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SURVEY FOR BATS, QUANG NGAI PROVINCE, VIETNAM, MAY-JUNE 2011 and MARCH 2012

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Abstract. We conducted a survey for bats in the southeastern Truong Son Mountains, Ba To District, Quang Ngai Province, Vietnam in 2011 and 2012. Our objectives were to determine the bat fauna, assess bat diversity and community similarity in comparison with past surveys elsewhere in Vietnam, and to describe aspects of bat reproduction and echolocation calls. We documented 17 species of insectivorous bats, including six species of *Murina* (tube-nosed bats) with poorly known distributions in Vietnam. Pregnant females of several species of bats were observed in the late dry season but no volant juveniles, whereas in the early wet season most females were lactating or post-lactating and volant juveniles of 10 species were captured. We recorded and analyzed echolocation calls of 16 of the species, and reviewed similarities and discrepancies with call descriptions from the same species elsewhere in Asia. Comparisons of echolocation calls indicate the likely existence of cryptic taxa in some problematic groups. Bat diversity at the study area was high considering the lack of a karst substrate for roosting opportunities. Diversity and abundance indices compared favorably with the literature on bat surveys in three nature reserves elsewhere in Vietnam.

INTRODUCTION

In late May and early June 2011 and again in March 2012, we volunteered to sample bats as part of a first survey of biodiversity in southwestern Quang Ngai Province, in central Vietnam. The overall survey was sponsored by Wildlife At Risk, a non-government conservation organization headquartered in Ho Chi Minh City, and conducted in cooperation with the Quang Ngai Forest Protection Department, Vietnam Ministry of Agriculture and Rural Development. In this preliminary report we provide detailed results of the bat survey. The state of knowledge on the systematics, identification, and ecology of bats in southeast Asia is very incomplete. Future research will build on these findings.

This report provides information on the species we captured, the subset of those captures for which we obtained voucher material, measurements of echolocation calls, observations on bat reproduction, and basic information on the bat fauna. It also includes comparisons with results of bat surveys at two nature reserves in adjacent Gia Lai Province, and comparisons with recently published information on the bat fauna at Kim Hy Nature Reserve in Bac Kan Province in northern Vietnam (Furey et al. 2010), which is to our knowledge the most thorough survey of a bat community in Vietnam.

Past surveys of the bat fauna of Vietnam were reviewed by Hendrichsen et al. (2001), who provide a detailed summary of species records for the entire country. Although records of bats have been documented in many provinces of Vietnam, there have been no surveys for bats in Quang Ngai Province and the review by Hendrichsen et al. (2001) lists no records for bats in Quang Ngai Province.

METHODS AND MATERIALS

Study Area

Our study area was in central Vietnam in the southeastern Truong Son (Annamite) Mountains, Ba To District, southwestern Quang Ngai Province (Figure 1). The area was near the borders with Gia

Lai Province, Kon Tum Province, and Binh Dinh Province. We based our work at two campsites, one at about 750 m elevation occupied in late May and early June 2011, and one at about 930 m elevation occupied in March 2012. In 2011 most sampling locations were within about 800 m of our main camp, which was in a cleared grassy area at latitude 14.6602 N and longitude 108.6075 E (Figure 2). The surrounding forest was primarily secondary regrowth after logging activities about 40 years earlier. In March 2012 our study camp was located at 14.6206 N, 108.5865 E, 4.9 km SSW (bearing 207^{o}) of the May-June 2011 camp. The sampling area in March was also secondary regrowth since logging in about 1980, but was more heavily forested and had a greater number of mature, large diameter trees. The March 2012 camp was on the River Lay above the highest waterfall. All nets and traps were set at ground level within 1.7 km of the camp in 2012, with most (> 80%) locations within 800 m of camp. Further details on the study areas are available from Wildlife At Risk and at the Ministry of Forestry in Quang Ngai.

Bat Sampling

The study began at the onset of the wet season in May 2011 (Figure 3). We captured bats using mist nets and harp traps set from ground level. We set nets across trails in forest, over small ponds and streams in forest or near forest edges, and at openings at the edges of forest vegetation. We set harp traps at similar locations and in dry streambeds that could function as travel corridors for bats. We deployed two different harp traps in 2011. One was a 4-bank trap ca. 1.5 x 1.5 m in area (2.25 m^2) and the other was a 2-bank trap 0.9 x 1.1 m in area (1.0 m^2). In 2012 we deployed the same size traps and a larger 4-bank trap 2 m x 2 m in area (4 m^2). Mist nets ranged from 6.0 to 12.8 m in length, with most nets 2.6 m in height. In 2011 most (90%) sampling locations were within 800m of camp, with a maximum distance of 1.25 km between any of the sites near camp (Figure 2; See Appendix A-1 for coordinates of sampling locations in 2011). Elevations at netting sites in 2011 varied from ca. 712 m to 772 m. Nets and/or traps were set on 11 nights between 28 May and 9 June inclusive at locations near camp. In addition to sampling at the main camp, in 2011 we also hiked to locations at higher elevations (ca. 930-950 m elevation) where we set nets on two additional nights (31 May and 1 June; sites 14 and 15 in Appendix A-1). In March 2012 we set nets and traps on 9 nights, with most (> 80%) locations within 800 km of camp (Appendix A-2). Elevations of 90% of the sampling sites in 2012 were between 880 and 991 m elevation, but on two nights nets were set at 330-650 m elevation (with only one bat captured).

Species Identifications

We relied on two sources for identifications of bats in the field based on external characters: Borissenko and Kruskup (2003) and Francis (2008). We also compared specimens in the field with descriptions of new taxa that appeared in Furey et al. (2009a), Kruskop and Eger (2008), and Kruskop and Tsytsulina (2001). In the laboratory we also compared voucher specimens with descriptions of new species of bats of the genus *Murina* by Csorba et al. (2011, 2007), Csorba and Bates (2005), Eger and Lim (2011), and Francis and Eger (2012). We collected voucher specimens in ~ 95% ethanol for most of our tentatively identified species (unfortunately we were limited in our materials in 2011 and were not prepared to save all specimens or to make study skins). We also took samples of liver or wing tissue in

95% ethanol for future DNA analysis by others. As noted by Csorba et al. (2011) for *Murina*, saving tissues for DNA analysis is now imperative for understanding systematics of many bats. All samples and voucher specimens were placed with collections at the Institute for Ecological and Biological Resources, (IEBR) at the Vietnam Academy of Sciences and Technology,Hanoi.Use of English common names follows Francis (2008) and original publications for species that have been discovered more recently.

Reproduction

We categorized adult females as pregnant, lactating, post-lactating, or non-reproductive following standard field techniques for bats (*e.g.* Racey 2009). In cases where pregnancy was detected in voucher specimens we recorded rump-crown lengths of embryos. Males were categorized as non-reproductive or as with engorged scrota (or analogous sacs). Age was categorized as volant juvenile or adult based on fusion of the phalangeal epiphyses (Brunet-Rossinni and Wilkinson 2009).

Echolocation Recordings

We recorded echolocation sounds of some species, including individuals that were prepared as voucher specimens. Such recordings can allow comparison of results with the literature on echolocation of bats recorded elsewhere in Asia. Such comparisons may be useful aids to species identification, particularly for cryptic taxa that may be members of species complexes that are not yet well understood (Francis 2008). Bats were recorded as they were followed in flight in an enclosure made with mosquito netting (ca. 2 m high x 2 m wide x 3 m long), when hanging freely on the sides of the enclosure, or while they were held in hand. We disregarded call data from hand-held bats if they differed strongly from bats recorded in flight. Recordings of bats in flight in enclosures or in hand are commonly employed for bat surveys (e.g. Kingston et al. 1999, Kingsada et al. 2011, Hughes et al. 2010, 2011) but measurements can be biased and are inferior to recordings of free-flying bats. However, given the low capture success and need for voucher specimens (see Results) we chose not to release bats for recordings in the open.

We used two different recording systems for echolocation calls. In 2012 we sampled echolocation calls as WAV files using an Echometer EM 3 digital ultrasonic recorder (Wildlife Acoustics 2012). The EM3 allows recording at sampling rates of 256 and 384 kHz (providing analysis of calls up to frequencies of about 192 kHz). We analyzed properties of calls recorded in 2012 in Hanning windows using spectrograms, oscilloscope tracings, and power spectra features of Call Viewer software (Skowronski and Fenton 2008). We analyzed time and frequency characteristics for 12 calls per individual, selecting calls that appeared to provide the greatest amount of information. For bats with predominantly constant frequency (CF) calls we calculated the frequency of maximum energy (FMAXE, kHz), the frequency range of the preceding upsweep (FM rise, kHz), the frequency range of the terminal downsweep (FM tail, kHz), and the sound duration (ms). For bats with predominantly frequency modulated (FM) calls we calculated mean ± 1 SD and ranges for start frequency (kHz), end frequency (kHz), FMAXE (kHz), midpoint (kHz) and duration (ms). We did not measure interpulse intervals because of the confined recording context. In 2011 recordings were made with AnaBat II bat detectors with programmable zero-crossing analysis interface modules (AnaBat™ CF Storage ZCAIM; Titley Electronics, NSW, Australia). We used AnalookW software, version 3.8.13

(http://users.lmi.net/corben/WinAnalook.htm) to view and describe the call recordings made in 2011. This system allows time and frequency measurements , but does not allow thorough acoustic analysis of bat calls (Fenton et al. 2001). The Anabat system also does not allow reliable measurements of the upper ranges of echolocation calls of some species that utilize very high frequencies. In our study areas these were primarily bats of the genera *Murina* and *Kerivoula*. *Murina* produce calls that are faint in intensity, making upper frequencies difficult to record. We provide results from Anabat recordings for those species of *Murina* that were recorded only in 2011 with the caveat that start frequencies are likely underestimates. For comparative purposes we also tabulate these same metrics from the published literature on echolocation calls of the same species we recorded in Quang Ngai but were captured elsewhere in Asia.

Computations and Statistical Analyses

We provide original data and simple descriptive summary statistics: means, standard deviations (SD), ranges, and coefficients of variation (CV; SD/mean). We calculated metrics for bat species diversity and community similarities to compare with the three other bat surveys in Vietnam described above. We also made comparisons between the two sites sampled within our Quang Ngai study area in 2011 and 2012. These computations follow methods given in Kingston (2009) and Furey et al. (2010). We calculated effort based on mist net or harp trap areas times the number of hours nets or traps were set , and tabulated success by dividing numbers of bats and numbers of species captured per unit effort. We provide species richness (S) as the total number of species in a community. We also calculated a species diversity index, a measure of evenness of distribution of individuals among species, predicted species richness, and inventory completeness using program SPADE (Chao and Shen 2010). We calculated the inverse Simpson index of diversity as 1/D where $D = [\Sigma n(n-1)]/[N(N-1)]$, n is the number of individuals in each observed species, and N is the total number of individuals captured (Magurran 1988). Evenness of the distribution of individuals among species is expressed by the formula $(1/D)/S$, where S is the number of observed species. We followed Furey et al. (2010) and used program SPADE to calculate predicted species richness based on a hypothetical increase in sampling effort that was double the number of bats captured; we used two estimation methods (Solow and Polasky 1999, Shen et al. 2003), and measured inventory completeness as the range in the ratio of observed species richness to predicted species richness x 100% based on the two estimation computations. We also used two indices to compare similarity of communities in pair-wise contrasts. We calculated the simple Jaccard's index as $J = C/(A + B - C)$, where C is the number of species in common between the faunas of two regions, A is the number of species in one region, and B is the number of species in the other region (Magurran 1988; incidence index of Chao and Shen 2010). We used Program Spade to calculate the abundance-based adjusted Jaccard similarity indices and standard error estimates with 500 bootstrap replications (Chao et al. 2006). For comparison we recalculated some of these statistics for the insectivorous bat fauna in the Kim Hy study results based on original data in Furey et al. (2010).

RESULTS AND DISCUSSION

Bats Captured May-June 2011.

We set mist nets for 758 square-meter net-hours (m^2nh) on two nights (31 May-1 June 2011) at locations above 900 m but caught no bats. We also saw no bats in flight at these sites, although others in our party occasionally saw bats in the mountain area while searching for reptiles and amphibians. Heavy rain fell during most of the first night and intermittently the latter part of the second night. We do not include effort and results at these higher mountain sites in further treatment of our results.

We sampled for bats at 33 georeferenced locations within 1.25 km of camp (Appendix A-1) on 11 nights between 28 May and 9 June 2011 inclusive. Sampling sites ranged between 712 and 772 m in elevation. We captured 50 bats of 13 species (Table 1; Appendix B-1)) at 15 of these locations in 2,845m^2h of mist net and 174m^2h of harp trap sampling. Four species were captured only in harp traps, three only in nets, and six in both (Table 1). A striking feature of our sampling was an absence of fruit bats (Pteropodidae). At least two species of fruit bats were captured in surveys at Kon Cha Rang and Kon Ka Kinh Nature Reserves in nearby Gia Lai Province (Hendrichsen 2001) and four species of fruit bats were present at Kim Hy Nature Reserve in Bac Kan Province (Furey et al. 2010).

Our results were also notable for the presence of six species of *Murina*. Bats of the genus *Murina* are very poorly known, with several new species named from Vietnam or elsewhere in southeast Asia during the past decade,and likely more to follow (Csorba and Bates 2005; Csorba et al. 2007, 2011; Furey et al. 2009a; Kruskop and Eger 2008; Eger and Lim 2011; Francis and Eger 2012). In addition, some experts suspect that other currently recognized taxa of Asian bats, such as *Hipposideros larvatus*, some species of *Rhinolophus*, and *Kerivoula hardwickii* may consist of complexes of several species (Francis 2008). Zhang et al. (2009) also reported a likelihood of cryptic species of *R. pusillus* in Asia based on geographic differences in echolocation calls. We captured six species of bats in 2011 that were not taken in March 2012: *Glischropus bucephalus, Murina annamitica, Murina cyclotis, Murina eleryi, Murina huttoni, and Myotis ater.*

We collected 24 whole specimens of the 13 tentative species in 95% ethanol, with a separate small vial of liver tissue in 95% ethanol for each of these whole specimens (Appendix C-1). We sampled wing tissue from an additional eight bats of three of the 13 species (Appendix C-1), each of which was released following sampling. These samples are at IEBR and can be made available to researchers for DNA analysis.

Bats Captured March 2012

We sampled bats at 52 georeferenced locations within 1.75 km of camp on 9 nights between 12 and 20 March 2012, inclusive (Appendix A-2). Most of thesampling locations (45 of 52) ranged from 883 m to 991 m in elevation. We captured 69 bats, with 65 bats captured within the 883-991m elevational range (Appendix B-2). We identified 11 species of insectivorous bats but no fruit bats in March 2012, with 9,487.5 m^2nh and 770.5 m^2nh trapping effort (Table 2). Results were dominated by captures of *Rhinolophus affinis* : 47 of 69 bats (68%) were identified as this species. Four species were taken in March 2012 that were not captured in 2011: *Megaderma lyra, Myotis muricola, Rhinolophus pearsoni, and Scotomanes ornatus* (Table 2).

During 2012 we collected 27 bats as whole specimens in 95% ethanol with liver tissue in separate vials of ethanol (Appendix C-2). We also sampled muscle as well as liver for the three specimens of *Murina* and one specimen of *Kerivoula*. We sampled seven additional bats by wing biopsy

in 95% ethanol prior to their release (Appendix C-2). These samples are at IEBR and can be made available to researchers for DNA analysis.

Total Bats for the Quang Ngai Study Area

We captured 119 bats of 17 species (Table 3). We obtained 51 entire specimens with corresponding tissue samples in ethanol for possible DNA analysis, and wing tissue for DNA analysis from another 15 specimens (Appendices C-1, C-2). Individuals of the six species of *Murina* were taken at locations within 630 m of each other, with up to four species of *Murina* taken at the same trap or net site (Appendices B-1, B-2). Within the Quang Ngai study area, the number of species detected and individuals detected per unit effort was higher at the sites sampled in 2011 than at the sites sampled in 2012 (Tables 1 and 2).

Species Accounts

Below we provide brief accounts of sampling by family and species. We include reference to voucher specimens, sex, age class, forearm length, echolocation calls, reproduction, and some capture details and pertinent information from recent literature. See Appendices B-1 and B-2 for capture records and Appendices C-1 and C-2 for a full list of specimen material.

Pteropodidae

We did not capture any fruit bats at the Quang Ngai study area; however, we observed *Cynopterus* sp. in the town of Ba To, 17 km northeast of our camp. Fruit bats are well known to make local and regional movements to exploit temporal and spatial differences in availability of fruit. Pteropodid bats may utilize the Quang Ngai study area at other times of the year if fruit is more abundant than in the dry or in the early wet seasons (when we sampled the bat fauna). Although no fruit bats were seen in the study area in 2011 and 2012, on 21 March 2012 we observed bat-expressed fruit pulp on the ground beneath a fruiting tree at about 825 m elevation.

Megadermatidae

Megaderma lyra. (Greater False Vampire). We captured two *M. lyra* in March 2012, both in mist nets near water along the River Lay at 917-920 m elevation. One (QN066) was a non-reproductive adult male (forearm 65.5 mm, mass 36.5g). The other bat escaped before it was examined and measured. Echolocation calls in this species can vary depending on prey type and orientation behavior (Leippert et al. 2002). We only recorded 6 echolocation calls from one bat (data not included here), but characteristics of calls were consistent with those reported in the literature (*e.g.* Leippert et al. 2002).

Rhinolophidae

Rhinolophus affinis (Intermediate Horseshoe Bat). In 2011 we captured four *R. affinis*. Two were adult females (TJO 419v, 420v—wing tissue), one lactating and one non-reproductive, forearms 49.6,52.2 mm, body mass 14.0, 15.5 g. Two were volant juvenile females (TJO 424v-wing tissue, TJO 425v-wing tissue) , forearms 49.8, 51.0, body mass 11.0, 11.5 g. These bats were captured in the harp trap in the dry streambed near camp on two nights. *R. affinis* were much more abundant throughout the

2012 sampling area, where they accounted for 68% of the bats captured. We captured 47 individuals in 2012: 30 adult females (mean forearm length 50.1 ± 1.3 mm, n= 25, mean body mass 17.2 ± 2.6 g, n =19) and 17 adult males (mean forearm length 50.7 ± 1.1 mm, n = 13 , mean body mass 15.4 ± 0.3 g, n = 4). Adult males captured in 2012 were non-reproductive. Twenty-five of the 30 females captured in March 2012 were pregnant, 4 were not reproductive, and in one case reproductive status was not determined. The pregnant females each contained a single embryo (Appendix C-2). The high proportion of females that were pregnant in March and the presence of lactating females and volant juveniles in early June suggests timing of reproduction to coincide with the advent of the wet season. This seasonal pattern in reproduction is consistent with findings in rhinolophid bats (including *R. affinis*) by Furey et al. (2011) at Kim Hy Nature Reserve in northern Vietnam.

