

The First Survey of Bats in the Tsukuba Botanical Garden, Ibaraki Prefecture, Japan

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Abstract We conducted the first field survey of bats in the Tsukuba Botanical Garden (Ibaraki Prefecture, Japan) and collected individuals of two species, *Miniopterus fuliginosus* (two males) and *Pipistrellus abramus* (two females). This is the second record of *M. fuliginosus* in Ibaraki Prefecture. The two species were found in different sections of the botanical garden: *M. fuliginosus* were captured in the Cool Temperate Deciduous Broad Leaved Forest section, and *P. abramus* in the Fern Garden. The results of this survey suggest that the wide variety of patchy vegetation in the Tsukuba Botanical Garden provides rich food resources for several bat species.

Key words: new record, *Miniopterus fuliginosus*, *Pipistrellus abramus*.

Introduction

Ibaraki Prefecture is home to eight species of bats in six genera, and three families (Nagaoka, 1998; Koyanagi *et al.*, 2003; Shibata and Yasui, 2006; Yamazaki *et al.*, 2008; Yasuda *et al.*, 2010; Takeuchi *et al.*, 2015). The eastern bent-winged bat, *Miniopterus fuliginosus* Hodgson, 1835, is distributed in Afghanistan, India, China, the Korean Peninsula, and Japan including Honshu, Shikoku, Kyushu, Sado Island, Oki Island, Fukue Island, Tsushima Island, and Yakushima Island (Sano, 2015). Before the current study, *M. fuliginosus* had been captured only once in Ibaraki Prefecture, in Taga town, Hitachi city, in the northwestern part of the prefecture (Yasui and Yamazaki, 2013). The Japanese pipistrelle bat, *Pipistrellus abramus* Temminck, 1840, is distributed in the Ussuri area of Russia, China, Taiwan, Korea, Vietnam, Myanmar (Burma), India and Japan. In Japan, *P. abramus* occurs in urban and suburban areas in all prefectures including smaller islands (Kawai, 2015). This species is

considered common in Tsukuba city (e.g., Takeuchi *et al.*, 2015).

Here, we report *M. fuliginosus* and *P. abramus* captured in the first field survey of bats in Tsukuba Botanical Garden, National Museum of Nature and Science, conducted during May 16–18, 2019.

Materials and Methods

The Tsukuba Botanical Garden is located in central Tsukuba city, in the southwestern part of Ibaraki Prefecture. The garden is surrounded by many buildings belonging to universities and other institutions. We conducted a survey in the Botanical Garden on May 16–18, 2019 (two nights), setting two harp traps from 18:30 to 05:00 each night (Fig. 1). The first day we set harp traps at site I (the Cool Temperate Deciduous Broad Leaved Forest section; 13) and site II (the Endangered Plants section; 21). The second day we set harp traps at site III (between the Montane Riverside Sandy and Gravelly section and the Montane Scrub section; 3–5) and site IV (the Fern Garden; 22). We set traps only on trails

