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The *Laboratory Primate Newsletter* provides a central source of information about nonhuman primates and related matters to scientists who use these animals in their research and those whose work supports such research. The *Newsletter* (1) provides information on care and breeding of nonhuman primates for laboratory research, (2) disseminates general information and news about the world of primate research (such as announcements of meetings, research projects, sources of information, nomenclature changes), (3) helps meet the special research needs of individual investigators by publishing requests for research material or for information related to specific research problems, and (4) serves the cause of conservation of nonhuman primates by publishing information on that topic. As a rule, research articles or summaries accepted for the *Newsletter* have some practical implications or provide general information likely to be of interest to investigators in a variety of areas of primate research. However, special consideration will be given to articles containing data on primates not conveniently publishable elsewhere. General descriptions of current research projects on primates will also be welcome.

The *Newsletter* appears quarterly and is intended primarily for persons doing research with nonhuman primates. Back issues may be purchased for \$10.00 each. We are no longer printing paper issues, except those we will send to subscribers who have paid in advance. We will not accept future subscriptions, unless subscribers are willing to pay \$80/year within the U.S.; \$100/year outside the U.S. (Please make checks payable to the Psychology Department, Brown University.) Readers with access to electronic mail may receive the nongraphic contents of each issue by sending the message **subscribe LPN-L your-own-name to listserv@listserv.brown.edu** (Send the message **subscribe LPN-PDF** to receive PDF files by e-mail; or the message **subscribe LPN-WARN** to receive a notice when a new issue is put on the Website.) Current and back issues of the *Newsletter* are available on the World Wide Web at <<http://www.brown.edu/primate>>. Persons who have absolutely no access to the Web, or to the electronic mailing, may ask to have paper copies sent to them.

The publication lag is typically no longer than the three months between issues and can be as short as a few weeks. The deadline for inclusion of a note or article in any given issue of the *Newsletter* has in practice been somewhat flexible, but is technically the tenth of December, March, June, or September, depending on which issue is scheduled to appear next. Reprints will not be supplied under any circumstances, but authors may reproduce their own articles in any quantity.

**PREPARATION OF ARTICLES FOR THE NEWSLETTER.** – Articles, notes, and announcements may be submitted by mail, e-mail, or computer disk, but a printed copy of manuscripts of any length or complexity should *also* be sent by regular mail. Articles in the References section should be referred to in the text by author(s) and date of publication, e.g., Smith (1960) or (Smith & Jones, 1962). Names of journals should be spelled out completely in the References section. Latin names of primates should be indicated at least once in each note and article. In general, to avoid inconsistencies within the *Newsletter*, the scientific names used will be those in *Mammal Species of The World: A Taxonomic and Geographic Reference*, 2nd Ed. D. E. Wilson & D. M. Reeder (Eds.). Washington, DC: Smithsonian Institution Press, 1993. For an introduction to and review of primate nomenclature see the chapter by Maryeva Terry in A. M. Schrier (Ed.), *Behavioral Primatology: Advances in Research and Theory* (Vol. 1). Hillsdale, NJ: Lawrence Erlbaum Associates, 1977.

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Cover photograph of a Bonobo (*Pan paniscus*) family at the Jacksonville, Florida, Zoo, by Marian Brickner

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# Update on Studies of Belizean Primates, Emphasizing Patterns of Species Distribution

