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WILD MAMMALS of Lombok Island

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THE WILD MAMMALS OF LOMBOK ISLAND

WILD MAMMALS of Lombok Island:

Nusa Tenggara, Indonesia: Systematics and Natural History.

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Cover: Botol obat, Lombok I., with stylised carvings of the Long-tailed Macaque, *Macaca fascicularis,* and a civet, probably the Common Palm Civet, *Paradoxurus hermaphroditus.*

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Abstract

This report increases the recorded mammal fauna on Lombok I. from 24 to a possible 53 species. The additions comprise 24 chiropteran bats, a squirrel, a murid rodent, a civet, a felid and a pangolin. Many of the chiropteran species are significant extensions of their distributional range. *Callosciurus notatus*, is the first squirrel recorded east of Wallace's biogeographic line.

The mammal fauna of Lombok I., while depauperate in ground mammals compared to other Sunda islands, is much more similar to that of Bali I. than was previously supposed. This indicates that Wallace's line, which is drawn through the Lombok Strait, is not an important marker indicating the eastward break in the Oriental sundaic mammal fauna.

Evidence is presented to question the prevailing notion that Lombok I. was separated from Bali I. by a wide deep strait throughout the Pleistocene. A dry land southern corridor may in fact have linked these islands through Nusa Penida I.

Observations on reproductive activity indicate that most species of chiroptera have bred or are pregnant just before the onset of the monsoon rains in November. Pteropodid bats are reproductively active at the end of the rainy season in May but reduced activity is observed in some microchiropterans. Limited data indicate that at least one species of bat *(Cynopterus titthaecheilus)* gives birth to young earlier in the moister northern parts of Lombok I. than it does in the drier southern parts of the island. Chiropteran species diversity on Lombok I. is relatively high from sea-level to 50 m altitude. It is highest at low-intermediate altitudes (200 m). At 400 m it has dropped slightly and at 1200 and 1700 m it has fallen dramatically. These changes are paralleled by species richness. Relative abundance of chiropterans does not, however, change markedly from 0-400 m, although it is highest on the coast.

Background

Regional geological history and biogeography

There has been fauna exchange between elements of the Australian and Oriental fauna since at least the late Tertiary. The nature of this exchange is poorly known for most fauna, particularly mammals, although a number of zoogeographic lines have been drawn (Figure 1) to demark elements of the fauna that are Australian to the east and Oriental to the west (Darlington, 1957). Simpson (1977), however, has argued that only two of these lines have merit (Huxley's and Lydekker's).

Chiroptera and murid rodents are particularly useful groups to evaluate the recent nature of this faunal exchange, chiroptera particularly so because there is no recognizably distinct boundary between the Australian and Oriental bat faunas (Koopman, 1970).

The interchange between the Australian and Oriental mammals and other fauna, particularly along the island chains in the intermediate biogeographical region (Wallacea) depends on an understanding of several key historical events involving the formation and isolation of larger islands and island chains between Sulawesi and the Sula Peninsula of Irian Jaya and Nusa Tenggara (Lesser Sunda Is) between Java and Australia.

Lombok I. is one of a group of islands that lie between the two great continental masses of the Sunda shelf to the west and the Sahul shelf to the east. The Sahul shelf unites Australia, New Guinea and the Aru islands. The Sunda shelf, which is the

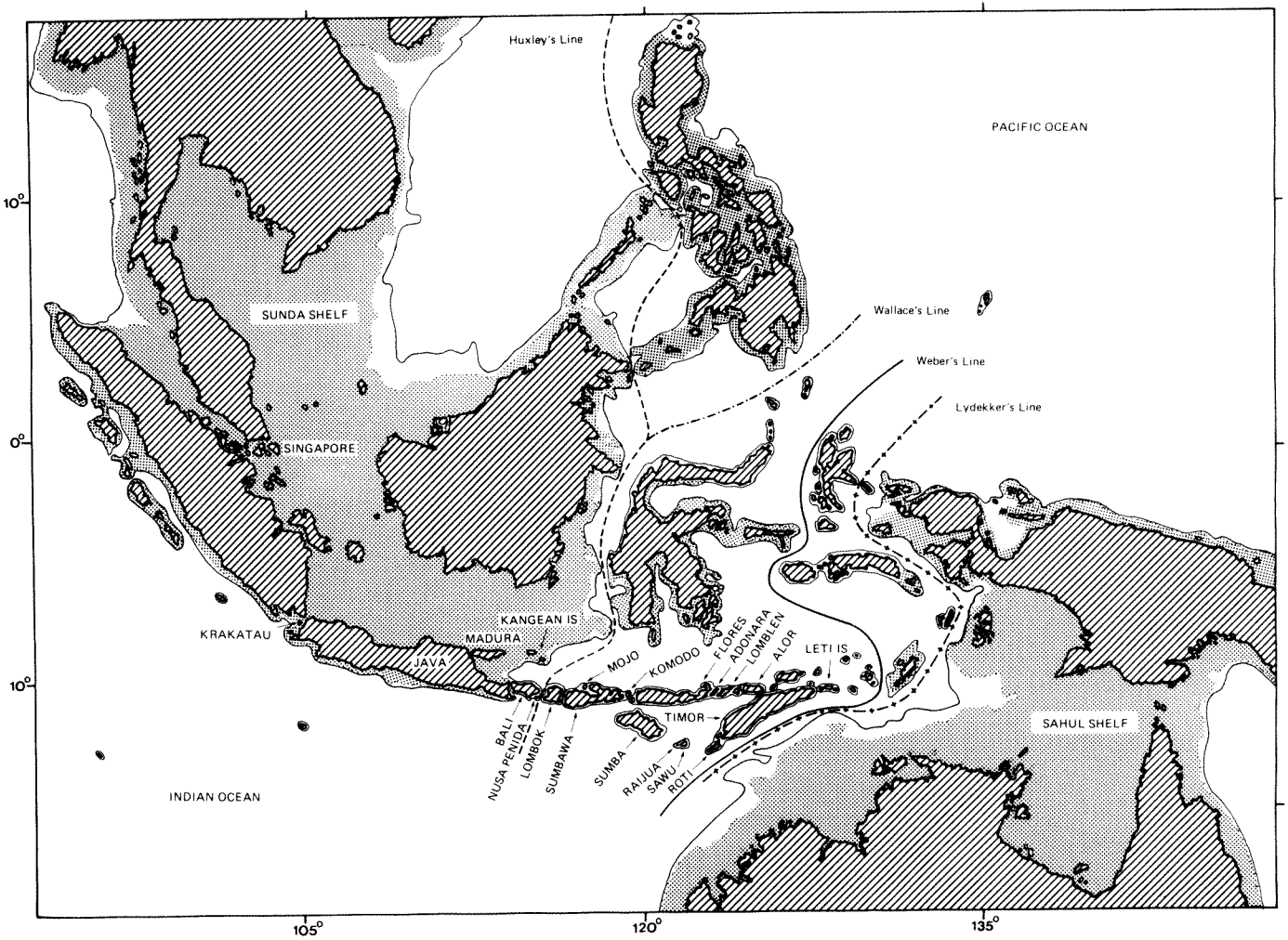


Figure 1 Map of the current land mass of S.E. Asia, Australia and New Guinea (striped). The 100 m bathymetric line indicates the probable extent of dry land in this region during the late-Pleistocene (stippled), the 200 m bathymetric line is also shown (white). Major zoogeographic lines drawn to demark the Oriental and Australian Regions are indicated as are the islands important to this project.

continental extension of Southeast Asia, unites Sumatra, Java and Borneo with Malaysia. While Sunda shelf has had a relatively stable geological history throughout the Tertiary (Batchelor, 1979) the same is not true for the Sahul shelf (Figure 1).

Between the Sunda and Sahul shelves are two, almost parallel arcs of islands, referred to as the Inner and Outer Banda arcs. These islands developed, along with the other ancient Sunda islands, along a geosynclinal arc extending in a loop from the edge of the Mesozoic Sundaland (Audley-Charles, 1981).

In the Miocene/early Pliocene the northwards drifting Australian/New Guinea continent collided with the Inner Banda volcanic arc causing considerable deformation of rocks in the collision zone. Audley-Charles (1981) states that new islands were produced in this zone by two processes. Firstly, from volcanic arcs built up before the collision (Inner Banda arc), and secondly, non-volcanic islands arose in front of the collision zone where "low density sedimentary rocks of great thickness and mechanically depressed into the denser crustal basement arc are uplifted by their buoyancy" to produce the islands of the Outer Banda arc. Australian continental margin rocks have been recorded below the Outer Banda arc islands of Sawu, Roti, Timor, Leti, Babar, Tanimbar, Kai, Seram, Buru and the small islands between Kai and Seram.

The age of emergence of volcanic islands in the Inner Banda arc is dated as early Miocene by Van Bemmelen (1949). The gradual decrease in size of the Inner Banda arc, particularly east of Wetar, may reflect the differing extent to which the ocean floor is subducted along this island chain or that the islands to the east of Wetar are younger and perhaps overridden by the Australian continental margin (Audley-Charles, 1981).

The later and most important events influencing the biogeography of this region were the eustatic changes in sea level resulting from the lowering of the seas during the Pleistocene glaciations and to other events. Recent advances in the use of stable oxygen and carbon isotopes from deep-sea foraminifera has led to significant advances in our understanding of past glacial events and past changes in ocean hydrography (Williams *et al.*, 1988). Application of these methodologies, and a clearer understanding of glacioisostasy, hydroisostasy and local neotectonism in the region of the Inner and Outer Banda arcs are prerequisite to an understanding of how the subaerial land masses in these regions were related during the late Tertiary and Quaternary periods. Sea level during the late Pleistocene (*c.* 18000 yr BP) has been estimated to have been about 120 m lower than at present (Donn *et al.* 1962, Gascoyne *et al.*, 1979). Hopley and Thom (1983) reviewed lowering of sea level in Australian waters during the last glaciation (*c.* 18000 yr BP) and reported that sea levels fell from 132-175 m. Based on evidence from tropical fossil reefs and estimates from conversion of ice volumes during the supposed period of maximum glaciation *c.* 180,000 yr BP, sea levels fell to 137-159 m below present (Donn *et al.*, 1962). However, Batchelor (1979) suggests that during parts of the Pleistocene they may have been more than 230 m below present levels. At these times Borneo, Sumatra, Java and the Malay Peninsula were connected by dry land (Molengraaf, 1921). Mayr (1944) considered that sea levels fell at least 70 m and probably 150 m. On this basis he asserted that Bali and Lombok Is. were separate throughout the Pleistocene. He gave the depth of the Lombok Straight as 315 m. He considered Lombok I. was joined with Sumbawa I. during the Pleistocene. Some islands in Nusa Tenggara were also

connected. For example Auffenberg (1980) considered Komodo, Padar, Rintja and W. Flores were probably broadly connected, but that no evidence exists for connection of Komodo to either Sumbawa or Sumba. Musser (1981) pointedly disagrees with Auffenberg's (1980) assertion that Komodo I. was not connected to Sumbawa I. and considers that sometime during the Pleistocene, eustatic drops in sea level during the last few periods of glaciation were probably enough so that most or all the islands in Nusa Tenggara, except Timor I. and Sumba I., were either joined or separated by very narrow water gaps (Van Andel *et al.*, 1967; Jongsma, 1970 and Batchelor, 1979). Hooijer (1975) considered that Timor was separated from the Australian mainland by only 99 km of sea, while Goodwin (1979) considered this gap to be as little as 72km. Rensch (1936) postulated the presence of a land bridge between Timor and Australia but there has been no later geological or faunal evidence to support this theory or his belief that Timor was connected by land to Sumba, Alor, Wetar and Tanimbar Is. Musser (1981) reports that there is some evidence that the native murids of Timor may be more closely related to the New Guinea fauna than to the Floresian rodents. He considers that access to Timor from New Guinea via Australia during the Pliocene would have been possible if Veevers (1969) is correct in postulating that at that time Timor was smaller and much closer to northwestern Australia than it is now, or was during periods of low sea level during the late Pleistocene. Veevers (1969) considered that land with stepped surfaces extended from the current Australian coastline almost to Timor I. Audley-Charles and Hooijer (1975) postulated a land connection between Timor and Flores Is, via Alor I. in the early to mid Pleistocene to explain the occurrence of the pygmy stegodons, *Stegodon trigonocephalus* and *S. sompoensis* on both Timor and Flores Is. This land connection disappeared during the late Pleistocene and Holocene as a result of downfaulting to the extent of about 3000 m. These authors also postulated a land connection between Flores and Sulawesi Is. to account for the stegodons on that latter island. They considered that stegodons also transmigrated between Sulawesi and Flores Is via a series of ridges, currently submerged but uplifted above sea level by the plate collision between eastern and western Sulawesi in the late Pliocene early Pleistocene. However, if stegodons were capable of swimming long distances like Recent elephants (Johnson, 1980) and many species of small mammals (Diamond, 1987) then there is no reason to postulate such a land bridge. As pointed out by Musser (1981) and Groves (1985) if such a land bridge did exist more species besides stegodons should be shared between Sulawesi and Flores Is. Auffenberg (1980) considered that the recent herpetofauna of Komodo I. contained endemics that were all closely related to Sulawesi species or to species in which Sulawesi may have been an important stepping stone to the Nusa Tenggara islands via an actual land connection, the 'Saleyer Bridge', first proposed by Sarisin and Sarisin (1901). The interchange of herpetofauna between Komodo and Sulawesi Is was thought by Auffenberg (1980) to have occurred during the Pliocene. This was when Sulawesi was postulated to have been juxtaposed with the middle part of the Nusa Tenggara chain during compression of the island arc after collision of the Sunda and Sahul shelves. At that time Sulawesi was also postulated to have been close to Borneo and may have received fauna from that island. Musser (1981) found that Floresian rodents *Papagomys, Hooijeromys, Komodomys* and probably *Floresomys* appear to be

phylogenetically more closely related to Sulawesian *Eropeplus* and *Lenomys* than to *Spelaeomys* and the old native genera of Australia and New Guinea.

Musser (1981) considered several hypotheses to explain the close relationship of the Flores rodents to those of Sulawesi. Because no recent indigenous species of murids are common to Sulawesi and Flores Is he favoured the view that these islands were not connected by a land bridge. He considered that the Sulawesi and Flores rodents were possibly derived from a common murid fauna that migrated separately from the Sunda shelf to Flores I. and Sulawesi I. He stated that "an early murid stock may have been able to get to Flores from Java with little or no island hopping". If Auffenberg (1980) is correct there must have been some island hopping because he suggests some water barriers have always been in place between some islands in the Nusa Tenggara to the west of Flores. Their movement to Sulawesi may have been along several hypothesised routes discussed by Musser (1981). These include via the Pulau Laut Centre of Diastrophism (Van Bemmelen, 1949). This 'Centre' was a large uplifted island extending from Mangkalihat Peninsula southwards and across the Makassar Strait to Pulau Laut to the southeast and ending near Muriah volcano in Java. At that time (upper Pliocene) the present areas of southeastern Borneo, western Sulawesi and northern Java were covered by sea. Groves (1976:213) states that, "it is in fact uncertain whether there was at any time a complete land bridge from Java or Borneo to Sulawesi" but that from time to time there may have "been a brief connection at least at the southern end between Java and the Pulau Laut Centre". Musser (1981) stated that it appears certain that East Kalimantan was at one time much closer to Sulawesi than it is now and was probably even connected. However, Musser (1987) considered that all mammal immigrants to Sulawesi from Sundaland "have probably been obliged to cross a sea barrier". There is, however, disagreement as to when the Makassar Strait was closed. Katili (1978) considered that the strait of Makassar had disappeared by late Pliocene with Sulawesi pushed by movement of the Pacific plate to a position adjacent to Kalimantan but still probably separated from that island by a very narrow water gap. During the Quaternary the strait of Makassar gradually reappeared as a result of spreading of the sea floor with Sulawesi taking up its present position. Hamilton (1979) on the other hand presents evidence that Sulawesi was a part of Borneo until middle Palaeocene time. The Strait opened later as Sulawesi drifted south from Borneo and has remained open from the early Miocene to the present. Musser (1987) notes that all fossil vertebrates reported from Sulawesi are from the southwest arm of the island and are of either Pliocene or Pleistocene age. He speculates that this part of Sulawesi was an island, the mammal fauna of which became exterminated by competition when it became joined to Central Sulawesi.

The validity of hypotheses put forward as to routes used to connect related mammal faunas in S.E. Asia depend on reliable palaeontological evidence. Groves (1985), however, points out that such evidence is largely lacking in this region and that there is "controversy over just about every facet". Further, there is a dearth of modern phylogenetic studies on both past and modern mammals from which to judge

evolutionary relationships of mammals. For these reasons, proposed past land connections based on information derived from mammals should be regarded with considerable circumspection.

Broad project objectives

Over the next three to four years the senior author, in conjunction with colleagues from Australia and from the Puslitbang Biologi, will survey the mammal fauna on 18 islands in the Inner and Outer Banda arcs to gain a better understanding of systematic and biogeographic problems in this little studied region.

While some mammal surveys have already been carried out on some of these islands, most have been inadequately surveyed.

Phase I of this project, the survey of North, West and South Lombok was carried out between September 23 and October 31, 1987. At the completion of the survey on each island or island group a report similar to this one will be prepared for publication.

Lombok I.

General introduction

Lombok I. is approximately square-shaped *c.* 113 km long and 81 km wide. It has an area of 4729 km^2; including adjacent islands. It is separated from Bali I. to the west by 31 km wide strait of Lombok, which has a maximum depth of *c.* 300 m, and from Sumbawa I. to the east by the strait of Alas, which is *c.* 15 km wide and has a maximum depth of *c.* 130 m. With Sumbawa I. it forms the administrative province of Nusa Tenggara Barat (NTB). The capital of Lombok I. and administrative centre for NTB is Mataram. Good access to Mataram is available from adjacent islands, both by daily ferries and light aircraft. The airport is at Ampenan, *c.* 5 km from Mataram; the ferry terminus is at Lembar, *c.* 18 km from Ampenan (Figure 2).

Topographically Lombok I. is dominated by two mountain ranges running east and west which are connected by a central wide sloping valley in the centre. The southern mountain ranges are low and do not exceed 300 m in height; they include the two peninsulas extending to the east and west. The western of these two peninsulas is clothed by extensive tracts of near-pristine primary forest.

The northern chain of mountains is more spectacular and is dominated by the Gunung Rinjani volcanic massif, which at 3726 m is one of the highest points in the entire Malay Archipelago. At the western edge of Gunung Rinjani is an extensive and steep caldera containing a shallow lake (Segara Anak) at about 2000 m altitude (Figure 3). In the centre of this lake is Gunung Baru, a small volcanic cone active in the 1930's and still emitting smoke. The Kali Putih river emerges from Segara Anak in an impressive waterfall then courses towards Bayan in the north through steep gorges (Figure 4). From the central Rinjani massif the Rinjani complex falls to the gentler slopes in the west and to lower peaks and steep valleys in the east. Most of the mountainous areas of the Rinjani complex are of Quaternary origin with a base of basalt covered with breccia, andesites, recent volcanic ash and pumice. They are covered with relatively undisturbed lowland and highland tropical semi-evergreen rainforest. The south and west slopes

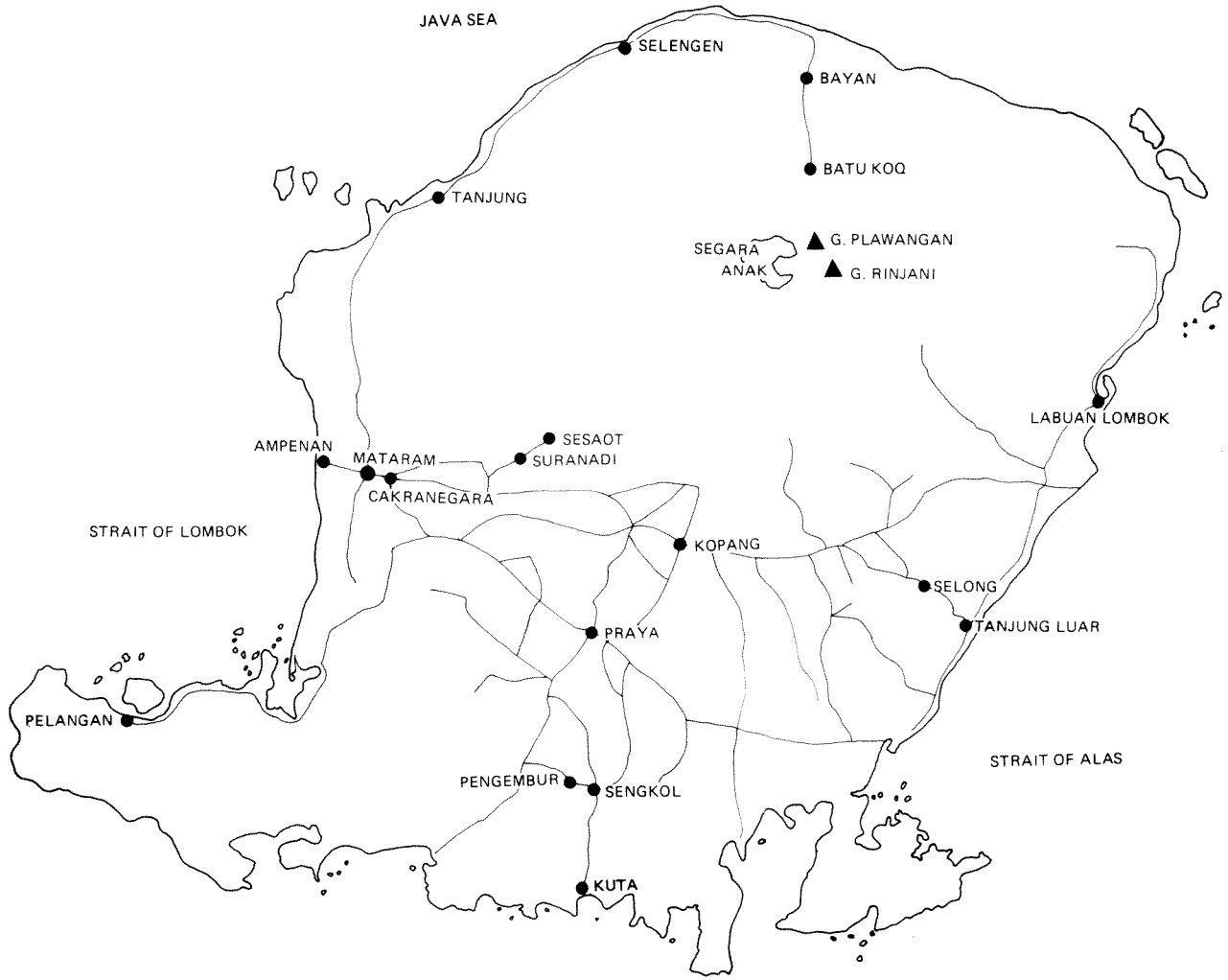


Figure 2: Lombok I., location of sites referred to in text and major roads.

Figure 3: Steep caldera of G. Rinjani containing the shallow lake, Segara Anak, and the small volcano, G. Baru.

Figure 4: Steep valley on the lower north slopes of G. Rinjani below Desa Batu Koq. The river Kali Putih courses through the bottom of this valley.

appear to be the easternmost moist forests of the Greater and Lesser Sunda islands (Anon 1981) and are the major water catchment areas supplying the majority of the island. The westernmost of the northern chain of ranges are much lower; their highest point is Gunung Punikan (1490 m). Parts of the forests at lower altitudes (for example near Sesaot, to the south, and Santong to the northwest) have been replaced by commercial forests of *Albizzia falcata, Pterospermum javanicum* and *Swietonia mahogoni, Cinnamomum burmanii, Toona sureni, Artocarpus integra* and *Aleurites moluccana.* Much of the northeastern slopes of Rinjani have been extensively cleared and burnt for grazing giving way to alang alang, *Imperata cylindrica,* grassland and shrubland dominated by *Melastoma* sp. and fire resistant riparian belts of gallery forests. Above 1500 m the fire subclimax 'Cemara forests' have emerged. The eastern parts of the Rinjani complex reflects its greater aridity and are vegetated with dry monsoon forest dominated by *Acacia* spp., *Ficus* spp., and *Schleichera* spp., (Anon 1981).

It is probable that the grasslands of the massif are derived from the long continuous burning of the forests by man (Richards 1976). Anon (1981) considers that human activity such as onion, coffee, fruit and cinnamon plantation, cattle and horse grazing and the collection of firewood and other forest products continues to encroach on the forests at the margin of the Rinjani complex. However, these activities have been greatly curtailed here and elsewhere on Lombok I. by the activities of the Kehutanan Department which made the cutting of the forests illegal in 1950. This process of deforestation of the lower slopes apparently began soon after 1944 (Anon 1981).

A narrow coastal strip varying in width from 5-10 km borders the northern mountains. The landscape is characteristically savannah. Cederroth (1981) states that it is mainly used for shifting agriculture.

The central low valleys in the island are most fertile and benefit greatly from the orogenic rainfall on the Rinjani massif which falls mostly on the west and south slopes of this massif (Anon 1981). Cederroth (1981) states that 90 per cent of the population live in this central region where there is sufficient rainfall for intense wet rice cultivation in an area stretching the east-west length of the island and with a width of about 35 km. The road system on Lombok I. (Figure 2) gives a measure of the distribution of people on the island. The southern point of the island is, by comparison with the central region, a very arid landscape with heavy vertisoils and scarce unreliable rainfall.

The effect on Lombok I. of the massive and devastating volcanic eruption of Tambora on W. Sumbawa in 1815 can only be speculated upon. However, Van Eck 1875 (in Cederroth 1981) stated that extensive areas of Lombok I. were completely destroyed and covered with ash from this Tambora eruption.

Mammal fauna

Early exploration

Zollinger was the first collector to visit Lombok I. (1847). He noted the occurrence there of the common macaque monkey, deer and muntjak. Later he visited Sumbawa and made lists, the highlights of which were, according to Mertens (1936), *'Pteropus edulis', 'Paradoxurus masanga', 'Hystrix fasciculata', 'Sus vitatus', 'Cervus russa'* and *'Halicore Dejung'.* Lombok I. was reported by Zollinger to have the same species but as

noted by Mertens (1936) most modern authors consider some of these records unreliable (e.g. *Hystrix*). In 1856 Wallace travelled to Lombok I. (Wallace 1886), but reported only the occurrence of deer and wild pigs. Allen, Wallace's assistant, however, made some collections on Lombok I. which were published upon by Dobson (1878) who described *Pteropus l. lombocensis* from Lombok I. The ornithologist Everett travelled to Lombok I. in 1896. He briefly reported on his travels (Everett 1896) and recorded both *Macacus cynomolgus (= Macaca fascicularis)* and *Semnopithecus maurus (=Trachypithecus auratus).* Most interestingly he states "Of Carnivora there appear to be three kinds, called respectively by the Sasaks *Ujat, Rasih,* and *Mamah,* the first two being by their description a *Paradoxurus* and a *Viverra,* and the third either *Felis bengalensis* or a feral domestic cat. Among the Chiroptera there are found *Pteropus* (2 spp.), *Megaderma, Rhinolophus, Kerivoula,* and other genera. The *Rodentia* are represented by two rats and a mouse (and perhaps other Muridae), and a porcupine, *Hystrix javanica* without doubt. Of *Ungulata* the island has a deer and *Cervulus muntjac* the latter introduced by the Balinese Rajahs and now common. Zollinger, I think, mentions the Pelandok *(Tragulus)* also as existing in Lombok, but I could hear nothing of it. Wild pig, of course, abound, but I do not know of what species".

Mammal specimens were collected by Everett in 1856 on Lombok I. In 1905 Andersen described three species of *Rhinolophus* from Everett's collection: *R. acuminatus audax, R. affinis princeps* and *R. simplex* and *Cynopterus titthaecheilus* was also recognised for Lombok I. from that collection. Modern authors have discounted the occurrence on Lombok I. of one of the viverrids, the felid, *Hystrix, Tragulus* and *Megaderma* reported there by Everett.

There apparently was also a report of a Balinese Tiger on Lombok I. This report was discounted by Everett (1896) who noted that the collector Mr William Doherty "could not find any confirmation of the report that the tiger had crossed over from Bali to Lombok. This report seems to be an unfounded newspaper note".

Modern records

There has been no systematic attempt to collect mammals on Lombok I. prior to the present study. However, by 1986, 12 species of bat, one insectivore, two primates, five rodents, one carnivore and three artiodactyls had been reported in the literature for Lombok I. (e.g., Mertens 1936, Chasen 1940, Tate 1941a, Pohle 1950, Laurie and Hill 1954, Oei 1960, Honacki *et al.* 1982, Nowak and Paradiso 1983, Strein 1986). These species are listed in Appendix 1. There have been few additions since 1960.

In compiling the mammal fauna for Lombok I. from literature the following three species of bat listed by Pohle (1950) are considered dubious following comments by Laurie and Hill (1954: 51, 54, 55) and are omitted as unreliable records: *Taphozous melanopogon, Hipposideros bicolor* and *H. galeritus.* Similarly some records from available reports are not apparently based on specimens and cannot be substantiated. These include some of the mammal species listed in the field report for the Rinjani complex (Anon 1981) which combines "incidental field observations" as well as information from literature. These include *Viverricula malaccensis (?V. indica rasse), Suncus murina* (sic), *Cynopterus sphynx* (sic) (=*C. t. titthaecheilus?), Taphozous melanopogon, Hipposideros diadema, H. larvatus, Myotis mystacinus (=M. muricola),*

Pipistrellus javanicus, Scotophilus kuhlii and Kerivoula hardwickei. While the authoritative literature referred to previously considers most of the above species may occur on Lombok I. the list in Anon (1981) is considered too speculative and in part, at least, unsubstantiated by specimen records at that time. In May 1978 and March 1979 the United States Naval Medical Research Unit, Detachment II, (NAMRU II) collected *Eonycteris spelaea, Dobsonia peronii, Chaerephon plicata, Scotophilus kuhlii, Myotis muricola* and *Rattus exulans* on Lombok I.; these specimens may have been the basis of their listing in Anon (1981), but otherwise the NAMRU II collections have remained unreported. In October 1969 Boeadi, Puslitbang Biologi, Bogor, collected *Chaerephon plicata* at Sesaot, West Lombok, and in 1981 A. Suyanto, of the same institution, collected *Cynopterus t. titthaecheilus* at Sewela, East Lombok.

An internal report on Suranadi Park prepared in 1968 by the Direktorat Inventarisesi dan Pereneanean Kehutanan for the mountainous region of Lombok I. lists the Giant Black Squirrel, *Ratufa bicolor,* as present in the Park. A Kehutanan report (undated) listed the following mammals as protected on Nusa Tenggara Barat (Lombok and Sumbawa Is): Otter Civet or Musang Air, *Cynogale bennettii;* Black Giant Squirrel, *R. bicolor;* Spotted Flying Squirrel or Bajing terbang, *Petaurista degons (P. elegans)?;* Pangolin, *Manis javanica;* Leopard Cat, *Felis bengalensis* and Banteng, *Bos sondaicus (=B. javanicus?)* The following mammals are listed as present in this region but not requiring protection: Babi Hutan or wild pigs, *Sus* sp; Crab-eating Monkey *Macaca irus (= M. fascicularis)* and the Luwak or Marbled Cat, *Felis marmorata.* It is not indicated which of these species may be present on Lombok I. but the Kehutanan officer at Suranadi stated that the Black Giant Squirrel was present in Suranadi Park.

Lombok I. is the type locality for the following mammal forms: *Pteropus l. lombocensis* Dobson, 1878; *Acerodon mackloti prajae* Sody, 1936; *Rhinolophus acuminatus audax* K. Andersen, 1905; *R. affinis princeps* K. Andersen, 1905; *R. simplex* K. Andersen, 1905; *Pipistrellus tenuis sewelanus* Oei, 1960; *Tylonycteris pachypus bhaktii* Oei, 1960; and *Paradoxurus hermaphroditus rindjanicus* Mertens, 1929.

Cederroth (1981) provides the following figures for the number of domestic animals on Lombok I. in 1971: cattle 158,000; water buffalo 50,000; horses 13,000; goats 49,000; sheep 15,000 and pigs 6,600. These figures are all lower than values listed for 1962, except for horses, which increased by 2000.

Climate

Cool northwesterly monsoon winds arrive in Lombok I. about mid November. They are met by other winds blowing towards the equator from the high pressure zone over the southern Indian Ocean. The meeting of these two winds produces heavy rains on Lombok I. and other islands in the Nusa Tenggara group, all the Sunda shelf, and Sulawesi. On Lombok I. these prevailing winds are from the west (Musim Barat). Most rain falls on Lombok I. between late November and late April. Considerably less rain falls on the south coast and the rainy season (Musim Hujan) in that region of Lombok I. was reported to end often by late February. Local people at Desa Kuta, S. Lombok I. considered that in recent years the climate had a five year cycle. Our expedition to Lombok I. in September/October 1987 coincided with the period of extreme aridity in

this five year rainfall cycle. Cederroth (1981), however, states that the climatic cycle on Lombok I. has a six or seven year periodicity.

Between April and June southeasterly winds blow from the high pressure zones of the dry and wintery land mass of Australia to the low pressure zones over central Asia. These winds which deposit rain as a result of orogenic uplift on islands in the Sunda shelf result in little rain falling on Lombok I. and other islands in the Nusa Tenggara and eastern

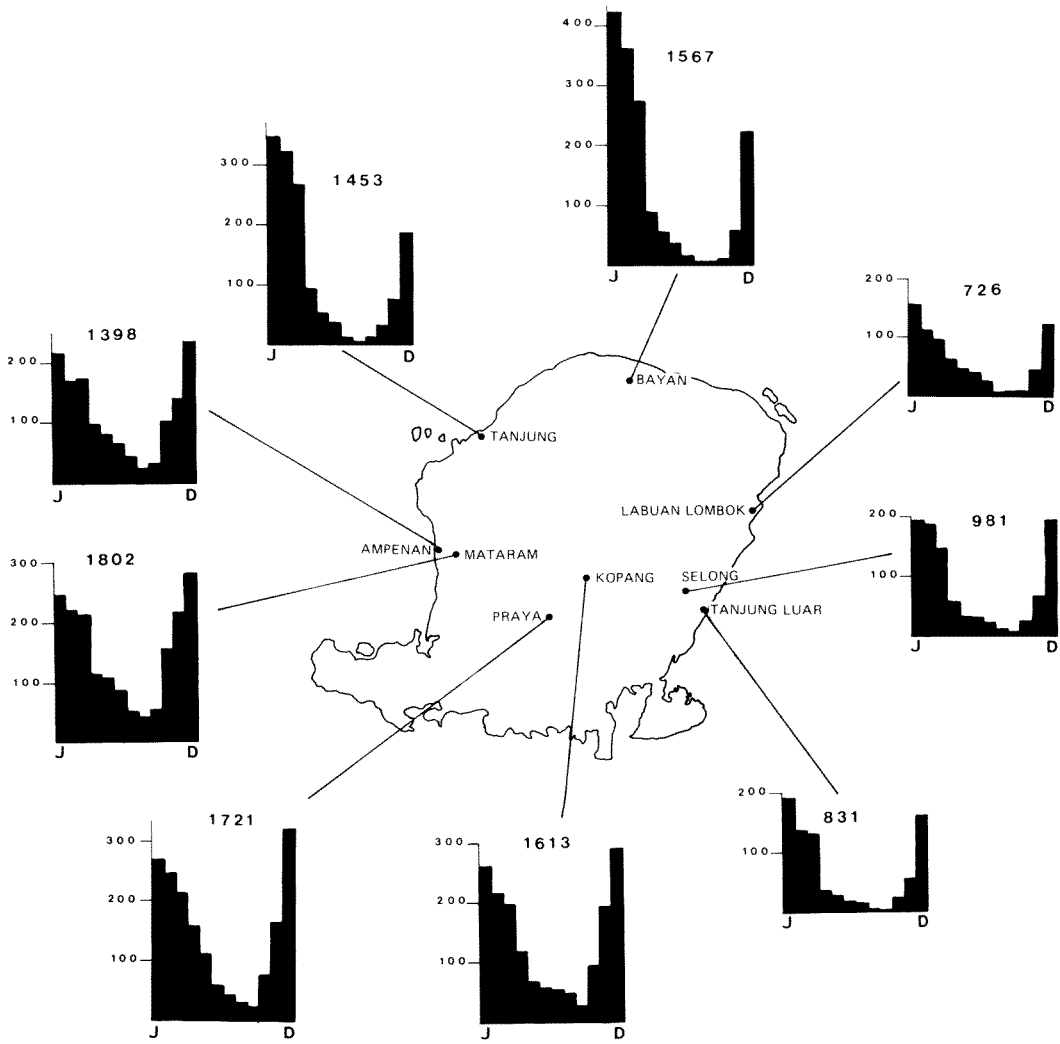


Figure 5: Monthly rainfall patterns for nine localities on Lombok I. Data from Oldeman *et al.* (1980). Annual values (in brackets) are on each histogram. Data represents 25 to 47 years of records, in mm.

Java because of the rain shadow caused by the land mass of Australia, although extensive rain does fall in parts of southwestern Sulawesi during this period (Whitten *et al.* 1987).

Total annual rainfall on the Rinjani complex from September to April varies from 2000-4000 mm with more on the higher elevations of the south central areas (Cederroth 1981). These values exceed figures given in Oldeman *et al.* (1980) for nine lowland (less than 360m) localities on Lombok I. (Figure 5) which have an annual rainfall of from 726-1802 mm. None of these rainfall stations were in the south of the island. The eastern side of the island is considerably drier with an annual rainfall from *c.* 700-1000 mm. Most rain falls on the west and south slopes of Rinjani during the rainy season but these slopes also receive condensation in the dry season as a result of the uplifting of the south eastern monsoon winds. The central plain localities of Mataram, Praya and Kopang receive considerable annual rainfall (1721-1802 mm). Sufficient rain falls on the northern coastal strip during the wet season to allow a shifting agriculture, but none falls in the dry season (Cederroth 1981). The climatic map of S.E. Asia of Whitmore (1984) indicates that only the central part of Lombok I. is "ever wet" (i.e. Q value of 14.3-33.3). This picture is supported by the agroclimatic map of Oldeman *et al.* (1980); most of Lombok I. is considered "dry" or of Agroclimates D & E and only the small hilly parts "moist" (Agroclimate C). Continuous running surface water is now available from streams all year round only close to the Rinjani massif, although Wallace (1886: 164) reports many streams flowing in the central plains in June and July 1856. Most of the existing available water is harnessed for irrigation of the rice producing areas. In the dry season streams dry up or pool water (Crippen 1975). In October 1987 streams at our study sites flowed at Suranadi and Batu Koq but not at Pelangan where water was pooled. No potable water was seen in stream beds at Kuta. Clearing of forests since 1944 has adversely affected water sources on Lombok I. and Anon (1981) reports that four or five traditional water sources south of Sesaot had become dry *c.* 1979.

People

Cederroth (1981) states that about one hundred years ago the island had only about 400,000 people. In 1920 there were *c.* 620,000 and by 1971 this had increased to *c.* 1,600,000. Most people live in the central fertile plain which has a population density of about 700 inhabitants per km^2. Wallace (1886) observed during his visit to Lombok I. that the central plains were already overcrowded and intensively cultivated for rice.

The original inhabitants were Sasaks who appeared to have settled on the north coast near Bayan. Islam was introduced to the island about 1545 (Cederroth 1981). For the next four centuries Lombok I. was a disputed area fought over by the Balinese Klungkung Kingdom and Macassarese Sultanate on Sulawesi. From the latter part of the eighteenth century to 1894 Lombok I. was under the rule of the Balinese. From 1894 the Dutch ruled Lombok I. until they were driven out by the Japanese in 1942. Van der Kraan (in Cederroth 1981) states that "in their half-century of rule the Dutch had succeeded in transforming an island described by F. A. Liefrinck in 1887 as 'a rich land blessed by nature' into a region of endemic famine." The Dutch again returned after 1945 for four more years until Lombok I. was incorporated into the Republic of Indonesia.

