

proteins. Red howlers are quite opportunistic in their diets in disturbed habitat (de Thoisy and Richard-Hansen, 1997). Plant diversity is low on the island: only 28 ligneous species are common on the island (M. Nugent, unpub. data), and just six of them are among the 195 species constituting the diet of howlers in their natural habitats on the mainland, none of which are included amongst the 40 species most regularly consumed (Julliot and Sabatier, 1993). Hunting was observed mainly during the dry season, when fruits are scarce on the island. Meat-eating by blue monkeys (*Cercopithecus mitis*) has also been reported during the driest seasons and has been interpreted as an important protein contribution to its diet (Fairgrieve, 1997).

Although the unusual history of this howler complicates any conclusion about this behaviour, the repeated successful predation of iguanas is significant. Howlers are generally peaceful "opportunistic folivore-frugivores" (Julliot and Sabatier, 1993). Nonetheless, they are capable of showing considerable aggression (Crockett and Pope, 1988), and at times show unexpected behaviours (see Richard-Hansen *et al.*, 1998), and occasionally resort to unusual food items (de Thoisy and Richard-Hansen, 1997).

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References

- Boinski, S. and Timm, R. M. 1986. Predation by squirrel monkeys and double-toothed kites on tent-making bats. *Am. J. Primatol.* 9: 121-128.
- Clarke, A. S. 1987. Animal foods in the diets of prosimian and New World primates. In: *Comparative Primate Biology, Vol. 2B: Behavior, Cognition, and Motivation*, G. Mitchell and J. Erwin (eds.), pp.133-165. Alan R. Liss, Inc., New York.
- Crockett, C. M. and Pope, T. T. 1988. Inferring patterns of aggression from red howler monkey injuries. *Am. J. Primatol.* 15: 289-308.
- Crockett, C. M. and Eisenberg, J. F. 1987. Howlers: Variation in group size and demography. In: *Primate Societies*, B. B. Smuts, D. L. Cheney, R. M. Seyfarth, R. W. Wrangham and T. T. Struhsaker (eds.), pp. 54-68. University of Chicago Press, Chicago.
- Dunn, F. L. 1970. Natural infection in primates: Helminths and problems in primate phylogeny, ecology and behavior. *Lab. Anim. Sci.* 20: 383-388.
- Fairgrieve, C. 1997. Meat eating by blue monkey (*Cercopithecus mitis stuhlmanni*): Predation of a flying squirrel (*Anomalurus derbianus jacksoni*). *Folia Primatol.* 68: 354-356.
- Fedigan, L. M. 1990. Vertebrate predation in *Cebus capucinus*: Meat-eating in a Neotropical monkey. *Folia Primatol.* 54: 196-205.
- Galetti, M. 1990. Predation on the squirrel, *Sciureus aestuans*, by capuchin monkeys, *Cebus apella*. *Mammalia* 54: 152-154.
- Julliot, C. and Sabatier, D. 1993. Diet of the red howler monkey (*Alouatta seniculus*) in French Guiana. *Int. J. Primatol.* 14: 527-550.
- Neville, M. K., Glander, K. E, Braza, F. and Rylands, A. B. 1988. The howling monkeys, genus *Alouatta*. In: *Ecology and Behavior of Neotropical Primates*, Vol 2, R. A. Mittermeier, A. B. Rylands, A. F. Coimbra-Filho and G. A. B. da Fonseca (eds.), pp.349-453. World Wildlife Fund, Washington, D. C.
- Newcomer, M. W. and de Farcy, D. D. 1985. White-faced capuchin (*Cebus capucinus*) predation on nestling coati (*Nasua narica*). *J. Mammal.* 66: 185-186.
- Richard-Hansen, C., Bello, N. and Vié, J.-C. 1998. Tool use by red howler monkey (*Alouatta seniculus*) towards a two-toed sloth (*Choloepus didactylus*). *Primates* 39: 545-548.
- Souza, L. L., Ferrari, S. F. and Pina, L. C. B. 1997. Feeding behaviour and predation of a bat by *Saimiri sciureus* in a semi-natural Amazonian environment. *Folia Primatol.* 68: 194-198.
- de Thoisy, B. and Richard-Hansen, C. 1997. Diet and social behaviour changes in a red howler monkey (*Alouatta seniculus*) troop in a highly degraded rainforest. *Folia Primatol.* 68: 357-361.
- de Thoisy, B. and H. Contamin, H. 1998. The squirrel monkey breeding colony of the Pasteur Institute, Cayenne, French Guiana. *Neotropical Primates* 6(1): 14-18.

