Abstract

The Maya Mountains Archaeological Project (MMAP), a multidisciplinary survey of ancient Maya resource exploitation and exchange in the southern Maya Mountains of Belize, extended its efforts in 1994 into the western portions of the range, primarily the Central (Esperanza) and Snake Creek valleys, along the Little Quartz Ridge and main divide. Archaeological finds included three unlooted sites of modest size but considerable complexity and several intact ceramic vessels associated with caves. Of special note were a Mixtec-style globular vessel and a highly unusual modeled pot. Biological operations uncovered a new variety of swordtail fish possibly distinguished by an exceedingly rare form of melanoma. Three harpy eagle sightings were also made, and the unidentified monkey reported in 1993 was determined to be a variety of spider monkey with extreme and unexpected variation in pelage coloration. The geological reconnaissance continued to find copious pigment and grinding stone materials. Potential materials for chopping tools were also identified, as were likely impacts of lithologic variation on settlement patterns. The overall results are consistent with earlier findings, highlighting the significance of the region for the exploitation and exchange of key mineral and biotic resources.
Introduction

The Maya Mountains Archaeological Project (MMAP) is a multidisciplinary survey of ancient Maya resource exploitation, resource exchange, and resource-related sites in the southern Maya Mountains of Belize. Extremely rugged and remote, the region had previously resisted penetration by archaeologists. It was traditionally thought to have been little-occupied and of minimal archaeological import. Recently, however, scholars have begun to note its potential as a zone for resource procurement (Hammond 1981, Graham 1987). To date, the MMAP has uncovered ten sites of significant size and complexity and a multitude of crucial natural resources, providing substantial concrete evidence that it was heavily inhabited and probably served as a major source area for resources (Dunham et al. n.d. a,b).

The goal of the MMAP is to inventory the main mineral and biotic resources of this geologically and biologically unique range, along with any sites it contains that may have been associated with resource exploitation and exchange. The identification of sources for numerous key raw materials in the centrally located Maya Mountains will act to offset the long-standing emphasis on the role of distant exotic trade in complex development, especially among the Maya. The study area also offers a singular opportunity to examine the techniques and organization of production for a broad range of materials, from utilitarian to elite. We believe that extraction and processing will ultimately prove to be fairly extensive and decentralized. These findings would be in keeping with expectations based on the segmentary state and other multipolity models currently gaining favor in Maya studies (Dunham i.p. a,b.).

Given the formerly underexamined nature of the study area, the MMAP research divides itself per force into two stages, extensive reconnaissance and intensive investigations. The first phase has been devoted to identifying, locating, and sampling the major resources and mapping the main sites across the breadth of the southern flank of the range. With now three seasons of exploration complete, this stage of the work is nearing conclusion. The results of the latest such efforts are reported here. Based on the information gathered in our survey, we hope to return and focus our attentions on those discoveries that hold the greatest promise for illuminating resource exploitation and exchange. We will excavate processing areas, characterize mineral sources and related artifacts, and further document the most biologically complex ecosystems.

The first two seasons of the MMAP (1992 and 1993) probed the central portions of the study area (Fig. 1): the middle Swasey, Trio, and Bladen Branches of the Monkey River. The third and most recent season (1994) concentrated to the west in the headwaters of the Rio Grande and Bladen Branches, the Central or Esperanza and Snake Creek valleys, along the Little Quartz Ridge and main divide. In so doing, we endeavored to broaden our understanding of the igneous deposits and related flora, fauna, and sites of the Maya Mountains. With the only major volcanic mineral materials and igneous-associated biotic communities in the Maya lowlands, these locations offer resource opportunities found nowhere else in the vicinity, making them prime targets for a study of resource exploitation and exchange such as the MMAP.

Numerous significant finds were made. Among other things, we discovered three previously unreported sites, all of them unlooted and each situated in close proximity to important resource zones. We also established that the peculiar monkey sighted in 1993 is a variety of spider monkey with extreme and unexpected variation in pelage coloration. We continued to encounter abundant quantities of pigment and grinding stone materials, along with possible materials for chopping tools, and we clarified the likely impacts of lithologic variation in the region on its settlement patterns. Our preliminary assessment is summarized as follows.
1994 Operations

The 1994 reconnaissance was directed primarily at the main Esperanza and Snake Creek pockets, which feed underground into the Rio Grande and Bladen Branch of the Monkey River, respectively. Esperanza was targeted because it drains the Little Quartz Ridge, which by virtue of its prominent profile—unusual—even within the Maya Mountains—was a potential source of uncommon and perhaps useful mineralization. Snake Creek was selected because it dissects the western reaches of the Bladen volcanics, the eastern and central parts of which were inspected in prior years. We also spent some time in the upper Bladen, pursuing leads from last year and finishing work there that was left undone with the onset of the 1993 rainy season (Fig. 2).

