CONSERVATION STATUS OF PHILIPPINE FRUIT BATS (PTEROPODIDAE)

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ABSTRACT. Of the 25 species of fruit bats presently known from the Philippines, 15 (60%) are endemic. The conservation status of each species is reviewed based on published and unpublished results of studies conducted in the last ten years. Of the 15 endemic species two, *Acerodon lucifer* and *Dobsonia chapmani* are now considered extinct. Species recognized to be most highly endangered are *Acerodon jubatus*, *A. leucotis*, *Eonycteris robusta*, *Nyctimene rabori* and *Pteropus leucopterus*. These five species are part of the endemic fauna. Factors considered to contribute to population declines are discussed, including habitat destruction and geographical distribution. The discussion focuses on strategies for conservation.

INTRODUCTION

Information on the ecology and distribution of Philippine fruit bats increasingly points to a strong association between endemic species and forest habitats (Heaney *et al.*, 1981; Heaney *et al.*, 1989; Heideman and Heaney, 1989). Considering the high rate at which forests in the Philippines have been destroyed (Myers, 1988; Kummer, 1990), it is imperative to initiate evaluation of the status of the remaining fauna, including a review of published information, so that gaps in knowledge and needs for further study and protection might be identified.

Of the 25 species of fruit bats presently known from the Philippines, 15 (60%) are endemic. These include six species belonging to four endemic genera, *Alionycteris* (1), *Haplonycteris* (2), *Otopteropus* (1), and *Ptenochirus* (2). Although several zoological surveys in the Philippines have been undertaken prior to the 1900s, a number of endemics were described only in the years following the first use of mist nets in the 1960s. The historical descriptions of Philippine endemics are chronicled in Figure 1, using 10 year intervals beginning at the turn of the 19th century; the species names are listed in Table 1. Non-endemic species are included to demonstrate the historical importance of species discoveries. Years when the non-endemic species were described are not directly indicative of their actual discoveries in the Philippines (since very few were described from this country); however, descriptions of endemic species show temporal progress of systematic work on the pteropodids. *Acerodon jubatus* was the first endemic species to be described in 1831. The list of endemic species contin-

ues to grow with the discovery of a possible new species of *Haplonycteris* in 1989 on Sibuyan Island (S. Goodman and L. Heaney, pers. comm.). Most striking is the fact that from 1931 to the present, seven of eight species which have been documented in the Philippines for the first time are endemic (Fig. 1). The single non-endemic added to the species list is *Pteropus dasymallus*, whose identity was only recently recognized (Ingle and Heaney, in press) although specimens of this species have apparently been in collections (in the Philippine National Museum) from as early as 1948 .

The list presented here represents a first approximation of the conservation status of the various bat species known from the Philippines. Sources of information include published literature, field studies from 1981 to the present, and unpublished observations of colleagues who have worked with and still are actively involved in studies on various aspects of Philippine fruit bat biology. A listing of each species with comments on habitats and distribution may be found in an annotated checklist of Philippine land mammals by Heaney, Gonzales, and Alcala (1987). An identification key to Philippine bats (both mega- and microchiropterans) is currently in press (Ingle and Heaney, in press). Likewise, a number of pertinent publications on fruit bat ecology and biogeography have been published in the last decade (e.g., Heaney, 1991; Heaney *et al.*, 1989; Heideman, 1989; Heideman and Heaney, 1989), some of which are reviewed in this volume (Balete *et al.*).

CATEGORICAL LISTING OF SPECIES AND THEIR PROTECTION NEEDS

The functional categories used here are patterned after those used in a more general review of the conservation status of Philippine land mammals (Heaney and Utzurrum, 1991). Categories have been modified and expanded to improve descriptions of the state of knowledge of each species. The annotations are focused on biological information that may be useful in the assessment of the protection needs of the various species. The list itself is not intended to replace official listings, such as those by Convention on International Trade of Endangered Species and International Union for Conservation of Nature. Rather, it is to provide a baseline for future research and conservation activities by focusing on currently available ecological and biogeographical knowledge.

Category 1. Species thought to be extinct; status critically in need of investigation.

Under this category are two species of Philippine fruit bats recently reported as extinct by Heaney and Heideman (1987). Both were endemic species limited in distribution to the Pleistocene Negros-Panay faunal region (sensu Heaney, 1986).