ADOPTION OF A YOUNG JUVENILE IN BLACK HOWLER MONKEYS (*ALOUATTA PIGRA*)

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Introduction

Infant adoptions have been reported in several non-human primate species (Thierry and Anderson, 1986). Permanent infant adoption may be a selfish behaviour of the adoptive mother to practice mothering skills (Lancaster, 1971) or it may also be altruistic and explicable by kin-selection theory (West-Eberhard, 1975). It is hard to explain all reported adoptions by these two theories, but in all cases it serves to aid the survival of a lost or abandoned infant. In this study a small juvenile female black howler monkey (*Alouatta pigra*) was adopted by a mother suckling her own small juvenile. Despite aggression from two males the orphan survived and remained in the troop. This paper describes the process of the adoption and discusses its implications.

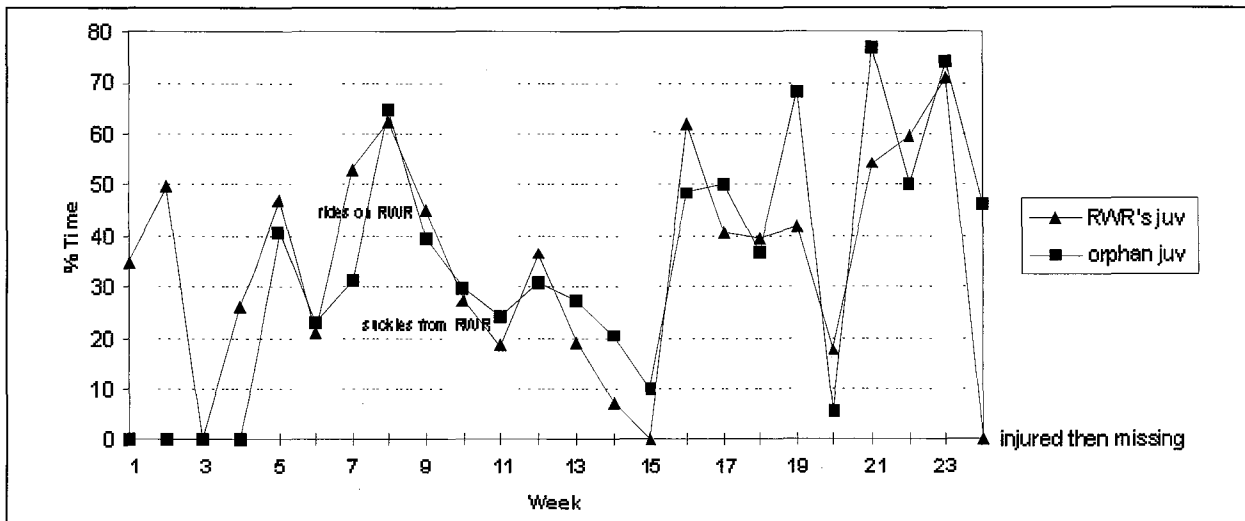


Figure 1. Percentage of time the orphan and rwr's daughter spent near or touching rwr female.

Methods

A stable howler monkey troop, known as Y-troop, was studied at the Community Baboon Sanctuary (CBS) in rural Belize, Central America. The study site is an area of secondary growth riverine forest and new *milpa* (small, temporary farmed plots) supporting at least nine troops ranging in size from two to 14 individuals. Y-troop consisted of nine individuals at the start of the study period: two adult males, a subadult male which left the troop part way through the study, three adult females, two juvenile females, and a juvenile male. All the juveniles were approximately 13-16 months old.

The animals in the troop were identified by sex, size and age along with coloured ankle discs as follows: rM = red male, lM = lime male, saM = sub adult male, rwrF = red white red female, lF = lime female, umF = unmarked female, sj = small juvenile and mj = medium juvenile. The troops at Bermudian Landing, within the Community Baboon Sanctuary, have been studied since 1985. Regular censuses have taken place and the ages and kinship of the younger animals are known (R. H. Horwich, unpublished). Scan samples, recording activity and proximity, were taken every 15 minutes. Proximity data was recorded as follows: 'touching' (in physical contact), 'near' (within 6 feet), or 'distant' (further than 6 feet). At each scan, proximity data for all individuals near or touching each animal, as was the identity of any individuals near or touching, was recorded. For each individual, the number of 'near', 'touching', 'distant' and 'not visible' scans was totalled each week, multiplied by 100, and divided by the weekly total number of scans, to provide a percentage of total time spent in each proximity category in relation to all other members of the troop. *Ad libitum* notes were also taken throughout the periods of observation, covering these and other behaviours, such as aggression, travel, suckling.

