

## 科学研究費助成事業 研究成果報告書

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研究課題名(和文)音響ルアーをもちいた森林性コウモリの社会生態の分析

研究課題名(英文) Investigation of the social system and population dynamics of *Murina ussuriensis* using acoustic lure

研究代表者

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研究成果の概要(和文)：コウモリは観察が困難であるため、その社会性はよくわかっていない。そこで屋久島と北海道においてコテングコウモリの社会システムを調査した。DNA分析の結果、血縁メスが群れを形成すること、およびオスはメスに比べてより分散するが、出生地域のそばにとどまる事、がわかった。彼らの音声进行分析した結果、メスがねぐらを離れる際、および新しいねぐらを見つけた際に最も頻繁に社会的コールを発することが分かった。プレイバックすると、その発声頻度は増加し、他個体の音声に対して積極的に応答することがわかった。コテングコウモリはほぼ毎日ねぐらを変えており、音声コミュニケーションが群れのコヒーレンスを支えていると考えられる。

研究成果の概要(英文)：Bats show are highly social animals, but little is known about most species because of their elusive nature. We investigated the social system of the Ussuri tube-nosed bat (*Murina ussuriensis*) in Yakushima and Hokkaido. Using DNA analysis to study the fine-grained population genetics we showed that social groups consist of kin-related females. Males showed more evidence of dispersal, but most seemed to stay quite close to their natal areas. Aspects of vocal communication were also investigated. Social calls were produced most frequently around the times that females left their roosts, and when they found new roosts before dawn. In playback experiments call rate was enhanced, showing that bats respond actively to the calls of others. Bats of this species switch to a new roost almost every day and vocal communication is probably used to coordinate roost-finding. Comparative data was collected on vocal communication of forest bats in Australia that seem to have similar a social system.

研究分野：Social Ecology

 キーワード：Social system Forest bat Fission-fusion society Vocal communication Sex-biased dispersal  
 Playback experiment *Murina ussuriensis* Roosting behaviour

## 1. 研究開始当初の背景

With over 1,300 species, bats are the second largest order of mammals and they are found on every continent except Antarctica, and on many oceanic islands. Across this wide geographic distribution bats exhibit a high degree of ecological and behavioural diversity. Most bat species live in social groups, but the variety of social systems they exhibit is comparable to that of primates, ranging from apparently monogamous pairings to complex multi-level societies. For the vast majority of bat species, however, little or nothing is known about their social behavior. This is in part because their highly elusive nature makes bats difficult to study. All bats are nocturnally active and most species spend the daylight hours roosting in inaccessible places. This means that, unlike most primates for example, it is generally not possible to study social behavior of bats by direct observation, and special techniques must be used such as radio-tracking, thermal imaging and night vision equipment. There is growing evidence that vocal communication is a very important element of bat social behavior, but with the exception of the Pteropodidae (Old World fruit bats), most bat vocalisations are in the ultrasonic range, and so can only be studied using specialist equipment. So, while bats present great opportunities for studies of social systems and social complexity, they also present significant challenges.

This project concerned the Ussuri tube-nosed bat, *Murina ussuriensis*, which is found in many forested areas of Japan,

parts of Korea and far eastern Russia. Although widespread little was known about this species because it was difficult to catch or otherwise study. We found that, in addition to echolocation, *M. ussuriensis* frequently produces ultrasonic vocalisations for communication. By mimicking these “social calls” using a custom built acoustic lure (the Autobat) we were able to catch it quite easily, which made this project possible.

## 2. 研究の目的

The main purpose of this study was to elucidate aspects of the social system of the *M. ussuriensis*, including sex differences in dispersal and philopatry. Data were collected from populations in Yakushima, Ashiu (Kyoto) and in Hokkaido to assess whether the social system is consistent across these different habitats. As a secondary aim, faecal samples were also collected to allow an assessment of regional difference in diet. An experiment was also conducted to provide basic information on the nature and likely function of social calls. In addition preliminary comparative data were collected on vocal communication and responsiveness to the lure of other species of *Murina* in Malaysia, and of bats of the genus *Nyctophilus* in Australia.

