forested. *C. oenanthe* is still at risk in these areas, since its preferred habitat is also sought after by rice-farmer tenants. Perhaps of note is that *C. oenanthe* near the banks of the Río Mayo differs in color from populations of *C. oenanthe* in the Aguaruna territory to the northeast. If conservation efforts intend to protect both color morphs, then action will need to be taken outside of native lands as well.

Conservation efforts should also be made to protect small populations in isolated fragments, encouraging landowners to preserve them on their land while management plans can be drawn up and put into action. The first step in this process should be an intensive survey of all potential *C. oenanthe* habitat in both the lower and upper regions of the Alto Mayo valley, with particular attention paid to determine the distributions of the different color morphs.

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Group, Range, and Population Size of *Alouatta pigra* at Monkey River, Belize

Mary S. M. Pavelka

Introduction

A number of studies of the Belizean black howling monkey, *Alouatta pigra*, have been published over the past 10 years, not only contributing to the growing information base for this species, but also suggesting greater variability in behavior and ecology within the genus than had been previously recognized (Brockett and Clark, 2000; Brockett *et al.*, 1999a, 1999b, 2000a, 2000b; Clark and Brockett, 1999; González-Kirchner, 1998; Horwich *et al.*, 2001a, 2001b; Ostro *et al.*, 1998, 2000, 2001; Silver *et al.*, 1998; Treves *et al.*, 2001). While howlers in general are considered to be the most folivorous of the New World monkeys, the earliest reports of *A. pigra* described it as frugivorous (Coelho *et al.*, 1976; Schlichte, 1978). It has become clear, however, that while Central American black howlers can survive for long periods on just leaves (Horwich and Lyon, 1990), fruit and other reproductive plant parts are consumed whenever available (Silver *et al.*, 1998, 2000; Ostro *et al.*, 1999). Silver *et al.* (1998) reported that fruit consumption comprises 48% of the monthly feeding time, and they described *A. pigra* as being as frugivorous as possible and as folivorous as necessary.

Directly relevant to this paper are the significantly smaller group sizes reported for *A. pigra* (2-10 individuals per

group) when compared to those of its geographic neighbour and close relative, *A. palliata*. Small group size and suspected monogamy were among the factors taken into account which led to the black howler being assigned species status in the early 1970s (Smith, 1970; Horwich, 1983; Horwich and Johnson, 1986). However, as Estrada *et al.* (2002) recently pointed out, detailed studies of the populations, ecology and behaviour of *A. pigra* have been restricted to just two localities within its entire geographic range; the Community Baboon Sanctuary (CBS) in north-central Belize, and CBS groups transplanted to the Cockscomb Basin Wildlife Sanctuary (CBWS) in south-central Belize. More sites need to be surveyed to document the variation in density and group size of *A. pigra* within its current geographic distribution. Here I provide information on group size and composition, as well as population density and home range size, for a previously unstudied population of *A. pigra* in the south of Belize.

Methods

The study population inhabits a lowland, semi-evergreen, broadleaf riparian forest in a subtropical moist life zone, on slightly acidic mixed alluvial soils (Wright, 1995), on the north side of Monkey River, 1 km west of the river mouth (16°21'N, 88°29'W, Fig. 1). There, creeks flood regularly during the rainy season (June-December), and the habitat is precisely the seasonally-flooded, riparian forest that *A. pigra* is reported to favour (Horwich and Johnson, 1986; Lyon and Horwich, 1996). The average annual temperature in Belize is 26°C, and average annual rainfall in the southern part of the country is approximately 250 cm. The most common trees in the study area are cohune palms (*Attalea* / *Orbignya*), provision trees (*Pachira*), figs (*Ficus*) and swamp kaways (*Pterocarpus*).

Data presented in this paper are based on daily monitoring of social groups within a 52-ha study area during May-August 1999 and January-May of 2000 and 2001. Some of the groups were followed more closely for the collection of data as part of a study underway on the behavioural ecology of this population. A minimum of two people monitored the site during this time, and during May of each year three to four researchers, accompanied by a forest guide, made intensive observations of each of the social groups. Group size and composition data for eight groups are thus based on direct counts. Home ranges were estimated for five, for which we have 10 months of behavioural data. It is not possible with these data to examine seasonal variation in ranging patterns, and efforts to obtain a full annual cycle were thwarted by Hurricane Iris, which severely damaged the forest and its monkey population (Pavelka *et al.*, 2003). Local forest guides indicated that any seasonal increase in home range (in months not covered in this study) would be minimal.

