奄美大島における捕獲と音声調査によって発見されたコウモリ種

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Bat species found during capturing and acoustic surveys in Amami–Oshima Island, Japan

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Abstract. The aim of this study was to understand bat species inhabiting Amami–Oshima Island to help promote bat conservation. Six species were captured from 30 sites in Amami–Oshima Island from January 2016 to July 2018: *Rhinolophus cornutus*, *Myotis macrodactylus*, *Myotis yanbarensis*, *Miniopterus fuscus*, *Murina ryukyuana*, and an unknown species. *Pipistrellus abramus* and *Tadarida latouchei* were not found in our survey. The results of the present study and previous reports reveal that at least eight species of bats inhabit Amami–Oshima Island.

Introduction

The Amami Islands belong to Kagoshima Prefecture and are part of the Nansei Islands of Japan (370 km to the south-west of Kyushu Island). The Amami Islands formed in the Lower Pleistocene (approximately 1.7 million years) at the latest and have many endemic species (Mizuta 2016). Six species of small bats have been recorded in Amami–Oshima Island (Yoshiyuki et al. 1989; Sawada 1994; Maeda et al. 2002; Abe et al. 2008; Funakoshi 2010): *Rhinolophus cornutus*, *Pipistrellus abramus*, *Myotis yanbarensis*, *Miniopterus fuscus*, *Murina ryukyuana*, and *Tadarida latouchei*. However, there is still not enough information about the bat fauna of the Amami Islands. Here, we report a list of bat species found by our capturing and observation survey in Amami–Oshima Island.

Materials and methods

Our 37-night survey was conducted at 30 sites in Amami–Oshima Island, Kagoshima Prefecture, Japan (N 28°11′–28′, E 129°9′–40′) from January 2016 to July 2018. The monthly minimum and maximum temperatures at Naze in 2016 were 14.6 ºC in February and 29.5 ºC in July, respectively (Japan Meteorological Agency), and the monthly minimum and maximum precipitation (total amount of each month) at Naze in 2016 were 98.5 mm in November and 354.5 mm in May, respectively. We set two to eight mist nets (width: 6 m and 12 m) and one harp trap (Austbat 2–bank Harp Trap; Faunatech and Austbat, Australia, width: 1.8 m) at each forest, riverside, and sea coast location (Fig. 1 and Table 1). The mist nets and harp trap were set up from dusk to 23:00 or to the next morning. Flying bats were detected using a bat detector (Mini 3, Ultra Sound Advice, United Kingdom). We also observed or captured some bats with a butterfly net in three air raid shelters and in a cave by the sea during the daytime to understand what bat species inhabit different environments. Species, sex, age, weight and measured FAL (forearm length) were recorded for each captured bat. Identification of species and age class (adult or young) was based on the Bat Study and Conservation Group of Japan (2011), and FAL was measured with a digital caliper (Digital

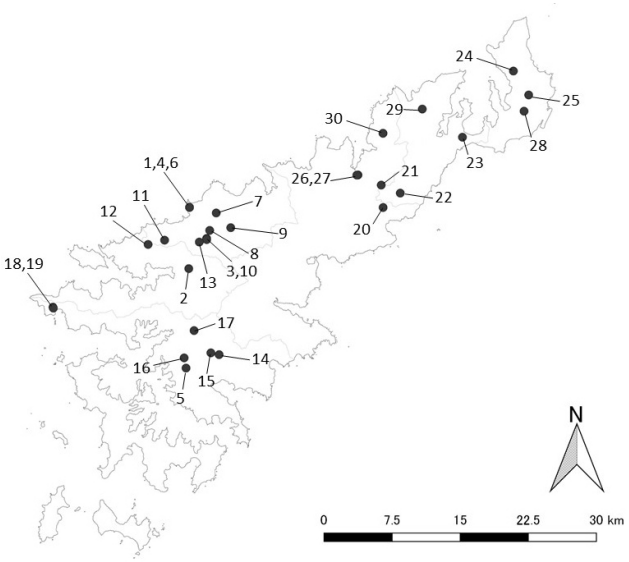

Fig. 1. Sampling locations in Amami–Oshima Island. Black dots and numbers indicate sampling locations.
図 1. 奄美大島における調査地点
黒丸とそれぞれの番号は調査地点を示す.

Table 1. Sampling locations and captured species. Site numbers correspond to those in Fig. 1.
*1, The echolocation calls of 20-30kHz were recognized at multiple times; *2, The echolocation calls of *Rhinolophus cornutus* were recognized.
表 1　調査地点と捕獲されたコウモリ種．地点番号は図 1 に示す番号と同一 .
*1, 20 － 30kHz のエコーロケーションコールが複数回確認された ; *2, コキクガシラコウモリのエコーロケーションコールが確認された .