Our previous work had shown that *M. ussuriensis* uses a variety of roost types, but that most roosts are in hanging bunches of dead leaves. The bats switch to a new roost almost every day and when female bats formed a maternity colony they roosted in subgroups whose composition changed each

day, thus resembling a fission-fusion system. As roosts did not appear to be a defensible resource, and as group composition appeared to be quite fluid, we aimed to establish whether females in group were kin-related or not.

### 3 . 研究の方法

#### DNA analyses

Bats were caught using the Autobat acoustic lures and harp traps. A biopsy wing punch sample was obtained from each bat for DNA analysis. Prior to release, the bats were kept in a cotton holding bag for 30 minutes to try to obtain faecal samples. Each individual was fitted with an aluminium ring on the forearm which had a unique identifying number.

DNA was extracted from the skin samples and microsatellite and mitochondrial DNA analyses were used to establish the distribution of female haplotypes and relative dispersal of males and females.

Faecal samples were sent to a collaborating lab in Copenhagen for analysis of insect DNA to indicate dietary composition

#### Vocal communication

A pair of ultrasound recorders was set in the forest overnight at a different site on each of 16 nights in the summer maternity season, and for 16 nights in the autumn post-maternity. One recorder was paired with an Autobat linked to a timer that played bouts of synthesized social calls at hourly intervals through the night. The second recorder was set without

an Autobat to record levels of calling in the absence of calling.

### 4 . 研究成果

#### DNA data

Analysis of mitochondrial DNA revealed 6 haplotypes in the Yakushima population and 11 from Hokkaido. (Unfortunately, the samples from Ashiu there were too few to allow meaningful analysis.) In Yakushima for the females the haplotypes were spatially clumped, suggesting limited dispersal by females from their natal range. Samples for males showed more evidence of dispersal, but over short distance. Analysis of kinship indicated that females that were likely sibs or half-sibs were much more likely to be caught at the same site than at different sites. Males did not show such a pattern, so the results are consistent with the common mammalian model of female philopatry and male dispersal.

Analysis of faecal samples indicated that the bats ate a great range of insects and also some spider species. There was little overlap in dietary composition between Yakushima, Ashiu and Hokkaido, highlighting the ecological flexibility of this species.

#### Vocal communication

Social calls of *M. ussuriensis* were frequently recorded in the summer and less frequently in the autumn. In summer, two peaks in calling rate coincided with the times when the females would be leaving their roosts after dusk and finding new roost before dawn, with a third smaller peak half way through the night. In autumn

the only clear peak was just after dusk. To In both seasons playing the synthesised calls led to an increase in calls from the bats.

The results suggest that calling is related emergence from the roost and coordinating roosting activity. The calls varied in acoustic parameters and there appeared to be different types of call. We are currently exploring methods for categorising the calls, after which we will examine whether there were differences in the quality of calls given passively compared with those elicited by the Autobot.

#### 5. 主な発表論文等

(研究代表者、研究分担者及び連携研究者には下線)

〔雑誌論文〕(計 5 件)

Flanders, J.; Inoue-Murayama, M.; Rossiter, S.J. & Hill, D.A. 2016. Female philopatry and limited male-biased dispersal in the Ussuri tube-nosed bat, *Murina ussuriensis*. **Journal of Mammalogy**, **97**(2): 545-553. doi: 10.1093/jmammal/gyv200

Fukui, D.; Hill, D.A.; Kim, S-S. & Han, S-H., 2015. Echolocation call structure of fourteen bat species in Korea. **Animal Systematics, Evolution and Diversity** 31 (3), 160-175.

Ryu, H.; Hill, D.A. & Furuichi, T., 2015. Prolonged maximal sexual swelling in wild bonobos facilitates affiliative interactions between females. **Behaviour** 152(3-4): 285-311. doi 10.1163/1568539X-00003212

Hill, D.A., Armstrong, K.N. & Barden,

P.A., 2015. Preliminary assessment suggests that acoustic lures can increase capture rates of Australian echolocating bats. **Australian Mammalogy**, 37(1): 104-106. doi 10.1071/AM14019

Hill, D.A.; Fukui, D.; Agetsuma, N. & Macintosh, A.J.J., 2014. Influence of trap environment on the effectiveness of an acoustic lure for capturing vespertilionid bats in two temperate forest zones in Japan. **Mammal Study**, 39(4): 229-236.

〔学会発表〕(計 0 件)

〔図書〕(計 0 件)

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