1. *Acerodon lucifer* Elliot- Panay Flying fox

This endemic species is currently represented in museums only by the type series collected by J. B. Steere near Concepcion, Iloilo on Panay Island in January and April 1888, and two additional specimens taken in 1893 also near Concepcion (specimens in Bell Museum of Natural History, University of Minnesota; Timm and Birney, 1980). *Pteropus vampyrus* were taken by Steere at the same location in 1888, but *Acerodon jubatus* has never been reported from Panay (Steere, 1890; Heaney, unpubl. data). No other sightings of *A. lucifer* have been reported since that time despite several surveys conducted over the last 10 years. A recent examination of the type series suggests the need for a critical re-evaluation of its taxonomic status (L. Heaney, pers. comm.). Cranial measurements of *A. lucifer* all fall within the range exhibited by its congener, *A. jubatus* (Ingle and Heaney, in press).

2. *Dobsonia chapmani* Rabor- Philippine Naked-backed Fruit Bat

Named a new species by D. S. Rabor (1952), this fruit bat was believed to be relatively common when last recorded in 1964. Noted as roosting principally in caves with associated patches of lowland forest, its disappearance from known localities on southern Negros Island may be attributed to disturbance by guano miners, the rampant harvest of bats from caves for food, and the extensive removal of forest cover in the lowlands. Skeletal remains consisting of one mandible and a few leg bones of a long-dead individual found by Heaney and Heideman in 1981 (Heaney and Utzurrum, 1991), were the last indications of the species' occurrence despite surveys in the last 10 years of previously documented localities on Negros (Heaney, Heideman, and Utzurrum, unpubl. data). It is doubtful whether the species persists on southern Cebu Island, where the one specimen from outside of Negros was taken, as since the 1960's the island has been severely denuded.

Given the Pleistocene connection between Negros and Panay Islands (Heaney, 1986), there is a possibility that *D. chapmani* may occur on Panay in lowland areas with associated limestone caves in or near forest. Survey of such caves reported to hold populations of fruit bats should be made a priority for future inventory work.

Category 2. Species known to be seriously threatened by habitat destruction; vulnerability exacerbated by limited distribution.

1. *Nyctimene rabori* Heaney and Peterson- Philippine Tube-nosed Fruit Bat

The first specimens of this fruit bat were obtained in the 1960s but the species was not described until 1984 (Heaney and Peterson, 1984). It is restricted to Negros where it is closely associated with low- to mid-elevation primary forests. Extensive netting and mark-and-recapture studies on southern Negros indicate the species is uncommon (Heaney *et al.*, 1989; Utzurrum, unpubl. data). Heideman and Heaney (1989) estimated densities at two to three individuals per 10 hectares in primary lowland forest surrounding Lake Balinsasayao, Negros Oriental. It appears to depend largely on figs (*Ficus* spp.) for food (Utzurrum, 1984). Although its roosting habits are unknown, studies suggest a requirement for forest habitats. It has never been found in caves, and only a few individuals were captured in disturbed habitats all of which were within a 1 km-radius from the edge of an adjoining forest (Heaney *et al.*, 1981; Heideman and Heaney, 1989; Utzurrum, unpubl. data).

Category 3. Species with populations known to have declined substantially in recent years and to be in need of protection, but status uncertain due to inadequate information.

1. *Acerodon jubatus* Eschscholtz- Golden-crowned Flying Fox

Considered by some as the largest bat in the world by weight, this endemic species was once reported to occur in large mixed species colonies (with *Pteropus vampyrus*) of 100,000 or more individuals on all major islands (Taylor, 1934 in Nowak and Paradiso, 1983) except the Palawan faunal region. This species is closely associated with forests (Heideman and Heaney, 1989), and feeds principally on wild figs and other forest fruits (Utzurrum, 1984). Because of its large size, it is often hunted with guns, modified fish nets, and aerial fish hook lines (locally known as "salabay" or "surambao"; Utzurrum, unpubl. data). Exportation to Guam as a food delicacy during the late 1980's may have contributed to the decline of these populations (W. Rainey and G. Stiles, pers. comm.). It now appears to be absent in most parts of its known range (Heaney and Heideman, 1987). Colonies located since 1981 (e.g., on Maripipi Island) numbered no more than 5,000 individuals, and often were in the low hundreds (Rickart *et al.*, in prep.; Heideman and Heaney, unpubl. obs.). Body size of this species is geographically variable, perhaps indicating several genetically distinct forms (Heaney and Heideman, unpubl. data).