Climatic vagaries are still endemic on Lombok I. and Cederroth (1981) states that 30,000 people died as recently as 1966, in a great famine in the southern part of the island.

1987/1988 mammal survey

The 1987 survey group comprised Darrell Kitchener and Lorna Charlton, Western Australian Museum, Perth, and Maharadatunkamsi, Puslitbang, Biologi, Bogor. The 1988 group was again Kitchener and Maharadatunkamsi, as well as Richard How and Ronald Johnstone, Western Australian Museum.

1987 Survey schedule

24 September: arrive Mataram (Lombok); 25-30 September: Desa Suranadi; 30 September: Desa Suranadi to Batu Koq; 30 September-4 October: Desa Batu Koq; 5-9 October: Pos III, Gunung Rinjani; 11 October: Desa Batu Koq to Mataram; 12 October: Mataram to Desa Pelangan; 18 October: Desa Pelangan to Desa Kuta; 24 October: Desa Kuta to Mataram; 25-26 October: leave Mataram to Bogor (Jawa).

1988 Survey schedule

1 May: arrive Suranadi (Lombok); 3 May: Desa Kuta; 6 May: Desa Kuta to Sumbawa Besar (Sumbawa I.).

Survey approach

Where possible, collection sites were selected in relict patches of natural forest (Suranadi) or in extensive areas of natural forest (Rinjani, Desa Pelangan). Desa Kuta was collected because of the proximity of caves for bats.

Ground mammals were captured in collapsible traps (aluminium of two sizes). Bats were collected in five strand mist nests (12.2 x 18.3 x 2.7 m), a bat trap and by hand in caves, *Ficus* and coconut trees. Several viverrids and a felid were collected in snares or by poison by village people and presented to us. All mammals were weighed and blood taken by heart puncture with hypodermic needle. Both blood and dissected liver were placed in liquid nitrogen. A large series of duplicate samples of blood and liver were taken for NAMRU II for viral studies.

All animals collected (Appendix III) were injected with 10% formalin and placed in a solution of 10% formalin. Reproductive condition was recorded from all individuals. Specimens will be deposited in equal numbers in the Museum Zoologicum Bogoriense, Bogor, and the Western Australian Museum.

Collection effort

See Table 1.

Table 1: Collecting effort for 1987 and 1988 (in brackets), expressed as the number of traps and the area of mist-nets (M), multiplied by the number of collecting nights (SE, Small Elliott; LA, Large Elliott, BBt, Rat Trap in tree; BBg, Rat Trap on ground; BT, Harp Bat Trap.

	SE	LA	BB_t	BB_g	BT	M (sq metres)
Kuta	280(16)	0	0	160 (16)	4	1070 (318)
Pelangan	125	10	50	50	6	870
Suranadi	255 (43)	48	60	60 (14)	4	752 (234)
Batu Koq	160	32	40	40	1	635
Pos II Rinjani	0	0	0	0	0	33
Pos III Rinjani	342	0	75	75	0	1070

Survey sites

These were selected to sample both 'pristine' and disturbed vegetation, wet and dry aspects of the islands' climate and a range of available altitudinal sites. They were as follows:

Suranadi Park:

Located about 25 km east of the capital Mataram at an altitude of *c.* 200 m. It consists of an area of 52 ha and has the status of a recreational park (Taman Wisata Sk Mentan). It is vegetated with a mixed moist natural forest. A shallow stream flows through the centre of this park (Figure 6) and along the southern edge. The park is bordered by rice fields, coconut and banana plantations and human dwellings. Fingers of vegetation dominated by relict native trees extend into the fields to the west and north. It has a Kehutanan (Forestry Department) office and a resident ranger. The National Conservation Plan for Indonesia (Anon 1982) recommended that its present status should be maintained with the development of "active interpretative programs (trails and exhibits) and domestic tourism and recreation".

The vegetation at Suranadi (from an internal Kehutanan document) has three strata. A crown of trees 25-30 m high dominated by the following: Beringin, *Ficus;* Garu, *Dioilum* sp.; Terep, *Artocarpus elastica;* Suren, *Toona sureni;* Kemiri, *Aleurites moluccana* and Purut, *Pararlocarpus venenosus.* The middle strata is of trees 15-20 m high dominated by Pulai, *Alstonia scholaris;* Salam, *Eugenia polyantha;* Kopang, *Parkia biglobosa;* Buah Odak, *Planchonella nitida;* Durian, *Durio zebethinus;* Sentul, *Sandoricum koetjape;* Berora, *Kleinhovia hospita* and Jambu, *Eugenia* sp. The third strata is of young trees less than 10 m high dominated by Jambu, Garu, and Sentul. Beneath the tree strata are grasses and herb ferns and lianas, the palms Rotan Manan, *Calamus manan* Mig., Rotan Lilin, *Calamus javensis* Bl; and Rotan Sega, *C. caesius* Bl. In the gullies there is a low cover to 0.4 m of *Asplenium* sp. cf. *tenerum* Frost. *Lindsaea scandens* Hook. var. *terrestris* Holtt. and the *Drynaria quersifolia* J. Sm. with occasional *Pandanus* sp. to 3-4 m high.

Bats were collected from a cave, Batu Kota, *c.* 5.8 km east of Suranadi.

Batu Koq:

Located at an altitude of 400 m several km from Bayan at the foothills of the north slopes of Gunung Rinjani. A large river flows below Batu Koq through a deeply dissected valley. Vestiges of the riparian forest border the river and patchily cover the upper slopes of the foothills (Figure 4). Most of the flatter ground surrounding Batu Koq is cleared for bananas, rice and onions. Water from the slopes of Rinjani is funnelled through Desa Batu Koq via a canal and anastamoses into the surrounding fields through a complex of irrigation canals. Two caves at Gua Sawa, 7 km east of Bayan, were visited for bats.

Rinjani, Pos Tiga:

Located just below the current tree line on Gunung Rinjani at an altitude of 1700 m. The gullies have a dense and tall layered primary semi-evergreen rainforest. On the ridges in the area immediately around Pos Tiga, which is identified by a small wooden hut, is more open forest with lower trees up to 6 m covered with lichens and moss (Figure 7). The ground cover is dominated by wild raspberries and a complex assemblage of ferns.

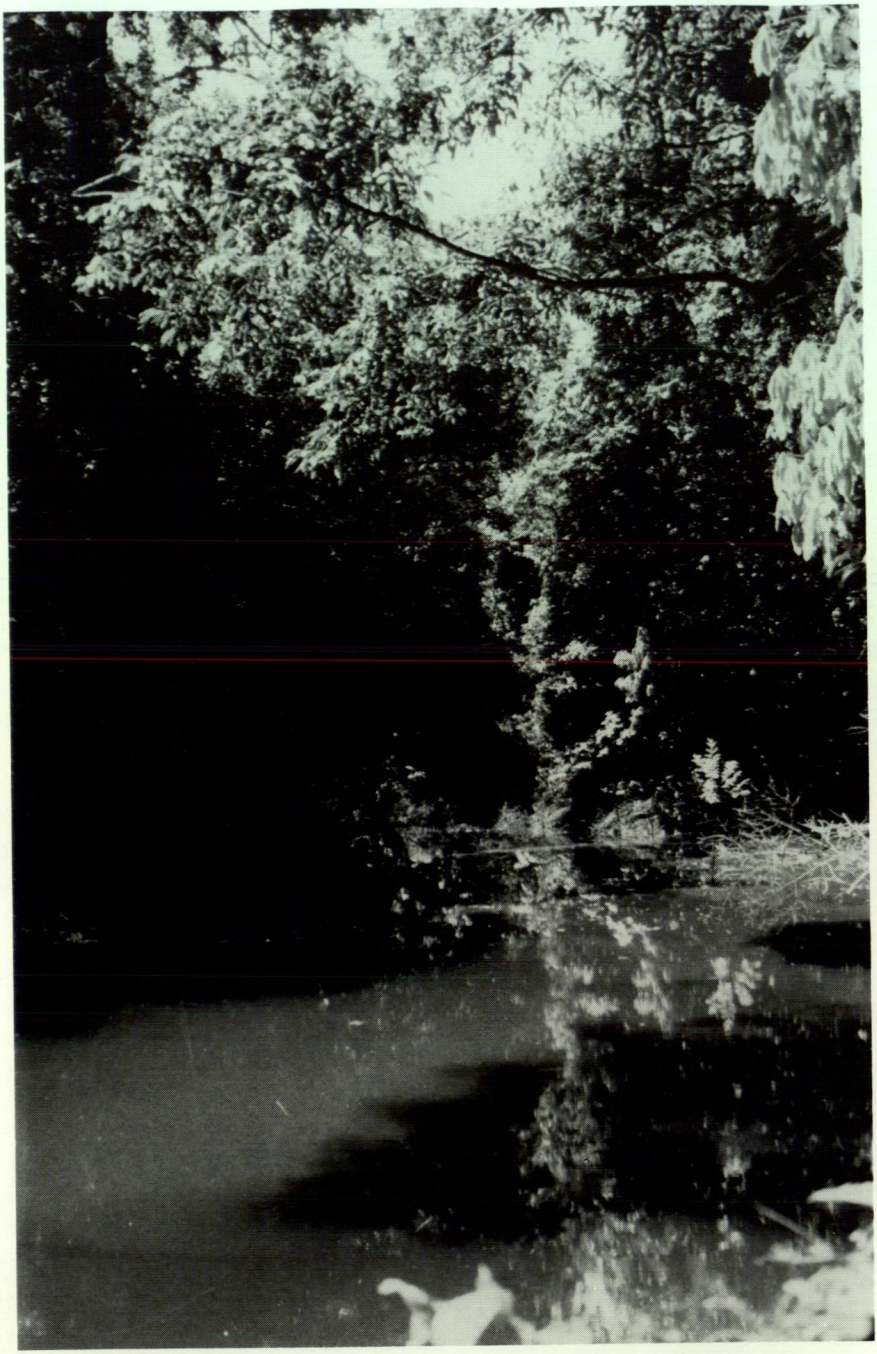


Figure 6: Suranadi Recreational Reserve, Lombok I. Shallow stream flowing through the centre of the Reserve is bordered by lowland evergreen primary forest.

Figure 7: Gunung Rinjani, Pos Tiga, at 1750 m altitude. Low evergreen primary forest with moss and lichen on trees and a dense fern layer.

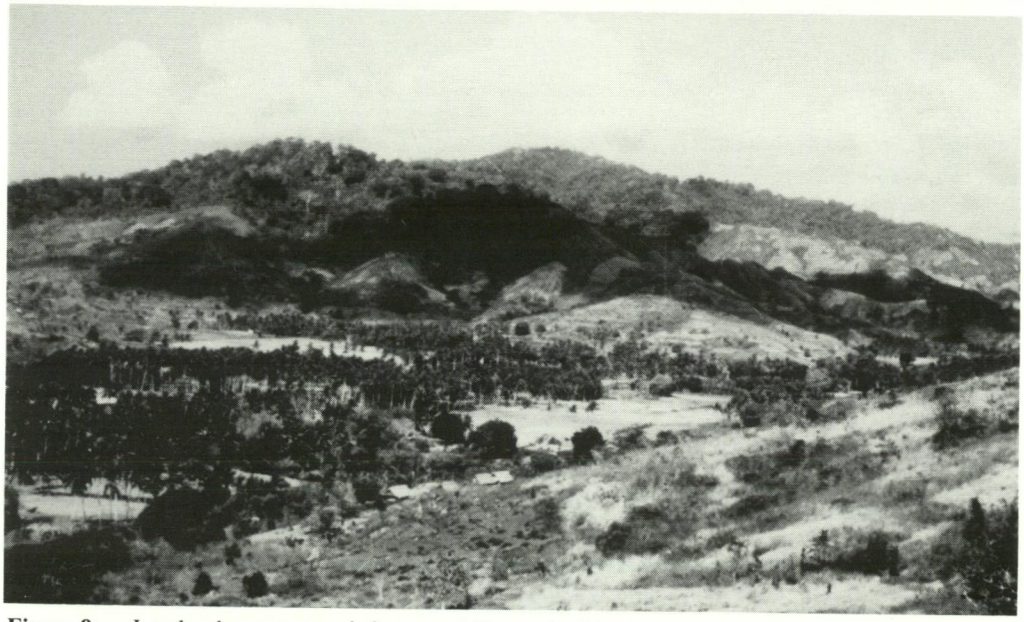


Figure 8: Lowland evergreen rainforest on hills overlooking Desa Pelangan, Lombok I. This forest is continuous with that of the south west peninsula of the island.

Dominant trees in this area are *Pteroapermum* spp., *Oroxylum* spp., *Neonauclea lanceolata, Duabanga moluccana, Engelhardtia spicata, Eugenia* sp. and *Pigeon* spp. Several hundred metres above Pos Tiga towards the tip of Gunung Rinjani the vegetation is dominated by a narrow zone of 'Cemara' forest giving way to grassland dominated by *Casuarina* sp.

Pelangan:

Desa Pelangan is surrounded by low hills up to about 200 m in height which are vegetated on the tops and gullies by lowland mixed evergreen primary rainforest (Figure 8). These forests are continuous with the extensive forest of the southwestern peninsula of Lombok I. The shrub layer is very sparse and there is an extensive fern layer. The Desa is small, about 400 people, and situated along a water course which was not flowing but contained a number of unconnected pools. The surrounding fields are cultivated for rice, banana, onions and coconuts. Some large stands of bamboo and mango tree, grow along the edge of the water courses. Several caves occur on the coastal limestone to the southwest. These were visited but access to these caves along the coast was not possible due to the tides.

Kuta:

Desa Kuta is located approximately in the centre of the south coast of the island. It is surrounded to the north by the low undulating ridges of the south coastal ranges, about 300 m in height, and by the Indian Ocean to the south (Figure 9). The vegetation is a low deciduous moderately dense forest which still clothes most of the upper slopes and gullies surrounding Desa Kuta. Some of the flatter plateaus to the west are cleared for agriculture. Immediately surrounding the Desa are plantations of bananas and

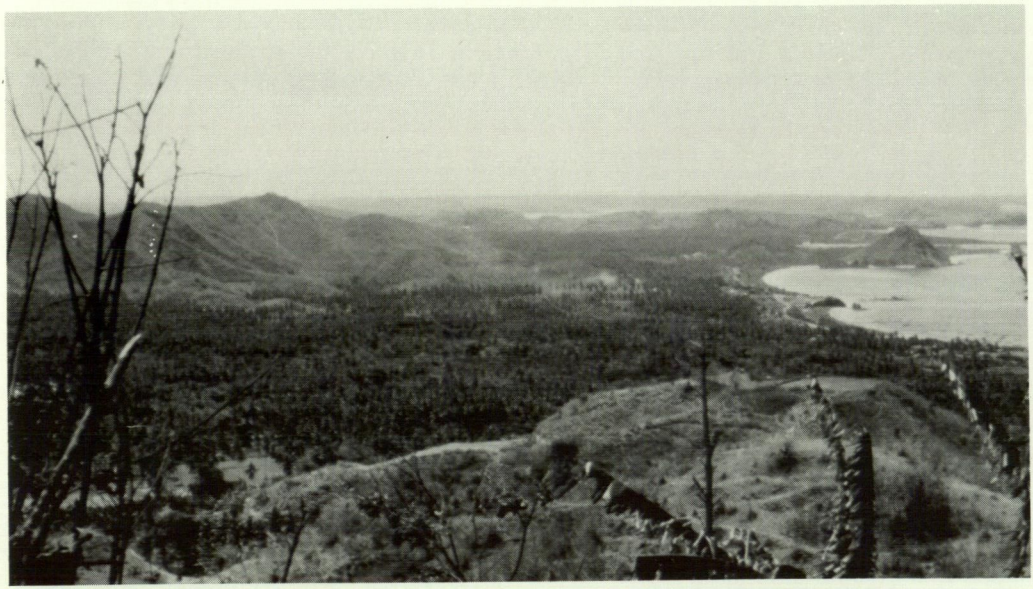


Figure 9: Kuta, central south coast of Lombok I. which is fringed by the low southern range of hills clothed with low deciduous forest.

coconuts. Several large water courses traverse the Desa but these were dry and contained no water in October 1987. Approximately 600 people live in the village and the surrounds. These are mostly connected with the fishing industry. Two caves were visited in this area. One 4 km to the west of Desa Kuta at an altitude of *c.* 300 m and another in Gunung Saung, near Desa Pingember, 25 km to the east.

Measurements

All measurements presented are from adults. Animals were judged as adults if they had a fully erupted adult dentition and had ossified cranial sutures. For rodents and bats particular note was given to the closure of the basioccipital and basisphenoid suture. Adult bats also had no swellings of the epiphyses (joints) of the metacarpals and phalanges (fingers). All measurements were from specimens fixed in 10 percent formalin and preserved in 70 percent ethanol. Measurements were recorded in millimetres and fresh weights in grams, unless otherwise stated. The position of measurements are shown in Figure 10.

Colour of pelage was described from Ridgway's (1912) colour charts; such colours are capitalised in text. Colours are described from 'alcoholic' specimens (which had been in fluid for two months), after careful drying or from scientific skins. No detectable difference was observed in pelage colour between specimens of the same species which had been preserved in fluid or as dry skins.

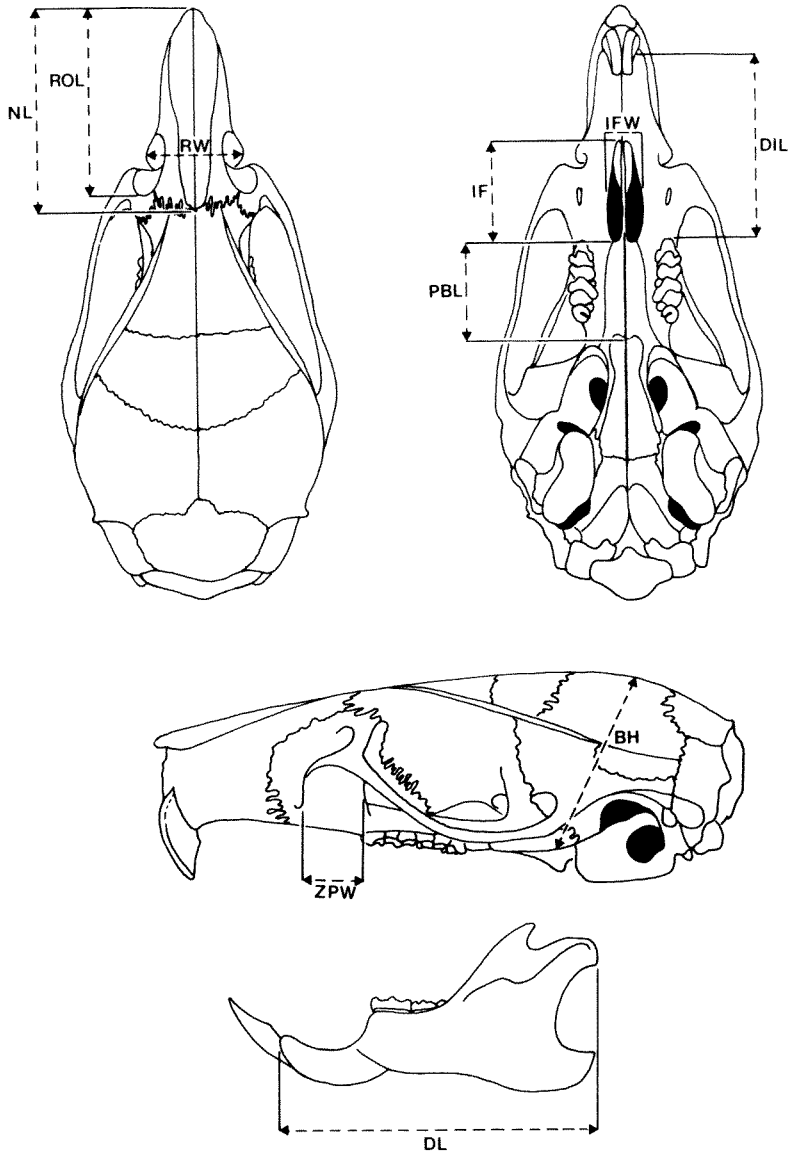
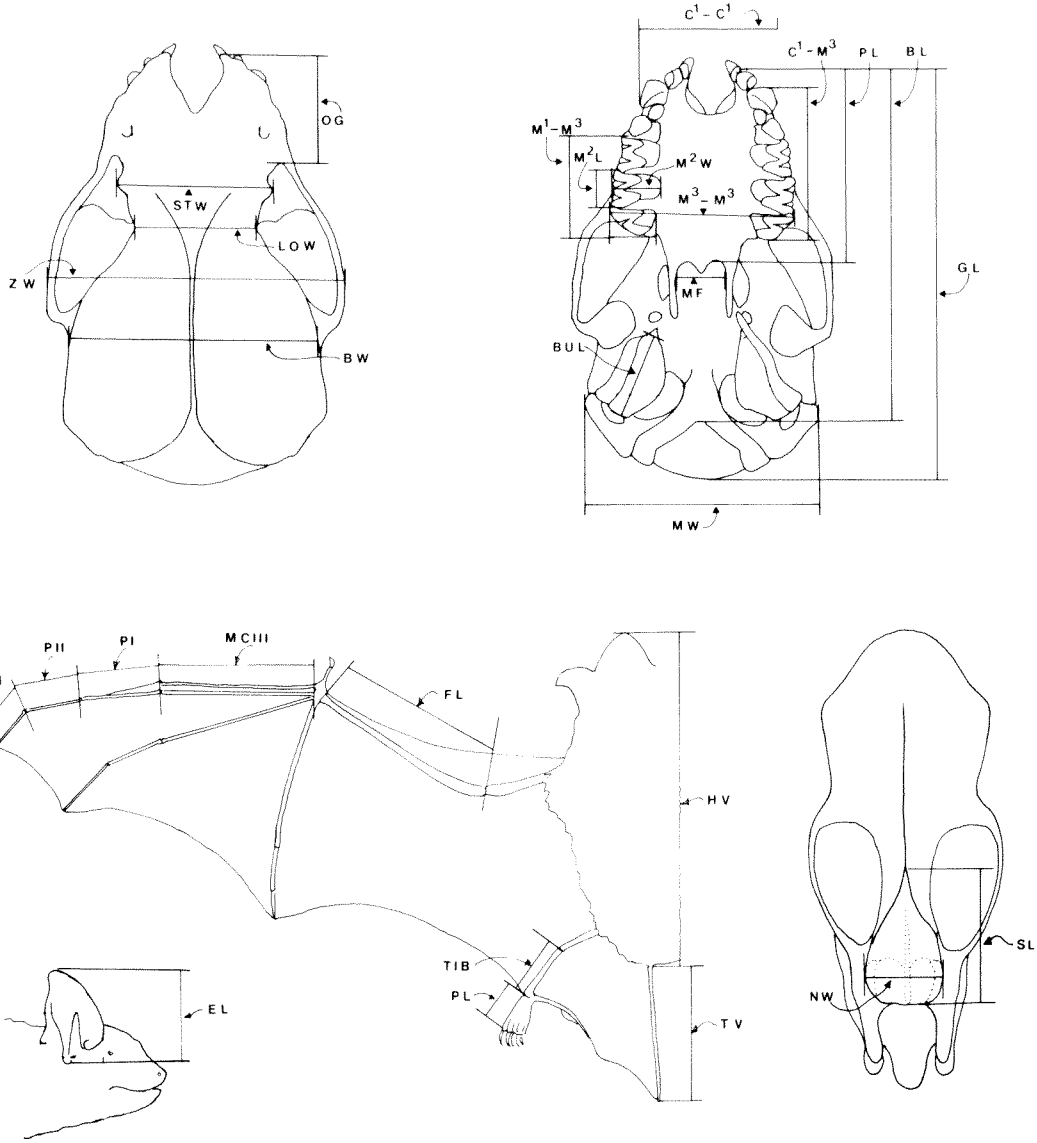


Figure 10: Skull, dentary and external body measurements referred to in text and their recording points. GL greatest skull length; LOW least interorbital width; ZW zygomatic width; NL nasal length; ROL rostrum length; RW rostrum width; BH braincase height; ZPW zygomatic plate width; DIL diastema length; IF incisive foramen length; IFW incisive foramen width; PL palatal length; PBL palatal bridge length; MF mesopterygoid fossa width; OG orbit to gnathion; STW supraorbital tubercle width; MW mastoid width; BW



braincase width; length BL basicranial length; BUL bulla length; C^1-C^1 distance outside canines; C^1-M^3 upper maxillary tooth row length; M^1-M^3 upper molar row length; M^1L upper first molar length; M^1W upper first molar width; M^3-M^3 distance outside last upper molars; DL greatest dentary length; HV head to vent length; TV tail to vent length; EL ear length; FL radius length; MCIII metacarpal III length; PI digit III, phalanx I length; Pii digit III, phalanx II length; PIII digit III, terminal phalanx length; TIB tibia length; PL pes (foot) length.

Species Accounts

Chiroptera

KEY TO CHIROPTERA OF LOMBOK I.

(Characters with superscript a-x are illustrated in Figure 11)

Margin of ear forming complete ring(a); interfemoral membrane narrow(b) Suborder Megachiroptera: **Family-Pteropodidae** 1

Margin of ear not forming complete ring(a^1); interfemoral membrane well developed(b^1) Suborder Microchiroptera 12

1. Forearm longer than 100 mm 2
   Forearm less than 100 mm 5
2. Second finger without claw; wing membranes from spine giving appearance of naked back ..... *Dobsonia peronii grandis* (p. 28)
   Second finger with claw(c); wing membranes from side of back 3
3. First upper molar without distinct anterointernal cusp; first and second inner molars without inner basal ledges; less than 14 palatal ridges 4
   First upper molar with distinct anterointernal cusp(d); first and second lower molars with basal ledge(e); greater than 16 palatal ridges(f); forearm length 120-150 mm . *Acerodon mackloti prajae* (p. 33)

4.0 Forearm longer than 180 mm ..... *Pteropus vampyrus pluton* (p. 29)

4.1 Forearm length 160-175 mm ..... *Pteropus a. alecto* (p. 31)

4.2 Forearm length 113-122 mm ..... *Pteropus l. lombocensis* (p. 32)

5. No claw on second digit ..... *Eonycteris spelaea glandifera* (p. 48)
   Claw on second digit 6
6. Muzzle and tongue very long and narrow(g); teeth very small(h) ..... *Macroglossus m. minimus* (p. 51)
   Muzzle and tongue not very long and narrow; teeth normal 7
7. Muzzle normal length, 34 teeth 11
   Muzzle short, 28-30 teeth 8
8. Tail absent, 28 teeth ..... *Aethalops a. alecto* (p. 44)
   Tail present, 30 teeth 9
9. Ear clearly edged with white(i); cheek teeth broad, sub-rectangular in outline(j); well developed peg-like surface cusp always present on last lower premolar (PM_4) and first lower molar M_1(k) ..... *Cynopterus h. horsfieldi (p. 35)*
   Ear not clearly edged with white; cheek teeth oval in outline (j^1); surface cusps on PM_4 and M_1 absent or small 10
10. Forearm length 74-85 mm ..... *Cynopterus t. titthaecheilus* (p. 36)
    Forearm length less than 65 mm ..... *Cynopterus b. brachyotis* (p. 40)
11. Upper maxillary molar row (C^1-M^2) less than 14.0 mm ..... *Rousettus a. amplexicaudatus* (p. 42)
    C^1-M^2 greater than 14.0 mm ..... *Rousettus leschenaultii shortridgei* (p. 43)

12. Tail perforates dorsal surface of interfemoral membrane with base of tail loosely enclosed in the membrane(l)
Family-Emballonuridae ..... *Taphozous m. melanopogon* (p. 53)
Tail does not perforate dorsal surface of interfemoral membrane 13

13. Tail extends beyond interfemoral membrane (l^{I})
Family-Molossidae ..... *Chaerephon plicata tenuis* (p. 55)
Tail enclosed within interfemoral membrane (l^{III}) 14

14. Distinct nose-leaf present(m) 15
Nose-leaf absent 21

15. Ears lacking tragus, not connected across top of head 16
Ears with tragus (long, divided)(n), connected across top of head. **Family-Megadermatidae.** ..... *Megaderma spasma trifolium* (p. 64)

16. 30 teeth; sella absent; posterior noseleaf rounded and low (m^{I}) **Family-Hipposideridae** 17
32 teeth; sella present; posterior noseleaf triangular(m^{III}); 3 phalanges in toes(o) **Family-Rhinolophidae** 18

17. Forearm length greater than 80 mm, pelage brown or buff ..... *Hipposideros d. diadema* (p. 57)
Forearm length less than 43 mm, pelage orange . *Hipposideros ater saevus* (p. 56)

18. Connecting process sharp pointed(p) 19
Connecting process rounded (p^{I}) 20

19. Forearm length greater than 45 mm ..... *Rhinolophus acuminatus audax* (p. 61)
Forearm length less than 43 mm ..... *Rhinolophus p. pusillus* (p. 63)

20. Forearm length greater than 48 mm ..... *Rhinolophus affinis princeps* (p. 59)
Forearm length less than 45 mm ..... *Rhinolophus simplex* (p. 62)

21. **Family-Vespertilionidae** .....
Tubular nostrils(q) 22
Nostrils normal 23

22. Forearm length greater than 40 mm; last upper molar very reduced(r) ..... *Harpiocephalus h. harpia* (p. 65)
Forearm length less than 40 mm; last upper molar not reduced ..... *Murina cyclotis peninsularis* (p. 66)

23. Ears funnel-shaped(s) 24
Ears not funnel-shaped 27

24. Tragus with deep notch in posterior margin(t); canines with longitudinal grooves; forearm *c.* 38 mm ... *Phoniscus jagorii javanus* (p. 68)
Tragus without deep notch in posterior margin; canines without grooves 25

25. Braincase width greater than 7.0 mm; maxillary tooth row (C^{I}-M^{3}) longer than 5.9 26
Braincase width less than 7.0 mm; C^{I}-M^{3} less than 5.9 mm ..... *Kerivoula p. picta* (p. 71)

26. Forearm length less than 37.5 mm; greatest skull length less than 15.0 mm ..... *Kerivoula h. hardwickei* (p. 69)
Forearm length greater than 37.5 mm; greatest skull length more than 15.0 mm ..... *Kerivoula flora* (p. 70)

27. Base of thumb and sole of foot with white or yellowish pad(u); skull markedly flattened(v) 28
No foot or thumb pad; skull not markedly flattened 29

28. Larger: greatest skull length more than 11.5 mm; supraorbital tubercle width more than 5.5 mm . *Tylonycteris r. robustula* (p. 72)
Smaller: greatest skull length less than 11.5 mm; supraorbital tubercle width less than 5.5 mm ..... *Tylonycteris pachypus bhaktii* (p. 73)

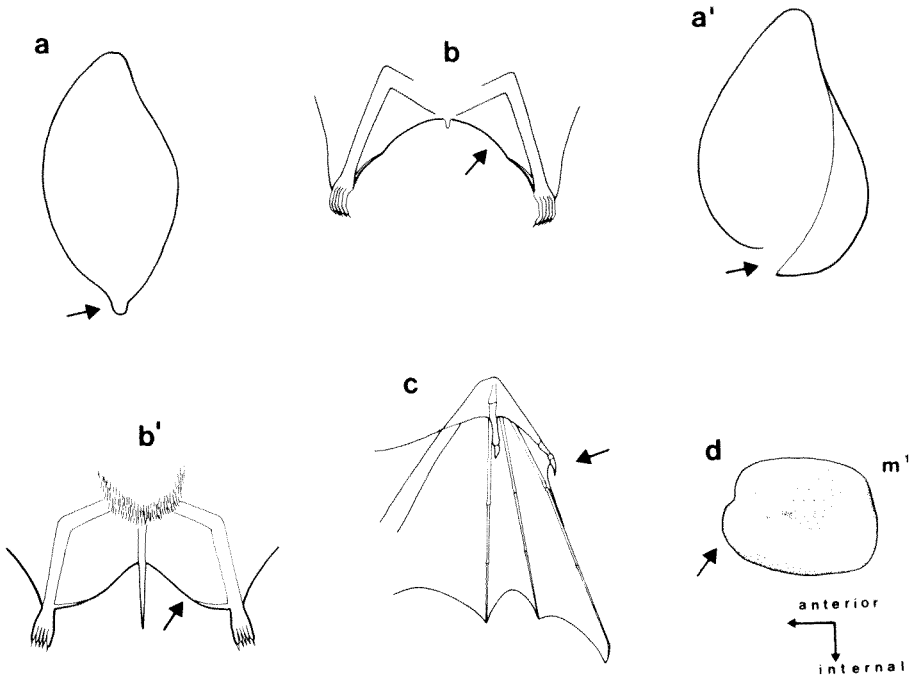
29. Long fingers: third finger with terminal phalanx 3 times length of second phalanx(w) 30
Fingers normal length: third finger with terminal phalanx much shorter 31

30. Maxillary tooth row (C^1 M^3) length greater than 5.5 mm ..... *Miniopterus schreibersii blepotis* (p. 75)
C^1-M^3 length less than 5.5 mm ..... *Miniopterus pusillus macrocneme* (p. 76)

31. Ears moderately long, triangular at tip; tragus tapered, moderately long, bent slightly forward(x); 38 teeth ..... *Myotis m. muricola* (p. 77)
Ears more rounded; tragus shorter, not tapered; less than 38 teeth 32

32. Forearm length greater than 50 mm; 30 teeth ..... *Scotophilus kuhlii temminckii* (p. 79)
Forearm length much less than 50 mm; 34 teeth 33

33. Broader skull: zygomatic width more than 8.0 mm; forearm length 32-38 mm ..... *Pipistrellus imbricatus* (p. 80)
Narrower skull: zygomatic width less than 8.0 mm; forearm length 33-35mm ..... *Pipistrellus tenuis sewelanus* (p. 81)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c
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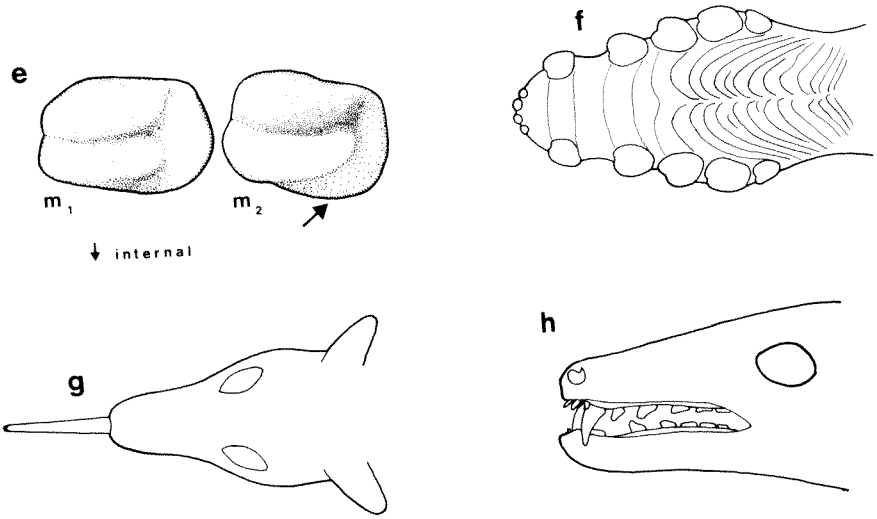
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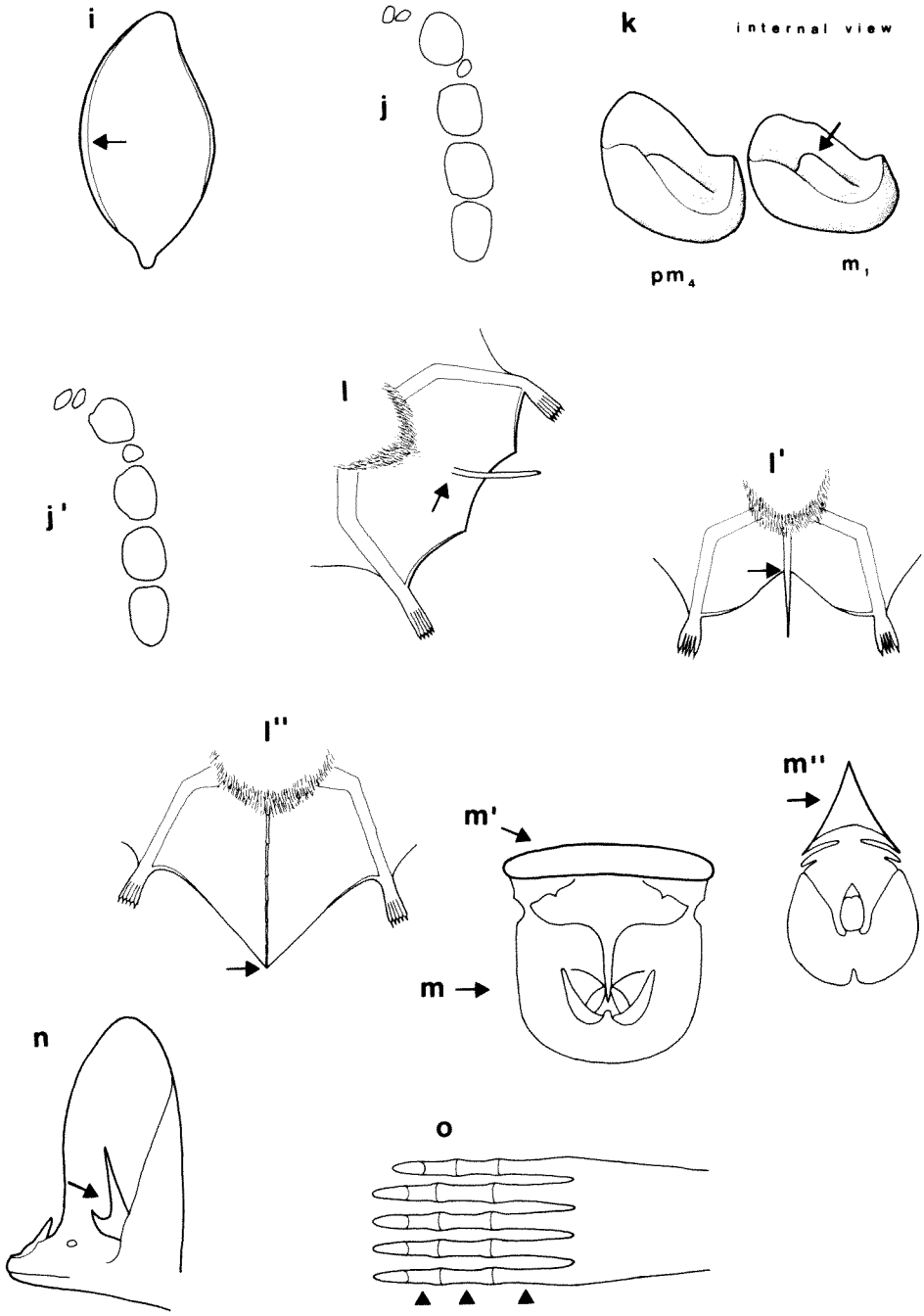
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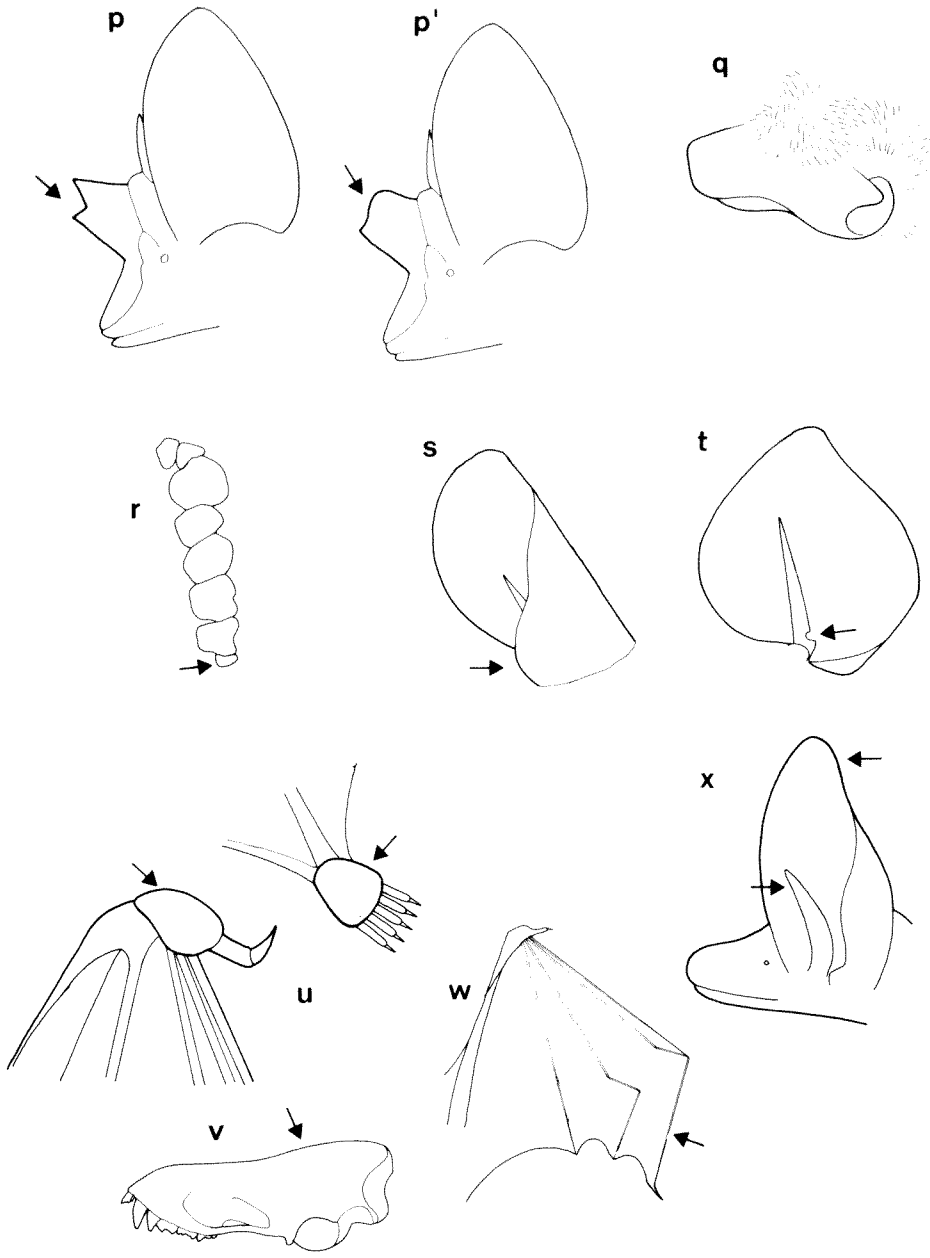


Figure 11: Illustrations of diagnostic characters used in the Key to the chiroptera of Lombok I.

