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Home range and pair duration of the Bonin Islands Honeyeater *Apalopteron familiare*

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Introduction

The Bonin Islands Honeyeater *Apalopteron familiare* is a bird species endemic to the Bonin Islands, which are about 1,000 km south of Tokyo. This is the sole endemic survivor of the Bonin Islands' avifauna. It seems to have enjoyed a wide distribution on many of the Bonin Islands, such as Mukojima, Hahajima and Chichijima islands. However, at present this species inhabits only Hahajima and its satellites in the southern Bonin Islands (OSJ 1974, Brazil 1991). Though it is not a rare species on Hahajima, the prospect for its survival does not look good, considering the highly limited distribution.

Some aspects of the ecology and behavior of this species have been studied by several authors. For example, Morioka and Sakane (1978) described the foraging behavior and nesting habits, Higuchi et al. (1984) reported the singing activity and social behaviors such as allopreening and contact roosting, and Suzuki (1993) gave a more detailed description of singing activity. We studied some unknown aspects of their ecology and behavior, based on color-banded individuals. In this paper, we report the site fidelity, pair duration, territorial behavior, clutch size, and nesting habits.

Study area and methods

We studied honeyeaters in the forest of Ontake Shrine on Hahajima from March 1983 to December 1984. Research was conducted for 5–7 days on each of nine visits to the island.

The shrine stands on a 70 m hill south of Oki Port. The forest is occupied by indigenous tree species such as *Calophyllum inophyllum*, *Ochrosia nakaiana*, *Ardisia sieboldii* and *Rhaphiolepis wrightiana*; and introduced ones such as *Leucaena leucocephala*, *Ficus microcarpa* and *Casuarina equisetifolia* (Fig. 1). The study area was approximately 4 ha of forest, and was surrounded by arable land.

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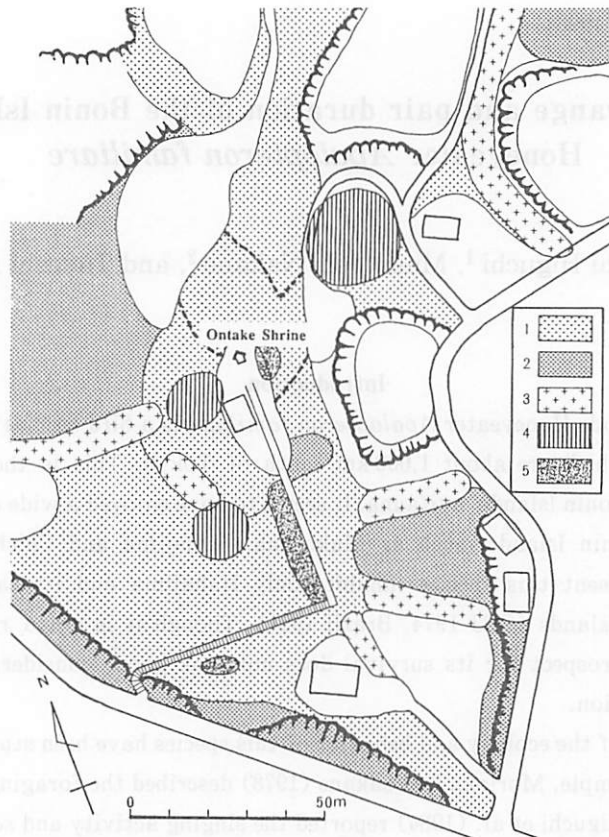


Fig. 1. Vegetation map in and around the study area of Ontake Shrine on Haha-jima Island. 1. *Calophyllum inophyllum-Rhaphiolepis wrightiana*, 2. *Leucaena leucocephala*, 3. *C. inophyllum*, 4. *Ficus microcarpa*, 5. *Casuarina equisetifolia*. White parts represent farm, grass or bare area.

Captured with mist nets, the birds were marked with unique color combinations of leg-bands. A total of 59 honeyeaters were color-banded at the study area. After measuring and releasing them, we observed their movements and interactions during the subsequent study periods.

The home range boundaries were drawn based on 20–38 observation hours on each visit to the island. Sex was determined by singing and territorial behavior. Only one member of each pair sang songs and engaged in physical fighting along territory boundaries, and it was treated as the male. However, there were some pairs in which we could not determine the sex because we lacked data on such behaviors.

