.4.9.

*Remarks.* Although not mentioned in Major's papers nor discovered with this exact spelling on any map, Ranobe appears as a locality on a number of specimens collected sporadically during the several months that Major stayed at Antsirabe (Table III). A lake about 8 km to the north-west of Antsirabe, however, is marked on many contemporary and recent maps as Lake Andranobe. The proper usage of the prefix “An”, meaning “the place at” in Malagasy, is highly variable in local speech, such that Major's Ranobe (“lots of water”) is plausibly equivalent to Andranobe (“the place of lots of water”) (S. M. Goodman, personal communication). MacPhee (1987) did not locate Ranobe but listed it as near Frandriana [*sic*] and Ampitambe, places far to the south of Antsirabe; this interpretation conflicts with the dates of collection and Major's focus of operation around Antsirabe during that period.

*Locality 9: Andraikiba Lake (W of Andraykiba L.[ake], Andraykiba L.[ake] W of Sirabe); 19°52'S, 46°58'E (USBGN)*

*Geographic references.* Mullens (1875), mapped as Lake Iraikiba [or Iraikiva], ca 19°51'S, 47°05'E; Roblet (1885), mapped as Lac Andraikiba; Grandidier in Oliver (1886), mapped as L. Andraikiva; Laillet and Suberbie (1889), mapped as Lac Iraikiba; Sibree (1891), recorded as ca 4 miles [6 km] west of Antsirabe; Major (1896a, p 320), "...obtained in a marsh west of Andraykiba Lake, two hours to the west of Sirabè (Vakinankaratra district, S W Imerina), at about 1600 metres above sea level"; Geographical Section, General Staff No.4243 (1941–43), Sheets 17 and 18, as Lake Andraikiba, ca 19°52'S, 46°58'E.

*Habitat.* Marshland.

*Altitude.* 1600 m (Major 1896a).

*Specimens.* *Limnogale mergulus*: BM(NH) 1994.366.

*Remarks.* The collection dates on both mammal and bird specimens (Table III) document that Major visited the site on several occasions while based at Antsirabe. According to the original description (Major 1896a), one of the two specimens of the rare aquatic tenrec *Limnogale mergulus* was collected here "in a marsh west of Andraykiba Lake". Major's published version departs from the original label on this *Limnogale*, which reads only "marsh near Masinandraina". Masinandraina is variously marked as a Norwegian Mission west of Lake Iraikiba (or Iraikiva) by Mullens (1875; ca 19°51'S, 47°04'E), west of Lac Andraikiba on the map of Roblet (1885; ca 19°50'S, {44°40'E}), or south of Lac Iraikiba by Laillet and Suberbie (1889; ca 19°55'S, {44°42'E}). The differing references raise suspicion that there are two separate lakes, Andraykiba and Iraikiba; however, Major's (1896a) version indicates that he considered them to be equivalent. All bird specimens were recorded from Andraykiba and were collected during Major's first stay at Antsirabe in early 1895. The *Limnogale* was obtained on 24 February 1896, apparently during his return from Antananarivo and prior to his second visit to Ampitambe in March. Major (1897a) did not mention a third collecting effort at Antsirabe, but the town, or the Norwegian Mission at Masinandraina, would have been a logical rest stop while travelling south and allowed another opportunity to collect at the nearby lake.

*Locality 10: Betafo; 19°50'S, 46°51'E (USBGN)*

*Geographic references.* Oliver (1886), ca 19°50'S, 46°51'E; Laillet and Suberbie (1889), ca 19°48'S, {44°35'E}; Grandidier (1893), 19°50'S, {44°29'E}; Geographical Section, General Staff No.4243 (1941–43), Sheets 17 and 18, 19°50'S, 46°51'E; General Staff No.4371 (1943), 19°50'S, 46°51'E; Viette (1991), listed.

*Habitat.* Unknown, possibly lakeside forest edge and disturbed habitat.

*Altitude.* Ca 1500 m (General Staff No.4371 1943).

*Specimens.* *Viverricula indica*: BM(NH) 1897.12.2.9.



*Remarks.* Betafo is clearly marked about 20 km to the north-west of Antsirabe on several old and recent maps. The specimen from this locality was collected during Major's stay at Antsirabe (Table III).

*Locality 11: Tritriva (Fribriva); 19°56'S, 46°50'E (USBGN, as Lake Tritriva)*

*Geographic references.* Roblet (1885) and Laillet and Suberbie (1889), marked as Tritriva, SW of Antsirabe; Sibree (1891), recorded as ca 10 miles [16 km] SW of Antsirabe; Geographical Section, General Staff No. 4243 (1941–43), Sheets 17 and 18, as Lake Tritriva, ca 19°55'S, 46°55'E; Viette (1991), listed as lac Tritriva.

*Habitat.* Possibly forest edge and disturbed areas, according to the species collected.

*Altitude.* Ca 1500–2000 m (General Staff No. 4371 1943).

*Specimens.* *Viverricula indica*: BM(NH) 1897.9.1.117.

*Remarks.* Described as a volcanic crater-lake by Sibree (1891), this is another well-known locality, south-west of Antsirabe and, based on the collector's number and date, probably visited while stationed there. A small isolated area of natural forest currently exists not far from the lake (S. M. Goodman, personal communication), but a century ago, Major presumably encountered considerably more forest around the lake and in the vicinity of Antsirabe.

*Locality 12: Ivohitra; ca 19°52'S, 47°00'E (Geographical Section, General Staff No. 4243, 1941–43, Sheets 17 and 18)*

*Geographic references.* Mullens (1875), ca 19°51'S, 47°09'E; Geographical Section, General Staff No. 4243 (1941–43), Sheets 17 and 18, ca 19°52'S, 47°00'E.

*Specimens.* *Rattus rattus*: BM(NH) 1897.9.1.155.

*Remarks.* This locality was visited while working in the vicinity of Antsirabe.

*Locality 13: Ampitambe (Ampitambe forest, or for.[est], or f.[orest], foret d'Ampitambe); ca 20°24'S, 47°48'E (Geographical Section, General Staff No. 4243 1941–43, Hill Features)*

*Geographic references.* Major (1896a, p 320–323), “Ampitambè forest (N.E. Betsileo)”, “the neighbourhood of Ampitambè”, or “Loc. Ampitambè forest, Betsimisaraka country (on the border of N.E. Betsileo), 6 hours S.E. of Fandriana”; Major (1897a), “Finally, losing patience, I left Sirabé, crossed over the whole central plateau to the east, and settled in the forest at Ampitambé, on the border of the Betsimisaraka country ... My collecting work at Ampitambé proved very successful, thanks chiefly to the cooperation of the natives, Betsileos and Betsimisarakas...”; Major (1897b, p 697), “Loc. Ampitambè Forest, Betsimisaraka country (on the border of N.E. Betsileo), 6 hours S.E. of Fandriana”; Major (1899, p 554), “Ampitambè, N. E. Betsileo (at the confines of the Betsimisaraka country”; Geographical Section, General Staff No. 4243 (1941–43), Hill Features, as Ampitambe, ca 20°24'S, 47°48'E; Morrison-Scott (1948), 20°20'S, 47°30'E; Tattersall (1986), incorrectly mapped too far north-east and too low for the fauna recorded; Jenkins

(1987), 20°17'S, 48°25'E, incorrect, based on USBGN listing (1955); Jenkins (1987), 19°46'S, 48°22'E, incorrect too far north-east, following Tattersall (1986) and based on another USBGN listing (1955); MacPhee (1987), indeterminate but advanced an Ampitabe (20°44'S, 47°38'E) as possible; Carleton and Schmidt (1990), as Ampitambe or Ampitabe, ca 20°22'S, 47°46'E; Peterson et al. (1995), erroneously as 18°51'S, 48°14'E, far to the north of Major's sphere of activity.

*Habitat.* Eastern moist montane forest and a variety of habitats near the principal site (see Carleton and Schmidt 1990).

*Altitude.* 900–1300 m (Major 1899); ca 900 m (Carleton and Schmidt 1990); ca 1000–1500 m (General Staff No. 4371 1943).