Family: Pteropodidae

Dobsonia peronii grandis Bergmans, 1978

Western Naked-backed Bat

Type Locality

Dompu, Sumbawa I.

Distribution

Dobsonia p. grandis: Lombok I., Sumbawa I., Komodo I., Bali I., Nusa Penida I. Species: also Timor I., Sumba I., Flores I., Alor I., Wetar I., Babar I.

Habitat/Ecology

Two adult males and two adult females were collected in 1987 at Pelangan, Lombok I. These were netted using oval fishing nets by village people among coconuts in the early evening. Another specimen collected by NAMRU II in a garden at Bilekedit, W. Lombok I., on 24 March 1979.

Goodwin (1979) states that on Timor I. the nominate subspecies is common and widely distributed. Adult males are highly coloured and have a very strong musky odour. They roost in limestone caves, fissures, crevices and ledges. The largest colonies of up to 300 individuals, composed of adults and young adults of both sexes, were in dimly lit large chambers of caves; smaller groups, mainly of subadults, were in smaller enclosures. Occasionally individuals rested beneath large fan-shaped leaves of *Corypha* and *Borassus*. In large chambers on Timor they roost with *Taphozous melanopogon* and feed most commonly with *Rousettus amplexicaudatus* and *Pteropus griseus*. They begin about one and one half hours after dark and have been seen feeding on fruits of *Borassus, Muntingia* and at least two species of *Ficus*. They apparently feed all night. Andersen (1912: 455) stated that *D. peronii* were collected from a rock shelter on the coast at sea-level by Everett. Mertens (1936) reports that a large series of *D. p. grandis* were collected from a hollow tree on Sumbawa; he also observed a considerable flock of *D. peronii* in the top of a tree on Flores I. Bergmans (1978) states that they have been collected from sea-level to altitudes of 880 m.

Reproduction

Both females collected in October 1987 on Lombok I. appeared to have recently bred. They were lactating and had both left and right uterine horns slightly swollen (maximum diameter *c.* 4.0). Goodwin (1979) reports that five adult males on Timor were in breeding condition in March and April. A female was pregnant in March with a foetus weighing 48 gm.

Taxonomic Remarks

Van Strein (1986) recognises the following two subspecies in addition to *D. p. grandis: D. p. peronii* (E. Geoffrey, 1810) (Timor); *D. p. sumbana.* K. Andersen, 1909 (Sumba).

An unnamed form is recognised by Bergmans (1978) from Flores I., Alor I., Wetar I. and Babar I. Goodwin (1979) questions the need to recognise the Sumba population as distinct from that of Timor. *Dobsonia p. grandis* differs from these other two subspecies chiefly by its larger size. The Lombok I. specimens agree reasonably closely with measurements of *D. p. grandis* presented in Bergmans (1978).

Measurements (mean, range, sample size)

Forearm length 118.8 (114.5-121.0) 4; head to vent length 148.4 (141.5-158.0) 4; tail to vent length 30.8 (29.5-32.1) 4; ear length 25.5 (24.5-26.4) 4; pes length 27.7 (24.2-30.4) 4; tibia length 58.6 (55.5-59.8) 4; weight 209.8 (162.0-235.0) 4; greatest skull length 50.9 (49.3-51.9) 4; condylobasal length 48.6 (45.3-49.8) 4; condylocanine length 47.4 (44.1-48.2) 4; zygomatic width 30.5 (28.8-31.9) 4; least interorbital width 9.6 (9.4-10.1) 2; mastoid width 18.6 (16.7-19.9) 4; orbit to gnathion length 17.7 (16.9-18.2) 4; braincase width 19.6 (19.0-20.1) 4; M^3-M^3 width (alveoli) 14.5 (13.7-14.9) 4; C^1-C^1 width (alveoli) 9.8 (9.6-9.9) 4; C^1-M^2 length (alveoli) 21.1 (20.8-21.3) 4; C^1-M^3 length (alveoli) 22.7 (22.2-23.1) 4; dentary length 40.9 (39.5-42.0) 4.

Pelage

The colour of the adult female is Chaetura Drab on the head, back and rump while the shoulders are a lighter Hair Brown. The back and rump are very sparsely haired appearing almost naked on the back. Ventrally, the upper chest and extending down each side the pelage is Light Grayish Olive mixed with hair of Chaetura Drab tipped with Cartridge Buff. The central chest and central abdomen are Chaetura Drab tipped with Honey Yellow. The subadult male is lighter than the adult female, the shoulders being Drab and upper chest and sides Light Drab.

Pteropus vampyrus pluton Temminck, 1853

Large Flying Fox

Type Locality

Bali I.

Distribution

P. v. pluton: Lombok I., Bali I. and Sumbawa I. Species: also Timor, Savu I., Java, Borneo, Sumatra, Malay Peninsula, Philippines, Indochina and adjacent small islands.

Habitat/Ecology

Not collected in 1987. Payne *et al.* (1985) report that *Pteropus v. natunae* in Borneo is found throughout lowland coastal areas, occasionally invading the interior country during the fruiting season; it is known to fly long distances to eat both nectar and fruit, including some orchard species. Goodwin (1979) observed a spectacular colony of 2000 adults of both sexes, and juveniles near Metinar, Timor, in a dense mangrove forest

which extended for about 8 km along the coast. He observed no other species of bats near this colony. It did, however, feed on fruits of *Ficus* in association with *Pteropus griseus, Acerodon mackloti* and *Dobsoni peronii*. They also ate mangoes. Taylor (1934) mentioned a colony of *P. vampyrus* and *Acerodon jubatus* in the Philippines that covered 8-10 ha and had some 150,000 bats. These flew 9-16 km each evening to feed on wild fruit. On Krakatau Is, off W. Java, the nominate subspecies is thought to move between these islands (Tidemann *et al.* 1988); on these islands a single specimen was seen in a daytime roost in *Casuarina* and a colony of 250 individuals roosted in *Terminalia* trees on Sertung I., Krakatau, in 1985 but was not there in 1986. In the same region Dammerman (1948) observed large numbers of *Pteropus* moving between Sebesi I. and Sebuku I. At Bogor Gardens, W. Java, it roosts in a variety of trees, including dead ones, in groups of hundreds of individuals. It is an extremely social species and during the day in Bogor Gardens there is a constant noise resulting from agonistic behaviour; the Bogor colony begins hovering flight over the gardens approximately half an hour before dusk and do not settle on trees until about half an hour after dawn. In Borneo it also roots on open branches of trees, in mangrove or Nipah palm. Gould (1977) observed *P. vampyrus* individuals in the Malay Peninsula defending an entire *Durio* tree while feeding. Utzurrum (1984) reports that fruit of figs *(Ficus* spp.*)* are a major component of their diet on Negros I., Philippines. Medway (1978) stated that this species is commoner in the coastal areas of Malaya, but occurs up to an altitude of 1370 m.

Reproduction

Lekagul and McNeely (1977) state that *P. vampyrus* in Thailand produce a single young in late March or early April which becomes independent after 2-3 months. Medway (1978) reports pregnant females in the Malay Peninsula in November, December and January.

Taxonomic Remarks

Van Strein (1986) considers that *Pteropus vampyrus kopangi* Kuroda, 1933 is consubspecific with *P. v. pluton* which seems reasonable to us. Andersen (1912) and Van Strein (1986) recognise the same subspecies. These are, in addition to *P. v. pluton: P. v. vampyrus* (Linnaeus, 1758) (Java); *P. v. edulis* E. Geoffroy, 1810 (Timor I., Savu I.); *P. v. lanensis* Mearns, 1905 (Palawan I.; extralimital to island Southeast Asia); *P. v. malaccensis* K. Andersen, 1908 (Sumatra; Riau-Lingga Is; Bangka I., Sipora I., Pagai Is, Siantan I., Anamba Is, extralimital to island S.E. Asia); *P. v. natunae* K. Andersen, 1908 (Borneo, Banggi I. and Balembangan Is, Natuna Besar I.). Goodwin (1979) considers that a taxonomic reappraisal of the species is needed but that this task is hampered by the lack of extensive series and specimens from a range of islands.

Measurements

From Andersen (1912:355) four cotypes of *P. v. pluton* (skull of one specimen measured) followed in brackets by measurements for the Lombok I. form by Kuroda (1933). Forearm 214, 217 (193, 196, 187); greatest skull length 86 (81, 81, 75); front of orbit to nasal tip 31; brain case width 29.5; zygomatic width 47.5 (43.0, 47.5, 42.0); M^1-M^1 width 23.5; C^1-C^1 width 16.2; interorbital width 11.0; C^1-M^2 length 33.8; C^1-M^3 length 36.3; dentary length 69.0.

Pelage

(From Kuroda 1933) "mantle varies from pale dirty buff (females) to chestnut buff (males), much paler than and strongly contrasting with the back, which varies from brownish to blackish, sprinkled with pale brown or grayish white hairs. Breast and abdomen varying from dark russet-brown to blackish, sprinkled with pale brown hairs".

Pteropus alecto alecto Temminck, 1837

Central Flying Fox

Type Locality

Menado, N. Sulawesi

Distribution

P.a. alecto: Lombok I., Sulawesi; Selayar I., Peleng I. Species: Bawean I; Kangean Is; Sumba Is; Savu Is; S. New Guinea; N. Australia.

Habitat/Ecology

Not collected in 1987 but are recorded from Lombok I. by a number of authors (Appendix I). In Australia Kitchener *et al.* (1978) reports them as common in *Melaleuca* trees along watercourses and in mangroves and other coastal situations. One camp of more than 30,000 individuals was reported in N.W. Australia by McKenzie *et al.* (1977). Ratcliffe (1931) considered that this species in Australia moved only locally and did not migrate.

Reproduction

Not collected in 1987 on Lombok I.

In Australia, Nelson (1965) observed that the species congregates in large camps from early to late summer, during which time young are born and raised. By April, numbers of individuals in these colonies falls dramatically as individuals disperse; immature animals form winter camps.

Taxonomic Remarks

Van Strein (1986) recognises the following subspecies of *alecto* additional to the nominate subspecies *P. a. aterrimus* Matschie, 1899 (Bawean I.): *P. a. gouldi* Peters, 1876 (S.C. New Guinea, N. Australia); *P. a. morio* K. Andersen, 1908 (Sumba I., Savu I.). This arrangement is that of Andersen (1912) with the addition of *gouldi* as a subspecies following Tate (1942a).

Measurements

(From Andersen 1912: 368, 369). Forearm length 160-175 (N = 5); ear length 29.5 (estimate); tibia length 72-78 (N = 5); pes length 52-53 (N = 5); greatest skull length 70.5-73.8 (N = 6); front of orbit to tip of nasals 24.2-27.2 (N = 6); braincase width 25.0-25.8 (N = 6); zygomatic width 38.0-39.0 (N = 6); M^1-M^1 width 19.0-21.2 (N = 8);

C^1-C^1 width 14.2-15.0 (N = 8); interorbital constriction 9-10 (N = 6); dentary length 55.5-59.8 (N = 6); C^1-M^2 length 26.7-29.7 (N = 8); C_1-M_3 30.2-33.8 (N = 8).

Pelage

(From Andersen 1912: 367). Colour of back and rump glossy seal-brown or blackish seal-brown often thinly sprinkled with silvery whitish hairs. Underparts from chin to interfemoral, including flanks, blackish seal-brown, generally thinly sprinkled with greyish-white or greyish buffy hairs. Colour generally blackest on throat and foreneck. Mantle deep seal-brown, head similar to underparts.

Pteropus lombocensis lombocensis Dobson, 1878

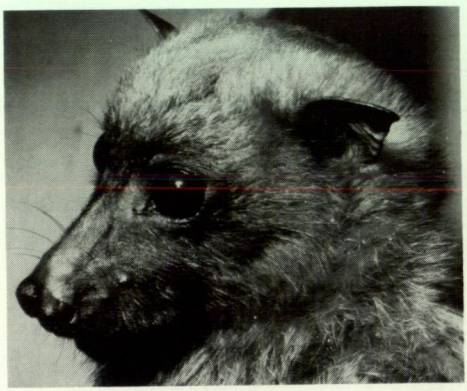
Lombok Flying Fox

Type Locality

Lombok I.

Distribution

P. l. lombocensis: Lombok I., Flores I. Species: also Alor Is.



Habitat/Ecology

One was captured at Pelangan, S.W. Lombok I. by locals during early evening among a coconut plantation. It was caught by the use of hand-held oval-shaped fishing nets attached to the end of large poles. Another three males (one escaped) and a female nursing a young were mist-netted near a banana plantation in the environs of Desa Kuta, S. coastal Lombok I. At Pelangan, individuals were observed in the heads of coconut palms. It is apparently reasonably common at Pelangan where it is caught and eaten by local villagers.

Reproduction

In October 1987, the adult female weighing 266 gm was still nursing a large (130 gm) juvenile. In May 1988, two females were collected from Kuta, neither was lactating and the one that could be examined had small uterine horns with diameters of *c.* 1.4 it appeared to be nulliparous.

Taxonomic Remarks

Andersen (1912: 269) noted that the earliest reference to this species in literature is in Gray's Catalogue of monkeys, Lemurs and fruit eating bats (1870). Gray was misled by the similarity in colour of pelage of *P. lombocensis* with that of *Acerodon mackloti* and thought that it was a variety of that larger species. Dobson in his description of *P. lombocensis* noted its affinities with *P. rayneri*. Van Strein (1986) places *P. solitarius* K. Andersen from Alor I. in synonomy with *P. lombocensis*.

Measurements (mean, range, sample size)

Forearm length 113.2 (108.8-117.2) 6; head to vent length 144.0 (130.2-156.7) 6; ear length 25.9 (24.3-27.2) 6; pes length 29.2 (25.5-31.0) 6; tibia length 51.7 (47.5-55.5) 6; weight 234.6 (184-266) 7; greatest skull length 55.1 (52.4-57.9) 5; condylobasal length 53.0 (50.3-54.8) 5; zygomatic width 29.9 (28.2-30.9) 5; least interorbital width 7.9 (7.4-8.6) 5; mastoid width 18.5 (18.0-19.1) 5; orbit to gnathion length 19.3 (18.6-20.4) 5; braincase width 21.0 (20.4-21.9) 5; M^2-M^2 width (alveoli) 13.4 (12.6-14.5) 5; C^1-C^1 width (alveoli) 10.7 (10.4-11.3) 5; C^1-M^2 length (alveoli) 20.2 (19.7-20.6) 5; C_1-M_3 length (alveoli) 22.5 (21.9-22.9) 5; dentary length 41.8 (40.4-43.7) 5.

Pelage

The colour of two adult males is Clove Brown tipped with a mixture of Warm Buff and Buckthorn Brown creating a "golden" effect. This effect is strongest on the back of the head and as a collar around the neck. It is less pronounced on the remainder of the body, particularly on the back where Clove Brown can predominate to the exclusion of any other colouration.

Acerodon mackloti prajae Sody, 1936

Sunda Flying Fox

Type Locality

Lombok I.

Distribution

A. m. prajae: Lombok I. Species: also Timor I., Alor I., Flores I., Sumbawa I., Sumba I.

Habitat

Goodwin (1979) stated that in Timor I. the species is common from sea-level to an altitude of 450 m. He observed two colonies on Timor I. each with 300-5-- individuals. At both sites the bats were spread out over a large portion of the crowns of large fig trees on the edge of open forest; the roosting areas were largely defoliated.

Ecology

On Lombok I. in 1987, six adult females (weight 410-490 gm) and three juveniles (weight 130-215 gm) were collected for us by village people at Desa Pelangan. These were caught early in the evening while flying in a coconut plantation. One was caught on a fish hook tied by a short line in a tree; the others were netted with a large oval fish net held on a long pole. During the day several solitary individuals were seen roosting in a large Mango tree (fruit ripe). At dusk they were frequently seen fluttering in the crowns of coconut trees at Pelangan.

While no other species of bat roosted with *Acerodon* on Timor I., Goodwin (1979) observed them feeding with *Pteropus griseus, P. vampyrus* and *Dobsonia peronii;* their staple food in March, April and May consisted of the fruit of at least two species of fig. He noted that they also fed on some indeterminate part of the coconut palm. He concluded that most of their nutrition is probably obtained from the juice of fruit. Goodwin (1979) observed that at dusk they fly in groups of two to six individuals and were most frequently observed flying into and out of the crowns of coconut palms.

Reproduction

On Lombok I. in October 1987 all six adult females collected were breeding. Two were lactating and three others appeared to be lactating, although 'milk' could not be expressed from their teats. Three had a small foetus (one in left uterine horn and two in the right uterine horn); the diameters of these horns ranged from 7.2-8.4. The other three females also had slightly enlarged horns, probably with a developing embryo (all in the left uterine horn). The appearance of a lactating female that was also pregnant suggests that this species may be at least seasonally polyoestrous. Goodwin (1979) reports pregnant females in Timor I. in March and May. The March specimen had a small embryo 7.0 long in the right uterine horn, while the May one had a foetus with crown to rump length of 25 in the left horn.

Taxonomic Remarks

As noted by Goodwin (1979) each insular population of *Acerodon mackloti,* except for the Sumbawa population, has been given a subspecific name. In addition to *A. m. prajae* the following subspecies are recognised by Van Strein (1986). *A. m. mackloti* (Temminck, 1837) (Timor I.); *A. m. alorensis* K. Andersen, 1909 (Alor I.); *A. m. floresi* (Gray, 1870) (Flores I., Sumbawa I.); and *A. m. gilvus* K. Andersen, 1909 (Sumba). Goodwin (1979) notes that these taxa are all based on slight differences in colour and/or size of single specimens and doubts the necessity for recognising them as subspecies. Sody (1936), in describing *A. m. prajae,* stated that it resembled *floresi* and Goodwin (1979) notes that the measurements given by Sody in his description fall within the range of the series from Timor.

Measurements (mean, range, sample size)

Forearm length 134.2 (126.6-142.4) 6; head to vent length 169.5 (157.0-176.0) 6; ear length 30.9 (28.6-32.6) 6; pes length 39.6 (38.0-41.8) 6; tibia length 65.0 (61.2-68.7) 6; weight 443.3 (410.0-490.0) 6; greatest skull length 68.1 (57.4-69.9) 6; condylobasal length 66.0 (54.1-67.0) 6; condylocanine length 61.0 (59.5-62.0) 6; zygomatic width 36.7 (35.6-38.2) 6; least interorbital width 8.9 (8.3-9.2) 6; mastoid width 21.3 (20.0-22.3) 6; orbit to gnathion length 25.4 (22.1-26.7) 6; braincase width 24.3 (22.1-24.6) 6, M^2-M^2 width (alveoli) 19.0 (18.4-19.4) 6; C^1-C^1 width (alveoli) 12.3 (10.7-13.0) 5; C^1-M^2 length (alveoli) 26.9 (25.5-28.0) 6; C_1-M_3 length (alveoli) 30.0 (27.2-30.6) 6; dentary length 53.1 (52.6-53.6) 6.

Pelage

The colour of the four adult females is Clove Brown on top of the head becoming Cinnamon Brown down the centre of the back of the neck to the shoulders, mixed thickly with larger Cream Color hairs. The area below the base of each ear Cream Color.

Back, rump and dorsal surface of elbows Cinnamon Brown mixed with some larger Cream Color hairs. The chest and central abdomen are Clove Brown mixed with some larger Cream Color hairs. The area below each nipple Cinnamon Brown extending down each side to the anus.

Cynopterus horsfieldi horsfieldi Gray, 1843
Horsfield's Fruit Bat

Type Locality
Java, Indonesia

Distribution
C. h. horsfieldi: Lombok I., Java. Species: also Sumatra, Borneo, Malaya, Thailand and adjacent islands.

Habitat/Ecology
On Lombok I. mist-netted in most habitats, particularly disturbed situations, but was most common at Pelangan and Batu Koq. In Borneo it often roosts in rock shelters or caves, usually near the entrance, but is occasionally found in trees or palms. It feeds mainly on fruit (Payne *et al.* 1985). In Thailand *C. horsfieldi lyoni* is often found roosting with *C. brachyotis* in Nipah palms, coconut trees and mangroves.

Reproduction
All 13 females examined from Lombok I. in October 1987 showed some reproductive activity. Six were pregnant and had a foetus with a crown to rump length varying from 3.7-33.9. Three of these pregnant females were also lactating suggesting at least a seasonal polyoestry. All the remaining females had a slightly swollen uterine horn suggestive of recent parturition or early pregnancy; four of these were lactating. The larger uterine horn was roughly equally distributed between the left and right side. The smallest pregnant and/or lactating female had a forearm length of 67.4. The single female collected in May 1988 from Lombok I. was recently pregnant. It had a swelling in the left uterine horn of 2.4 diameter; it appeared to be primiparous. No juveniles were collected. In the Malay Peninsula *C. horsfieldi* gives birth to young throughout the year (Start, 1974; Medway, 1978).

Taxonomic Remarks
Andersen (1912) revised *Cynopterus* and placed *horsfieldi* in the "Niadius section". Members of this section are recognised by the subrectangular outline of the cheek teeth and the strong development of surface cusps on P_4 and M_1. At the time of his revision Andersen recognised *lyoni* as a subspecies of *horsfieldi*. Chasen (1940) recognised *C. h.*

horsfieldi Gray, 1843 (Java); *C. h. persimilis* Andersen, 1912 (Borneo); *C. h. lyoni* Andersen, 1908 (Sumatra, Malay States, see also Hill 1983: 117); and *C. h. princeps* Miller, 1906 (Nias I., W. Sumatra). The specimens from Lombok I. are most like *C. h. horsfieldi.*

Measurements (See Table 2)

Pelage

The colour of adult males is Light Neutral Gray dorsally tipped with Buffy Brown on the head, neck and rump and with Buckthorn Brown and Yellow Ocher on the back. Ventrally the neck tufts, throat, chest and sides are Yellow Ocher to Raw Sienna. The abdomen and small tufts under each corner of the mouth are Drab tipped with Cream Buff. Females are also a Light Neutral Gray dorsally but the head and neck hairs are tipped with Chaetura Drab and the back with Tawny Olive. Ventrally the neck tufts, throat and cheeks are Honey Yellow. Chest and chin are Drab tipped with Honey Yellow. Abdomen as for males.

Cynopterus titthaecheilus titthaecheilus (Temminck, 1825)
Short-nosed Fruit Bat

Type Locality
Buitenzorg, Java

Distribution
Lombok I., Sumatra; Krakatau Is., Sebesi I., Java.

Habitat

Mist-netted in October 1987 on Lombok I. from sea level to 400 m in all habitats, particularly disturbed situations, but most common at lower altitudes, particularly Pelangan and Kuta. Also collected by A. Suyanto and NAMRU II at Sewela and Kelayn, Lombok Timur, respectively. Very common in disturbed situations in Java from low altitudes (Bogor Botanical Gardens) to 1600 m (Cibodas Botanical Gardens). One of the most common bats in the Krakatau Is (Tidemann *et al.* 1988). On Anak Krakatau they probably roost in trees because there are no caves. Circumstantial evidence from the Krakatau Is suggests that this species moves between these islands with some facility. The taxonomically close *Cynopterus terminus* from Timor is found in forests of *Corypha* palms usually located along edges of clearings, where it roosts in shelters which it constructs 2.4 to 6 m above the ground from large fan-shaped leaves. At higher altitudes *C. terminus* roost in large trees, usually *Ficus* (Goodwin, 1979).

Reproduction

On Lombok I. in October 1987 the smallest pregnant female had a forearm length of 75.3 and weighed 52 gm. Only two of the the 23 females above this size were not pregnant: seven appeared primiparous from the appearance of their teats; eight were breeding at least for a second time as they were also lactating. Six young were collected at this time; these ranged in forearm length from 48.7-71.0. Females were pregnant with a single embryo, with pregnancies approximately equally distributed between the right and left horns. There was some indication that alternate horns were used for each pregnancy.

There was a suggestion of asynchrony in the reproductive cycle of this species from different areas on Lombok I. Of the 12 females from Kuta, two had not bred, five were apparently primiparous; they were not lactating, had tiny teats and had a very young embryo with the diameter of the pregnant horn ranging from 2.0-3.2; four were pregnant with uterine horns ranging in diameter from 6.3-33.4 but were not lactating and one was both pregnant (diameter of the horn 6.3) and lactating. At Pelangan, Suranadi and Batu Koq all but two females were also lactating. However, these two females that were not lactating had foetuses with crown to rump lengths of 15 to 16, and one of them had elongate bruised teats indicative of recent lactation. These observations are taken to indicate that the species in the moister areas (which have streams with running water or pooled water) had generally bred once and were pregnant again. While at the very dry area of Desa Kuta on the central south coast (no potable water) several females had not bred and most females were only recently pregnant (this is even more pronounced when it is remembered that Kuta was the last site visited in October 1987).

In May 1988, four adult females were collected at Kuta. Two of these appeared to be primiparous with small embryos (diameters of horn 3.0 and 3.8); one was both lactating and pregnant (diameter of horn 3.3) and the other appeared nulliparous. Three juveniles with forearm lengths ranging from 69.8 to 73.6 were also collected.

Taxonomic Remarks

Cynopterus titthaecheilus was considered a subspecies of *C. sphinx*. Since Andersen's (1912) treatment of the genus, Hill (1983) drew attention to its sympatric occurrence with that latter species, and gave *titthaecheilus* specific rank.

Comparison of *C. titthaecheilus* from Lombok I. with specimens of this taxon in the Western Australian Museum from Krakatau I., Bogor and Cibodas, W. Java, shows them to be very similar (e.g., Figure 12).

Hill (1983) states that *C. sphinx terminus* from Timor, which was characterised by Sody (1940) and Goodwin (1979) as being large with a relatively compact skull with a stout but short rostrum, is "more likely to represent *C. tittaecheileus* (sic): its relatively small skull might well justify recognition as a distinct species". Measurements of *C. terminus* from Goodwin (1979) and two specimens from Timor in the Western Australian Museum are presented in Table 2 and Figure 12. We believe this taxon is probably a species.

Measurements

(See Table 2)

Table 2: Skull, teeth and external measurements of *Cynopterus* spp. from Lombok I. and *Cynopterus terminus* from Timor. Males and females combined, adults only, mean, range and sample size.

	LOMBOK I.			TIMOR I.	
	Cynopterus. b. brachyotis (7♂♂, 9 ♀♀)	*Cynopterus h. horsfieldi* (12 ♂♂, 13 ♀♀)	*Cynopterus t. titthaecheilus* (13 ♂♂, 13 ♀♀)	*Cynopterus terminus* WAM (1 ♂, 1 ♀)	*Cynopterus terminus* Goodwin (1979)
Forearm length	61.1 (59.1—64.7) 16	70.2 (67.4— 74.7) 25	77.4 (74.2—80.5) 26	79, 75	(75.2—80.5) 11 +
Head to vent length	79.1 (69.2—85.6) 16	93.6 (83.8—102.9) 25	96.7 (85.0—112.4)26		104 (98—113) 11
Tail length	6.8 (4.5—10.0) 16	10.1 (7.7— 14.2) 25	12.2 (8.8—17.2) 26		8 (6—13) 11
Ear length	16.4 (15.3—18.1) 16	18.9 (16.9— 23.2) 25	20.2 (17.6—21.8) 26		20 (17—21) 11
Pes length	11.0 (10.0—12.8) 16	13.1 (10.0— 16.4) 25	16.6 (13.3—19.3) 26		
Tibia length	24.9 (23.7—26.8) 16	27.0 (21.4— 29.3) 23	32.4 (28.3—36.1) 26		
Weight	28.4 (21.5—35.0) 15	48.2 (41.0— 58.5) 20	59.8 (49.0—70.0) 23	62.0, 47.0	52 (42—69) 11
Greatest skull length	27.9 (26.8—29.1) 9	32.3 (30.9— 33.5) 16	35.3 (34.0—37.2) 11	32.5, 32.5	32.5 (31.5—33.2) 6
Condylocanine length	25.8 (24.4—26.9) 9	30.2 (28.5— 31.7) 16	32.7 (31.5—34.8) 11	31.0, 30.4	30.6 (29.8—31.3) 6
Zygomatic width	19.0 (16.2—18.0) 9	21.2 (19.6— 22.5) 16	22.0 (20.5—23.4) 11	21.0, 20.3	20.6 (20.0—21.3) 4
Least interorbital width	5.8 (5.3— 6.5) 10	6.5 (5.8— 7.1) 16	6.6 (6.1— 7.2) 11	6.4, 6.1	6.6 (6.4—6.8) 5
Mastoid width	11.4 (10.5—12.2) 10	13.1 (12.6— 13.8) 16	13.6 (13.1—14.8) 11	13.2, 13.2	13.1 (12.9—13.2) 5
Orbit-gnathion length	9.2 (8.6— 9.8) 10	10.2 (9.2— 11.1) 16	11.6 (10.9—12.8) 11	10.6, 10.3	
Braincase width	11.9 (11.4—12.4) 10	13.4 (12.5— 14.0) 16	14.0 (13.5—14.4) 11	13.7, 13.5	
M^1-M^1 width (alveoli)	8.3 (7.9— 8.8) 10	10.0 (9.3— 10.4) 16	10.9 (10.4—11.5) 11	9.9, 9.8	10.0 (9.5—10.5) 5 ++
C^1-C^1 width (alveoli)	5.7 (5.3— 6.0) 10	6.9 (6.4— 7.5) 16	7.7 (7.5—7.9) 11	6.7, 6.7	7.1 (6.8—7.3) 5
C^1-M^1 length (alveoli)	9.0 (8.5— 9.6) 10	10.7 (10.1— 11.1) 16	12.2 (11.6—13.9) 11	11.1, 11.1	11.1 (10.9—11.8) 6
C_1-M_2 length (alveoli)	10.0 (9.3—10.7) 10	12.1 (11.8— 12.7) 16	13.8 (13.4—14.5) 11	12.1, 11.9	
Dentary length	20.7 (20.0—21.3) 10	24.8 (23.6— 25.9) 16	27.7 (26.8—29.4) 11	25.2, 24.5	

+ skin and skeletal

++ measurements outer surfaces

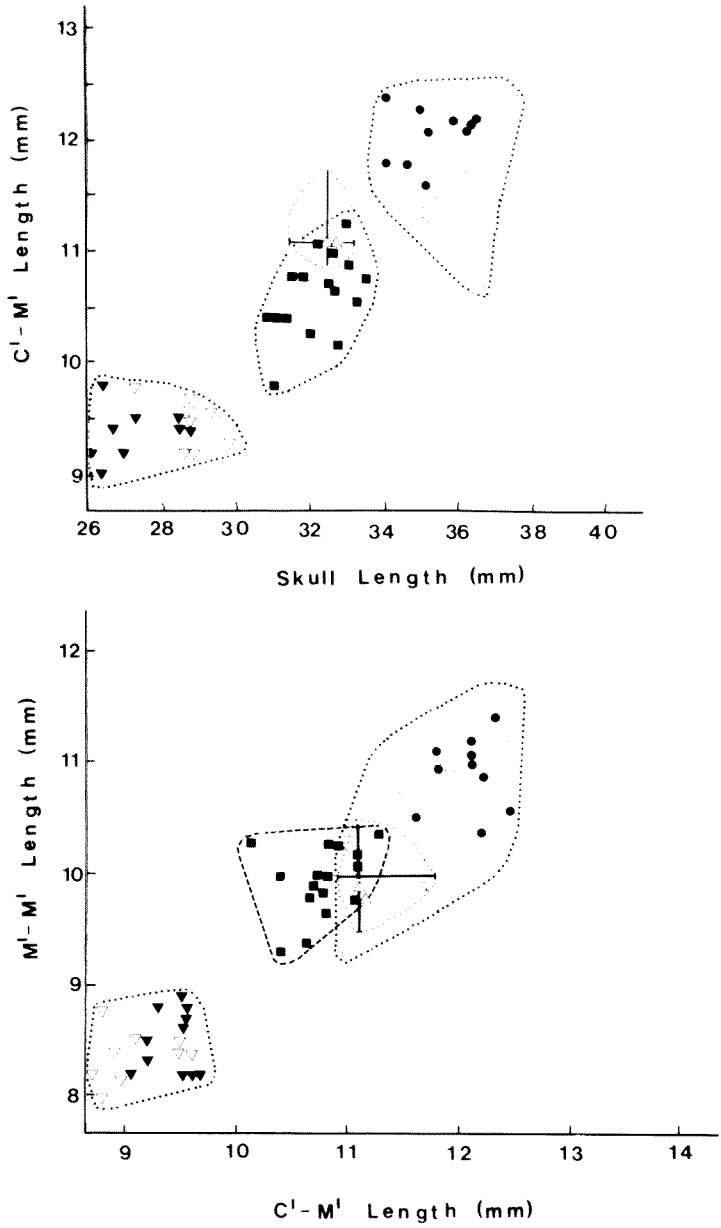


Figure 12: Relationship between upper maxillary tooth row length (alveoli) and both upper molar row lengths (alveoli) and greatest skull length for three species of *Cynopterus*: ▼, *C.b. brachyotis* (Lombok I.); ▽, *C. b. brachyotis* (W. Java); ■, *C. h. horsfieldi* (Lombok I.) △, *C. terminus* (Timor), ●, *C. t. titthaecheilus* (Lombok I.), ○, *C. t. titthaecheilus* (W. Java). The mean values and range of measurements for *C. terminus* from Goodwin (1979) are also presented.

Pelage

The colour of adult males is Pale Neutral Gray dorsally tipped with Chateura Drab on the head, with Olive Brown on the back and with Buffy Brown on the rump. Ventrally they are Pale Neutral Gray tipped with Drab. The pelage of adult females is similar to that of males except that males have a thin band across the back of the neck which is Pale Neutral Gray through Raw Sienna tipped with Olive Brown. In addition the neck tufts, across the throat and down each side of the males ventrally is Raw Sienna tipped with Drab but this contrasting colour is not as extensive as the Honey Yellow of *C. horsfieldi.*

***Cynopterus brachyotis brachyotis* (Muller, 1838)**
Short-nosed Fruit Bat

Type Locality
Borneo

Distribution

C. b. brachyotis: Lombok I., Riau Is, Bangka I., Belitung I. Species: also S.E. Asia, Java, Madura I., Bali I., Nusa Penida I., Sumatra, Borneo, Sulawesi, Malaysia, Burma, Philippines, Nicobar Is, Andaman Is, Talaud Is and adjacent small islands.

Habitat/Ecology

On Lombok I. it was mist-netted in a wide variety of habitats, both disturbed and 'natural'. It was most common, however, near Desa Kuta where 20 were collected along a dry watercourse fringed with banana plantations and village gardens. It appeared about equally abundant from sea-level to *c.* 200 m, but only one animal was collected at Batu Koq (at 400 m altitude).

Payne *et al.* (1985) report this species roosting in small groups in trees or in more well-lit areas of caves, including lower montane forest; Medway (1978) reports them also roosting under fronds of palm and occasionally in houses in Malaya. In Thailand they occur from sea-level to 1500 m (Lekagul and McNeely, 1977).

Diet includes pollen, wild figs, fruit of *Piper aduncum, Musa* sp., *Aporosa simplicifolia, Syzigium* sp., and other trees; occasionally insects are taken, perhaps incidentally (Medway, 1978; Utzurrum, 1984). Payne *et al.* (1985) consider the main food is small fruits. Medway (1978) states that the fruit is carried in the mouth to a feeding roost where juices and flesh is eaten and fibrous matter spat out in pellets. Utzurrum (1984) reports that figs and fruit are a major component of the diet of *C. brachyotis* on Negros I., Philippines; they are 'generalists' and transfer from one feeding tree to another at high frequency. They contribute to the dispersal requirement of three of the five species of *Ficus* studied by Utzurrum (1984).

One of the few confirmed reports of rabies in bats from Asia is from a *C. brachyotis* in Thailand (Hill and Smith, 1984).

Reproduction

On Lombok I. in September and October 1987, 13 of the 17 females examined were pregnant and one, while not pregnant, was lactating. The pregnant females each had a single embryo (seven in the right uterine horn and six in the left horn). The foetuses had crown to rump lengths ranging from 4.0 to 27.0. These pregnant females all had forearm lengths greater than 59.2. Three of the pregnant females were also lactating, suggesting the species may at least be seasonally polyoestrous. Only four obviously subadult animals were collected with forearm lengths of 53.3 to 60.0.

In May 1988 at Lombok I., three adult females were collected. One of these had a swollen right uterine horn of 2.4 diameter and was lactating. The other two had a similarly swollen uterine horn and appeared to have been pregnant recently.

Cynopterus brachyotis breeds throughout the year in the Malay Peninsula; breeding adults have pelage with a broad area of orange or yellow around the shoulders or throat. One young is born at a time (Medway, 1978). In Thailand they probably also breed throughout the year with most pregnancies from March to June but with pregnancy peaks in January and September (Lim in Lekagul and McNeely, 1977).

Taxonomic Remarks

Some large *Cynopterus brachyotis* are difficult to distinguish from young adult *C. sphinx angulatus*. Characters given to identify these two species by Hill (1983:118) are not completely satisfactory and overlap exists in the measurements suggested as diagnostic. In addition to the nominate subspecies the following five subspecies are generally recognised in island S.E. Asia: *C. b. concolor* Sody, 1940 (Enggano I.); *C. b. insularum* Andersen, 1910 (Kangean Is, Matisiri I.); *C. b. javanicus* K. Andersen, 1910 (Java, Madura I., Bali I., Nusa Penida I.) *C. b. luzoniensis* (Peters, 1862) (Palawan I.; Balabac I., Culion I., Busuanga I., Sebuku I.) and *C. b. minutus* Miller, 1906 (Nias I.). The Lombok I. specimens agree generally with *C. b. brachyotis* although this is considered only weakly differentiated from *C. b. javanicus* (Kitchener and Foley, 1985).