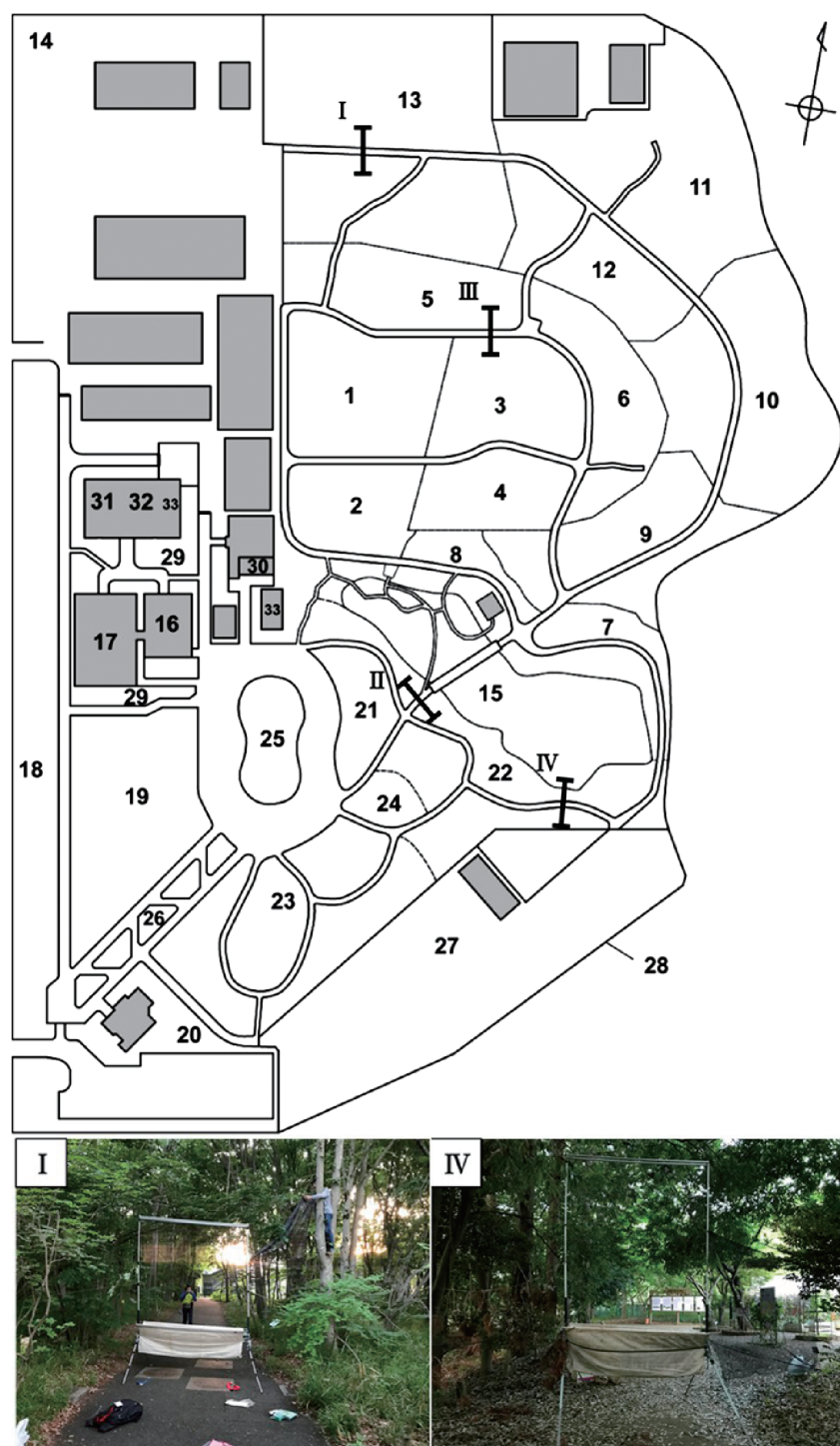


Fig. 1. Map of the Tsukuba Botanical Garden (upper) and pictures of harp trap (lower). Trapping sites (I–IV) are shown on the map.

in which plants growing along both sides and forming a tunnel overhead. This field survey was conducted with capture permission from Nature and Environment Division, Ibaraki Prefectural Government (Permission No. 3 and 4) and Wildlife Division, Kanto Regional Environment Office, Organization of the Ministry of the Environment (Permission No. 19041614).

For each specimen obtained in the survey, we photographed whole bodies and faces (EOS Kiss X8i, Canon, Lens: EF 100 mm F2.8 Macro USM, Canon), and recorded echolocation calls in a cloth bag using a bat detector (D240x Ultrasound Detector: Petterson, Uppsala, Sweden; recorder: Linear PCM Recorder DR-05, TASCAM, Santa Fe Springs, CA, USA). Then we euthanized the bats, weighted them on a digital scale (Digital Pocket Scale, Q-Beau), and measured them with a digital caliper (CD-15AX; Mitutoyo, Kawasaki, Japan). The following measurements were recorded: BW, body weight (g); TL, total length (mm); HB, head and body length (mm); T, tail length (mm); Tibia, tibia length (mm); HFsu, hind foot length without unguis (mm); HFcu, hind foot length with unguis (mm); E, ear length (mm); and Tragus, tragus length (mm). Liver tissues and feces (except NSMT-M63007) were preserved in 99% ethanol, and ectoparasites recovered from the bats were preserved in 10% formalin. We removed and cleaned the skull of each specimen. The bodies were immersed in 10% formalin for 1 week and then transferred to 70% ethanol. Specimens were deposited in the National Museum of Nature and Science, Ibaraki Prefecture, Japan, as skulls and preserved bodies.