Site No. 地点 No.	Capture day 捕獲日	Municipality name 市町村名	Captured environment 捕獲環境	Elevation 標高	Methods 方法	Captured species 捕獲種
No.1*[1]	2016/7/11	Yamato Village 大和村	Sea coast 海岸	0m	Mist net かすみ網	nothing なし
No.2	2016/1/30	Uken Village 宇検村	Air raid shelter 防空壕	354m	Butterfly net 捕虫網	*Rhinolophus cornutus* コキクガシラコウモリ
No.3	2016/1/29	Yamato Village 大和村	Forest / River 森林 / 川	229m	Mist net かすみ網	nothing なし
No.4	2016/1/30	Yamato Village 大和村	Cave 洞穴	0m	Mist net かすみ網	nothing なし
	2016/1/31				Butterfly net 捕虫網	*Miniopterus fuscus* リュウキュウユビナガコウモリ
No.5	2016/1/30	Setouchi Town 瀬戸内町	Air raid shelter 防空壕	348m	Butterfly net 捕虫網	*Rhinolophus cornutus*, *Myotis macrodactylus*, *Miniopterus fuscus* コキクガシラコウモリ，モモジロコウモリ，リュウキュウユビナガコウモリ
No.6	2016/1/31	Yamato Village 大和村	Forest 森林	5m	Mist net かすみ網	nothing なし
No.7	2016/7/8	Yamato Village 大和村	Forest 森林	427m	Mist net かすみ網	nothing なし
No.8	2016/7/8	Yamato Village 大和村	Forest 森林	287m	Harp trap ハープトラップ	*Myotis macrodactylus*, *Myotis yanbarensis*, *Murina ryukyuana* モモジロコウモリ，ヤンバルホオヒゲコウモリ，リュウキュウテングコウモリ
No.9	2016/7/9	Yamato Village 大和村	Forest 森林	273m	Harp trap ハープトラップ	*Myotis yanbarensis*, *Murina ryukyuana* ヤンバルホオヒゲコウモリ，リュウキュウテングコウモリ
No.10	2016/7/9	Yamato Village 大和村	Forest / River 森林 / 川	858m	Mist net かすみ網	nothing なし
	2016/7/11				Harp trap ハープトラップ	*Myotis macrodactylus* モモジロコウモリ
No.11	2016/7/10	Yamato Village 大和村	Forest 森林	415m	Harp trap ハープトラップ	nothing なし
No.12*[2]	2016/7/10	Uken Village 宇検村	Forest / River 森林 / 川	182m	Mist net かすみ網	nothing なし
No.13	2016/7/11	Yamato Village 大和村	Forest 森林	405m	Mist net かすみ網	*Myotis yanbarensis* ヤンバルホオヒゲコウモリ
No.14	2016/11/16	Setouchi Town 瀬戸内町	Forest 森林	280m	Harp trap ハープトラップ	*Murina ryukyuana* リュウキュウテングコウモリ
No.15	2016/11/16	Setouchi Town 瀬戸内町	Forest 森林	292m	Mist net かすみ網	nothing なし
No.16	2016/11/17	Setouchi Town 瀬戸内町	Forest 森林	331m	Harp trap ハープトラップ	*Murina ryukyuana* リュウキュウテングコウモリ
No.17	2016/11/17	Setouchi Town 瀬戸内町	River 川	101m	Mist net かすみ網	*Myotis macrodactylus* モモジロコウモリ
No.18	2016/11/18	Setouchi Town 瀬戸内町	Forest 森林	1m	Mist net かすみ網	*Miniopterus fuscus* リュウキュウユビナガコウモリ
No.19	2016/11/18	Setouchi Town 瀬戸内町	Forest 森林	1m	Harp trap ハープトラップ	nothing なし

Table 1 (Continued). 表 1 (続き).