As before, efforts were focused in the alluvial bottomlands of the major canyons, where there are good soils for agriculture, sufficient year-round water to sustain populations, the most complex biotic communities, and creekbeds with useful mineral exposures and "float" (water-borne debris). Opportunities were also investigated as they arose along the access routes.

Once more, the archaeological survey first targeted locations that looked the most promising on the basis of previous experience in the region (elevated banks near water with well-developed high-canopy covers). If such efforts proved unproductive, then secondary and tertiary targets were systematically reconnoitered, generally by blanketing them with parallel traverses no more than 50 mts. apart. Virtually the entire Esperanza pocket was surveyed, including the main valley, eastern lobe, and western or Jalisco branch, the immediate drainage for the eastern face of the Little Quartz Ridge. The northern half of the Snake Creek valley was checked (the southern half turned out to be too rugged for settlement), and the Cuyamel pocket, between the Ramos and Ek Xux quebradas on the Bladen, was searched in its entirety. Sites were cleared, photographed, videotaped, and mapped, with a transit and stadia rod. We also tried to inspect, as much as possible, neighboring caves in order to save cave materials from looting.

Biological collections and observations were conducted in the same locations as the archaeological survey: Esperanza (eastern, main, and Jalisco branches), northern Snake Creek, and Cuyamel. In addition, biological operations were performed in the Ek Xux pocket and in the area between Teakettle Camp and the Ramos Quebrada on the Bladen. Biological data were also collected along access routes. Collections were made of reptiles, amphibians, fish, and some invertebrates, mostly ticks. Observations were made mainly of vegetation, birds, and monkeys, the latter in hopes of identifying the unusual white-faced monkey reported during the 1993 season (neither of the two species documented for Belize, the howler and the spider monkey, are known to exhibit such pelage coloration). An attempt was made to relocate a specimen of the unusual trogan sighted last year at Tiampihá on the Bladen, and ambient light levels were recorded along the Bladen between Forest Hill and the Ramos Quebrada.

The geological reconnaissance was most extensive in the Bladen, where numerous and sizable samples were taken from the vicinity of Ek Xux, Cuyamel, Ramos Quebrada, Teakettle Camp, Forest Hill, and Tiampihá. Materials were also sampled in the lower reaches of the Esperanza pocket and in the Jalisco ravine. Collecting was precluded in the Snake Creek valley by the advent of heavy rains. As in previous seasons, samples were collected primarily from the float. The Maya probably obtained most of their minerals from such deposits, which concentrate a variety of materials, enjoy easy access, and are readily exploited. Through the good graces of Brian Holland of Belize Minerals, Ltd., specimens were also acquired from Doyle's Delight, the highest point in the range just above Snake Creek, and from quarries on the outskirts of Punta Gorda (Shaffer Mountain, Sand Hill, and Lester).
Thus, the upper Bladen and Esperanza pockets were reconnoitered on all three fronts—archaeological, biological, and geological. Snake Creek was only surveyed for archaeological and biological purposes; a geological reconnaissance was not performed there. As far as we know, these efforts constitute the first such extensive surveys for the west-central interior of the main mountain massif, aside from some preliminary ecological assessments by Matola (1994), Holland, and others at Doyle’s Delight and a brief visit by primatologist Dahl (1994, personal communication to Dunham) to the divide in the vicinity of the upper Bladen.

Archaeological Findings

Archaeological operations in the Esperanza, Snake Creek, and Cuyamel pockets produced three previously unreported sites and several significant offerings associated with caves. The three sites were modest in size relative to the major centers in the Maya heartland, like Tikal, but they were substantial and complex for the Maya Mountains. All three were unlooted, a highly fortuitous circumstance, and situated in close proximity to major resource areas or corridors, suggesting that they likely served as platforms for resource exploitation and exchange.