Results and Discussion

1. Site fidelity and pair duration

a. Movements

Thirty (50.8%) of the 59 color-banded honeyeaters were not observed again after

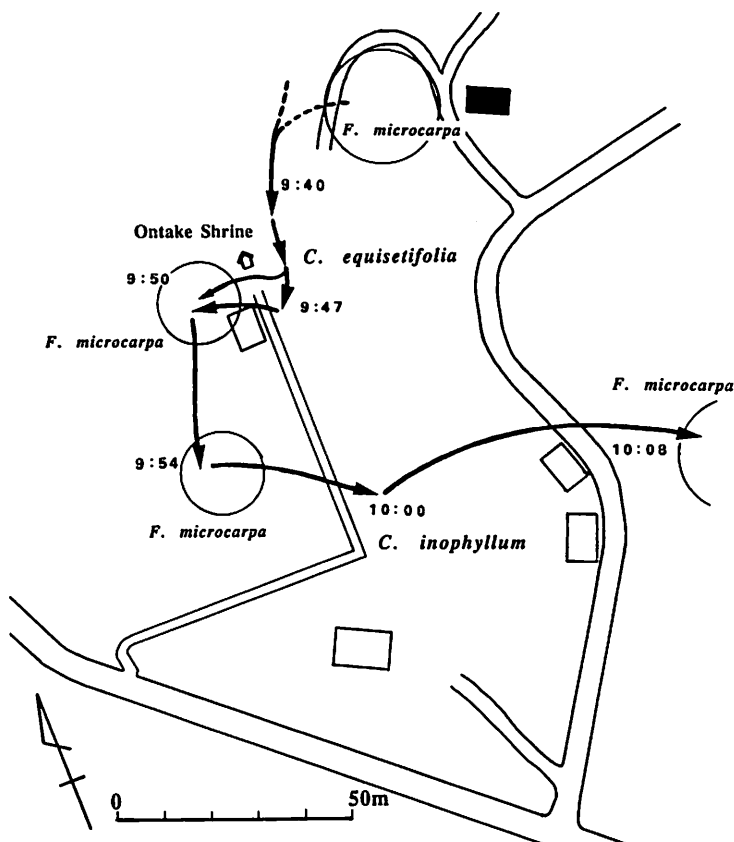


Fig. 2. Movements of a flock of 15 unestablished honeyeaters observed in the study area on December 23, 1984.

release. Sixteen of those 30 birds were banded in July 1983. These birds are considered to have been unestablished juveniles which fledged during the spring and summer. A flock of 15 honeyeaters which seemed to be dispersing were observed in December 1984 (Fig. 2). This flock moved together from one *Ficus microcarpa* stand to another, which had kept their leaves, unlike the other trees in the forests which had lost their foliage during the typhoons of autumn 1984. Resident honeyeaters did not take aggressive behavior against the group, and sometimes joined it for a short time. This flock soon disappeared from the study area.

b. Site fidelity

Twenty-three (39.0%) of the 59 color-banded honeyeaters were observed several times after release, and six others (10.2%) were seen a few times. Out of the former 23 honeyeaters, 12 (52.2%) remained for one year or more, but three of them (U-6, U-8, and U-10) were seen sporadically and did not breed in the study area (Table 1).

Residents such as the above 12 birds remained in distinct, single home ranges throughout the year (Fig. 3). Range size fluctuated seasonally (Fig. 4), but the difference was not statistically significant except between April/May (breeding

Table 1. Observation records of color-banded Bonin Islands Honeyeaters that were observed several times after release in the study area. U-4 was shown here because it spent some time with U-3 for breeding in March 1983. Circles in the breeding column show that breeding behavior was observed during the two-year period. M, F and U individuals represent the male, the female, and unknown sex, respectively.

No.	Individuals	1983				1984				Breeding	
		Mar	Jul	Oct	Dec	Mar	Apr/May	Jul	Sep		Dec
1	M-1	●	●	●	●	●	●	●	●	●	○
2	M-2	●	●	●	●	●	●	●	●	●	○
3	U-1	●	●								
4	U-2	●	●								
5	U-3	●	●								○
6	U-4	●									○
7	M-3	●	●		●	●	●				○
8	M-4	●	●		●	●	●	●	●	●	○
9	U-5	●	●	●							○
10	U-6	●			●			●		●	
11	U-7		●	●							
12	U-8		●					●			
13	U-9			●	●	●	●				○
14	M-5			●	●	●	●	●	●	●	
15	M-6			●		●	●	●	●		○
16	F-1				●	●	●	●	●	●	○
17	F-2				●	●	●	●	●	●	○
18	M-7				●	●	●	●			○
19	F-3				●	●	●	●	●	●	○
20	F-4				●	●	●				○
21	U-10				●		●			●	
22	M-8					●	●				○
23	U-11					●		●			

season) and December (Mann-Whitney $U=6.5$, $z = -2.308$, $n_1 = n_2 = 7$, $P < 0.05$, two-tailed) and between July and December ($U=5$, $z = -2.044$, $n_1 = 5$, $n_2 = 7$, $P < 0.05$, two-tailed). After this study, honeyeater M-5 was observed in March and July of 1990 and in March of 1991 within its home range described from 1983 and 1984 (Ueda, K. pers. com.), which means that this bird lived there for eight years at least.