Echolocation calls (*n* = 216) of 18 R. affinis were CF at an average FMAXE of 80.6 kHz, with a beginning rise of about 11 kHz and a descending FM tail of about 19 kHz, total duration averaging 30.6 ms (Table 4). Zhang et al. (2009) reported that even within the same cave individuals identified as *R. affinis* had widely separated dominant frequencies, and suggested that this may indicate the presence of cryptic species. FMAXE of *R. affinis* at Quang Ngai were higher than published reports for *R. affinis* from Bac Kan Province (Vietnam), Cambodia, Laos, Malaysia, Thailand, and four regions in China, but similar to records from bats reported as *R. affinis* from Yunnan, China and Kon Tum Province in Vietnam (Table 4). Additional research is needed on geographic variation in echolocation calls and systematics of *R. affinis*.

Rhinolophus pearsoni.(Pearson's Horseshoe Bat). We captured one non-reproductive adult male in March 2012 (QN006; forearm 50.4 mm). Echolocation calls of this bat were CF sounds averaging 64 kHz with short preceding FM rises and terminal sweeps, and a duration of 38 ms (Table 4). These recordings were generally consistent with reports from elsewhere (Table 4), although FMAXEmeasurements were higher than those recorded from free-flying bats in Bac Kan Province, Vietnam (Furey et al. 2009b).

Rhinolophus pusillus. (Least Horseshoe Bat). In 2011 we captured ten females: one volant juvenile (forearm 36.4 mm, body mass 5.0 g) and nine adults (three pregnant, six lactating;eight specimens retained: TJO 402v, 405v, 428v, QN041, QN043, QN044, QN045, QN048). These bats were captured at 6 separate locations in nets and harp traps, one in an insect sweep net. Bats were captured in forest, in clearings, and in dry streambeds. In March 2012 we captured eight *R. pusillus* (5 adult females, 2 adult males, 1 sex not determined). The 5 adult females were all pregnant, with 4 examined on dissection having 1 embryo each. The two adult males were non-reproductive. The March pregnancies together with the presence of lactating and volant juvenile *R. pusillus* in June suggests wet season timing of reproduction, as in *R. affinis*. Body measurements of adult female *R. pusillus* captured in Quang Ngai were: forearm length 39.4 ± 1.2 mm (n = 14), mass 6.9 ± 0.7 g (n = 10). Two adult males (specimen QN047 retained) each were 5.0 g body mass and had 38.2 mm forearm lengths. Echolocation calls of eight R. pusillus measured in 2012 averaged 99.7 ± 0.7 kHz FMAXE, with a beginning rise of about 14.9 kHz and a descending FM tail of about 17.5 kHz, total duration averaging 35.8 ms (Table 4). Zhang et al. (2009) reported a likelihood of cryptic species of *R. pusillus* in Asia based on geographic differences in echolocation calls.Calls we measured were near the range reported for this

species in Bac Kan Province in Vietnam and some locations in China , but were about 10 kHz lower than *R. pusillus* recorded in Guangxi (China), at some locations in Laos, and in Thailand (Table 4). According to Dr. Vu Dinh Thong of IEBR (personal communication, 28 March 2012), *R. pusillus* he has recorded in Vietnam produce echolocation calls with FMAXE at about 108 (range 103-113) kHz. Additional research on echolocation and systematics of *R. pusillus* is needed to clarify these seeming discrepancies.

Hipposideridae

Hipposideros larvatus. (Intermediate Roundleaf Bat). In 2011 we captured three adult males (one reproductive), forearms 64.9, 65.0, and 68.2 mm, body mass 24.0, 24.5, and 29.0 g; and two volant juvenile females, forearms 63.3, 65.5 mm, body mass 20.0, 20.5 g. Four of these bats were captured in a harp trap in the dry streambed near camp, and one was captured in a net on a wide trail through forest. We preserved one voucher specimen plus liver tissue for one bat (TJO 400v), and wing tissue samples from four other bats in 2011 (TJO 409v, 412v, 418v, 426v). In 2012 we captured one *H. larvatus*, a non-reproductive adult female with a forearm length of 64.6 mm (released, but with wing tissue saved in ethanol; QN005).

Echolocation calls of the volant juvenile female specimen (TJO 400v) taken at Quang Ngai in 2011 were nearly identical to those of the bat recorded in 2012 (Table 4). Calls of these two bats averaged 93.2 kHz FMAXE, had no initial FM rise, aterminal downsweep of 14.8 kHz, and were about 5.8 msec duration. FMAXE of calls from both animals were also nearly identical to those recorded from *H. larvatus* from Myanmar, but dissimilar to those recorded in Bac Man Province (Vietnam), Thailand (in part), Malaysia, India (in part), and various regions of China (Table 4). Thabah et al. (2006) have suggested that bats from Myanmar with echolocation frequencies similar to the bats sampled at Quang Ngai are the species *Hipposideros grandis* rather than *H. larvatus*. However, forearm length measurements of *H. larvatus* from Quang Ngai are larger than any reported by Thabah et al. (2006), but are more similar to forearm lengths from bats sampled in Myanmar and India than from those sampled in Malaysia and China (Table 4). *H. larvatus* seems to present another case where additional research on variability in echolocation in relation to systematics is needed.

Hipposideros pomona. (Large-Eared Roundleaf Bat). In 2011 we captured two males (TJO 427v), one non-reproductive adult (forearm 43.4, body mass 7.0 g) and one of unknown age class and reproductive status (escaped), forearm 42.8. Both were captured in nets across small trails in forest at two different sites. In 2012 we captured three adults: two non-reproductive adult males and one pregnant female with a single embryo. Echolocation calls were recorded for the female and one of the males in 2012; no recordings were made in 2011. FMAXE of these two bats averaged 128.6 kHz, with no initial rise in frequency, a terminal downsweep of 10.7 kHz, and a duration of 5.3 ms. These measurements of ultrasound are consistent with published reports from Bac Kan Province, Vietnam and multiple locations in China and Laos, but averaged lower than at some locations in Thailand and Myanmar (Table 4).

Vespertilionidae

Glischropus bucephalus (Indochinese Thick-Thumbed Bat).We captured one lactating adult female, forearm 34.5 mm, body mass 7.0 g. This was the first bat we captured. It was netted and

released over a small pond on 28 May 2011. No other bats of this species were subsequently captured during our field work. Using Borissenko and Kruskup (2003) and Francis (2008) we initially identified the bat as *Glischropus tylopus*. Subsequently we learned that Csorba (2011) presented new evidence that all bats of this genus in southeast Asia north of the Isthmus of Kra (above the Malaysian peninsula) should be referred to under the name of a new taxon, *G. bucephalus*, and that *G. tylopus* should be restricted to bats south of the isthmus. We did not record echolocation calls of this species.

Kerivoula hardwickii (Hardwicke's Woolly Bat). One volant juvenile male (forearm 33.3 mm, body mass 4.3 g; TJO 408v) was taken in 2011 in a harp trap in a dry stream channel at 727 m, and an adult female (forearm 34.8, mass 5.8 g; QN022) was taken on 14 March 2012 in a harp trap at 984 m elevation. The female was pregnant with a single (15 mm) embryo. The bat recorded in 2012 had short duration (1.4 ms ± 0.56 ms) echolocation calls with high average start (169.5 ± 19.9 kHz) and end (95.2 ± 9.1 kHz) frequencies, and peak frequencies averaging 149.3 ± 26.5 kHz (Table 5).

Hughes et al. (2011) provided data for echolocation calls of *Kerivoula hardwickii* from Thailand (Table5). These calls were very similar to those we recorded (nearly identical start and end frequencies, and overlap with other measures). We are unaware of any other published information about echolocation sounds of *K. hardwickii*. Kingston et al. (1999) report that five species of *Kerivoula* from Malaysia also have very high start frequencies (averaging about 172-178 kHz) and end frequencies (averaging about 50-86 kHz), and short durations, with mean call length ranging from 1.7 to 2.7 ms.

Murina annamitica (Annamite Tube-Nosed Bat). This species was very recently described (Francis and Eger 2012) based on four specimens from Laos with two additional referred specimens from Laos and two from Vietnam (Quang Nam and Binh Phuoc provinces). We captured *M. annamitica* in 2011. We obtained four voucher specimens of this species (TJO 401, TJO404, TJO421, TJO423) and also released one bat tentatively identified as *M. annamitica* (a volant juvenile male captured in a mist net over a small spring on 4 June 2011). The voucher specimens were two females (one lactating adult, forearm length 32.2 mm, body mass 7.0 g; one volant juvenile, forearm length 33.5 mm, body mass 7.0 g) and two males (one non-reproductive adult, forearm length 31.2 mm, body mass 6.0 g; one volant juvenile, forearm length 31.2 mm, body mass 4.5 g). The bats saved as specimens were taken in mist nets in forest over or near a small stream, at the edge of a small rainwater pond at the forest edge, and in a harp trap at the forest edge. The locations in Quang Ngai province are about 315 km northeast and 88 km southeast of the two previously known locations in Vietnam. We are unaware of any published information about echolocation sounds of *M. annamitica*. Echolocation calls of two individuals (TJO404 and TJO421) recorded in 2012 were FM sweeps from about 131 to 71 kHz, 1.1 ms duration (Table 5). However, we believe the start frequencies and midpoint frequencies may have been underestimated.

Murina beelzebub (Beelzebub's Tube-Nosed Bat). *M. beelzebub* is a recently discovered species,described based on three specimens collected in 2007 at Bac Huong Hoa Nature Reserve, Huong Hoa District, Quang Tri Province, Vietnam, elevation 400 m,from disturbed secondary forest (Csorba et al. 2011). Referred specimens are also known from Kon Ka Kinh Nature Reserve in Gia Lai Province (Csorba et al. 2011). Our records add to the known distribution of the species: locations are about 330 km southeast of the type locality and 40-45 km northeast of Kon Ka Kinh Nature Reserve. We captured

one volant juvenile female (forearm length 37.3 mm, body mass 5.5 g) in a harp trap at a small trail entering a strip of forest above camp at 753 m elevation (TJO 407v) on 4 June 2011. We captured a second bat (QN023, non-reproductive adult male, forearm length 34.4 mm, body mass 5.5 g) on 14 March 2012 in a mist net in forest at 967 m elevation. Echolocation calls measured in 2012 averaged 146 kHz in start frequency, 74 kHz in end frequency, were short duration (1.4 ms) and had maximum energy at a mean frequency of 124.5 kHz (Table 5). We are unaware of any published information about echolocation in this species.

Murina cyclotis (Round-Eared Tube-Nosed Bat). This species has a fairly widespread distribution in southeast Asia (Francis and Eger 2012). In 2011 we took five of these bats as voucher specimens (TJO 403, TJO 414, TJO 416, TJO 417, TJO 422) on three nights at two separate locations near the lower elevation camp: three in mist nets at a small rain-water pond in forest habitat on 30 May and 5 June, and two overnight in a harp trap in a dry stream channel at camp on 5 and 7 June. Three were adult females, each with evidence of recent reproduction (two post-lactating, one lactating); one was a volant juvenile female with no evidence of reproduction, and the fifth bat was an adult, non-reproductive male. We also captured one bat that was released but tentatively identified as this species (a volant juvenile female on 7 June) at the same harp trap location. Mean forearm lengths and body masses of females were 33.6 ± 0.8 mm and 6.1 ± 0.9 g; the male forearm length was 30.6 mm and body mass 5.5 g. Echolocation calls of three of these bats were measured. They had short duration (1.9 ms) calls sweeping from about 129 to 62 kHz (Table 5). Kingston et al (1999) report that calls of bats of the genus *Murina* tend to be similar to one another, of short duration and faint intensity, sweeping a broad range with high frequency start points. They sampled *M. cyclotis* from peninsular Malaysia and noted a lower end point (51.6 kHz; Table 5), but higher start frequencies and longer durations than we measured, likely indicating that the faint higher frequencies may not have been detected in the recording system we used in 2011. However, our measurements of calls of *M. cyclotis* are very similar to those reported for this species by Hughes et al. (2011) in Thailand (Table 5).

Murina eleryi (Elery's Tube-Nosed Bat).This species was recently described based on six specimens taken in 2007 at Kim Hy Nature Reserve in Bac Kan Province, Vietnam (Furey et al. 2009a). Two specimens are also known from Son La Province and Ha Giang Province (Furey et al. 2009a), and five specimens have been reported from Quang Nam province (Eger and Lim 2011). Habitats of the specimens from Bac Kan province are in forested karst landscape, including disturbed areas (Furey et al. 2009a). We documented this species in Quang Ngai with capture of one volant juvenile male, forearm 29.9 mm, body mass 3.5 g (TJO 415v). The single bat was captured in a harp trap in a dry stream channel at camp on 5 June 2011, about 86 km southwest of the southernmost published location in Vietnam (Eger and Lim 2011). Other recently published locations for *Murina eleryi* are in Guangxi and Guizhou provinces, China, and Khammmouane and Houphan provinces, Laos (Eger and Lim 2011, Francis and Eger 2012). The bat we recorded had the shortest duration call of any species sampled (0.6 ms). Its frequency range swept from about 128 to 85 kHz (Table 5), but the recordings may have been biased low in frequency. We are unaware of any published information about echolocation sounds of *M. eleryi*.

Murina fionae (Fiona's Tube-Nosed Bat). This species was very recently described based on 2 specimens from Laos, with two additional specimens known from Quang Nam province, Vietnam about 86 km northwest of our study area (Francis and Eger 2012). We captured *M. fionae* at Quang Ngai in 2011 and 2012. We obtained one voucher specimen and captured but released one bat tentatively identified as this species in 2011. One lactating adult female was taken on 3 June 2011 (TJO406, forearm 37.2 mm, body mass12.0 g) at the small rain-water pond at the forest edge where the *M. cyclotis* were captured, and a second lactating adult female was captured but released on 4 June 2011 in the harp trap near camp (forearm length 39.9 mm, body mass 11.0 g). Two non-reproductive adult males were taken on 13 and 19 March 2012 (QN021, forearm length 34.2 mm, mass 8.5 g; QN069, forearm length 35.0 mm). The bats captured in 2012 were taken in a harp trap and a mist net in forest, one at 911 m and one at 381 m elevation. Echolocation calls of the one *M. fionae* measured in 2012 swept from about 153 kHz to 67 kHz with a peak frequency of 112 kHz (Table 5).

Murina huttoni (Hutton's Tube-Nosed Bat). This species was captured in 2011 only. We took three voucher specimens (TJO 410, TJO 411, TJO 413) at the same two locations where the *M. cyclotis* were captured. Two were adult females (lactating, forearm length 32.5 mm, body mass 8.0 g; and post-lactating, forearm length 35.0, body mass 7.0 g), and one was a volant juvenile female (forearm length 39.0 mm, body mass 11.0 g). We also captured but released three bats (two lactating females, one with forearm length 32.6 mm, body mass 5.0 g; one bat escaped prior to determining sex, age or reproduction) that were tentatively identified as this species. These three were taken in mist nets over a small stream in the forest on 8 and 9 June 2011. The nearest records for *M. huttoni* are in Quang Nam province, about 86 km northwest of our study area (Francis and Eger 2012). Echolocation calls of four bats measured in 2011 were FM sweeps from at least 128 to 63 kHz, 1.7 ms in duration. We are unaware of any published information about echolocation sounds of *M. huttoni*.

Myotis ater (Peters's Myotis).We captured six of these bats at two different sites in 2011, both sites over streams in forest. Four adult males (TJO430v, 431v) had forearms of 33.6, 34.8, 35.1, 36.1 mm and body masses of 4.5, 5.0, 5.5, and 5.5 g; one volant juvenile female (TJO 429v wing tissue) 36.6 mm, 5.0 g; and one volant juvenile male 36.9 mm, 6.5 g. These bats appeared most similar to descriptions of *M. ater* based on pelage, relative size of canine and premolars, body size, presence of a narrow calcar, and insertion of the wing at the base of the first digit. Pelage is dense and blackish with sparse light brown tips. Echolocation consisted of FM sweeps spanning about 105 to 53 kHz, 2.3 ms duration (Table 5). Call characteristics are similar to those reported for this species in Bac Kan Province, Vietnam (Furey et al. 2009b).

Myotis muricola (Asian Whiskered Myotis). We captured one adult female (QN055; pregnant, 1 embryo) in a mist net over the River Lay on 16 March 2012. Echolocation calls we recorded from this bat had similar start (115 kHz) and end (50) frequencies as recorded from *M. muricola* in Thailand (Hughes et al. 2011); peak frequencies (FMAXE, 65 kHz) and durations(3.1 ms) were higher and longer, but within one standard deviation of *M. muricola* calls recorded in Thailand. Call characteristics were similar to those reported for this species in Bac Kan Province, Vietnam (Furey et al. 2009b).

Scotomanes ornatus (Harlequin Bat). We captured two of these bats on 16-17 March 2012 (QN054, QN064). Both were non-reproductive adult males and were captured in mist nets set across the River Lay. Echolocation sounds were recorded from one hand-held bat, with an FMAXE of about 64 kHz, start frequency of about 105 kHz, end frequency of about 20 kHz, and a duration of 3.3 ms (Table 5). The start and end frequencies are higher than that reported by Furey et al. (2009) for free-flying bats of this species, most likely because the free-flying individuals emphasized the first harmonic whereas our peak measurements of hand-held bats were all in the second harmonic. Measurements of calls recorded by Liu et al. (2011) had lower start frequencies than we reported, but similar FMAXE and end frequencies (Table 5).

Reproduction

In much of Vietnam there is a predictable rainy season following a winter dry season, with the monthly pattern of precipitation varying by region (Sterling et al. 2006). In many tropical and subtropical regions of the world reproduction of insectivorous bats is timed to coincide with predictable rainy seasons, such that young are born and become independent when community productivity and insect abundance is high (*e.g*. Racey and Entwistle 2000, Fleming et al.1972, Bernard and Cumming 1997). Furey et al. (2011) found strong evidence for this pattern in the insectivorous bat fauna in Bac Can province in northern Vietnam and suggested that the pattern may hold for a wider region in southeast Asia. Rainfall in the Quang Ngai study region is lowest in January through March, then increases and remains relatively high from May through November (Figure 3). Our findings on reproduction are consistent with Furey et al.'s (2011)suggestion of rainy season reproduction in the insectivorous bats (Table 6). In March 2012 (prior to the rainy season), most female bats that were taken were pregnant, none were lactating or post-lactating, and no volant juveniles of either sex were captured (Table 6). This differed from late May and June, when most adult females were lactating, a few were pregnant,and volant juveniles of 10 species were captured (Table 6). A single embryo was found in each pregnant female saved as a voucher specimens; the following species and number of individual females (in parentheses) were examined for embryos: *Hipposideros larvatus* (1), *Kerivoula hardwickii* (1), *Myotis muricola* (1), *Rhinolophus affinis* (4), *Rhinolophus pusillus*(4). Given the longer period of seasonal rainfall at our study area compared to the Kim Hy Nature Reserve, it is possible that the reproductive season for some species of bats also may be more prolonged than in areas with shorter rainy seasons.