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## Introduction

The threat to primates from bushmeat hunting has been well documented for African species (Wilkie et al., 1998; Cowlshaw & Dunbar, 2000, Chapter 9), especially the charismatic great apes (Wilkie & Carpenter, 1999; Bakarr et al., 2001). Much less attention has been focused upon the causes and consequences of hunting for primate populations and species in the Neotropics, especially Mesoamerica (but see *New Scientist*, 2007). Several researchers are attempting to document and to assess the severity of hunting of the two Belizean monkey species: the black howler monkey, *Alouatta pigra*, and the Central American spider monkey, *Ateles geoffroyi*. Four outcomes are possible: these studies (1) will document the absence of primate hunting by residents of Belize; (2) will demonstrate opportunistic hunting of primates by residents; (3) will provide evidence for the presence of subsistence hunting of primates by Belizean residents; and/or (4) will identify the presence of one or more markets for hunting primates by one or more of the human populations at one or more locations in Belize. In the present note, we describe the results of systematic investigations of non-sustainable hunting and other features of Belizean primates. A significant finding is that the distribution of *Alouatta pigra* appears to support the view that *Alouatta* spp. are colonizers, with highly effective mechanisms of dispersal (see Jones, 1995; Crockett, 1998; and Primate Info Net, 2007a); and that *Ateles geoffroyi yucatanensis* is more restricted, probably because of its dietary dependence upon fruit (Primate Info Net, 2007b).

## Study Site and Animals

Belize is a biologically rich nation in Mesoamerica with original forest cover still remaining, estimated from 31% in riparian habitat (Di Fiore, 2002) to approximately

60% for the whole country (FRA, 2000; MNREI, 2003). Belize's population density is among the lowest in the world, with approximately 250,000 inhabitants occupying 22,960 km<sup>2</sup> (Horwich & Lyon, 1990). Black howlers and Central American spider monkeys, both members of the family Atelidae (Groves, 2001), are the only nonhuman primates inhabiting the forests of Belize (Groves, 2001; Rylands et al., 1995), although populations may be locally endangered or extinct (C. B. Jones, personal observation; Horwich et al., 1993; Crockett, 1998; Pavelka et al., 2003). The welfare of Belizean primates is managed by the Belize Forestry Department, Ministry of Natural Resources and the Environment (Belmopan), and hunting of these animals is a criminal offense in this country (MNREI, 2003). Although neither *Alouatta pigra* nor *Ateles geoffroyi yucatanensis* is well known, the former species is better studied than the latter subspecies.

## Studying the Hunting of Belizean Primates

Redford (1992) concluded that deforestation is the major cause of population and species extinction in rainforests of the Neotropics although, where forest remains standing, hunting presents the greatest threat to wildlife. We inferred from Redford's analysis that, if Belizean primates are threatened, hunting is likely to be the primary determinant, since most live in areas that are still-forested (*Figures 1 and 2*).

We initiated a four-phase program to investigate the hunting of Belizean primates. Phase 1 culminated with the publication of Jones and Young (2004), documenting "hunting restraint" on the part of Creole men at the Community Baboon Sanctuary (CBS). Jones and Young (2004) found no evidence that Creoles at the CBS hunted monkeys. However, the results of this report suggested that Belizean primates may be vulnerable to hunting from British soldiers, loggers, the Chinese population, and other immigrants, possibly Guatemalans crossing the disputed western border between the two countries. Jones & Young (2004) also found that utilitarian factors, in particular economic ones, determine the relative benefits or costs of hunting among men at the CBS. Phase 2 entailed another survey (questionnaire) in an attempt to determine what ethnic groups in Belize hunt monkeys, where the ethnic groups are located in the country, and the nature of the hunting activity, if hunting occurs (e.g., whether sustainable or non-sustainable; for pet trade or for food, etc.). The first author of the present note (CBJ), in collaboration with parties in Belize, initiated this study in the country in

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We are very grateful to Robert H. Horwich for sharing the results of his surveys of Belizean primates with us. CBJ appreciates the helpful input, information, and logistic assistance received from Marcelo Windsor (Belize Forestry Department), Ivis Chan (Belize Audobon Society), Sharon Matola (Belize Zoo), Colin Young (Community Baboon Sanctuary and Galen University, Belize), Linda K. Price (U.S. Embassy, Belize), and the Ministry of Natural Resources (Belmopan, Belize). Anthony Rylands generously identified the subspecies of *Ateles* found in Belize. CBJ also thanks her student assistants, Heather Davis and Sarah Ersoz, and her technical assistant, Sarah DiGloria.