Measurements

(See Table 2)

Pelage

The colour of adult males is Light Neutral Gray dorsally tipped with Olive Brown on the head and with Buffy Brown on the back and rump. Ventrally the throat and chest are Tawny Olive and the abdomen is Light Neutral Gray tipped with Tawny Olive. Females are a Light Neutral Gray dorsally tipped with Hair Brown on the head and with Olive Brown on the back and rump. Ventrally the throat and chest are Drab and the abdomen is Light Neutral Gray tipped slightly with White.

Males have a band across the back of the neck that is Pale Neutral Gray through Cream Buff to Buffy Brown at the tips.

Rousettus amplexicaudatus amplexicaudatus (Geoffroy, 1810)

Geoffroy's Rousette

Type Locality

Timor I.

Distribution

R. a. amplexicaudatus: Lombok I., Timor I., Roti I., Ndao I., Sawu I., Sumba I., Enggano I., Mentawai I., Kisar I., Bagabag I., Japen I., New Guinea, Ambon I., Seram I., Halmahera I., Ternate I., Philippines, Borneo, Malay Peninsula, Thailand, Burma. Species: also Sumatra, Krakatau Is., Java, Bali I., Nusa Penida I., Flores I. and possibly Alor I., Bismark Archipelago and Solomon Is.

Habitat/Ecology

On Lombok I. in 1987 moderately abundant in all habitats from sea-level to 400 m altitude.

Medway (1978) reports this species as uncommon in the Malay Peninsula but notes that it roosts from the lowlands to the mountains. Nowak and Paradiso (1983) report that members of the genus also roost in tombs, temples, rock crevices, garden trees and date plantations. Goodwin (1979) only found them roosting in caves on Timor I. with up to 800 individuals in a colony. They concentrated in chambers close to the entrance of the cave. While in flight in caves Medway (1978) notes that they make a "high-pitched buzzing call". This sound is used in echolocation in a manner similar to microchiropteran bats. On Timor I. Goodwin (1979) observed them feeding on *Muntingia* fruit, with as many as 50 individuals feeding on a single tree at the one time.

Reproduction

On Lombok I. in October 1987 it appeared that a birth season had recently finished. None of the nine adult females were pregnant but seven of them were lactating. These lactating females had a single uterine horn still slightly enlarged (diameters 2.1-5.0); in six individuals this was the left horn.

In May 1988, the single adult female collected (at Suranadi) was lactating with both uterine horns small. A juvenile female weighing 32 gm was collected at the same time.

On Timor I. Goodwin (1979) reports that most of the adult specimens collected in March, April and May were in breeding condition with many of the females pregnant, recently parturient, or lactating. On Bougainville I. McKean (1972) reported pregnant females in July and September and a lactating female in September.

Taxonomic Remarks

Rookmaaker and Bergmans (1981) comprehensively reviewed the taxonomic history of this species. They recognise three subspecies of *R. amplexicaudatus*. These are *R. a. amplexicaudatus* (Geoffroy, 1810), *R. a. infumatus* (Gray, 1870) and *R. a. brachyotis* (Dobson, 1877). These subspecies differ mainly in overall size, particularly the lengths of metacarpals and skull.

These authors note that with increasing collections the "distinction of subspecies may eventually become impossible", while some island populations may be recognised as more distinct. The Lombok I. form appears to bear out the former statement because on its measurements it tends to be intermediate between *R. a. amplexicaudatus* and *R. a. infumatus*. We have accorded the Lombok I. form the earlier name *R. a. amplexicaudatus*. It is separated from the subspecies *R. a. brachyotis* by its much larger size.

Measurements (mean, range, sample size)

Forearm length 78.2 (72.7-86.0) 20; head to vent length 107.1 (93.0-117.2) 20; tail to vent length 17.3 (12.0-22.3) 19; ear length 17.6 (12.5-20.0) 20; pes length 15.5 (13.9-18.0) 18; tibia length 35.9 (33.0-40.4) 20; weight 65.9 (53.0-84.0) 19; greatest skull length 36.4 (34.1-38.1) 9; condylobasal length 35.1 (32.9-36.7) 9; condylocanine length 33.3 (31.5-34.5) 9; zygomatic width 22.3 (20.6-23.6) 9; least interorbital width 7.9 (7.2-9.3) 9; mastoid width 13.7 (12.4-14.8) 9; orbit to gnathion length 13.3 (12.1-14.1) 8; braincase width 14.3 (13.7-14.9) 9; M^2-M^2 width (alveoli) 10.2 (9.5-10.6) 8; C^1-C^1 width (alveoli) 6.8 (6.2-7.4) 9; C^1-M^2 length (alveoli) 12.7 (11.8-13.8) 9; C_1-M_3 length (alveoli) 14.1 (13.2-15.3) 9; dentary length 28.7 (27.0-30.0) 9.

Pelage and Skin

The colour of adult males and females is Olive Brown to Hair Brown dorsally and Drab ventrally. Males have Honey Yellow neck tufts at the base of each cheek. The skin of the nose radius and feet is Hair Brown.

Rousettus leschenaultii shortridgei Thomas & Wroughton, 1909

Shortridge's Rousette

Type Locality

Java.

Distribution

R. l. shortridgei: Lombok I., Bali I., Aru Is, Simeulue I., Java, Sumatra. Species: also India, Nepal, Pakistan, Burma, Thailand, Vietnam, Laos, possibly Cambodia, S. China, Hong Kong.

Habitat/Ecology

On Lombok I. in 1987 a subadult female was collected by villagers at Suranadi. In May 1988, two adult females were mist-netted in a banana plantation at Suranadi. Lekagul and McNeely (1977) report that this species shifts around considerably depending on the supply of fruit. Their roosting groups in Thailand vary from several individuals to 2000; there is no sexual segregation.

Reproduction

The two females collected on Lombok I. in May 1988 were both pregnant and lactating. Each had a single embryo in the left uterine horn which had crown to rump

lengths of 4.5 and 16.0. In India, Gopalakrishna and Choudhari (1977) found that pregnancies lasted from November to March and from March to July, with females having a post-partum oestrus. A single young is born to each female. Sexual maturity is attained at five months of age. Males did not mature sexually until 15 months of age.

Taxonomic Remarks

Dimensions of the teeth of the Lombok I. specimens accord well with those given for this subspecies by Rookmaaker and Bergmans (1981) and with a similar sized Western Australian Museum specimen of this subspecies from Bali I.

Measurements (2 specimens only)

Forearm length 81.1, 82.8; head to vent length 128.4, 128.5; tail to vent length 15.2, 16.8; ear length 20.4, 21.2; pes length 20.4, 21.1; weight 109, 110 gm; greatest skull length 40.6, 43.2; condylobasal length 39.6, 42.0; condylocanine length 37.4, 39.2; zygomatic width 24.5, 24.6; least interorbital width 8.1, 9.0; mastoid width 15.7, 15.8; orbit to gnathion length 15.0, 16.9; braincase width 16.0, 16.3; M^2-M^2 width (alveoli) 11.8, 12.4; C^1-C^1 width (alveoli) 7.4, 8.3; C^1-M^2 length (alveoli) 15.0, 16.0; C_1-M_3 length (alveoli) 16.6,17.3; dentary length 32.1, 33.4.

Pelage and Skin

The colour is slightly darker than *R. amplexicaudatus* being Fuscous dorsally and Hair Brown ventrally. The skin of the nose, radius and feet is Chaetura Drab.

Aethalops alecto alecto (Thomas, 1923)

Pygmy Fruit Bat

Type Locality

Inderapura Peak, Sumatra.

Distribution

Lombok I., Java, Sumatra, Malaya.

Habitat

A single adult female was mist-netted in low closed mossy forest, at *c.* 1700 m at Pos Tiga (position three), Mt Rinjani. Other specimens have been collected from Inderapura Peak at 2225 m (holotype) and Cibodas, Mt Gede, at 1450 m. Little is known of this montane species or its congener *A. aequalis* Allen, 1938 from Borneo.

Reproduction

The single female collected on Lombok I. in early October 1987 had a large foetus with crown to rump length of 21.0 in the right uterine horn. It had moderately enlarged teats and mammary glands but did not appear to be lactating.

In the Malay Peninsula pregnant females have been reported from February and May (Hill, 1961) and February to June (Medway, 1978).

Taxonomic Remarks

Hill (1961, 1983) recognised two subspecies of *Aethalops alecto*: the typical species from Sumatra and Malaya; and *A. a. aequalis* Lawrence, 1939 from Borneo. Boeadi and Hill (1986) considered specimens from Cibodas, Mt Gede, W. Java to be a third subspecies, *A. alecto ocypete*.

Boeadi and Hill (1986) noted that the Javanese specimens when compared to the holotype of *A. alecto* had longer forearms and skulls; longer and more massive incisors; anterior lower premolar (PM_2) larger and about twice rather than one and a half times the crown area of the lower incisor (I_2). Measurements presented by us for a further nine specimens of *Aethalops a. ocypete* from Cibodas are in close agreement (Table 3) with those presented by Boeadi and Hill (1986). Overall the Lombok I. specimen tends to be intermediate in size between *A. a. alecto* and *A. a. ocypete* but appeared closer to the Sumatran *A. a. alecto*.

Specimens of *Aethalops a. ocypete* available to us differed noticeably from *aequalis* and had longer forearms, skull and toothrows; slightly heavier canines; upper incisor (I^2) distinctly shorter than the outer incisor (I^3); lower canine rounded anterointernally, not especially flattened; larger anterior premolars (PM2) with PM_2 in particular more massive and much larger rather than subequal to the second premolars; PM3 less closely approximated to canines; PM^3 anterior secondary cusp well developed and PM_3 rounded anteriorly and lacking a projecting vertical anterior ridge.

We have compared nine specimens of *Aethalops alecto* from Cibodas with four specimens of *aequalis* from Borneo. In addition to differences between *alecto* and *aequalis* noted by Hill (1961, 1983) and Boeadi and Hill (1986) we would add that *aequalis* has thicker zygomata; nasals extend distally further such that they cover significantly more of the premaxillaries when viewed from above (Figure 13) and a glans penis that is blunt rather than pointed distally with a η shape rather than a vertical urethral groove (Figure 14).

The combination of these differences amount to distinctness such that we consider *A. aequalis* a species.

The single specimen from Lombok I. is clearly not *A. aequalis*. Comparison of its measurements with those from other *Aethalops* in Table 3 indicate that in size it is generally closer to the Sumatran holotype of *A. alecto* than it is to the Javan form of *A. alecto*. It is generally smaller than the Cibodas form and a number of measurements are outside the range of that form (greater skull length, braincase width, skull height, C^1-M^1 length, dentary length, palatal length and ear length). The Lombok I. specimen also has noticeably narrower least interorbital and least postorbital and braincase widths than those from Malaya. The pelage colour of the Lombok I. specimen is very similar to that of the Cibodas specimens.

Measurements

(See Table 3).

Pelage

The colour of the adult female from Mt Rinjani is Neutral Gray tipped with Chaetura Black on the top of the head and shoulders. Hair on the back, rump and extending over

the dorsal surface of the hind feet is Chaetura Drab. Ventrally the chest and abdomen are Drab, the throat Hair Brown. Hairs of the abdomen and throat are tipped with Gray.

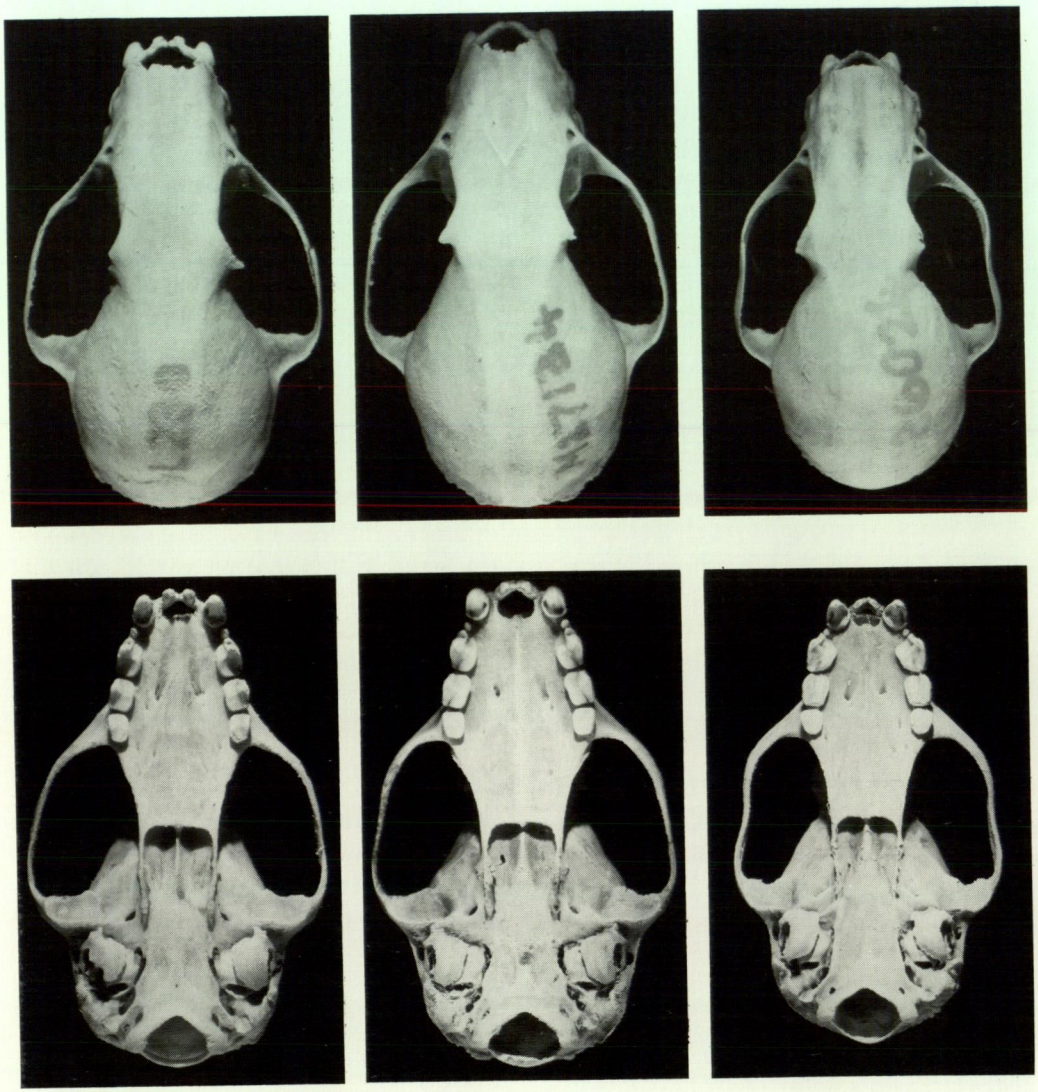


Figure 13: Skull of *Aethalops alecto* from G. Rinjani, Lombok I. and from Cibodas, W. Java, and of *A. aequalis,* Crocker Ra., Sabah, Borneo (from left to right).

Table 3: Skull, teeth and external measurements of *Aethalops alecto* and *A. aequalis*, taken from specimens in the Western Australian Museum and those presented in Hill (1961). Mean, range and sample size, in mm.

	Aethalops alecto				*A. aequalis*
	Rinjani Lombok	Cibodas* *W. Java* *A. a. ocypete*	Holotype *A. a. alecto*	Pahang Malaya *A. a. alecto*	Crocker Ra. Sabah
SEX	1♀	7♀♀, 2♂♂	1♀	2♀♀, 2♂♂	1♀, 3♂♂
Forearm length	49.6	50.7 (49.3—52.7)	47.0	45.6 (44.5—47.5)	4.0 (43.5—44.5)
Head to vent length	71.3	60.2 (56.2—61.6)			60.1 (55.4—64.6)
Ear length	12.1	14.1 (13.0—15.3)			11.0 (10.0—11.8)
Pes length	10.8	11.1 (10.3—12.3)			9.8 (8.6—10.7)
Tibia length	19.4	19.6 (18.9—20.6)			17.1 (16.6—17.5)
Weight					15.0 (13.2—18.0)
Greatest skull length	24.8	25.7 (25.1—26.0)	24.5	24.9 (24.2—25.4)	23.7 (22.8—25.4)
Condylobasal length	23.8	24.7 (23.8—25.3)	23.3	23.7 (23.2—24.4)	22.7 (21.6—23.1)
Condylocanine length	23.3	24.5 (23.3—25.0)			22.1 (21.4—22.4)
Zygomatic width	15.6	15.8 (15.4—16.2)	15.3	15.7 (14.9—16.4)	14.8 (13.7—15.5)
Least interorbital width	5.0	5.3 (5.0— 5.8)	4.8	5.5 (5.3— 5.6)	5.1 (4.6— 5.5)
Least postorbital width	5.8	5.8 (5.4— 6.1)	5.2	6.3 (6.1— 6.4)	5.5 (5.2— 5.7)
Mastoid width	10.4	10.9 (10.4—11.3)	10.2	10.5 (10.4—10.7)	10.3 (9.8—10.6)
Orbit to gnathion	7.8	8.1 (7.7— 8.3)			7.2 (6.8— 7.5)
Palatal length	12.4	13.0 (12.5—13.4)	12.2	12.6 (12.0—13.0)	11.8 (11.5—12.3)
Braincase width	10.2	11.0 (10.6—11.3)	10.2	10.8 (10.7—11.1)	10.6 (10.0—11.0)
Skull height	8.8	9.2 (8.9— 9.5)			9.0 (8.8— 9.1)
M^1—M^1 width (alveoli)	7.4	7.7 (7.3— 7.8)			6.9 (6.6— 7.0)
C^1—C^1 width (alveoli)	4.8	5.1 (4.8— 5.4)	4.8	4.8 (4.7— 4.9)	4.6 (4.3— 5.0)
C^1—M^1 length (alveoli)	7.4	7.9 (7.5— 8.4)	7.4	7.7 (7.5— 7.8)	7.0 (6.8— 7.3)
C_1—M_2 (alveoli)	8.2	8.7 (8.2— 9.2)	8.3	8.4 (8.3— 8.6)	8.0 (7.6— 8.3)
Dentary length	17.7	18.5 (18.0—19.2)			17.1 (16.5—17.9)

* external measurements from only 6 ♀♀, 2 ♂♂

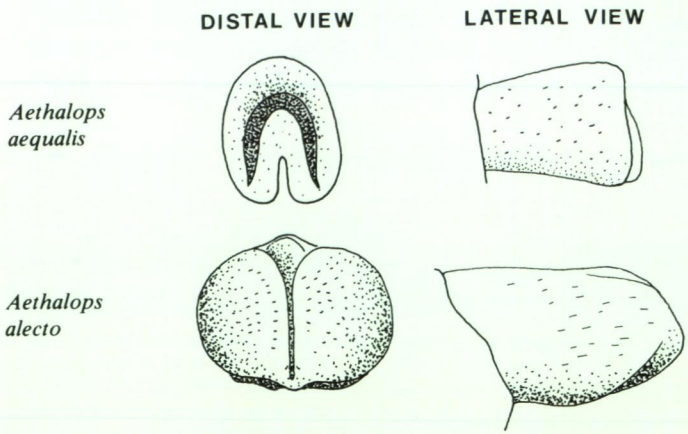


Figure 14: Glans penis of *Aethalops alecto* from Cibodas, W. Java, and A. *aequalis*, Crocker Ra., Sabah, Borneo.

Eonycteris spelaea glandifera Lawrence, 1939
Cave Fruit Bat

Type Locality
Montalban Caves, Rizal Province, Luzon, Philippines.

Distribution
E. s. glandifera: Lombok I., Bali I., Sumba I., Timor I., Palawan I., S.E. Sulawesi, Sumatra, and Muna I. Species: also N. India; Burma; S. China; Thailand; Malaya; Java; Borneo.

Habitat
Mist-netted on Lombok I. from sea level to 400 m in all habitats but most commonly in banana plantations, near Mango trees and over watercourses, with or without water. Not recorded in caves on Lombok I. but that is the usual roost site of this species. Start and Marshall (1976) state that it is common in the Malay Peninsula from sea-level to at least 1800 m, in a wide diversity of forest types. Goodwin (1979) records them in Timor from solution caves and cavelike crevices near the coast; in one cave they roosted only five metres above high tide level. He records them as associating in caves with *Rousettus amplexicaudatus, Rhinolophus borneensis parvus, R. creaghi timorensis, Miniopterus australis, M. magnater, M. pusillus, Taphozous melanopogon* and *Dobsonia peronii.*

On Lombok I. fishermen on the coast south of Pelangan described a bat similar to *Eonycteris* but possibly *Rousettus* in coastal limestone caves, but we were unable to get to these caves because of high tides.

Ecology

Payne *et al.* (1985) state that in Borneo they roost in large noisy colonies in caves, often in almost total darkness. Goodwin (1979), however, states that they prefer to roost in subdued light rather than in the darker, deeper parts of caves and gather in groups of five to ten individuals. Beck and Lim (1973) report colonies of tens of thousands in large limestone massifs in Malaysia. They are reported to travel long distances daily in search of flowering trees to feed on pollen and nectar (Payne *et al.* 1985). Start and Marshall (1976) suggest that the Batu Cave population travel about 38 km each night to their feeding area among *Sonneratia alba* mangal. They remain in one locality for considerable periods of time. Andersen (1912) reports that they feed by dodging swiftly about in the inflorescences alighting only fleetingly on the flowers; and that when feeding they were difficult to distract. Start and Marshall (1976) confirm this and indicate that they feed in the same same manner as *Macroglossus minimus* and report on the crucial role played by *Eonycteris* in the pollination of the Durian tree *Durio* spp.

Start and Marshall (1976) report that *E. spelaea* from Batu caves is a truly nectarivorous species which feed on at least 31 different species of plant with pollen from the following plants most common in their faeces: *Durio* spp.; *Parkia* spp.; *Artocarpus* spp.; *Eugenia malaccensis; Duabanga grandiflora* and *Sonneratia* spp. They conclude that *E. speleae* must play a significant role in the pollination of many plants, particularly those listed for *Macroglossus minimus* (see p. 54)

Reproduction

On Lombok I. in October 1987 the smallest parous female had a forearm length of 68.5; it was lactating and with the left uterine horn not completely regressed. Of the 24 females with forearm lengths greater than 68.5, 11 were nulliparous or had not recently bred; 12 had recently bred and only two were pregnant — these had a large foetus with crown to rump length of 22.4 and 35.4. More than one-third of the 86 specimens examined were juveniles. These juveniles had forearm lengths ranging between 53 to 68. Approximately equal numbers of adults and juveniles were males and females.

In May 1988, eight adult females were examined. Seven of them were pregnant with a single embryo located equally in the right and left uterine horn, and were lactating. These embryos had crown to rump lengths ranging from 6.9 to 23.4. The female that was not lactating had a foetus with crown to rump length of 28.1. Only two of the 16 specimens collected in May were juveniles.

These observations suggest that by October, prior to the onset of the wet season, their period of births had all but finished, or at least was going through a temporary lull, and that most young from the most recent parturient season had assumed a degree of independence. Clearly one-third of those females of adult size had not bred in the previous breeding season. There was no indication that breeding was not synchronous at Batu Koq, Pelangan, Suranadi and Kuta. At the end of the wet season there were few juveniles captured but all adult females were in active breeding condition. These

observations suggest that the wet season is not a period of intensive reproductive activity in this species.

A study by Beck and Lim (1973) of *Eonycteris spelaea* at Batu Caves in Malaya, over a period of two years, indicated that about half of the mature females were pregnant and/or lactating at one time, with extensive breeding through the years (see also Start 1974); females were polyoestrous and successive pregnancies could begin in late stages of lactation; gestation was more than six months; there was usually only one young but twins occurred; young attach to nipples for four to six weeks and sexual maturity is reached at one to two years, possibly longer for males. There was no evidence from the Lombok I. specimens of polyoestry such as at the Batu Caves. Brosset (1962) states that young of this species in India are carried for the first month after birth and then roost independently of the adults and do not emerge from the roost until they are weaned. Goodwin (1979) reports a lactating female in Timor in March but located no nursery roosts during March, April and May, nor were juveniles collected during that period. It is probable that in Nusa Tenggara *Eonycteris spelaea* reproduction is more seasonal than is reported elsewhere.

Taxonomic Remarks

Goodwin (1979) notes that lack of specimens has made it difficult to resolve taxonomic uncertainties regarding this species. These uncertainties are detailed by Hill (1983) who like Tate (1942a) recognises three species of *Eonycteris: spelaea, major* and *robusta.* Both these authors recognise two subspecies of *spelaea* but Hill (loc cit) disagrees with Tate (loc cit) by considering that the subspecies on Sumatra is *E. spelaea glandifera* rather than *E. s. speleae.* Further, Hill (loc cit) argues that if *Eonycteris rosenbergi* (Jentink, 1889) is in fact a young adult *E. s. glandifera* then *rosenbergi,* as the earlier name, must replace *glandifera.* Lawrence (1939) refers to the colour of the throat pelage of male *E. s. glandifera* as tawny, russet and ochraceous tawny. Tate (1942a) notes that a large series of males which he examined from Bali I. also had this throat colour, whereas females and young males show no such differentiation. The Lombok I. males had a Tawny Olive throat colour. *Eonycteris s. spelaea* examined by Tate showed no such throat colouring. Hill (1983) considered that *E. s. glandifera* differed from the typical subspecies in having a longer forearm and stronger rostrum.

Measurements (mean, range, sample size)

Forearm length 72.4 (68.0-77.2) 33; head to vent length 110.5 (99.9-122.5) 33; tail length 16.0 (11.6-19.6) 33; ear length 17.9 (15.9-19.4) 33; pes length 15.0 (12.2-17.7) 32; tibia length 34.0 (30.0-36.3) 33; weight 66.6 (53.0-84.0) 28; greatest skull length 36.6 (33.5-37.5) 16; condylobasal length 35.1 (33.4-36.5) 14; condylocanine length 32.4 (30.9-33.8) 14; zygomatic width 20.7 (18.9-22.7); least interorbital width 6.9 (6.0-7.4) 17; mastoid width 13.5 (12.4-14.4) 15; orbit to gnathion length 14.6 (13.8-15.3) 17; braincase width 14.6 (14.0-15.2) 16; M^2-M^2 width (alveoli) 8.8 (8.2-9.4) 15; C^1-C^1 width (alveoli) 7.3 (6.4-7.9) 17, C^1-M^2 length 12.2 (11.7-12.9) 17; C_1-M_3 length 13.7 (13.3-14.6) 17; dentary length 27.3 (26.1-28.2) 17.

Pelage

The colour of adult males and females is Fuscous dorsally and Drab tipped with Pale Drab Gray ventrally. The larger hairs across the throat of males is a Tawny Olive.

Macroglossus minimus minimus (E. Geoffroy, 1810)
Long-tongued Nectar Bat

Type Locality
Java, Indonesia

Distribution
M. m. minimus: Lombok I., Bali I., Madura I., Java I., Kangean Is. Species: also N. Australia, Bismark Archipelago, New Guinea, Solomon Is, Thailand to Philippines.

Habitat
On Lombok I. in October 1987, 29 individuals were mist-netted, with roughly equal numbers from locations ranging from 50-400 m altitude. Most specimens were captured among banana plantations but three were captured flying along a track in dense primary rainforest at Suranadi. Others were mist-netted over water courses at Pelangan and Batu Koq. Interestingly, none were collected at the coastal site at Desa Kuta.

Start and Marshall (1976) observed that in W. Malaya Peninsula *M. minimus* was intimately associated with *Sonneratia* and in fact was not recorded away from areas of mangrove. Lekagul and McNeely (1977) similarly note the preference of this species for mangrove and coastal areas. However, McKean (1983) states that in Papua New Guinea it occurs in a variety of forested areas from sea level to 260 m and in the Solomon Is up to 1155 m from both primary and secondary forests. In Australia it occurs in lowland rainforest, paperbark swamps, bamboo thickets, monsoon scrub along watercourses and banana plantations; it is also abundant in mangroves and in paperbark along watercourses (Kitchener *et al.*, 1978).

Ecology
Macroglossus minimus is a truly nectarivorous bat (Start and Marshall, 1976; Utzurrum, 1984). It feeds extensively on the soft flesh and juices of *Sonneratia* spp. in West Malaya where it is common (Start and Marshall, 1976). These authors further state that *M. minimus* (and *M. sobrinus* and *Eonycteris spelaea*) must play a significant role in the pollination of many plants, most notably members of the family Musaceae, Bignoniaceae, Bombacaceae, Leguminosae, Myrtaceae and Sonneratiaceae. In Australia, McKean (1983) considers they are an important pollinator of *Melaleuca cajuputi* and feed on the Century Plant. Start and Marshall (1976) observed that when feeding they land on the inflorescences and probe rapidly for nectar while occasionally they lick pollen direct from the stamens. Most pollen is obtained, however, by grooming after visiting flowers. They spend only a few seconds on each inflorescence; flowers of *Sonneratia caseolaris* received, on average, 16 visits by *M. minimus* per flower each hour.

Start and Marshall (1976) report that it roosts singly or in small groups under the canopy of large-leafed trees and palms and beneath the roofs of uninhabitated buildings. They tend to use the same roost site repeatedly. They start foraging at dusk and the maximum activity is generally within the first few hours after dusk with individuals foraging alone close to their roost site; they ranged over at least 2 km but often returned repeatedly to one tree to feed.

Reproduction

Only three of the 13 females, all apparently adult (forearm lengths 38.8-41.4), collected in Lombok I. in late September and October 1987 showed any indication of reproductive activity. These three females were still lactating and had a uterine horn (one a left and the other a right horn) slightly swollen and bruised indicative of recent parturition. The single adult female collected at Lombok I. in May 1988 was pregnant in the right uterine horn which had a single swelling of *c.* 4.5 diameter; it was not lactating. A juvenile weighing 10 gm was collected in May 1988.

Lim *et al.* (1972) report that female *M. minimus lagochilus* Matschie, 1899 in Sarawak was pregnant with a single embryo in mid June and that pregnant females were also reported from the Malay Peninsula in April and June. Start (1974) examined the reproductive status of 473 adult female *M. minimus* at Selangor, Malay Peninsula, and concluded that there was little seasonal variation in their reproductive condition throughout the year. Individuals were seasonally polyoestrous with one young born about every five months. Gestation lasts about 120 days; there is probably a post-partum oestrus. Breeding appears to be synchronous. Females do not usually carry young during feeding. McKean (1972) found that female *M. m. lagochilus* in New Guinea and the Solomons were pregnant with a single young in each month they were collected . Kitchener *et al.* (1978) report that female *M. m. nanus* Matschie, 1899 in Northwestern Australia show considerable reproductive activity during the dry season.

Taxonomic Remarks

Hill (1983) confirmed the observations of Andersen (1912) that there are two species of *Macroglossus* in Java. These correspond to *sobrinus* Andersen, 1911 and *minimus* Geoffroy, 1810. Hill (1983) states that "it is not certain to which of the two Javan forms Geoffroy's name refers and the syntypes apparently are lost (Andersen 1912) but for the present it seems both convenient and sensible to retain Andersen's fixation of this appropriate name *(minimus)* on to the smaller form". Hill (1983) recognised as species only *minimus* and *sobrinus* and the following subspecies of *minimus* additional to the nominate subspecies : *M. minimus lagochilus* Matschie, 1899 (S. Thailand, S. Vietnam, Malaya, Nias I., Sirhassen I. (?), Sri Buat I. (?), Bunguran Selatan I., N. Natuna Is, Borneo to Phillipine Is, Sulawesi, Peleng I., Sangihe Is and Molucca Is); *M. m. nanus* Matschie, 1899 (Aru Is, Kei Is, Mysol I., New Guinea, Bismark Archipelago, Admiralty Is; Queensland, Australia); *M. m. pygmaeus* Andersen, 1911 (Murray I., Torres Strait Is); *M. m. microtus* Andersen, 1911 (Bougainville I., San Christobal I., Guadalcanal and Florida Is, Solomon Is). Hill (1983) allows that McKean (1972) may be correct in considering *M. m. pygmaeus* and *M. m. microtus* synonyms of *M. m. nanus.*

Measurements (mean, range, sample size)

Forearm length 40.7 (38.9-42.7) 24; head to vent length 63.7 (58.3-70.1) 24; ear length 14.5 (12.5-16.9) 24; pes length 9.2 (7.9-12.2) 23; tibia length 18.2 (17.0-20.0) 24; weight 14.6 (11.5-18.2) 15; greatest skull length 25.1 (23.7-25.8) 8; condylobasal length 23.9 (22.6-24.5) 8; condylocanine length 22.6 (21.3-23.3) 8; zygomatic width 13.4 (12.7-14.3) 8; least interorbital width 4.7 (4.4-5.1) 8; mastoid width 10.0 (9.6-10.4) 8; orbit to gnathion length 10.2 (9.5-11.0) 8; braincase width 11.0 (10.6-11.8) 7; M^3-M^3 width (alveoli) 5.7 (5.5-5.9) 8; C^1-C^1 width (alveoli) 4.8 (4.6-5.1) 8; C^1-M^3 length (alveoli) 7.9 (7.5-8.5) 8; C_1-M_3 length (alveoli) 8.7 (7.6-9.1) 8; dentary length 18.9 (18.3-19.9) 8.

Pelage

The colour of adult males and females is Drab dorsally and ventrally, the hairs of the dorsal surface tipped with Buffy Brown.

Family: Emballonuridae

***Taphozous melanopogon melanopogon* Temminck, 1841**

Black-bearded Tomb Bat

Type Locality

Bantum, W. Java

Distribution

T. m. melanopogon: Lombok I., Sumbawa I., Timor I., Savu I., Bali I., Nusa Penida I., Java, S. Sulawesi. Species: also W. Sumatra, Borneo, Kai Is.

Habitat/Ecology

On Lombok I. in October a very large collection of dead animals from a cave near to Kuta was presented to us by local people. A further nine specimens were collected from a large cave sited on a hilly plateau 4 km W and overlooking Desa Kuta on the south coast; in this case several hundred animals were clustered in large groups in the twilight at the mouth of the cave. When disturbed they would fly deeper into the cave only to return to the twilight zone in a few minutes. As noted by Goodwin (1979) when roosting they do not hang freely by their feet but always use their wings to assist in support. Goodwin (1979) reports that the species on Timor roosts in solution caves and cave-like crevices within a few hundred metres of the sea and cliff fissures only five metres above high tide level. On Timor I. it roosts with *Rousettus amplexicaudatus, Rhinolophus borneensis parvus, R. creaghi timorensis, Miniopterus australis, M. magnater (?), M. pusillus* and *Dobsonia peronii.*

In India, Subbaraj and Chandrashekaran (1977) found this species emerged from the roost at about the same time each day regardless of the time of sunset. Lekagul and

McNeely (1977) report colonies of 150 to 4000 individuals in Thailand; each individual in the roost has a definite territory. Some colonies consist only of males, usually located close to colonies of females.

Reproduction

On Lombok I. on 19 October the ratio of adult males to adult females was 1:1.9. Sixty-four of the 86 female specimens examined from near Kuta were pregnant with large foetuses, all in the right uterine horn; these had crown to rump lengths of 23.8 ± 4.90 (7.4-31.6). These pregnant females had forearm lengths of 60.9 to 64.8; none appeared to be lactating. Eight had a right uterine horn that appeared to be regressing; they had enlarged nipples. These are thought to have recently given birth to a young. The other 14 females appeared to be nulliparous. In May 1988, 12 adult females were collected from Kuta. Two were apparently recently pregnant and had a small swelling of the right uterine horn; 6 had apparently recently bred and 4 were nulliparous. These data suggest that October and May are peak periods of female reproductive activity indicating a much longer period of births than is recorded for this species. The absence of obvious sub-adults in October and May suggests that breeding is not continuous. On Timor I., Goodwin (1979) recorded a lactating female in March 1968. Lekagul and McNeely (1977) state that the mating season in Thailand is January to February; a single young is born in April or May and is weaned after two months; juvenile mortality is high.

Taxonomic Remarks

Goodwin (1979) could find no appreciable differences between body and skull measurements of *T. m. melanopogon* from Bali and Timor I. and *T. achates* Thomas, 1915 from Savu I. Consequently he considered *T. m. melanopogon* and *T. achates* consubspecific.

The measurements presented below for the Lombok I. *Taphozous* fall within the range of those presented by Goodwin (1979) for *T. m. melanopogon* from Nusa Tenggara.

Measurements (mean, range, sample size)

Forearm length 64.4 (62.5-66.4) 9; head to vent length 74.8 (70.1-77.4) 9; tail length 26.0 (24.2-27.6) 9; ear length 20.2 (19.1-21.1) 9; pes length 12.3 (11.3-13.1) 9; tibia length 24.2 (23.5-25.1) 9; weight 26.6 (24.0-30.5) 9; greatest skull length 21.4 (20.8-21.8) 4; condylocanine length 20.0 (19.8-20.2) 4; zygomatic width 12.9 (12.5-13.2) 4; least intertemporal width 5.1 (4.9-5.3) 4; mastoid width 11.4 (11.2-11.6) 4; braincase width 10.1 (10.0-10.2) 4; M^3-M^3 width (alveoli) 9.2 (9.0-9.3) 4; C^1-C^1 width (alveoli) 4.3 (4.2-4.5) 4; C^1-M^3 length (alveoli) 9.0 (8.6-9.5) 4; C_1-M_3 length (alveoli) 10.4 (10.0-11.2) 4; dentary length 16.8 (16.5-17.1) 4.

Pelage

The colour of adult males is White tipped with Buffy Brown dorsally. Adult males possess a "beard" of coarse, stiff Black hairs tipped slightly with Cinnamon Buff. Cinnamon Buff hairs surrounding the "beard" blend with the paler hairs of the chest and abdomen which are White tipped with Vinaceous Buff. Adult females are white tipped with Chaetura Drab dorsally and White tipped with Hair Brown ventrally. Subadult

males have no obvious "beard"; they have no tooth wear and shorter testes than "bearded" adult males (3.5 ± 0.38, N = 6 versus 4.6 ± 0.31, N = 6).

Family: Molossidae

***Chaerephon plicata tenuis* (Horsfield, 1822)**
Wrinkle-lipped Bat

Type Locality
Proewoto, *c.* Java

Distribution
C. p. tenuis: Lombok I., C. E. Java, Bali I. Species: also India and Sri Lanka to S. China and Vietnam, southeast to Philippines, Borneo I., Hainan I., Cocos Keeling Is.

Habitat/Ecology
Collected at Sasaot, Lombok Barat, by Boeadi on 19 October 1969 from beneath the roof of a house and by NAMRU II detachment from a garden in Kerongkong, near Selong, Lombok Timur on 13 May 1978. Not previously recorded in literature from Lombok I. In Borneo, Thailand and Java the species roosts in caves in densely packed colonies, sometimes containing hundreds of thousands of individuals (Boeadi, *et al.* 1983; Payne *et al.* 1985; Legakul and McNeely 1977). Their diet is mainly moths.

Reproduction
Sudarwati and Sutasuria (1975) report a bi-annual breeding season: in March/April and September/October. A single young is born.

Taxonomic Remarks
Van Strein (1986) recognises the following subspecies of *Chaerephon plicata* from island Southeast Asia: *C. p. plicata* (Buchannan, 1800) (Borneo, Sumatra, extralimital); *C. p. dilatata* (Horsfield, 1822) (W. Java) and *C. p. tenuis.* Although the latter subspecies was recognised by Tate (1941b) and Hill (1961), Hill (1983: 195) referred to it as a doubtful subspecies.