Further Comparisons with Reports of Echolocation from the Scientific Literature on Southeast Asian Bats

Echolocation calls of the two species of *Murina* we recorded in 2012 (Table 5) are concordant with findings reported for other species in this genus. Kingston et al (1999) and Thong et al. (2011) report that calls of species of *Murina* tend to be similar to one another, of short duration and faint intensity, sweeping a broad bandwidth with high frequency starting points, typically about 150 kHz. These characteristics match those we recorded for *M. beelzebub* and *M. fionae*. Calls for the *Murina* we sampled in 2011 also match these characteristics, but our start frequency estimates were generally

limited by the equipment used at that time. For these species the maximum values in the range of the start frequencies are probably most reliable. Midpoint values are also likely biased low. However, our measurements of calls of *M. cyclotis* in 2011 are very similar to those reported for this species by Hughes et al. (2011) in Thailand (Table 5).

Our measurements of echolocation calls of the other species of vespertilionid bats are consistent with the literature. Echolocation sounds from *Scotomanes ornatus* were recorded from a hand-held bat in our study, and the start and end frequencies are higher than that reported by Furey et al. (2009a) for free-flying bats of this species. This is most likely because the free-flying individuals emphasized the first harmonic, whereas our peak energy measurements of the hand-held bat were all in the second harmonic. Measurements of calls of *S. ornatus* recorded by Liu et al. (2011) had lower start frequencies than we reported, but similar FMAXE and end frequencies (Table 5).

Greater discrepancies in echolocation call measurements are seen when comparing rhinolophid and hipposiderid bats recorded at Quang Ngai with calls of the same species recorded elsewhere in Asia (Table 4). It is suspected by some experts that other currently recognized species of these bats in Asia, such as *Hipposideros larvatus* and some species of *Rhinolophus*, may consist of complexes of several species of similar morphology (Francis 2008). Additional research will be required to determine the causes of geographic variation in echolocation calls of rhinolophid and hipposiderid bats in relation to their systematic status. Such variation is apparent in comparing FMAXE measurements among locations (Table 4) for *Rhinolophus affinis*. In *R. affinis* the coefficient of variation was < 1 % for FMAXE of 216 calls from 18 bats recorded at our study area in Quang Ngai, whereas calls recorded from this species at locations in Vietnam, China, Laos, Myanmar, and Malaysia were outside of the range of minimum-maximum values from Quang Ngai (Table 4). Similar discrepancies with bats from Quang Ngai exist among locations for *R. pusillus* from some parts of China, Thailand, Laos, and Vietnam (Table 4). Dr. Vu Dinh Thong of IEBR (personal communication, 28 March 2012), has recorded *R. pusillus* elsewhere in Vietnam that produce echolocation calls with FMAXE at about 108 (range 103-113), outside the range measured in Quang Ngai. Considering this variability in echolocation calls, our findings support Zhang et al.'s (2009) suggested likelihood of cryptic species of *R. pusillus* in Asia based on differences in echolocation calls. Values of FMAXE for *R. pearsoni* also showed some discrepancies as well as similarities among locations.

Among hipposiderids, we found overlap with our range of estimates of FMAXE for *H. pomona* in Quang Ngai and published reports from elsewhere, including China, Laos, Myanmar and Thailand (Table 4). In contrast, great variation is seen in FMAXE of bats referred to as *Hipposideros larvatus* across Asia, with results reported from Myanmar more consistent with those of bats we recorded in Quang Ngai than from many other locations (Table 4). Thabah et al. (2006) suggested that bats from Myanmar with echolocation frequencies similar to the bats we sampled at Quang Ngai may be a species other than *H. larvatus*. *H. larvatus* seems to present another case where additional research on variability in echolocation and systematics is needed. There is a possibility that some of the discrepancies that we highlight among various published studies could be an artifact of improper identification of bats, circumstances of recording (*e.g*. free-flying vs. in-hand), or variability in equipment. Nonetheless the number of differences suggests a real biological basis for this variation and the need for further study.

Bat Community Comparisons with the other Bat Faunal Surveys in Vietnam

Prior bat surveys were undertaken nearby in adjacentGia Lai province at Kon Cha Rang Nature Reserve (14.567^{o}N, 108.567°E) and Kon Ka Kinh Nature Reserve (14.333°N, 108.367°E). These surveys were conductedfor two-three weeks in each reserve during March and April 1999, as part of biodiversity surveys sponsored by BirdLife International (Hendrichsen et al. 2001). Centers of the reserves are about 42 km (Kon Ka Kinh) and 10 km (Kon Cha Rang) from our study area. These surveys revealed the presence of 15 species of insectivorous bats at Kon Cha Rang and 13 species of insectivorous bats at Kon Ka Kinh. (Two species of pteropids also were found at Kon Cha Rang and two at Kon Ka Kinh). Measures of effort and relative abundance are not available in the published summary (Hendrichsen et al. 2001). For the insectivorous bat fauna, Jaccard's indices of similarity between Quang Ngai and these two reserves are fairly low (J = 0.30 with Kon Ka Kinh and J = 0.28 with Kon Cha Rang). In addition to a greater number of species of insectivorous bats at Quang Ngai, only seven species were found in common with either survey in Gia Lai. Six species were unique to the survey at Quang Ngai: *G. bucephalus*, *Rhinolophus pusillus*, and four recently described species of Murina (*M. annamitica, M. beelzebub, M. eleryi, M. fionae*). Only *M. eleryi* was taken exclusively in a harp trap at Quang Ngai, suggesting that differences in sampling techniques alone does not explain the higher species richness at Quang Ngai.

The excellent study by Furey et al. (2010) at Kim Hy Nature Reserve in Bac Kan Province, northern Vietnam, was much more thorough than our preliminary sampling effort at Quang Ngai, and emphasized comparisons among the bat faunas of three habitat types: undisturbed forest (elevations 660-750 m), secondary forest (elevations 720-790 m), and agriculture/degraded forest (elevations 440-582 m). Effort within each of these habitats was roughly comparable to effort at our study area in Quang Ngai (Table 7), but sampling occurred throughout the year at Kim Hy. The study at Kim Hy also took place in an area of karst substrate, providing roosting opportunities for many species of bats. Our study area had no obvious karst features. Our list of tentative species of insectivorous bats totaled 17. Overall, Kim Hy had 32 species of insectivorous bats (including *Megaderma lyra*), with 27 species in primary forest, 21 species in secondary forest, and 23 in agricultural/degraded areas. Exclusive of bats in the genus *Murina*, there were 6 species at Quang Ngai that were also present at Kim Hy (out of 28 non-*Murina* present; Furey et al. 2010). Only *Glischropus bucephalus* was present at Quang Ngai but not at Kim Hy.

The bat fauna at Quang Ngai had fewer species of insectivorous bats than any of the three habitats at Kim Hy (Table 7). Abundance of bats per unit of mist-netting effort was roughly twice as high at Kim Hy, and results per unit trapping were roughly similar. Species detected per unit of mist-netting was roughly similar, but species detected per unit trapping was higher at Quang Ngai overall (Table 7). Interestingly, within the Quang Ngai study area the number of species detected and individuals detected per unit effort was higher at the 2011 sites than at the sites sampled in 2012 (Table 7). They were also comparable to or higher than the Kim Hy sites overall, and than at two of the three forest types at Kim Hy (Table 7). The sites sampled in 2011 were mostly at lower elevation than those sampled in 2012. The adjusted Jaccard abundance-based estimate of community similarity between the 2011 and 2012 study areas in Quang Ngai was 0.67 ± 0.13 SE (basic Jaccard incidence index = 0.41). This was the same as the level of similarity between the full survey results in Quang Ngai, compared to full survey results for insectivorous bats at Kim Hy, where the adjusted abundance-based Jaccard index was 0.69 ± 0.10 SE

(basic Jaccard Index = 0.46). The greatest similarity between Quang Ngai and forest types at Kim Hy was with agricultural/degraded forest (adjusted abundance based Jaccard index of 0.75 ± 0.16 SE, basic Jaccard incidence index 0.34). The most dissimilar comparison was the Quang Ngai insectivorous bat fauna with that of the primary forest at Kim Hy (adjusted abundance based Jaccard index of 0.49 ± 0.12 SE, basic Jaccard incidence index 0.29).

Inventory completeness at Quang Ngai was estimated to be 83-89 %, with a predicted 19-20 species likely to be detected with a doubling in numbers of bats captured (Table 8). As with species richness, Simpson's Inverse Index of Diversity was higher at the karst study areas at Kim Hy than at Quang Ngai, and evenness was lower (Table 8). Lower evenness and diversity was especially pronounced at the higher elevation sites sampled in 2012; diversity comparisons are more similar among the lower elevation sites sampled in 2011 and the sites at Kim Hy. Two ecological factors may contribute to the differences in diversity between the lower and higher elevation sampling areas in Quang Ngai province. The diversity of bats along elevational gradients in tropical and subtropical latitudes has been shown to decline with increasing elevation in some regions of the world (*e.g.* Graham 1983, Patterson et al. 1998). Additionally, some of the differences could be due to differences in seasonal timing of the surveys at the two areas in Quang Ngai province. Furey et al's (2010) study sampled the bat fauna at Kim Hy year round and found that some species of bats may be unique to each season. Only about half of the species they documented were found in both dry and wet seasons (40-52%, depending on habitat type), and fewer species were recorded in each habitat type during the wet season than during the dry season (Furey et al. 2010).

The community similarity and diversity comparisons suggest that the bat fauna of the Truong Son Mountains in southwestern Quang Ngai Province is diverse for a region that does not have a large karst geological substrate (karst provides many potential roosting sites). Greater species richness may occur here than in two designated Nature Reserves in nearby Gia Lai Province, and bat community metrics of the lower elevation zones at Quang Ngai compared with those of the karst-dominated Kim Hy reserve suggest a good diversity of insectivorous bats. Our findings also suggest a declining diversity of bats in secondary forest at Quang Ngai with increasing elevation. Our surveys also revealed a surprising diversity of tube-nosed bats within a very limited region. Tube-nosed bats also seemed to be more diverse at the lower elevation survey region.

CONSERVATION IMPLICATIONS

This study revealed significant biodiversity in the bats of the southeastern Truong Son Mountains in Quang Ngai Province, Vietnam. Additional surveys at lower elevations or at different times of the year might find still other species. Also, closer study may show that some currently identified species inhabiting Quang Ngai may actually represent two separate species. Conservation and protection planning for the forests within this area will be critical for maintaining the diversity of bats and other wildlife of the region in the future. The number bat species inhabiting the Truong Son Mountains likely will remain relatively high if forests are protected or are logged selectively in a manner that can be sustained. The bat fauna will likely become more depauperate if forests are intensively logged or cleared for agriculture.

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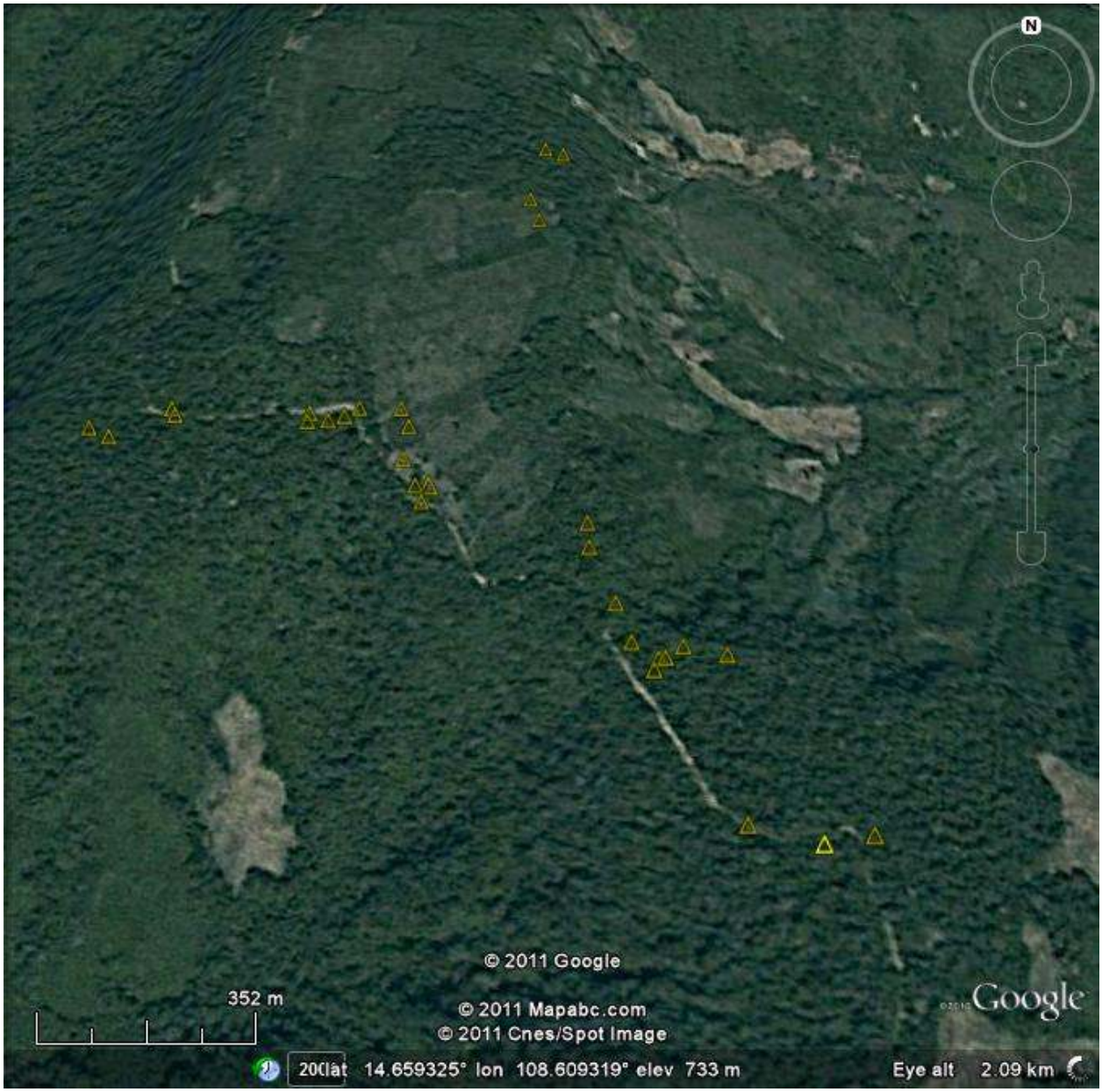
Figure 1. Study area locations in relation to neighboring provinces.

Figure 2. Preliminary map of bat sampling locations (triangles) in Quang Ngai Province, Vietnam, May-June 2011. Higher elevation sites sampled on 31 May and 1 June are not shown. No map is available for March 2012 locations.



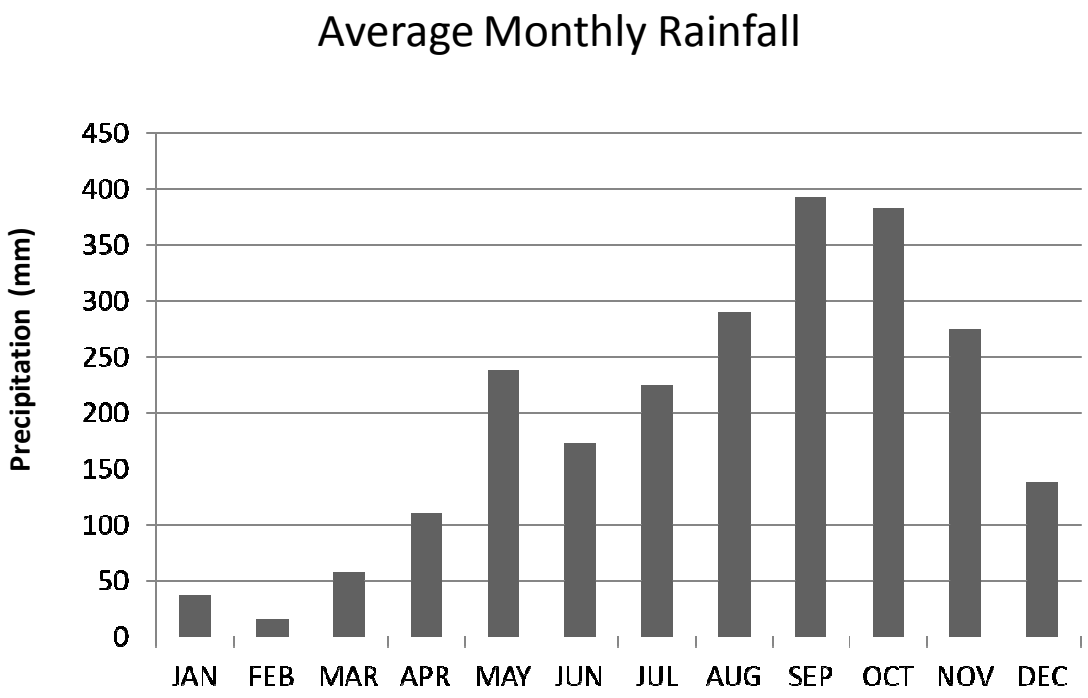


Figure 3. Average monthly rainfall in the region of the study area in the southeastern Truong Son Mountains, Ba To District, Quang Ngai Province, Vietnam, 1997-2009. (Data courtesy of NASA Langley Research Center POWER Project, NASA 2012.)