c. Pair duration

Resident birds remained paired throughout the year, though M-5 was not paired during the breeding season of 1984. Pairs seemed to change mates only when one died. M-1 and F-2, and M-4 and F-1 lived together, respectively, as pairs throughout the year from December 1983 to December 1984 when the study ended (Fig. 3). In pairs with a banded and an unbanded member, there were no cases in which two neighboring

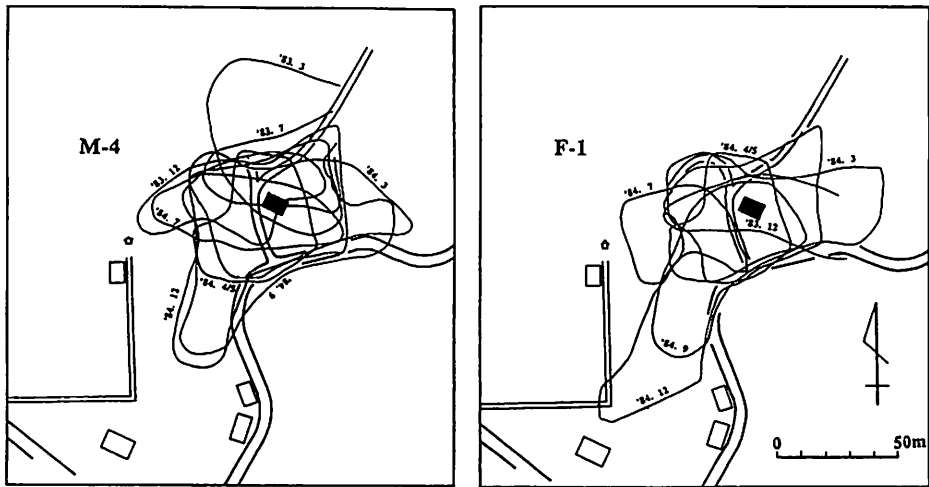
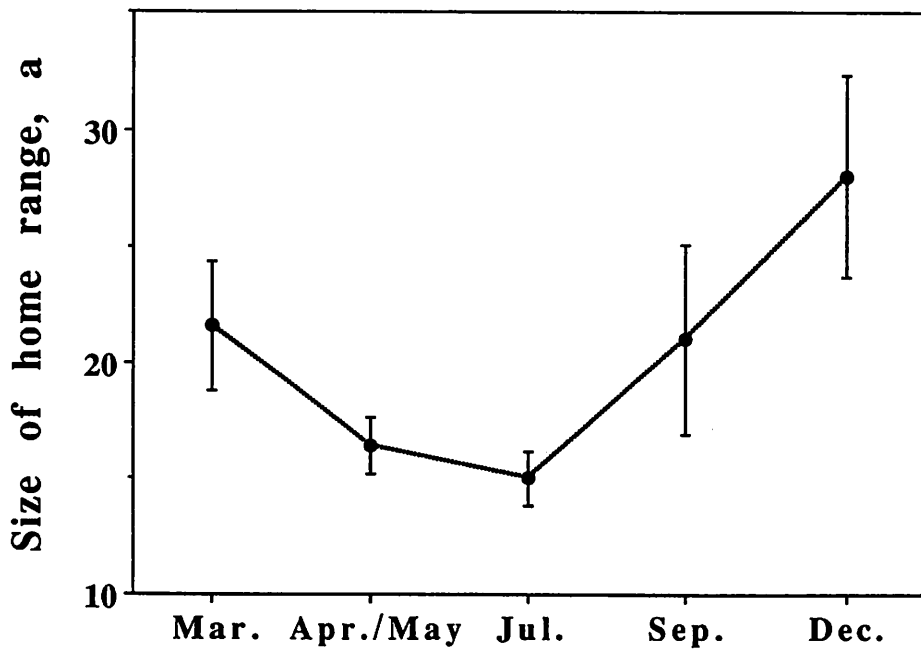


Fig. 3. Continued.