In expanding the survey of the Bladen begun last year, we inspected nearly all of the Cuyamel pocket (Fig. 3), with the exception of a few minor portions of the lower reaches that were too rough for settlement. Much of the valley was heavily eroded and had little cohun palm for thatch, which probably discouraged occupation. We did not find much of archaeological significance, aside from a small platform within a rockshelter in the northeast corner (UTM 9950/2735) and a handful of low mounds on the eastern bank of the creek along its lower stretches (UTM 9935/2540). We also examined a number of caves, none of which were very extensive or rich in archaeological materials. Cuyamel 1, in the northwest lobe of the canyon (UTM 9825/2675), contained some curious lithic artifacts (see discussion of cave finds below). A few sherds were found scattered in other caves within the encircling escarpment.

No large center was documented. While geologist Meurer observed formations near the mouth of the valley that he did not believe were natural in origin, archaeologist Dunham did not note any clearly artificial constructions among them. Heavily incised by flood channels, the location was not a promising one for habitation. The likely absence of major remains may reflect the marginal character of the soils, vegetation, and land surface. This pocket is smaller than those of its neighbors (i.e. Ek Xux, Ramos Quebrada, Quebrada de Oro) and seems to be in a different stage of geological evolution. Its alluvial bottomland is not as extensive, which would have limited agriculture and population, and its cover is not as well developed, perhaps restricting biotic resource possibilities. Geological sampling was curtailed by rain, but nothing distinctive was collected, suggesting that mineral resource prospects were likewise constrained.

The headwaters of the Bladen, the Snake Creek pocket (Fig. 4), proved far more productive than was Cuyamel. Similar to Cuyamel, the southern portions of the valley turned out to be too convoluted and unsuited either for agriculture or settlement. The northern half, however, was significantly better. The land surface was much more regular, the vegetation more developed, and the soils superior. With cloud, palm, and fern forests at hand, and the highest point in the Maya Mountains (Doyle’s Delight) immediately above, Snake Creek enjoys a bonanza of unusual biological resource opportunities. It drains the main divide and the western extreme of the Bladen volcanics, probably affording access to igneous materials, although collections were not made here again because of rain.
Not surprisingly, with all these resource and settlement advantages, there were numerous house mounds scattered about the northern part of the depression. Some were rather sizable (up to 2 mts. high), well constructed (with nicely laid cut stone facades and stairways), and arranged in complex groupings (extensive, neatly defined, multiple-plaza units). The surrounding escarpments were honeycombed with caves, many of which contained ceramic remains but have at least partially collapsed since aboriginal times, crushing much of their contents. One particularly noteworthy ceramic deposit was found in a cave on the southeastern rim (UTM 8485/2040). Details are discussed below with other major cave finds. In the middle of the valley floor, beneath the best canopy in the pocket, a small center was encountered, seated atop a high bank overlooking the main creek on the northeast side (UTM 8490/2110).

Saach'olil Ruin, or the "Happy" site in local K'ekchi Maya (so named because it was a pleasure to find after such a grueling trek and an afternoon spent searching for it in the rain), is perhaps the most removed site in the entire Maya lowlands. The pocket is certainly one of the most rugged and remote valleys in the Maya Mountains. We approached it from the village of San Pedro Columbia, passing through Esperanza and opening trail across the jagged and trackless intervening ridges. The only other access routes are either by ascending the Bladen and Snake Creek chasms from the coastal plain or by crossing the main divide of the range, neither of which represents easy going. Even in its day the location was a difficult one. The site lies some 35 kms. south southeast of Caracol and 22 kms. north northeast of Lubaantun, the closest major centers. It is 4.75 kms. north of Chac Bolai (see below) and 12.25 kms. west southwest of Ek Xux (Dunham et al. n.d.b), the nearest known mountain sites.

Saach'olil is not large or elaborate compared to the great Maya sites, nor is it very sizable or complex for a mountain ruin. It is, however, considerably more substantial than simple residential remains, and it is especially impressive considering its extreme setting. It consists of two main plazas flanked by an extended range structure (Fig. 5). There are no monuments, and the tallest construction is merely 2 to 3 mts. high. Nevertheless, the cut stone facades and stairways are superb, and the layout is exceedingly tight, in the manner of a major site. The surface remains appear to date, as at most other mountain ruins, to the Late or Terminal Classic (AD 700-900), the end of the Maya florescence and the time of decline.

An undetermined portion of the northwest corner of the site has fallen over the bluff, being undermined by the erosive action of the creek. The destruction will increase as the scarp continues to weather, but the diminutive size and difficult location of the site discourage remediary measures. The ruin had not been looted as of our visit and was otherwise remarkably well preserved, with several stretches of neatly stacked masonry that may yield additional insights into chronological and intersite relations upon further examination.