Observations of the troop took place between September 1996 and October 1997. This paper covers the period from 5 February to 4 September 1997 inclusive: the period covering the first sighting of the orphan juvenile female until the

injury and subsequent disappearance of the adoptive mother's small juvenile female. A total of 1,121 scan samples, covering over 269 contact hours, were taken in this period.

Results

A foreign young juvenile female was initially seen with Y-troop between 5-7 February, 1997. She was not seen again until 18 March when she then remained with the troop. Aggressive behaviour towards the orphan was exhibited by Lime male (the subordinate adult male) on 6 February, and by the sub-adult male on 18 March, the day of her reappearance, and again on 4 and 14 April. However, when the orphan screamed and was aggressive towards L male, he retreated and no physical contact took place. The subadult male, in contrast, bit her, despite her screaming aggressive defence, and she continued to show concern toward the subadult male whenever he was nearby. No other troop members interfered in any instances of aggressive behaviour toward the orphan.

The female rwrF had a daughter, still suckling, of similar size to the orphan. The orphan began following rwrF and her daughter almost immediately when she rejoined the troop in March; within five weeks of her first appearance and 17 days after her second appearance the orphan was observed riding on rwrF. Two days later, she was seen suckling from rwrF. Both juveniles were in the process of being weaned. The adult female would push both off or move away when either approached; there appeared to be no distinction in her treatment of her daughter and the orphan at these times.

RwrF showed no aggression toward the orphan during her integration into the troop, and the time taken to be adopted by rwrF appeared to be a function of the orphan's behaviour rather than that of the adult female. The orphan seemed to be the initiator of contact between herself and rwrF. On most occasions of suckling, rwrF's daughter would be the first to suckle and the orphan would then join in. This was especially true during the earlier stages of the adoption. RwrF was not observed encouraging the orphan to ride or

suckle. If the orphan fell behind when the troop was moving and she started to make distress calls, rwrF would not return for her. RwrF would often leave her own daughter behind as well, although she was seen to return for her on at least two occasions, and on one occasion appeared to go and search for her when she had been separated from the troop for over an hour.

Figure 1 shows the percentage of scan observations each week that the two juveniles spent either near or touching rwrF. Percentages were used because of the different numbers of observations during the weeks of the study. It should be noted that the adopted female was not observed with the troop in Weeks 2 and 3. Within a week of her reappearance in the troop the orphan closely matched the patterns of rwrF's daughter in terms of the time spent near or touching rwrF. The orphan interacted infrequently with the other adult females in the troop. She was sometimes near other members of the troop during resting periods but she did not appear to seek out other adult females. On one occasion she was observed resting with and grooming the unmarked female. The orphan was seen to initiate play with the two medium-sized juveniles on one occasion and the medium-sized juvenile male initiated play with her once.

After the initial aggression shown by Lime male no other instances of aggression by him toward the orphan were observed, and the orphan was seen sleeping in contact with him when rwrF was absent from the troop. The orphan stayed close to rwrF when travelling, often closer than the daughter, who was observed lagging behind, calling and being helped by other adult females. RwrF did not usually return for her daughter when she gave distress calls; rwr female had shown a similar lack of response to her daughter prior to the orphan's arrival. She allowed the orphan to suckle at six weeks from the first sighting (19 days after her return to troop). Both juveniles suckled at the same time on nearly all occasions once the orphan began suckling.

On the morning of 4 September both juveniles were observed with the troop, and were in good health. A rainstorm prevented further observations until the afternoon when it was noted that the daughter was unable to use one leg. Over the next three days the daughter was unable to move quickly and consequently could not follow the troop. She did not call and was not carried. When the troop returned to the same tree she attempted to climb to her mother but was unable to do so and again did not call. Over the next two days she was observed feeding occasionally on leaves and flowers but appeared to become increasingly weak. On 7 September, she was missing and was presumed dead. The orphan remained close to and continued to suckle from rwrF.