Measurements (mean, range, sample size)
Forearm length 46.3 (42-49) 14; head to vent length 61.4 (58-68) 14; tail to vent length 35.7 (32-38) 14; ear 15.5 (14-18) 14; tibia 15.1 (14-16) 14; weight 11.0 (N = 1), greatest skull length 18.3 (17.6-18.7) 6; condylobasal length 17.0 (16.5-17.4) 6; condylocanine length 16.1 (15.8-16.5) 6; zygomatic width 10.6 (10.4-11.2) 6; least interorbital width 3.7 (3.5-3.7) 6; mastoid width 9.8 (9.6-10.0) 6; orbit to gnathion length 4.5 (4.1-4.7) 6; braincase width 8.9 (8.8-9.2) 6; M^3-M^3 width (alveoli) 8.0 (7.8-8.4) 6; C^1-C^1 width (alveoli) 4.8 (4.6-5.3) 6; C^1-M^3 length (alveoli) 6.7 (6.6-7.0) 6.

Pelage

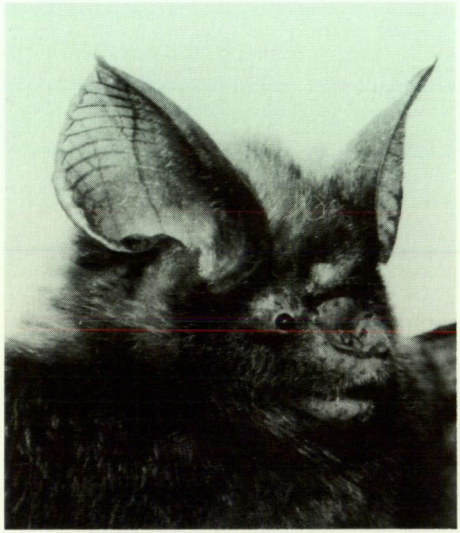
The colour of the adult is Chaetura Drab dorsally with a slightly darker Fuscous Black head. Ventrally the pelage is Hair Brown tipped with Drab.

Family: Hipposideridae.

***Hipposideros ater saevus* K. Andersen, 1918**
Dusky Leaf-nosed Bat

Type Locality

Kei I.



Distribution

H. a. saevus: Lombok I., Bali I., Sumatra; Java; Sulawesi; Borneo (?); Buru; Seram (?); Peleng I., Halmahera; Sangir (?) Is; Talaud Is (?). Species: also Sri Lanka; India to Malaya.

Habitat/Ecology

Six specimens were collected in early May 1988 from a small cave near Batu Kota, *c.* 5.8 km E. Suranadi, Lombok I. . Approximately 30 other individuals were seen in the cave. They appeared to be the only species present. Reported in colonies of a few hundred individuals in Borneo (Payne *et al.* 1985).

Reproduction

Two of the four females collected in May 1988 appeared to have recently bred. They each had an elongate teat (but were not apparently lactating) and had the left horn still slightly enlarged to a diameter of *c.* 2.3. The other two females appeared to be nulliparous.

Taxonomic Remarks

John Hill, (British Museum of Natural History), most kindly examined a specimen from our Lombok I. series. He compared it in detail (and provided us with extensive comparative measurements) with *Hipposideros a. ater, H. ater nicobarulae, H. a. saevus, H. a. antricola, H. ater* (Sabah), *H. a. aruensis, H. a. gilberti, H. cineraceus* (India, Thailand, Assam, Burma, Singapore, Kalimantan, Sabah, Peninsular Malaya) in the British Museum. He concluded that the specimen from Lombok I. accords well with the holotype of *H. a. saevus.* However, he pointed out that the drawing of the baculum of the Lombok I. specimens that we provided to him was unlike *H. a. ater* from India but was similar to that of *H. c. cineraceus* from Vietnam as they are figured in Topal (1975). While John Hill notes that there is a trend in both *H. ater* and *H. cineraceus* to increase in size from west to east, the Lombok I. specimen is "very large for

cineraceus as currently understood, even taking into account its eastward range". We have not had the opportunity to examine the baculum of *H. a. saevus* but until we can do this we have followed John Hill in regarding the Lombok I. specimen as *H. a. saevus.*

Measurements (mean, range, sample size)

Forearm length 40.0 (39.5-41.2) 5; head to vent length 41.7 (39.1-43.0) 5; tail to vent length 27.5 (26.1-30.9) 5; ear length 18.7 (18.5-19.2) 5; tibia length 17.9 (17.3-18.9) 5; pes length 6.3 (6.0-6.8) 5; weight 5.8 (5.4-6.1) 5; condylocanine length 14.1 (14.0-14.4) 5; zygomatic width 8.2 (8.2-8.2) 5; least interorbital width 2.5 (2.4-2.5) 5; mastoid width 8.5 (8.4-8.6) 5; orbit to gnathion length 3.9 (3.0-4.3) 5; braincase width 7.8 (7.7-7.9) 5; M^3-M^3 width (alveoli) 5.5 (5.4-5.5) 5; C^1-C^1 width (alveoli) 3.4 (3.2-3.4) 5; C^1-M^3 length (alveoli) 5.2 (5.0-5.5) 5; C_1-M_3 length (alveoli) 6.1 (6.0-6.2) 5; dentary length 10.2 (9.8-10.4) 5.

Pelage

Ochraceous Orange tipped with Russet.

Hipposideros diadema diadema E. Geoffroy, 1813

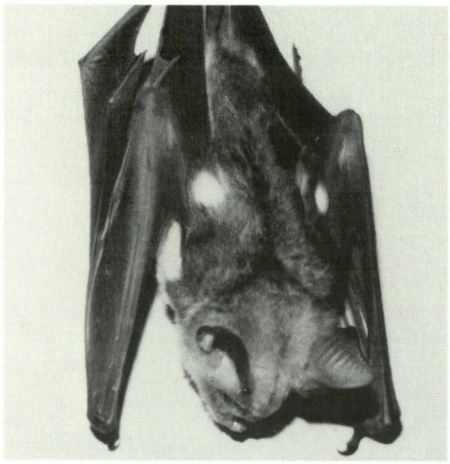
Diadem Leaf-nosed Bat

Type Locality

Timor I., Nusa Tenggara

Distribution

H. d. diadema: Lombok I., Timor, Kangean Is, Sepandjang I., Bali, Java. Species: also N.E. and N.Central Australia, Solomon Is, Bismarck Archipelago, New Guinea, Philippines, Sulawesi, Borneo, Malay Peninsula, Indochina and Burma.



Habitat/Ecology

On Lombok I. in October-November 1987, three were mist-netted along a narrow track at Suranadi in dense tall mixed evergreen rainforest; ten were caught in a cave near Batu Kota, 5.8 km E. Suranadi; five were mist-netted on the south coast at Desa Kuta in a dry wide watercourse. At Batu Kota they were present in large numbers, probably about 50 individuals, and were located in the upper ampitheatre of this cave. Also in the cave were *Rhinolophus affinis, R. simplex, R. pusillus* and *Megaderma spasma.* A further two males were mist-netted in a banana plantation at Kuta in May 1988. Payne *et al.* (1985) state that they usually roost in large colonies in caves, often mixed with other species. Medway (1978) considers them a common gregarious bat, roosting in caves but also reports them roosting in small colonies in crevices and hollows in trees.

Reproduction

In late September 1987 on Lombok I. all eight females were pregnant; each with a single foetus in the left uterine horn. The maximum diameter of the left horn ranged between 5.6 and 22.2. None were lactating. The smallest pregnant female had a forearm length of 84.0.

Medway (1978) states that females congregate in maternity colonies in selected caves at the time of giving birth. One young is born. At Batu Caves Selangor, Malay Peninsula, young bats are present in March and April each year.

Taxonomic Remarks

The most recent reviews of this genus are by Tate (1941a) and Hill (1963).

Hill (1963) recognises 16 subspecies of *H. diadema*. Specimens from Nusa Tenggara and Java are attributed to the nominate subspecies. Goodwin (1979) tends to agree with Hill (1963) that the subspecies *nobilis* (Horsfield, 1823) from Timor I. is synonymous with the nominate subspecies. Measurements of the Lombok I. specimens are similar to those from Bali I., presented by Goodwin (1979) and Kitchener and Foley (1985), and Timor I. (Goodwin 1979).

The forearm lengths of the Lombok I. specimens range between 84.0-93.0 while those from Bali I. are 86.4-93.0 and from Timor I. they are 82.0-89.0.

Measurements (mean, range, sample size)

Forearm length 88.3 (84.0-93.0) 10; head to vent length 87.6 (83.2-94.0) 9; tail to vent length 53.2 (48.8-56.9) 9; ear length 27.8 (25.2-29.5) 10; pes length 15.2 (13.1-17.1) 10; tibia length 38.0 (34.5-41.4) 10; weight 47.5 (40.0-54.0) 12; condylocanine length 28.2 (27.5-29.6) 5; zygomatic width 19.0 (18.7-19.5) 5; least interorbital width 3.5 (3.2-3.7) 5; mastoid width 15.3 (14.8-15.5) 5; orbit to gnathion length 10.2 (9.9-10.4) 5; braincase width 12.9 (12.6-13.2) 5; M^3-M^3 width (alveoli) 12.3 (12.1-12.6) 5; C^1-C^1 width (alveoli) 8.2 (7.7-8.8) 5; C^1-M^3 length (alveoli) 12.2 (11.9-12.7) 5; C_1-M_3 length (alveoli) 14.6 (14.4-15.0) 5; dentary length 23.7 (23.3-24.6) 5.

Pelage

The colour of adult males is Snuff Brown through Cartridge Buff to Snuff Brown at the tips dorsally and Drab through Cartridge Buff to Avellaneous at the tips ventrally. Adult females differ only slightly from males; the tips of the dorsal hairs are Bister, those of the ventral hairs a Snuff Brown.

Family: Rhinolophidae

***Rhinolophus affinis princeps* K. Andersen, 1905**
Intermediate Horseshoe Bat

Type Locality
Lombok I.

Distribution
R. a. princeps: Lombok I., Sumba I., Sumbawa I., Flores I. Species: also Java, Sumatra, Kangean I., Mentawai Is, Madura Is, Natuna Besar I., Anamba Is, W.S. Borneo, India to S. China through to Malay Peninsula.

Habitat/Ecology
On Lombok I. in October 1987, 17 males and 2 females were collected from Batu Kota Cave, 5.8 km E. Suranadi; and 10 males and 2 females from Gua (cave) Sawa, 7 km E. Bayan. At Batu Kota they were located in the deepest amphitheatre of the cave; other species present were *R. pusillus, Murina cyclotis Megaderma spasma* and *Hipposideros diadema.* At Gua Sawa several hundred *R. affinis* appeared to be the only species in the cave. A male was mist-netted at two metres height at Pos Dua, Rinjani at an altitude of about 1350 m. Five were mist-netted at two metres height near Desa Pelangan; two over a dry water course and three in a watercourse with pooled water present. Three were mist-netted in a dry watercourse at Kuta. In May 1988, six were mist-netted in a banana plantation at Kuta. Medway (1978) reports that in the Malay Peninsula this species is common throughout the lowlands and foothills up to an altitude of 1190 m where it flies at dusk between tree trunks at about one metre above the ground. Payne *et al.* (1985) state that it forages in the understorey of forest.

Reproduction
On Lombok I. the eight females collected in October 1987 were all pregnant. These females had forearm lengths of 50.0-54.0. They each had a single foetus in the right uterine horn. These foetuses were of similar size; they had a crown to rump length (mean and standard deviation) of 13.3 ± 3.5. The four females collected from Lombok I. in early May (forearm lengths >51.1) were parous but were neither pregnant or lactating. Their right uterine horns were slightly distended to a diameter of *c.* 1.5.

Lim (in Medway, 1969) reports that collections from Batu Caves, Selangor, Malay Peninsula may have two breeding seasons each year. A high proportion of females were pregnant in April to May and again in October. Medway (1969) states that in the Malay Peninsula many females were pregnant in February to March; all with a single foetus in the right uterine horn.

Table 4: Skull, teeth and external measurements of *Rhinolophus* spp. on Lombok I. Males and females combined, adults only. Mean, range and sample size, in mm.

	Rhinolophus affinis princeps 29 ♂♂, 8 ♀♀	*Rhinolophus acuminatus audax* 3 ♀♀	*Rhinolophus simplex* 3 ♂♂, 2 ♀♀	*Rhinolophus p. pusillus* 4 ♂♂
Forearm length	52.4 (50.0—54.8) 36	47.0 (46.1—48.1) 3	42.1 (40.9—44.6) 5	40.0 (39.5—40.8) 3
Head to vent length	59.8 (56.5—64.0) 37	50.5 (48.9—51.6) 3	41.8 (40.2—44.4) 5	40.1 (38.7—41.7) 3
Tail to vent length	25.6 (21.8—29.5) 37	26.3 (25.1—27.0) 3	23.6 (20.8—25.3) 5	19.8 (18.9—21.4) 3
Ear length	22.5 (20.2—24.0) 37	19.4 (18.9—19.9) 3	18.3 (17.0—19.5) 5	15.9 (15.4—16.6) 3
Pes length	10.1 (9.2—11.5) 37	10.3 (10.2—10.5) 3	7.9 (7.1—8.4) 5	6.9 (6.8—7.1) 3
Tibia length	25.7 (23.5—26.5) 34	20.6 (10.1—21.5) 3	18.4 (17.9—18.7) 5	16.6 (16.2—17.0) 2
Noseleaf width	10.2 (8.7—11.3) 35	7.4 (7.2—7.7) 3	8.2 (8.1— 8.5) 5	6.5 (6.5—6.5) 3
Weight	15.0 (12.5—18.5) 37	11.2 (10.0—12.5) 3	6.2 (5.6—7.5) 5	5.6 (5.1—6.0) 4
Condylocanine length	20.5 (19.9—21.0) 18	18.0 (17.7—18.7) 3	16.2 (16.2—16.3) 4	13.7 (13.6—13.8) 3
Zygomatic width	11.8 (11.6—12.0) 18	10.7 (10.4—11.1) 3	9.1 (9.0—9.2) 4	7.9 (7.6—8.0) 3
Least interorbital width	2.1 (1.9— 2.2) 18	2.4 (2.3—2.5) 3	2.3 (2.1—2.5) 4	2.1 (2.1—2.2) 3
Mastoid width	10.9 (10.7—11.1) 18	9.7 (9.6—10.0) 3	8.8 (8.8—8.8) 4	7.8 (7.6—7.9) 3
Orbit to ant. edge C^1 length	7.4 (6.9—8.8) 18	6.1 (5.8—6.5) 3	5.6 (5.3—5.8) 4	4.4 (4.2—4.5) 3
Braincase width	9.9 (9.6—10.0) 18	8.7 (8.6—8.9) 3	7.7 (7.6—7.8) 4	6.9 (6.7—7.2) 3
Rostral swelling width	6.4 (6.2—6.6) 18	5.7 (5.6—6.0) 3	5.1 (5.0—5.1) 4	4.1 (3.8—4.2) 3
Supraorbital to rostrum length	5.5 (4.9—6.0) 18	4.7 (4.6—4.8) 3	5.7 (5.6—5.8) 4	4.1 (3.9—4.3) 3
M^3—M^3 width (alveoli)	8.6 (8.3—8.8) 18	7.8 (7.7—7.9) 3	6.4 (6.3—6.5) 4	5.9 (5.8—5.9) 2
C^1—C^1 width (alveoli)	6.6 (6.3—6.9) 18	5.7 (5.3—6.1) 3	4.6 (4.5—4.8) 4	3.9 (3.8—4.0) 2
C^1—M^3 length (alveoli)	9.2 (8.5—9.6) 18	7.8 (7.5—8.2) 3	6.7 (6.5—7.0) 4	5.6 (5.5—5.7) 3
C_1—M_3 length (alveoli)	10.0 (9.5—10.2) 18	8.4 (7.6—9.0) 3	7.5 (7.2—7.7) 4	6.1 (6.0—6.2) 3
Dentary length	16.3 (16.0—16.7) 18	14.3 (14.0—14.7) 3	12.3 (12.2—12.3) 4	10.2 (10.0—10.4) 3

Taxonomic Remarks

Van Strein (1986) recognises four subspecies in addition to *R. a. princeps* in island Southeast Asia. These are *R. a. affinis* Horsfield, 1823 (Java, Madura I., Mentawai Is, Kangean Is); *R. a. nesites* K. Andersen, 1905 (W. S. Borneo; Natuna Besar I., Anamba Is) and *R. a. superans* K. Andersen, 1905 (Sumatra, extralimital).

Rhinolophus affinis is a widespread and apparently morphologically variable species.

Measurements

(See Table 4)

Pelage

The colour of the adult is variable for both sexes. Some specimens are a Buffy Brown tipped with Olive Brown dorsally and Honey Yellow tipped with Tawny Olive ventrally while others have a lighter pelage of Orange Rufous tipped with Burnt Sienna both dorsally and ventrally.

Rhinolophus acuminatus audax K. Andersen, 1905
Acuminate Horseshoe Bat

Type Locality

Lombok I.

Distribution

R. a. audax: Lombok I., Bali I. Species: also Java, Enggano I., Nias I., N. Borneo, N. W. Sumatra, Palawan I., Malaya Peninsula, Thailand, Cambodia, Laos.

Habitat

On Lombok I. two specimens were mist-netted at Desa Pelangan in a dry watercourse bordered with banana plantation and bamboo. In Sabah, Borneo, Payne *et al.* (1985) report it from the understorey of lowland dipterocarp forest up to an altitude of 1600 m.

Reproduction

The two females captured on Lombok I. in October 1987 were both pregnant. They each had a single well developed foetus, with crown to rump length of 14.7 and 15.0, in the right uterine horn. The Lombok female collected in early May 1988 was neither pregnant nor lactating. Its right uterine horn was slightly enlarged; (1.2 in diameter) but had no implantation scar indicating that it had not recently bred.

Taxonomic Remarks

Tate and Archbold (1939) review the Oriental *Rhinolophus* and report that the forearm length of *R. acuminatus* Peters, 1871 in the type description was 48 and not

50.5-51 as supposed by Andersen (1905) in his description of *R. a. audax*. These authors suggested that there may be "less racial difference between *acuminatus* and *audax* than Andersen supposed". Comparison of measurements from the Lombok I. specimens with those from the holotype of *audax* from Andersen (1905) and measurements of *R. a. acuminatus* from S. Sumatra support this view, although the dentary length of the Lombok I. specimens collected in 1987 were also considerably shorter then the value of 16.0 provided for the holotype of *R. acuminatus* by Andersen (1905).

Measurements

(See Table 4)

Pelage

The colour of the two adult females is Fuscous to Hair Brown dorsally and Light Drab ventrally. The hairs are tipped very slightly with Pale Drab-Gray all over the body and particularly on the top of the head and on the chest.

Rhinolophus simplex K. Andersen, 1905
Lombok Horseshoe Bat

Type Locality

Lombok I.

Distribution

Also Sumbawa and Komodo I.

Habitat

First collected by A. Everett on Lombok I., in June 1886 at an altitude of 762 m. On Lombok I. in 1987, three males and three females were mist-netted in a dry river bed in the environs of Desa Kuta, on the south coast. Another female was mist-netted in the same locality on 4 May 1988.

Reproduction

Of the Lombok I. specimens, two of the three females collected in late October 1987 were pregnant with a single foetus in the right uterine horn. The crown to rump length of these foetuses were 11.5 and 12.7. The female collected in May 1988 had the right uterine horn slightly enlarged to a diameter of 1.5 which had an apparent implantation scar. None of the females were lactating.

Measurements

(See Table 4)

Pelage

The colour of adult males is Drab Gray tipped with Buffy Brown dorsally and Avellaneous ventrally. Adult females are a Light Drab tipped with Fuscous dorsally and Drab ventrally.

Rhinolophus pusillus pusillus Temminck, 1834
Least Horseshoe Bat

Type Locality
Java

Distribution
R. p. pusillus: Lombok I., Java, Borneo, E. Kalimantan, Madura I., Malay offshore islands. Species: also India, Thailand, Malaysia.

Habitat
On Lombok I. four specimens were collected from a cave, Batu Kota, 5.8 km E. Suranadi. In this cave when disturbed they circled the perimeter of the large amphitheatre before flying into a narrow hole less than 0.5 m in diameter at the deepest point of the cave. In excess of 10 individuals were seen in the amphitheatre but the population may have been considerably in excess of this number. This species is rare in collections. One of us (D.J.K.) mist-netted this species in low closed primary rainforest fringing a beach on Rakata I., Krakatau. It was flying at dusk at 2-3 m in height through the lower canopy in company with tens of apparent conspecifics, which streamed over the top of the mist-net in a simple avoidance manouvre.

Reproduction
On Lombok I. all four females collected in October 1978 were pregnant but not lactating. Each had a moderately large foetus in the right uterine horn which had a crown to rump length of 9.6 to 12.7.

Taxonomic Remarks
Following Hill and Yoshiyuki (1980), Van Strein (1986) recognises the following subspecies in addition to the nominate subspecies in island S.E. Asia: *R. p. minutillus* Miller, 1906 (Siantan I., Anamba Is), *R. p. pagi* Tate and Archbold, 1939 (N. Pagai Is, Mentawai Is).

Measurements
(See Table 4)

Pelage
The colour of four adult females is Bister sometimes strongly tipped with Ochraceous Tawny dorsally and Snuff Brown strongly tipped with Cinnamon Buff to Ochraceous Orange ventrally.

Family: Megadermatidae

Megaderma spasma trifolium E. Geoffroy, 1810

Lesser False Vampire Bat

Type Locality

Java

Distribution

M. s. trifolium: Lombok I., Java, Borneo, Kangean Is, S. Natuna Is, Tambalan Is, S. Sumatra. Species: also Ternate I., Sulawesi, Siumatis I., Aceh W. Sumatra, Nias I., Siberut I., Natuna Besar I., Karimata Is, Sula Is, Togian Is, Babi + Reusam (Lasia) Is, Riau Is, Sri Lanka and India through S.E. Asia to Java.

Habitat/Ecology

On Lombok I. in 1987 three males and three females were mist-netted adjacent to a large opening in a giant Beringin fig tree *Ficus benyamina* (?) in dense tall evergreen mixed rainforest. One was also collected from a large cave, Batu Kota, 5.8 km E. Suranadi. Other bats in the cave were *Hipposideros diadema, Murina cyclotis, Rhinolophus affinis* and *R. pusillus.* Lekagul and McNeely (1977) state that they roost in small groups (4-27) in caves, tree hollows and buildings and are usually the sole occupant of their retreat. Their diet includes lizards, grasshoppers and moths which they eat on a feeding roost. Payne *et al.* (1985) state that they also eat other bats.

Reproduction

On Lombok I. in late September 1987 two of the three adult females examined were pregnant. Each had two foetuses with crown to rump lengths ranging from 12.8 to 25.0. Neither was lactating. The other female appeared to be non-parous.

Nowak and Paradiso (1983) state that the sexes live together throughout the year and mate in December and January in India. Gestation lasts 150 to 160 days and young are born from April to June before the onset of rains. Twins are occasionally born. Young are almost the same size as adults 45 days after they are born and are independent at two months of age (Brosset, 1962).

Taxonomic Remarks

Andersen (1918) revised *Megaderma* and subsequently Chasen (1940), Tate (1941b) and Hill (1983) have made additional comments. Van Strein (1986) refers all *Megaderma* in island Southeast Asia to *Megaderma spasma* and lists 11 subspecies. The specimens from Lombok I. appear most similar in form to *M. s. trifolium* of W. Java.

Measurements (mean, range, sample size)

Forearm length 58.6 (57.2-59.4) 5; head to vent length 66.8 (62.2-71.0) 5; ear length 38.8 (37.2-41.4) 5; pes length 16.8 (16.0-18.0) 5; tibia length 34.0 (32.7-34.9) 5; weight 24.9

(20.0-29.5) 5; greatest skull length 25.7 (24.9-26.7) 5; condylobasal length 20.8 (20.2-21.3) 5; condylocanine length 23.0 (22.4-23.8) 5; zygomatic width 15.3 (15.0-15.8) 5; least interorbital width 3.8 (3.7-3.8) 5; mastoid width 11.9 (11.8-12.0) 5; braincase width 11.1 (10.9-11.4) 5; M^3-M^3 width (alveoli) 8.8 (8.6-9.0) 5; C^1-C^1 width (alveoli) 5.7 (5.5-5.9) 5; C^1-M^3 length (alveoli) 9.5 (9.3-9.7) 5; C_1-M_3 length (alveoli) 10.9 (10.8-11.1) 5; dentary length 17.9 (17.6-18.5) 5.

Pelage

The colour of adult males and females is Neutral Gray tipped with Hair Brown dorsally and Light Neutral Gray tipped with Avellaneous ventrally.

Family Vespertilionidae

***Harpiocephalus harpia harpia* Temminck, 1840**

Hairy-winged Bat

Type Locality

Mt Gede, Java

Distribution

Lombok I., Java, Sumatra, Borneo, Moluccas, Taiwan, Indochina, Thailand, Burma.

Habitat/Ecology

A single old male was mist-netted at Surandi, Lombok I. across a path amongst tall dense evergreen forest. In Borneo it occurs in the understorey of lowland dipterocarp forest. Nowak and Paradiso (1983) state they have been observed to frequent hilly country and probably roost in vegetation. Beetle remains have been found in the stomach of an individual.

Reproduction

Unknown.

Taxonomic Remarks

Ellerman and Morrison-Scott (1951) considered the genus monospecific with three subspecies in addition to the nominate subspecies. These are: *Harpiocephalus h. rufulus* Allen, 1913 (Indochina), *H. h. lasyurus* (Hodgson, 1847) (N.E. India) and *H. h. madrassius* Thomas, 1923 (S.E. India). They considered *mordax* (Burma) may be another subspecies of *H. harpia.*

Honacki *et al.* (1982) recognise only one species of *Harpiocephalus.* However, Corbet and Hill (1986) also recognise *H. mordax* Thomas, 1923 (Borneo and Burma) which Thomas diagnosed as having a much larger skull than *H. harpia* with larger crests; wider

zygomata; broader and heavier muzzle; larger canines and incisors and slightly broader premolars. Hill and Francis (1984) present measurements of a specimen of *H. mordax* from Borneo. Following their comparison with Thomas' two original specimens from Burma, Hill and Francis state that the largest size differences relate to the width of the muzzle and zygomata (*H. mordax* C^1-C^1 (cingula) 7.2-7.5; zygomatic width 14.3-14.9.) Clearly measurements presented below for the Lombok I. specimen show this specimen to agree very closely with *H. h. harpia.*

Measurements

(Lombok I. specimen, followed in brackets by those from a near topotypical and similarly aged male *H. harpia* from Cibodas, W. Java)

Forearm length 43.4 (46.8); head to vent length 52.3 (53.7); tail length 45.8 (50.0); ear length 16.4 (16.2); pes length 10.2 (9.5); tibia length 21.5 (23.3); weight 11.0 (NA) greatest skull length 20.8 (21.2); condylobasal length 18.9 (19.3); condylocanine length 18.3 (18.5); zygomatic width 12.1 (13.1); least interorbital width 5.5 (5.6); mastoid width 10.4 (10.6); rostrum length 4.6 (5.2); braincase width 9.5 (9.5); M^3-M^3 length (cingula) 6.8 (6.9); C^1-C^1 length (cingula) 5.8 (6.4); C^1-M^3 length 6.6 (6.9); C_1-M_3 7.2 (7.7); dentary length 7.7 (8.4).

Pelage

The colour of the adult male is Dusky Neutral Gray through Pinkish Buff to Mikado Brown at the tips dorsally. Mikado Brown hairs extend to cover the dorsal surface of the tail, uropatagium and hind legs. Ventrally the hair is Neutral Gray through Pale Pinkish Buff to Light Pinkish Cinnamon at the tips.

Murina cyclotis peninsularis Hill, 1964

Orange Tube-nosed Bat

Type Locality

Ulu Chemperoh, Bentong District, Pahang, Malaya.

Distribution

Lombok I., Borneo (Sarawak, Sabah), Malay Peninsula.

Habitat

One specimen was collected at Suranadi in a Harp bat trap placed across a narrow path in dense tall mixed evergreen lowland primary forest. The other was collected by hand in a cave, Batu Kota, 5.8 km E. Suranadi. Other species in this cave were *Hipposideros diadema, Megaderma spasma, Rhinolophus affinis* and *R. pusillus.* Hill and Francis (1984) review the few records of this species.

Reproduction

The female collected on Lombok I. in October 1987 was pregnant with a foetus in each horn which had crown to rump lengths of 15.2 and 16.6.

Taxonomic Remarks

The two Lombok I. specimens fall clearly into Hill and Francis' (1984) second group of *Murina,* namely those with rostrum broad anteriorly; tooth rows more nearly parallel; I^3 situated more laterally to I^2 such that at the extreme its inner face lies more or less alongside the outer face of that tooth with PM2 less reduced. This group includes *huttoni, cyclotis, aenea* and *rozendaali.* The position of the incisors of the Lombok I. specimens do not approach the extreme form seen in the last two of these above species where I^3 lies almost totally alongside the outer face of I^2. The upper and lower anterior premolars are larger than *huttoni* and the molar tooth cusps, particularly mesostyles of the first two upper molars, are less well developed than in *huttoni.* Comparison with *cyclotis* is restricted by lack of available specimens but this Lombok I. form is most like the *M. cyclotis peninsularis* description in Hill (1964). They have a relatively wide upper tooth row anteriorly with a ratio of C^1-C^1 length to M^3-M^3 length of 76-79% (versus 80-85%), large canines and premolar teeth and long rostrum with length of orbit to gnathion to rostral width of 83-84% (versus 78-83%). The Lombok I. specimens differ from measurements of *M. c. peninsularis* in Hill (1964) in having the length of orbit to gnathion longer at 4.7-4.8 (versus 4.2-4.6); also the ratio of length of orbit to gnathion to greatest length of skull is greater at 0.266-0.267 (versus 0.250-0.259). Further specimens may indicate the need to recognise the Lombok I. form as a distinct subspecies.

These Lombok I. *M. c. peninsularis* are only the second species of this genus east of Wallace's Line (Van Deusen, 1961; Hill, 1983).

Measurements (2 specimens only)

Forearm length 34.6, 35.2; head to vent length 50.5, 49.8; tail to vent length 39.4, 39.0; ear length 15.1, 14.4; pes length 8.4, 8.5; tibia length 18.7, 19.0; weight 11.0, 10.0; greatest skull length 17.7, 18.0; condylobasal length 16.2, 16.7; condylocanine length 16.0, 15.9; zygomatic width 10.1, 10.0; least interorbital width 4.6, 5.5; mastoid width 8.5, 8.5; orbit to gnathion length 4.7, 4.8; braincase width 7.7, 7.8; M^3-M^3 width (alveoli) 5.8, 5.8; C^1-C^1 width (alveoli) 4.6, 4.4; C^1-M^3 length (alveoli) 6.0, 6.1; C_1-M_3 length (alveoli) 6.4, 6.4; skull height 12.0, 12.1; dentary length 12.0, 12.1.

Pelage

The colour of two adult females is Light Neutral Gray tipped with Snuff Brown dorsally and Pale Neutral Gray tipped with Tilleul Buff ventrally. Snuff Brown hair covers the dorsal surface of the tail, uropatagium, hind feet, radius and first digit of each wing.

Phoniscus jagorii javanus Thomas, 1880
Frosted Groove-toothed Bat

Type Locality
Java

Distribution
Lombok I., Bali I., Java, C. Borneo, Philippines.

Habitat
A single female was collected near Desa Pelangan in a Harp bat trap set in a banana plantation on the edge of a wide watercourse with pools of water.

Reproduction
The Lombok I. female collected in October 1987 had a small embryo in the right uterine horn, which was swollen to a maximum diameter of 2.0. It's teats were very small. No further information is recorded for this species.

Taxonomic Remarks
Phoniscus Miller, 1905 was considered a genus by Hill (1965) but not by Koopman (1979). Honacki *et al.* (1982) remarked that it is probably a subgenus of *Kerivoula.* The measurements are in good agreement with published measurements in Hill (1965).

Measurements (one specimen only)
Forearm length 37.5; head to vent length 42.0; tail to vent length 40.5; ear length 14.5; pes length 8.0; tibia length 18.2; greatest skull length 16.5; condylobasal length 15.4; least interorbital width 4.3; zygomatic width 10.0; mastoid width 8.4; braincase width 7.8; C^1-C^1 width 3.7; M^3-M^3 width 5.7; C^1-M^3 length 6.8; dentary length 12.1.

Pelage
The colour of the adult female is Chaetura Drab tipped with Mustard Yellow dorsally. Shorter hairs sparsely covering the dorsal surface of the bones comprising the 1st, 2nd and 5th wing digits, the tail and the hind legs are Mustard Yellow. Ventrally this specimen is Hair Brown, the hairs of the chest and abdomen tipped with Cream Color.

Kerivoula hardwickei hardwickei (Horsfield, 1824)

Hardwicke's Woolly Bat

Type Locality

Java

Distribution

Lombok I., Java, Kangean Is., Sumatra, Borneo, Sulawesi, Philippines, Malaya.

Habitat/Ecology

The two specimens from Lombok I. were collected in late September 1987 in a Harp bat trap set across a narrow path in dense tall primary evergreen forest at Suranadi. Payne *et al.* (1985) state that they roost in hollow trees and was once found roosting in a dead *Nepenthes* pitcher. They appear to be uncommon over their range.

Reproduction

The two females from Lombok I. in September/October 1987 had a single foetus in the right uterine horn. These had a crown to rump length of 2.4 and 11.7. Neither female was lactating.

Medway (1978) reports that a lactating female with a nearly full grown young was collected in the Malay Peninsula in January.

Taxonomic Remarks

Hill (1965) reviewed *Kerivoula.* He recognised the following subspecies of *K. hardwickei* in addition to the nominate subspecies: *K. h. flora* Thomas, 1914 (S. Flores); *K. h. engana* Miller, 1906 (Enggano I., Mentawai Is); *K. h. depressa* Miller, 1906 (N. India, upper Burma, Indochina); *K. h. crypta* Wroughton and Ryley, 1913 (S. India); *K. h. malpasi* Phillips, 1932 (Ceylon). Hill (1965: 542) states *Kerivoula h. hardwickei* from Sulawesi, Philippines and Sarawak are smaller in some respects than those from Java, Sumatra, and Malaya. *K. h. hardwickei* is smaller than *K. h. flora* on the values given by Hill, particularly in the following characters (maximum values for *K. h. hardwickei* and for the *K. h. flora* holotype only) condylobasal length 13.6 versus 14.8; zygomatic width 8.7 versus 9.5; braincase width 7.3 versus 7.7; mastoid width 7.5 versus 8.0; C^1-M^3 length 5.7 versus 6.1 and forearm length 35.2 versus 38.7.

Measurements for the Lombok I. specimens presented below show them to accord well with *K. h. hardwickei.*

Measurements (two specimens only)

Forearm length 34.3, 36.7; head to vent length 35.0, 35.6; tail to vent length 38.6, 48.0; ear length 13.1, 13.6; tibia length 16.9, 19.8; pes length 8.5, 8.7; weight 4.8, 6.8; greatest skull length 14.0, 14.7; condylobasal length 13.5, 13.7; least interorbital width 3.2, 3.2; zygomatic width 8.8, 9.0; braincase width 7.3, 7.4; mastoid width 7.5, 7.5; C^1-C^1 width

(cingula) 3.3, 3.5; M^3-M^3 width (cingula) 5.5, 5.6; C^1-M^3 length (cingula) 5.9, 6.0; dentary length 10.6, 10.9.

Pelage

The colour of the adult females is Chaetura Drab tipped with Tilleul Buff and Hair Brown dorsally and Chaetura Drab tipped with Light Drab and Drab ventrally.

Kerivoula flora Thomas, 1914

Thomas' Woolly Bat

Type Locality

S. Flores, Nusa Tenggara.

Distribution

Lombok and Flores Is.

Habitat/Ecology

One collected from Lombok I. in late September 1987 in a Harp bat trap. Another was mist-netted in May 1988. Both were from a narrow path in dense tall and primary evergreen forest at Suranadi in the same situation where the *Kerivoula hardwickei* was captured.

Reproduction

The female from Lombok I. in late September 1987 had a single foetus with a crown to rump length of 11.3 in the right uterine horn; it was not lactating. The female from May 1988 was neither pregnant nor lactating; it had small uterine horns with maximum diameters of 0.7.

Taxonomic Remarks

Described by Thomas (1914) as a species which he distinguished from *Kerivoula hardwickei* by being "larger and more robust throughout ... skull essentially as in *hardwickei* but decidedly larger. Braincase rather more inflated anteriorly than posteriorly". Most recent authors (e.g. Hill, 1965; Honacki *et al.*, 1982; Van Strein, 1986) considered *flora* a subspecies of *K. hardwickei.* J.E. Hill and W. Rozendaal *(pers. comm.)* recognise *K. flora* as distinct from *K. hardwickei.* The two Lombok I. specimens attributable to the taxon *K. flora* accord well with the measurements and description of both Thomas (1914) and Hill (1965). Their occurrence in sympatry with *K. h. hardwickei* at Surandi supports Hill and Rozendaal's view that *K. flora* is a species.

Measurements (two specimens only)

Forearm length 38.1, 38.4; head to vent length 38.9, 41.5; tail to vent length 45.5, 49.8; ear length 14.2, 14.9; tibia length 20.0, 19.9; pes length 8.0, 7.4; weight 5.8, 6.1; greatest skull length 15.4, 15.7; condylobasal length 14.4, 14.4; least interorbital width 3.2, 3.4; zygomatic width 9.2, 9.5; braincase width 7.4, 7.7; mastoid width 7.7, 8.0; C^1-C^1 width

(cingula) 3.5, 3.6; M^3-M^3 width (cingula) 5.4, 5.6; C^1-M^3 length (cingula) 6.1, 6.2; dentary length 11.3, 11.6.

Pelage

Chaetura Drab tipped with Tilleul Buff and Hair Brown dorsally and Chaetura Drab tipped with Light Drab and Drab ventrally.

Kerivoula picta picta Pallas, 1767
Painted Bat

Type Locality

Probably Ternate I., Molucca Is. (see Tate 1941: 586).

Distribution

Lombok I., Bali I., Ternate I., Amboina I., Molucca Is, Java, S. Vietnam, Sri Lanka, S. India.

Habitat/Ecology

Not collected in 1987 but reported as present on Lombok I. by a number of authors (Appendix I). Inhabits forests; shelters among dry leaves of vines and other plants, in plantain fronds and in flowers. They emerge late in the evening and have a slow fluttering flight close to the ground (Nowak and Paradiso, 1983).

Reproduction

Unknown.

Measurements (measurements are from Hill, 1965; mean, range, sample size)

Forearm length 34.7 (32.7-36.5) 13; condylobasal length 13.3 (12.7-13.8) 4; least interorbital width 3.2 (3.2-3.3) 5; zygomatic width 8.7 (8.7) 2; braincase width 6.7 (6.5-6.8) 4; mastoid width 7.3 (7.0-7.5) 4, C^1-C^1 width 3.1 (3.0-3.2) 5; M^3-M^3 width 5.5 (5.3-5.6) 5; C^1-M^3 length 5.6 (5.4-5.8) 5.

Pelage [from Dobson (1878: 335)]

"Fur above deep orange: beneath paler. The ears, antebrachial, and interfemoral membranes of the same deep orange colour; the wing-membrane between the humerus and the posterior limb, the free margin of the membrane between the foot and the fifth finger, along the posterior side of the forearm, and on both sides of each finger, deep orange; the remaining parts deep black with scattered orange dots, especially on the membrane between the metacarpal bones of the third and fourth fingers."

Tylonycteris robustula Thomas, 1915
Greater Bamboo Bat

Type Locality
Upper Sarawak, Sarawak, Malaysia.

Distribution
Lombok I., Timor I., Peleng I., Bali I., Java, Sumatra, Borneo, Sulawesi, S. China, Indochina, Thailand, Malay Peninsula.

Habitat/Ecology
At Suranadi, Lombok I., in late September 1987 a colony of three male and 27 female *T. robustula* were collected by hand, along with four *T. pachypus*. These were from a bamboo internode. Six were mist-netted at Suranadi in September 1987 and one in May 1988 over a narrow flowing stream fringed with dense tall evergreen mixed rainforest. Legukal and McNeely (1977) report them as also being found between rocks and other sites where they can utilise their gripping pads. Their group structure is as described for *T. pachypus*.