2. *Eonycteris robusta* Miller- Philippine Nectar Bat

This endemic species is widespread in the Philippines (excluding Palawan) but appears to be uncommon throughout its range. It has been captured most often in slightly degraded habitats associated with patches of *Musa* spp. in proximity to for-

ests. Unlike its congener, *E. spelaea*, it has never been reported from heavily disturbed areas, agricultural lands, or urban orchards. On Negros, where its occurrence has been previously recorded, it has not been netted since 1987 despite regular intensive surveys. On Leyte, where it was abundant in the 1960s, a few were found in 1984 and 1987 (Rickart *et al.*, in prep.). Its roosting habits are unknown. While *E. spelaea* has been found regularly in caves, the existence of *E. robusta* colonies in such sites is unknown.

3. *Pteropus leucopterus* Temminck- Philippine White-winged Flying Fox

Originally described in 1853 from specimens from Luzon (Heaney *et al.*, 1987), this endemic species remains poorly represented in collections worldwide. It is, thus, presumed to be rare in the wild. Recent surveys on Catanduanes Island have led to the capture of several individuals: two in 1988 in a "kaingin" area at 200 m elevation adjacent to a large tract of primary forest, and three more in 1991 at 600 m elevation in montane forest within that tract (Heaney *et al.*, 1991; Heaney *et al.*, unpubl. data). They are now known to occur throughout northeastern Luzon and on the islands of Catanduanes and Dinagat (Heaney *et al.*, 1987; Heaney et al., 1991; Heaney and Rabor, 1982). Two live individuals (male and female) are now in captivity at Silliman University as a founding pair for a captive breeding program. The female gave birth to the first captive-bred pup in March 1992.

Category 4. Potentially vulnerable due to a limited distribution, but status uncertain due to inadequate information.

1. *Acerodon leucotis* Sanborn- Palawan Flying Fox

Described in 1950, this endemic species is restricted to the Palawan faunal region where it appears to replace *A. jubatus* (Heaney *et al.*, 1987). There are two subspecies reported, one occurring on Palawan and the Balabac islands, and a second confined to Busuanga. These poorly-defined taxa require critical review. Large colonies of flying foxes on small islands off northern Palawan and in Honda Bay east of Puerto Princesa, Palawan (L. Dolar and E. Solis, pers. comm.) could be *A. leucotis*. This species may be moderately common in forests of mainland Palawan, but little current information is available.

2. *Haplonycteris* sp. - (undescribed pygmy fruit bat)

Substantially larger than *Haplonycteris fischeri*, individuals of this putative species of the endemic genus *Haplonycteris* were first collected in 1989 from Sibuyan Island (Goodman and Heaney, unpubl. data). All specimens were taken in primary

forest habitat. Preliminary genetic analyses indicate substantial differences from populations of *H. fischeri* (Peterson and Heaney, in press).

3. *Pteropus dasymallus* Temminck- Wooly Flying Fox

P. dasymallus was previously known to range from southern-most Japan to Taiwan; it was described by Temminck (1825) on the basis of specimens from the Liukiu Islands (near Okinawa). Its occurrence in the Philippines has recently been verified by L. R. Heaney (pers. comm.) and recognized by Ingle and Heaney (in press) from specimens taken in the late 1980s from the Babuyan and Batanes Islands off northern Luzon. Specimens taken in the 1940s (in the research collection at the Philippine National Museum) were initially identified as *P. hypomelanus*. These specimens, however, show a distinct cranial morphology and long, dense pelage characteristic of *P. dasymallus*. No observations on habitat use or estimates of population size are currently available.

Category 5. Species for which little or no current information is available; status unknown.