Like the Snake Creek pocket, the Esperanza valley is a fairly rugged and remote one (Fig. 6), accessible only by climbing the gorge of the Rio Grande north from San Pedro Columbia (Lubaantun). Also similar to Cuyamel and Snake Creek, a great deal of the Esperanza pocket is unsuitable for habitation and unoccupied. Much of the lower floor of the main valley appears to suffer from heavy erosion and flooding. The Jalisco pocket--to the west, at the foot of Little Quartz Ridge--has literally no cohon palm for thatch, which was perhaps a factor in the lack of occupation there. The valley as a whole enjoys advantageous access to unique upland biotics and useful mineral materials. The major remains occur associated with the southeast lobe of the valley, where there are a number of substantial, complex, and well-executed house mound groups, mainly on the east bank of the river. Perched immediately above the river, high atop
this eastern bluff, is Chac Bolai (UTM 8395/1635), named after the K'ekchi term for the jumping tommypoff (*Porthidium nummifer*), a pygmy pit viper that abounds at the site.

Small to medium in terms of monumentality for a mountain center, Chac Bolai is nonetheless relatively extensive and complex. It is composed primarily of a large civic plaza with a range structure (Fig. 7). This central courtyard is connected by a causeway with low flanking parapets (< .5 mt. high) to a low temple mound (3 mts.), the tallest building at the site. The courtyard-causeway layout is highly reminiscent of the upper Bladen sites (Quebrada de Oro, RHF, and Ek Xux) and certain sizable centers in the Petén (e.g., Poptún, Nakum, and Itzán), although here there is no plaza or stelae at the temple end of the causeway. It does not at all resemble the compact organization of Lubaantun, the major Rio Grande site, but it is similar to neighboring K'antulai (see below). There are also several adjoining minor courtyards, and some of the stonework is rather impressive. Again, the surface materials seem to date to the Late and Terminal Classic (AD 700-900). Chac Bolai remains unlooted, with several nicely preserved walls. The southwestern corner of the center is collapsing into the river, but once more the distance and expense involved discourage stabilization.

The heights between Esperanza and the Rio Grande proper produced an exceptional find. This elevated limestone ridge is heavily dissected, with little soil and no surface water, an unlikely location for remains of any import. Surprisingly, during his field work on Maya cave utilization, Gary Rex Walters (1992, personal communication to Dunham) spied what he thought was a defensive wall across the principal pass. We were initially skeptical, since intercenter fortifications are rare in the Maya area. Despite our incredulity, when we first encountered the feature our impression was the same. Upon further examination, though, the remains revealed themselves to be those of a very substantial, complex, and well-constructed ruin, K'antulai (the K'ekchi word for a variety of large stinging wasp, two colonies of which were discovered there). The long "wall" turned out to be a peculiar chain of range-like structures that form the northern boundary for the main plaza and an adjoining causeway (Fig. 8).

K'antulai straddles the pass, which is essentially a channel that cuts through the ridgetop. There are saddles at the northern and southern ends. The ruin occupies the southern saddle, on the Rio Grande or Lubaantun side (UTM 8490/1525). The main plaza, flanked by large range structures, sprawls across the seat of the saddle. The masonry rivals that of Lubaantun and includes megalithic blocks, huge paving slabs, and neatly executed stairways. As at Lubaantun, there are no monuments. The structures are quite sizable, with facades up to 5 mts. high. A narrow parapeted causeway extends up the eastern horn of the saddle—an unusual uphill trajectory—toward a group of massive terraces. A short alleyway parallels the lower end of the causeway. The terraces are designed, in the fashion of southern Belize, to look like a pyramidal platform of considerable size, when they are really just a natural hillside spur that has been reshaped and faced around. With residential structures and courtyards on top, this commanding facility likely housed the leading family. The remains again appear to date to the Late or Terminal Classic (AD 700-900) and are undisturbed, with some facades in spectacular condition.