Discussion

Black howler monkeys (*Alouatta pigra*) live in troops of 2-16 individuals, averaging eight. A troop is composed of one or two adult males, a number of adult females and their juveniles. Female howlers have typically been observed

carrying and caring for infants and small juveniles other than their own and all members of the troop have some contact and interactions with infants (Horwich and Gebhard, 1986).

There have been reports of adoptions in *Alouatta palliata* and *A. seniculus* but no previous reports of such behaviour in *A. pigra*. In *A. palliata*, when a mother was lost, infants and juveniles were observed initiating care from other females in the group (Clarke and Glander, 1981). Clarke and Glander also observed the short term adoption of an infant from a subgroup, and adoption of a foreign juvenile male. *A. palliata* live in much larger groups than *A. pigra*; the large groups divide into subgroups, the sub groups come together and separate, and infants have been adopted between sub groups (Clarke and Glander, 1981). In this population of *A. pigra* the troops are smaller and subgrouping, if it occurs, is not obvious. Territorial behaviour is exhibited by all adults and subadults in the troop. It involves chases and physical aggression, as well as howling. When a troop is chased all individuals are chased and may be grabbed and bitten if close enough. Infanticide and bite injuries have been observed during troop take-over (Horwich *et al.*, in prep.). Solitary animals and neighbouring troops which come within a troop's territory will be chased if noticed.

In *A. seniculus*, adoptions have been seen between kin (grandmother and grandchild) and also from another troop by a nulliparous female (Agoramoorthy and Rudran, 1992). This last adoption was of an injured infant abandoned after a male invasion of its troop. Izawa reports the adoption of a related newborn infant after the loss of the mother's own infant (Izawa, 1989). The mother lost her own infant possibly after attack by a foreign male, and she then adopted her sister's newborn infant.

The adoption of orphans from within the same troop or from subgroups of the troop may be a genetic mechanism to preserve the genes of the family (kin selection theory). Adoption of an orphan from outside the troop is harder to explain, particularly where territory is vigorously defended and infanticide and injuries have been seen to occur.

This adoption does not obviously fit the theory of females learning mothering skills. The adult female in question had already raised a number of infants. Presumably the nursing of a second juvenile put a further strain on her own resources and could have had a detrimental effect on her own daughter. Also during this time, over 90% of Y-troop's home range was cleared by bulldozer. The troop already appeared to be less fit than other local troops, the juveniles were much smaller than juveniles of similar age in other parts of the Community Baboon Sanctuary and females had longer than expected inter-birth intervals, presumably due to a lack of resources.

There is some chance that the orphan was related to rwrF. We do not have any definitive evidence for the origin of the orphan but it seems likely that she was from a small

unmarked troop that borders Y-troop to the north. This troop has not been studied but has been observed occasionally. It appears that an adult female disappeared from this troop. Additionally the orphan was first observed with Y-troop in a border area between the two troops. If the orphan did come from this troop then there is some possibility that the mother was known to Y-troop or even possibly the offspring or related to some troop members. This might explain the adoption on the basis of kin selection.

It is also possible that the troops in CBS are closely related and developed from a relatively small founder population (James *et al.*, 1997). However, other behaviour towards neighbouring troops and solitary animals indicates that territorial considerations take precedence over kinship. It was therefore surprising that a juvenile from a foreign troop was allowed within Y-troop's territory and adopted by a member.

The persistence and assertiveness shown by the adopted juvenile perhaps overcame the initial aggression exhibited by two of the males. She appeared to have initiated care behaviour and received it even at the probable detriment to the adoptive mother and the mother's own offspring. The behaviour of the adopted juvenile appeared to be a very important component of the adoption. The adopted female actively tried to stay close to rwrF. RwrF did not appear so much to encourage the adopted female as to tolerate her. This could be a genetically maladaptive trait of the mother (Dawkins, 1976).

It is perhaps possible that by allowing small juveniles into a stable population promotes some genetic diversity within the group. Immigrations into troops appear to occur infrequently for females, and males must often take-over a troop, with the consequent risk of severe injury, to enter it (Brockett, pers. comm.; Horwich, 1995). However, it remains to be seen if the juvenile will act as a daughter and leave when she becomes a sub-adult, as is the usual case with the offspring of the males.