1. *Alionycteris paucidentata* Koch- Least Pygmy Fruit Bat

Since its description in 1969 (Kock, 1969a), this smallest of Philippine fruit bats was known only from the type series collected on Mt. Kitanglad in Mindanao. A recent (1992) survey on Mt. Kitanglad produced the first few specimens outside of the type series (Heaney *et al.*, unpubl. data). A preliminary re-evaluation of the type series suggests that this endemic monotypic genus is very closely related to the endemic genus *Haplonycteris* (L. R. Heaney, pers. comm.). Given the virtual absence of any information on the species, efforts to the study the species in the immediate future are in order.

2. *Dyacopterus spadiceus* Thomas- Dayak Fruit Bat

This species is known from Borneo, Sumatra, the Malay Peninsula, and the Philippines (Heaney *et al.*, 1987). In the Philippines, it is only known from two specimens, one from Mindanao and another from Luzon. Nothing is known about its status locally, but populations are probably stable in the species' range outside of the Philippines. Specimens in collections show three discrete size classes throughout its range, a small-sized population in Borneo, medium-sized from Sumatra, and large-sized from the Philippines, suggesting the possibility of three genetically distinct populations (L. R. Heaney, pers. comm.).

3. *Megaerops wetmorei* Taylor- White-collared Fruit Bat

Until recently, this species was considered a Philippine endemic (Heaney *et al.*, 1987), but is now also known from Borneo and the Sunda Shelf islands (Payne *et al.*, 1985). Its distribution in the Philippines is restricted to Mindanao and may be confined largely to primary forest habitats, or on disturbed areas right at the fringes of forest tracts (Heaney et al., 1987; Heaney *et al.*, unpubl. data). As with the two other fruit bats listed in this category, there is virtually no information on this species in the Philippines.

Category 6. Species with populations known to have declined substantially in recent years, but are geographically-widespread and/or under some protection.

This category includes three non-endemic species of *Pteropus* whose distribution ranges outside the Philippines. As with the aforementioned *Acerodon jubatus*, these species were once reported in colonies of thousands of individuals at various localities, often in mixed-species aggregations. However, their visibility in tree roosts and their large sizes have made the species vulnerable to hunting pressure. Unlike the endemic flying foxes mentioned in other sections here, all three species listed below regularly forage in agricultural areas and orchards well removed from tracts of forests. This habit increases their exposure to hunters using more sophisticated equipment. Populations appear to have declined and they are now absent from extensive forest-associated lowland areas where they were reported to be abundant in the 1960s.

1. *Pteropus hypomelanus* Temminck- Island Flying Fox

This is probably the least endangered of the flying foxes in the Philippines and occurs throughout the islands except in the Palawan faunal region. Outside of the Philippines, its range extends from Australia to Thailand (Heaney *et al.*, 1987). A colony of about 2000 individuals was recently (1991) recorded at the Sampunong Bolo Bird Sanctuary in Sara, Iloilo, and is tentatively identified as *P. hypomelanus* (Utzurrum, unpubl. report). This particular colony is presently protected indirectly as part of a purple heron (*Nycticorax caledonicus* Vigors) conservation program at the sanctuary.

2. *Pteropus speciosus* Andersen- Sulu Flying Fox

This species is currently documented only from two small island groups in the Java Sea (Indonesia) and the southernmost parts of the Philippines (Heaney *et al.*, 1987). Although largely centered in the Sulu Archipelago, it has also been recorded

from Basilan and extreme southwestern Mindanao (Heaney and Utzurrum, 1991). Previous reports of this species from Cebu and Negros appear to have been based on misidentified *P. hypomelanus* (Heaney, unpubl. data). Voucher specimens from the late 1980s (Smithsonian Institution) indicate its persistence despite the extensive removal of forests in Sulu. Religious taboos on meat consumption may reduce hunting pressure on the animals in this largely Muslim region. However, extensive collection in the 1980s for exportation to Guam may have offset this advantage. Taxonomic review of the species is needed since some evidence indicates a close relationship with *P. griseus,* a species widespread in Wallacea (Klingener and Creighton, 1984; L. Heaney, pers. comm.).

3. *Pteropus vampyrus* Linnaeus- Giant Flying Fox

This geographically widespread species ranges in distribution from Indochina to the Lesser Sunda Islands and occurs throughout the Philippines (Heaney *et al.*, 1987). It now appears to be uncommon in the Philippines where it was previously reported in large numbers (see Category 3 on *A. jubatus*). Of the three species in this category, this may be the most threatened.