Table 1. Sampling effort and bats captured by mist nets and harp traps at the Quang Ngai study area in southwestern Quang Ngai Province, Vietnam, May-June 2011. Netting effort on two rainy nights at elevations above 900 m is not included. m^2nh = square-meter net-hour; m^2hth = square-meter trap-hour

	Mist Nets	Harp Traps	Total
Effort	2,845 m^2nh	174 m^2th	--
Nights Sampled	10	10	11
Hours Sampled	114	102	
Individuals Captured by Species			
Glischropus bucephalus	1	0	1
Hipposideros larvatus	1	4	5
Hipposideros pomona	2	0	2
Kerivoula hardwickii	0	1	1
Murina annamitica	4	1	5
Murina beezelbub	0	1	1
Murina cyclotis	3	3	6
Murina eleryi	0	1	1
Murina fionae	1	1	2
Murina huttoni	5	1	6
Myotis ater	6	0	6
Rhinolophus affinis	0	4	4
Rhinolophus pusillus	5	5	10
Total Bats Captured	28	22	50
N Species	9	10	13
N Unique Species	3	4	--
Bats per night	2.8	2.2	4.5
Bats per hour	0.25	0.22	
Bats per m^2nh or m^2th	0.010	0.126	--

Table 2. Sampling effort and bats captured by mist nets and harp traps at the Quang Ngai study area in southwestern Quang Ngai Province, Vietnam, March 2012. Species identifications are tentative (see Methods and species accounts). Abbreviations: m^2nh = square-meter net-hour; m^2hth = square-meter trap-hour

	Mist Nets	Harp Traps	Total
Effort	9,487.5m^2nh	770.5 m^2th	
Nights Sampled	9	8	9
Hours Sampled	378.5	322	
Individuals Captured by Species			
Hipposideros larvatus	1	0	1
Hipposideros pomona	2	1	3
Kerivoula hardwickii	0	1	1
Megaderma lyra	2	0	2
Murina fionae	1	1	2
Murina beezelbub	1	0	1
Myotis muricola	1	0	1
Rhinolophus affinis	37	10	47
Rhinolophus pearsoni	1	0	1
Rhinolophus pusillus	3	5	8
Scotomanes ornatus	2	0	2
Total Bats Captured	51	18	69
N Species	10	5	11
N Unique Species	6	1	--
Bats per night	5.7	2.25	7.7
Bats per hour	0.135	0.056	
Bats per m^2nh or m^2th	0.005	0.023	

Table 3. Sampling effort and bats captured by mist nets and harp traps at the Quang Ngai study area in southwestern Quang Ngai Province, Vietnam, May-June 2011 and March 2012 combined. N unique species is the number captured only in harp traps or only in mist nets. Abbreviations: m^2nh = square-meter net-hour; m^2hth = square-meter trap-hour

	Mist Nets	Harp Traps	Total
Effort	12,332.5 m^2nh	944.5 m^2hth	
Nights Sampled	19	18	20
Hours Sampled	492.5	424	
Individuals Captured by Putative Species			
Glischropus bucephalus	1	0	1
Hipposideros larvatus	2	4	6
Hipposideros pomona	4	1	5
Kerivoula hardwickii	0	2	2
Megaderma lyra	2	0	2
Murina annamitica	4	1	5
Murina beelzebub	1	1	2
Murina eleryi	0	1	1
Murina cyclotis	3	3	6
Murina huttoni	5	1	6
Murina fionae	2	2	4
Myotis ater	6	0	6
Myotis muricola	1	0	1
Rhinolophus affinis	37	14	51
Rhinolophus pearsoni	1	0	1
Rhinolophus pusillus	8	10	18
Scotomanes ornatus	2	0	2
Total Bats Captured	79	40	119
N Species	15	11	17
N Unique Species	5	2	17
Bats per night	4.2	2.2	6.0
Bats per hour	0.039	0.094	--
Bats per m^2nh or m^2th	0.006	0.042	--

Table 4. Characteristicsof echolocation calls of bats with predominantly constant frequency (CF-FM and FM-CF-FM) calls sampled at the Quang Ngai study area, in southwestern Quang Ngai Province, Vietnam. Values are means +/- 1 SD and ranges in parentheses. NR = not reported. (~) = value estimated from single published sonagram. Catalog numbers are those of bats recorded and prepared as voucher specimens or tissue samples. Boldface indicates echolocation information obtained in this study.

Tentative species identification	**Specimen Field Catalog Numbers/Reference**	**N bats**	**N calls**	**CF component FMAXE (kHz)**	**FM rise (kHz)**	**FM tail (kHz)**	**Duration (ms)**
***Rhinolophus affinis*: Quang Ngai, Vietnam**	TJO419v, 420v, QN001, 002, 004, 007, 010, 012, 013, 020, 024, 025, 041, 049, 051, 052, 053.	18	216	80.6 ± 0.77 (79.3-82.5)	11.0 ± 6.1 (0-58.9)	19.2 ± 4.9 (2.2-59.9)	30.6 ± 7.0 (13.9-52)
Rhinolophus affinis: Kon Tum Province, Vietnam	Thong 2011 cited in Kingsada et al. 2011	1	NR	84.5	NR	NR	NR
Rhinolophus affinis: Bac Kan Province, Vietnam	Furey et al. 2009b	18 (1 call each bat)	18	71.1 ± 0.9	ca. 14.2	ca. 14.5	43.2 ± 10.4 (17.6-55.4)
Rhinolophus affinis: Hainan, Guangdong, Guangxi (China)	Zhang et al. 2009	NR	NR	(70-74.3)	NR	NR	NR
Rhinolophus affinis: Peninsular Malaysia	Kingston et al. 2000	4	24	77.6	NR	~10	~25
Rhinolophus affinis: Cambodia	Kingsada et al. 2011	8	≥ 40	(76.1-79.9)			
Rhinolophus affinis: Thailand	Robinson 1996	6		(75-80)	NR	NR	NR
Rhinolophus affinis: Laos	Francis 2008	NR	NR	(73-78)			
Rhinolophus affinis: Yunnan, China	Zhang et al. 2009	NR	NR	(82.6-83.7)	NR	NR	NR
Rhinolophus affinis: Laos	Francis and Habersetzer 1998	NR	NR	73	NR	NR	NR

Rhinolophus affinis: Myanmar	Francis and Habersetzer 1998	NR	NR	78.4	NR	NR	NR
Rhinolophus affinis: Jiangxi, China	Zhang et al. 2009	NR	NR	(88.1-88.5)	NR	NR	NR
Rhinolophus affinis: Fujian, China	Zhang et al. 2009	10	NR	(71.9-86.1)	NR	NR	NR
***Rhinolophus pearsoni:* Quang Ngai, Vietnam, 2012**	QN006	1	12	64.0 ± 0.3 (63.7-64.4)	11.1 ± 1.9 (8.4-13.6)	13.2 ± 4.2 (6.9-18.4)	38.3 ± 2.9 (33.9-43.1)
Rhinolophus pearsoni: Thailand	Robinson 1996	9	NR	65	NR	NR	NR
Rhinolophus pearsoni: Thailand	Hughes et al. 2010	12 (1 call each bat)	12	60.0	NR	NR	ca. 40
Rhinolophus pearsoni: Bac Kan Province, Vietnam	Furey et al. 2009b	18 (1 call each bat)	18	53.0 ± 1.5 (51.1-55.4)	ca. 10.1	ca. 12.1	41.5 ± 9.7 (26.7-59.7)
Rhinolophus pearsoni: multiple locations, China	Zhang et al. 2009		89	57.6-70	NR	NR	NR
***Rhinolophus pusillus*: Quang Ngai, Vietnam, 2012**	QN07, QN41, QN42, QN43, QN44, QN45, QN47, QN50	8	96	99.7 ± 0.7 (97.9-101)	14.9 ± 4.8 (2-22.5)	17.5 ± 4.8 (5-26.7)	35.8 ± 9.8 (13.5-52.3)
Rhinolophus pusillus: Bac Kan Province, Vietnam	Furey et al. 2009b	10 (1 call each bat)	10	105.0 ± 1.2 (102.3-106.1)	ca. 14.8	ca. 18.2	31.6 ± 8.9 (20.5-47.6)
Rhinolophus pusillus: China	Zhang et al. 2009	NR	NR	(100.3-111.2)	~15	~15	NR
*Rhinolophus pusillus:*Guangxi, China	Zhang et al. 2009	NR	NR	111.2	NR	NR	NR
Rhinolophus pusillus: Thailand	Hughes et al. 2010	174 (1 call each bat)	174	112.5 (ca. 107-127)	NR	NR	NR
Rhinolophus pusillus: Thailand	Robinson 1996	9	NR	(90-95)	NR	NR	NR

Rhinolophus pusillus: Laos	Francis and Habersetzer 1998	NR	NR	100	NR	NR	NR
Rhinolophus pusillus: Laos	Francis 2008	NR	NR	(108-110)	NR	NR	NR
***Hipposideros larvatus*: Quang Ngai, Vietnam**	See above	2	24	93.2 ± 0.3 (92.6-93.8)	0.0	14.8 ± 4.0 (9.4-21.7)	5.8 ± 1.8 (3.5-13.0)
Hipposideros larvatus: Bac Kan Province, Vietnam	Furey et al. 2009b	32 (1 call each bat)	32	86.5 ± 1.8 (83.8-89.3)	ca. 0.2	ca. 11.3	7.8 ± 1.4 (5.2-11.2)
Hipposideros larvatus: Hainan, Guangdong, Guangxi (China)	Zhang et al. 2009			(83.2-88)	0.0	~12	~11
Hipposideros larvatus: Thailand	Robinson 1996	5	NR	85	NR	NR	NR
Hipposideros larvatus: Thailand	Hughes et al. 2010	NR (many)	NR (many)	94.7 (ca. 87-100)	0.0	~12	~10
Hipposideros larvatus: Yunnan, China	Zhang et al. 2009			(79.2-84)	0.0	~12	~11
Hipposideros larvatus: Peninsular Malaysia	Kingston et al. 2000	5	30	100.0	NR	~14	~10
Hipposideros larvatus: Myanmar[1]	Thabah et al. 2006	30 ♂♂ 21 ♀♀	30 21	92.6 ± 1.5 (♂♂) 93.0 ± 1.0 (♀♀)	NR	NR	NR
Hipposideros larvatus: Myanmar[1]	Struebig et al. 2005	51 bats (1 call each bat)	51	92.7 ± 1.4 (89.2-95.2)	NR	NR	NR
Hipposideros larvatus: Malaysia[1]	Thabah et al. 2006	12 ♂♂ 7 ♀♀	12 7	100.6 ± 0.8 (♂♂) 100.6 ± 0.6 (♀♀)	NR	NR	NR
Hipposideros larvatus: Myanmar[1]	Francis and Habersetzer 1998	NR	NR	97.7	NR	NR	NR
Hipposideros larvatus: India (Phonic group 1)[1]	Thabah et al. 2006	12 ♂♂ 10 ♀♀	12 10	83.7 ± 1.8 (♂♂) 85.1 ± 0.7 (♀♀)	NR	NR	NR
Hipposideros larvatus: India (Phonic group 2)[1]	Thabah et al. 2006	22 ♂♂ 15 ♀♀	22 15	96.7 ± 2 (♂♂) 98.0 ± 2 (♀♀)	NR	NR	NR

Hipposideros larvatus: Guangxi, China	Wei et al. (2011)	NR	NR	85.2 ± 0.5	NR	NR	7.8 ± 0.9
Hipposideros larvatus: Peninsular Malaysia	Francis (2008)	NR	NR	(97-100)	NR	NR	NR
Hipposideros larvatus large form: Laos	Francis (2008)	NR	NR	(93-97)	NR	NR	NR
*Hipposideros larvatus*medium form:Laos	Francis (2008)	NR	NR	(86-89)	NR	NR	NR
*Hipposideros larvatus*small form:Laos	Francis (2008)	NR	NR	(99-102)	NR	NR	NR
***Hipposideros pomona*: Quang Ngai, 2012**		2	24	128.6 ± 4.2 (124.3-134.1)	0.0	10.7 ± 4.1 (5.3-18.4)	5.3 ± 1.0 (3.1-6.7)
Hipposideros pomona: Bac Man Province, Vietnam	Furey et al. 2009b	7 bats (1 call each bat)	7	125.1 ± 2.3 (122-127.7)	ca. 0.1 kHz	ca. 21 kHz	7.0 ± 2.3 (3.7-9.3)
Hipposideros pomona: Yunnan, China	Zhang et al. 2009	NR	NR	120.8 –125.6	NR	NR	NR
Hipposideros pomona: Guangdong, China	Zhang et al. 2009	NR	NR	125–129	NR	NR	NR
Hipposideros pomona: Hainan, China	Zhang et al. 2009	NR	NR	121	NR	NR	NR
Hipposideros pomona: Hong Kong, China	Shek and Lau (2006)	NR	NR	129.6 (125.7–132.5)	NR	NR	NR
Hipposideros pomona: Laos	Francis and Haberstetzer (1998)	NR	NR	125	NR	NR	NR
Hipposideros pomona: Laos	Francis (2008)	NR	NR	120-126	NR	NR	NR
Hipposideros pomona: central	S. Puechmaille *in*	NR	NR	125.6-128.2	NR	NR	NR

Thailand	Douangboubpha et al. (2010)						
Hipposideros pomona: Myanmar	Struebig et al. (2005)	22 bats (1 call each bat)	22	134.9 ± 1.4 (132.1-137.2)	NR	NR	NR
Hipposideros pomona: Myanmar	S. Puechmaille *in* Douangboubpha et al. (2010)	NR	NR	131.8-135.4	NR	NR	NR
Hipposideros pomona: Thailand	Douangboubpha et al. (2010)	23♂♂ 15♀♀	230 150	133.3 ± 3.9 (127.3-139.3) 139.3 ± 3.7 (127.7-140.2)	NR	NR	NR

Table 5. Echolocation call characteristic of vespertilionid bats with frequency modulated (FM) calls sampled at the Quang Ngai study area, in southwestern Quang Ngai Province, Vietnam. Values are means +/- 1 SD and ranges in parentheses. NR = not reported, NA = measurement not applicable. Catalog numbers are those of bats recorded and prepared as voucher specimens or tissue samples. Boldface indicates echolocation information obtained in this study.

Tentative species identification	Specimen Field Catalog Numbers/ Reference	N bats	N calls	Start	End	Duration (ms)	FMAXE	Midpoint Frequency
***Kerivoula hardwickii*: Quang Ngai, Vietnam. In flight.**	QN022	1	12	169.5 ± 19.9 (147-192)	95.2 ± 9.1 (90-124)	1.4 ± 0.56 (0.8-2.2)	149.3 ± 26.5 (126-190)	132.3 ± 12.4 (119-158)
Kerivoula hardwickii: Thailand	Hughes et al. (2011)	88 (1 call per bat)	88	169.6 ± 28.8	90.7 ± 8.1	3.1 ± 2.7	118.3 ± 11.9	NR
****Murina annamitica*: Quang Ngai, Vietnam**	TJO 404v, TJO421v	2	24	>130.6 ± 6.5 (122.1-148.1)	71.5 ± 18.2 (46.2-113.5)	1.1 ± 0.3 (0.5-1.7)	NA	101.1 ± 9.5 (84.6-125.1)
Murina beelzebub*: **Quang Ngai, Vietnam		1	12	146.0 ± 8.3 (127.0-156.5)	74.3 ± 7.1 (66.3-86.0)	1.4 ± 0.7 (0.9-3.1)	124.5 ± 8.4 (102.4-131.9)	110.1 ± 5.0 (102.8-118.9)
****Murina* eleryi: Quang Ngai, Vietnam**	TJO415v	1	12	127.9 ± 6.6 (121.2-141.6)	84.7 ± 6.3 (75.5-94.2)	0.6 ± 0.1 (0.4-0.8)	NA	106.3 ± 5.1 (99.3-114.3)
****Murina cyclotis*: Quang Ngai, Vietnam**	TJO416, TJO417, TJO414	3	36	128.8 ± 7.5 (118.5-152.4)	62.2 ± 13.9 (35.0-111.9)	1.9 ± 0.5 (1.0-3.1)	NA	95.5 ± 8.0 (82-121)
Murina cyclotis: Thailand	Hughes et al. 2011	28 (1 call per bat)	28	121.4 ± 44.6	57.4 ± 25.9	1.8 ± 1.2	93.8 ± 7.6	NR
Murina cyclotis: Peninsular Malaysia	Kingston et al. 1999	22	131	165.2 ± 7.4	51.6 ± 7.0	2.0 ± 0.6 (1.2-4.1)	77.2. ± 13.45 (54.4±136.8)	135.1 ± 12.7 (89.6-166.4)
***Murina huttoni*: Quang Ngai, Vietnam**	TJO 413	1	12	> 126.6 ± 3.3 (119.4-130.1)	52.1 ± 6.5 (40.2-61.3)	2.6 ± 0.6 (1.2-3.4)	NA	> 89.4 ± 4.1 (84.1-95.0)

***Murina fionae*: Quang Ngai, Vietnam**	QN021	1	12	152.8 ± 7.8 (135.8-163.1)	66.8 ± 7.5 (51.6-76.1)	1.05 ± 0.2 (0.9-1.6)	112 ± 21.3 (72.0-133.4)	109.8 ± 6.9 (93.7-116.7)
***Murina annamitica*: Quang Ngai, Vietnam**	TJO 404v, TJO421v	2	24	>130.6 ± 6.5 (122.1-148.1)	71.5 ± 18.2 (46.2-113.5)	1.1 ± 0.3 (0.5-1.7)	NA	101.1 ± 9.5 (84.6-125.1)
***Myotis ater*: Quang Ngai, Vietnam**	TJO 430v	2	24	105.0 ± 7.0 (95.8-117.7)	53.4 ± 4.9 (44.8-60.4)	2.3 ± 0.7 (1.4-3.9)	NA	79.2 ± 4.2 (73.4-87.3)
Myotis ater: Bac Kan, Vietnam	Furey et al. 2009b	2	4	104.7 (95.4-110)	57.5 (53.7-60.1)	1.4 (1.0-1.7)	66.7 (64.3-71.3)	62.5 (60.4-64.1)
***Myotis muricola*: Quang Ngai, Vietnam.**	QN055	1	12	115.5 ± 7.3 (102.4-127.2)	49.9 ± 2.2 (45.7-53.1)	3.1 ± 0.9 (102.4-127.2)	65.4 ± 2.8 (59.9-69)	82.7 ± 3.5 (76.8-88.6)
Myotis muricola: Bac Kan, Vietnam	Furey et al. 2009b	2	4	97.8 (75.3-114.1)	54.5 (51.5-59.2)	1.9 (1.0-2.4)	66.2 (62.0-73.6)	59.7 (57.0-63.6)
Myotis muricola: Thailand	Hughes et al. 2011	49 (1 call per bat)	49	118.0 ± 17.1	55.6 ± 10.1	5.2 ± 2.5	82.3 ± 16.6	NR
***Scotomanes ornatus:* Quang Ngai, Vietnam, 2012**	This study	1	12	104.6 ± 6.3 (98-122.6)	20.1 ± 0.7 (19.2-21.4)	3.3 ± 0.9 (2-4.8)	63.8 ± 3.0 (56.2-67.1)	62.4 ± 3.2 59.1-71.3
*Scotomanes ornatus:*Bac Kan, Vietnam	Furey et al. 2009b	6	6	54.1 ± 7.0 (43-62)	21.0 ± 1.9 (18.6-23.1)	3.4 ± 0.8 (2.2-4.4)	31.7 ± 2.5 (29.7-35.9)	28.8 ± 1.8 (26.6-31.3)
Scotomanes ornatus: Mianyang, China	Liu et al 2011	NA	NA	73.9 ± 11.5	22.9 ± 2.6	NA	57.9 ± 1.4	NA

Table 6. Sex, age, and reproductive condition of bats captured at the study area in Ba To District, Quang Ngai Province, Vietnam during the early wet season in late May-June 2011 and near the end of the dry season in March 2012. Abbreviations: Ad= adult;L = lactating; ND = not determined; NR = non-reproductive; P = pregnant; PL= post-lactating; VJ = volant juveniles.