*Specimens.* *Hemicentetes nigriceps*: BM(NH) 1897.12.2.6, 1897.9.1.62–64. *Hemicentetes semispinosus*: BM(NH) 1994.259–260. *Microgale cowani*: BM(NH) 1897.9.1.92, 1897.9.1.111, 1975.2227. *Microgale dobsoni*: BM(NH) 1897.12.2.8, 1897.9.1.101, 1897.9.1.105, 1939.1631–1633, 1975.2230–2232, 1994.350; CUMZ E.5458.B; FMNH 5636; MNHN 1897.523; NMW 953/B2749, 954; USNM 49673. *Microgale thomasi*: BM(NH) 1897.9.1.108/1975.2226. *Oryzorictes hova*: BM(NH) 1897.9.1.77, 1994.290. *Oryzorictes hova?*: BM(NH) 1975.2211; NMW 949. *Oryzorictes tetradactylus*: BM(NH) 1897.9.1.70, 1897.9.1.76, 1975.2212, 1994.279–281, 1994.364; CUMZ E.5453.D. *Setifer setosus*: BM(NH) 1939.1616. *Tenrec ecaudatus*: BM(NH) 1897.12.2.4, 1939.1598. *Eptesicus matroka*: BM(NH) 1897.9.1.33. *Mormopterus acetabulosus*: BM(NH) 1996.X27; NMW 27421. *Mormopterus jugularis*: BM(NH) 1897.9.1.49–53, 1996.X18; FMNH 5647; NMW 27434. *Scotophilus borbonicus*: BM(NH) 1989.161. *Avahi laniger*: LIVM A19.4.98.14. *Cheirogaleus major*: FMNH 5656. *Cheirogaleus major major*: BM(NH) 1897.9.1.15. *Eulemur rubriventer*: BM(NH) 1939.1257. *Lepilemur microdon*: BM(NH) 1897.9.1.16, 1897.9.1.18–20, 1919.10.2.3, 1981.760–761, 1958.3.4.6. *Lepilemur microdon?*: MCZ 44941. *Lepilemur mustelinus*: BM(NH) 1897.9.1.17, 1897.9.1.24, 1981.785–786. *Lepilemur mustelinus?*: FMNH 5653; LIVM A19.4.98.12; USNM 49668. *Microcebus rufus*: FMNH 5633. *Propithecus diadema*: BM(NH) 1958.3.4.10; NMW 933/B3503. *Propithecus diadema edwardsi*: BM(NH) 1897.9.1.1–3; LIVM A19.4.98.13. *Felis catus* (domestic, feral): BM(NH) 1979.2183, 1952.10.20.4, 1958.3.4.11. *Fossa fossana*: BM(NH) 1958.3.4.18. *Viverricula indica*: BM(NH) 1897.9.1.118. *Potamochoerus larvatus*: BM(NH) 1897.9.1.162–163; FMNH 5660; USNM 49667. *Brachyuromys betsileoensis*: BM(NH) 1897.9.1.126, 1897.9.1.131, 1898.3.8.11–13, 1948.290, 1948.292, 1979.139; FMNH 5628; LIVM A19.4.98.23; MNHN 1897-535; UZMC 1823, UZMC 7943. *Brachyuromys ramirohitra*: BM(NH) 1897.9.1.125, 1897.9.1.132A, 1897.9.1.133–136, 1897.9.1.138–139, 1897.12.2.11, 1898.3.8.14–16, 1939.1897, 1947.12.5.10–12, 1947.12.5.18–19, 1947.12.5.21, 1947.12.5.23–24, 1947.12.5.27, 1947.12.5.30, 1947.12.5.35, 1947.12.5.38–40, 1947.12.5.46, 1947.12.5.52, 1948.282–289, 1948.291, 1958.2.28.219, 1974.764, 1979.140, 1987.111; FMNH 5627, 29468–29470; LIVM A19.4.98.24; MCZ 12433, 45935, 46262; MNHN 1897-531–1897-533; NMW 2342, 2345/B437; RMNH 26525; USNM 49669, 154992; UZMC 1223, 7944. *Eliurus minor*: BM(NH) 1897.9.1.153/1958.3.4.3; FMNH 5629. *Eliurus penicillatus*: BM(NH) 1897.9.1.148–152, 1897.12.2.10, 1939.1892, 1947.12.5.7–8, 1947.12.5.26, 1947.12.5.28, 1947.12.5.32, 1947.12.5.43–45, 1947.12.5.51, 1947.12.5.53, 1947.12.5.55, 1958.2.28.8, 1958.3.4.1–2; FMNH 5630; LIVM A19.4.98.26; MCZ 12435, 45932; MNHN 1897-536, 1909-191; NMW 2413/B419; USNM 49672; UZMC 1219, 1224, 7941; ZFMK 82.217,

83.56. *Gymnuromys roberti*: BM(NH) 1897.9.1.140–143, 1897.9.1.145–146, 1898.3.8.8–10, 1939.1893, 1947.12.5.5–6, 1947.12.5.9, 1947.12.5.29, 1947.12.5.31, 1947.12.5.34, 1947.12.5.36–37, 1947.12.5.41–42, 1947.12.5.47–48, 1947.12.5.50, 1947.12.5.54, 1948.296, 1958.2.28.1, 1974.767, 1995.296, 1996.270; FMNH 5632; LIVM A19.4.98.27; MCZ 45930–45931; MNHN 1897-537, 1897-538; NMW 2341/B439, 2414; RMNH 26523–26524; USNM 49670–49671, 154990; UZMC 1220, 1824, 7942. *Nesomys rufus*: BM(NH) 1897.9.1.122–123, 1897.9.1.159, 1898.3.8.17–19, 1903.2.25.5, 1939.1894, 1947.12.5.20, 1957.5.7.1, 1958.2.28.3, 1958.2.28.5–6, 1974.765–766, 1995.297–300; LIVM A19.4.98.25; MCZ 12432, 45937–45939; MNHN 1897-530; NMW 2344/B440, 2409, USNM 241117; UZMC 1218, 1221, 7945; ZFMK 79.431, 79.432. *Rattus rattus*: BM(NH) 1897.9.1.156, 1948.297.

*Remarks.* Although the USBGN (1955, 1989) lists several places as Ampitambe or Ampitabe, none of these coordinates seems consistent with Major's (1897a, 1897b) descriptions of its general location relative to Antsirabe and Fandriana, with the local peoples who worked for him, or with the assortment of montane-forest species he collected. Nor is this locality traceable on any of the historical maps we consulted. The probable location of Ampitambe was discussed at length by Carleton and Schmidt (1990: 11–13), who proposed coordinates (ca 20°22'S, 47°46'E) as estimated from an Ampitambe found on the 1942 British War Office map. Refinement of their placement, as given above (ca 20°24'S, 47°48'E), follows a different edition of this map series (Geographical Section, General Staff No. 4243 1941–43, Hill Features). Another place, Ampitamalandy (ca 20°19'S, 47°46'E), is also marked on the 1941–43 map, just to the north-west of Ampitambe; coincidentally, Ampitamalandy lies just north of the location of the Ampitambe suggested by Carleton and Schmidt (1990) and is also on a tributary of the Nosivolo River. All are on or near trails that link Fandriana, Masindry and Ambositra. The coordinates provided by Morrison-Scott (1948) also seem plausible if based (as discussed by Carleton and Schmidt 1990) on the estimated distance travelled south-east from Fandriana in 6 hours (Major 1896a, 1897b). Proximity to Masindry and Fandriana (see below) is corroborated by specimens from both localities that were collected within the periods that Major spent at Ampitambe. These contending sites, all in relatively close proximity, place Ampitambe nearer to Ambositra than to Antsirabe, which concords with Major's (1897a) account that material was despatched from Ambositra after his first visit to Ampitambe (June to August 1895) and before journeying back to Antsirabe (September 1895).

Major was based at this important collection site on two occasions: June to August 1895 and a briefer stint in March 1896 (Table III). He (1897a) stated that 804 specimens of Recent mammals had been collected at the end of his first stay at Ampitambe. No original label has been discovered for M804, but the next collector's number, M805, was issued to a specimen collected at Andraikiba Lake on 24 February 1896, near the beginning of Major's next phase of collecting Recent mammals. As noted previously, there are some inconsistencies in collector's numbers and dates, and some records are obviously missing from the database. M788, dated July 1895 and M791, undated, are the highest collector's numbers recovered for the first session at Ampitambe; the latest collector's date encountered is 11 August 1895 for M751.