Fig. 4. Seasonal fluctuation in the home range size (are) of honeyeaters in the study area, based on seven banded individuals. Mean \pm SE are shown.

banded members formed a pair while their mates were alive.

The male and female of each pair were often observed allopreening throughout the year, and they also roosted close together on a twig. These activities seemed to perform an important function in sustaining a pair bond (Higuchi et al. 1984).

2. Breeding ecology

There were already many fledglings at the beginning of the study period in late March of 1983, which shows that honeyeaters bred as early as February and March. Therefore, breeding habits such as nest building and clutch size were only observed in April and May of 1984. We will report the results from that period.

a. Territory and territorial behavior

In the breeding season of 1984, home ranges partly overlapped but had an orderly arrangement (Fig. 5). Territories were occupied in home ranges, and the territory boundaries were defended by violent attacks against invading birds (Fig. 5). One pair sometimes confronted another pair on the ground or tree of the territory boundaries, but only one member of each pair actually engaged in physical fighting. We treated that member of the pair as the male. The male uttered "chichichichi" calls during the territorial fighting and "pee, pee-oh" calls before and after the fighting. The female

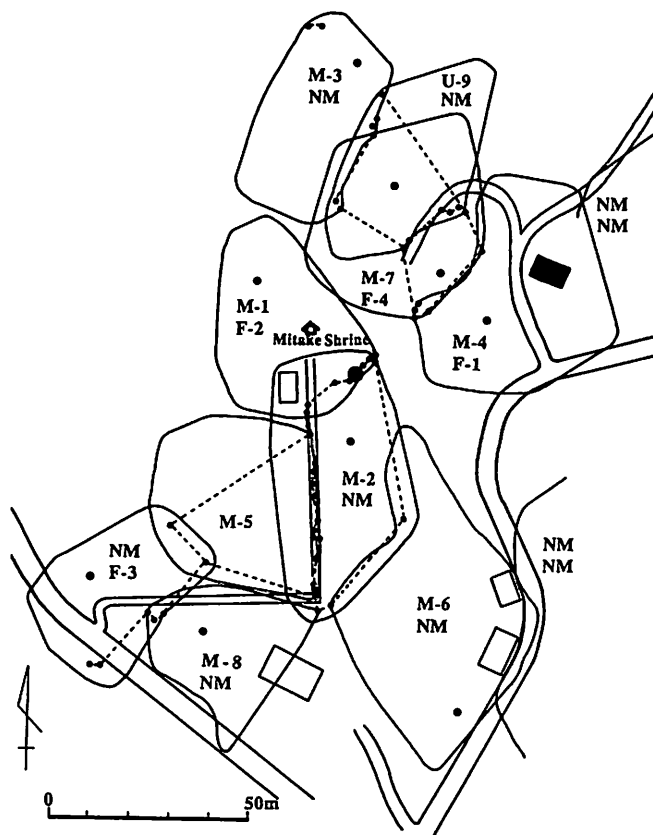


Fig. 5. The distribution of home ranges (solid lines) and nests (dots) in the study area during the breeding season of late April and early May, 1984. NM represents birds without color bands. Asterisks indicate fighting site. Broken lines indicate the territory boundaries. Large dot in the territories of M-1/F-2 and of M-2/NM indicates a bathing site.

uttered "chichichi" calls from behind the fighting male.

Territories were, however, not clearly shown in some pairs, such as F-3/NM (no mark), M-8/NM, M-7/F-4, and U-9/NM. We do not know why they were inactive in defending their territories.

Although territorial behavior was common in pairs M-2/NM and M-1/F-2, one bathing site in the overlapping area of their territories was used in common with several other honeyeaters such as F-1, M-5, F-3, and U-10. The bathing site was usually visited by pairs. When a pair was bathing, another pair was waiting several meters away. Fighting was only rarely observed at the bathing site.

b. Songs

Songs were not frequently heard. However, M-4 and M-5 sang songs often in December 1983 and in April and May 1984, respectively. M-4 changed its mate between October 1983 and March 1984, and probably that December was the period when it chose its mate. On the other hand, M-5 remained unmated during the breeding season of 1984.