Site No. 地点 No.	Capture day 捕獲日	Municipality name 市町村名	Captured environment 捕獲環境	Elevation 標高	Methods 方法	Captured species 捕獲種
No.20	2017/6/16	Amami City 奄美市	Forest 森林	273m	Mist net かすみ網	nothing なし
No.21	2017/6/16	Amami City 奄美市	Forest 森林	314m	Harp trap ハープトラップ	nothing なし
No.22	2017/6/17		Forest / River 森林 / 川	65m	Harp trap ハープトラップ	nothing なし
	2017/6/18				Harp trap ハープトラップ	nothing なし
No.23	2017/6/18		Forest 森林	36m	Mist net かすみ網	nothing なし
No.24	2017/6/19		Forest 森林	48m	Mist net かすみ網	nothing なし
	2017/12/12				Harp trap ハープトラップ	nothing なし
No.25	2017/6/19		Forest 森林	38m	Harp trap ハープトラップ	nothing なし
No.26	2017/7/13	Amami City 奄美市	Canal 水路	8m	Butterfly net 捕虫網	
	2017/7/13				Harp trap ハープトラップ	nothing なし
No.27	2017/10/17	Amami City 奄美市	Building 建造物	8m	Harp trap ハープトラップ	
	2018/7/9				Harp trap ハープトラップ	
	2018/7/10				Harp trap ハープトラップ	
No.28	2017/12/13	Amami City 奄美市	Forest 森林		Harp trap ハープトラップ	nothing なし
No.29	2017/12/13	Amami City 奄美市	Forest 森林		Mist net かすみ網	nothing なし
No.30	2017/12/14	Amami City 奄美市	Forest 森林		Harp trap ハープトラップ	nothing なし

Vernier Caliper 19979, Shinwa Rules Co. Ltd., Niigata, Japan). All captured bats were released after identification and measurement.

Vegetation of the study sites was mainly broadleaf trees, such as the Japanese chinquapin (*Castanopsis sieboldii*) and Shima-uri-kaede (*Acer insulare*), and conifer trees like the Ryukyu Island pine (*Pinus luchuensis*). There were only small shrubs in the cave by the sea.

Our survey was permitted by both the Ministry of the Environment (license No. 11 76–78 and No. 11 29–31 in 2016, No. 11 39–41 in 2017, No. 11 1–2 in 2018) and Kagoshima Prefecture (license No. 167–169 and No. 59–61 in 2016, No. 108–110 in 2017, No. 116–117 in 2018).

Records

We captured 43 individuals of bats belonging to six species (*Rhinolophus cornutus*, *Myotis macrodactylus*, *Myotis yanbarensis*, *Miniopterus fuscus*, *Murina ryukyuana*, and an unknown species) in Amami–Oshima Island (See Table 2 for measurements of each adult species). Asari & Kimoto (2018) have already reported on the unknown species captured in this report in detail.

1. *Rhinolophus cornutus*

We captured 15 individuals (seven adult males and eight adult females) from the air raid shelter and a canal. Colonies were found at two air raid shelters (No. 2, No. 5) in the winter. The colony size at No. 2 was approximately 80 individuals, of which six males and three females were captured. The colony size at No. 5 was approximately 200 individuals; five females were captured from this colony. The echolocation calls of this species (100–110 kHz)

were also recognized at No. 12 in mixed forests with conifer and broadleaf trees in July 2017.

2. *Myotis macrodactylus*
We captured six individuals (four adult females and two juvenile females) from the air raid shelter, forest, and riverside locations. Some individuals were resting in a colony of *Rhinolophus cornutus* at an air raid shelter (No. 5) in the winter. One female was captured for measurements from this shelter. At broadleaf forest and riverside sites (No. 8 and No. 10), we caught two post-lactating females and two juvenile females in summer 2016. Furthermore, one adult female was captured at the riverside site (No. 17) in November 2016.

The weights of adults (6.64 g, 6.91 g, 7.02 g and 7.23 g) were similar to those of juveniles (6.48 g, 7.60 g). This is the first distributional and breeding record of *Myotis macrodactylus* on Amami–Oshima Island.

3. *Myotis yanbarensis*
We caught four adults (one adult male and three adult females) at forest and riverside sites (No. 8, No. 9 and No. 13) in summer 2016. All females were post-lactation.

No data have been reported about the reproduction of this species on Amami–Oshima Island. Our finding of the presence of post-lactating females in broadleaf forests indicate that this species is breeding on Amami–Oshima Island.

4. *Miniopterus fuscus*
We captured six individuals (two adult males and four adult females) from cave, air raid shelter and forest. In the winter, we found some individuals resting in a colony dominated by *Rhinolophus cornutus* in an air raid shelter (No. 5). One male each was also captured at the cave by the sea in the winter and in the forest in autumn, respectively.

5. *Murina ryukyuana*
We captured five individuals (four adult males and one adult female) from forest sites. One post-lactating female and one male were captured in the summer (No. 8 and No. 9). Three males were also captured in forests (No. 14 and No. 16) in the autumn. One bat was observed inside a rolled dead leaf but escaped before we could capture it and check its age and sex (No. 7).