During the nearly 4 months that Major worked around Ampitambe, longer than in any other locality, he amassed a greater number of taxa (28 endemic plus three introduced species) and specimens (at least 295) than from any other locality (Table III). He collected 22 species in each collecting session, 14 species of which were common to both periods.

Ampitambe also yielded the most new taxonomic discoveries, serving as the type locality of two rodent genera and six species of rodents and tenrecs (Table II). Although representatives of all mammalian orders that occur on Madagascar were collected here, Afrosoricida, Primates and Rodentia are abundantly represented. Evidence of sympatry is recorded in several genera: *Hemicentetes*, *Microgale* (three species), *Oryzorictes*, *Lepilemur*, *Brachyuromys*, and *Eliurus*. Three introduced species (*Felis catus*, *Potamochoerus larvatus* and *Rattus rattus*) were collected. According to Major (1899), *Eulemur rubriventer* was collected only from highland forests, an assessment of ecological fidelity consistent with current understanding of its restriction to middle and high-altitude rain forests (Mittermeier et al. 1994).

*Locality 14: Masindrary (Imasindrary, Masindrary, Masindray); 20°17'S, 47°31'E (USBGN)*

*Geographic references.* Major (1896a, p 320), "Caught March 18, 1896. Hab. Imasindrary, N.E. Betsileo"; Geographical Section, General Staff No. 4243 (1941–43), Sheets 17 and 18, as Masindrary, ca 20°17'S, 47°31'E; USBGN (1955, 1989) [Masindrary=Masindray]; Carleton and Schmidt (1990), discussed; Peterson et al. (1995), [Imasindrary=Masindrary, Sahamananina].

*Habitat.* Forest border (Carleton and Schmidt 1990).

*Altitude.* Ca 1000–1500 m (General Staff No. 4371 1943); 1600 m (Peterson et al. 1995).

*Specimens.* *Limnogale mergulus*: BM(NH) 1897.9.1.113/1958.2.27.26, 1897.9.1.161; *Miniopterus majori*: BM(NH) 1897.9.1.38, 1897.9.1.43–44, 1977.2693–2707, 2000.82–84; *Miniopterus manavi*: BM(NH) 1897.9.1.37, 1897.9.1.41–42, 1977.2719–2731, 1996.X30; MCZ 45101; NMW 27454.

*Remarks.* Although unmarked on 19th-century maps, Carleton and Schmidt (1990) reasoned that a locality spelled Masindrary or Masindray, as found on the 1942 British War Office map about 15 km east-south-east of Fandriana, was a likely contender. Their supposition seems correct, since Major's spelling on the original labels of some specimens is "Masindrary" and omission of the initial "I" (=an article in Malagasy) is common practice. In this form, the locality is uniformly marked on modern maps and offers another circumstantial clue to position Ampitambe, since specimens from Masindrary were obtained during both visits to the former. The source of Sahamananina as a synonym for Masindrary (Peterson et al. 1995) is unknown.

Masindrary is the type locality of *Limnogale mergulus* and only the second place (also Andraikiba Lake) where Major caught this rare semi-aquatic tenrec. Two sympatric species of *Miniopterus* (*M. majori* and *M. manavi*) were recorded from this locality by their BM(NH) registration numbers (Hill 1993). Peterson et al. (1995) additionally listed a third species, *M. fraterculus*, from this locality and the same museum collection without recording specific registration numbers; however, P.D.J. believes this information to be erroneous.

*Locality 15: Fandriana (Ifandriana); 20°14'S, 47°23'E (USBGN)*

*Geographic references.* Mullens (1875), ca 20°06'S, 47°32'E; Roblet (1885), Fandriana ca 20°11'S, {45°04'E} and Ifandriana ca 20°19'S, {45°09'E}; Laillet and Suberbie (1889),



Fandriana ca 20°06'S, {45°09'E} and Ifandriana ca 20°21'S, {45°14'E}; Geographical Section, General Staff No. 4243 (1941–43, Sheets 17 and 18), ca 20°14'S, 47°23'E; General Staff No. 4371 (1943), ca 20°14'S, 47°23'E.

*Habitat.* Unknown; perhaps not forest if synonymous with the Fandriana of modern maps, which today is a major population centre and west of continuous forest, however S. M. Goodman (personal communication) considers that there would have been substantial forests near this location at the time of Major's expedition.

*Altitude.* Ca 1000–1500 m (General Staff No. 4371 1943).

*Specimens.* *Hemicentetes nigriceps*: BM(NH) 1897.9.1.65.

*Remarks.* Two candidates, Fandriana and Ifandriana, are possible according to the maps of Roblet (1885) and Laillet and Suberbie (1889). Fandriana, the more northern locality, is marked as a Norwegian Mission by Mullens (1875) and cited by Oliver (1886), and is essentially congruent as depicted on all the historical maps. It is located to the east of a trail linking Antananarivo, Antsirabe, Ambositra and Ambohimanga on the two French maps and, although separated from the main track by one or two watercourses, a mission post would have been an attractive stopping point. The more southern Ifandriana is shown on the Antananarivo–Ambohimanga trail and is close to the intersection where a side-trail leads to Ambositra. The Fandriana indicated on modern maps is a major population centre and most likely corresponds to the Ifandriana as located on the 19th-century French maps. While a minor collection locality (one specimen), Major's record provides another known point for circumscribing the position of Ampitambe: the date of collection falls within the period of his second visit to Ampitambe, in March 1896 (Table III). Although Major most probably would have passed through Fandriana during his first trip as well, we discovered no specimens acquired during this first passage.

*Locality 16: Ankeramadinka; ca 18°55'S, 48°02'E (Mullens 1875)*

*Geographic references.* Roblet (1885), ca 18°55'S, {45°38'E}; Mullens (1875), as "Ankeramadinka", ca 18°55'S, 48°02'E; Oliver (1886), ca 18°55'S, 48°11'E; Oliver (1886), sketch map based on Grandidier and Mullens, ca 18°55'S, 48°05'E; Laillet and Suberbie (1889), as "Ankeramadinka", ca 18°55'S, {45°40'E}; Grandidier (1893), 18°55'S, {43°32'E}; Sibree (1896), mapped; Major (1896a, p 325), "from the neighbourhood of Ankeramadinka (one day's journey to the east of Antananarivo)"; Major (1897a), "in the forest of the Ankeramadinka, at a day's journey to the east" [of Antananarivo]; MacPhee (1987), noted as 25 km east of Antananarivo.

*Habitat.* Forest [transitional eastern rainforest/eastern sclerophyllous montane forest].

*Altitude.* 1386 m (Roblet 1885); 4620 ft [1409 m] (Oliver 1886); 1400 m (MacPhee 1987).

*Specimens.* *Hemicentetes semispinosus*: BM(NH) 1897.9.1.61, 1994.266–269. *Tenrec ecaudatus*: BM(NH) 1897.9.1.55, 1947.12.5.4, 1948.281, 1994.243. *Cheirogaleus sibreei*: BM(NH) 1897.9.1.160. *Microcebus rufus*: BM(NH) 1897.9.1.28.



*Remarks.* Major (1897a) remarked that he spent some weeks in the forest around Ankeramadinika (at least from 10 to 21 January 1896; Table III), an opportunistic sojourn during “a forced stay of nearly two months in the capital”. The locality was obviously well known at the time of Major’s expedition, as commonly shown on period maps, but has not been mapped subsequently. Oliver (1886) described Ankeramadinika as a regular halting station “on the route from the coastal port of Tamatave to the capital Antananarivo” and also as a Government post and small market town in the province of Imerina. He reported the distance from Antananarivo as 31 miles (ca 50 km), quite a remarkable transit for Major’s “one day’s journey”. The time taken and distance covered provide an interesting insight to the exceptional rates of travel that Major must have attained at times during the expedition. In contrast, Oliver (1886) calculated an average rate as 20 miles (ca 32 km) per day for the journey from Antananarivo to Tamatave (Toamasina). Major achieved a comparably high rate in his treks between Fandriana and Ampitambe (locality 13) and between Fianarantsoa and Vinanitelo (see locality 19).

Ankeramadinika marks the start of Major’s second phase of collecting Recent mammals, after devoting several months to collecting fossils at Antsirabe (early September 1895 to early January 1896). Major (1897a) noted that few species were collected here, among them two species of cheirogaleid lemurs, one of which, *Cheirogaleus sibreei*, he (1896a) described as new. A significant occurrence at this locality is *Microgale gracilis*, a skeleton of which was collected by a Dr Moss (probably Dr C. F. A. Moss, M.B., C.M.), as reported by Major (1896a). Since this is one of only two specimens of *M. gracilis* found during the expedition and its distribution remains poorly documented, it is unfortunate that we failed to uncover it in the museums searched.