We tagged the trees in which the monkeys were found and mapped their locations using a GPS. These tree-points were then imported into ArcView® to calculate the home range using a modified version of the Digitized Polygon method (Ostro *et al.*, 1999). Each of the tree-points was given a 20-m buffer (10-m radius), and then joined to create a digitized polygon. Once plotted, we joined areas of their home range disconnected by actual sightings by a 10-m corridor.

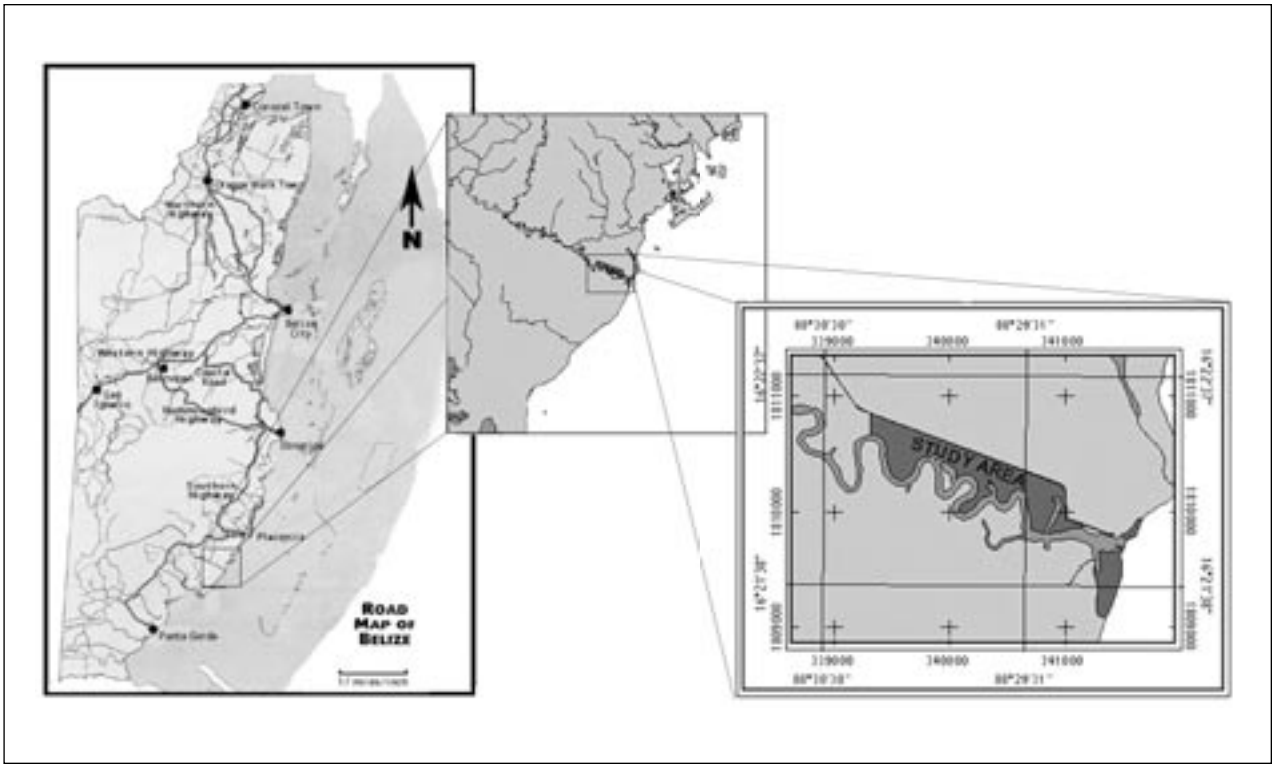

Figure 1. Location of the study area (map prepared by Aaron Osicki). Dark-shaded study area = 52 ha.

Results

Group size varied from 2-10 individuals, with a mean of 6.6. Four of eight groups contained eight members, the modal size. Estrada *et al.* (2001) suggested that smaller *A. pigra* groups might be newly-formed, and our limited observations support this. The Cold Creek (CC) group (a male/female pair) was not observed until 2001. A solitary male was seen in the Cold Creek range in 2000, and it is possible that by January 2001 he had joined up with a female. Likewise Group 5, a male-female pair with an infant in 2001, was first observed in May 2000 as a pair without an infant, and before that there were observations of a solitary male in the area. We thus may have been witnessing the formation of new groups. If we exclude these two small groups, the mean group size would be eight. Note that solitary males were also resident in the ranges of Groups 1 and 2 (Table 1). They were included in the overall group size calculations; if excluded, the mean group size would be 6.37.