Reproduction
None of the 34 adult females collected on Lombok I. in late September 1987 showed any indication of reproductive activity. They all had very small teats, no mammary gland development and small uterine horns, the latter ranged in diameter from 1.0-1.7. The single female collected on Lombok I. in early May 1988 was also neither pregnant nor lactating. However, from the appearance of its right uterine horn, which was slightly enlarged and 'bruised', this female may have recently bred. Medway (1978) states that usually twins are born to this species and in the Malay Peninsula births occur from February to May, with most births in April; there is a single record of a female pregnant in August. Gestation, the period of dependence on the mother, and sexual maturity is as for *T. pachypus*.

Taxonomic Remarks
Tate (1942b) recognised both *T. robustula* and *T. malayana*. The latter was described by Chasen (1940: 52) from Perak, Malay Peninsula, on the basis that it was larger and heavier than *robustula* with forearm length greater than 28.5. Medway (1969) synonymised *malayana* with *robustula*.

Measurements
(See Table 5)

Pelage
The colour of adult males and females is Olive Brown dorsally; the hair of the head and shoulders tipped with Mummy Brown. Ventrally they are Drab with Light Drab across the throat.

Table 5: Skull, teeth and external measurements of *Tylonycteris* spp. on Lombok I. Adult females only. Mean, range and sample size, in mm.

	T. pachypus 4 ♀♀	*T. robustula* 34 ♀♀
Forearm length	25.9 (25.6—26.5) 4	27.4 (26.2—28.6) 34
Head to vent length	34.7 (32.1—36.5) 4	41.3 (38.4—44.6) 33
Tail length	26.4 (25.4—26.8) 4	28.1 (24.5—31.0) 34
Ear Length	8.1 (7.8— 8.6) 4	9.1 (7.3—10.7) 34
Pes length	4.6 (4.4— 5.0) 4	5.3 (4.8— 5.8) 34
Tibia length	12.0 (11.9—12.3) 4	12.5 (11.3—13.8) 33
Weight	3.4 (2.9— 3.8) 4	5.1 (3.9— 6.2) 34
Greatest skull length	11.0 (11.0—11.1) 4	12.2 (11.7—12.9) 15
Condylobasal length	10.6 (10.6—10.6) 4	11.5 (11.2—12.4) 15
Zygomatic width	7.8 (7.7— 8.0) 4	8.9 (8.6— 9.3) 15
Least interorbital width	3.5 (3.2— 3.9) 4	4.0 (3.7— 4.2) 15
Supraorbital tubercle width	4.9 (4.8— 5.0) 4	5.9 (5.6— 6.3) 14
Mastoid width	6.8 (6.7— 6.9) 4	7.4 (7.0— 7.8) 15
Orbit to gnathion length	3.5 (3.4— 3.6) 4	3.8 (3.3— 4.2) 15
Braincase width	6.5 (6.4— 6.6) 4	7.2 (6.7— 7.4) 15
M^3—M^3 width (alveoli)	4.9 (4.9— 5.0) 4	5.6 (5.4— 5.8) 15
C^1—C^1 width (alveoli)	3.5 (3.4— 3.6) 4	4.0 (3.6— 4.2) 15
C^1—M^3 length (alveoli)	3.5 (3.5— 3.6) 4	4.0 (3.8— 4.2) 15
C^1—M_3 length (alveoli)	3.7 (3.7— 3.8) 4	4.2 (4.1— 4.4) 15
Dentary length	7.6 (7.5— 7.7) 4	8.6 (8.5— 9.0) 15

Tylonycteris pachypus bhaktii Oei, 1960

Lesser Bamboo Bat

Type Locality

Sewela, E. Lombok I.

Distribution

T. p. bhaktii: Lombok I. Species: also Bali I., W. Java, Borneo, Philippine Is, India, S. China, Vietnam and Andaman Is.

Habitat/Ecology

Four female specimens were collected with a colony of 30 *T. robustula* from bamboo at Suranadi in late September 1987. Payne *et al.* (1985) and Nowak and Paradiso (1983) state that they roost in the internodes of bamboos, entering through small slits created by chrysomelid beetles. Both these *Tylonycteris* species may sometimes use the same roost at different times. Medway (1978) reports that they are among the earliest bats to fly each evening. Their diet includes swarming

termites. They roost in groups of 40 or more individuals, usually in a harem type of arrangement (Medway and Marshall, 1972).

Reproduction

On Lombok I. in late September 1987 none of the four females collected was lactating or pregnant. Medway (1972b) states that they have a restricted annual breeding season with births generally occurring over a one month period between February to May. Gestation is about 12-13 weeks and twins are common. Young are carried by the mother for the first few days and then are left at the roost until weaning and independence, which is reached at about six weeks of age. Both sexes become sexually mature in their first year after birth.

Taxonomic Remarks

Tate (1942b) reviewed the literature on *Tylonycteris* and concluded that there were only two groups: *pachypus* and *robustula*; the distinction drawn between these two groups devolved on both the degree of development of supraorbital tubercles and of the lambdoidal crests.

Van Strein (1986) recognises two subspecies in addition to *T. p. bhaktii* in island S.E. Asia. These are *T. p. pachypus* (Temminck, 1840) (W. E. Borneo, W. Java, Sumatra, Bali I., extralimital) and *T. p. meyeri* Peters, 1872 (Palawan I., Culion I., Calamian Is, extralimital).

Tate (1942b) was unable to distinguish between forms of *T. pachypus* from Bali I., Sumatra, Laos and Indochina and stated that *T. aurex* from India was only slightly different. *T. p. meyeri* from the Philippines was much smaller with forearm length of 22.3-24.0. Specimens of this species collected from Lombok I. agree closely with measurements presented by Oei (1960: 25) for the type series of *T. p. bhaktii.* Oei (1960) states that the Lombok I. form has a clearly larger forearm (26.5-27.6) than *T. p. meyeri* and a narrower braincase (6.2) than either *meyeri* or the nominate subspecies.

Measurements

(See Table 5)

Pelage

The colour of the four adults is Buffy Brown dorsally; the hair of the head and shoulders tipped with Olive Brown. Ventrally they are Drab with Light Drab across the throat.

Miniopterus schreibersii blepotis (Temminck, 1840)
Common Bent-winged Bat

Type Locality

Lectotype restricted to Java by Tate (1941)

Distribution

M. s. blepotis: Lombok I., Timor I., Amboina I., Java, Sumatra, Sulawesi and Malaya. Species: also W. Europe, Africa, Afghanistan, Japan, China, Vietnam, India, Sri Lanka, Philippines, Australia.

Habitat

Two males and a female recorded by Oei (1960) from Sewela, Lombok Timur. Not collected in 1987.

Ecology

M. schreibersii populations in India tend to be focused in a single large cave, with individuals spending some of their time in secondary roosts which may be 70 km distant from the main cave (Lekagul and McNeely, 1977).

Reproduction

Van der Merwe (1975) showed that pregnant *M. schreibersii* females in Southern Africa migrate in late winter to late spring from their wintering caves in the south to maternity caves in the north. In late summer females and weaned young move back to the south.

Each female gives birth to a single young from early November to early December. These young are not carried by the mother but are deposited in a large communal nursery with up to 110,000 juveniles (Nowak and Paradiso, 1983). In Australia Richardson (1977) reports that *M. schreibersii* is monoestrous with mating occurring in late May to early June, fertilisation and development of the blastocyst followed immediately but implantation was delayed until August. Births occurred in December.

Taxonomic Remarks

Maeda (1982) reviewed Eurasian, Australian and Melanesian *Miniopterus.* He suggested changes to the conventional view of *M. schreibersii* (Kuhl, 1819) which was taken to include all those forms with forearms ranging from 44 to 50 and with condylobasal skull lengths from 14.5 to 16.0 except for *M. s. magnater* Sanborn 1931, from New Guinea which is larger. Maeda (1982) separated off from *M. schreibersii* the larger forms with the longer skulls, toothrows and wider palate which he described as *M. macrodens* Maeda, 1982. Maeda (1982) placed the remaining forms in *schreibersii.* Hill (1983) considered this taxonomic treatment of the *schreibersii* complex (excluding *magnater* and *macrodens*) by Maeda to be very arbitrary and without due consideration of morphological and zoogeographical factors which results in a number of curious distributional anomalies, partly arising from initial identification problems. For this

reason Hill (1983) retains the more traditional view (followed by us) that all medium sized *Miniopterus* in Indo-Australia (excluding *magnater* and *macrodens*) form a polytypic species with the following subspecies: *M. s. japoniae* Thomas, 1906 (Japan); *M. s. chinensis* Thomas, 1908 (N.E. China); *M. s. parvipes* Allen, 1923 (S. China and Vietnam); *M. s. fuliginosus* Hodgson, 1835 (India and Sri Lanka); *M. s. eschscholtzii* Waterhouse, 1845 (Philippines); *M. s. blepotis* Temminck, 1840 (Malaya, Sumatra east to Sulawesi and Java); *M. s. oceanensis* Maeda, 1982 (Molucca Is, New Guinea, Solomon Is, E. Australia and *M. s. orianae* Thomas, 1922 (N. Australia).

Hill (1983) considered that *M. magnater* from Timor I. reported in Goodwin (1979) is probably *M. s. oceanensis*. The measurements below for the three specimens from Lombok from Oei (1960) indicate that C^1-M^3 length (5.7 - 5.8) are smaller than values given by Hill (1983: 182) for *M. s. blepotis* from Java (5.9-6.3). The braincase width of the Lombok I. specimens of 7.0-7.1 given by Oei (1960) are suspect because they are far lower than for any of the *M. schreibersii* forms. We consider that the identity of Oei's specimen from Lombok I. requires verification.

Measurements [from Oei, 1960]

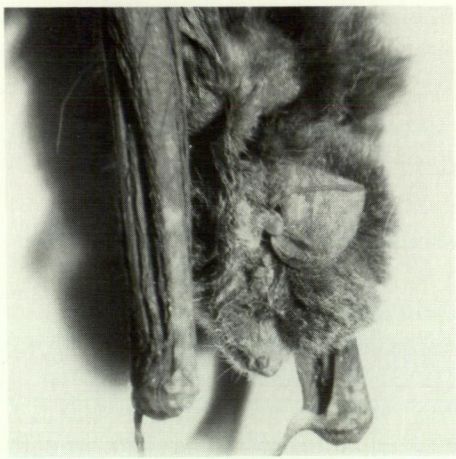
Forearm length 42.1 (42.0-42.2) 3; head and body length 45.3 (44-46) 3; tail length 48.3 (47-49) 3; tibia length 19.0 (19.0-19.1)3; ear length 10 (9-11) 3; hindfoot (with claw) 7.7 (7.5-8.0) 3; greatest skull length 14.0, 13.7; zygomatic width 7.5, 7.8; braincase width 7.0, 7.1; least interorbital width 3.8, 3.9; C^1-M^3 length 5.8 (5.7-5.8) 3.

Pelage

Dwyer (1983) describes the pelage of this subspecies from E. Australia as "blackish to reddish-brown above, paler below; mantle of contrasting brown in some moulting females, rufescent forms present in some northern Queensland populations".

Miniopterus pusillus macrocneme Revilliod, 1914

Small Bent-winged Bat



Type Locality

New Caledonia and Loyalty Is.

Distribution

Lombok I., Sulawesi east to New Hebrides, New Caledonia and Loyalty Is. Species: also Sumatra, Sarawak, Borneo, W. Java, Timor I.

Habitat

From a cave on Gunung Saung, near Desa Pingember, 25 km S. Desa Kuta, Lombok I. Goodwin (1979) reports that *M. p. macrocneme* roost together in caves on Timor I. with *M. australis* and *M. magnater, Rousettus amplexicaudatus, Taphozous melanopogon, Rhinolophus borneensis parvus, R. creaghi timorensis* and *R. philippinensis montanus.*

Reproduction

Both females from Lombok I. in late October 1987 were pregnant. One had a small embryo in both the right and left uterine horn which had diameters of *c.* 3.2; the other had a single large foetus with crown to rump length of 17.0.

Taxonomic Remarks

As noted by Goodwin (1979) the systematics of the Asian members of this genus remains confused. *M. macrocneme* has been considered conspecific with *M. medius* Thomas and Wroughton, 1909 but Peterson (1981) related it to *M. pusillus.* Hill (1983) reports *medius* in near sympatry with *pusillus* in Thailand and Java, indicating *medius* and *pusillus* are specifically distinct and that *"pusillus* and *macrocneme* are most probably conspecific". Maeda (1982), however, considered *macrocneme* was in the *fuscus* group. Hill (1983) reports that *macrocneme* represents the eastern form characterised by a long tibia, up to 20.0.

Comparison of measurements from the Lombok I. specimens with those in Hill (1983) and Goodwin (1979) indicate them to be within the size range for *M. p. macrocneme.*

Measurements (two specimens only)

Forearm length 42.5, 43.4; head to vent length 43.8, 48.2; tail to vent length 49.6, 51.5; ear length 8.8, 9.4; pes length 8.2, 8.5; tibia length 19.4, 19.7; weight 6.5, 8.4; greatest skull length 13.7, 13.7; condylobasal length 13.0, 13.0; condylocanine length 12.1, 12.1; zygomatic width 7.4, 7.4; least interorbital width 3.6, 3.5; mastoid width 7.8, 7.7; orbit to gnathion length 4.5, 4.6; braincase width 7.3, 7.5; M^3-M^3 width (cingula) 5.4, 5.5; C^1-C^1 width (cingula) 3.8, 3.7; C^1-M^3 length (cingula) 5.2, 5.2; C_1-M_3 5.5, 5.6; dentary length 9.6, 10.3.

Pelage

The colour of the adult females is Chaetura Black.

Myotis (Selysius) muricola muricola (Gray, 1846)

Whiskered Bat

Type Locality

Nepal.

Distribution

Lombok I., Bali I., Java, Borneo, Philippines, New Guinea, Malay Peninsula, Vietnam, Thailand, Burma, E. India and many small associated islands.

Habitat

On Lombok I., captured in a wide range of habitats: mist-netted in banana plantations at Batu Koq and Suranadi, over an irrigation canal (Batu Koq), over a running stream (Suranadi), over a watercourse with pooled water (Pelangan), in a dry watercourse (Kuta)

and in a garden by NAMRU II (Gerung). Bat-trapped in dense tall mixed evergreen primary forest (Suranadi) and banana plantation (Pelangan) and caught by hand during the day in the base of young banana leaves at Suranadi and Batu Koq. Two groups from banana leaves: one with eight females and six males and the other with six females and five males. Medway (1978) reports that this species (as *M. mystacinus*) in the Malay Peninsula frequently roost in groups of one to eight individuals in the broad-leafed varieties of bananas. Also recorded in caves (Medway, 1978; Legakul and McNeely, 1977).

Reproduction

Fourteen of the 16 females collected from Lombok I. in September and October 1987 were pregnant. The smallest pregnant females had a forearm length of 34.0. The two females that were not pregnant were young adults and appeared to be nulliparous; they had forearm lengths of 33.6 and 33.7. Each pregnant female had a single embryo in the right uterine horn. Breeding appeared to be synchronous throughout Lombok I; the smallest foetuses were usually from those areas collected earlier (in September and early October).

Lekagul and McNeely (1977) state that in Thailand the species (as *M. mystacinus*) usually form maternity colonies in caves numbering over 10,000 individuals. One young is born after a gestation period of 50-70 days. Medway (1978) indicates that they apparently breed all year, but most frequently in April and May.

Taxonomic Remarks

There has been much confusion over the correct name for the Indo-Australian *Myotis* with small feet (subgenus *Selysius*), forearm lengths between 30-36 and PM3 reduced but not intruded or only slightly intruded from the toothrows. Authors (Tate, 1941d; Chasen, 1940; Laurie and Hill, 1954 and Findley, 1972) have variously associated these *Myotis* with *M. mystacinus* (Kuhl, 1819) or *M. muricola* (Gray, 1846). Hill (1983) extensively discussed this situation and considered that the Indo-Australian forms should be related to *M. muricola* and tentatively referred most specimens to this region and its many islands to *M. muricola muricola.* The exceptions are the very small and possibly distinct *M. m. niasensis* from Nias I., and *M. m. herrei* Taylor, 1934 and *M. m. browni* Taylor, 1934 from the Philippines.

Measurements (mean, range, sample size)

Forearm length 34.4 (30.1-35.6) 18; head to vent length 39.8 (38.9-41.2) 18; tail to vent length 39.8 (35.7-43.4) 18; ear length 10.7 (9.3-12.4) 18; pes length 6.3 (5.7-7.2) 18; tibia length 15.9 (15.3-17.0) 18; greatest skull length 13.7 (13.4-13.9) 7; condylobasal length 13.0 (12.7-13.2) 7; condylocanine length 12.0 (11.4-12.3) 7; zygomatic width 8.3 (7.9-8.7) 7; least interorbital width 3.1 (3.1-3.2) 7; mastoid width 6.9 (6.7-7.0) 7; orbit to gnathion length 6.3 (6.1-6.6) 7; braincase width 6.3 (6.1-6.4) 7; M^3-M^3 width (alveoli) 5.4 (5.2-5.6) 7; C^1-C^1 width (alveoli) 3.3 (3.2-3.5) 7; C^1-M^3 length (alveoli) 5.1 (5.0-5.3) 7; C^1-M^3 length (alveoli) 5.5 (5.2-5.6) 7; dentary length 10.2 (9.9-11.0) 7.

Pelage

The colour of both adult males and females is Fuscous Black dorsally and ventrally, the latter tipped with Tilleul Buff.

Scotophilus kuhlii temminckii (Horsfield, 1824)
Yellow House Bat

Type Locality
W. Java

Distribution
S. k. temminckii: Lombok I., Sumba I., Flores I., Timor I., Aru Is., Banda I. (?), Bali I., Java, Sulawesi, Pakistan to Taiwan, south to Sri Lanka and Malay Peninsula, Philippines, Nicobar Is, Hainan I.

Habitat/Ecology
On Lombok I. in October 1987 two were mist-netted at Pelangan over a wide watercourse which had pools of water and was fringed with banana and coconut plantations, bamboos, and mango trees. One specimen was collected by NAMRU II in gardens at Kerongkong, Lombok Timur, on 12 May 1978. Payne *et al.* (1985), Legakul and McNeely (1977) state that this species often roosts in attics of houses usually in groups of about 30 individuals but occasionally up to 200. They may also roost in large numbers in trunks and hollows of trees. At Bogor Gardens, W. Java they roost in large groups in the fronds of fan palms; chitinous remains of their meals litter the ground indicating that they frequently take their prey to their roost to eat. Nowak and Paradiso (1983) state that their diet is beetles, termites, moths and other insects. Nowak and Paradiso (1983) state that in Java this species has two colour phases: a brilliant rufous and a dull olive brown. This species is one of the earliest bats to fly each night and is frequently seen hawking in urban areas.

Reproduction
On Lombok I., the two adult females collected in October 1987 had small teats and undeveloped mammary glands. However, both had clearly swollen right and left uterine horns with diameters *c.* 6 indicative of early pregnancy.

Nowak and Paradiso (1983) state that in India this species breeds in March; gestation is about 105-115 days and the number of young is one or two.

Taxonomic Remarks
Goodwin (1979) states that it is difficult to determine the distribution of this subspecies because the taxonomy is still unsettled. He compared two specimens from Timor I. with a series from Java and Bali I. and found them to be identical. Comparison of the measurements of the two females from Lombok I. with those provided by Goodwin (1979) indicated that they were larger overall. However, the Lombok I. specimens are very similar to those of this species from Bali I., presented by Kitchener and Foley (1985). We have followed the most recent authors who have reviewed this situation (Hill and Thonglongya, 1972; Honacki *et al.*, 1982) who place *temminckii* with *kuhlii*.

Measurements (two specimens only)

Forearm length 52.7, 53.0; head to vent length 68.0, 70.0; tail length 49.5, 50.0; ear length 14.3, 14.0; pes length 10.3, 11.0; tibia length 19.9, NA; weight 21.5, 21.5; greatest skull length 19.4, 19.0; condylobasal length 18.0, 17.7; condylocanine length 18.5, 17.6; zygomatic width 13.7, 13.5; least interorbital width 5.0, 5.0 ; mastoid width 11.5, 11.7; braincase width 9.3, 9.3; M^3-M^3 width (alveoli) 8.8, 8.7; C^1-C^1 width (alveoli) 6.6, 6.5; C^1-M^3 length (alveoli) 6.7, 6.6; C_1-M_3 length (alveoli) 8.0, 7.5; dentary length 14.4, 14.6.

Pelage

The colour of the two adult females is Olive Brown dorsally and Tawny Olive ventrally. The hair on the head and base of the chin is tipped lightly with Dark Olive.

Pipistrellus imbricatus Horsfield, 1824

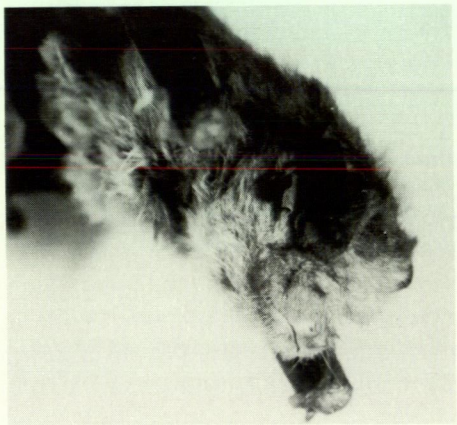
Brown Pipistrelle

Type Locality

Java

Distribution

Lombok I., Bali I., Java, Kangean Is, Philippines



Habitat

On Lombok I. in October 1987 this species was collected from the coast to 400 m altitude. At Kuta one was mist-netted in a dry wide watercourse fringed by banana plantations and bamboo. At Suranadi it was mist-netted over a stream and amongst banana trees in a village garden. At Batu Koq it was mist-netted over water in an irrigation canal and three were captured by hand in banana leaves. One animal, tentatively identified as this species, escaped from a mist net at Pos-Tiga, Rinjani. Medway (1978) reports it from lowland areas of the Malay Peninsula.

Reproduction

The single female collected from Lombok I. in September 1987 had both right and left uterine horns slightly swollen to a maximum diameter of 1.4. The teats were moderately large but there was no mammary gland development. These observations suggest early pregnancy.

Taxonomic Remarks

P. imbricatus is frequently confused with *P. javanicus*. However, an excellent diagnosis of these two species is available in Francis and Hill (1986).

Measurements (mean, range, sample size)

Forearm length 35.2 (33.0-37.3) 7; head to vent length 42.7 (41.0-44.9) 7; tail length 38.1 (35.8-41.0) 7; ear length 14.3 (13.5-14.9) 7; pes length 6.1 (5.8-6.4) 7; tibia length 15.4

(14.4-16.0) 7; weight 5.0 (4.4-5.3) 6; greatest skull length 12.9 (12.7-13.0) 6; condylobasal length 12.5 (12.3-12.6) 6; condylocanine length 11.9 (11.7-12.1) 6; zygomatic width 8.6 (8.1-9.0) 6; least interorbital width 3.6 (3.4-3.7) 6; mastoid width 7.4 (7.3-7.6) 6; braincase width 7.4 (7.2-7.5) 6; M^3-M^3 width (alveoli) 5.4 (5.2-5.5) 6; C^1-C^1 width (alveoli) 4.2 (4.1-4.2) 6; C^1-M^3 length (alveoli) 4.2 (4.1-4.4) 6; C_1-M_3 length (alveoli) 4.5 (4.4-4.6) 6; dentary length 9.0 (8.9-9.3) 6.

Pelage

The colour of adult males and females is Fuscous Black tipped with Snuff Brown to Olive Brown dorsally and Fuscous Black tipped with Buffy Brown ventrally.

Pipistrellus tenuis sewelanus Oei, 1960

Oei's Pipistrelle

Type Locality

Sewela, E. Lombok I.

Distribution

Lombok I.

Habitat/Ecology

Unknown; not collected in 1987.

Taxonomic Remarks

Koopman (1973) reviewed the Indo-Australian pipistrelles related to *P. tenuis*. He united *P. sewelanus* with the following forms as subspecies of *tenuis: P. papuanus* Peters and Doria, 1881; *P. angulatus* Peters, 1880; *P. collinus* Thomas, 1920; and *P. ponceleti* Troughton, 1936 (all from Papua New Guinea); *P. subulidens* Miller, 1900 (Serasan I.) and *P. murrayi* Andrews, 1900 (Christmas I.) and *P. nitidus* Tomes, 1858 (Borneo). Kitchener *et al.* (1986) reviewed Australo-papuan pipistrelles and considered all the above New Guinea forms, except *ponceleti* (a subspecies of *P. angulatus*), as species and speculated that *murrayi, nitidus* and *sewelanus* may also be species. We have not been able to examine specimens of this species and so have tentatively followed Koopman (1973) in considering *sewelanus* synonymous with *tenuis*.

Measurements [From Oei (1960: 28) mean, range, sample size]

Forearm length 34.1 (33.8-34.6) 4; greatest skull length 12.2 (12.0-12.5) 3; zygomatic width 7.6 (7.4-7.9) 3; braincase width 6.5 (6.3-6.8) 4; mastoid width 6.8 (6.7-6.9) 4; lacrimal width 4.8 (4.7-4.8) 4; C_1-M_3 4.7 (4.7-4.8) 4.

Rodentia

Family: Sciuridae

Callosciurus notatus stresemanni Thomas, 1913

Plantain Squirrel

Type Locality

Bali I.

Distribution

C. n. stresemanni: Bali, Lombok I. Species: also on many islands from Java to Malaya; Borneo and Selayer I.

Habitat/Ecology

An adult female and two young were captured in late May 1988 from Desa Kateng, 6 km W. Desa Kuta, Lombok I. They were caught by hand after they were forced to the ground from the top of a coconut palm. Dammerman (1931) states that *C. notatus* is the most common squirrel in the lowlands of Java and is abundant up to 1000 m. He reports that it is a notorious pest, especially of coconuts into which it eats a round hole to get at the kernel. They also eat many different kinds of fruit, buds and blossoms and damage the bark of different trees; insects are also eaten. Payne *et al.* (1985) observed it as similarly abundant in Borneo in gardens, plantations and secondary forest. They state that it can exist entirely in monoculture plantations, particularly in coastal areas and 'swamp forests' but that it is rare in tall dipterocarp forests. They report it as present up to 1600 m on Gunung Kinabalu. It is diurnal but is most active in the early morning and late afternoon when it travels and feeds in small trees.

Reproduction

Dammerman (1936) reports that it makes a nest in high trees in Java that consist of a loose structure of twigs and leaves with a lining of fibres, usually 'cocos' fibres. Usually only two young are produced at each birth with the breeding season mainly 'in the wet monsoon'. The occurrence of the two juveniles at Kuta that were about half adult size in May supports this observation. The adult female collected at Kuta at the same time was not pregnant and appeared to be nulliparous. Nowak and Paradiso (1983), however, report that in Borneo breeding may occur later as three pregnant females, each with three embryos, were collected there in July.

Taxonomic Remarks

Callosciurus notatus is morphologically very variable over its range with many island forms having been named. Van Strein (1986) recognises 49 subspecies in island S.E. Asia, including three subspecies on Java. Thomas (1913: 505) described *Callosciurus notatus stresemanni* from Bali I. which he recognised as having a general colour of "Clay

colour, less grey than *C. n. madurae,* paler and more buffy than in true *notatus". C. n. stresemanni* also has narrow orbital rings. The adult specimen from Lombok I. has pelage colouration similar to the Bali I. form, although the orbital rings are not noticeably narrow. Also the measurements presented below for this Lombok I. specimen are generally smaller than the forms of this species from Java and Bali I. presented in Thomas (1913) and Dammerman (1931).

Measurements (one specimen only)

Head to vent length 163.0; ear length 17.4; pes length 40.4; weight 144.0; greatest skull length 46.2; condylobasal length 41.5; zygomatic width 26.6; least interorbital width 16.6; mastoid width 20.0; orbit to gnathion length 18.6; braincase width 20.5; diastema length 11.1; nasal length 14.6; incisive foramen length 2.8; palatal bridge length 14.0; mesopterygoid fossa width 4.0; bulla length 8.8; M^1 length 2.2; M^1 width 2.4; M^1-M^1 width (alveoli) 10.9; M^1-M^3 length (alveoli) 6.5; M_1-M_3 length (alveoli) 6.9; dentary length 27.7.

Pelage

The dorsal pelage is predominately Deep Olive strongly flecked with Cinnamon-Rufous, particularly on the flanks. The base of the dorsal hairs are Deep Grayish Olive. The tail is predominately Cinnamon-Rufous with bands of Black. Hands and feet are Hair Brown flecked with Cinnamon-Rufous. The ventral surface varies from Cinnamon-Rufous to Cinnamon with a Deep Mouse Gray base. The eye is encircled by a broad band of Olive Buff. The sides of the abdomen to the armpit are clearly marked with a narrow band of Cinnamon-Rufous.

Family: Hystricidae

***Hystrix javanica* (F. Cuvier, 1823)**

Sunda Island Porcupine

Type Locality

Java

Distribution

Lombok I., Sumbawa I., Flores I., Bali I., Java, Madura I., Tanahdjampea I. and S. Sulawesi.

Habitat

On Lombok I. a juvenile was seen in captivity at the remote Desa Pelangan. This animal was supposedly captured in the adjacent lowland evergreen primary forest. Nowak and Paradiso (1983) state that *Hystrix* are highly adaptable and are found in all types of forest, plantations, rocky areas, mountain steppe and sandhill deserts from sea level to an altitude of 3500 m. They are nocturnal and terrestrial and do not usually climb trees; they can swim very well.

Reproduction

There has been no study on *H. javanica.*

Taxonomic Remarks

Schwarz (1911) separated this form from the nominate subspecies on the basis of a number of cranial differences but particularly the different shape of the occiput, flatter bulla and smaller size. Van Weers (1979), however, considered *H. javanica* monotypic, a view followed by us.

Measurements (from Van Weers 1979: Lombok I. sub-adult specimen followed in brackets by adult values for Bali I. specimens; mean, range, sample size)

Skull only: occipital to nasal length 102.9 (107.0, 104.0-110.7, 3); basilar length 88.1 (92.2, 90.1-95.2, 3); nasal length 37.8 (40.5, 38.5-42.8, 3); frontals length 30.0 (32.3, 31.4-33.2, 2); palatal length 53.3 (53.3, 52.6-54.0, 2); diastema length 26.5 (29.3, 28.4-30.1, 2); postorbital width 33.6 (31.0, N = 1); zygomatic width 56.2 (56.3, 56.0-56.6, 3); skull height 33.9 (34.8, 34.1-35.6, 3); P^4-M^3 length (alveoli) 23.3 (23.5, 23.1-23.9, 2); P_4-M_3 length (alveoli) 23.5 (23.9, N = 1).

Pelage

Body is densely covered with flattened spines, each of which is deeply grooved longitudinally and increases in rigidity toward the tip. The spines are smaller along the tail and are more flexible on the underparts. Coarse, bristlelike hairs cover the feet. The front half of the body is covered with short, dark brown spines, while the hindquarters have long pointed, whitish quills.

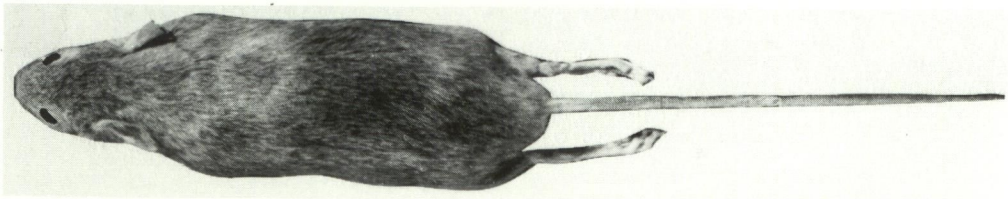
Family: Muridae

KEY TO MURIDAE OF LOMBOK I.

1. Hind foot length less than 20.0 mm; upper molar row (M^1-M^3) length less than 4.0 mm 2
   Hind foot length greater than 20.0 mm; upper molar row length more than 4.0 mm 3
2. Generally larger (weight more than 16.0g); pelage underparts tipped with white, sides and back generally not tipped with ochraceous; leading edge of zygomatic plate tends to be straight or gently curved ..... *Mus domesticus homourus* (p. 85)
   Generally smaller (weight less than 16.0g); pelage underparts not tipped with white, sides and back generally tipped with ochraceous; leading edge of zygomatic plate tends to be very convex ..... *Mus castaneus* (p. 86)
3. Tail length less than head to vent length, or subequal; juveniles with tuft of orange hair in front of ears; upper molar row length more than 7.6 mm ..... *Rattus argentiventer bali* (p. 87)
   Tail length more than head to vent length; juveniles without tuft of orange hair in front of ears; upper molar row length less than 7.6 mm 4

4. Small, hind foot length less than 30.0 mm; upper molar row length less than 6.8 mm ..... *Rattus exulans* (p. 89)
   Large, hind foot length more than 30.0 mm; upper molar row length more than 6.8 mm ..... *Rattus rattus diardii* (p. 91)

Mus domesticus homourus Hodgson, 1845
European House Mouse



Type Locality:
Southern Coorg, India.

Distribution:
Lombok I., Sumbawa I., Flores, Java through to Pakistan.

Habitat
Its habitat is not recorded on Lombok I. where it is reported to occur by Kloss (1921) and a number of recent authorities (see Appendix I). Marshall (1977) reports it as occurring in mountains above 2000 m, among boulders and shrubs near rivers, and in buildings.

Reproduction
The breeding behaviour of *M. domesticus* is somewhat confused because many accounts that relate to it may have been published under the name of *M. musculus* (see Pelikan, 1981). However, it would appear that the species is capable of breeding throughout the year given favourable conditions. Apparently given sufficient food and shelter, ambient temperature is the factor that limits its reproductive potential.

Taxonomic Remarks
M. domesticus homourus is the only Asian subspecies recognised of the European House Mouse. Because we have been unable to examine Kloss's specimen of *Mus* from Lombok I. the possibility remains that they have been misidentified considering the difficulty in distinguishing between *M. domesticus* and *M. castaneus.*

Measurements (from Marshall, 1977: 201; mean, standard deviation, sample size)
Head and body length 78.8 ± 6.8 (33); tail length 79.2 ± 7.9 (33); pes length 18.2 ± 0.66 (33); weight 16.2 ± 3.7 (4); greatest skull length 21.5 ± 0.77 (33); nasal length 7.9 ± 0.48 (32); zygomatic plate width 2.1 ± 0.13 (31); interorbital width 3.6 ± 0.14 (30); incisive foramen length 5.0 ± 0.26 (30); M^1-M^3 length (crowns) 3.5 ± 0.14 (31); braincase width 9.9 ± 0.24 (31); bulla length 3.7 ± 0.12 (30).

Pelage

Marshall (1977) states that the underparts are white with grey bases but as noted by Marshall and Sage (1981) it adapts to its local settings by adopting extremes of colouration.

Mus castaneus Waterhouse, 1843

Asian House Mouse

Type Locality

Philippine Is.

Distribution

Lombok I., Sumba I., Komodo I., Lomblen I., Timor I., and urban areas of S.E. Asia.

Habitat/Ecology

On Lombok I. in 1987 it was collected in houses at Desa Batu Koq. Musser (1977) states that this species has been collected only in houses and other buildings. Marshall (1977) found it rare in Thailand where it was found only in grain warehouses. He also referred to it as an "indoor commensal".

Marshall and Sage (1981) refer to it, along with *Mus poschiavinus* as man's closest indoor associate among undomesticated mammals.

Reproduction

On Lombok I. in October 1987 the single adult female was pregnant with three foetuses in the right uterine horn and two in the left horn; these had crown to rump lengths of 15.

Taxonomic Remarks

Marshall (1977) and Musser (1977) consider *castaneus* to be a subspecies of *M. musculus*. However Marshall and Sage (1981) regard it as a species. Marshall (1977) considers *M. castaneus* to be "certainly derived from an east Asiatic population, judging from the distinctive shape of their zygomatic plates", whereas the other mouse on Lombok I., *M. d. homourus* is considered by him to be related to European mice. It is similar to *M. d. domesticus* although smaller and usually tinted with ochraceous; the Lombok I. specimen of *M. castaneus* examined also had the peculiar convex outline of the anterior edge of the zygomatic plate, although Marshall and Sage (1981) state that this is not a universal attribute. The Lombok I. specimen has opisthodont incisors and this character distinguishes it from the two other species *(M. caroli* and *M. cervicolor)* which are often carried about by man in S.E. Asia.

Measurements (one specimen only)

Head to vent length 73.5; tail to vent length 91.8; ear length 12.2; pes length 16.9; tibia length 16.6; weight 20.5; greatest skull length 21.2; zygomatic width 10.9; interorbital

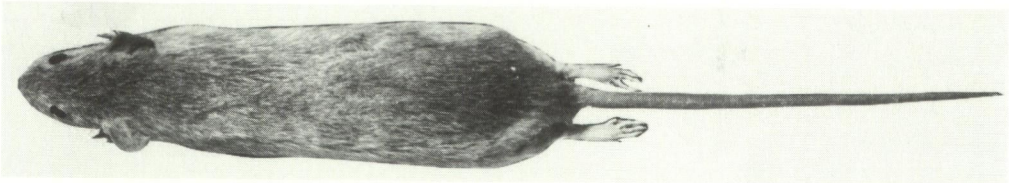
width 3.8; length of nasals 7.4; length of rostrum 6.4; braincase width 9.3; zygomatic plate width 2.5; diastema length 5.0; incisive foramen length 5.0; palatal length 11.0; palatal bridge length 3.5; M^1-M^3 length (alveoli) 3.6; M_1-M_3 length (alveoli) 3.0; M^1 length (alveoli) 1.4; M^1 breadth (crown) 0.9; bulla length 3.3.

Pelage

The colour of the adult female is a Deep Neutral Gray dorsally tipped with Warm Buff and Fuscous Black mixed with longer hairs of Fuscous Black. Ventrally the pelage is Neutral Gray tipped with Cream Buff. The feet are Tilleul Buff to Drab and the tail Hair Brown and not bicoloured.

Rattus argentiventer bali Kloss, 1921

Ricefield Rat



Type Locality

Bali I.

Distribution

R. argentiventer bali: Lombok I., Bali I., Java, Kangean I., Borneo, Sumatra. Species: also Rintja I., Flores I., Timor I., Sumba I., Komodo I., Sumbawa I., S. C. New Guinea, Sulawesi, Philippines, Malay Peninsula north to Thailand and S. Vietnam.

Habitat/Ecology

This species was not collected on Lombok I. in 1987 although it is reported there most recently by Musser and Boeadi (1980).

Musser (1973) summarises available information on *R. argentiventer* and states that it is essentially a lowland inhabitant from sea level to 700 m, although he reports that a specimen from Flores came from 1000 m and one was trapped at 1600 m on Gunung Kinabalu, Sabah. When rice is not growing, this species disperses from paddy fields; during the day they congregate in burrows and crevices in slopes of dikes and rivulets. Once the rice is planted they invade the fields to feed on the growing rice and make burrows in the banks of the rice fields. In Malaya it is most commonly found in rice fields and is a major pest. It is also found in the tall grass *Imperata cyclindrica* and in plantations of young oil palms where it is also a major pest. Musser and Boeadi (1980) state that it is a human commensal and is not known from primary forest. According to Musser (1973) *R. argentiventer* is omnivorous and eats flowers of oil palms and bunches of fruit, nuts, leaves, shoots and roots, growing rice plants (by eating the interior of the stem bases) and ripening rice grain. About half its diet is insects, particularly

Table 6: Skull, teeth and external measurements of *Rattus* spp. on Lombok I. Males and females combined, adults only. Mean, range and sample size, in mm. Those for *R. argentiventer* are from Sumba I. from Musser (1973) and Musser and Boeadi (1981).