Re-Attachment or Regressive Periods

Although normal, age-related re-attachment periods have been noted in a variety of primates and other mammals (Horwich, 1974, 1989) there have only been indications of such developmental periods in the wild. Such periods occur in recurring cycles throughout individuals' lives. In wild black howlers, re-attachment has been noted in association with a second period of infant transfers at 7-11 weeks of age, when the infants were carried by other females and in one case spent time on a male as well (Horwich and Gebhard, 1986). This association supports the hypothesis that infant transfer behaviour as well as re-attachment behaviours may function in adoption for the survival of the infant in the event of its mother's death (Horwich and Manski, 1975). Regressive behaviour on the part of a juvenile, facilitating its adoption by a female outside of its troop gives stronger support that it plays an important role in infant survival. Dolhinow and DeMay (1982) support this view, noting that

a potential advantage to colobine infants having multiple caregivers is that they might be more likely to acquire care from others in the group in the event of the loss of their mother. They noted further that such adoptions were initiated and maintained by the infant, as occurred in this study. Since infant transfer and multiple caregivers have been observed in howler monkeys as well, the howlers are probably showing the same pattern in their adoptions as the colobine monkeys.

Regressive periods and accompanying behaviours on the part of the infant seem to play a role in other primate and howler species at about the same age (2-3 months). It has been noted in captive *Colobus guereza* (see Horwich and Wurman, 1978), and patas monkeys (Chism, 1978). Data from mantled howlers in the field showed a slight increase in mother-infant contact at 11-13 weeks and very clear increases at six months and a year (Clarke, 1982; Horwich and Gebhard, 1986). We feel that this is a case where the infant being in a regressive period in synchrony with a similar age step-sibling facilitated the adoption by the stepmother.

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References

- Agoramoorthy, G. and Rudran, R. 1992. Adoption in free-ranging red howler monkeys, *Alouatta seniculus* of Venezuela. *Primates* 33(4): 551-555.
- Chism, J. 1978. Relationships between patas infants and group members other than the mother. In: *Recent Advances in Primatology*, Vol. 1, D. J. Chivers and J. Herbert (eds.) pp.173-176. Academic Press, New York.
- Clarke, M. R. 1982. Socialization, infant mortality, and infant non-mother interactions in howling monkeys (*Alouatta palliata*) in Costa Rica. Ph.D. thesis, University of California, Davis.
- Clarke, M. R. and Glander, K. 1981. Adoption of infant howling monkeys (*Alouatta palliata*). *Am. J. Primatol.* 1:469-472.
- Dawkins, R. 1976. *The Selfish Gene*. Oxford University Press, Oxford.
- Dolhinow, P and DeMay, M. G. 1982. Adoption: the importance of infant choice. *J. Hum. Evol.* 11: 391-420.
- Horwich, R. H. 1974. Regressive periods in primate behavioral development with reference to other mammals. *Primates* 15: 141-149.

- Horwich, R. H. 1989. Cyclic development of contact behavior in apes and humans. *Primates* 30: 269-279.
- Horwich, R. H. 1995. Howler Research. Newsletter, *Community Conservation Consultants, Howlers Forever, Inc.* 6(2), Fall/Winter: 1.
- Horwich, R. H. and Gebhard, K. 1986. Relation of allomothering to infant age in howlers, *Alouatta pigra*, with reference to Old World monkeys. In: *Current Perspectives in Primate Social Dynamics*, D. Taub and J. King (eds.), pp.66-88. Van Nostrand Reinhold, New York.
- Horwich, R. H. and Manski, D. 1975. Maternal care and infant transfer in two species of colobus monkeys. *Primates* 16: 49-73.
- Horwich, R. H. and Wurman, C. 1978. Socio-maternal behaviors in response to an infant birth in *colobus guereza*. *Primates* 19: 693-713.
- Izawa, K. 1989. The adoption of an infant observed in a wild group of red howler monkeys (*Alouatta seniculus*). *Field Studies of New World Monkeys, La Macarena, Colombia* 2: 33-36.
- James, R. A., Leberg, P. L., Quattro, J. M. and Vrijenhoek, R. C. 1997. Genetic diversity in black howler monkeys (*Alouatta pigra*) from Belize. *Am. J. Phys. Anthropol.* 102: 329-336.
- Lancaster, J. B. 1971. Play-mothering: the relations between juvenile females and young infants among free ranging vervet monkeys (*Cercopithecus aethiops*). *Folia Primatol.* 15: 161-182.
- Thierry, B. and Anderson, J. A. 1986. Adoption in anthropoid primates. *Int. J. Primatol.* 7(2): 191-216.
- West-Eberhard, M.J. 1975. The evolution of social behavior by kin selection. *Quart. Rev. Biol.* 50: 1-33