Category 7. Endemic species currently believed to have relatively stable populations, but vulnerable to habitat destruction.

Surveys of fruit bats conducted since 1981 indicate the relative stability of populations of six endemic species of Philippine fruit bats. All six are, however, consistently found in close association with forests (Heaney *et al.*, 1989; Heideman and Heaney, 1989; Utzurrum, unpubl. data). Hence, they may be seriously threatened by continued deforestation in the Philippines.

1. *Haplonycteris fischeri* Lawrence- Fischer's Pygmy Fruit Bat

The species is widespread in the Philippines (probably excluding the Palawan faunal region; Heaney *et al.*, 1987; Heaney, 1991). Its association with primary forest from low to high elevations is well-documented. It is locally common in primary forests (Heideman and Heaney, 1989) where it appears to specialize on fruits of *Ficus* spp. and *Piper* spp. (Heideman, 1987; Utzurrum, 1984). It is uncommon in secondary forest, rare in adjoining degraded habitats, and absent in areas more than 0.5 km from forest (Heideman and Heaney, 1989; Utzurrum, unpubl. data). Heideman (1988, 1989) has published a thorough study of its reproductive biology and ecology. Of all the Philippine fruit bats, it is, perhaps, the species for which the most comprehensive information is available.

2. *Harpyionycteris whiteheadi* Thomas- Harpy Fruit Bat

Although long known from Mindanao, Negros, and Mindoro, its occurrence on Luzon was first documented in 1988 by Heaney *et al.* (unpubl. data; Heaney, 1991). Estimated densities of this species are low (Heideman and Heaney, 1989; Utzurrum, unpubl. data). Typically absent outside of forest, it is uncommon in lowland primary forest but is moderately common in mid- to high elevations where it appears to specialize on both the flowers and fruits of pandan (*Freycinetia* spp.) (Heaney *et al.*, 1989; Utzurrum, unpubl. data).

3. *Otopteropus cartilagonodus* Loch- Luzon Pygmy Fruit Bat

Described in 1969 (Koch, 1969b), this member of the monotypic endemic genus *Otopteropus* is restricted to Luzon. It is reportedly common in primary and mature secondary forest throughout its range. Moderate numbers were recently (1992) captured in the forests of Zambales by a survey team from the Philippine National Museum and the Cinncinati Museum of Natural History (P. Gonzales, pers. comm.). However, the size of local populations throughout its range on Luzon Island appears to be highly variable. For example, only low densities were recorded during an intensive survey of Mt. Isarog, southern Luzon in 1988 (Heaney, Rickart and Utzurrum, unpubl. data). None of the individuals taken in the 1988 survey were captured outside of forest; thus, forest denudation may seriously threaten the survival of this species. Preliminary analysis of its reproductive pattern showed evidence of delayed development of embryos (Heideman *et al.*, in press). The only other fruit bat in the Philippines for which such a pattern has been established is the endemic *Haplonycteris fischeri* (Heideman, 1989).

4. *Ptenochirus jagori* (Peters)- Philippine Bear-faced Fruit Bat

The species occurs throughout the Philippines except in the Palawan region (Heaney *et al.*, 1987). Although occasionally netted in disturbed and agricultural habitats, it is typically absent in areas more than 1 km from forests (Heideman and Heaney, 1989; Rickart *et al.*, in prep.; Utzurrum, unpubl. data). It is common in lowland primary forest but uncommon at higher elevations or in secondary forest. Its dependence on wild fig fruits as food in forests and its role as a major seed dispersal agent are well-documented (Utzurrum, 1984; Utzurrum and Heideman, 1991).

5. *Ptenochirus minor* Yoshiyuki- Lesser Bear-faced Fruit Bat

This species appears to be restricted to the Mindanao faunal region; a single report of its occurrence on Palawan needs verification (Heaney *et al.*, 1987; Heaney,

1991). It is locally abundant in primary forest, especially at low elevations, but is uncommon in secondary forest, and rare to absent outside of these habitats (Heaney *et al.*, 1989; Rickart *et al.*, in prep.). In contrast to its congener, *P. jagori*, little is known of its ecology.