Results and Discussion

We captured four individuals of two species (Table 1). On the first day, two male *M. fuliginosus* were trapped in section 13 (site I, Fig. 1) in the early morning. On the second day, two female *P. abramus* were trapped at the entrance to the Clematis Garden (site IV, Fig. 1) immediately after sunset and in the early morning. Each individual was identified from external measure-

Table 1. List of specimens and measurements in this study.

No.	oriNo.	Species name	Sex	Date	Locality	Measurements									
						BW	TL	HB	T	FAL	Tibia	HF1	HF2	E	Tragus
NSMT-M63004	IY063	<i>Miniopterus fuliginosus</i>	♂	17 May 2019	Section 13, Tsukuba Botanical Garden	11.90	115.02	58.13	56.89	45.84	19.57	8.15	9.23	10.44	5.21
NSMT-M63005	IY064	<i>Miniopterus fuliginosus</i>	♂	17 May 2019	Section 13, Tsukuba Botanical Garden	12.73	114.59	58.26	56.33	47.14	20.03	9.73	10.58	9.00	5.09
NSMT-M63006	IY065	<i>Pipistrellus abramus</i>	♀	17 May 2019	The entrance of Clematis Garden, Tsukuba Botanical Garden	6.42	84.73	46.92	37.81	33.35	13.46	4.70	5.58	10.81	5.22
NSMT-M63007	IY066	<i>Pipistrellus abramus</i>	♀	18 May 2019	The entrance of Clematis Garden, Tsukuba Botanical Garden	7.49	93.03	49.89	43.14	35.52	14.36	5.37	6.36	12.01	5.19

*BW, body weight (g); TL, total length (mm); HB, head and body length (mm); T, tail length (mm); Tibia, tibia length (mm); HF1, hind foot length without toenail (mm); HF2, hind foot length with toenail (mm); E, ear length (mm); and Tragus, tragus length (mm).



Fig. 2. Photographs of the captured bats. a: The lateral view of the head of *M. fuliginosus*. b: The ventral view of the left wing of *M. fuliginosus*. c: *P. abramus*.

ments and morphology: *M. fuliginosus* were identified by their forearm length (≥ 46 mm), slender wings, second phalanx length of the third finger (about 3 times longer than the first phalanx length, see Fig. 2b), short and rounded auricle, and tragus shape (bent forward with rounded tip, Fig. 2a); *P. abramus* were identified by their forearm length (30–36 mm), greyish hairs across the back, thin ears, rounded tragus scarcely half as high as the ear, narrow bright brown wings, and tail tips do not protrude from the uropatagium (Fig. 2c). We could not record any echolocation calls because bats did not call.

In the Tsukuba Botanical Garden, we visually

and acoustically recognized many flying insectivorous bats immediately after sunset with around 45-kHz echolocation call frequencies. Bats were frequently found over open areas such as the Montane Grassland sections (sections 1 and 2, Fig. 1), the Sandy and Gravelly sections (sections 3 and 4, Fig. 1), and ponds (section 15, Fig. 1). These sightings indicate that there are abundant food resources for bats in the Tsukuba Botanical Garden.

In Ibaraki Prefecture, the only prior record of *M. fuliginosus* is that of Yasui and Yamazaki (2013) in Hitachi city; this, therefore, is the second report of this species in Ibaraki. In the previ-

ous report, *M. fuliginosus* was found in a hand-dug tunnel (an artificial cave whose walls were not covered with concrete) along a seaside river. It should be noted that this species was captured in urban area such as the central Tsukuba city because they normally use natural caves, abandoned mines, bomb shelters, unused tunnels, and underground culverts as their colonies and roosts (Sano, 2015). However, *M. fuliginosus* can fly relatively longer distances than other bats, so it can be difficult to determine their roosting sites. Further research is required to reveal the habitat status and to estimate the population size of *M. fuliginosus* in Ibaraki Prefecture, where the species has previously been little known.

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