The placement of the site is truly remarkable and worthy of comment. Obviously, the position is one that allows for absolute control of traffic between the Esperanza pocket (Chac Bolai), points beyond (Saach’olil?), and the Rio Grande (Lubaantun). K’antulai almost certainly regulated the movement of people and materials between these areas. Terracing observed on the opposite (northern) saddle may help explain how a sizable population was fed with such meager soil reserves, but the fact that the closest permanent source of water, the Central River, is a good 2 kms. away down a precipitous slope still begs for explanation. We suspect that the
inhabitants may have managed and stored water using perishable materials, like wooden sluices and cisterns, and that they may have taken advantage of a fortuitous feature in the local landscape. The site sits at the edge of an enormous sinkhole, which might conceivably have been plugged to capture water, a prospect that we hope to test in the future.

The sinkhole itself is also of archaeological note. At the base of the surrounding scarp, there is an immense rockshelter, with an ash-filled stone cairn containing jute shells at each end. The rear wall is cleaved horizontally by three recesses with shelves. The middle shelf had a low rock border along the front. This recess produced quantities of charcoal, a few utilitarian and polychrome sherds, a large vertebra, three oliva shells, and a small bit of shell carved in the shape of a monkey's head, with perforations around the perimeter, probably for mounting as an adorno on some other surface. We named the shelter "Monkey Head" in K'ekchi, or Holomi Mash. The surrounding slopes were both covered with residential structures and numerous small caves, many of which contained cultural materials, even a masonry wall.

We intend to give a fuller accounting of our cave finds elsewhere, but for the purposes of a preliminary report it is important to note that besides the discoveries at K'antulai our survey uncovered a number of other caves and significant remains associated with them. A few of the more significant finds are summarized here.

Snake Creek 1, a small moist grotto atop the southeastern scarp of the pocket (UTM 8470/2040), contained on the floor an offering of three Postclassic pots (ca. AD 1500): an urn, a handled censer, and a most remarkable globular tripod vessel (Fig. 9). The latter features the head of a bird modeled in clay upon its shoulder, with the body of the bird painted around the walls in the style of the Mixtec, some 650 kms. to the west in south central Mexico. It is noteworthy that the most remote valley in the mountains and possibly the entire Maya lowlands maintained such cosmopolitan connections at a time when much of the rest of the area was in decline. Perhaps it continued to enjoy prominence as a zone of resource procurement.

Another globular vessel came from the vicinity of Ek Xux on the Bladen (UTM 9600/2400). With small loop handles on opposite flanks, probably for suspension, its side wall sports a crudely modeled head, the mouth of which opens through to the interior (Fig. 10). The face appears to be feline, maybe that of a jaguar. It is unclear how the piece functioned, as a container with spout, a censer with vent, or a ceramic drum with sound hole. Nothing similar has ever been reported before from southern Belize. It is difficult to date with any security, although it is tempting to associate the modeling with the Postclassic censer tradition. The pot was recovered at the base of a tree, where it could not possibly have survived long exposed to the elements. The inside is stained with bat droppings, suggesting that it originated in a nearby cave. We suspect that it was removed by a hunter, who left it behind in favor of his quarry and intended to return for it later, or by an ecotour operator, who may have placed it there as a staged archaeological wonder (a nonMaya camp was found nearby).

Intriguing nonceramic finds were also made in caves. Atop a high shelf in the back of a small cave in the northwest lobe of the Cuyamel pocket (UTM 9860/2880), was an odd cache of small subrectangular bars of limestone, with red stains on their smoothly abraded faces. The surfaces and traces of red suggest that the bars may have been used to grind pigments, or possibly to polish pigment-stained materials (Justin Kerr 1994, personal communication to Dunham). They may have been employed in the very resource processing that is of interest here. Almost 2 kms. southwest of K'antulai, above the subterranean stretch of the Rio Grande, is a truly gargantuan sinkhole called La Cumbre (UTM 8563/1360). On the floor of the mammoth chamber at its base were found collections of small travertine lozenges that much
resemble phalanges (finger bones). Their purpose is unknown. There are also low retaining walls in the talus around the entrance. According to one of our guides, this cave and others in the vicinity were originally explored by Gary Rex Walters several years before.

In short, the archaeological reconnaissance yielded three previously unreported sites, one in Snake Creek (Saach’o’ol) and two associated with the Esperanza valley (Chac Bolai and K’antulai), the headwaters of the Bladen and Rio Grande, respectively. All three were unlooted and are located in close proximity to important resource pockets, likely reflecting some involvement in resource exploitation or exchange. The Mixtec-style vessel from Snake Creek, in particular, indicates that the region sustained wide-ranging contacts at a very late date, when much of the rest of the southern lowlands was in retreat.