	R. exulans	*R. rattus*	*R. argentiventer*
Head to vent length	106.3 (86.4—133.9) 13	138.3 (115.3—164.0) 6	198.0 (176—230) NA
Tail to vent length	129.2 (118.8—144.0) 12	166.7 (147.4—192.0) 6	185.7 (172—201) NA
Ear length	17.8 (15.9— 20.3) 13	20.0 (19.2— 21.3) 6	21.8 (20— 24) NA
Pes length	26.0 (22.7— 28.0) 13	33.3 (32.0— 34.4) 6	36.9 (35— 40) NA
Tibia length	30.1 (26.9— 34.0) 13	38.1 (33.9— 46.7) 6	NA
Weight	46.5 (34.5— 65.0) 12	103.0 (65—166) 6	NA
Greatest skull length	32.2 (29.8— 35.0) 8	40.1 (36.8— 43.4) 6	43.1 (41.2—46.9) 14
Zygomatic width	14.7 (14.0— 15.8) 7	18.4 (16.8— 20.0) 6	20.8 (19.4—21.7) 10
Least interorbital width	4.9 (4.7— 5.2) 9	5.8 (5.4— 6.1) 6	5.9 (5.5— 6.3) 15
Nasal length	11.8 (10.2— 13.4) 7	14.0 (11.9— 15.8) 6	15.5 (14.5—16.9) 15
Rostrum length	9.6 (8.9— 10.3) 8	11.9 (10.4— 13.3) 6	12.8 (11.6—14.2) 15
Rostrum width	5.4 (4.8— 6.2) 9	6.7 (6.2— 7.4) 6	8.0 (7.4— 8.5) 14
Braincase width	13.6 (13.1— 14.7) 9	15.8 (15.3— 16.2) 6	16.2 (15.9—16.8) 14
Braincase height	10.6 (9.2— 12.0) 9	13.3 (11.8— 14.2) 6	12.2 (11.4—12.7) 14
Zygomatic plate width	3.3 (3.0— 3.6) 8	3.9 (3.5— 4.3) 6	5.2 (4.5— 6.0) 15
Diastema length	8.4 (7.5— 9.8) 9	10.3 (8.6— 12.0) 6	11.6 (10.9—12.5) 15
Incisive foramen length	6.2 (7.6— 9.1) 9	7.5 (6.0— 8.2) 6	8.6 (7.4— 9.3) 15
Incisive foramen width	2.3 (5.5— 6.7) 9	2.5 (2.3— 2.8) 6	2.8 (2.4— 3.0) 15
Palatal length	16.7 (15.3— 18.2) 9	21.4 (18.9— 23.9) 6	23.6 (22.7—25.8) 14
Palatal bridge length	6.1 (5.6— 7.0) 9	7.9 (7.2— 9.0) 6	8.3 (7.9— 9.4) 14
Mesopterygoid fossa width	2.2 (1.9— 2.7) 8	2.5 (2.2— 2.8) 6	2.6 (2.3— 2.8) 13
Bulla length	5.9 (5.5— 6.6) 9	7.0 (6.4— 7.3) 6	8.4 (8.0— 8.8) 14
M^1—M^3 length (alveoli)	5.7 (5.1— 6.4) 9	7.0 (7.1— 7.3) 6	8.0 (7.6— 8.5) 15
M_1—M_3 length (alveoli)	5.3 (4.8— 6.2) 9	6.4 (6.0— 6.6) 6	—
M^1 length	3.1 (2.7— 3.6) 9	3.6 (3.7— 3.8) 6	—
M^1 width	1.6 (1.4— 1.8) 9	1.9 (1.8— 1.9) 6	—

grasshoppers, termites, ants, land snails, slugs and occasionally lizards. Harrison (1958) calculated the diameter of their home range in grassland in the Malay Peninsula at 273 m.

Reproduction

Harrison (1951) found that about ten percent of mature females were pregnant throughout the year in wasteland in the Malay Peninsula. Litter size averaged six and ranged between five and seven. Their mean life expectancy in the wild was 6.2 months.

Taxonomic Remarks

Musser (1973) summarises the nomenclatural history of *R. argentiventer*. The subspecies *bali* has been considered by a number of authors as synonymous with *R. r. argentiventer* and also as a subspecies of *R. rattus*. Musser (1973: 23) states that this species is morphologically similar throughout its known range, although there is geographic variation in pelage colour sufficient to maybe recognise valid subspecies when the species is taxonomically revised.

Measurements (See Table 6)

Pelage

Described for *R. a. bali* by Kloss (1921: 123) as "hair with grey bases and slender spines with pale bases: long piles or bristles on the rump. Above grizzle of ochraceous tawny and brownish black, below creamy white often with traces of a median grey stripe. Forefeet brown, hind feet white, broadly brown mesially".

Rattus exulans (Peale, 1848)

Polynesian Rat

Type Locality

Sumatra

Distribution

R. exulans: Lombok I., Sumbawa I., Sumba I., Flores I., Timor I., Bali I., Java, Borneo, Palawan I., Calamian Is, Balabak I., Sulawesi, Togian I., Tanahdjampea Is; Ambon I., Ternate I., Batjan I., Seram I., Morotai I., Sumatra, Simeulue I., Bangladesh, Burma, Thailand, Indochina, Malaysia, New Guinea to Micronesia, New Zealand and Polynesia.

Habitat/Ecology

On Lombok I. in 1987 one specimen was captured from disturbed gallery forest close to Batu Koq. Twenty-seven specimens were collected from Pos Tiga, Gunung Rinjani, at 1700 m altitude. This site was in disturbed

low evergreen mossy forest (that had been thinned somewhat). Four specimens were collected from low, deciduous forest near Desa Kuta, on the south coast and one specimen from the environs of Desa Pelangan.

This species is commensal throughout its range and is not found in undisturbed primary forest. Medway (1978) states that in the Malay Peninsula the species is a ground dweller that frequents houses, gardens, paddy fields, grassland, scrub and the forest fringe from sea-level to *c.* 1220 m. Harrison (1958) calculated its home range in Peninsula Malaya to have a mean diameter of 280 m.

Harrison (1962) reports that its natural diet is vegetable matter. Wirtz (1972) estimated that in Hawaii it occurred in densities of 70-188 individuals per ha.

Reproduction

On Lombok I. in October 1987 only two of the 18 females examined were pregnant (from Kuta) and none were lactating. One of the pregnant females had only a single foetus which had a crown to rump length of 20. The other pregnant female had four embryos in the right uterine horn (each uterine swelling *c.* 6 in diameter); the contralateral horn had 4 implantation scars. Two females from Pos Tiga, Rinjani, appeared to have each recently given birth to three young; their uterine horns appeared to be still involuting. Nine were non-parous ('thread' uteri, no implantation scars, and tiny teats) and five were parous. The parous females had implantation scars roughly equally distributed between the uterine horns. The mean number of implantation scars was 4.6 (1-7) suggesting that some of these parous females had bred twice. A juvenile weighing 15.5 g was collected at Batu Koq on 1 October 1987.

Wirtz (1972, 1973) found that in Hawaii *R. exulans* females are polyoestrous. In the wild they have a seasonal reproductive cycle with greatest activity in the summer months. They produce one to three litters a year following a gestation period of 19 to 30 days. The average litter size is about four and they are weaned by three weeks of age. Some females do not reach maturity until the season following their first winter. They are obviously considerably flexible in their reproductive cycle as in captivity. Wirtz (1972) found that they will breed throughout the year with individuals producing up to 13 litters annually. Harrison (1955, 1956) found that in the Malay Peninsula almost one-third of female *R. exulans* were pregnant throughout the year. Litter size was one to eight young, with a mean value of 4.3. He estimated their life span in the wild to average 3.2 months, with some individuals living 9 months.

Taxonomic Remarks

Schwarz and Schwarz (1967) stated that *R. exulans* may have originated in Nusa Tenggara, possibly on Flores I. Musser (1981) considers that there is no evidence for this assertion and that this species is probably introduced. There have been some 24 names applied to *R. exulans* in the Australasian Archipelago among which Van Strein (1986) recognises 11 subspecies.

The specimens of *R. exulans* collected from Kuta, Lombok Selatan, had spiny fur with prominent guard hairs, while those from G. Rinjani had softer fur with far fewer guard hairs. This change in texture of the pelage of this species with altitude was noted by Sody (1941: 277). He reported that at 1300 m on N. Sumatra their pelage was softer but

that at Cibodas (1400-1450 m), and Garoet, W. Java (1640 m) the fur was still spiny, while at Mid Preanger, W. Java (1700 m), the pelage was softer. The darker form of *R. exulans* with softer pelage has been given the subspecific name of *equile* Robinson and Kloss, 1927 while the lighter coloured and spiny furred form accords with *R. e. ephippium*. Further specimens are required on Lombok I. before a clearer taxonomic appraisal of lowland and highland forms is possible.

Measurements

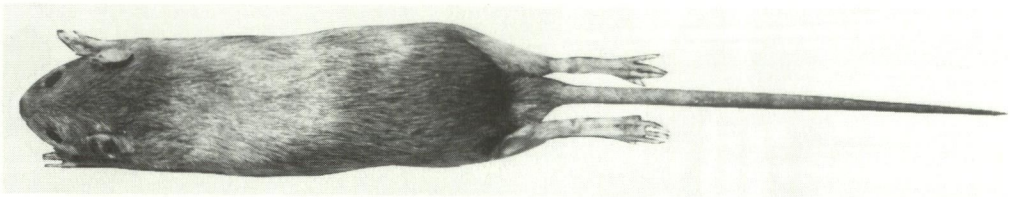
(See Table 6)

Pelage

The colour of adult highland forms dorsally is Deep Neutral Gray tipped with Clay Color mixed with longer hairs tipped with Fuscous Black. Ventrally the pelage is Neutral Gray tipped with Cartridge Buff. On the throat, ventral surface of the legs, behind the elbows and on the flanks the hair is tipped with White. The hair on the feet is Hair Brown becoming White distally and the tail is Hair Brown. The dorsal pelage of adult lowland forms is as for the above except that the longer hairs are Marguerite Yellow tipped with Fuscous Black. These hairs are very numerous, thick and spinous. Ventrally the lowland forms are Pallid Neutral Gray tipped with Honey Yellow mixed with longer, spinous hairs of Honey Yellow. The pelage colour of the rest of the body is as for the highland forms.

***Rattus rattus diardii* (Jentinck, 1880)**

House Rat



Type Locality

W. Java

Distribution

Lombok I., Sumbawa I., Komodo I., Selayar I., N. Sulawesi, Sunda Shelf, Maratua Is, Mentawi Is. Species: also commensal worldwide in tropics and warm temperate zones.

Habitat

On Lombok I. in 1987, six males and one female were collected at Desa Pelangan from gardens and houses. It is considered commensal by Musser (1981) and is reported in Borneo by Payne *et al.* (1985) to occur in most areas of human activity from sea level to 1700 m; these include environs of human habitation, rice fields and oil-palm plantations.

Ecology

Dammerman (1938) reports that on the Krakatau Is the species could often be seen on the ground or running along the branches of low trees fringing the beach and even in the surf zone of the ocean. Ewer (1971) found in Ghana that *R. rattus* formed social groups dominated by a single male and several equally ranking top females which, although subordinate to the dominant male, were dominant to all other members of the group. A group territory was formed.

They are omnivorous. In captivity they have been reported to live four years and two months (Nowak and Paradiso, 1983).

Reproduction

On Lombok I. in October 1987 the single female, collected at Pelangan, appeared to be non-parous. In Ghana, Ewer (1971) observed *R. rattus* to breed throughout the year. The gestation period was 21 to 29 days with litters averaging eight young. Females were able to give birth when aged only three to five months. Medway (1978) similarly reports that this species breeds throughout the year in the Malay Peninsula but has a larger litter size (1 to 11 young) and reaches sexual maturity in about 3 months.

Taxonomic Remarks

There has been considerable discussion as to the taxonomic status of *diardii*. Medway and Yong (1976) considered that this form in the Malay Peninsula and East Indies is a species. We follow Musser (1981) and Van Strein (1986) who list it as one of the 12 subspecies of *R. rattus* in island S.E. Asia.

Measurements

(See Table 6)

Pelage

The colour of the soft dorsal hair of adults is Light Neutral Gray tipped with Clay Color mixed with slightly longer spinous hairs of Marguerite Yellow tipped with Fuscous Black and very long (3 cm) guard hairs of Fuscous Black. The guard hairs become shorter and tipped with White on the rump and legs. Ventrally the soft hair is Pallid Neutral Gray tipped with Cream Buff mixed with longer, spinous hairs of Cream Buff. Short hair around the mouth is White. Hair on the feet is Fuscous Black tipped with Cartridge Buff. The tail is Chaetura Drab.

Carnivora

Family: Viverridae

Viverricula indica baliensis Sody, 1931

Little Civet

Type Locality

Bali I.

Distribution

V. i. baliensis: Lombok I., Species: also Sumbawa I., Bawean I., Kangean I., Java, Sri Lanka, India to S. China and Hainan I., and Malay Peninsula; Bali I.

Habitat/Ecology

On Lombok I., in October 1987 a female was snared during the night at Desa Pelangan by village people in the lowland primary evergreen rainforest near the village. At Desa Kuta a female was poisoned in a banana plantation along with a Common Palm Civet. Medway (1978) states that it is reputed to spend most of its time on the ground and rarely climbs trees. Its diet in India consists of birds, small mammals, frogs, insect larvae, fruit and roots. Roberts (1977) states that in Pakistan it inhabits grassland or forest and probably excavates its own burrow. Lekagul and McNeely (1977) report it as nocturnal and sheltering in clumps of vegetation, buildings and drains. Nowak and Paradiso (1983) consider that it is usually solitary but occasionally associates in pairs. Laurie and Hill (1954) considered that it was introduced to Sumbawa I.

Reproduction

On Lombok I. in October 1987 the female was neither pregnant nor lactating. Medway (1978) reports that in India 3-5 young are born in a chamber at the end of a small burrow, usually under a rock or tree stump or in a field drain.

Taxonomic Remarks

Both Lekagul and McNeely (1977) and Medway (1978) referred to this species as *V. malaccensis* gmelin. However, Nowak and Paradiso (1983) and Van Strein (1986) use *V. indica.* Van Strein (1986) recognises two other subspecies in addition to *V. i. baliensis* in island S.E. Asia. These are: *V. i. atchinensis* Sody, 1931 (Sumatra) and *V. i. rasse* (Horsfield, 1823) (Java, Kangean I., Bawean I., Sumbawa I.). The Lombok I. specimens appear attributable to *V. i. baliensis* because of their tendency to have a series of more or less longitudinal spots on the pelage between the two black neckstripes. These spots are absent in *V. i. rasse* and *atchinensis* (Sody 1933).

Measurements (two specimens only)

Head to vent length 450, 440; tail to vent length 307, 290; ear length 40.8, 31.0; pes length 89.2, 89.6; weight 1.95 kg; greatest skull length 89.3, 98.8; condylobasal length

88.7, 90.6; condylocanine length 82.1, 83.1; zygomatic width 45.8, 40.1; least interorbital width 12.8, 13.2; mastoid width 26.0, 26.6; orbit to gnathion length 26.9, 29.8; braincase width 29.6, 29.7; M^3-M^3 width (alveoli) 21.2, 22.2; C^1-C^1 width (alveoli) 15.6, 15.8; C^1-M^3 length (alveoli) 33.8, 35.5; C^1-M^3 length (alveoli) 37.1, 40.2; dentary length 65.0, 69.2.

Pelage

The colour of the adult is influenced by the spinous hairs that are Fuscous Black basally through an intermediate Cream Color to a Fuscous Black tip. Small spots arranged in longitudinal stripes on the forequarters and larger spots on the flanks are areas in which the individual hairs are mostly Fuscous Black along their length. Along the centre of the lower back the Cream Color is replaced with Buckthorn Brown. There are eight stripes. Neck stripes consist of alternating bands of hair tipped with Fuscous Black (as for the body) and hair tipped only with Cream Color. The tail has eight alternating bands of Ivory Yellow and Chaetura Drab. The legs are Chaetura Drab. A thin stripe of Fuscous Black runs through the line of each eye.

Paradoxurus hermaphroditus rindjanicus Mertens, 1929

Common Palm Civet

Type Locality

Sembaloen-Hochebene, Lombok I., (see Mertens, 1979).

Distribution

P. h. rindjanicus: Lombok I. Species: also Sri Lanka and India to S. China, Hainan I. and Malaysia, Philippines, Bali I., Belitung I., Enggano I., Timor I., Java, Kangean Is, Sumbawa I., Flores I., Komodo I., Selayer I. (?), Sipora I., Pagai Is, Sumatra, Riau Is, Bangka Is, Anamba Is, Simeulue I., Seram I., Aru I., Kai Is, Sulawesi.

Habitat/Ecology

On Lombok I. in October 1987 one was snared during the night by village people at Desa Pelangan in lowland primary evergreen forest close to the village. At Desa Kuta one was poisoned in a banana plantation along with a Little Civet, *Viverricula indica,* only several hundred m from the village. Mertens (1929) lists specimens from the type locality at an altitude of 1200 m and also nearby at 1850 m. Nowak and Paradiso (1983) state that they are nocturnal forest dwellers, excellent climbers and spend most of their time in trees. They are often found near habitation where they shelter in thatched roofs and in dry drain tiles and pipes. They eat small vertebrates, insects, fruits and seeds and were clearly regarded as pests of bananas at Desa Kuta.

Reproduction

Nowak and Paradiso (1983) stated that they breed throughout the year. However, Lekagul and McNeely (1977) noted that in Thailand young are most commonly seen from October to December. Litter size is two to four young. Sexual maturity is gained at 11 to 12 months of age. A captive animal lived for 22 years and five months.

Taxonomic Remarks

Clearly this species is in need of taxonomic review. Different subspecific names have been applied to the forms found on many islands. Van Strein (1986) recognises 16 subspecies and lists a further 10 named forms from island S.E. Asia.

Measurements (one specimen only)

Head to vent length 380.0; tail to vent length 400.0; pes length 70.0; ear length 34.4; greatest skull length 103.8; condylobasal length 100.7; condylocanine length 94.1; zygomatic width 50.2; least interorbital width 16.7; mastoid width 32.9; orbit to gnathion length 34.9; braincase width 33.2; M^3-M^3 width (alveoli) 33.5; C^1-C^1 width (alveoli) 18.0; C^1-M^3 length (alveoli) 40.4; C_1-M_3 length (alveoli) 44.5; dentary length 79.0.

Pelage

This is an extremely dark, nearly black form being Chaetura Black dorsally and a slightly paler Fuscous ventrally. The typical pelage pattern of the nominate subspecies which has three longitudinal stripes besides a row of spots on the back and white on the head, is absent. In the extent of its melanism *P. h. rindjanicus* is similar to the forms on Bali, Sumbawa and Kangean Is (see Sody, 1933).

Family: Felidae

***Felis bengalensis javanensis* Desmarest, 1816**

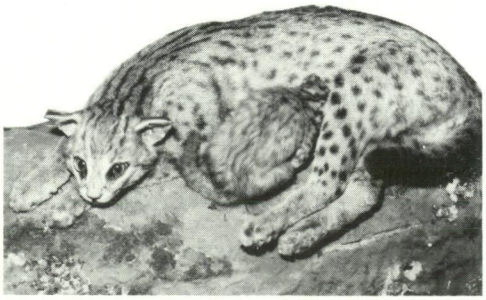
Leopard cat

Type Locality

Java

Distribution

F. b. javanensis: Lombok I., Bali I., Java. Species: also E. Siberia through Korea and N.E. China and most of Oriental region west to Baluchistan and S.E. Taiwan; Philippines and Borneo.



Habitat/Ecology

On Lombok I. one adult male specimen was captured by villagers in hills surrounding Desa Kuta in 1987 and presented to us. Everett in Hartert (1896) also reported their possible presence on Lombok I. but did not substantiate this record with a specimen. Mertens (1929) and later authors omitted this record on Lombok I. as unreliable. Lekagul and McNeely (1977)

state that it is found in many kinds of forest at both high and low elevations; also in plantations and gardens (Payne *et al.* 1985). It has its dens in hollow trees or small caves or under overhangs or large roots. It is mainly nocturnal and is an excellent swimmer which has populated many offshore islands. Nowak and Paradiso (1983) report that it apparently hunts on the ground as well as in trees and feeds on hares, rodents, young deer, birds, reptiles and fish. Medway (1978) remarks that they enter caves to feed on fallen bats. They have been recorded to live 13.5 years in captivity.

Reproduction

Lekagul and McNeely (1977) state that they breed throughout the year in S.E. Asia. If a litter is lost a female may mate and produce another within four or five months. The gestation period is 65 to 72 days. Medway (1978) reports the gestation period as 56 days. Number of young per litter is one to four. They reach sexual maturity at 18 months of age.

Taxonomic Remarks

A.H. Shoemaker in Honacki *et al.* (1982) states that the subspecies of *F. bengalensis* are extremely variable. Van Strein (1986) recognises the following subspecies in addition to *F. b. javanensis* in island S.E. Asia: *F. b. borneoensis* (Brongersma, 1935) (Borneo; Palawan I.; extralimital); *F. b. sumatrana* Horsfield, 1821 (Sumatra, Nias I.) and *F. b. tingia* Lyon, 1908 (Tebing Tinggi I., E. coast Sumatra, extralimital). Guggisberg (1975) lists at least ten recognised subspecies of *F. bengalensis* over its entire distribution. We have tentatively included *bengalensis* in the genus *Felis* following some recent authors (Nowak and Paradiso, 1983), although others (Guggisberg, 1975) place it in the genus *Prionailurus.*

The identity of the cat collected at Lombok I. in October is not immediately obvious from its pelage and markings, this is because it is almost the same size as a number of apparently domestic cats *(Felis catus/silvestris)* seen on Lombok I. (and Sumbawa I.) which also had similar spotted markings and a dull grey base colouration typical of Javan and Balinese *F. bengalensis.*

Identification based on the skull also caused us some early difficulty. Lydekker (1896) and Guggisberg (1975) state that the *Felis (Prionailurus) bengalensis* skull is short, rounded, and has the orbits of the eye sockets open at the back. The anterior upper premolar is usually present. On the other hand Van Peenen *et al.* (1969) report that the orbit of the eye is generally enclosed with bone. The posterior closure of the orbit appears, then to be a variable character as it is in *F. catus* in Australia (although in the skulls we examined it is usually open but to a varying extent). The specimen from Lombok I. has a closed posterior orbit and anterior premolars are present. Pocock (1917) provides an extensive generic distinction separating the *Prionailurus* (including *bengalensis*) from *Felis* (including *catus,* and *silvestris*). On these characters our specimen falls clearly into *bengalensis.* For example, Pocock (1917) states that the skull of *bengalensis* may be separated from *catus/silvestris* by having a narrower skull compared to its length (see Figure 15); less dome-shaped in profile, with the face being less steeply sloped from the interorbital region; frontal postorbital processes narrower, especially from behind, nasals depressed, not everted apically and mesopterygoid fossa narrower.

Measurements (one specimen only)

Head to vent length 515; tail to vent length 195; ear length 39; pes length 118; greatest skull length 89.8; condylobasal length 77.8; condylocanine length 78.9; zygomatic width 57.2; least interorbital width 13.1; mastoid width 35.5; orbit to gnathion length 21.8; braincase width 37.8; M^1-M^1 width (alveoli) 31.5; C^1-C^1 width (alveoli) 20.4; C^1-M^1 length (alveoli) 25.6; C_1-M_1 length (alveoli) 25.6; dentary length 56.0.

Pelage

The generally greyish fur is marked over most of the body by small blackish-brown spots which form nearly transverse bars on the end of the tail. Four longitudinal black bands pass from the forehead over the head to the neck where they break up becoming spots on the shoulders.

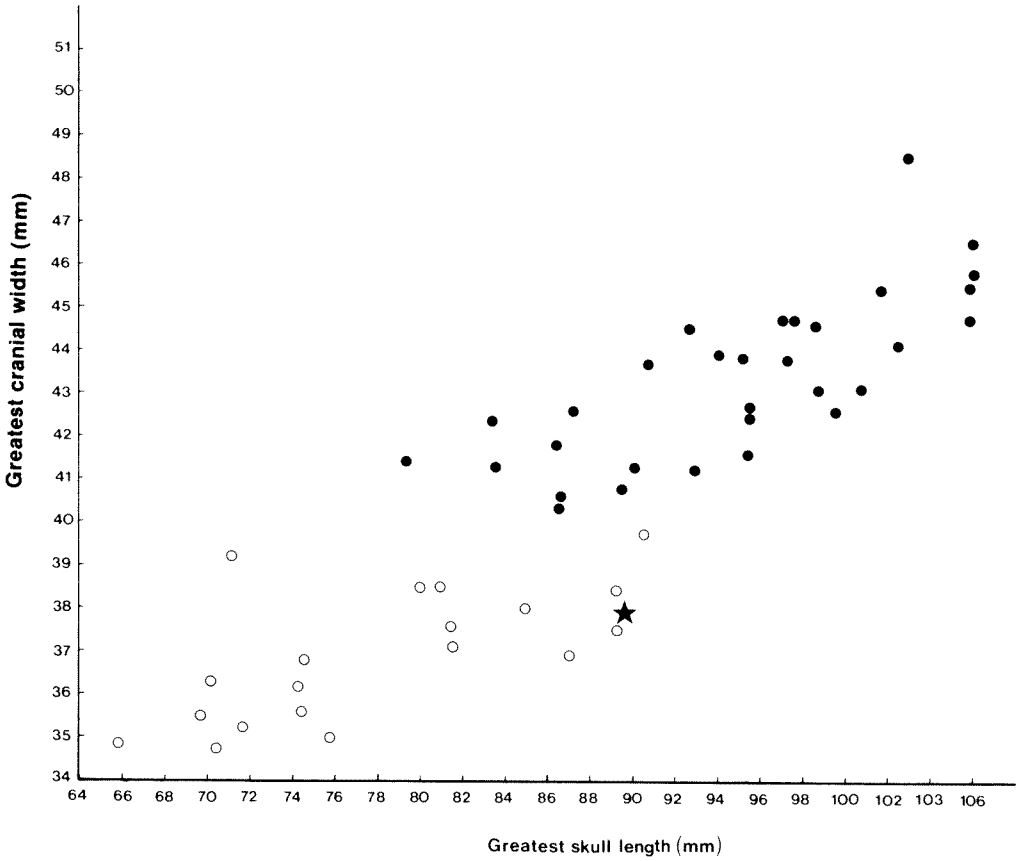


Figure 15: Relationship between greatest cranial width and greatest skull length in *Felis catus* from Western Australia (●), *Felis bengalensis* from Java (○) and *Felis bengalensis* from Lombok I. (★)

Primates

Family: Cercopithecidae

***Macaca fascicularis sublimitus* Sody, 1933**

Long-tailed Macaque

Type Locality

Sumba I.

Distribution

M. f. sublimitus: Lombok I., Sumbawa I., Sumba I., Kambing I., Flores I. Species: also Burma, Thailand, Indochina, Philippines south to Sumatra, Java and Borneo and Timor.

Habitat

Common on Lombok I.; occur in all habitats from sea level to at least 1700 m altitude. Kawamoto *et al.* (1984) considers that they prefer riparian zones, secondary forest, mangrove swamp and the environs of human habitation. They were seen as pets in all villages visited on Lombok I. (Figure 16). Although Kawamoto *et al.* (1984) state that population density is low in primary forest, sighting of individuals and pairs were common in primary forest on Gunung Rinjani.

Ecology/Genetics

Kawamoto *et al.* (1984) carried out an electrophoretic study of this species at three localities on Lombok I. (Suranadi, Kuta and Gunung Pengsong) as well as Sumatra, Java, Bali and Sumatra Is. They concluded that on Lombok I. (and Bali and Sumbawa Is) troops were relatively homogeneous genetically but that the island populations were genetically less variable than continental counterparts. This they attributed to genetic drift.

Marked genetic differentiation was observed among the troops of *M. fascicularis* on different islands. There is controversy as to whether *M. fascicularis* occur east of Wallace's line as a result of human introduction, as was thought to have been the case by Darlington (1957) and Medway (1970), or to have occurred in the Pleistocene (Fooden, 1975). However, Aimi *et al.* (1982) carried out a rather cursory morphological study of this species from central and north Sumatra, Bali I., Lombok I. and Sumbawa I. and concluded that the Lombok I., and Bali I. populations were very similar. On the basis of their morphological similarity and their statement that "this macaque is a good swimmer and is distributed on many islands" they conclude that their distribution on Lombok I. is a natural one. In a later study Kawamoto and Suryobroto (1985) showed that genetically the Lombok I. population of this species was closer to that on Bali I. than to those on Sumbawa I., or Timor I., they concluded that this pattern of island association favoured the human introduction hypothesis.

Figure 16: The Long-tailed Macaque, *Macaca fascicularis,* common as pets throughout Lombok I.

Nowak and Paradiso (1983) state that this species will feed on crabs, other crustaceans, shellfish and other littoral animals exposed by tides. Koyama (1984) states that they also eat termites, cockroaches, cicadas, moths and carpenter bees. They have been reported to occur in densities of 36-90/sq km and Schaik and Noordwijk, (1985) record that they have home ranges of 42-125 ha. Koyama (1984) reports that at Gunung Meru, W. Sumatra, adult males and adult females made up about 10 percent and 30 percent of the population, respectively; the remainder were juveniles. Troop size ranged from 27-43 individuals. Survival rate of adult males, adult females and juveniles was 50 percent, 84 percent and 36 percent, respectively. Many males emigrated from their troops but females seldom moved from their natal troop. Other workers report group sizes range from 26.0-48.5 (Schaik and Noordwijk, 1985). Koyama (1984) reported a good deal of aggressive behaviour. Most adult male aggression is directed at other adult males; there is a linear dominance hierarchy between adults of the same sex in each troop. Galdikas and Yeager (1984) report that the species is preyed upon by crocodiles in Borneo. Medway (1978) reports that the species is a pest in some areas because of its raids on fields and gardens.

Reproduction

Fooden (1971) states that there is apparently a spring birth peak in this species in Thailand. Nowak and Paradiso (1983) state that the oestrus cycle is 24-52 days and the gestation period 160-170 days. Sexual maturity is usually reached in 2.5 to 4 years in females and 2 or 3 years later in males; a zoo individual lived to be 37 years old.

Taxonomic Remarks

Van Strein (1986) recognises 11 subspecies of *M. fascicularis* in island S.E. Asia, although more than 20 subspecies have been recognised over its known range. Kawamoto and Suryobroto (1985) stated that those on the "main body of the Sunda Is. are classified into four subspecies: *M. f. fascicularis (= M. i. irus)* for Sumatra and Borneo, *M. f. mordax (= M. i. mordax)* for Java and Bali, *M. f. sublimitus (= M. i. sublimitus)* for Lombok, Sumbawa and Flores, and *M. f. limitus (= M. i. limitus)* for Timor". Kawamoto and Suryobroto (1985) consider on the basis of his genetic studies that their classification is unacceptable. Although they do not propose an alternative taxonomy, presumably the Lombok I. form should be linked with that from Bali I. on the genetic evidence perhaps retaining the name *M. f. mordax* Thomas and Wroughton, 1909. Sody (1949) states that the single Lombok I. specimen that he examined differed from others from Sumba, Flores, Sumbawa and Kambing Is and only tentatively considered it consubspecific with *M. f. sublimitus.*

Measurements

(not available)

Pelage

The coloration is usually yellowish brown above and lighter below.

Trachypithecus auratus kohlbruggei Sody, 1931
Silvered Leaf Monkey

Type Locality
Bali I.

Distribution
P. c. kohlbruggei: Bali I., Lombok I. Species: also Peninsula Burma, Thailand, Malaysia, Sumatra, Java.

Habitat
Common on Lombok I.; seen in groups of one or two at Suranadi and at Rinjani from the base to 1700 m. The largest grouping was five individuals near Suranadi. In Borneo and Malaya they occur in many kinds of coastal, riverine and swamp forests, both tall and secondary and in tall forests inland from lowlands to hilltops (Medway, 1978; Payne *et al.*, 1985).

Ecology
Medway (1978) reports that in the Malay Peninsula they normally associate in groups of 6-20, but also occur as individuals. They eat young leaves and shoots. Everett (1896: 593) stated this species (as *Semnopithecus maurus*) was "certainly introduced by the Balinese Rajahs and is now abundant in the hills from Ampenan to Rinjani".

Reproduction
Medway (1978) states that oestrus occurs in captive females at regular intervals of approximately three weeks. The gestation period is *c.* 20 weeks. Normally only one young is born. New born young have been recorded only in the early months of the year.

Taxonomic Remarks
Sody (1931) states that the form *kohlbruggei* is smaller and not as white in the pelage as the Javanese form. This species was previously called *Presbytis cristata*. We have followed Weitzel and Groves (1985) in referring the Lombok I. form to *T. auratus*.

Measurements
Skull measurements from a juvenile male and a subadult male from "Waldoberhalb, Sapit, Lombok I." in the collections of the Museum Zoologicum Bogoriense MZB 6600 and MZB 6689.

Greatest skull length 85.2, 100.4; condylobasal length 63.0, 79.2; condylocanine length 58.2, 75.6; zygomatic width 62.5, 74.2; least interorbital width 7.0, 10.7; braincase width 59.5, 62.7; nasal length 11.6, 11.6; bulla length 24.2, 28.9; maximum distance between bullae 5.6, 5.9; maximum diameter of orbit 20.3, 25.5; C^1-M^1 (alveoli) 22.6, 30.2; M^1-M^1 width (alveoli) 29.6, 36.1; M^1 length x width (crown) 7.0 x 6.9, 6.9 x 6.9; dentary length 52.2, 69.8; greatest dentary height 31.7, 42.2.

Pelage

A well-defined row of stout black hairs or bristles is located across the eyebrows. Uniformly coloured; the upper parts generally blackish, the underparts paler.

Artiodactyla

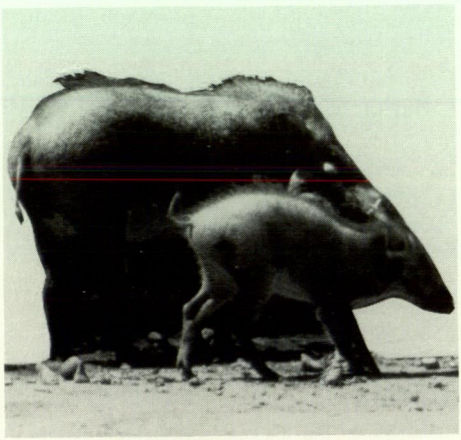
Family Suidae

***Sus scrofa vittatus* Boie, 1828**

Wild Pig

Type Locality

Sumatra



Distribution

S. s. vittatus: presumably Lombok I; Sumbawa I., Komodo I., Bali I., Java and offshore islands of Peucang; Bulan I., Jeri I., Ungar I., Batam I., Riau Archipelago; Sumatra; Peninsula Malaya, Terutao I. and Langkawi I.

Habitat

Not seen on Lombok I. in 1987. Wallace (1886: 155) reports the occurrence of numerous wild pig at Labuan Tring, S. of Ampenan in 1856. Everett (1896) observed that wild pig of unknown species were abundant on Lombok I. Laurie and Hill (1954: 86) state that pigs of the *vittatus* group (= *scrofa*) probably occur on Lombok I. Van Strein (1986) reports that "wild pigs of uncertain affinities" occur on Lombok I. and that feral or hybrid populations are found throughout the area. On Java, Groves (1981) states that wild pig inhabit alang-alang fields, scrub, secondary, tidal and teak forests and mountainous regions.

Ecology

Groves (1981) provides a translation of Sludskii's (1956) Eurasian study of the ecology and behaviour of *Sus scrofa* which is summarised below. The Eurasian species is mainly herbivorous, eating roots, shoots, leaves, rushes, reeds and berries. However, in certain times they will eat locusts, carcases of large animals, bird nestlings and eggs. Groves (1984) states that in Java wild pigs (two species) also eat fallen fruit, small rodents, snakes, insect larvae, deer fawns and perhaps occasionally domestic animals.

The basic social group in Eurasia is an adult sow and her offspring (males up to 1.5 years and females up to 2.5 years). Other males are solitary. Gestation averages 140 days

but may be less for young adult females. Litter size appears to vary with geography, varying from 4 to 6.

Groves (1981) states that there is confusion as to the mating season in Java. Hoogerwerf (1970) reports striped piglets in W. Java from October to January but notes that elsewhere they have been seen during a variety of seasons. The species makes nests, the largest measured by Hoogerwerf (1970) was three m in diameter.

Taxonomic Remarks

Groves (1981) states that the wild pig on Lombok I. is presumably *S. s. vittatus* and states that there is enormous geographic variation in size in this subspecies. He considers that the extention of this race east of Wallace's line is probably natural because pigs are such good swimmers.

Measurements (from Groves 1981: 78; Bali values, followed in brackets by Sumbawa values; mean, standard deviation if more than two specimens; sample size)

Greatest skull length 289.0 ± 8.08, 4 (284, 2); zygomatic width 122.0 ± 6.68, 4 (123.0, 2); total skull height 174.0 ± 9.53, 4 (175.5, 2); nasal length 139.0 ± 6.98, 4 (135.5, 2); M^3 length 29.5 ± 3.70, 4 (29.0, 2).

Pelage (from Groves 1981: 40)

"Brown or agouti; shafts black, tips or bands straw-coloured, yellow, ochre, or reddish; legs black; snout usually with yellow or white snout and mouth gonion bands; mane fairly long, often red or yellow-tipped. Body hair very sparse, with no underwool."

Family: Cervidae

***Muntiacus muntjak nainggolani* Sody, 1932**

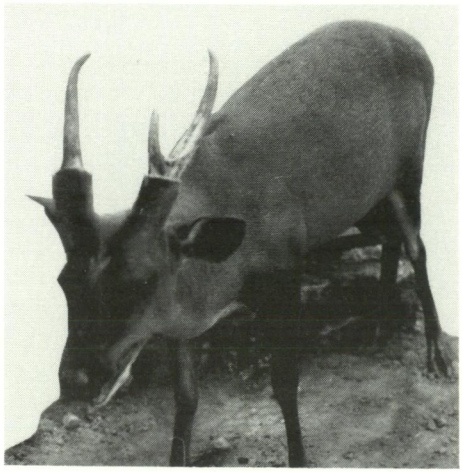
Barking Deer

Type Locality

Bali I.

Distribution

M. m. nainggolani: Lombok I., Bali I. Species: also Java, Kangean I., S. Sumatra, Nias I., Borneo I., Bawal and Matisiri Is, Bangka I., Belitung I., Bintan I., Riau Is, Lingga I. (?), Sri Lanka; India to S. China and Hainan I. Indochina.



Habitat

Not observed on Lombok I. in 1987 but reported there by Pohle (1950), Laurie and Hill (1954) and Van Strein (1986). Everett (1896) suggested that they were introduced into Lombok I. by the Balinese Rajahs. In the Malay Peninsula they are widespread in forest from the lowlands to the hills (Medway, 1978).

Ecology

In the Malay Peninsula they are generally solitary and active during both the day and night and feed by browsing on leaves of shrubs and herbs (Medway, 1978). In Sri Lanka, Barrette (1977) found them to be "nibblers" of fallen fruit and soft leaves; when they browse they eat only tender leaves, buds and flowers and are most active just after sunrise and just before sunset. Hoogewerf (1970) observed a slight preponderance of females in the adult population on W. Java as did Barrette (1977) in Sri Lanka. Barrette (1977) observed that individuals showed a strong fidelity to a restricted area. He quotes values for their home range of 4 to 5 km^2 with a density of 1.5 to 2.5 adults per Km^2. He observed them to be shy and seldom venturing into the open. They were usually solitary but almost one-third of sightings were of a pair comprising an adult male with an adult female. There is apparently a good degree of fighting between individuals, particularly males, as about half the males seen by Barrette had some injuries.

Reproduction

Barrette (1977) found that on Sri Lanka reproduction occurred throughout the year as it probably does in Burma and W. Java. He notes, however, that there are reports that muntjaks in N. India and China have a definite breeding season in the "cold weather". In the Malay Peninsula, Medway (1978) reports that there is no evidence for a specific breeding season. However, Lekagul and McNeely (1977) state that in Thailand mating occurs in December and January with births in June or July. Gestation is approximately seven months; oestrus lasts less than 48 hours.