*Locality 17: Angavo (Angavo F[orest]); ca 18°53'S, 48°09'E (Mullens 1875)*

*Geographic references.* Mullens (1875), ca 18°53'S, 48°09'E; Oliver (1886), ca 18°50'S, 48°12'E; Oliver (1886), sketch map based on Grandidier and Mullens, ca 18°54'S, 48°10'E; Laillet and Suberbie (1889), ca 18°51'S, {45°46'E}; Grandidier (1893), mapped; Viette (1991), listed.

*Habitat.* Forest.

*Altitude.* Variably described as a “lofty pass” (Mullens 1875), recorded as 6500 feet (1983 m) by Oliver (1886) and estimated as >1300 m using modern maps.

*Specimens.* *Viverricula indica*: BM(NH) 1897.9.1.119.

*Remarks.* Only one mammal specimen (and one bird) is recorded from Angavo, which is not mentioned in any of Major’s reports. Dates on field labels place Major’s visit here within the time frame he spent at Ankeramadinika and their close proximity is corroborated by contemporary maps. Angavo was well known during the 19th century and was on the main route between the port of Tamatave (Toamasina) and the capital of Antananarivo. Mullens (1875) mapped and mentioned Angavo, while Oliver (1886) mapped and variously referenced it either as Angavo, the mountain range of Angavo, or the Pass of Angavo, reported as 7 miles (ca 11 km) to the east of Ankeramadinika. We could not definitely locate this locality as such on modern maps, although S. M. Goodman (personal communication) suggested that the area currently called Angavokely (18°55'S, 47°44'E), about 30 km east of Antananarivo and 15 km west of Ankeramadinika, is a possible

contender. According to late 19th-century maps, Angavo and Angavokely are separate localities, the former to the east and the latter to the west of Ankeramadinika. In all likelihood, Major was well acquainted with these maps and given his general sense of geographic whereabouts as we have come to appreciate it, we doubt that he would have confused these localities.

*Ambataroa; not located*

*Geographic references.* Jenkins (1987), incorrectly as 16°46'S, 49°58'E.

*Habitat.* Unspecified, but certainly forest based on the habitat requirements of the lemur captured.

*Altitude.* Unknown.

*Specimens.* *Eulemur fulvus fulvus*: BM(NH) 1897.9.1.6; FMNH 5657.

*Remarks.* Ambataroa has not been traced, but the collection date (12 January 1896) and field numbers localize this locality within the vicinity of Ankeramadinika and Angavo. Both places are also situated within the known range of the lemur subspecies collected at Ambataroa. The coordinates given by Jenkins (1987) incorrectly refer to a different locality that is far to the north of Major's field operations.

*Locality 18: Ambohimandroso; ca 21°12'S, 46°59'E (Cowan 1882)*

*Geographic references.* Mullens (1875), ca 21°14'S, 47°03'E; Cowan (1882), ca 21°12'S, 46°59'E; Roblet (1885), ca 21°12'S, {44°28'E}.

*Habitat.* Unknown.

*Altitude.* Ca 1000–1500 m (estimated from modern maps).

*Specimens.* *Lepilemur microdon* BM(NH) 1897.9.1.21, 1981.762.

*Remarks.* Some uncertainty surrounds our placement of this site, since two such settlements occur, or formerly occurred, in the vicinity of Vinanitelo. The collection date (23 April 1896) of the lemurs reasonably implies that Major was in transit from Ambositra (latest date 8 April) to his last collecting station at Vinanitelo (earliest date 12 May). One regularly mapped town of Ambohimandroso (21°53'S, 46°57'E; USBGN), illustrated on both period and recent maps, lies about 36 miles [58 km] south of Fianarantsoa (Oliver 1886) and south-west of Vinanitelo. This candidate seems unlikely because it would require that Major travelled beyond Vinanitelo and then doubled back north and east, when maps available to him indicate a more direct trail from Fianarantsoa to Vinanitelo. Major (1896a) recollected this distance as 30 miles and a single day's passage, figures that are at odds with a circuitous journey via the well-known Ambohimandroso. We advance a lesser known Ambohimandroso that is located on several 19th-century maps and situated to the north-north-west of Fianarantsoa; however, it is slightly to the west of the main Ambositra–Fianarantsoa track. Although neither locality is shown as a forested region on modern maps, the presence of *Lepilemur* indicates the former proximity of forest.

*Locality 19: Vinanitelo (Vinanitelo for. [est]); 21°43'S, 47°16'E (USBGN)*

*Geographic references.* Cowan (1882), ca 21°45'S, 47°16'E, as Ivinanitelo; Roblet (1885), ca 21°43'S, {44°59'E}; Oliver (1886), ca 21°42'S, 47°12'E, as Ivinanitelo; Grandidier (1893), 21°44'S, {44°54'E}; Major (1896a, p 320), "...the forest of the Independant Tanala of Ikongo, in the neighbourhood of Vinanitelo, one day's journey south of Fianarantsoa, May 22, 1896"; Major (1896b, p 462–463), "Hab. Forest of the Independant Tanala of Ikongo, in the neighbourhood of Vinanitelo, thirty miles south of Fianarantsoa"; Major (1897a), "Lastly, a lengthened sojourn was made in a more southern region, viz. near Vinanitelo, in the forest of the independent Tanalas, 30 miles south of Fianarantsoa"; Major (1899, p 554), "Vinanitelo, Southern Betsileo, on the confines of the Tonalas [*sic.*] of Ikongo"; Geographical Section, General Staff No. 4243 (1941–43), Sheets 20 and 21, ca 21°43'S, 47°16'E; General Staff No. 4371 (1943), ca 21°44'S, 47°16'E; Morrison-Scott (1948), 21°45'S, 47°20'E; Tattersall (1986), mapped; Jenkins (1987), 21°44'S, 47°16'E; MacPhee (1987), 21°45'S, 47°17'E; Carleton and Schmidt (1990), discussed and coordinates given per USBGN (1989); Viette (1991), listed under spellings of Vinanytelo and Vinanitelo; Peterson et al. (1995), 21°44'S, 47°15'E.

*Habitat.* Eastern moist montane forest.

*Altitude.* 900–1300 m (Major 1897a, 1899); 1300 m (MacPhee 1987).

*Specimens.* *Hemicentetes nigriceps*: NMW 1299/B2729. *Hemicentetes semispinosus*: BM(NH) 1939.1607; FMNH 5635. *Microgale cowani*: BM(NH) 1897.9.1.84, 1897.9.1.91, 1898.3.8.6–7, 1939.1626, 1975.2218–2222, 1994.334–337, 1995.2; CUMZ E.5459.A, E.5459.D; FMNH 18865, MNHN 1897-524a, 1897-526, 1991-393; USNM 49675, 49676. *Microgale dobsoni*: BM(NH) 1897.9.1.102–104, 1939.1634–1635; MNHN 1897-522. *Microgale pusilla*: BM(NH) 1897.9.1.96–97, 1897.9.1.99, 1939.1621–1622, 1994.353; FMNH 5645; MCZ 45032; MNHN 1897-527–528, 1991-394. *Microgale talazaci*: BM(NH) 1897.9.1.107. *Oryzorictes tetradactylus*: BM(NH) 1897.9.1.71, 1974.557, 1974.559, 1975.2200–2210, 1991.282, 1994.278, 1994.284; NMW 948/B2748; USNM 49674, 154989. *Tenrec ecaudatus*: BM(NH) 1897.9.1.56, 1948.280. *Eidolon dupreanum*: BM(NH) 1897.9.1.30. *Miniopterus manavi*: BM(NH) 1897.9.1.39–40, 1977.2732–2734; NMW 931. *Myotis goudoti*: BM(NH) 1897.9.1.45–46. *Avahi laniger*: BM(NH) 1897.9.1.14. *Eulemur rubriventer*: BM(NH) 1897.9.1.10, 1981.706. *Hapalemur griseus griseus*: BM(NH) 1897.9.1.13. *Lepilemur microdon*: BM(NH) 1897.9.1.22–23, 1897.12.2.2, 1939.1280–1282, 1981.763–766; NMW 936/B3506. *Lepilemur microdon?*: BM(NH) 1995.R24; FMNH 5658. *Microcebus rufus*: BM(NH) 1897.12.2.3, 1897.9.1.26–27. *Propithecus diadema edwardsi*: BM(NH) 1897.9.1.4. *Brachytaromys albicauda*: BM(NH) 1897.9.1.120; MNHN 1897-529. *Brachyuromys betsileoensis*: BM(NH) 1897.9.1.130, 1948.294, 1987.113–114; UZMC 1222. *Eliurus tanala*: BM(NH) 1897.9.1.154, 1958.2.28.7; FMNH 5631. *Rattus rattus*: BM(NH). 1897.9.1.157–158.