Biological Findings

The 1994 biological survey was as productive as the archaeological reconnaissance and as successful as any of our previous efforts. It provided further evidence that the region contains many unusual biota, underlining the elevated potential of the Maya Mountains as a source of unique biological resources. It also helped identify the most complex biotic communities, which by virtue of their very diversity offer heightened resource possibilities. We hope that our data, some of the first and most extensive for the area, will help inform management efforts.

A major focus of the 1994 MMAP work on the Bladen was to resolve periodic reports of a white-faced monkey in the southern Maya Mountains, especially a sighting by MMAP personnel during 1993 in the Ramos Quebrada. Only two monkeys are known for Belize, the black howler monkey (Alouatta pigra) and the spider monkey (Ateles geoffroyi), in particular the subspecies yucatanensis. Neither of these has a white face. We anticipated finding a fringe population of capuchin monkeys (Cebus capuchinas limitanus), which have lighter facial coloration. There is some evidence indicating that capuchins may have once extended their range this far north, including possible representations in ancient Maya art, where they may have been associated with scribes (Baker 1992). Such a find would constitute a new third monkey for Belize, expand the range of the capuchin, and verify the presence in the Maya Mountains of a primate that may have been of great significance to the Maya and otherwise rare within the Maya area.

We assembled a special primatological crew to explore the possibility that there might be a vestigial isolate of capuchin monkeys surviving in the remote and rugged haven of the southern Maya Mountains. Led by Dr. Jeremy F. Dahl of Yerkes Regional Primate Research Center at Emory University, the team consisted of Mary E. Baker, a doctoral student specializing in capuchin monkeys at the University of California, Riverside; Sharon Matola, Director of the Belize Zoo; Martin Meadows, noted forester and naturalist; Dr. James Wilson also of Yerkes and an avid ornithological enthusiast; Greg Sho, a Mopan Maya resident of Maya Centre well-versed in Belizean flora and fauna; and a number of K’ekchi and Mopan Maya guides, including Fidel Pop (Chun), who was a member of the MMAP group that observed the white-faced monkey in 1993. Members of the group spent up to three weeks thoroughly surveying the area between Teakettle Camp and the Ramos Quebrada, scene of the prior report.

In spite of our expectations, we did not encounter any capuchins during the course of our investigations, but we did find surprising and relevant variation among spider monkeys. The Bladen supports a relatively large population of spider monkeys with considerable diversity in
pelage coloration, more consistent with *Ateles velerosus* than with *Ateles geoffroyi*, the variety generally assigned to Belize. Some individuals have markedly lighter undersides, which may have inspired the sightings of a "white-faced" monkey. In fact, other scholars have suggested that the Belizean spider monkey is actually *velerosus*, not *geoffroyi*. The MMAP findings provide further documentation for this interpretation. Details of the primatological background, the reconnaissance, its results, and their importance are summarized in the addenda by Dahl and Wilson (Appendix 1) and by Matola and Meadows (Appendix 2).

On the ornithological front, we revisited Tiampihá to pursue the 1993 sighting by a MMAP team of a previously undescribed trogon, relative of the spectacular and endangered quetzal bird (Murray 1993). Unfortunately, we were unable to relocate this bird and still cannot determine whether it represents a new species, subspecies, hybrid, or color variant. We did see harpy eagles (*Harpia harpyja*) in the Esperanza pocket (Murray 1994) and in the Ramos Quebrada. Remains of what appeared to be another were encountered near Calera Camp on the Bladen. Confirmed harpy eagle sightings are extremely rare in Belize. The last recorded sighting may have been over twenty years earlier. Numerous other raptors were sighted, suggesting that the food chain is comparatively intact and the ecosystem relatively undisturbed, although we saw signs of heavy hunting in all but Snake Creek. Over 100 species of birds were observed, a number of which are endangered. Notably, the scarce keel-billed motmot (*Electron carinatum*) occurs in quantities around Teakettle Camp on the Bladen. Both Appendices 1 and 2 include further information on bird sightings.