Species	May-June		March	
	Males	Females	Males	Females
Megaderma lyra	0	0	1 Ad-NR	
Rhinolophus affinis	0	1 Ad-L, 2 VJ, 1 Ad-NR	17 Ad-NR	25 Ad-P, 1 Ad-ND, 4 Ad-NR
Rhinolophus pearsoni	1 Ad-NR	0	0	0
Rhinolophus pusillus	0	7 Ad-L, 3 Ad-P, 1 VJ,	2 Ad-NR	5 Ad-P
Hipposideros larvatus	2 Ad-NR, 1 Ad-R	2 VJ	0	1 Ad-NR
Hipposideros pomona	1 Ad-NR, 1 Ad-ND	0	2 Ad-NR	1 Ad-P
Glischropus bucephalus	0	1 Ad-L	0	0
Kerivoula hardwickii	1 VJ	0	0	1 Ad-P
Murina annamitica	2 VJ, 1 Ad-NR	1 Ad-L, 1 VJ	0	0
Murina beelzebub	1 VJ	0	1 Ad-NR	0
Murina cyclotis	1 Ad-NR	1 Ad-L, 2 Ad-PL, 2 VJ	0	0
Murina eleryi	1 VJ	0	0	0
Murina fionae	0	2 Ad-L	2 Ad-NR	0
Murina huttoni	0	3 Ad-L, 1 Ad-PL, 1 VJ	0	0
Myotis ater	4 Ad-NR, 1 VJ	1 VJ		
Myotis muricola	0	0	0	1 Ad-P
Scotomanes ornatus	2 Ad-NR	0	0	0

Table 7. Number of bat species and individuals captured, and capture method and effort in surveys at the Quang Ngai study area in Quang Ngai Province compared to surveys at Kim Hy Nature Reserve in Bac Kan Province, Vietnam (Furey et al. 2010), all species of bats. S = number of species; N = number of individuals; m^2nh = square-meter net-hour; m^2hth = square-meter trap-hour.

Study Area	Ground mist nets					Harp Traps				
	S	N	m^2nh	S/m^2nh	Bats/m^2nh	S	N	m^2th	S/m^2th	Bats/m^2th
Quang Ngai Total	15	79	12,332.5	0.001	0.006	11	40	944.5	0.012	0.042
Quang Ngai May-June 2011	9	28	2,845.5	0.003	0.010	10	22	174	0.057	0.126
Quang Ngai March 2012	10	51	9,487.5	0.001	0.005	5	18	770.5	0.006	0.023
Kim Hy Primary Forest	22	313	11,871	0.002	0.026	18	88	1,380	0.013	0.064
Kim Hy Disturbed Forest	18	71	11,928	0.002	0.006	14	73	1,392	0.010	0.052
Kim Hy Agriculture/ Disturbed Forest	21	114	12,030	0.002	0.009	11	35	1,393	0.008	0.025
Kim Hy All Sites	30	498	35,829	0.0008	0.0139	25	196	4,165	0.006	0.047

Table 8. Comparison of bat community diversity statistics for insectivorous bats among samples from the Quang Ngai survey site and three habitats surveyed by Furey et al. (2010)at Kim Hy Nature Reserve in Bac Kan Province, Vietnam. In the analyses sampling effort (numbers of individuals captured) was doubled, and estimated species richness calculated with a cut-off point of 3 individuals usingProgram Spade (Chao and Shen 2010). Estimates are ± 1 SE.

	Quang Ngai All sites	Quang Ngai 2011 sites	Quang Ngai 2012 sites	Kim Hy All sites	Kim Hy primary forest	Kim Hy disturbed forest	Kim Hy agricultural/degraded forest
Number of species observed	17	13	11	32	27	22	22
Estimated Species Richness							
Solow and Polasky (1999)	19 ± 2.1	16.5 ± 3.3	14.8 ± 3.4	35.8 ± 3.4	30.6 ± 3.3	36.5 ± 7.7	29.2 ± 4.7
Shen et al. (2003)	20.5 ± 2.4	17.4 ± 3.2	15.3 ± 2.9	35.0 ± 1.8	31.1 ± 2.3	32.4 ± 5.9	30.6 ± 4.2
Inventory Completeness	83-89 %	75-79%	72-74 %	89-91 %	87-88 %	60-68 %	72-75 %
Simpson's Diversity Index (1/D)	4.49 ± 0.20	8.7 ± 1.7	2.07 ± 0.42	10.91 ± 0.18	7.78 ± 0.21	7.62 ± 0.26	8.20 ± 0.24
Evenness ($E_{1/D}$)	0.264	0.669	0.191	0.341	0.295	0.346	0.403

Appendix A-1. Location, description, and productivity of bat sampling sites, Quang Ngai study area, Vietnam May-June 2011.

Site Number	Northing (Decimal Degrees, WG 84)	Easting (Decimal Degrees, WG 84)	approx elevation (m) field	elev (m) via Google Earth	Capture Equipment and Site Description	Dates and Times Deployed (2011)	Species (N individuals) Captured
1	14.66016	108.60753	752	731	12 m net at ground level parallel to drainage at main camp	28 May (1800-0000)	None
2	14.66017	108.60734	727	732	Harp trap at camp in wash	28 May (Gore trap; 1800-0000); 4 June (Khoi trap 1800-dawn); 5 June (Khoi trap 1800-dawn); 6 June (Khoi trap 1800-dawn); 7 June (1800-dawn); 8 June (1800-dawn)	*Hipposideros larvatus* (4), *Rhinolophus pusillus* (3), *Rhinolophus affinis* (4), *Kerivoula hardwickii* (1), *Murina cyclotis* (3), *Murina eleryi* (1), *Murina fionae* (1), *Murina huttoni* (1)
3	14.66055	108.60715	750	739	9.1 m (30') net at ground level across old logging road N of spreading tree below camp	28 May (1800-0000)	*Rhinolophus pusillus* (1)
4	14.66114	108.60629	746	755	12.8 m (42') net at ground level across round pond on logging road N of camp	28 May (1800-0000), 4 June (1800-2210)	*Glischropus bucephalus* (1)
5	14.66104	108.60577	736	759	harp trap at "alcove" in vegetation wall near site 4 pond	28 May (Khoi trap; 1800-2100)	*Murina annamitica* (1)
6	14.66111	108.60387	763	766	12.8 m (42') net at ground level across logging road N of camp, near where trail branches into forest	29 May (1800-2145), 2 June (1800-2100)	*Rhinolophus pusillus* (2)

Appendix A-1 continued

7	14.66121	108.60381	770	766	6.1 m (20') net at ground level across trail where it enters forest off logging road N of camp	29 May (1800-2145)	*Rhinolophus pusillus* (1)
8	14.66081	108.60293	768	758	Harp Trap (Gore) across trail through forest off logging road N of camp	29 May (1800-2145), 2 June (1800-2100)	*Rhinolophus pusillus* (2)
9	14.66096	108.60261	772	756	5.5 m (18') net at ground level across trail through forest off logging road N of camp	29 May (1800-2145)	*Hipposideros pomona* (1)
10	14.65549	108.61334	749	750	9.1 m (30') net at ground level across trail S of camp	30 May (1800-2100)	None
11	14.65539	108.61271	738	745	Gore harp trap across logging trail S of camp	30 May (1800-2100)	None
12	14.65562	108.61179	745	737	6.1 m (20') net suspended 2m high across logging trail S of camp, plus lower 5.5 m (18') net at ground level	30 May (1800-2100)	None
13	14.65758	108.61069	723	721	12.8 m (42') net at ground level parallel to edge of very shallow "pond" at edge of forest, "Dead Frog Pond"	30 May (1800-2100), 3 June (1800-2220), 5 June (1800-2220), 7 June 2011 (1830-2200)	*Murina annamitica*(1),*Murina cyclotis* (3), *Murina fionae* (1), *Murina huttoni* (2)
14	14.6258	108.6138	953	947	9.1 m (30') net at ground level across small clearing at upstream mountain campsite, plus 5.5 m (18') net at ground level across creek at same place	31 May (all night), 1 June (5.5 m only, 2200-dawn)	None

Appendix A-1 continued

15	14.6205	108.6131	926	931	Mountain marsh area: 12.8 m (42') net at ground level across opening parallel to edge of logging trail at edge of marsh; one 5.5 m (18') net at ground level across logging trail about 50 m S of marsh; one 5.5 m (18') net at ground level across logging trail N of marsh; one 6.1 m (20') net at ground level across stream draining marsh in "tunnel" through vegetation	1 June (1800-2100)	None
16	14.65778	108.61169	726	723	9.1 m (30') net at ground level across stream and trail in forest on trail behind "Dead Frog Pond" ("site 1" on capture sheet for 3 June); 6 m net over stream added on 7 June	3 June (1800-2220); 7 June (1830-2200)	*Myotis ater* (3), *Murina annamitica* (2)
17	14.6579	108.6111	716	720	Harp trap (Gore) across trail through forest behind "Dead Frog Pond" ("site 2" on capture sheet for 3 June)	3 June (1800-2220)	
18	14.65773	108.61076	712	722	6.1 m (20') net at ground level across trail through forest behind "Dead Frog Pond" ("site 3" on capture sheet for 3 June)	3 June (1800-2220)	
19	14.65774	108.61085	726	724	9 m net at ground level across logging trail S of camp ("site 4" on capture sheet of 3 June)	3 June (1800-2220)	
20	14.65797	108.6104	728	714	6.1 m (20') net at ground level across trail into forest off logging road S of camp ("site 5" on capture sheet of 3 June)	3 June (1800-2220)	
21	14.66102	108.60722	751	746	9.1 m (30') net at ground level across edge of forest strip near "shower tree" at camp	4 June (1800-2210)	

Appendix A-1 continued

22	14.66129	108.6071	753	750	Harp trail (Gore) at trail into forest strip near "shower tree" at camp	4 June (1800-dawn)	*Murina beelzebub* (1)
23	14.66127	108.6065	744	755	12.8 m (42') net at ground level across berm parallel to long pond at drinking water spring near camp	4 June (1800-2210)	
24	14.66107	108.60606	745	756	12.8 m (42') net across logging trail near ponds N of camp	4 June (1800-2210)	
25	14.66116	108.6058	744	762	9 m net at ground level across logging trail S of camp near spring sometimes used for laundry and bathing water	4 June (1800-2210)	*Murina annamitica* (1)
26	14.65926	108.60983	730	732	6.1 m (20') net at ground level across side trail off logging road S of camp	5 June (1800-2220)	None
27	14.65961	108.60981	739	758	Harp trap (Gore) across side trail leading from logging road S of camp	5 June (1800-2220)	None
28	14.65849	108.61019	733	722	6.1 m (20') net at ground level in "V" configuration across logging trail S of camp	5 June (1800-2220)	*Hipposideros larvatus* (1)
29	14.65994	108.60743	728	728	Harp trap (Gore) across camp flyway about 25 m S of site 2; coordinates from Google Earth	6 June (1800-dawn)	None
30	14.66462	108.6091	741	739	9 m net at ground level across trail at edge of forest patch E of camp towards village	8 June (1830-2200)	None
31	14.66501	108.60896	739	739	9 m net at ground level across trail a short distance inside forest patch E of camp towards village	8 June (1830-2200)	*Rhinolophus pusillus* (1), *Hipposideros pomona* (1)

Appendix A-1 continued

32	14.666	108.6092	738	738	9 m net at ground level across stream within forest patch E of camp towards village	8 June (1830-2200), 9 June (1800-2015)	*Murina huttoni* (3), *Myotis ater* (3)
33	14.66598	108.60949	738	729	6 m net at ground level across stream within forest patch E of camp towards village, 30 m down from site 32; coordinates from Google Earth	8 June (1830-2200), 9 June (1800-2015)	

Appendix A-2. Location, description, and productivity of bat sampling sites, Quang Ngai study area, Vietnam, March 2012, ordered by date.

Net or Trap Number	Dates Deployed (2012)	Start Time	End Time	Northing (Decimal Degrees, WG 84)	Easting (Decimal Degrees, WG 84)	Elev Google Earth (m)	Elev GPS (m)	Capture Equipment and Site Description	Species (N individuals) Captured
Harp 1	12 March	18:00	6:00	14.62168	108.58884	940	944	CSU Harp 2 m, upslope from camp -- mature forest	None
Harp 2	12 March	18:00	6:00	14.62138	108.58813	928	941	JG Harp 1m upslope from camp -- mature forest	None
Harp A	12 March	18:00	6:00	14.623056	108.58333	834	980	Son Harp 2.25 m primary forest	None
Harp B	12 March	18:00	6:00	14.623056	108.58333	834	980	Son Harp 2.25 m primary forest	None
Net 1	12 March	18:00	22:00	14.62166	108.58875	937	946	6 m net, upslope from camp -- mature forest	None
Net 2	12 March	18:00	22:00	14.62180	108.58892	937	951	12 m net upslope from camp -- mature forest	*R. affinis* (1)
Net 3	12 March	18:00	22:00	14.62180	108.58892	937	951	6 m net upslope from camp -- mature forest, net 2 and 3 are adjacent	None
Net 4	12 March	18:00	22:00	14.62193	108.58920	943	954	6 m net upslope from camp -- mature forest	None
Net S1	12 March	17:50	6:00	14.620556	108.58417	912	987	12 m net primary forest; along trail to camp	Total of 17 bats in these nets. *R. affinis* (12), *R. pearsoni* (1), *R. pusillus* (1), *H. pomona* (2), *H. larvatus* (1)
Net S2	12 March	18:00	6:00	14.620556	108.58417	912	987	12 m net primary forest; along trail to camp	
Harp 2	13 March	18:00	6:00	14.62138	108.58813	928	941	JG Harp 1m, upslope from camp (same location as 12 March)	None
Harp 3	13 March	18:00	6:00	14.62064	108.58423	912		CSU Harp 2 m, across trail in mature forest, about 30 m east of Net 5 and upslope about 5 m elev	None
Harp A	13 March	18:00	6:00	14.62059	108.58647	923	930	Son Harp 2.25 m, very close to camp, used camp location	None

Harp B	13 March	18:00	6:00	14.62059	108.58647	923	930	Son Harp 2.25 m, very close to camp, used camp location	None
Net 5	13 March	18:00	22:00	14.62064	108.58443	913	911	13 m net across trail in mature forest (other side of creek from camp)	*R. affinis* (1) *M. fionae* (1)
Net 6	13 March	18:00	22:00	14.61996	108.58448	922	920	6 m net across trail in mature forest (other side of creek from camp)	None
Net 7	13 March	18:00	22:00	14.61953	108.58465	922	920	6 m net across trail in mature forest (other side of creek from camp)	*R. affinis* (1)
Net S3	13 March	18:00	6:00	14.62059	108.58647	923	930	12 m net very close to camp, used camp location	None
Harp 5	14 March	18:00	6:00	14.61928	108.58474	922	919	CSU Harp 2 m across trail, mature forest	*R. affinis* (6)
Harp 6	14 March	18:00	6:00	14.61909	108.58485	923	914	JG Harp 1m across trail, mature forest	None
Harp A	14 March	18:00	6:00	14.621944	108.595556	984	991	Son Harp 2.25 m primary forest, big trees; near small bamboo area mix with small tree s	*K. hardwickii* (1)
Harp B	14 March	18:00	6:00	14.621667	108.597222	988	979	Son Harp 2.25 m primary forest, big tree	None
Net S4	14 March	18:00	6:00	14.621667	108.597222	978	979	12 m net primary forest, big tree	None
Net 10	14 March	18:00	22:00	14.61905	108.58514	922	914	6 m net parallel to trail, across side trail	None
Net 11	14 March	18:00	22:00	14.61901	108.58537	922	920	9 m net over stream	None
Net 7	14 March	18:00	22:00	14.61953	108.58465	922	920	6 m net across trail, mature forest (other side of creek from camp)	*R. affinis* (1)
Net 8	14 March	18:00	22:00	14.61868	108.58508	925	920	13 m net across old camp by small stream	None
Net 9	14 March	18:00	22:00	14.61894	108.58514	923	920	9 m net parallel to trail, across side trail	*R. affinis* (1)

Net S5	14 March	18:00	6:00	14.6225	108.598056	974	967	6 m net primary forest, big tree. primary forest, many big tree. Net set up across a trail through forest	*M. beelzebub* (1) *R. affinis* (1)
Net S6	14 March	18:00	6:00	14.6225	108.598056	994	967	3 m net primary forest, big tree an d small tree	None
Harp 5	15 March	18:00	6:00	14.61928	108.58474	922	919	CSU Harp 2 m across trail, mature forest	None
Harp 7	15 March	18:00	6:00	14.61838	108.58472	929	915	JG Harp 1m across small rocky stream ca. 1 m wide, few cm deep	None
Harp A	15 March	18:00	6:00	14.621944	108.59556	984	964	Son Harp 2.25 m primary forest, big tree	Eight bats in these two traps: *H. pomona* (1) *R. affinis* (3) *R. pusillus* (4)
Harp B	15 March	18:00	6:00	14.621944	108.59556	984	964	Son Harp 2.25 m primary forest, big tree	
Net 10	15 March	18:00	21:00	14.61905	108.58514	922	920	6 m net parallel to trail, across side trail	None
Net 12	15 March	18:00	21:00	14.61836	108.58463	930	915	6 m net across stream and trail, about 20 m upstream of Harp 7	None
Net 13	15 March	18:00	21:00	14.61825	108.58420	933	920	6 m net across trail and dry streambed in forest	None
Net S7	15 March	18:00	6:00	14.621944	108.59556	984	964	13 m net primary forest, big trees, placed along the trail where two adjoining slopes. Many forest trees with large diameter.	Nine bats in these nets: *R. affinis* (7) *R. pusillus* (2)
Net S8	15 March	18:00	6:00	14.621944	108.59556	984	964	6 m net primary forest, big trees, placed along the trail where two adjoining slopes. Many forest trees with large diameter	
Net S9	15 March	18:00	6:00	14.621944	108.59556	984	964	3 m net primary forest, big trees, placed along the trail where two adjoining slopes. Many forest trees with large diameter	

Harp 8	16 March	18:00	6:00	14.61908	108.58533	922	907	CSU Harp 2 m on shore where trail enters river, high on bank	None
Harp 9	16 March	18:00	6:00	14.61809	108.58647	922	911	JG Harp 1m at entry into small "wetland alcove" off trail	None
Harp A	16 March	18:00	6:00	14.624444	108.58278	826	883	Son Harp 2.25 m primary forest, big tree. Set at the border between the top of mountain and trail down village, distance 500m from camp area.	*R. pusillus* (1)
Harp B	16 March	18:00	6:00	14.625556	108.58389	797	780	Son Harp 2.25 m primary forest, big tree	*R. affinis* (1)
Net 14	16 March	18:00	22:00	14.61861	108.58574	924	905	9 m net across and parallel to trail-"L" shape	*R. affinis* (1)
Net 15	16 March	18:00	22:00	14.61862	108.58618	922	917	9 m net across edge of frog pond in grassy sandbank along river	None
Net 16	16 March	18:00	22:00	14.61814	108.58644	922	916	13 m net across river, vegetation arching and overhanging stream	*S. ornatus* (1) *M. muricola* (1)
Net S10	16 March	18:00	6:00	14.625556	108.58444	772	780	13 m net primary forest, big trees, placed along the trail, where two adjoining slopes. Many forest trees with large diameter.	*R. affinis* (2)
Net S11	16 March	18:00	6:00	14.624444	108.58278	826	883	6 m net close the big stream, small trees, placed along the trail, where two adjoining slopes. Many forest trees with large diameter.	None
Harp 10	17 March	18:00	6:00	14.61827	108.58632	922	919	CSU Harp 2 m In stream adjacent to net 19	None
Harp 9	17 March	18:00	6:00	14.61809	108.58647	922	911	JG Harp 1m at entry into small "wetland alcove" off trail	None
Net 14	17 March	18:00	22:00	14.61861	108.58574	924	905	9 m net across and parallel to trail-"L" shape	None