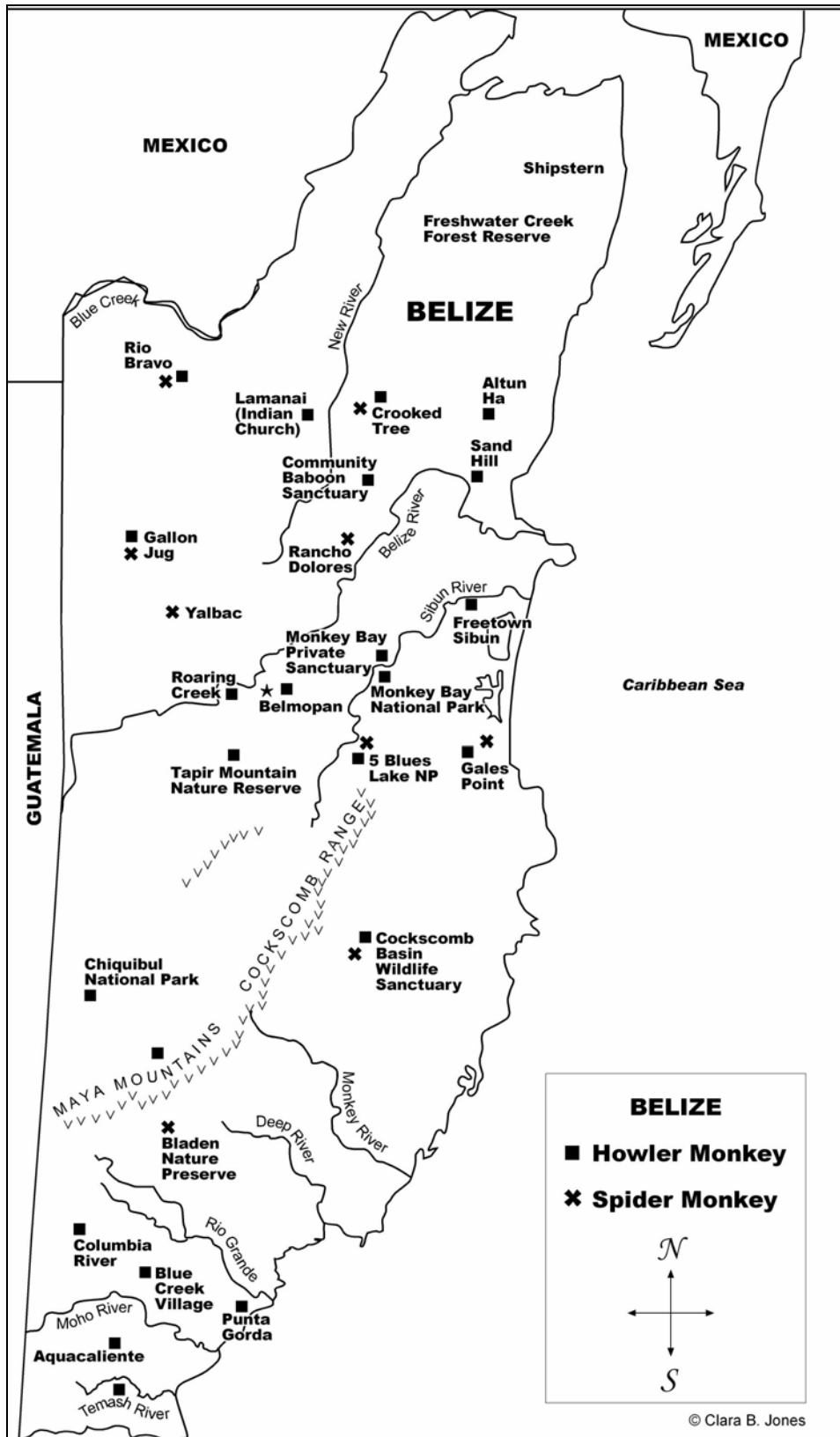


Figure 1: Species distribution map based upon opportunistic surveys conducted by Robert H. Horwich in the 1980s and 1990s. Some data points represent reports by local residents (R.H. Horwich, personal communication). See text for further discussion. ©Clara B. Jones



Figure 2: Map of forest cover (black area= deforestation) based upon satellite image (<[www.googleearth.com](http://www.googleearth.com)>).