*Remarks.* Despite the vagaries in spelling, Vinanitelo is well known and variations in coordinates among authors are minor. From the middle of May to early June 1896, Major spent nearly a month at this location, which marks the southernmost extent reached by his expedition, an area he evidently used as a base for regular sorties to nearby localities (see numbers 20–22). Major (1897a) stated that by the time he departed from Vinanitelo he had more than doubled the number of Recent mammals collected at the end of his first stay at

Ampitambé (804 specimens). The last number attributable to a specimen from Vinanitelo, M1685 collected in May 1896, confirms his own accounting. The last specific collection date that we documented is 6 June 1896 (field numbers M1511–M1522). Major's time at Vinanitelo was also spent in sorting and readying the collections for departure. Some high field numbers were allocated to specimens taken much earlier, such as the series M1578–M1580 of uncleaned skulls and skeletons that he collected in November 1894 at Ivohimanitra, an example of the specimens that came in “in such abundance, that we often found it impossible to master all the work” (Major 1897a).

Although Major's stay at Vinanitelo was comparatively short, the faunal list is diverse, second only to the variety documented at Ampitambe, with all groups other than carnivores represented. Two mammalian species that he eventually described (1896a, 1896b) as new to science were first encountered here (Table II). Also noteworthy are the four species of *Microgale* that Major obtained in sympatry. Vinanitelo is the only locality where he collected the highly arboreal *Brachytarsomys albicauda*, although according to its known distribution (e.g. Carleton and Goodman 2003), this species surely occurs at other localities visited during the expedition. Another species from limited localities, *Microgale pusilla*, was collected from Vinanitelo and Ambohimanana and was first encountered as a subfossil at Antsirabe. Although uncommonly collected, *M. pusilla* is known to occur over a wider range in the eastern forest, generally in marshy habitat, so its absence from other localities visited by Major is somewhat anomalous.

*Locality 20: Ambohimanana (Ambohimanana n[ear] Vinanitelo, Ambohimanana-Vinanitelo, Ambohi., Ambohima.); ca 21°44'S, 47°15'E (Cowan 1882)*

*Geographic references.* Cowan (1882), ca 21°44'S, 47°15'E; Roblet (1885), ca 21°44'S, {44°58'E}; Laillet and Suberbie (1895), ca 21°44'S, (ca 47°15'E, as per Carleton and Schmidt 1990); MacPhee (1987), 20°42'S, 47°21'E, as 9 km west-south-west of Ambohimambo; Carleton and Schmidt (1990), discussed and coordinates estimated as 21°44'S, 47°15'E.

*Altitude.* Ca 1000–1500 m (General Staff No. 4371 1943).

*Specimens. Microgale cowani:* BM(NH) 1897.9.1.82–83, 1897.9.1.85–87, 1897.9.1.90, 1898.3.8.5, 1939.1623–1625, 1939.1627–1630, 1974.556, 1975.2223–2225; FMNH 5642–5643; MCZ 12431, 45023, 45024; MNHN 1897-524, 1897-525b, 1962-2473, 1987-109 1991-392; NMW 951/B2796, 952/B2795. *Microgale cowani nigrescens:* FMNH 5644; MNHN 1897-525a. *Microgale dobsoni:* BM(NH) 1994.349. *Microgale pusilla:* BM(NH) 1897.9.1.93–95, 1897.9.1.98; NMW 955/B2797. *Oryzorictes tetradactylus:* BM(NH) 1897.9.1.72–75. *Miniopterus majori:* FMNH 5650. *Miniopterus manavi:* NMW 930. *Brachyuromys betsileoensis:* BM(NH) 1897.9.1.127–129, 1939.1896, 1948.293, 1948.295–295A, 1974.762–763, 1987.112, 1995.295; MCZ 12434, 45944; MNHN 1897-534; NMW 2343/B438.

*Remarks.* The exact location of Ambohimanana is uncertain, but it was variously plotted in the close neighbourhood of Vinanitelo on 19th-century maps. Cowan (1882), for instance, showed Ambohimanana as just north-west of “Ivinanitelo”, whereas the relative positions of the two are reversed on the French maps of Roblet (1885) and Laillet and Suberbie (1895). The locality is not marked on the previous edition of Laillet and Suberbie (1889), nor on modern maps, nor listed in the USBGN (1955, 1989) in the vicinity of Vinanitelo.

The village of Ambohimanana located near Ambohimitombo, as proposed by MacPhee (1987), is unfeasible as the one visited by Major. As noted by Carleton and Schmidt (1990), the collection dates and field numbers indicate very close proximity to Vinanitelo (Table III), with some specimens from both places even collected on the same day. Some field tags actually bear the locality designation of “Ambohimanana-Vinanitelo”, indicating either that the locations are nearly contiguous or that specimens were collected while travelling between the two. “Ambolimanona (near Vinanitelo?)”, as interpreted by MacPhee (1987), is an errant transcription of Ambohimanana.

Major (1896b) himself underscored the proximity of the two places when he recorded the type locality of *Microgale pusilla* as “forest of the Independent Tanala of Ikongo, in the neighbourhood of Vinanitelo”. The locality on the original label of the holotype (C.I.F. Major M139=BM(NH) 1897.9.1.93) is Ambohimanana. The type locality of *Microgale pusilla* is herewith emended as follows: Ambohimanana, near Vinanitelo, Fianarantsoa Province, Madagascar, ca 21°44'S, 47°15'E.

Major obtained fewer taxa here than from Vinanitelo and all but one species, *Miniopterus majori*, were also collected at Vinanitelo. Ambohimanana is the type locality of the only subspecies named from Major's collections, *Microgale cowani nigrescens* Elliot, 1905.

*Locality 21: Amboasary (Amboasari); 21°51'S, 47°14'E (USBGN)*

*Geographic references.* Cowan (1882), ca 21°48'S, 47°11'E; Grandidier (1893), mapped; Geographical Section, General Staff No. 4243 (1941–43), Sheets 20 and 21, ca 21°51'S, 47°14'E, as Amboasary; Carleton and Schmidt (1990), discussed as Amboasary and USBGN coordinates cited.

*Altitude.* Ca 1000–1500 m (General Staff No. 4371 1943).

*Specimens.* *Eidolon dupreanum*: FMNH 5648. *Brachyuromys ramirohitra*: BMNH 1897.9.1.137. *Gymnuromys roberti*: BMNH 1897.9.1.144.

*Remarks.* Three similar spellings on original labels—Amboasari, Amboazara and Amboanara—may or may not refer to the single locality Amboasary. All specimens bearing these names were collected during late May and early June 1896, when Major was working at Vinanitelo and its vicinity (see above). Although not mentioned by Major (1897a), an Amboasary appears close to (ca 15 km south-west) Vinanitelo on the period maps of Cowan (1882) and Grandidier (1893) and may be reasonably equated to the USBGN (1989) coordinates given for an area of indeterminate boundaries near Vinanitelo.

*Amboanara (Amboazara?); not located*

*Geographic references.* MacPhee (1987), possibly near Fandriana/Ampitambe.

*Habitat.* Forest.

*Specimens.* *Microgale longicaudata*: BM(NH) 1897.9.1.110, 1939.1620. *Potamochoerus larvatus*: BM(NH) 1897.9.1.164.

