

## MOVEMENT AND CALLING BEHAVIOR OF THE LINED FOREST-FALCON (*MICRASTUR GILVICOLLIS*) IN THE BRAZILIAN AMAZON<sup>1</sup>

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This is the first study of the behavior of the Lined Forest-Falcon (*Micrastur gilvicollis*). It was not widely recognized as a distinct species until as late as 1972 when Schwartz (1972) separated it from the sympatric Barred Forest-Falcon (*M. ruficollis*). The Lined Forest-Falcon is a relatively small (211 g; Bierregaard, in press) falconid occurring throughout lowland tropical forests of Amazonia (Meyer de Schauensee and Phelps 1978).

We used radio telemetry to study four birds in the late wet season from March to June 1985. Also included are observations from 7.5 years of bird banding with over 70 captures of the Lined Forest-Falcon. Data are presented on vocalizations, home range size, and prey species.

### STUDY AREA

The study area was 70 to 85 km north of Manaus, Brazil (2°25'S × 59°50'W). The forest there has a relatively even, closed canopy about 35 m in height, with emergents reaching 55 m. The most common tree families in the canopy are Burseraceae, Sapotaceae, Lecythidaceae, and Leguminosae (Rankin-de Merona, pers. comm.). The soils are predominantly nutrient-poor, sandy or clayey yellow latosols (Chauvel 1982). The understory is dominated by stemless palms. Annual rainfall is about 2.2 m, with a dry season from July to September when rainfall averages less than 100 mm/month. During the peak of the rainy season, rainfall averages over 300 mm/month (Anonymous 1978).

### METHODS

Radio transmitters were mounted at the base of the central tail rectrice and weighed less than 7 g. One of the four falcons was captured in a 10-ha forest fragment that was surrounded on three sides by a clearcut 100 to 150 m in width and on the fourth side by an expanse of cleared forest 6 to 7 km in width. The other three birds were studied in contiguous undisturbed forest that extends hundreds of kilometers north of the study site. Unless otherwise indicated, the data presented are only from the birds in the contiguous forest.

Observations were made all times of the day during 67 observation days. On 34 of the 67 days, the falcons

were followed uninterrupted from before dawn to after dusk. The birds' locations were plotted on maps at 07:00, 12:00, and 17:30. These data were analyzed with Micro-computer Programs for the Analysis of Animal Locations (McPAAL 1985) to estimate home range size with the Minimum Convex Polygon, 95% Ellipse (Bivariate Normal), and Minimum Concave Polygon techniques. During March to July 1985, we made 26 periodic calling censuses from 05:30 to 06:30 on unradioed birds within the 10-ha forest fragment. We stood in the center of the 10-ha fragment where we could hear a forest-falcon calling from any part of the 10-ha area. After hearing a bird call, we approached to within 30 to 40 m, to confirm that the falcon was within the forest fragment.

## RESULTS AND DISCUSSION

### VOCALIZATIONS

Data from days when the falcons were followed from before dawn to after dusk show that vocalizations were mostly confined to a narrow 20-min period in the early morning (Table 1). Except during periods of heavy rain, every radioed falcon called every morning between 05:35 and 05:55.

In the morning, during and preceding calling, the falcons were perched approximately 10 to 25 m high in the forest. During other times, the falcons were usually observed 6 to 8 m from the ground on vines or understory plants. This is contrary to Willis et al.'s (1983) hypothesis that the Lined Forest-Falcon is primarily a canopy species.

After a bird started to vocalize, it usually received a response from a conspecific. If the response came from a distant bird, then one of the pair would move toward the other. Thus, facilitated by morning vocalizations, the birds appeared to travel in pairs through the forest.

### MOVEMENT PATTERNS

Home-range areas for three falcons in contiguous forest were estimated at from 20 to 67 ha depending on the bird and the calculation method (Table 2). The estimates from three different techniques are given to facilitate comparison between other studies. Koepl et al. (1975), Madden and Marcus (1978), and Anderson (1982) discussed the relative merits of the techniques. The convex polygon is probably the most frequently used method. It entails drawing the smallest convex polygon which encloses the outermost points of the home range. The main problem is that the technique

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TABLE 1. Vocalization times and duration ( $\bar{x} \pm 1$  SD) from birds that were followed from dawn to dusk ( $n = 41$ ).