All social groups with more than three individuals were multi-male. The ratio of adult and subadult males to adult and subadult females ranged from 1:1.5 to 2:1. In the case of Group 3 – with two fully adult and two sub-adult males – it is reasonable to speculate that one or more of the males would have soon dispersed. All of these social groups were destroyed or dismantled by Hurricane Iris in October 2001, preventing us from tracking these anticipated events (Pavelka *et al.*, 2003). Overall, the sex ratio for adults and subadults combined was 1.2 males (n = 21) to 1.0 females (n = 17).

The 53 howlers counted in the 52-ha study site yield a population density of 102 individuals per km² (1.02/ha). The study site is a relatively narrow band of forest between the river and the Monkey River road, approximately 2 km in length and averaging 0.25 km in width (Fig. 1). Figure 2 shows the home ranges of the five groups we monitored, and it is clear that large sections of the study area were not used, at least during the time we were watching them. Considering only the area actually used by the monkeys indicates a much higher density at 3.7 monkeys/ha or 370 monkeys/km² (37 monkeys using a total of 9.74 ha of forest).

Discussion

These new data from Monkey River, Belize, confirm the small group sizes reported elsewhere for *A. pigra*, which ranged from 2-10 individuals (2-9 if solitaries sharing the same range are not included), with a mean size of 6.6 individuals (or 6.37 without solitaries). Estrada *et al.* (2002) reported groups at Palenque ranging from 2-12, with a mean of 7.0, while in Quintana Roo they were much smaller, averaging 3.16, which they believed to be due to the very small size of the forest fragments. At CBS in Belize, groups ranged in size from 2-9 individuals with a mean of 5.9, nearly identical to that of Monkey River. These data support the conclusion of Horwich and Johnson (1986) that group size is less variable in *A. pigra* than in other howlers, particularly its close relative *A. palliata*.

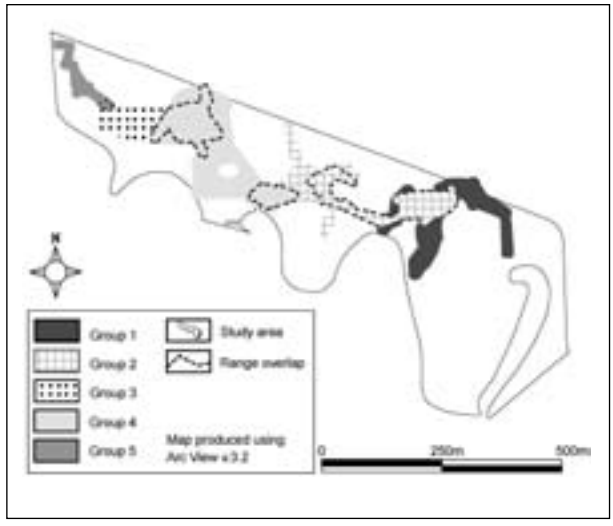

Figure 2. Home ranges of five groups of black howlers (*Alouatta pigra*) at Monkey River, Belize.

Table 1. Group size, composition and home range size of *Alouatta pigra* at Monkey River, Belize.

Group	Adult & subadult males	Adult & subadult females	Immatures	Infants	Solitaries	Total group size	Home range size (Ha)
CC	1	1	0	0	0	2	-
1	2	3	1	1	1	8	2.64
2	2	3	2	2	1	10	2.63
3	4	2	2	0	0	8	3.16
4	3	3	1	1	0	8	1.87
5	1	1	0	1	0	3	0.48
6	3	2	1	0	0	6	-
7	3	2	1	2	0	8	-
Total	**19**	**17**	**8**	7	**2**	**53**	**9.74***
Mean	**2.3**	**2**	**1**	**0.9**	**0.3**	**6.6**	**1.95**

*Total area used by the monkeys minus the 2.84 ha of overlapping area. CC = Cold Creek Group.