By and large, the 1994 fish were the same as those reported in prior seasons, with several notable exceptions. A variation on the green swordtail (*Xiphophorus helleri*), but with black spots on its sides, was collected in the Esperanza and Snake Creek valleys. James Thomerson, a leading authority on Central American fish, believes (1994, personal communication to Murray) that these markings may be an exceedingly rare form of melanoma that has only ever before been produced in the laboratory by artificially hybridizing swordtails and plattys. This swordtail may be a new variety. Another new variation with two parallel red lateral lines, instead of one, was collected at Teakettle Camp on the Bladen. Interestingly, no cichlids were noted in Esperanza and Snake Creek, in spite of their profusion downstream in the Rio Grande and Bladen. They apparently do not ascend the subterranean passages linking the headwaters and lower reaches of the drainages. Aside from a few pseudohelleri (*Heterandria bimaculata*), fish were absent from the Jalisco lobe of the Esperanza pocket. There was plenty of food for fish in the creek and no serious obstacle to their ascent, just a minor stretch of rapids. We wonder if there might be a chemical reason for the heavy selection evident here.

A dozen snakes were collected; a far greater number was observed. Most were varieties that we have collected or observed before. Two were unfamiliar to our K’ekchi and Mopan Maya guides. One, with a golden diamond pattern on a black background, was from Ek Xux on the Bladen. The other, with a blue-black motting on a pink ground, came from Esperanza. The former appears to be a ratsnake (*Elaphe triaspis*) and the latter a snail-eating snake (*Sibon nebulata*), uncommon in Belize (S. Matola 1994, personal communication to Dunham; R. Reynolds 1994, personal communication to Murray). No fer-de-lances (*Bothrops asper*), which abound at lower elevations, were observed in either Esperanza or Snake Creek, whereas numerous jumping tommygoffs (*Porthidium nummifer*) were seen in both of these locations in the mountain interior. They seem to be in complementary distribution, with *Bothrops* preferring the lowlands and *Porthidium* the uplands. Also, one of our guides killed what appears to be a huge (1.5 mt.-long) coral snake (*Micrurus diastema*) in, appropriately enough, Snake Creek.

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Forester Meadows has also provided a wealth of insights into the nature of the plant communities in the vicinity of the Ramos Quebrada and their importance to the Maya. He notes that approximately 500 mts. north northeast of the RHF Site lies a cluster of ground palm (*Calyptrogyne ghesbreghitiana*), which was not otherwise seen and may constitute the remains of a sort of tree garden. The same alluvial bottomland features a multitude of species of fruit trees that would have been of interest to the Maya, including the mammey (*Pouteria sapota*) and monkey apple (*Licawia platypus*). More information on these areas and others—such as hillside, sinkhole, and mountain scrub pine forests—is contained within his contribution to Appendix 2.

In addition to the above finds, we collected numerous frogs, lizards, spiders, ticks, aquatic macroinvertebrates, and millipedes. Further observations on their significance, though, must await continued analyses. We also observed a number of mammals, other than spider monkeys. Many of these sightings are listed in Appendix 2. A comprehensive list of specimens collected is included in Appendix 3.

In sum, the areas examined produced a sizable body of data on the biotic communities of the southern Maya Mountains and the associated biological resource potential. Singular finds like the fish with melanoma underline the uniqueness of this resource base and its probable importance to the Maya. The primate survey helped to clarify the identity of the variety of spider monkey present in Belize (*Ateles velenosa*, not *geoffroyi*), while the documentation of wildlife under stress, such as the harpy eagle (*Harpia harpyja*), may aid efforts to protect these species and the overall region. Other recent information on the biota of the Bladen and greater Columbia (Esperanza) areas may be found in Brokaw et al. (1987), Iremonger and Sayre (1994), and Parker et al. (1993).

**Geological Findings**

Most of the 1994 work was conducted along the upper Bladen, between Ek Xux and Teakettle Camp, but reconnaissance was also performed around Tiampihá on the coastal plain and in the Esperanza pocket. Samples were restricted mainly to materials of potential resource value to the ancient Maya (pigments, volcanics for grinding stones, etc.). They were collected primarily from the float found in the drainages. As in earlier seasons, we encountered a large number of useful mineral materials. Preliminary identifications are listed in Appendix 4. We begin our discussion with the major focus of the work, the Bladen.

In general, the Bladen float is noteworthy for its igneous and volcanic-derived materials, which originate along the divide in the upper catchments. Materials noted throughout the Bladen but not sampled include bull quartz, chert, and limestone. The only outcrop observed in the Bladen below 300 mts. of elevation is fine-grained limestone. Extensive development of karstic features, including caves and sink holes, occurs in this area. The drainage itself is deeply incised, a veritable canyon in the jungle, entrenched between sheer limestone precipices. Consideration of the geology of the Bladen will proceed from west to east (i.e., from upstream to downstream).