6. *Pteropus pumilus* Miller- Little Golden-mantled Flying Fox

This species is the smallest member of the genus *Pteropus* and is widespread in the Philippines, except in the Palawan faunal region (Heaney *et al.*, 1987). Unlike its non-endemic congeners, it is rare in degraded and cultivated areas exceeding 1 km from tracts of forest. It may be locally common or uncommon in primary forest and is typically uncommon in secondary forest. Its close affiliation with low to mid-elevation primary forest habitats has been repeatedly noted in numerous surveys conducted since 1981 in various forests on Negros, Leyte, and Maripipi (Heaney *et al.*, 1989; Heideman and Heaney, 1989; Rickart *et al.*, in prep.). Unlike the larger species of flying foxes, it is regularly captured in nets set below forest canopies (Utzurrum, unpubl. data). Although this may be the least threatened of the endemic flying foxes, it appears to be under increasing pressure from hunting. An ongoing study (Utzurrum, unpubl. data) of the fruit bat community on Mt. Talinis, Negros Oriental has documented several instances of serious injuries resulting from gun shots and fish hooks, including extensive wing tear, tissue injuries from hooks, and hind limb amputations . With the increasing rarity of the larger flying foxes, hunting pressure on this species is likely to intensify. Its apparent requirement for forest trees as roosts and sources of food will exacerbate its vulnerability to local extinction as lowland forests continue to decline.

Category 8. Species with populations known to be stable or increasing, and are geographically widespread.

This category includes four species of fruit bats widespread both within and outside of the Philippines. All species are associated with disturbed, agricultural, and/or urban habitats where they are usually abundant (Heaney *et al.*, 1989; Heideman and Heaney, 1989; Rickart *et al.*, in prep.; Utzurrum, unpubl. data). They are known from primary and secondary forests where they typically have low to moderate abundance. Occurrence in high-elevation forests is often associated with the proximity of cultivated and/or disturbed patches.

1. *Cynopterus brachyotis* (Muller)- Short-nosed Fruit Bat

This species is widespread in Southeast Asia and throughout the Philippines (Heaney *et al.*, 1987). It is most abundant in lowland cultivated areas and ranges up to montane forest habitats. In forests, it appears to rely mostly on wild figs for food

(Utzurrum, 1984, unpubl. data). In disturbed and cultivated habitats, it is regularly netted in large numbers around orchards and patches of bananas (*Musa* spp.). It is one of a few species commonly associated with urban centers. (A cluster of four individuals was found roosting under a palm leaf (*Livistona* sp.) in 1991 at a zoo in downtown Manila; Utzurrum, unpubl. obs.). Fecal analysis indicate its consumption of fruits of *Melastoma* spp., shrubs common in secondary growth and disturbed habitats (Utzurrum and Heideman, unpubl. data). The species may be an important contributor to seed exchange between forests and altered habitats and may be valuable to natural regeneration of degraded habitats.

2. *Eonycteris spelaea* (Dobson)- Cave-roosting Nectar bat

This species ranges from India to Timor and is widespread in the Philippines (Heaney *et al.*, 1987). It is most common in agricultural and disturbed habitats with patches of banana and abaca (*Musa* spp.) (Heaney *et al.*, 1981; Heideman and Heaney, 1989; Utzurrum, unpubl. data). Information on its food habits throughout its geographical range strongly indicate its specialization on nectar and pollen; the species may be an important pollinator of commercial trees such as durian (*Durio zibethicus* Murr.) and kapok (*Ceiba pentandra* (L.) Gaertn.) and of mangrove trees such as *Sonneratia* spp. (e.g., Start and Marshall, 1976). In the Philippines, this bat typically roosts in caves where it may occur in groups of less than 10 individuals to huge colonies of a few thousand individuals (Utzurrum and Heaney, in prep.; Utzurrum, unpubl. data). Although populations appear stable, its habit of roosting in caves exposes the species to indiscriminate harvesting for local food consumption. A recent (1991) visit to caves at the Bulabog-Putian National Park in Dingle, Iloilo (Panay Island), yielded considerable evidence of poaching in caves occupied by this and other fruit bats (Utzurrum, unpubl. project report). Implements used for such collections found within and outside the caves included empty rice sacks, sections of old fish gill nets, large wood frames (for the nets), long bamboo poles, and kerosene torches.