Net 15	17 March	18:00	22:00	14.61862	108.58618	922	917	9 m net across edge of frog pond in grassy sandbank along river	None
Net 16	17 March	18:00	22:00	14.61814	108.58644	922	916	13 m net across river, vegetation arching overhanging stream	*S. ornatus* (1)
Net 17	17 March	18:00	22:00	14.61756	108.58686	923	922	6 m net across stream in mature forest	None
Net 18	17 March	18:00	22:00	14.61892	108.58579	922	912	6 m net across mouth of old or intermittent side channel of stream; parallel to main channel	None
Net 19	17 March	18:00	22:00	14.61827	108.58632	922	919	9 m net across part of stream, angled to side of CSU harp trap	None
Net S12	17 March	17:45	6:00	14.621667	108.58583	843	898	12 m net close the big stream, small tree	None
Net S13	17 March	17:50	6:00	14.619722	108.58528	922	905	18 m net close the big stream, small tree	None
Net S14	17 March	17:50	6:00	14.619167	108.58528	922	908	12 m net close the big stream, small tree	Seven bats taken in these two nets: *R. affinis* (7)
Net S15	17 March	17:50	6:00	14.619167	108.58528	922	908	12 m net close the big stream, small tree	
Harp 10	18 March	18:00	6:00	14.61827	108.58632	922	919	CSU Harp 2 m In stream adjacent to net 19	None
Harp 9	18 March	18:00	6:00	14.61809	108.58647	922	911	JG Harp 1m at entry into small "wetland alcove" off trail	None
Net 15	18 March	18:00	21:30	14.61862	108.58618	922	917	9 m net across edge of frog pond in grassy sandbank along river	*M. lyra* (escaped)
Net 16	18 March	18:00	21:30	14.61814	108.58644	922	916	13 m net across river, vegetation arching overhanging stream	None
Net 17	18 March	18:00	21:30	14.61756	108.58686	923	922	6 m net across stream in mature forest	None
Net 18	18 March	18:00	21:30	14.61892	108.58579	922	912	6 m net across mouth of old or intermittent side channel of stream; parallel to main	None

								channel	
Net 19	18 March	18:00	21:30	14.61827	108.58632	922	919	9 m net across part of stream, angled to side of CSU harp trap	None
Net 20	18 March	18:00	21:30	14.61762	108.58674	923	920	9 m net across sandy-grassy shoreline perpendicular to stream and net 21	None
Net 21	18 March	18:00	21:30	14.61762	108.58674	923	920	12 m net across sandy-grassy shoreline perpendicular to stream and net 20	None
Net 22	18 March	18:00	21:30	14.61797	108.58666	923	920	6 m net along trail parallel to river and trail	None
Net S16	18 March	17:50	6:00	14.628056	108.58556	637	648	18 m net	None
Net S17	18 March	17:55	6:00	14.628889	108.58500	590	602	12 m net	None
Harp 10	19 March	18:00	6:00	14.61827	108.58632	922	919	CSU Harp 2 m In stream adjacent to net 19	None
Harp 11	19 March	18:00	6:00	14.61969	108.58697	929	885	JG Harp 1m in small stream feeding into main stream under overhanging vegetation	None
Harp A	19 March	17:50	6:00	14.631944	108.581111	382	402	Son Harp 2.25 m in banana forest missing small tree	*M. fionae* (1)
Harp B	19 March	17:50	6:00	14.63333	108.58028	332	340	Son Harp 2.25 m in the road go down village	None
Net 15	19 March	18:00	21:30	14.61862	108.58618	922	917	9 m net across edge of frog pond in grassy sandbank along river	None
Net 16	19 March	18:00	21:30	14.61814	108.58644	922	916	13 m net across river, vegetation arching overhanging stream	None
Net 17	19 March	18:00	21:30	14.61756	108.58686	923	922	6 m net Across stream in mature forest	None
Net 18	19 March	18:00	21:30	14.61892	108.58579	922	912	6 m net across mouth of old or intermittent side channel of stream; parallel to main channel	None

Net 19	19 March	18:00	21:30	14.61827	108.58632	922	919	9 m net across part of stream, angled to side of CSU harp trap	None
Net 20	19 March	18:00	21:30	14.61762	108.58674	923	920	9 m net across sandy-grassy shoreline perpendicular to stream and net 21	None
Net 21	19 March	18:00	21:30	14.61762	108.58674	923	920	12 m net across sandy-grassy shoreline perpendicular to stream and net 20	None
Net 23	19 March	18:00	21:30	14.61859	108.58621	922	917	6 m net at eastern edge of frog pond very near net 15	None
Net 24	19 March	18:00	21:30	14.61856	108.58607	923	896	6 m net over edge of small "frog pond" on same overwash and sandbar as net 15 & 23	None
Net 25	19 March	18:00	21:30	14.61882	108.58608	922	897	6 m net over main stream, under over-arching trees, near frog ponds	None
Net S18	19 March	17:50	6:00	14.633611	108.579444	312	332	18 m net lower elev, nearer to village. Primary forest and banana	None
Net S19	19 March	17:40	6:00	14.631944	108.581111	382	381	12 m net over stream, lower elev, nearer village	None
Net 15	20 March	18:00	21:00	14.61862	108.58618	922	917	9 m net across edge of frog pond in grassy sandbank along river	None
Net 16	20 March	18:00	21:00	14.61814	108.58644	922	916	13 m net across river, vegetation arching overhanging stream	None
Net 20	20 March	18:00	21:00	14.61762	108.58674	923	920	9 m net across sandy-grassy shoreline perpendicular to stream and net 21	*M. lyra* (1)
Net 21	20 March	18:00	21:00	14.61762	108.58674	923	920	12 m net across sandy-grassy shoreline perpendicular to stream and net 20	None
Net 23	20 March	18:00	21:00	14.61859	108.58621	922	917	6 m net Edge of frog pond very near net 15	None
Net 24	20 March	18:00	21:00	14.61856	108.58607	923	896	6 m net over edge of small "frog pond" on same overwash	None

								and sandbar as net 15 & 23	
Net 25	20 March	18:00	21:00	14.61882	108.58608	922	897	6 m net over main stream, under over-arching trees, near frog ponds	None
Net 26	20 March	18:00	21:00	14.62073	108.58450	912	923	9 m net parallel to main trail above net 5 on ridgeline above valley	*R. affinis* (2)
Net 5	20 March	18:00	21:00	14.62064	108.58443	913	911	13 m net across trail in mature forest (other side of creek from camp)	None
Net 6	20 March	18:00	21:00	14.61946	108.58448	922	920	6 m net across trail in mature forest (other side of creek from camp)	None

Appendix B-1. Records of all bats captured at Quang Ngai study area, Vietnam, May-June 2011. Abbreviations: A= Adult; VJ = volant juvenile; P=pregnant; L= lactating; PL=post-lactating; NR=non-reproductive; UNK = unknown. Location coordinates are decimal degrees north latitude and east longitude. Species identifications are tentative.

Rec-ord ID #	Species	Age	Sex	Repro	Fore-arm (mm)	Mass (g)	Capture Date (2011)	Capture Time	Location Coordinates	Elev GPS (m)	Elev Google Earth (m)
1	Glischropus bucephalus	A	F	L	34.5	7.0	28-May	1919	14.66114N 108.60629E	746	755
2	Murina annamitica	VJ	F	NR	33.5	7.0	28-May	2000	14.66104N 108.60577E	736	759
3	Rhinolophus pusillus	A	F	P	39.4	7.0	28-May	1915	14.66055N 108.60715E	750	739
4	Hipposideros larvatus	VJ	F	NR	65.5	20.5	28-May	2100	14.66017N 108.60734E	727	732
5	Rhinolophus pusillus	A	F	P	39.2	8.5	29-May	1850	14.66111N 108.60387E	763	766
6	Rhinolophus pusillus	VJ	F	NR	36.4	5.0	29-May	1900	14.66081N 108.60293E	768	758
7	Rhinolophus pusillus	A	F	L	40	7.0	29-May	1910	14.66121N 108.60381E	770	766
8	Hipposideros pomona	Unk	M	Unk	42.8	Unk	29-May	1900	14.66096N 108.60261E	772	756
9	Murina annamitica	VJ	M	NR	31.2	4.5	30-May	< 2000	14.65758N 108.61069E	723	721
10	Murina cyclotis	A	M	NR	30.6	5.5	30-May	< 2000	14.65758N 108.61069E	723	721
11	Rhinolophus pusillus	A	F	L	40.5	7.5	2-Jun	1850	14.66081N 108.60293E	768	758
12	Rhinolophus pusillus	A	F	P	38.8	6.5	2-Jun	1920	14.66111N 108.60387E	763	766
13	Murina fionae	A	F	L	37.5	12.0	3-Jun	19:30	14.65758N 108.61069E	723	721

14	Myotis ater	A	M	NR	36.1	5.5	3-Jun	19:15	14.65778N 108.61169E	726	723
15	Myotis ater	A	M	NR	34.8	5.5	3-Jun	19:30	14.65778N 108.61169E	726	723
16	Myotis ater	VJ	M	NR	36.9	6.5	3-Jun	19:05	14.65778N 108.61169E	726	723
17	Murina annamitica	VJ	M	NR	30	5.0	4-Jun	20:30	14.66116N 108.6058E	744	762
18	Rhinolophus pusillus	A	F	L	37.8		4-Jun	18:50	14.66017N 108.60734E	727	732
19	Rhinolophus pusillus	A	F	L	38.4		4-Jun	Over night	14.66017N 108.60734E	727	732
20	Rhinolophus pusillus	A	F	L	39.6		4-Jun	Over night	14.66017N 108.60734E	727	732
21	Murina beelzebub	VJ	F	NR	37.3	5.5	4-Jun	Over night	14.66129N 108.60710E	753	750
22	Kerivoula hardwickii	VJ	M	NR	33.3	4.3	4-Jun		14.66017N 108.60734E	727	732
23	Murina fionae	A	F	L	39.9	11.0	4-Jun	Over night	14.66017N 108.60734E	727	732
24	Hipposideros larvatus	VJ	F	NR	63.3	20.0	5-Jun	1915	14.65849N 108.61019E	733	722
25	Murina huttoni	A	F	L	32.5	8.0	5-Jun	1930	14.65758N 108.61069E	723	721
26	Murina cyclotis	A	F	PL	32.8	7.0	5-Jun	2030	14.65758N 108.61069E	723	721
27	Murinahuttoni	A	F	PL	34.6	7.0	5-Jun	2045	14.65758N 108.61069E	723	721
28	Murina cyclotis	A	F	PL	34.4	8.0	5-Jun	2051	14.65758N 108.61069E	723	721
29	Rhinolophus affinis	A	F	L	52.2	15.5	5-Jun	Over night	14.66017N 108.60734E	727	732
30	Rhinolophus affinis	A	F	NR	49.6	14.0	5-Jun	Over night	14.66017N 108.60734E	727	732

31	Murina eleryi	VJ	M	NR	29.9	3.5	5-Jun	Over night	14.66017N 108.60734E	727	732
32	Murina cyclotis	VJ	F	NR	33.0	5.0	5-Jun	Over night	14.66017N 108.60734E	727	732
33	Hipposideros larvatus	A	M	NR	64.9	24.0	5-Jun	2000	14.66017N 108.60734E	727	732
34	Murina huttoni	VJ	F	NR	38.2	7.5	5-Jun	Over night	14.66017N 108.60734E	727	732
35	Hipposideros larvatus	A	M	NR	65	29.0	6-Jun	21:20	14.66017N 108.60734E	727	732
36	Murina annamitica	A	M	NR	31.2	6.0	7-Jun	20:02	14.65778N 108.61169E	726	723
37	Murina annamitica	A	F	L	32.2	7.0	7-Jun	20:35	14.65778N 108.61169E	726	723
38	Murina cyclotis	VJ	F	NR	35	7.0	7-Jun	22:15	14.66017N 108.60734E	727	732
39	Murina cyclotis	A	F	L	34	6.0	7-Jun	Over night	14.66017N 108.60734E	727	732
40	Rhinolophus pusillus	A	F	L	40.5	6.0	8-Jun	19:08	14.66501N 108.60896E	739	739
41	Hipposideros pomona	A	M	NR	43.4	7.0	8-Jun	21:07	14.66501N 108.60896E	739	739
42	Rhinolophus affinis	VJ	F	NR	49.8	11.5	8-Jun	<22:40	14.66017N 108.60734E	727	732
43	Murina huttoni	A	F	L	32.6	5.0	8-Jun	20:02	14.666N 108.6092E	738	738
44	Rhinolophus affinis	VJ	F	NR	51	11.0	8-Jun	Over night	14.66017N 108.60734E	727	732
45	Myotis ater	A	M	NR	33.6	4.5	8-Jun		14.666N 108.6092E	738	738
46	Hipposideros larvatus	A	M	Scrotum Engorged	68.2	24.5	8-Jun	Over night ?	14.66017N 108.60734E	727	732

47	Myotis ater	A	M	NR	35.1	5.0	8-Jun		14.666N 108.6092E	738	738
48	Myotis ater	VJ	F	NR	36.6	5.0	8-Jun		14.666N 108.6092E	738	738
49	Murina huttoni	A	F	L			8-Jun		14.666N 108.6092E	738	738
50	Murina huttoni	Unk	Unk	Unk			9-Jun		14.666N 108.6092E	738	738

Appendix B-1 continued: supplemental information.

Record ID #	Location Description	Voucher	Trap or Net	Comments
1	small pond N of camp	None	Net-water	42 ft net over pond
2	harp trap in "alcove" in vegetation edge, N of camp near small pond	TJO401v	Khoi Trap	401v is M. annamitica
3	sweep net at 30 ft net stretched across logging trail near spreading tree N of camp	None	Sweep net	Escaped while handling, id tentative
4	Harp trap at camp in wash	TJO 400v	Gore Trap	
5	12.8 m (42') net at ground level across logging road N of camp, near where trail branches into forest	None	Net-water	echolocation at ca. 120kHz on JAG Peterson
6	Harp Trap (Gore) across trail through forest off logging road N of camp	None	Gore Trap	echolocation at ca. 120kHz on JAG Peterson
7	6.1 m (20') net at ground level across trail where it enters forest off logging road N of camp	TJO402v	Net-land	bot fly larvae on wing joints. 9 total; forearm msmt from carcass
8	5.5 m (18') net at ground level across trail through forest off logging road N of camp	None	Net-land	escaped prior to completion of examination

9	12.8 m (42') net at ground level parallel to edge of very shallow "pond" at edge of forest, "Dead Frog Pond"	TJO404v	Net-water	404v is M. annamitica
10	12.8 m (42') net at ground level parallel to edge of very shallow "pond" at edge of forest, "Dead Frog Pond"	TJO403v	Net-water	403v is M. cyclotis
11	Harp Trap (Gore) across trail through forest off logging road N of camp	None	Gore Trap	Released
12	12.8 m (42') net at ground level across logging road N of camp, near where trail branches into forest	TJO405v	Net-land	Forearm 39.5 on carcass
13	12.8 m (42') net at ground level parallel to edge of very shallow "pond" at edge of forest, "Dead Frog Pond"	TJO406V	Net-water	Forearm 38.0 on live, 37.5 on carcass. 406v is Murina fionae
14	9.1 m (30') net at ground level across stream and trail in forest on trail behind "Dead Frog Pond" ("site 1" on capture sheet for 3 June);	None	Net-water	Narrow keel on calcar; tooth row appears > 5 mm
15	9.1 m (30') net at ground level across stream and trail in forest on trail behind "Dead Frog Pond" ("site 1" on capture sheet for 3 June);	None	Net-water	Narrow keel on calcar; tooth row appears > 5 mm
16	9.1 m (30') net at ground level across stream and trail in forest on trail behind "Dead Frog Pond" ("site 1" on capture sheet for 3 June);	None	Net-water	Narrow keel on calcar; tooth row appears > 5 mm
17	9 m net at ground level across logging trail N of camp near spring sometimes used for laundry and bathing water	None	Net-water	
18	Harp trap at camp in wash	None	Khoi Trap	
19	Harp trap at camp in wash	None	Khoi Trap	parasites that appeared to be bot fly larvae on wings (3-L, 5-R). All 8 located along 5th digit phalanges. 1.8-3.2 mm long
20	Harp trap at camp in wash	None	Khoi Trap	
21	Harp trail (Gore) at trail into forest strip near "shower tree" at camp	TJO407v	Gore Trap	407v is Murina beelzebub. Dark black-brown pelage; skull excised and dentition examined

22	Harp trap at camp in wash	TJO408v	Khoi Trap	
23	Harp trap at camp in wash	None	Khoi Trap	mass of bat recorded after full night in harp trap.
24	6.1 m (20') net at ground level in "V" configuration across logging trail S of camp	TJO409V	Net-land	
25	12.8 m (42') net at ground level parallel to edge of very shallow "pond" at edge of forest, "Dead Frog Pond"	TJ0411v	Net-water	
26	12.8 m (42') net at ground level parallel to edge of very shallow "pond" at edge of forest, "Dead Frog Pond"	TJO414v	Net-water	
27	12.8 m (42') net at ground level parallel to edge of very shallow "pond" at edge of forest, "Dead Frog Pond"	TJO410v	Net-water	
28	12.8 m (42') net at ground level parallel to edge of very shallow "pond" at edge of forest, "Dead Frog Pond"	TJO416v	Net-water	Head orange; no dark belly. This bat was paler than others we considered as M. huttoni
29	Harp trap at camp in wash	TJO420v	Khoi Trap	
30	Harp trap at camp in wash	TJO419v	Khoi Trap	Tail 45.5, Ear 10.9, Foot 8.0
31	Harp trap at camp in wash	TJO415v	Khoi Trap	415v is Murina eleryi
32	Harp trap at camp in wash	TJO417v	Khoi Trap	seems paler than other huttoni417v is Murina cyclotis
33	Harp trap at camp in wash	None	Khoi Trap	
34	Harp trap at camp in wash	TJO413v	Khoi Trap	413v is M. huttoni
35	Harp trap at camp in wash	TJO412v-wing tissue	Khoi Trap	
36	One 9.1 m (30') and one 6 m net at ground level across stream and trail in forest on trail behind "Dead Frog Pond"	TJO421v	Net-water	421v is M. annamitica

37	One 9.1 m (30') and one 6 m net at ground level across stream and trail in forest on trail behind "Dead Frog Pond"	TJO423v	Net-water	423v is M. annamitica
38	Harp trap at camp in wash	None	Khoi Trap	
39	Harp trap at camp in wash	TJO422v	Khoi Trap	422v is Murina cyclotis
40	9 m net at ground level across trail a short distance inside forest patch E of camp towards village	TJO428v	Net-land	428v is R. pusillus
41	9 m net at ground level across trail a short distance inside forest patch E of camp towards village	TJO427v	Net-land	bot fly right elbow
42	Harp trap at camp in wash	TJO425v-wing tissue	Khoi Trap	
43	9 m net at ground level across stream within forest patch E of camp towards village	None	Net-water	
44	Harp trap at camp in wash	TJO424v-wing tissue	Khoi Trap	
45	9 m net at ground level across stream within forest patch E of camp towards village	TJO430v	Net-water	
46	Harp trap at camp in wash	TJO426v-wing tissue	Khoi Trap	
47	9 m net at ground level across stream within forest patch E of camp towards village	TJO431v	Net-water	
48	9 m net at ground level across stream within forest patch E of camp towards village	TJO429v-wing tissue	Net-water	
49	9 m net at ground level across stream within forest patch E of camp towards village	None	Net-water	Escaped
50	9 m net at ground level across stream within forest patch E of camp towards village	None	Net-water	Escaped

Appendix B-2. Records of all bats captured at Quang Ngai study area, Vietnam, March 2012. Abbreviations: A= Adult; VJ = Volant juvenile; P=pregnant (with number of embryos, rump-crown length); L= lactating; PL=post-lactating; NR=non-reproductive; UNK = unknown. Location coordinates are decimal degrees north latitude and east longitude. Measurements (mm) under comments are total length-tail length-ear length from notch (en)-hind foot length.