June 2006, finding support for the view that the “Xateros” (Guatemalans crossing the border to harvest palm leaves) constitute a significant threat to primates in the Chiquibul region of southwestern Belize (see Bridgewater et al., 2004).

Phase 3 is the primary focus of this communication. These preliminary results were presented as a poster paper at a recent scientific meeting (Fayetteville State University Research Initiative for Scientific Enhancement Symposium, 2006). *Figure 1* presents results of surveys of Belizean primates conducted in the 1980s and 1990s by Robert H. Horwich (personal communication, 2006). Briefly, *Figure 1* displays a species distribution map of black howler monkeys and spider monkeys. A tentative pattern in these findings is that black howlers, entering Belize from the North, have crossed the Maya Mountains/Cockscomb Range in southern Belize, while the range of spider monkeys, spreading from the south, appears to be restricted by the mountain range. As noted above, the genus *Alouatta*, comprised of folivorous species, is recognized as a group of colonizers, while *Ateles*, sensitive to environmental perturbations and predominantly frugivorous, is not.

Folivory is thought to facilitate colonization, providing a relatively accessible food resource in most habitats and allowing relatively flexible “switching” from preferred (e.g., new leaves, flowers, fruits) to less preferred (mature leaves) foods during periods of food scarcity. (See, for example, Milton, 1980; Jones, 1995; Crockett, 1998.) Frugivory, on the other hand, is costly because fruit is patchily distributed and an inferior source of food (Fleming et al., 1987), factors that may limit or slow the geographical spread of species if appropriate food types and/or habitats are not encountered. If the patterns apparent in *Figure 1* are supported by additional field surveys, it may have important implications not only for the distribution and abundance of primates in Belize but also for the mechanisms and biogeography of speciation of *Alouatta* and *Ateles* and the differential vulnerabilities of these taxa to microhabitat and macrohabitat effects (see Hernández Fernández & Vrba, 2005). In addition, future research on the socioecology of these two genera may yield important information about their vulnerabilities to human exploitation (e.g., variations in vulnerability to hunting). Finally, additional investigations have the potential to yield information permitting empirical assessment of hunting pressure(s) based upon optimal foraging theory.

*Figure 2* shows a satellite image of forested areas, permitting the creation of an overlay for *Figure 1*. As expected, a comparison of the two figures shows that primates are least likely to occur where deforestation is

most severe (e.g., the coastline). *A. pigra* appear to persist in more deforested areas while *A. geoffroyi yucatanensis* are more limited to larger tracts of forest, possibly required by the patchiness of fruit. One of us (CAJ) has observed a similar species distribution pattern in Costa Rica. Future studies of bushmeat hunting in Belize, in particular, the hunting of primates, should exhibit additional overlay maps, for example, of the distribution of ethnic groups and/or population densities in Belize. These displays will allow an assessment of the relationship between the presence or absence of the two primate taxa, the degree or absence of forest cover, the density of the human population (see Green & Sussman, 1990), and other factors (e.g., clustering of ethnic groups in relation to primate populations and their differential vulnerabilities in space).

### Conclusions

It is likely that the incidence of hunting primates, if it occurs to any significant degree, varies from community to community among Belizean ethnic groups, including new immigrants. In Costa Rica, for example, howlers and other monkeys are protected and are generally not hunted by the population. Nonetheless, in Puntarenas, Costa Rica, a seaport, preserved body parts of howlers have occasionally been seen in the tourist market (CBJ, personal observation). Bushmeat hunting, likewise, may vary in frequency, rate, intensity, duration, and quality (e.g., as a result of hunting or habitat destruction) and as a function of spatial, temporal, and other factors (e.g., demographic characteristics of human populations). We look forward to additional descriptive and hypothetico-deductive research as well as theoretical and experimental tests of hypotheses generated by phylogeographic studies of primates in Belize and elsewhere.

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