

Conservation ecology of Okinawa's endangered plant-roosting bats, *Murina ryukyuana* and *Myotis yanbarensis*

(沖縄における植物をねぐらとするリュウキュウテングコウモリと
ヤンバルホオヒゲコウモリの保全生態学)

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Summery

The Ryukyu tube-nosed bat *Murina ryukyuana* and Yanbaru whiskered bat *Myotis yanbarensis* are both endangered and endemic to three islands in the Central Ryukyus, Japan. The aim of this thesis is to provide fundamental information for the conservation strategies for these bats. The contributions of this dissertation can be summarized in the following four points. First, a systematic literature review reveals the current status of research on bats in Japan and points out the need for more research on these two bat species in particular. Secondly, the effectiveness of acoustic lures was demonstrated as a new method for capturing these rare species for research. Third, the behavioral ecology of plant-using roosts was clarified for these two species. Fourth, a habitat distribution model for small bats was proposed based on comprehensive acoustic record data in the target area (Kunigami Village), and the relationship between the distribution status of four bat species including the above two species and environmental factors was clarified. The contents of the chapters are summarized as follows.

Chapter 1 is a general introduction and discusses the importance of bat conservation globally, the state of conservation in the Ryukyu Islands, and available background information concerning *M. ryukyuana* and *M. yanbarensis*.

Chapter 2 is a systematic review of bat research and conservation in Japan to compare research effort thus far to conservation priorities (i.e. threatened IUCN categories). This review revealed that endemic species are disproportionately threatened and that these threatened species have received the least research effort. There is a noticeable shortage of basic ecological information concerning over half of Japanese bat species. Also prioritized species were identified in need of future research based on

endemism, IUCN category, and existing research. *M. yanbarensis* and *M. ryukyuana* were identified as the second and third-highest research priorities, respectively, reinforcing the need for further research.

Chapter 3 investigates the efficacy of an acoustic lure in increasing *M. ryukyuana* and *M. yanbarensis* capture rates to determine if further ecological study would be feasible. The lure trial demonstrated a ten-fold increase in the catch rate for *M. ryukyuana*, with lure stimuli based on the social calls of *Murina* species being twice as effective as those based on calls of non-*Murina* species. In subsequent capture surveys, *M. ryukyuana* particularly males was consistently caught more with lures than without. The effect of acoustic luring on *M. yanbarensis* capture rates was unclear.

Chapter 4 discusses the implications of *M. ryukyuana* and *M. yanbarensis* roosting behaviors for bat-friendly forestry. Radiotracking revealed that *M. ryukyuana* used a variety of plant roosts in stands of various ages. Solitary individuals roosted mostly in understory foliage, while maternity colonies used both foliage and tree cavities. On the other hand, both nonmaternity and maternity *M. yanbarensis* roosts were almost entirely in tree cavities along streams in old-growth stands (>70 years old). Both species appear to be predominantly solitary but form small maternity colonies of mothers and pups between April and August.

Chapter 5 uses occupancy modeling based on data from automated recorders to examine the distribution and habitat preferences of Kunigami Village's endangered microbat fauna, including *M. ryukyuana* and *M. yanbarensis*. Acoustic records showed that the cave-roosting species, the Okinawa little horseshoe bat *Rhinolophus pumilus* and Southeast Asian long-fingered bat *Miniopterus fuscus*, were widespread in the study area. *M. ryukyuana* was relatively widespread within forests, but *M. yanbarensis* occupancy was concerningly low, limited to forested sites near old growth stands and streams.

Chapter 6 is a general discussion that summarizes the findings of the previous chapters and discusses their implications for the conservation of *M. ryukyuana* and *M. yanbarensis*. Specifically, the preservation of old growth stands, and riparian

corridors were recommended because these appeared to be critical habitats for *M. yanbarensis*. The needs of long-term acoustic monitoring were suggested. The ecology of Okinawa's plant-roosting bats highlights the importance of sustainable ecosystem management and the precautionary principle in biodiversity conservation. So long as stakeholder interest can be maintained, the recommendations made here should be relatively easy to incorporate into existing local forest management practices.