Rec-ord ID #	Species	Age	Sex	Repro	Fore-arm (mm)	Mass (g)	Date (2012)	Time	Location Coordinates	Elev GPS (m)	Elev Google Earth (m)
QN001	*Rhinolophus affinis*	A	F	NR	47.3	13.0	12 Mar	1803	14.6218N 108.58892E	951	937
QN002	*Rhinolophus affinis*	A	M	NR	51.9	Unk	12 Mar		14.62056N10 8.58417E	930	912
QN003	*Rhinolophus affinis*	A	M	NR	50.2	Unk	12 Mar		14.62056N10 8.58417E	930	912
QN004	*Rhinolophus affinis*	A	M	NR	50.6	Unk	12 Mar		14.62056N10 8.58417E	930	912
QN005	*Hipposideros larvatus*	A	F	NR	64.6	Unk	12 Mar		14.62056N10 8.58417E	930	912
QN006	*Rhinolophus pearsoni*	A	M	NR	50.4	Unk	12 Mar		14.62056N10 8.58417E	930	912
QN007	*Rhinolophus pusillus*	Unk	Unk	Unk	Unk	Unk	12 Mar		14.62056N10 8.58417E	930	912
QN008	*Rhinolophus affinis*	A	F	P, 1 emb x 19 mm	48.2	Unk	12 Mar		14.62056N10 8.58417E	930	912
QN009	*Rhinolophus affinis*	A	M	NR	52.5	Unk	12 Mar		14.62056N10 8.58417E	930	912

QN010	*Rhinolophus affinis*	A	F	NR	52.4	Unk	12 Mar		14.62056N10 8.58417E	930	912
QN011	*Hipposideros pomona*	A	M	NR	42.5	Unk	12 Mar		14.62056N10 8.58417E	930	912
QN012	*Rhinolophus affinis*	A	F	P, 1 emb x 21 mm	51.2	Unk	12 Mar		14.62056N10 8.58417E	930	912
QN013	*Rhinolophus affinis*	A	F	P, 1 emb x 20 mm	51.2	Unk	12 Mar		14.62056N10 8.58417E	930	912
QN014	*Hipposideros pomona*	A	M	NR	43.5	Unk	12 Mar		14.62056N10 8.58417E	930	912
QN015	*Rhinolophus affinis*	A	F	P	51.5	Unk	12 Mar		14.62056N10 8.58417E	930	912
QN016	*Rhinolophus affinis*	A	M	NR	50.5	Unk	12 Mar		14.62056N10 8.58417E	930	912
QN017	*Rhinolophus affinis*	A	M	NR	48.6	Unk	12 Mar		14.62056N10 8.58417E	930	912
QN018	*Rhinolophus affinis*	A	F	P	52.0	20.5	13 Mar	1830	14.62064N 108.58443E	911	913
QN019	*Rhinolophus affinis*	A	F	NR	48.2	Unk	12 Mar		14.62056N 108.58417E	930	912
QN020	*Rhinolophus affinis*	A	F	P	49.0	15.0	13 Mar	1830	14.61953N 108.58465E	919	922
QN021	*Murina fionae* ~~*cyclotis*~~	A	M	NR	34.2	8.5	13 Mar	2100	14.62064N 108.58443E	911	913

QN022	*Kerivoula hardwickii*	A	F	P, 1 emb x 15 mm	34.8	5.8	14 Mar		14.621944N 108.595556E	991	984
QN023	*Murina beezelbub*	A	M	NR	34.4	5.5	14 Mar		14.6225N 108.598056E	967	974
QN024	*Rhinolophus affinis*	A	F	P	50.7	Unk	14 Mar		14.6225N 108.598056E	967	974
QN025	*Rhinolophus affinis*	A	M	NR	49.6	Unk	14 Mar	A.M.	14.61928N 108.58474E	919	922
QN026	*Rhinolophus affinis*	A	M	NR	49.0	14.3	14 Mar	1830	14.61953N 108.58465E	919	922
QN027	*Rhinolophus affinis*	A	F	P	50.5	19.1	14 Mar	1830	14.61905N 108.58514E	914	922
QN028	*Rhinolophus affinis*	A	F	P	51.0	20.5	14 Mar	1800-1820	14.61928N 108.58474E	919	922
QN029	*Rhinolophus affinis*	A	F	P	Unk	19.5	14 Mar	1800-1820	14.61928N 108.58474E	919	922
QN030	*Rhinolophus affinis*	A	F	NR	50.0	16.0	14 Mar	1800-1820	14.61928N 108.58474E	919	922
QN031	*Rhinolophus affinis*	A	F	P	48.0	18.5	14 Mar	1800-1820	14.61928N10 8.58474E	919	922
QN032	*Rhinolophus affinis*	A	F	P	49.0	18.3	14 Mar	1800-1820	14.61928N10 8.58474E	919	922
QN033	*Rhinolophus affinis*	A	M	NR	51.8	Unk	15 Mar		14.621944N 108.595556	964	978

QN034	*Rhinolophus affinis*	A	M	NR	Unk	Unk	15 Mar		14.621944N 108.595556	964	978
QN035	*Rhinolophus affinis*	A	M	NR	Unk	Unk	15 Mar		14.621944N 108.595556	964	978
QN036	*Rhinolophus affinis*	A	M	NR	Unk	Unk	15 Mar		14.621944N 108.595556	964	978
QN037	*Rhinolophus affinis*	A	F	P	Unk	Unk	15 Mar		14.621944N 108.595556	964	978
QN038	*Rhinolophus affinis*	A	F	P	Unk	Unk	15 Mar		14.621944N 108.595556	964	978
QN039	*Rhinolophus affinis*	A	M	NR	Unk	Unk	15 Mar		14.621944N 108.595556	964	978
QN040	*Rhinolophus affinis*	A	F	P	Unk	Unk	15 Mar		14.621944N 108.595556	964	978
QN041	*Rhinolophus pusillus*	A	F	P, 1 emb x 14 mm	40.0	7.1	15 Mar		14.621944N 108.595556	964	978
QN042	*Rhinolophus pusillus*	A	F	P	36.9	Unk	15 Mar		14.621944N 108.595556	964	978
QN043	*Rhinolophus pusillus*	A	F	P, 1 emb x 11 mm	39.2	6.2	15 Mar		14.621944N 108.59556E	964	984
QN044	*Rhinolophus pusillus*	A	F	P, 1 emb x 14.5 mm	41.9	7.0	15 Mar		14.621944N1 08.59556E	964	984
QN045	*Rhinolophus pusillus*	A	F	P, 1emb x 12.5 mm	39.3	6.5	15 Mar		14.621944N1 08.59556E	964	984

QN046	*Hipposideros pomona*	A	F	P, 1 emb x 13.5 mm	42.8	7.8	15 Mar		14.621944N1 08.59556E	964	984
QN047	*Rhinolophus pusillus*	A	M	NR	38.2	5.0	15 Mar		14.621944N1 08.59556E	964	984
QN048	*Rhinolophus affinis*	A	F	Unk	51.2	12.2	15 Mar		14.621944N1 08.59556E	964	984
QN049	*Rhinolophus affinis*	A	F	P, 1 emb x 19 mm	50.6	17.2	15 Mar		14.621944N1 08.59556E	964	984
QN050	*Rhinolophus pusillus*	A	M	NR	38.2	5.0	16 Mar	1930	14.62444N 108.582778E	883	826
QN051	*Rhinolophus affinis*	A	M	NR	50.6	15.0	16 Mar	1930	14.62556N 108.58389E	786	772
QN052	*Rhinolophus affinis*	A	F	P	49.9	19.0	16 Mar	1930	14.62556N10 8.58444E	786	772
QN053	*Rhinolophus affinis*	A	F	P	49.8	15.5	16 Mar	1930	14.62556N10 8.58444E	786	772
QN054	*Scotomanes ornatus*	A	M	NR	55.3	24.5 (27.5 at capture)	16 Mar	1830	14.61814N 108.58644E	916	922
QN055	*Myotis muricola*	A	F	P, 1 emb x 3 mm	34.1	5.0	16 Mar	2000	14.61814N 108.58644E	916	922
QN056	*Rhinolophus affinis*	A	M	NR	51.0	15.5	16 Mar	1815	14.61861N 108.58574E	905	924

QN057	*Rhinolophus affinis*	A	F	P	49.2	17.7	17 Mar		14.619167N 108.58528E	908	922
QN058	*Rhinolophus affinis*	A	F	P	50.7	16.8	17 Mar		14.619167N1 08.58528E	908	922
QN059	*Rhinolophus affinis*	A	M	NR	51.0	15.5	17 Mar		14.619167N1 08.58528E	908	922
QN060	*Rhinolophus affinis*	A	F	P	50.2	12.0	17 Mar		14.619167N1 08.58528E	908	922
QN061	*Rhinolophus affinis*	A	F	P	51.4	18.3	17 Mar		14.619167N1 08.58528E	908	922
QN062	*Rhinolophus affinis*	A	M	NR	51.3	15.5	17 Mar		14.619167N1 08.58528E	908	922
QN063	*Rhinolophus affinis*	A	F	P	50.1	17.5	17 Mar		14.619167N1 08.58528E	908	922
QN064	*Scotomanes ornatus*	A	M	NR	53.3	22.2 at capture	17 Mar	1940-2000	14.61814N 108.58644E	916	922
QN065	*Megaderma lyra*	Unk	Unk	Unk	Unk	Unk	18 Mar	1835	14.61862N 108.58618E	917	917
QN066	*Megaderma lyra*	A	M	NR	65.5	36.5	20 Mar	2020	14.61762N 108.58674E	920	923
QN067	*Rhinolophus affinis*	A	F	P	50.8	19.3	20 Mar	1814	14.62073N 108.58450E	923	912

QN068	*Rhinolophus affinis*	A	F	P	Unk	Unk	20 Mar	1815	14.62073N 108.58450E	923	912
QN069	*Murinafionae*	A	M	NR	35.0	6.8	19 Mar		14.631944N 108.58111E	381	382

Appendix B-2 continued: supplemental information.

Record ID #	Location Description	Voucher	Trap or Net	Comments and measurements
QN001	Net 2; Upslope from camp ca. 150 m	Release	Net	1803; lots of parasites.Photos JG2532-2539
QN002	mix some big tree and small trip. Net set a long the road go up camp	Specimen; liver in etoh	Net	79-24-18en-12
QN003	mix some big tree and small trip. Net set a long the road go up camp	Specimen; liver in etoh	Net	76-24-19en-11
QN004	mix some big tree and small trip. Net set a long the road go up camp	Specimen; liver in etoh	Net	73-23-17en-10
QN005	mix some big tree and small trip. Net set a long the road go up camp	Release; wing in etoh	Net	
QN006	mix some big tree and small trip. Net set a long the road go up camp	Specimen; liver in etoh	Net	75-17-23en-10
QN007	mix some big tree and small trip. Net set a long the road go up camp	Escaped	Net	Originally thought to be lepidus.
QN008	mix some big tree and small trip. Net set a long	Specimen; liver	Net	Broken wing. 78-18-18en-9

	the road go up camp	in etoh		
QN009	mix some big tree and small trip. Net set a long the road go up camp	Specimen; liver in etoh	Net	75-19-18en-8
QN010	mix some big tree and small trip. Net set a long the road go up camp	Release; wing in etoh	Net	
QN011	mix some big tree and small trip. Net set a long the road go up camp	Specimen; liver in etoh	Net	73-25-20en-8
QN012	mix some big tree and small trip. Net set a long the road go up camp	Specimen; liver in etoh	Net	73-25-19en-12
QN013	mix some big tree and small trip. Net set a long the road go up camp	Specimen; liver in etoh	Net	79-20-20en-12
QN014	mix some big tree and small trip. Net set a long the road go up camp	Specimen; liver in etoh	Net	Dead in bag. 72-29-18en-8
QN015	mix some big tree and small trip. Net set a long the road go up camp	Release	Net	
QN016	mix some big tree and small trip. Net set a long the road go up camp	Release	Net	
QN017	mix some big tree and small trip. Net set a long the road go up camp	Release	Net	
QN018	mix some big tree and small trip. Net set a long the road go up camp	Release	Net	caught ca. 1830; 11 bat flies, many wing scars. Photos JG2547-51
QN019	mix some big tree and small trip. Net set a long the road go up camp	Specimen; liver in etoh	Net	77-21-17en-10

QN020	Net 7; across trail, mature forest across creek	Release; wing in etoh	Net	caught ca. 1830; parasites (flies) and wing scars. Photos JG2540-46
QN021	Net 5; mature forest across creek	Specimen; muscle, liver in etoh	Net	caught 2100; fur wooly, reddish brown and pale at base. 85-31-13en-7 Photos JG2552-59
QN022	Harp trap set up near small bamboo area mix with small tree in the tract go down other area and go up camp, about 1050m	Specimen; muscle, liver in etoh	Trap	92-41-13en-7
QN023	primary forest, many big tree. Net set up across a track through a forest	Specimen; muscle, liver in etoh	net	mass after held overnight. 82-33-13en-8
QN024	primary forest, many big tree. Net set up across a track through a forest	Release; wing in etoh	net	
QN025	Large harp trap (site 5) in morning; across trail, mature forest	Release	Trap	hole in wing
QN026	Net 7; across trail, mature forest across creek	Release	Net	winged and wingless flies
QN027	Net 10; parallel to trail, across side trail	Release	Net	winged flies. Photos JG2592-95
QN028	Large harp trap (site 5); across trail, mature forest	Release	Trap	winged flies, pale nose leaf. Photos JG2598-60
QN029	Large harp trap (site 5); across trail, mature forest	Release	Trap	winged flies and bugs in noseleaf, bot fly (?) on tail membrane.

				Photos JG2602-2607
QN030	Large harp trap (site 5); across trail, mature forest	Release	Trap	winged flies. None
QN031	Large harp trap (site 5); across trail, mature forest	Release	Trap	wingless fly. Photos JG2609-2611
QN032	Large harp trap (site 5); across trail, mature forest	Release	Trap	no visible ectos. None
QN033	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Release	net	
QN034	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Release	net	
QN035	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Release	net	
QN036	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Release	net	
QN037	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Release	net	
QN038	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with	Release	net	

	large diameter and average			
QN039	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Release	net	
QN040	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Release	harp	
QN041	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Specimen; liver in etoh	net	66-20-16en-7
QN042	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Release	net	Originally thought to be lepidus
QN043	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Specimen; liver in etoh	harp	Originally thought to be lepidus. 61-17-15en-7
QN044	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Specimen; liver in etoh	harp	Originally thought to be lepidus. 65-22-16en-7
QN045	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Specimen; liver in etoh	harp	Originally thought to be lepidus. 61-19-16en-8
QN046	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Specimen; liver in etoh	harp	73-28-18en-8

QN047	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Specimen; liver in etoh	harp	Originally thought to be lepidus. 57-16-15en-7
QN048	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Specimen; liver in etoh	harp	Dead in bag. 82-26-18en-9
QN049	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Specimen; liver in etoh	harp	81-23-21en-10
QN050	Harp trap A set up at the region border between the top of mountain and go down village, distance 500m from camp area, stip area.	Release	Trap	Originally thought to be lepidus
QN051	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Release	Trap	Son harp trap
QN052	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Release	Trap	
QN053	nets placed along the trail in the woods, where two adjoining slopes. Many forest trees with large diameter and average	Release	Trap	
QN054	Net 16; Across river, vegetation arching and overhanging stream	Specimen; liver in etoh	Net	Photos JG2691-2703. 130-52-16en-12
QN055	Net 16; Across river, vegetation arching and overhanging stream	Specimen; liver in etoh	Net	Photos JG2711-2717. 75-29-12en-6

QN056	Across and parallel to trail in L-shape	Release	Net	Photos JG2706-2709
QN057	close the big stream, small tree	Release	Net	Caught by Son on 3/17 < 2000
QN058	close the big stream, small tree	Release	Net	Caught by Son on 3/17 < 2000
QN059	close the big stream, small tree	Release	Net	Caught by Son on 3/17 < 2000
QN060	close the big stream, small tree	Release; wing in etoh	Net	Caught by Son on 3/17 < 2000
QN061	close the big stream, small tree	Release	Net	1/3 of ventral body hairless. Caught by Son on 3/17 < 2000
QN062	close the big stream, small tree	Release; wing in etoh	Net	Caught by Son on 3/17 < 2000
QN063	close the big stream, small tree	Release; wing in etoh	Net	Caught by Son on 3/17 < 2000
QN064	Net 16; Across river, vegetation arching and overhanging stream	Specimen; liver in etoh	Net	High in net over water below overhanging vegetation. 120-50-19en-13
QN065	Net 15; Across edge of frog pond in grassy sandbank along river	Escape	Net	In lower tier of net, escaped while TJO donning gloves
QN066	Net 20; across sandy-grassy shoreline perpendicular to stream and net 21	Specimen; liver in etoh	Net	95-29-37en-18
QN067	Net 26; parallel to main trail above net 5 on ridgeline above valley	Release	Net	Caught 3/20 at 1814 net 26.
QN068	Net 26; parallel to main trail above net 5 on ridgeline above valley	Release	Net	Caught 3/20 at 1814 net 26.

QN069	Over stream in harp trap	Specimen; muscle, liver in etoh	Trap	Body mass 2 days after capture. 88-34-14en-9.

APPENDIX C-1. Catalog of 32 bat specimens from Quang Ngai bat survey, Vietnam, May-June 2011. All species identifications are tentative.