Conclusions

Previous studies have reported six bat species from Amami–Oshima Island (Yoshiyuki et al. 1989; Sawada 1994; Maeda 1996; Funakoshi 2010). The present study recorded four already reported species (*Rhinolophus cornutus*, *Myotis yanbarensis*, *Miniopterus fuscus*, *Murina ryukyuana*), one newly recorded species (*Myotis macrodactylus*), and one unknown species. Consequently at least eight species of bat inhabit Amami–Oshima Island.

Only three specimens of *Tadarida latouchei* have been collected from Amami–Oshima, Kuchinoerabu and Yoron Islands (Yoshiyuki et al. 1989; Funakoshi & Kunisaki 2000; Yoshiyuki & Morita 2003). Although we could not capture *T. latouchei* or acquire any information on its distribution area, resting and reproductive sites, or foraging behavior, we recognized the echolocation call of 20–30 kHz. Funakoshi (2010) reported that *Vespertilio sinensis*, *Nyctalus aviator*, *Tadarida insignis* and *Tadarida* sp. emitted echolocation calls of 13.5–26.5 kHz (Peak Frequency: PF) in the Kyushu District. Of these four species, Funakoshi (2010) collected echolocation

Table 2. Captured bats and their measurements.
表 2. 捕獲されたコウモリ種と計測値 .

Species 種名	Sex 性別	Weight 体重 (g)		FAL 前腕長 (mm)		N 個体数
		Mean ± SD 平均 ± 標準偏差	Range 範囲	Mean ± SD 平均 ± 標準偏差	Range 範囲	
Rhinolophus cornutus	M	4.88±0.61	4.35–6.20	37.57±0.71	36.00–38.30	7
コキクガシラコウモリ	F	4.67±0.26	4.39–5.13	37.46±0.58	36.70–38.50	8
Myotis macrodactylus	F	6.95±0.21	6.64–7.23	38.05±0.56	37.10–38.50	4
モモジロコウモリ						
Myotis yanbarensis	M	5.09		36.70		1
ヤンバルホオヒゲコウモリ	F	5.12±0.50	4.56–5.77	36.37±0.52	35.90–37.10	3
Miniopterus fuscus	M	9.18±2.32	7.53–10.82	43.15±0.49	42.80–43.50	2
リュウキュウユビナガコウモリ	F	7.55±0.92	5.96–8.20	42.78±0.38	42.30–43.20	4
Murina ryukyuana	M	6.57±0.24	6.15–6.75	33.78±0.26	33.50–34.20	4
リュウキュウテングコウモリ	F	8.74		35.90		1

calls of 16.1–17.8 kHz (PF) from the site where *T. latouchei* was collected by Yoshiyuki et al. (1989) in Amami–Oshima. Therefore Funakoshi (2010) presumed that the echolocation call was *Tadarida latouchei*. We also assumed that the echolocation calls of 20–30 kHz (not PF) were of *T. latouchei*, as *Vespertilio sinensis*, *Nyctalus aviator* and *Tadarida insignis* have not been recorded from Amami–Oshima or surrounding islands.

No *Pipistrellus abramus* was found in our survey. This species generally adapts to urban environments where human can easily find the bats (Fukui et al. 2003; Tosuji & Shibata 2003). Despite a trial detection of echolocation calls by using a bat detector in urban environments, no echolocation was detected (unpublished data). The number of *Pipistrellus abramus* on Amami–Oshima Island might be extremely low, or their habitat might be locally restricted.

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奄美大島における捕獲と音声調査によって発見されたコウモリ種

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要旨 . コウモリの保全に寄与する基礎資料を得るため , 奄美大島に生息するコウモリ相の調査を行なった . 奄美大島の 30 地点で 2016 年 1 月～ 2018 年 7 月に捕獲調査を行ない , 6 種 (コキクガシラコウモリ *Rhinolophus cornutus*, モモジロコウモリ *Myotis macrodactylus*, ヤンバルホオヒゲコウモリ *Myotis yanbarensis*, リュウキュウユビナガコウモリ *Miniopterus fuscus*, リュウキュウテングコウモリ *Murina ryukyuana*, 不明コウモリ種) を確認した . 一方 , 確認情報の少ない

アブラコウモリ *Pipistrellus abramus* とスミイロオヒキコウモリ *Tadarida latouchei* は発見されなかった . 本研究の結果と過去の報告から , 奄美大島には少なくとも 8 種が生息することが分かった .

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