BLACK HOWLER MONKEY (*ALOUATTA PIGRA*) REINTRODUCTION PROGRAM: POPULATION CENSUS AND HABITAT ASSESSMENT

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Introduction

The Belize Forest Department has shown an interest in the reintroduction of confiscated howlers acquired via the illegal pet trade. This is a foundation project with far-reaching ramifications. A potential release site was identified as the Monkey Bay National Park (17°16'N, 88°32'W), Belize District, Belize, Central America where howlers are known to have occurred in the past. Monkey Bay National Park (MBNP) is a protected site of 911 ha. Government permits are necessary for entry. It is bordered to the north by the Monkey Bay Wildlife Sanctuary (BSWS), a 433-ha, privately-endowed property held in trust as a nature preserve. MBNP is bordered to the south by the large Manatee Forest Reserve which restricts access and encroachment.

The black howler monkey, *Alouatta pigra*, is a flagship species for Belize, representing the country's internationally-recognized, self-sustaining conservation

practices (Horwich, 1994). This species is considered "Lower risk" by the World Conservation Union (IUCN) (Rylands *et al.*, 1995; IUCN, 1996). However, Groombridge (1993) considered that *A. pigra* was possibly threatened and that there was insufficient data to determine their current population trends. The habitat and range of *A. pigra* is shrinking rapidly, especially in Mexico where it is not protected (Horwich and Johnson, 1986).

Howlers and spider monkeys, *A. geoffroyi*, ranged throughout the Monkey Bay region until a 1958 yellow fever epidemic and hurricanes in 1961 and 1978 decimated primate populations locally (Mahler and Wotkyns, 1995). Information from landowners gleaned during this study indicated that spider monkeys were last observed in 1993, and recent periodic sightings of howlers were claimed within Tiger Sandy Bay, a privately-owned citrus plantation bordering the east boundary of MBNP. In the late 1970's a howler family existed just east of Tiger Sandy Bay. This group was eventually shot, however, by locals (R. Foster and C. Farnetti-Foster, pers. comm. 1998). Tiger Sandy Bay's owner does not allow hunting on this property but it may well occur. The owner of MBWS heard howlers within MBNP until 1983 (M. Miller and J. Brown., pers. comm. 1998). A long-term local resident reported hearing howler vocalizations in the recent past (S. Young, pers. comm 1998).

Methods

Trail-cutting and mapping within MBNP was carried out from 12-19 April 1998. Bruce Clark coordinated field activities and Robin Brockett supervised the systematic mapping of the trail system (see Fig. 1). A total of 4,650 m of trails were cleared, tagged at approximately 20 m intervals and subsequently mapped. Care was taken, as topography permitted, to stratify the habitat forest types to estimate the extent of their occurrence within the study area as has been suggested in previous studies (Chapman *et al.*, 1988; NRC, 1981).

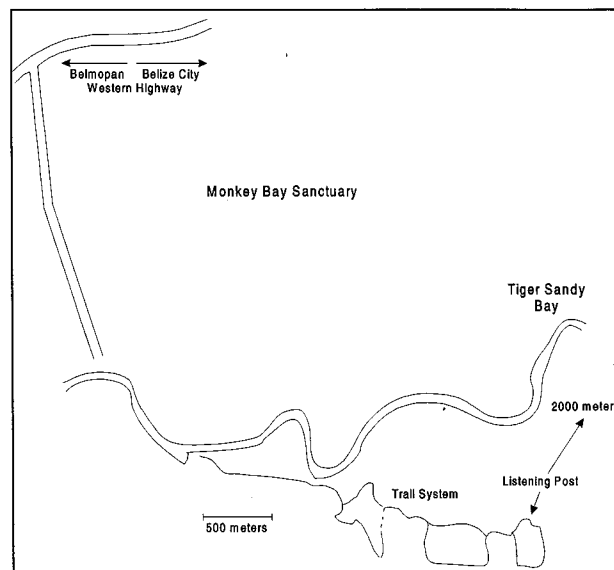


Figure 1. Trail systems within the study area and eventual release site at the Monkey Bay National Park, Belize.