*Remarks.* According to original labels, the two *M. longicaudata* from Amboanara f[orest] and the single specimen of *P. larvatus* from Amboazara for[est] were collected on the same



day. This date and the field numbers are within the range of other specimens collected while Major's field activity was focused around Vinanitelo (Table III). There is a slight doubt in our interpretation of the spelling on the original labels, but no locality has been traced for either spelling variation. These place-name variations may intimate that Major misspelled or mis-transliterated the locality of Amboasary (see above), although this seems unlikely because he continued to refer to an Amboanara for[est] in later correspondence with Hartert (1897). Collection dates contradict MacPhee's (1987) suggestion that Amboanara is near Fandriana and Ampitambe, localities far to the north of Vinanitelo.

*Locality 22: Itaombelo (Itambelo, Stambelo); ca 21°48'S, 47°15'E (Cowan 1882)*

*Geographic references.* Cowan (1882), ca 21°48'S, 47°15'E as Itaombelo.

*Altitude.* Ca 1000–1500 m (General Staff No. 4371 1943) altitude estimated from Cowan's (1882) map.

*Specimens.* *Eidolon dupreanum*: BM(NH) 1897.9.1.31; NMW 17896; ZFMK 78.528, 78.529.

*Remarks.* The dates and field numbers of the bats obtained indicate that Itaombelo was another satellite locality visited while the expedition was headquartered at Vinanitelo.

## Discussion

### *Geographic scope and field methods*

Major confined his survey activities to the eastern margin of the Central Highlands and to humid forest along its upper flanks in east-central Madagascar, approximately between 19° and 22° south latitude and mostly within the present-day provinces of Antananarivo and Fianarantsoa (Figure 3). Over a north–south tract of some 300 km and within an altitudinal range of 1500 m (about 500–2000 m), we identified 26 collecting localities that are certainly associated with specimens that emanated from Major's field efforts. He specifically referenced only nine in his sketchy expeditionary account (1897a). We may confidently supply geographic coordinates for 22 of these 26 localities, either as based on their correspondence to current USBGN listings or as estimated from period or modern maps. Although placement of the four remaining sites could not be precisely determined, collection dates and field numbers on Major's specimen tags logically delimit their location within a narrow search radius from known localities in specific regions. While the recovery of more specimens is naturally desirable, we strongly doubt that their addition would contribute wholly new localities. Nor would they substantially alter the geographic scope of Major's 1890s expedition as here refined, for remaining gaps in field numbers fall within locality series already documented and those localities concur with Major's broad outline of his field activities.

One other Malagasy specimen and locality, a *Lemur catta* (BM(NH) 1897.9.1.5) from Ihosy (22°24'S, 46°08'E; USBGN), may be reasonably linked to Major (Woodward 1898) but doubtfully issued from his 1894–1896 expedition. Its atypical but old label bears Major's handwriting on one side, but collector's measurements in another hand on the reverse. This specimen bears a plausibly sequential field number (M1687), although it is the highest recorded for Major's collection; however, the collection date, 25 September

1896, is well after Major's departure. The species is found mainly in southern and south-western Madagascar, extralimital to the collecting foci of his expedition and may have been sufficiently interesting to be collected, perhaps by his former field assistant Robert, and despatched to Major after he returned to the British Isles.

Excluding the above anomalous record, our museum searches have located 994 specimen records that are definitely traceable to Major's expedition in 1894–1896. These amount to about 60% of the mammals that he originally collected, as evidenced by the highest field number that we encountered (M1685) from Vinanitelo and by his (1897a, p 973) own general report: "... at the end of my first stay at Ampitambé 804 specimens of recent mammals had been collected; when I left Vinanitelo this figure had been more than doubled". The whereabouts or present existence of the 600 or so other specimens is uncertain. Slight contradiction exists about the number of specimens that actually arrived in Britain. The popular account reproduced by Sibree (1897) approximated the number of mammals as 1500 specimens, 100 fewer than stated by Major. Sibree reported that some alcohol-preserved specimens (probably mainly small mammals) had to be abandoned when Major fled during one of the insurrections of the Malagasy people against the French occupation. Also, some skeletons were lost when a house ceiling in Antsirabe collapsed (probably mainly birds; see Major 1897a). In addition to such incidental losses during the expedition, larger numbers of specimens or their associated data undoubtedly disappeared over the decades subsequent to their return to Britain, given the large size of the collection and especially its wide dispersal to other museums and private natural history collections. Unfortunately, search of the NHM archives has not yielded any information about which museums and people received specimens from Major's collection. Indeterminate numbers were probably dispersed to European institutions that suffered severe damage or wholesale destruction during the First and Second World Wars. Other specimens traded or gifted to private collectors and naturalists, as was customary during the period, may have been mislaid, lost or destroyed. Lastly, we expect that institutions not surveyed still contain Madagascar specimens that survive from Major's fieldwork and we appeal to readers to notify us about such holdings.

Major (1897a) is inexplicit about his field methods, but he mentioned that he relied heavily on local peoples, not only for transporting his considerable supplies and equipment but also training them to collect. For example, he specifically acknowledged the Betsileo and Betsimisaraka tribes for his successful collecting around Ampitambe and the Tanala around Vinanitelo (type locality of *Eliurus tanala*). During his work at Antsirabe, Major stated (1897a, p 973) that he "engaged in the intervals as many workmen as presented themselves, generally more than fifty". This crew size is probably higher than employed elsewhere due to the manual labour needed to excavate for *Aepyornis* and other fossils, but his statements serve to underscore the substantial involvement of indigenous peoples. In comparison with Major's very first forays into forest at Ivohimanitra and Ambohimitombo (Table III), the greater numbers and diversity of small mammals obtained later in the forests around Ampitambe and Vinanitelo must owe much to trial-and-error improvements in training his field workers and in adopting productive field techniques, as he alluded (Major 1897a, p 972). In canvassing museum collections, we were struck by the high proportion of Major's specimens whose skulls are wholly intact, unmarred by trap damage, suggesting that he was following the recommendation of the Royal Geographical Society (Bates 1889) to use traps, such as the "Excelsior" and "Premier", that captured small mammals without injuring them. Reliance upon local peoples familiar with the indigenous fauna suggests that small mammals were also captured by hand. Microchiroptera in

particular may have been hand-captured from roost sites in trees and thatched huts, since Major's field operations were conducted long before the advent of mist nets. Major also may have pioneered some field techniques. A few years after his return, a museum technical publication (British Museum (Natural History), 1900) advises that "Pitfall-traps, made out of a glass or metal jar sunk flush with the ground, are also often successful". It is conceivable that Major used such pitfalls, in view of the diversity of tenrecids collected, the ample series obtained for certain shrew tenrec species (Table IV) and the capture of the smaller shrew tenrecs, such as *Microgale pusilla* and *M. longicaudata*, and the tiny *Suncus madagascariensis*. Like other natural history collectors of the 19th century, Major imported his own firearms for shooting large mammals, such as lemurs, carnivores and possibly megachiropteran bats (Woodward 1897), although some of these species may also have been captured with traps and snares in local use.

Substantial local co-operation offers a plausible explanation for the several instances of simultaneous field activity at nearby localities as revealed in our database compilation (e.g. around Ampitambe, Antsirabe and Vinanitelo). These strings of specimen records, obtained from different localities but bearing the same collection date, indicate that some portion of his collectors worked independently at peripheral sites. In this context, Major's (1897a, p 981) expression of special indebtedness to his French assistant Alphonse Robert significantly highlights this individual's indispensable role (as honoured with the patronym *Gymnuromys roberti*). At great personal risk in view of Madagascar's social turmoil, Robert remained with Major throughout the expedition and must have assumed many discretionary responsibilities in its conduct, including supervision of fieldwork at outlying localities. In addition to Robert, Major enlisted the Reverend T. G. Rosaas, a missionary stationed at Antsirabe for more than 20 years, for co-ordination of palaeontological work. He obviously relied considerably on the London Missionary Society network in Madagascar, receiving support from, among others, the Reverend Johnson at Fianarantsoa and the Reverend James Sibree at Antananarivo.

Notwithstanding the overall high quality of Major's field data, some sequential conflicts in collector's numbers and dates are evident. These might be expected in consideration of the sheer amount of material, Recent and fossil, that he collected, his habit of simultaneously working several localities in certain areas and the daunting logistical conditions under which he was operating. The discrepancies are confined mainly to several "housekeeping" sessions when collecting activities were minimal, namely at Ambositra during interim packing sessions, at Antsirabe during palaeontological prospecting and at Vinanitelo for final assembling prior to departure. In some museums, we have encountered eviscerated and dried specimens, fully furred with the skull and skeleton still inside. Such mummified, temporary preparations could be carried along until opportunity for final preparation presented itself. On occasions, field numbers appear to have been assigned in blocks rather than in strict sequence. In particular, bat specimens, which require rather different collecting techniques, were often assigned blocks of numbers that are out of sequence with other mammals from the same or nearby localities (Table II), but their dates are chronologically consistent as if collected and processed independently.