It is likely from these observations that the songs play an important role in obtaining mates but are not important while remaining a mated pair. Suzuki (1993) has reported that the singing activity of this species is largely restricted to very early morning (before dawn) of the breeding season.

c. Nest

Nest building was done by both males and females that carried nesting materials. Eleven nests were found on branches at heights of 2.5 to 10 m off the ground, having a mean \pm SD of 5.59 ± 2.60 m. Morioka and Sakane (1978) found that 15 nests were placed about 1.7 to 12 m (mean 5.9 m) off the ground, which agrees with our results. Since Morioka and Sakane's study area was at the foot of Mt. Chibusa several hundred meters away from our study area, nest height does not seem to differ from one area to another. It took four or more days for honeyeaters to complete nests.

Honeyeaters nested on *Pandanus boninensis*, *Casuarina equisetifolia*, *Dendrocalamus latiflorus* and *Ficus microcarpa*. Morioka and Sakane (1978) found the majority of nests (about 70%) in *Schima mertensiana* and some in *A. sieboldii* and *R. wrightiana*. Although the tree species which the birds choose for nesting might vary according to vegetation, no nests have been found in *L. leucocephala*. Although a pair nested in a *L. leucocephala* shrub, the nest was not actually on the *L. leucocephala* itself, but on a *R. wrightiana* tree. The nest structure is an open-topped cup shape made of the leaf fibers of *Pandanus boninensis*, *Livistona chinensis* and others. They were usually built in a funnel-shaped crotch among tree branches and the foliage of *Pandanus boninensis*. It is likely that *L. leucocephala* are not suitable for nesting because they spread horizontal branches.

d. Clutch size and incubation

Clutch size was studied at five nests. Two and three nests contained three and four

eggs, respectively, and the mean \pm SD clutch size was 3.6 ± 0.55 .

The male and the female incubated in turn for similar lengths of time. In observations of pair M-8/NM, the male and the female respectively spent 58.9% and 41.1% of the nine hours of observed incubation time over two days, and changed roles 32 times during the period. Allopreening was observed three times between the male and female of that pair during the same period, in a bush 5-8 m away from the nest. Incubation period was not well studied but was estimated to be 10-14 days from fragmentary observations.

e. Raising young and second broods

Nestlings were fed by both parents. After leaving their nests, fledglings moved with their parents and solicited them for food. We observed eight pairs with such fledglings in 1983 and 1984. Five pairs had two young, two pairs had three young, and one pair had one young. Taking into account the mean clutch size, 1-2 young per nest are assumed to be lost.

Post-fledging periods seemed to be rather long. Fully fledged juveniles which were almost identical to their parents in appearance and size frequently solicited their parents for food, shivering their wings conspicuously. Takano et al. (1970) and Morioka and Sakane (1978) noted the courtship feeding of the honeyeaters, but they presumably mistook the feeding of fledglings by their parents. We did not observe any apparent courtship feeding in banded pairs.

Some pairs had a second brood after their first successful one. Pair M-2/NM spent time with fledglings in both March and July 1984. We banded four young of pair M 1/F-2 in May 1984, and the pair was accompanied by three fledglings with no bands in July, 1984. Pair M-4/F-1 built the nest in late April and early May 1984, and was accompanied by two young just fledged in late July.

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Summary

1. The site fidelity, pair duration, territorial behavior, clutch size, and nesting habits of the Bonin Islands Honeyeater *Apalopteron familiare* were studied on Hahajima of the Bonin Islands from March 1983 to December 1984.

2. Most honeyeaters lived as pairs in stable home ranges throughout the year. Pair mates seemed to change only when one died.

3. Territories were occupied in home ranges during the breeding season, and the territory

boundaries were defended by violent attacks against invading birds. However, some pairs did not show territorial behavior so often.

4. Songs were not frequently heard, and were considered not to be so important while remaining a mated pair.

5. Nest building, incubation, and feeding were conducted by both the male and the female. Clutch size was three or four. Some pairs had a second brood after their first successful ones.

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要 約

メグロの行動圏とつがい

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- 1983年3月から1984年12月にかけて、小笠原列島の母島でメグロの行動圏、つがい関係、なわばり、一腹卵数、営巣習性などを調査した。
- メグロの多くは、1年をとおして安定した行動圏内でつがいで生活していた。つがいの相手は、一方が死なないかぎりかわらないように思われた。
- なわばりは繁殖期の行動圏の中に占められ、境界はきびしく防衛された。ただし、つがいの中にはなわばり行動を示さないものもいた。
- さえずりは繁殖期でもあまり聞かれず、つがいになっているものにとってはあまり重要でないように思われた。
- 造巢、抱卵、育雛は雌雄ともに行なった。一腹卵数は3または4個だった。いくつかのつがいは、1回目の繁殖に成功したのち2回目の繁殖を行なった。

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