Time	Calls (%)	Duration (min)
05:35–05:55	73	$10.3 \pm 4.5$
05:55–06:27	2	32
06:27–07:33	2	66
17:45–18:08	22	$2 \pm 1.6$

is sensitive to sample size (Schoener 1981). Nonetheless, because home range size increases asymptotically (Bekoff and Mech 1984) with an increasing number of observations, the asymptote represents an adequate number of observations for home-range estimation. For two of the birds, the asymptote was reached at from 35 to 45 observations, corresponding to a home range of approximately 40 to 50 ha (Fig. 1). The curve for bird 3 does not level off indicating an inadequate number of observations for home-range estimation. Based on calling censuses and banding data, Scott Robinson (unpubl. data) gives a home-range estimate of from 35 to 40 ha for three pairs of the Lined Forest-Falcon in Manu, Peru.

The falcons typically remained in one area without moving more than 50 m for 1 to 3 days before making a relatively long-distance movement to another location. This resulted in a patchy use of space within the home range with no apparent patterns between long-distance movements (Fig. 2).

The longest movements, and all those over 200 m, occurred during, or immediately following the morning calling periods. During other times of the day, the birds were sedentary, rarely moving over 150 m.

Because the falcons called every morning, except during periods of heavy rain, we could monitor their presence or absence within an area. From calling censuses in the 10-ha forest fragment, and from one bird with a transmitter, we determined that at least one pair of falcons traveled over 100 m or more of clearcut forest a minimum of 11 times from March until July 1985. Given the small size, and deep forest habits of the Lined Forest-Falcon, we would have expected that this raptor, if any, would have been susceptible to population fragmentation through forest clearing acting as a movement barrier. This obviously was not of major importance.

#### FEEDING BEHAVIOR

Willis et al. (1983) reported three instances of the Lined Forest-Falcon at army ant raids. Whether the falcons

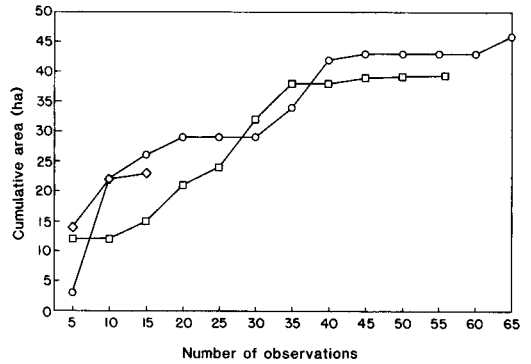


FIGURE 1. Estimated area of home range (minimum convex polygon technique) with an increasing number of observations for Lined Forest-Falcon numbers 2, 3, and 4.

were preying on the antbirds or insects and lizards scared from the front of the raid was unclear. The birds we followed were never found near ant raids.

A majority of the 70 captures of the Lined Forest-Falcon over 7.5 years of mist-netting was a result of falcons attacking small passerines entangled in nets. However, we do not infer from this that the species is specialized for avian prey capture. In fact, its relatively short toes are definitely not typical of raptors that prey heavily on other birds (Bierregaard 1978).

We suspect the falcons frequently prey on lizards and large insects. Brown and Amadon (1968), referring to the Lined Forest-Falcon and the Barred Forest-Falcon, which they treated as conspecific, mention lizards as being a frequent item in the diet. In one mist-net capture near Manaus, the forest-falcon appeared to have attacked a lizard that had become entangled in the net. The stomach contents of a Lined Forest-Falcon from Manu, Peru yielded a single cockroach (Blattidae; S. Robinson, unpubl. data). The available prey data and movement patterns from our study indicate that the Lined Forest-Falcon is an opportunistic generalist in diet that uses a sit-and-wait strategy for prey capture.

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TABLE 2. Home-range estimates (ha) for three falcons with three different techniques.

Individual	95% ellipse (bivariate, normal)	Convex polygon	Concave polygon
No. 2 ( $n = 27$ days, 64 observ.)	67	46	24
No. 3 ( $n = 27$ days, 55 observ.)	57	39	20
No. 4 ( $n = 9$ days, 19 observ.)	43	23	20
	$\bar{x} = 55.6$	$\bar{x} = 36.0$	$\bar{x} = 21.3$

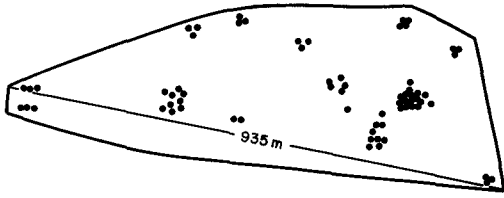


FIGURE 2. Home-range map for Lined Forest-Falcon number 2. Area enclosed by the minimum convex polygon is 46 ha. The movement patterns were similar for all the falcons followed.

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