Taxonomy

Van Strein (1986) recognises seven subspecies of *M. muntjak* in island S.E. Asia.

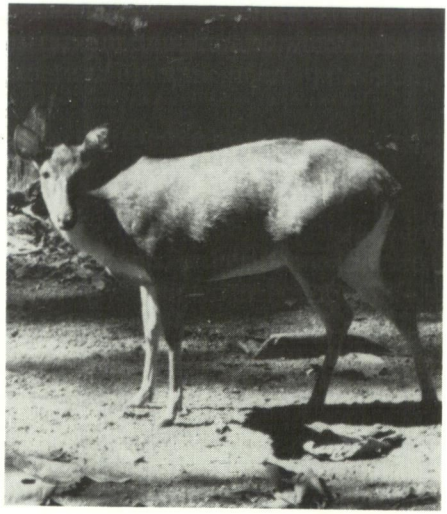
Measurements (not available)

Pelage

The body is covered with short, soft hairs, except for the ears which are sparsely haired. Coloration varies from deep brown to yellowish or grayish brown with creamy or whitish markings.

Cervus timorensis floresiensis (Heude, 1896)

Rusa Deer



Type Locality

Adonara I. and Ilimandiri, Flores.

Distribution

C. t. floresiensis: Lombok I., Sumbawa I., Komodo I., Rintja I., Adonara I., Flores I., Solor I., Sumba I. Species: also Timor and Roti Is, Senau I., Pulau I., Kambing I., Alor I., Pantar I., Buton I., Muna I., Banggai I. (?), Selayar I. (?) Sula Is, Halmahera I., Batjan I., Banda I., Nusa Barung I., Java, Sepandjang I., Kangean Is, Bali I., Sulawesi, Buru I., Seram I., Molucca Is. Introduced: S.E. Borneo, Obi I., Ambon I., Aru Is, New Guinea, N. Australia, New Zealand, New Britain Is, Sulawesi, (see Laurie and Hill, 1954: 90).

Habitat/Ecology

In 1987 two were seen in captivity at Suranadi Recreational Park. Recorded from Lombok I. by Mertens (1929) and more modern authors. Wallace (1886: 155) reports "plenty" of deer were rumoured to be present at Labuan Tring south of Ampenan. Everett (1896: 593) states "of *Ungulata* the island has a deer". Payne *et al.* (1985) state that it is found in open grassland in Borneo. Like most deer Rusa are very good swimmers and will readily cross water. For example, Bentley (1983) states that a herd of Rusa from the Mollucca Is was liberated on Friday I., Torres Strait. These deer swam from there to Prince of Wales I. where the main herd is now located. Bentley (1983) states that their preferred diet appears to be grass; they will drink sea water when fresh water is not available and also will eat certain seaweeds. Rusa are gregarious but males form separate groups from females and young except during the breeding period.

Reproduction

Bentley (1983) states that in Australia breeding occurs throughout the year, with mating activity at a peak from late June to August and a corresponding calving peak from about March to April. The Moluccan Rusa in Torres Strait mates in September and October with calves born in April and May. Antlers are usually cast in January or February in Australia.

Taxonomic Remarks

The rusine deer of island S.E. Asia were revised by Van Bemmel (1949, 1951). Van Strein (1986) follows this revision and recognises eight subspecies in island S.E. Asia. Human introductions and the facility with which this species crosses water barriers means that recognition of natural taxa of this group will probably await the integration of further detailed morphological and genetic studies.

Measurements: (from Bentley, 1983; mean, range)

Head and body length: males 157 (152-185) cm; females 149 (142-165)cm; tail length: males *c.* 20 cm, females *c.* 20 cm; shoulder height: males 94 (93-109) cm, females 86 (83-89) cm; weight: males 73 (58-115) kg, females 53 (50-75) kg.

Pelage

Greyish-brown, often rough and coarse in appearance.

Pholidota

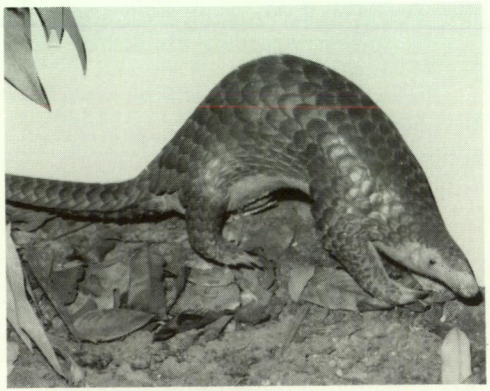
Family: Manidae

Manis javanica Desmarest, 1822

Pangolin

Type Locality

Java



Distribution

Lombok I., Bali I., Karimata Is, Nias I., Pagai Is, Natuna Besar I., Lingga Is, Sumatra, Bangka I., Belitung I., Riau I., Borneo I., Calamian Is, Culion I., Palawan I., Burma; Thailand, Indochina.

Habitat

On Lombok I. in 1987 two animals seen at Pelangan; village people report them as reasonably common in the surrounding primary lowland evergreen forests. They are caught for food and are considered a delicacy. They may be purchased for about 5000 rupiah. They were not reported from other localities visited in 1987. Medway (1978) reports them as common throughout the Malay Peninsula in primary forest and also in gardens and plantations. Payne *et al.* (1985) state that in Borneo they occur from lowlands up to 1700 m altitude on Gunung Kinabalu.

Ecology

Nowak and Paradiso (1983) state they are usually solitary or sometimes associated in pairs. They are largely terrestrial although they can climb well with the aid of their prehensile tail (Medway, 1978). Their diet consists mainly of ants and termites; other soft-bodied insects and larvae are taken on occasions. They are extremely powerful; the animal captured at Pelangan in 1987 destroyed and escaped from a large solid wire animal trap in which it was being held captive. These traps are designed to hold medium-sized animals, such as civets.

Reproduction

Medway (1978) states that normally only one young is born, fully covered in scales, which is carried on the back of its mother. Nowak and Paradiso (1983) report that scattered records suggest that some populations are capable of breeding throughout the year.

Taxonomic Remarks

Van Strein (1986) recognises only the one species in island S.E. Asia; although four species have been described for this region.

Measurements (from Payne *et al.,* 1985 for Bornean specimens range only)

Head and body length 397-645; tail length 351-565; hind foot length 61-97; weight, up to 7 kg.

Pelage

Elongate and tapering body, covered above with overlapping scales. Scales are lacking on the snout, chin, sides of the face, throat, belly and inner surface of the limbs. The colouration of the scales is pale olive. The hairs of the scaleless areas and the chin are grayish. Three or four hairs are present at the base of each scale.

Insectivora

Family: Soricidae

Crocidura (?)monticola Peters, 1870

Sunda Shrew

Type Locality

Gunung Lawu, Java

Distribution

Lombok I.(?), Flores I.(?), Sumba(?), Timor I.(?), Java, Borneo, Malay Peninsula.

Habitat

Not collected on Lombok I. in 1987. Reported from 1500 m altitude on G. Kinabalu, Sabah, by Payne *et al.* (1985) who state that it is probably widespread in upland forests.

Taxonomic Remarks

Laurie and Hill (1954) state that *C. monticola* Peters, 1870 occurs on Java, Nusa Tenggara Is (Lombok I., Sumbawa I., Komodo I., Flores I., Sumba I. and probably Timor I). However, Jenkins (1982) considers it unlikely that *C. monticola* is present on all the islands listed by Laurie and Hill (1954) but that it is sympatric with or replaced by, at least one other species — *C. maxi*— on some of these islands. Jenkins (1982) states that

C. monticola averages smaller than *C. maxi,* with "a short, broad skull in which the braincase is short, rounded and deep. In profile the skull slopes very gently upwards from the rostrum to the lacrimal region, then abruptly steepens so that the top of the braincase is distinctly above the rest of the skull. In contrast *C. maxi* has a longer, more slender skull in which the braincase is longer, narrower and shallower in relation to skull length than in *C. monticola;* in profile the skull slopes gently upwards from the rostrum to the back of the braincase."

Jenkins (1982) identified *C. maxi* on E. Java, Flores I., Sumba I. and Amboina I. It is possible that the species on Lombok I. (we have not been able to examine a specimen from Lombok I.) may be *C. maxi,* or both *C. maxi* and *C. monticola.*

Measurements [from Jenkins, 1982: 274. Mean, range for *C. monticola* (N = 15) and followed in brackets by values for *C. maxi* (N = 25)]

External length of upper unicuspids 1.76, 1.5-1.9 (2.13, 2.0-2.3); height of braincase 4.14, 3.9-4.8 (4.04, 3.5-4.4); ratio of height of braincase to upper tooth row length 59.63, 55.7-66.7 (51.34, 46.7-55.3); height of mandible at coronoid process 3.64, 3.3-4.0 (4.29, 3.9-4.9); length of mandibular tooth row 5.09, 4.5-5.2 (5.37, 5.0-5.7).

Pelage

Overall grey brown; tail paler.

General Discussion

The Wallacean islands have long fascinated biogeographers. Wallacea is described by Darlington (1957) as a zone of subtraction and transition. The subtraction or absence of strictly freshwater fishes and the poor representation of terrestrial mammals in Wallacea is as notable as the transition which occurs in this region for other Oriental to Australian animals from west to east. However, Simpson (1977) considered that Wallacea is not a truly transitional zone but is a unique region of its own.

Our detailed understanding of the nature of the mammal fauna in the southern part of Wallacea straddled by Nusa Tenggara is, however, dependent on more thorough surveys of the mammals of Nusa Tenggara than are currently available. Mayr (1944) considered that for birds the Lombok Strait was of much greater significance as a distributional barrier than the other major water barriers between Nusa Tenggara islands to the east (Alas, Sape and Flores Straits). Based on presence or absence of bird species Mayr (1944) considered that the dividing line between the Oriental and Australian birds lay to the east of Wallace's line. However, Lincoln (1975), who counted number of individuals in the bird families from Java to Sumbawa Is, observed that the most conspicious break between these continental bird faunas was indeed between Bali and Lombok Is. Mayr (1944) and particularly Lincoln (1975) drew attention to the importance of the increasing trends in aridity from W. Java through to E. Nusa Tenggara and the concommittent impact of this drier environment on availability of suitable habitat for birds. Lincoln (1975) states that on the drier islands to the east there is a wider variety of seed and nectar

eating birds taking advantage of the many flowering trees and shrubs. On the wetter western islands fruit-eating species are more abundant in response to greater availability of berries and fruits on these islands.

Darlington (1957) notes that whereas Java has an excellent representation of Oriental mammals (see list in Heaney, 1986), few of these extend further east. Bali I., for example, does not share the main part of the Javan mammal fauna. Darlington (1957) states that the mammals which reach Bali I. but not Lombok I. include a tree shrew *(Tupaia javanica),* two monkeys *(Macaca fascicularis, Trachypithecus auratus),* a scaly anteater *(Manis javanica),* two squirrels *(Ratufa bicolor, Callosciurus notatus),* the Leopard Cat *(Felis bengalensis)* and the Tiger *(Panthera tigris).* He also notes that only one civet *Paradoxurus hermaphroditus* is on Lombok I. Our survey of Lombok I. records that the list of species shared by Bali and Lombok Is is greater than supposed by Darlington (1957) and includes also *Macaca fascicularis, Trachypithecus auratus, Manis javanica, Callosciurus notatus, Felis bengalensis, Viverricula indica* and perhaps *Ratufa bicolor.*

Comparison between the ground and bat mammal faunas of Bali and Lombok Is (see Van Strein, 1986; Kitchener and Foley, 1985; and this report) also shows murid rodents and bats occurring on Bali I. that are absent from Lombok I. These are *Niviventer bukit, N. cremoriventer, Chiropodomys gliroides, Macroglossus sobrinus, Taphozous longimanus, Nycteris javanica, Coelops frithii, Hipposideros bicolor, H. galeritus, Rhinolophus celebensis, R. luctus, Myotis formosus, M. horsfieldii and Pipistrellus macrotis.* Considering that our rather brief survey of Lombok I. increased the known chiropteran fauna on that island by 24 species, it can be expected that more extensive field studies on Lombok I. will further reduce the differences in the mammal species common to these two islands.

Based on knowledge of the bat fauna in Nusa Tenggara current at the time of their study, Holloway and Jardine (1968) concluded from a cluster analysis, based on coefficients of faunal dissimilarity, that the bat fauna of Nusa Tenggara was the most distinct of all the regional groups that they examined including China/Formosa, and most of the major islands in S.E. Asia. They showed that the Nusa Tenggara bat fauna was far removed from Java and Bali I. They concluded that there was a distinct intercontinental or "Wallacean" region "but that the Lesser Sunda Is (Nusa Tenggara) are excluded from this, appearing as a distinct region". Our observations on Lombok I. and Sumbawa I. (unpublished data) and those of Goodwin (1979) for Timor I. show that the bat fauna of Nusa Tenggara is not particularly distinct from adjacent oriental bat faunas but in large part represents a transitional zone. A more detailed examination of these relationships will be attempted at the completion of our field work.

However, the modern mammal fauna of Nusa Tenggara is not merely a transitional zone between the Oriental and Australian faunas. On our existing understanding of taxonomy, the bats *Pteropus lombocensis, Acerodon mackloti, Cynopterus terminus, Hipposideros crumeniferus, Rhinolophus simplex, Kerivoula flora,* murid rodents *Papagomys armandvillei, Komodomys rintjanus* and the shrew, *Suncus mertensi* are endemic to these islands. Additionally, a number of subspecies of mammals are endemic to these islands. Clearly Simpson's (1977) view that Wallacea is a unique region with a fauna worthy of study in itself is very true of Nusa Tenggara.

There is no evidence that any of the species of Lombok I. mammals not endemic to Nusa Tenggara are other than Oriental in origin. This indicates that the boundary between the Oriental and Australian mammal faunas must be located to the east of Lombok I.

The much greater similarity between the mammal fauna of Lombok and Bali Is than was supposed by earlier workers caused us to examine more closely the relationship between these two dry land masses during the Pleistocene. Heaney (1985) considered that drawing a line around areas that are less than 120 m below sea-level in the Philippines, is likely to provide an accurate estimate of the extent of dry land area. This is because geological uplifting and subsidence since late Pleistocene would have changed the interpretation of the picture little. Similarly the 160 m bathymetric line would suggest, probably less accurately, the dry land area at the maximum Pleistocene glaciation. Using the 120 and 160 m bathymetric lines, drawn from joining data points in the British Admiralty Charts, January 1980 Edition, it is apparent (Figure 17) that the Lombok Strait was not the extensive water barrier supposed by Mayr (1944), who described it as 15 miles (24.1 km) wide and 315 m deep. There is, in fact every possibility that a southern corridor existed between S.E. Bali and S.W. Lombok, joined through Nusa Penida I., during the maximum lowering of Pleistocene seas. Wallace's (1886) account of the seas in the Lombok Strait suggest that erosion channels would be cut in the sea floor between Nusa Penida I. and the adjacent Bali and Lombok Is.

For example, Wallace (1886: 153) writes of the Lombok Strait that during spring-tides the seas can be very turbulent and that violent surf on the beaches near Mataram "increases suddenly during perfect calms, to as great a force and fury as when a gale of wind is blowing ... This violent surf is probably in some way dependent on the swell of the great southern ocean, and the violent currents that flow through the Straits of Lombok. These are so uncertain that vessels preparing to anchor in the bay are sometimes suddenly swept away into the Straits, and are not able to get back again for a fortnight! What seamen call the 'ripples' are also very violent in the straits, the sea appearing to boil and foam and dance like the rapids below a cataract; vessels are swept about helpless, and small ones are occasionally swamped in the finest weather and under the brightest skies." Recent studies by Murray and Dharma (1988) document the extent of the flow of water through the Lombok Strait observed by Wallace (1886). These authors found that the throughflow of water through this Strait from the Pacific to the Indian ocean may account for 20 percent or more of the total throughflow for the entire Archipelago. Further, they suggest that the transport of water into the Indian Ocean through the Lombok Strait alone was as large as was previously attributable to the entire Archipelago.

At present there is a narrow, perhaps less than 400 m wide, corridor of deeper water between the Bali and Nusa Penida island shelves. Few depth measurements are available for this corridor but they are as low as 184 and 214 m below the present sea level. Murray and Dharma (1988) state that the maximum depth of these corridors is about 350 m. It is possible that this represented a very narrow shallow water channel during the maximum Pleistocene glaciation between Bali and Nusa Penida Is. This is far from the formidable barrier supposed by Mayr (1944). It is equally likely that there was continuous dry land

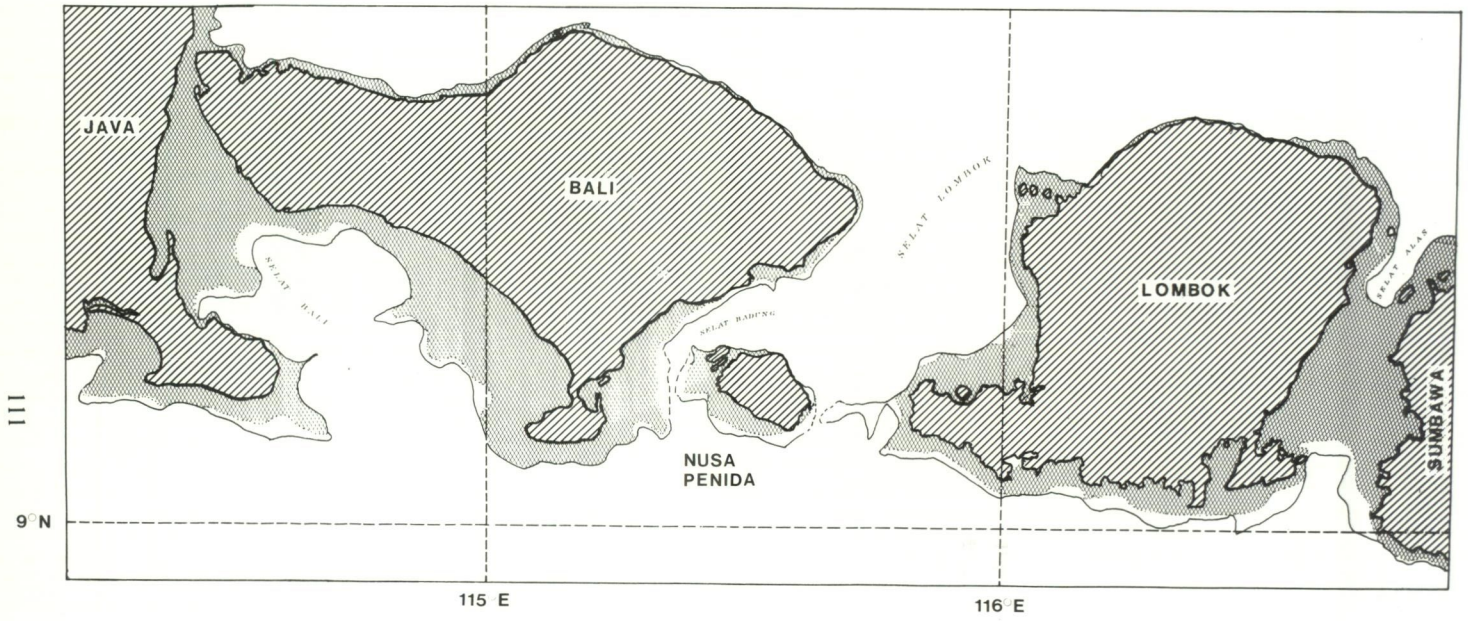


Figure 17: Relationships between the dry land masses of East Java, Bali, Nusa Penida, Lombok and Sumbawa Is from the present (striped), recent Pleistocene (stippled) and Pleistocene maximum glaciation (white) (see text for details). It is believed likely that a southern corridor of dry land, which included Nusa Penida I., linked Lombok I. to Bali I, sometime in the Pleistocene. Lombok I. was almost certainly joined to Sumbawa I. for long periods during the Pleistocene.

between Bali, Nusa Penida and Lombok Is during the Pleistocene and that this slightly deeper corridor between Nusa Penida and Bali is a post-Pleistocene erosion channel resulting from the north to south passage of water through the Lombok Strait. It is not clear whether or not a similar slightly deeper corridor (more than 160 m) exists between Nusa Penida and Lombok Is.

It would appear, then, that the Lombok Strait may not have been a major barrier to the movement of mammals between Bali I. and Lombok I. throughout the Pleistocene, and that the elements of the mammal fauna that are impoverished on both Lombok and Bali Is result from the reduced habitat diversity of these islands no doubt in response to their drier climate and small area.

It is also possible, as mentioned by Mayr (1944), that the relatively recent origin of the islands of the inner Banda arc has limited the number of chances of their colonisation by mammals and that the frequency of volcanic eruptions on these islands (and Java) has exterminated elements of the fauna. For example, Stresemann (1939) noted that the heavy Pleistocene eruptions of Gunung Rinjani seems to have destroyed much of the mountain fauna on Lombok I.

While it is possible that mammals arrived on Lombok I. across land bridges, it remains curious that all the mammal species on Lombok I. (excluding bats) are known to be either human commensals, are kept as pets, or do very well in environments disturbed by humans (Laurie and Hill, 1954; Musser, 1987). It remains possible that they were transported to Lombok I. by humans.

There can be little doubt that Lombok I. has relatively fewer squirrels, civets and murid rodents than occur on other small islands in island S.E. Asia which have moister climates. Heaney (1984) provides species versus area equations for ground mammals (excluding bats) of a number of islands on the Sunda Shelf. Using these equations an area the size of Lombok I. in the Sunda Shelf would have approximately 37 species. This is more than twice the number of species currently recorded on Lombok I. (17). Most interestingly, though, Heaney (1984) also presents a predictive model which includes elevation of an island as a variable. When the elevation of Lombok I. is taken into account, it can be predicted that Lombok I. should have about 99 species of ground mammals if it were situated on the Sunda Shelf. Clearly the mountainous parts of the island contribute little to the richness of mammal species on Lombok I., reinforcing Stresemann's comments that Pleistocene volcanic activity on the island may be an important factor contributing to its impoverished fauna.

It cannot, however, be argued that the chiropteran fauna of Lombok I. is notably depauperate. Although Lombok I. has no representatives of the pteropodid bats of the subfamilies: Harpionycterinae (one species, Sulawesi); Nyctimeninae (nine species, predominately New Guinea and Outer Banda arc islands, also Sulawesi, Halmahera); or the families Rhinopomatidae (one species, Sumatra) and Nycteridae (two species, widely distributed including Bali I.) the number of its species representative of the remaining chiropteran families is proportionately very close to that for island S.E. Asia as a whole (Table 7). Further, although comparative data are not yet available, from field experience the species diversity of bats mist-netted on Lombok I. would appear comparable to that for parts of W. Java, Krakatau Is, Seram I, Indonesia and Negros and Leyte Is, Philippines.

Table 7: Number of species of chiroptera by family and subfamily on Lombok I. and in the Australasian Archipelago (data from Van Strein, 1986). The proportion of the totals for these suprageneric groupings are in brackets.

	Lombok I.	Australasian Archipelago
Megachiroptera		
Pteropodidae		
Pteropodinae	11 (31)	57 (27)
Macroglossinae	2 (6)	9 (4)
Microchiroptera		
Emballonuridae	1 (3)	12 (6)
Megadermatidae	1 (3)	1 (<1)
Rhinolophidae	4 (11)	22 (10)
Hipposideridae	2 (<5)	27 (13)
Molossidae	1 (<1)	14 (7)
Vespertilionidae		
Vespertilioninae	6 (17)	36 (17)
Miniopterinae	2 (6)	7 (3)
Murininae	3 (9)	9 (4)
Kerivoulinae	4 (11)	17 (8)

Data for comparison of species diversity of bats on Lombok I. are available for the five major collecting sites on Lombok I. in September-October 1987 (Table 8, Appendix II). These data show that the species diversity at the three sites from sea-level to 50 m altitude [Kuta (0 m), Pelangan (50 m)], is approximately the same (5.97-6.13), the greatest diversity was at 200 m at Suranadi (8.87). However, at Batu Koq (400 m) the species diversity has fallen slightly to 4.65 and at 1700 m on G. Rinjani it has dropped to only 2.00.

It was interesting that at 400 m altitude at Batu Koq, although the species diversity of chiroptera had fallen markedly from the values at lower locations, the overall abundance of bats, using numbers caught per unit collecting effort, was similar to the values at lower altitudes (see Table 8). The number of species of bats collected in increasing altitudinal sequence from Kuta to G. Rinjani from all sources (including hand collection and bat-trapping) in September and October 1987 was 14, 14, 19, 9 and 2. These numbers, taken in conjunction with the number of species that were mist-netted only at these localities (see Table 8), emphasise the richness and diversity of Suranadi for bats. Also at Pos Dua (*c.* 1200 m) only one animal *(Rhinolophus affinis)* was mist-netted. No bats were sighted at 1200 m and 1700 m on Rinjani and very few were heard. Also the only ground mammal collected at these altitudes on G. Rinjani was *Rattus exulans.* Perhaps these observations bear out Stresemann's (1939) conclusions that the Pleistocene eruptions of G. Rinjani destroyed much of the mountain fauna. On the other hand they may represent a wider trend for diversity of mammal species to decrease with increasing altitude.

Table 8: Data for chiropterans mist-netted at five locations on Lombok I. in 1987. Mist-netting effort is presented in Table 1. The diversity index (D) is that of Simpson and Yule where $D=1/\sum_{i=1}^{n} Pi^2$ where Pi is the proportion of the ith species and n is the number of species.

	Kuta	Pelangan	Suranadi	Batu Koq	G. Rinjani Pos III
Number of species	12	10	13	8	2
Total number of captures	142	73	64	63	2
Captures/m^2 of mist net	0.132	0.075	0.085	0.099	(0.002
Diversity index (D)	6.13	5.97	8.87	4.65	2.00

Although there have been few studies examining such trends in Oriental fauna, Medway (1972a) and Langham (1983) observed a decrease in richness of mammal species with altitude in the Malay Peninsula and Borneo and the same appears to occur in Seram I. Also Wang *et al.* (1985) observed for small ground mammals in the Jawu mountains, Transhimalayas, an initial increase in species diversity between altitudes of 2100-3000 m. Above this altitude there was a decrease. The authors note that their results differed from a colleague working on the Biluo mountains, Yunnan Province "who found the greater variety of rodent species in the lowest zone (altitude)".

While it would be interesting to further investigate trends for a relationship between mammal species richness and altitude, it may be difficult to separate the causal factors. For example, on the five sites that we studied, habitat disturbance also decreased with altitude. Because many of the species we collected take advantage of crops and plantations, the increase in species diversity at lower altitudes may reflect such disturbances more so than altitude *per se.* This may be particularly so at Suranadi, Lombok I., where a small patch of natural vegetation was surrounded by farmland and plantations. Such a trend for a peaked function of species diversity of small ground mammals with increasing human disturbance to habitat was reported in Yunnan Province, China, by Kitchener *et al.* (1987). Many species of bats, particularly pteropodids, feed on plantation fruit or the pulp of coconut trees. Several *Pteropus* spp and *Acerodon mackloti* roost in the crown of coconut trees. *Macroglossus minimus, Pipistrellus imbricatus,* and *Myotis muricola* roost in the leaves of bananas and other plantation trees. The following species also inhabit man-made structures: *Rousettus amplexicaudatus, Cynopterus brachyotis, Macroglossus minimus, Chaerephon plicata, Megaderma spasma* and *Scotophilus kuhlii.* Additionally, both civets, all the murid rodents and the squirrel, *Callosciurus notatus,* reported on Lombok I. are human commensals or thrive close to human habitation.

The period of October and immediately preceeding the monsoonal rains, is obviously an important breeding season for bats on Lombok I. Of the pteropodine fruit bats, *Pteropus lombocensis, Acerodon mackloti, Cynopterus horsfieldi, C. titthaecheilus, C. brachyotis* and *Aethalops alecto* were pregnant and *Dobsonia peronii* and *Rousettus amplexicaudatus* were lactating and had recently bred. Both the macroglossine fruit bats, *Eonycteris spelaea* and *Macroglossus minimus* had almost completed the season of

births, with most females still lactating. All the leaf-nosed bats *(Rhinolophus affinis, R. acuminatus, R. simplex, R. pusillus, Hipposideros diadema* and *Megaderma spasma*) were pregnant as was the emballonurid *Taphozous melanopogon,* and the vespertilionids *Murina cyclotis, Phoniscus jagorii, Kerivoula hardwickei, K. flora, Miniopterus pusillus,* and *Myotis muricola. Scotophilus kuhlii* and *Pipistrellus imbricatus* appeared to be in early pregnancy. Only the two species of *Tylonycteris* showed no sign of reproductive activity. Medway (1972b) states that in the Malay Peninsula both these species of *Tylonycteris* have a restricted breeding period between February and May.

In early May 1988, immediately following the wet season, the pteropodid females that were collected on Lombok I. showed considerable reproductive activity, with many females either pregnant or lactating *(Cynopterus horsfieldi, C. titthaecheilus, C. brachyotis, Rousettus amplexicaudatus, R. leschenaultii, Eonycteris spelaea* and *Macroglossus minimus).* Interestingly all these species, as well as *Acerodon mackloti, Pteropus lombocensis* and possibly *Dobsonia peronii,* appear to be at least seasonally polyoestrous on Lombok I. and have been recorded as both pregnant and lactating.

None of the other species of bats on Lombok I. showed gross indications of polyoestry. Most non-pteropodid females collected in early May 1988 *(Rhinolophus affinis, R. acuminatus, R. simplex, Kerivoula flora)* showed no indication of reproductive activity. Only *Hipposideros ater saevus* and *Taphozous melanopogon* were breeding.

There is some evidence that *Cynopterus titthaecheilus* may breed earlier in the moister northern part of Lombok I. than in the drier south-coastal areas.

Village people on Lombok I. informed us that the commensal murid rodent populations had been very low for at least several months before October 1987 when *Rattus exulans* had only a low level of female reproductive activity; the single female *Rattus rattus* was not reproductively active and *Mus castaneus* appeared to be actively breeding with a pregnant female and a juvenile collected.

The known distribution range of a number of species is extended by this study. But none as much as the small tail-less fruit bat, *Aethalops alecto,* which is largely restricted to substantial mountains, and the vespertilionid bats *Harpiocephalus harpia* and *Murina cylotis.* The former two species have their nearest known populations at Mt Gede, W. Java and the latter at Sarawak and Sabah, Borneo. Others that have had their range extended are the bats: *Cynopterus horsfieldi, C. brachyotis, Rousettus leschenaultii, Macroglossus minimus, Chaerephon plicata, Rhinolophus pusillus, Megaderma spasma, Phoniscus jagorii, Kerivoula hardwickei, K. flora, Tylonycteris pachypus, Myotis muricola, Pipistrellus imbricatus;* the felid *Felis bengalensis;* the pangolin *Manis javanica* and the squirrel *Callosciurus notatus.*

Appendix I

Species listed for Lombok I. in major reviews of mammals from Mertens (1936) to Van Strein (1986), and this report.

	Mertens (1936)	Pohle (1950)	Laurie & Hill (1954)	Honacki *et al.* (1982)	Nowak & Paradiso (1983)	Van Strein (1986)	This report
CHIROPTERA							
Dobsonia peronii							✓
Pteropus vampyrus	✓	✓	✓		✓	✓	
P. alecto	✓	✓	✓	✓	✓	✓	
P. lombocensis	✓	✓	✓	✓	✓	✓	✓
Acerodon mackloti			✓	✓	✓	✓	✓
Cynopterus horsfieldi							✓
C. titthaecheilus	✓	✓	✓		✓	✓	✓
C. brachyotis							✓
Rousettus amplexicaudatus							✓
R. leschenaultii							✓
Aethalops alecto							✓
Eonycteris spelaea							✓
Macroglossus minimus							✓
Taphozous melanopogon							✓
Chaerephon plicata							✓
Hipposideros ater							✓
Hipposideros diadema							✓
Rhinolophus affinis	✓	✓	✓	✓	✓	✓	✓
R. acuminatus	✓	✓	✓	✓	✓	✓	✓
R. simplex	✓	✓	✓	✓	✓	✓	✓
R. pusillus							✓
Megaderma spasma							✓
Harpiocephalus harpia							✓
Murina cylotis							✓
Phoniscus jagorii							✓
Kerivoula hardwickei							✓
K. flora							✓
K. picta			✓	✓	✓	✓	
Tylonycteris robustula							✓
T. pachypus					✓	✓	✓
Miniopterus schreibersi					✓	✓	
M. pusillus							✓
Myotis muricola							✓
Scotophilus kuhlii							✓
Pipistrellus imbricatus							✓
P. tenuis					✓	✓	

Appendix I (continued)

	Mertens (1936)	Pohle (1950)	Laurie & Hill (1954)	Honacki *et al.* (1982)	Nowak & Paradiso (1983)	Van Strein (1986)	This report
RODENTIA							
Callosciurus notatus							✓
Hystrix javanica	✓	✓	✓				✓
Mus domesticus	✓	✓	✓	✓	✓	✓	
Mus castaneus							✓
Rattus argentiventer	✓		✓		✓	✓	
R. exulans	✓	✓	✓		✓	✓	✓
R. rattus	✓	✓	✓		✓	✓	✓
CARNIVORA							
Viverricula indica							✓
Paradoxurus hermaphroditus	✓	✓	✓		✓	✓	✓
Felis bengalensis							✓
PRIMATES							
Macaca fascicularis	✓	✓	✓		✓	✓	✓
Trachypithecus auratus	✓	✓	✓		✓	✓	✓
ARTIODACTYLA							
Sus scrofa	✓	✓			✓	✓	✓
Muntiacus muntjak	✓	✓	✓			✓	
Cervus timorensis	✓	✓	✓			✓	✓
PHOLIDOTA							
Manis javanica							✓
INSECTIVORA							
Crocidura (?) monticola	✓	✓	✓		✓	✓	-

Appendix II:

Number of individual chiroptera mist-netted at the five major collecting sites on Lombok I. in 1987

Altitude (m)	Kuta o	Pelangan 50	Suranadi 200	Batu Koq 400	Rinjani/ Pos III 1700
Pteropus lombocensis	5	0	0	0	0
Cynopterus horsfieldi	9	13	0	8	0
C. titthaecheilus	31	14	2	7	0
C. brachyotis	21	5	6	1	0
Rousettus amplexicaudatus	20	6	7	7	0
Aethalops alecto	0	0	0	0	1
Eonycteris spelaea	36	20	12	24	0
Macroglossus minimus	3	7	10	8	0
Hipposideros diadema	5	0	5	0	0
Rhinolophus affinis	3	3	0	0	0
R. acuminatus	0	2	0	0	0
R. simplex	6	0	0	0	0
Megaderma spasma	0	0	6	0	0
Harpiocephalus harpia	0	0	1	0	0
Murina cyclotis	0	0	1	0	0
Tylonycteris robustula	0	0	6	0	0
T. pachypus	0	0	1	0	0
Myotis muricola	2	1	5	7	0
Scotophilus kuhlii	0	2	0	0	0
Pipistrellus imbricatus	1	0	2	1	1?

? not positively identified, escaped.

Appendix III:

List of mammal specimens collected on Lombok I. in 1987 and 1988 (in brackets) from the five major collections sites. Field numbers (F and P prefixes) only are available.

	LOCALITIES				
	Kuta	Pelangan	Suranadi	Batu Koq	Rinjani Pos II & III
Dobsonia peronii		L287-9, L341			
Pteropus lombocensis	L401, P499-500, P511-12, [P297, P299, P309]	L327, L401			
Acerodon mackloti		L319, L328-35			
Cynopterus horsfieldi	L432-3, L437, L446, L463, L474,-7	L343, L346-52, L361-3, L365, L368	L262, [P250, P259]	L179, L192, L231, L243, L245, P328, P412, P416	
C. titthaecheilus	L390, L392, L413, L415, L419, L421, L430-1, L434, L438, L445, L453, L458-62, L466-7, L474-84, L492, L494, L498, P505, P513, P517, P296, P312, P317-8, P326, P359	L277, L279, L281, L292, L295, L309, L321-4, L336, L338-9, L345	L7, L82, P342, P346, L260-1	L178, L188, L238, P329 P330, P332-3	
C. brachyotis	L385-6, L395-6, L400, L409, L418, L447, L450, L464-5 L485, L499-501, L503-4, L508, P498, P514-15, [P295, P298, P302-3, P307, P310, P361]	L297, L308, L356, L358, L369	L3-6, L34, L148, [P251, P253-4, P260, P270]	L203	
Rousettus amplexicaudatus	L399, L402, L404, L410, L414, L427, L441, L449, L456-7, P493, P491-7, P496, P506, [P320, P324, P362]	L272, L275, L278, L326, L337, L344	L19, L2708, L71, L112, L147, L149-50, L263, P343, [P262-264]	L223, L232, L239, P406-7, P331, P418	
R. leschenaultii			P344 [P252, P268]		
Aethalops alecto					L230

Appendix III (continued)

	LOCALITIES				
	Kuta	Pelangan	Suranadi	Batu Koq	Rinjani Pos II & III
Eonycteris spelaea	L383-4, L387-9, L391, L393-4, L397-8, L403, L416-7, L420, L435-6, L439, L442-3, L448, L451, L452, L454-5, L478, L493, L495, L497, L502, L505, P501-4, P518-19, [P306, P311, P313-5, P319, P321-3, P325, P328]	L270-1, L273, L276, L280, L282, L290-1, L293-4, L296, L298-L300, L307, L316, L320, L325, L359-60	L14-5, L24-6, L31-3, L87-9, L151, L264, P341, P345, [P249, P256-7,	L173-4, L176-7, L180-4 L187, L189-91, L201-2, L209, L222, L224, L244, P405, P408-9, P414-5	
Macroglossus minimus	L486, L490, P516, [P300, P316, P355]	L302-3, L305, L310-12, L318	L8, L16-8, L20, L30, L57, L84, L86, L111, P334-6, P338-40, L265-9, [P248, P255, P258, P265]	L186, L204, L208	P404, P410-11 P413, P417
Taphozous melanopogon	L372-81, L513-70, P422-90, [P276-94]				
Hipposideros diadema	L411, P507-10, [P349, P354]		L29, L58-60, L91, L93, L99-101, L103-8 [P271-5, P304]		
Hipposideros ater					
Rhinolophus affinis	L406-7, L426, P348, P351-3 P356-7]	L301, L306, L353, L75-8,	L61, L63, L65-8, L70, L72, L80, L83, L92, L94-8, L102	L197-200, L210-11, L213-8	L228
R. acuminatus	[P301]	L342, L366			
R. simplex	L382, L405, L408, L412 L428, L468 [P360]				
R. pusillus			L62, L69, L73-4		
Megaderma spasma	[P350]		L9-12, L35-6, L64 [P269]		
Harpiocephalus harpia			L2		

Appendix III (continued)

	LOCALITIES				
	Kuta	Pelangan	Suranadi	Batu Koq	Rinjani Pos II & III
Murina cyclotis			L79, L153		
Phoniscus jagorii		L317			
Kerivoula hardwickei			L81, L152		
K. flora			L1, [P263]		
Tylonycteris robustula			L48, L50, L52-3, L56, L85, L113-21, L123-30, L132-7, L139-45, [P261]		
T. pachypus			L109, L122, L131, L146		
Miniopterus pusillus	L423-424				
Myotis muricola	L425, L440	L274, L364	L21-3, L37-47, L49, L51, L55, L90, L110	L157-70, L185, L193-5, L205-6	
Scotophilus kuhlii		L357, L367			
Pipistrellus imbricatus	L429		L13, L54, P337	L212, L219-21	
Mus castaneus				L154-6, L172, L175	
Rattus exulans	L422, L444, L469, L506-7	L285, L355		L171, L196, L207	L225-7, L229, L233-7, L240-2, L246-51, L252-9, P402
Rattus rattus	L511-2	L283-4, L286, L313-4, L340, L354			
Viverricula indica		L371, L470			
Paradoxurus hermaphroditus		L315, L370, L471, L488			
Felis bengalensis	K596				
Callosciurus notatus	[S412-4]				

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