Collector's Catalog Number	Entire Specimen in ethanol	Tissue Sample in Ethanol (small vials, for genetics)	Tentative Identification	General Location	Capture Location Coordinates (Decimal Degrees, WG84)	Approximate Elevation (m)	Date of Collection	Sex	Age
TJO 400v	Yes	Liver	Hipposideros larvatus	Quang Ngai Province, Ba To District, Vietnam	14.66017N 108.60734E	727	28 May 2011	F	Volant juvenile
TJO 401v	Yes	Liver	Murina annamitica	Quang Ngai Province, Ba To District, Vietnam	14.66104N 108.60577E	736	28 May 2011	F	Volant juvenile
TJO 402v	Yes	Liver	Rhinolophus pusillus	Quang Ngai Province, Ba To District, Vietnam	14.66121N 108.60381E	770	29 May 2011	F	Adult
TJO 403v	Yes	Liver	Murina cyclotis	Quang Ngai Province, Ba To District, Vietnam	14.65758N 108.61069E	723	30 May 2011	M	Adult
TJO 404v	Yes	Liver	Murina annamitica	Quang Ngai Province, Ba To District, Vietnam	14.65758N 108.61069E	723	30 May 2011	M	Volant juvenile

Appendix C-1 Continued

TJO 405v	Yes	Liver	Rhinolophus pusillus	Quang Ngai Province, Ba To District, Vietnam	14.66111N 108.60387	763	2 June 2011	F	Adult
TJO 406v	Yes	Liver	Murina fionae	Quang Ngai Province, Ba To District, Vietnam	14.65758N 108.61069E	723	3 June 2011	F	Adult
TJO 407v	Yes	Liver	Murinabeelzebub	Quang Ngai Province, Ba To District, Vietnam	14.66129N 108.60710E	753	4 June 2011	F	Volant juvenile
TJO 408v	Yes	Liver	Kerivoula hardwickii	Quang Ngai Province, Ba To District, Vietnam	14.66017N 108.60734E	727	4 June 2011	M	Volant juvenile
TJO 409v	No	Wing	Hipposideros larvatus	Quang Ngai Province, Ba To District, Vietnam	14.65849N 108.61018	733	5 June 2011	F	Volant juvenile
TJO 410v	Yes	Liver	Murina huttoni	Quang Ngai Province, Ba To District, Vietnam	14.65758N 108.61069E	723	5 June 2011	F	Adult
TJO 411v	Yes	Liver	Murina huttoni	Quang Ngai Province, Ba To District, Vietnam	14.65758N 108.61069E	723	5 June 2011	F	Adult
TJO 412v	No	Wing	Hipposideros larvatus	Quang Ngai Province, Ba To District, Vietnam	14.66017N 108.60734E	727	6 June 2011	M	Adult

Appendix C-1 Continued

TJO 413v	Yes	Liver	Murina huttoni	Quang Ngai Province, Ba To District, Vietnam	14.66017N 108.60734E	727	5 June 2011	F	Volant juvenile
TJO 414v	Yes	Liver	Murina cyclotis	Quang Ngai Province, Ba To District, Vietnam	14.65758N 108.61069E	723	5 June 2011	F	Adult
TJO 415v	Yes	Liver	Murina eleryi	Quang Ngai Province, Ba To District, Vietnam	14.66017N 108.60734E	727	5 June 2011	M	Volant juvenile
TJO 416v	Yes	Liver	Murina cyclotis	Quang Ngai Province, Ba To District, Vietnam	14.65758N 108.61069E	723	5 June 2011	F	Adult
TJO 417v	Yes	Liver	Murina cyclotis	Quang Ngai Province, Ba To District, Vietnam	14.66017N 108.60734E	727	5 June 2011	F	Volant juvenile
TJO 418v	No	Wing	Hipposideros larvatus	Quang Ngai Province, Ba To District, Vietnam	14.66017N 108.60734E	727	6 June 2011	M	Adult
TJO 419v	Yes	Liver	Rhinolophus affinis	Quang Ngai Province, Ba To District, Vietnam	14.66017N 108.60734E	727	5 June 2011	F	Adult
TJO 420v	No	Wing	Rhinolophus affinis	Quang Ngai Province, Ba To District, Vietnam	14.66017N 108.60734E	727	5 June 2011	F	Adult
TJO 421v	Yes	Liver	Murina annamitica	Quang Ngai Province, Ba To District, Vietnam	14.65778N 108.61169E	726	7 June 2011	M	Adult

Appendix C-1 Continued

TJO 422v	Yes	Liver	Murina cyclotis	Quang Ngai Province, Ba To District, Vietnam	14.66017N 108.60734E	727	7 June 2011	F	Adult
TJO 423v	Yes	Liver	Murina annamitica	Quang Ngai Province, Ba To District, Vietnam	14.65778N 108.61169E	726	7 June 2011	F	Adult
TJO 424v	No	Wing	Rhinolophus affinis	Quang Ngai Province, Ba To District, Vietnam	14.66017N 108.60734E	727	8 June 2011	F	Volant juvenile
TJO 425v	No	Wing	Rhinolophus affinis	Quang Ngai Province, Ba To District, Vietnam	14.66017N 108.60734E	727	8 June 2011	F	Volant juvenile
TJO 426v	No	Wing	Hipposideros larvatus	Quang Ngai Province, Ba To District, Vietnam	14.66017N 108.60734E	727	8 June 2011	M	Adult
TJO 427v	Yes	Liver	Hipposideros pomona	Quang Ngai Province, Ba To District, Vietnam	14.66501N 108.60896E	739	8 June 2011	M	Adult
TJO 428v	Yes	Liver	Rhinolophus pusillus	Quang Ngai Province, Ba To District, Vietnam	14.66501N 108.60896E	739	8 June 2011	F	Adult
TJO 429v	No	Wing	Myotis ater	Quang Ngai Province, Ba To District, Vietnam	14.6660N 108.6092	738	8 June 2011	F	Volant juvenile

Appendix C-1 Continued

TJO 430v	Yes	Liver	Myotis ater	Quang Ngai Province, Ba To District, Vietnam	14.6660N 108.6092	738	8 June 2011	M	Adult
TJO 431v	Yes	Liver	Myotis ater	Quang Ngai Province, Ba To District, Vietnam	14.6660N 108.6092	738	8 June 2011	M	Adult

Appendix C-1 Continued: supplemental information

Collector's Catalog Number	Reproduction Condition	Body Mass (g)	Forearm Length (mm)	Total Length	Tail Length	Ear Length (from notch)	Foot Length	Comments
TJO 400v	Not Reproductive	20.5	65.5	107	33.5	20	12	Experts suggest this taxon may include several cryptic species (see text in report)
TJO 401v	Not Reproductive	7.0	33.5	78	29.5	14	8	Skull excised and dentition examined:M. annamitica
TJO 402v	Lactating	7.0	40	56	18	14	7.5	Bot fly larvae on wing bones; experts suggest this taxon may include several cryptic species (see text in report); reproduction corrected from thought to be pregnant at capture to lactating when specimen prepared
TJO 403v	Not Reproductive	5.5	30.6	108	30	14.5	8	Skull excised and dentition examined:M. cyclotis

Appendix C-1 Continued: supplemental information

TJO 404v	Not Reproductive	4.5	31.2	72	27	15	16	Skull excised and dentition examined:M. annamitica
TJO 405v	Pregnant	6.5	39.5	51	17	13	6	Experts suggest this taxon may include several cryptic species (see text in report)
TJO 406v	Lactating	12.0	37.5	93	36	16	9	Skull excised and dentition examined: Murina fionae; location corrected on 9 July (after file was already sent to W.A.R.)
TJO 407v	Not Reproductive	5.5	37.3	82	33	14	8	Dark black-brown pelage; skull excised and dentition examined:Murina beelzebub
TJO 408v	Not Reproductive	4.3	33.3	88	45	11	8	Experts suggest this taxon may include several cryptic species (see text in report)
TJO 409v	Not Reproductive	20.0	63.3					Experts suggest this taxon may include several cryptic species (see text in report)
TJO 410v	Post-lactating	7.0	34.6	83	35	15	7	Skull excised and dentition examined:Murina huttoni
TJO 411v	Lactating	8.0	32.5	79	33	13	8	Skull excised and dentition examined:*Murina huttoni*

Appendix C-1 Continued: supplemental information

TJO 412v	Not Reproductive	29.0	65					Experts suggest this taxon may include several cryptic species (see text in report)
TJO 413v	Not Reproductive	11.0	40	89	35	14	10	Skull excised and dentition examined: Murina huttoni
TJO 414v	Post-lactating	7.0	32.8	83	33	12	7	Skull excised and dentition examined: Murina cyclotis
TJO 415v	Not Reproductive	3.5	29.9	69	25	10	7	Skull excised and dentition examined: Murina eleryi
TJO 416v	Lactating	8.0	34.4	82	31	15	8	Skull excised and dentition examined: Murina cyclotis
TJO 417v	Not Reproductive	5.0	33	73	25	13.5	7	Skull excised and dentition examined: Murina cyclotis
TJO 418v	Not Reproductive	29.0	65					Experts suggest this taxon may include several cryptic species (see text in report)
TJO 419v	Not Reproductive	14.0	49.6	74	20	20	9	Experts suggest this taxon may include several cryptic species (see text in report)
TJO 420v	Lactating	15.5	52.2					Experts suggest this taxon may include several cryptic species (see text in report)

Appendix C-1 Continued: supplemental information

TJO 421v	Not Reproductive	6.0	31.2	78	30	12	8	Skull excised and dentition examined: Murina annamitica
TJO 422v	Lactating	6.0	34	81	28	14	8	Skull excised and dentition examined: Murina cyclotis
TJO 423v	Lactating	7.0	32.2	78	28	13	8	Skull excised and dentition examined: Murina annamitica
TJO 424v	Not Reproductive	11.0	51					Experts suggest this taxon may include several cryptic species (see text in report)
TJO 425v	Not Reproductive	11.5	49.8					Experts suggest this taxon may include several cryptic species (see text in report)
TJO 426v	Scrotum Engorged	24.5	68.2					Experts suggest this taxon may include several cryptic species (see text in report)
TJO 427v	Not Reproductive	7.0	43.4	77	34	22	8	Experts suggest this taxon may include several cryptic species (see text in report)
TJO 428v	Lactating	6.0	40.5	54	19	15	7	Experts suggest this taxon may include several cryptic species (see text in report)
TJO 429v	Not Reproductive	5.0	36.1					Skull should be excised and dentition examined; location corrected on 9 July (after file was already sent to W.A.R.); forearm 36.6 on capture.

Appendix C-1 Continued: supplemental information

TJO 430v	Not Reproductive	4.5	33.6	77	33	12	5	Skull should be excised and dentition examined
TJO 431v	Not Reproductive	5.0	35.1	81	33	12	5	Skull should be excised and dentition examined

Appendix C-2. Catalog of 34 bat specimens from Quang Ngai bat survey, Vietnam, March 2012.

Collector's Catalog Number	Entire Specimen in ethanol	Tissue Sample in Ethanol (small vials, for genetics)	Tentative Identification	General Location	Capture Location Coordinates (Decimal Degrees, WG84)	Approx-imate Elevation (m; GPS)	Date of Collection	Sex	Age
QN002	Yes	liver	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.62056N 108.58417E	930	12-Mar-2012	M	Adult
QN003	Yes	liver	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.62056N 108.58417E	930	12-Mar-2012	M	Adult
QN004	Yes	liver	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.62056N 108.58417E	930	12-Mar-2012	M	Adult
QN005	No	wing	*Hipposideros larvatus*	Ba To District, Quang Ngai Province, Vietnam	14.62056N 108.58417E	930	12-Mar-2012	F	Adult
QN006	Yes	liver	*Rhinolophus pearsoni*	Ba To District, Quang Ngai Province, Vietnam	14.62056N 108.58417E	930	12-Mar-2012	M	Adult

QN008	Yes	liver	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.62056N 108.58417E	930	12-Mar-2012	F	Adult
QN009	Yes	liver	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.62056N 108.58417E	930	12-Mar-2012	M	Adult
QN010	No	wing	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.62056N 108.58417E	930	12-Mar-2012	F	Adult
QN011	Yes	liver	*Hipposideros pomona*	Ba To District, Quang Ngai Province, Vietnam	14.62056N 108.58417E	930	12-Mar-2012	M	Adult
QN012	Yes	liver	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.62056N 108.58417E	930	12-Mar-2012	F	Adult
QN013	Yes	liver	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.62056N 108.58417E	930	12-Mar-2012	F	Adult
QN014	Yes	liver	*Hipposideros pomona*	Ba To District, Quang Ngai Province, Vietnam	14.62056N 108.58417E	930	12-Mar-2012	M	Adult
QN019	Yes	liver	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.62056N 108.58417E	930	12-Mar-2012	F	Adult
QN020	No	wing	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.61953N 108.58465E	919	13-Mar-2012	F	Adult
QN021	Yes	muscle, liver	*Murina fionae*	Ba To District, Quang Ngai Province, Vietnam	14.62064N 108.58443E	911	13-Mar-2012	M	Adult

QN022	Yes	muscle, liver	*Kerivoula hardwickii*	Ba To District, Quang Ngai Province, Vietnam	14.621944N 108.595556E	991	14-Mar-2012	F	Adult
QN023	Yes	muscle, liver	*Murina beezelbub*	Ba To District, Quang Ngai Province, Vietnam	14.6225N 108.598056E	967	14-Mar-2012	M	Adult
QN024	No	wing	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.6225N 108.598056E	967	14-Mar-2012	F	Adult
QN041	Yes	liver	*Rhinolophus pusillus*	Ba To District, Quang Ngai Province, Vietnam	14.621944N 108.595556	964	15-Mar-2012	F	Adult
QN043	Yes	liver	*Rhinolophus pusillus*	Ba To District, Quang Ngai Province, Vietnam	14.621944N 108.59556E	964	15-Mar-2012	F	Adult
QN044	Yes	liver	*Rhinolophus pusillus*	Ba To District, Quang Ngai Province, Vietnam	14.621944N 108.59556E	964	15-Mar-2012	F	Adult
QN045	Yes	liver	*Rhinolophus pusillus*	Ba To District, Quang Ngai Province, Vietnam	14.621944N 108.59556E	964	15-Mar-2012	F	Adult
QN046	Yes	liver	*Hipposideros pomona*	Ba To District, Quang Ngai Province, Vietnam	14.621944N 108.59556E	964	15-Mar-2012	F	Adult
QN047	Yes	liver	*Rhinolophus pusillus*	Ba To District, Quang Ngai Province, Vietnam	14.621944N 108.59556E	964	15-Mar-2012	M	Adult
QN048	Yes	liver	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.621944N 108.59556E	964	15-Mar-2012	F	Adult

QN049	Yes	liver	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.621944N 108.59556E	964	15-Mar-2012	F	Adult
QN054	Yes	liver	*Scotomanes ornatus*	Ba To District, Quang Ngai Province, Vietnam	14.61814N 108.58644E	916	16-Mar-2012	M	Adult
QN055	Yes	liver	*Myotis muricola*	Ba To District, Quang Ngai Province, Vietnam	14.61814N 108.58644E	916	16-Mar-2012	F	Adult
QN060	No	wing	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.619167N 108.58528E	908	17-Mar-2012	F	Adult
QN062	No	wing	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.619167N 108.58528E	908	17-Mar-2012	M	Adult
QN063	No	wing	*Rhinolophus affinis*	Ba To District, Quang Ngai Province, Vietnam	14.619167N 108.58528E	908	17-Mar-2012	F	Adult
QN064	Yes	liver	*Scotomanes ornatus*	Ba To District, Quang Ngai Province, Vietnam	14.61814N 108.58644E	916	17-Mar-2012	M	Adult
QN066	Yes	liver	*Megaderma lyra*	Ba To District, Quang Ngai Province, Vietnam	14.61762N 108.58674E	920	20-Mar-2012	M	Adult
QN069	Yes	muscle, liver	*Murina fionae*	Ba To District, Quang Ngai Province, Vietnam	14.631944N 108.58111E	381	19-Mar-2012	M	Adult

Appendix C-2 Continued: supplemental information (ND= not determined)

Collector's Catalog Number	Reproduction Condition	Body Mass (g)	Forearm Length (mm)	Total Length	Tail Length	Ear Length (from notch)	Foot Length	Comments
QN002	Non-reprod	ND	51.9	79	24	18	12	
QN003	Non-reprod	ND	50.2	76	24	19	11	
QN004	Non-reprod	ND	50.6	73	23	17	10	
QN005	Non-reprod	ND	64.6	ND	ND	ND	ND	
QN006	Non-reprod	ND	50.4	75	17	23	10	
QN008	Preg, 1 emb x 19	ND	48.2	78	18	18	9	
QN009	Non-reprod	ND	52.5	75	19	18	8	

QN010	Non-reprod	ND	52.4	ND	ND	ND	ND	
QN011	Non-reprod	ND	42.5	73	25	20	8	
QN012	Preg, 1 emb x 21	ND	51.2	73	25	19	12	
QN013	Preg, 1 emb x 20	ND	51.2	79	20	20	12	
QN014	Non-reprod	ND	43.5	72	29	18	8	
QN019	Non-reprod	ND	48.2	77	21	17	10	
QN020	Pregnant	15.0 g	49.0	ND	ND	ND	ND	PHOTOS JG2540-46
QN021	Non-reproductive	8.5 g	34.2	85	31	13	7	PHOTOS JG2552-59
QN022	Preg, 1 emb x 15	5.8 g	34.8	92	41	13	7	
QN023	Non-reprod	5.5 g	34.4	82	33	13	8	

QN024	Pregnant	ND	50.7	ND	ND	ND	ND	
QN031	Pregnant	18.5 g	48.0	ND	ND	ND	ND	PHOTOS JG2609-2611
QN032	Pregnant	18.3 g	49.0	ND	ND	ND	ND	None
QN033	Non-reprod	?	51.8	ND	ND	ND	ND	
QN034	Non-reprod	?	?	ND	ND	ND	ND	
QN035	Non-reprod	?	?	ND	ND	ND	ND	
QN036	Non-reprod	?	?	ND	ND	ND	ND	
QN041	Preg, 1 emb x 14	7.1 g	40.0	66	20	16	7	
QN043	Preg, 1 emb x 11	6.2 g	39.2	61	17	15	7	
QN044	Preg, 1 emb x 14.5	7.0 g	41.9	65	22	16	7	

QN045	Preg, 1emb x 12.5	6.5 g	39.3	61	19	16	8	
QN046	Preg, 1 emb x 13.5	7.8 g	42.8	73	28	18	8	
QN047	Non-reprod	5.0 g	38.2	57	16	15	7	
QN048	Not Determined	12.2 g	51.2	82	26	18	9	
QN049	Preg, 1 emb x 19	17.2 g	50.6	81	23	21	10	
QN054	Non-reproductive	24.5 g (27.5 g on capture)	55.3	130	52	16	12	PHOTOS JG2691-2703
QN055	Preg, 1 emb x 3 mm	5.0 g	34.1	75	29	12	6	PHOTOS JG2711-2717
QN060	Pregnant	12.0 g	50.2	ND	ND	ND	ND	
QN062	Non-reprod	15.5 g	51.3	ND	ND	ND	ND	
QN063	Pregnant	17.5 g	50.1	ND	ND	ND	ND	

QN064	Non-reproductive	22.2 g at capture	53.3	120	50	19	13	
QN066	Non-reproductive	36.5 g	65.5	95	00	37	18	
QN069	Non-reprod	6.8 g	35.0	88	34	14	9	