Above all, Major was both pragmatic and opportunistic in deciding where, when and what—fossil or living vertebrates—to collect. The bouts of simultaneous collecting at nearby localities and return visits to productive sites (e.g. Ampitambe) evince a readiness to adapt to local circumstances, an attitude that often serves modern fieldwork as well. The consequent lengths of survey devoted to a specific locality vary considerably (Table III), from one (many sites) to 50 days (first Ampitambe stay), as did the effort expended in collecting Recent specimens according to his account (Major 1897a). In effect, a pragmatic

Table IV. List of mammal species documented from Major's 1894–1896 expedition.

Taxa	No. of localities	No. of specimen records with locality (total records)
Afrosoricida (N=430)		
Tenrecidae		
<i>Hemicentetes nigriceps</i>	5	11 (11)
<i>Hemicentetes semispinosus</i>	7	33 (35)
<i>Limnogale mergulus</i>	2	3 (3)
<i>Microgale cowani</i>	7	79 (83)
<i>Microgale dobsoni</i>	4	30 (30)
<i>Microgale gracilis</i>	1	1 (1)
<i>Microgale longicaudata</i>	2	3 (3)
<i>Microgale pusilla</i>	2	16 (16)
<i>Microgale taiva</i>	1	1 (1)
<i>Microgale talazaci</i>	1	1 (1)
<i>Microgale thomasi</i>	2	3 (3)
<i>Oryzorictes hova</i>	1	3 (3)
<i>Oryzorictes tetradactylus</i>	6	165 (167)
<i>Setifer setosus</i>	6	53 (54)
<i>Tenrec ecaudatus</i>	8	20 (22)
Lipotyphla (N=2)		
Soricidae		
<i>Suncus madagascariensis</i>	2	2 (2)
Chiroptera (N=112)		
Pteropodidae		
<i>Eidolon dupreanum</i>	3	6 (6)
<i>Pteropus rufus</i>	1	1 (1)
Vespertilionidae		
<i>Eptesicus matroka</i>	4	13 (15)
<i>Miniopterus fraterculus</i>	1	2 (2)
<i>Miniopterus majori</i>	3	22 (31)
<i>Miniopterus manavi</i>	4	30 (34)
<i>Myotis goudoti</i>	3	10 (10)
<i>Scotophilus borbonicus</i>	1	1 (1)
Molossidae		
<i>Mormopterus acetabulosus</i>	1	2 (2)
<i>Mormopterus jugularis</i>	2	10 (10)
Primates (N=89)		
Cheirogaleidae		
<i>Cheirogaleus major</i>	1	2 (2)
<i>Cheirogaleus sibreei</i>	1	1 (1)
<i>Microcebus rufus</i>	5	7 (8)
Indriidae		
<i>Avahi laniger</i>	5	5 (5)
<i>Propithecus diadema</i>	4	13 (13)
Lemuridae		
<i>Eulemur fulvus</i>	1	2 (2)
<i>Eulemur rubriventer</i>	4	17 (18)
<i>Hapalemur griseus</i>	3	5 (5)
Megaladapidae		
<i>Lepilemur microdon</i>	5	28 (28)
<i>Lepilemur mustelinus</i>	1	7 (7)
Carnivora (N=23)		
Felidae		
<i>Felis catus</i>	1	3 (3)

Table IV. (Continued.)

Taxa	No. of localities	No. of specimen records with locality (total records)
Viverridae		
<i>Fossa fossana</i>	4	13 (13)
<i>Galidia elegans</i>	1	1 (1)
<i>Viverricula indica</i>	5	5 (6)
Rodentia (N=240)		
Nesomyidae (Nesomyinae)		
<i>Brachytaromys albicauda</i>	1	2 (2)
<i>Brachyuromys betsileoensis</i>	3	33 (33)
<i>Brachyuromys ramirohitra</i>	2	61 (65)
<i>Eliurus majori</i>	1	2 (2)
<i>Eliurus minor</i>	1	2 (2)
<i>Eliurus penicillatus</i>	1	34 (36)
<i>Eliurus tanala</i>	1	3 (4)
<i>Gymnuromys roberti</i>	2	46 (46)
<i>Nesomys rufus</i>	2	42 (45)
Muridae (Murinae)		
<i>Rattus rattus</i>	3	5 (5)
Artiodactyla (N=5)		
Suidae		
<i>Potamochoerus larvatus</i>	2	5 (5)

course was immediately and necessarily imposed on him by the forceful French annexation of Madagascar in late 1894, an act that precipitated civil unrest and resentment toward Europeans over the next 15 months. Because of local hostility, activities in one area sometimes were curtailed (e.g. Antsirabe and Ankeramadinika) and another destination had to be abruptly substituted (e.g. Ampitambe). Concern for his own physical safety and especially that of Monsieur Robert, issues from between the lines of his terse accounting of the difficulties faced during this turbulent period in Madagascar's history.

#### *Documentation of mammal diversity*

We recorded 50 species among the 994 specimens traceable to Major's field efforts (Table IV). These 50 represent all six extant orders of Mammalia known from Madagascar (see Goodman 2003) and include 46 indigenous mammals, two introduced species (*Felis catus*, *Rattus rattus*) and two of uncertain biogeographic affinity (*Suncus madagascariensis*, see Hutterer 1993; *Potamochoerus larvatus*, see Grubb 1993). It is likely that other species will emerge from Major's material as revisionary investigation of certain groups, such as Tenrecidae and Chiroptera, proceeds and our identifications may be improved.

As expected, tenrecids and nesomyid rodents are the most abundant groups that Major obtained, both in terms of the number of specimens collected and the number of localities represented among them. Some tenrecs were documented from every locality where Major spent appreciable time, although no genus was found in all localities. In contrast, rodents were less ubiquitous, both in total numbers and number of localities, but were collected in moderately large series at certain sites. The difference between the capture success of tenrecs in comparison with rodents is difficult to explain, since both were presumably obtained by similar methods. Difficulties in sampling arboreal species may have limited collection of *Brachytaromys* and perhaps some *Eliurus*.



Also as expected, fewer carnivores and primates were collected, their lower taxonomic diversity and numbers plausibly reflecting both the difficulties in hunting large, predominantly nocturnal species and the smaller population sizes of large mammals. The 10 species of Chiroptera (Table IV) meagrely reflect the contemporary diversity of the order in Madagascar (29 species, see Peterson et al. 1995). Major's relatively poor success in obtaining bats is typical of the era, well prior to usage of mist nets, a collecting method not adopted by field mammalogists until the mid-1900s (e.g. Handley 1968). The assortment of Chiroptera impresses us as species were mostly gathered when incidentally encountered at roost sites, whether shot in trees (Megachiroptera) or hand-captured in caves and huts (Microchiroptera).

Major's excursions in east-central Madagascar were limited in geographic extent (Figure 3). Fortuitously for modern conservation biology, they emphasized collections in undisturbed forest, the first sustained and thorough surveys of this vegetation type conducted in Madagascar. Approximately half of the localities may be so categorized, either as moist montane forests, showing the greatest biodiversity, such as Ampitambe (31 taxa in 4 months) and Vinanitelo (21 taxa in 1 month), or sclerophyllous montane forests as at Ambohimitombo (19 taxa in 3 months). A majority of new discoveries emerged from such forest habitats (15 of 20 taxa; see Table II). Only one locality, Ambohimanga (500 m), is sited within lowland rain forest, but Major's stay here was abruptly shortened (see locality 4) and characteristic lowland forest species (e.g. *Eliurus webbi*) are correspondingly notable for their absence or rarity among Major's collections. Clearly, Major must have operated in forests surrounding a locality, rather than within the village designated on field tags, as underscored by his frequently used modifier "forêt de" (e.g. forêt d'Ampitambe). Because many prosimians are today restricted to areas of continuous, natural tree cover, localities where they were present signify nearly undisturbed to pristine forests at the time of Major's expedition. Similarly, many nesomyid rodents (*Brachytarsomys*, *Eliurus*, *Gymnuromys*, and *Nesomys*) and most occurrences of *Microgale* would have originated from primary forest. We are unable to discount the possibility that, in some cases, captured animals may have originated from very distant surrounding localities, perhaps purchased by Major in local markets and simply labelled with the locality where he was currently working (e.g. the few lemurs from Fianarantsoa). Records of the forest-dwelling *Fossa* from some localities that are known to be non-forested now or in the 1890s supply further evidence that specimens were sometimes obtained from far and wide. The other half of Major's localities represents a variety of ecological settings—wetlands, grasslands and mixed or disturbed associations—on the Central Highlands. In general, lower diversity and fewer new taxa were recorded from places in the Central Highlands (10 species recorded over 4 months); noteworthy are the variety and extensive series of large tenrecs collected over this region.