Group composition is more variable. At Monkey River, the social groups were predominantly multimale, and only the small, presumably newly-formed groups were made up of a single male paired with a single female. Sixty percent of groups at Palenque were multimale (Estrada *et al.*, 2002), but in Belize, Horwich *et al.* (2001a, p.1) described *A. pigra* as being "generally organized into polygynous demographic subunits of one adult male and two or three adult females in addition to immatures." The adult sex ratio at Palenque of 1.0 male to 0.95 females compares to 1.0:1.63 at CBS and 1.2:1.0 at Monkey River. It is not yet known if multi-male social groups represent multimale breeding groups.

The population density at Monkey River (102 individuals/km²) is high, but would seem to be a natural state. There is no evidence of crowding due to recent habitat loss, for example. Small milpa patches are periodically cleared in the area, but judging from Sheet 2 of the *British Honduras Natural Vegetation Map* (British Honduras Survey Forestry and Geological Departments, 1958) the forested area of the Monkey River watershed has remained relatively unchanged over at least the past 50 years. However, since the establishment of the Monkey River SDA (Special Development Area) in the early 1990s, the area has received greater protection, and the proportion of good howler habitat within the watershed forest may be increasing, allowing the population to grow through the formation of new groups. The proportion of immature to mature animals indicates population growth or growth potential. In the Monkey River study site, the 53 individuals comprised 38 adults and 15 immatures, which represented 28% of the study population.

The proportion of immatures to matures is lower than that reported for Palenque (Estrada *et al.*, 2002). The high population density may explain the preponderance of larger multi-male groups with more than two adult females. Ostro *et al.* (2001) and Horwich *et al.* (2001b) showed an increase in group size and in the number of groups containing two males and two or more females with increasing population density at CBS and CBWS in Belize. The high density at Monkey River and CBS (47-275 individuals/km²: Ostro *et al.*, 2001) challenges the assertion that *A. pigra* typically occurs in low population densities (Crockett and Eisenberg, 1987; González-Kirchner, 1998).

Home range sizes for the Monkey River groups are small, from 0.5-3.0 ha, with a mean of 2 ha. This compares with 25-50 ha reported at CBS (Ostro *et al.*, 1998). The density when computing only the home ranges (the sum of the home ranges adjusted to prevent duplication of overlap areas) is very much higher at 370 individuals/km². Further investigation of pre-hurricane vegetation data is underway to determine differences between the areas they use and those they apparently avoid to better understand the habitat requirements of this population. Ostro *et al.* (2000) found that translocated black howlers selected home range areas which were at low elevations and close to a waterway; at the Monkey River study site, however, neither of these shows any real variation. The lack of use of certain areas is more likely due to differences in vegetation (grassland and swamp near the river, and forest in regeneration). The possibility remains, however, that range sizes may be underestimated and they may be using other areas at other times of the year.

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News

Amapá Biodiversity Corridor

On 16 September, 2003, during the 5th World Parks Congress held in Durban, South Africa, the State Governor of Amapá, Brazil, Antônio Waldez Góes da Silva, announced the creation of a 10 million-ha Biodiversity Corridor which will connect 12 existing protected areas and four Indigenous Reserves. The existing protected areas and indigenous reserves already cover about 55% of the state, and include the recently created 3.87 million-ha Mountains of Tumucumaque National Park, the largest protected area for tropical rain forest in the world (see *Neotropical Primates* 10(3): 158-160). The state of Amapá has an area of 14,027,600 ha, of which 71% will be covered by this corridor. The protected areas system in the state includes seven federal areas and four state areas (see Table 1), besides five Private Natural Heritage Reserves (Seringal Triunfo, Retiro Paraíso, REVECOM, Retiro da Boa Esperança and Aldeia Ekinox), four Indigenous Reserves (Juminã, Galibi, Uaçá and Waiapi) and most of the Tumucumaque Indigenous Park.

Areas to be created will connect the Cabo Orange National Park with Lago Piratuba Biological Reserve, extending south to the Curiaú State Environmental Protection Area and the Fazendinha State Biological Reserve on the eastern (Atlantic) side of the state. In the north, the Uaçá Indigenous Reserve will be linked to the Mountains of Tumucumaque National Park. Primates protected in these parks and reserves include: *Saguinus midas*, *Saimiri sciureus*, *Cebus apella*, *Cebus olivaceus*, *Aotus infulatus*, *Pithecia pithecia*, *Chiropotes chiropotes*, *Alouatta seniculus* and *Ateles paniscus*.

The state of Amapá will invest US$15 million in the creation and management of this corridor over the next four years, and Conservation International, based in Washington, DC,