3. *Macroglossus minimus* (E. Geoffroy)- Dagger-toothed Flower Bat

Found throughout the Philippines, the species is abundant in agricultural areas, but also occurs uncommonly in secondary and primary forests over a broad elevational range (Heaney *et al.*, 1989; Utzurrum, unpubl. data). As with *E. spelaea*, the species is often associated with patches of *Musa* spp. but may not be as strictly nectarivorous. Outside of the Philippines, its range extends from Thailand to Australia (Heaney *et al.*, 1987).

4. *Rousettus amplexicaudatus* (E. Geoffroy)- Common Rousette

The species is geographically widespread from Thailand to the Solomon Islands, and occurs throughout the Philippines (Heaney *et al.*, 1987). It is most common in disturbed and agricultural areas. As with *E. spelaea*, it is most vulnerable to hunting in its cave roosts. It is uncommon in forests (Heideman and Heaney, 1989), but increases in abundance in association with disturbed habitat (Utzurrum, unpubl. data).

DISCUSSION

Recent studies of mammals other than fruit bats demonstrate a strong and consistent correlation between endemism and diversity on one hand and the extent of primary forest habitats on the other (Heaney and Rickart, 1990; Heaney *et al.*, 1989; Rickart *et al.*, 1991). This is compelling evidence for the importance of habitat preservation as a basic requirement for species conservation in the Philippines. However, it is becoming equally evident that habitat protection alone cannot guarantee the survival of many species, especially those whose natural populations have been pushed to the brink of extinction. In the face of diminishing forest habitat, such factors as unregulated local hunting and commercial trade can push threatened species towards extinction and imperil those species maintaining stable but precarious populations. Thus, there is a need for concerted efforts towards developing flexible and multidimensional programs to address problems of species conservation. In line with the problems that are discussed in this preliminary review, a five-point strategy is suggested under which programs should be developed. These strategies are:

1) **Habitat Protection** - Priority should be given to the designation of protected areas that will provide for the ecological needs of fruit bats and other valuable Philippine fauna and flora. If properly implemented, the recently-developed Integrated Protected Areas System (I.P.A.S.) is an important step in this direction. Species-specific habitat protection is needed for those bat species that typically form large aggregations, including the foliage-roosting flying foxes and cave-dwelling species. Critical sites supporting large colonies should be identified and completely protected against all forms of perturbation (e.g., small off-shore islands in Palawan reported to support large colonies of flying foxes). Foremost, they should be protected at roost sites where they are most vulnerable to collectors and where such vital biological activities as breeding and rearing of young occur.

2) **Captive Breeding** - A direct and aggressive approach is warranted in the case of those species whose populations in the wild have greatly declined. This is especially critical for those species whose roosting habits preclude direct protection through reserves or sanctuaries (i.e., as in those that may roost in small, discrete

groups). Captive breeding may be the principal means of ensuring that species survive if wild populations become so decimated that they drop below levels critical for successful reproduction. Species that should be accorded priority in captive breeding programs are those listed in Categories 1 to 3 (assuming the possibility of re-discovering wild populations of the currently presumed extinct species, *Acerodon lucifer* and *Dobsonia chapmani*).

3) **Ecological and Biogeographic Studies** - It is clear from this review that there are many species for which biological information is inadequate or absent (especially species under Categories 4 and 5). This problem is not peculiar to fruit bats and is one that limits our ability to formulate programs and regulations suited for the conservation of target species. Given the rate at which natural habitats are being destroyed, inventories and ecological surveys focusing on food and habitat requirements are needed. The recent discovery of a potentially new species of *Haplonycteris* from Sibuyan Island demonstrates the need for inventory work in poorly surveyed areas of the Philippines. New institutional collaborations are encouraged between academic, private, and governmental agencies, both national and foreign, to establish programs designed to accomplish goals outlined in this paper.

4) **Taxonomic Review** - Establishing the distinctiveness of species is sometimes viewed as an arcane exercise and thus is often accorded low priority in conservation work. A systematic knowledge of the validity of species is crucial when establishing priorities for species-specific action plans and captive breeding programs. The recognition of the genetic distinctiveness of populations from various geographical locations is vital for the management of captive populations. In combination with information from biogeographical and ecological studies, systematic analysis can provide insights into and better understanding of patterns of extinction and speciation as well as possible proximal and historical factors that may influence such processes. Among the fruit bats in this list, those that deserve immediate taxonomic study are: *Acerodon jubatus, A. leucotis, A. lucifer, Alionycteris paucidentata, Dyacopterus spadiceus, Haplonycteris* and *Pteropus speciosus*.