The two (or four) non-endemic mammals were collected from various localities during the expedition: *Rattus rattus* at Ampitambe, Ivohitra and Vinanitelo; *Potamochoerus larvatus* at Ampitambe and Amboasary; and the domestic cat (*Felis catus*) at Ampitambe. *Suncus madagascariensis* was collected at Antsirabe and Fianarantsoa, both old established towns, but not from forest locations. The presence of three introduced species deep in the forest around Ampitambe seems inconsistent with the absence of the domestic cat and *R. rattus* in Major's collections from any of the large human population centres. The specimens of *R. rattus* collected by Major are the earliest Madagascan records in the NHM collection, but this species was clearly well established in the forest locality of Ampitambe, even at this date (*contra* Goodman 1995). The earliest Madagascan records in the NHM collection for the other introduced species are: *Suncus madagascariensis* (1860), *Felis catus* (1870) and

*Potamochoerus larvatus* (1874). Two other commensal species, *Suncus murinus* and *Mus musculus*, may have been present in some localities, especially the larger population centres, but no specimens were obtained by Major. He was obviously aware of the presence of the former in Madagascar as a species apparently introduced from India (Major 1897a).

Major himself seemingly possessed an excellent grasp of what was already known about Madagascar's mammalian fauna and which forms were new as soon as they were discovered. He routinely penned scientific names on his field tags and many of these appear to have been coined as new taxa in the field in anticipation of their formal description when he returned to Britain. Some were in fact published as the name combination that he created in the field, but others were modified or abandoned, presumably based on further study immediately following his return. Many original tags have the field identifications crossed out and another name written above them, which suggests a subsequent period of museum comparison and taxonomic reconsideration by Major. These revised names or corrected identifications usually appear in darker ink, still in his distinctive script. For instance, Major had formulated *Brachyuromys* as a new genus when encountered in the field and provisionally recognized two new species, *B. ramirohitra* and *B. "arvicola"*; the former he designated as the type species, but the latter he replaced as *B. betsileoensis* in recognition of the incorrect generic allocation of Bartlett's (1880) *Nesomys betsileoensis* (Major 1896a). Similarly, he apprehended the generic differentiation of "*Myoxodon Roberti*" when examples were first acquired at Ampitambe in 1895, replaced this field-label name by "*Pseudomyoxodon*" for specimens collected in 1896 and ultimately finalized the generic name as *Gymnuromys* (Major, 1896a). Mandibles found in the upper strata of the Children's Cave, near Antsirabe, were initially labelled as the new species *Microgale "parva"*, a form that Major subsequently associated with living specimens captured at Ambohimana and Vinanitelo and formally described as *Microgale pusilla* (Major, 1896b). He was forced to abandon his field epithet *Nesomys "Dollmani"* because of its equivalence to *Nesomys rufus*. In other cases, later authors appropriated or adapted his field names, such as "*Schoenomys*" *penicillatus* (*Eliurus penicillatus* Thomas, 1908) and *Microgale cowani* "var. *nigra*" (*Microgale cowani nigrescens* Elliot, 1905). Major promptly formalized many of his provisional field taxonomies in his two descriptive papers in late 1896.

Compared with the long-term site surveys, improved collecting equipment and multidisciplinary field methods instituted in the late 20th century (e.g. Goodman 1996), Major more than adequately accounted for the mammalian biodiversity in those ecophysiological provinces where he worked. The 40 nonvolant species that we verified comprise approximately two-thirds of those now known from Eastern Humid Forest and the Central Highlands (66 species according to Goodman 2003). Major's expedition, of course, canvassed a narrower region within those geographically extensive zones. In view of his palaeontological background and formative research experiences, one should recall that Major's foremost destination in Madagascar was Antsirabe to search for fossils (1897a, p971). The superb Recent collections documented from undisturbed tropical forest around Ambohimambo, Ampitambe and elsewhere, arguably Major's most enduring scientific legacy in view of their alarming decline (Gade 1996; Nicoll 2003), emerged largely by happenstance when he sought refuge from the martial discord and logistical complications encountered en route to or while at Antsirabe. In retrospect, Major's frustrations in accomplishing his principal goal proved to be a happy irony that vastly expanded understanding of Madagascar's native mammals.

*Historical context of Major's expedition*

Major conducted his field survey during an exceptionally fertile era of discovery and description of the world's Mammalia, a period ushered in by profound changes in field methodology and collecting technology (e.g. introduction of the Cyclone trap) that were then being newly implemented in systematic mammalogy. Over the decade of the 1890s, descriptions of new genera and species, particularly of small and reclusive mammals, increased the taxonomic diversity of even supposedly well-known continental faunas, such as those in North America and Europe, by four- or five-fold (e.g. Miller 1929). Such previously unheard-of numbers stand in stark contrast to the sparse views of mammalian diversity that had prevailed over the 18th and most of the 19th centuries. Among the period innovations that Major incorporated into his own field procedures are: mammals at a given site were broadly sampled, not just the large, charismatic species; many sites were surveyed and specific locality designations were recorded for all specimens; specimens each received a unique collector's number, along with date of collection, gender and other individual data; forms were obtained in series to discriminate specific differences from geographic and non-geographic variation; specimens were preserved in multiple preparations and all such parts were tagged with the same field number; results of his fieldwork were promptly synthesized and published (Major 1896a, 1896b, 1896c, 1897a, 1897b). These elements of Major's field protocol follow the recommendations of the Royal Geographical Society (Bates 1889) and his methods of preparing, measuring and documenting specimens closely followed those detailed by Thomas (1894). They further recall the salient practices instituted and systematized a few years earlier by C. Hart Merriam as head of the US Biological Survey (Miller 1929; Storer 1969). Missing only is the maintenance of a companion field catalogue, but we believe that Major must have maintained such records, or their facsimile, in order to produce his periodic tallies of specimens collected and to organize specimen records obtained simultaneously from satellite localities. Merriam had visited European museums, including the British Museum, in 1885 (Sterling 1977) and we are tempted to speculate that he and Major had met and exchanged views on field investigations. Whether or not they did, Merriam did then meet and later regularly corresponded with Oldfield Thomas, F.R.S., renowned Assistant in charge of mammals in the Department of Zoology at the Museum (Sterling 1977; Hill 1990). Thomas was ever alert to the advantages of new field approaches and certainly would have advised Major on their details during his preparations for the Madagascar expedition.

In contrast to all earlier Malagasy collectors and collections, the progressive character of Major's 1894–1896 expedition is plainly evident. The 1600 specimens he obtained in the mid-1890s constitute the single largest and best documented collection of Madagascar's endemic mammals accrued to that time, particularly from the island's incomparable eastern forest. Prior to Major's expedition, the island's curious lemurs and carnivores had commanded the attention of natural history explorers, but even these were often taken in a typological manner and with imprecise provenance. Although Major's travels were restricted to east-central Madagascar and his habitat sampling concentrated in humid forest (moist montane and sclerophyllous associations), his collections doubled the taxonomic diversity of rodents and tenrecs as then known for the entire island. For the size of series and novel diversity documented for small mammals (Tables II–IV), his field results even surpass those of the more ambitious Mission Zoologique Franco-Anglo-Américaine (1929–1931; Rand 1932, 1936) and that of Cecil Webb (1939–1945; Ellerman 1949). Only the vigorous, multifaceted field programmes initiated a century later, in the mid-1990s, may be truly said to have eclipsed Major's pioneering collecting endeavours. Their

systematic significance will of course forever endure and serve to mark the inauguration of modern investigations of the island's endemic mammals.

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