5) **Public Education** - The public's image of and attitude towards bats need to be improved. Negative views, reinforced by years of folk horror stories and contemporary vampire movies, must be reversed. Unwarranted fear of rabies and other negative popular perceptions can be negated through public education programs that emphasize the important contributions of bats as agents of seed dispersal, pollination, control of insect populations, and in the production of guano fertilizer. Notions that populations in the wild are infinite can only be revised through an aggressive educational program that stresses the value of maintaining wild populations and seeks to recruit local human populations as partners in a stewardship and conservation program by imparting information of the species' needs for food, habitat and

successful reproduction. While public education programs are often difficult to undertake, they are most essential for the long-term success of other conservation programs that require the cooperation of local communities.

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Table 1. Chronological list of fruit bats known to occur in the Philippines. Endemic species are distinguished from the non-endemic. The year of description of a non-endemic species does not necessarily reflect its actual year of discovery in the Philippines.

Species Name	Year Described	Endemic Species	Non-Endemic Species
Pteropus vampyrus	1758		X
Macroglossus minimus	1810		X
Rousettus amplexicaudatus	1810		X
Acerodon jubatus	1831	X	
Cynopterus brachyotis	1838		X
Pteropus hypomelanus	1853		X
Pteropus leucopterus	1853	X	
Ptenochirus jagori	1861	X	
Eonycteris spelaea	1871		X
Dyacopterus spadiceus	1890		X
Acerodon lucifer	1896	X	
Harpyionycteris whiteheadi	1896	X	
Pteropus speciosus	1908		X
Pteropus pumilus	1910	X	
Eonycteris robusta	1913	X	
Megaerops wetmorei	1934		X
Haplonycteris fischeri	1939	X	
Acerodon leucotis	1950	X	
Dobsonia chapmani	1952	X	
Alionycteris paucidentata	1969	X	
Otopteropus cartilagonodus	1969	X	
Ptenochirus minor	1979	X	
Nyctimene rabori	1984	X	
Pteropus dasymallus	1825 (1992)		X
Haplonycteris sp.	(undescribed)	X	

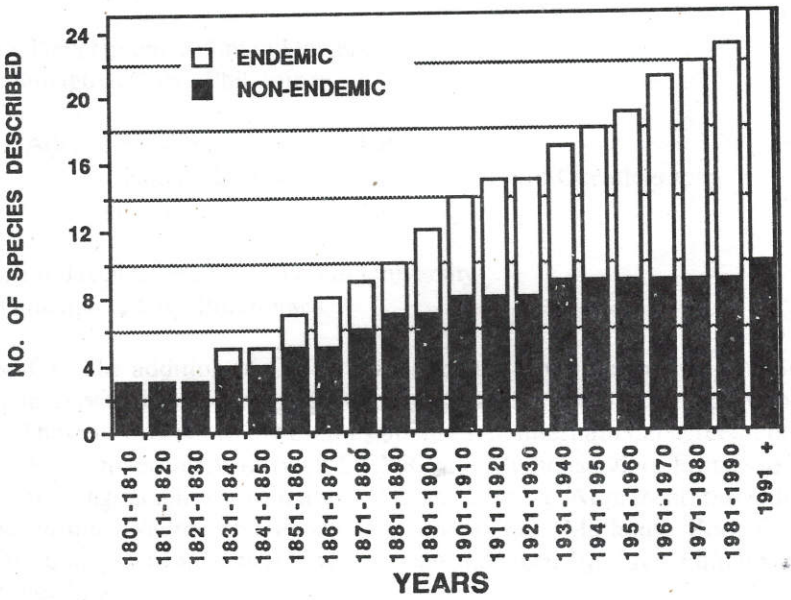

Figure 1. Number of Philippine fruit bat species described by ten-year intervals. Endemic species are distinguished from the non-endemic. With the exception of *Pteropus dasymallus*, whose occurence in the Philippines has only been recently recognized, all other non-endemic species are included under intervals embracing their actual year of description and not the year of their discovery in the Philippines.