Sampling in the Ek Xux pocket and the adjoining pocket to the west revealed only igneous materials: volcanics (from surface vulcanism), hypabyssal intrusives (from subsurface igneous activity), and possible volcaniclastic rocks (from the reconsolidation of volcanic materials). The bulk of the material observed was silicified volcanic ash, ranging from aphyric to twenty percent, by volume, crystals of quartz and feldspar. Most contained one to three
percent sulfides, primarily pyrite. Possible hypabyssal samples contain euhedral K-feldspar and pseudotetragonal quartz crystals. They also contain approximately three percent sulfides, possibly pyrohytite. Tentative identification of volcaniclastic rocks is based on high volume-percent crystals, making the material unlikely to have erupted. A feature of note in the Ek Xux pocket is the lack of hematite, limonite, and manganese oxides—all pigment materials used by the Maya. Examination of the next pocket to the east, Cuyamel, uncovered material that was not significantly different from that of Ek Xux, mostly silicified volcanic ash. The Ek Xux-Cuyamel materials represent good media for cutting and chopping tools and temper for pottery.

The adjacent Ramos Quebrada, however, produced abundant clastic sedimentary rocks and no potential hypabyssal material. Clastic rocks range in grain size from medium-grained sandstones to conglomerates, with clasts up to 2.5 cms. across. Volcanic and volcaniclastic materials similar to those seen in Ek Xux were also found in the Ramos Quebrada. Hematite and limonite, which served as coloring agents for red and yellow pigments, respectively, are abundant in the Ramos Quebrada, as most of the clastic rocks have ferruginous cements. Manganese oxide stains in the fractures from several samples also indicate the presence of colorants for black pigments. Samples were also collected at Teakettle Camp, but no rock types were observed that did not occur in the sampling upstream.

On the lower Bladen, sampling at Forest Hill, where the river emerges from the mountains, revealed a porphyritic granite that contains euhedral K-feldspar up to 3 cms. in size with well-developed carlsbad twins. This particular material does not resemble any grinding stone material familiar to the investigators, but it is possible that other materials associated with it may have had grinding stone applications. Samples were also studied in the area around Tiampihá, a sizable ruin on the coastal plain reported in 1993 by the MMAP (Dunham et al. n.d.b). No new rock types were noted. The Bladen bifurcates around the ruin. Large limestone blocks were found in the southern branch. Examination of these blocks indicated that they had been redeposited in the streambed from the erosion of the ruin. They appeared to have been worked, and the limestone was the same as that of the ruin.

A preliminary evaluation of the lithic resource potential of the Bladen valley is possible given the above data. The lithologic variation along the length of the Bladen suggests that the material is sorted in a linear fashion, with mineral resources at the top that do not occur downstream, and vice versa. Such a distribution has important implications for resource procurement and exchange and for resource-related settlement.

The uppermost pockets, Ek Xux and Cuyamel, contain materials suitable for cutting and chopping tools and temper for pottery. While some of the material in these pockets could have been used for grinding stones, it is viewed as less desirable for this purpose than are the clastic rocks found at Ramos Quebrada and Teakettle Camp. The uppermost pockets also lack pigment resources (hematite, limonite, and manganese oxides) that are relatively plentiful at Ramos Quebrada. On the other hand, Ramos Quebrada has abundant grinding stone resources and pigment materials but lacks any quality chopping tool lithologies. Sorting of materials along the Bladen is difficult to assess, but it appears to be a significant phenomenon, based on the samples taken from the lower Bladen. Only a few of the lithologies observed in the upper half of the Bladen are present at Forest Hill, and even less variability is seen at Tiampihá. Not all resource materials are available in every location, and the river does not transport resource materials very far downstream.

This arrangement has interesting sociocultural ramifications for the Bladen resource system. It means that no single community can exert direct command over all of the resources
in the valley. Even though a site along the lower reaches, like Tiampihá, might control traffic in and out of the watershed, it is not the immediate master of all of the resources themselves. It is not possible to exploit the variety of mineral resources on the Bladen from one location. It is necessary to do so from various centers within each lithologic resource zone. In fact, centers are found in each mineral resource zone. These centers undoubtedly doubled as nodes of exchange. In short, the linear sorting of mineral resources conditions the organization of exploitation and exchange and the associated pattern of settlement.

Survey geology was also conducted in the Esperanza pocket with samples taken from the Central River and Jalisco Creek, which drains Little Quartz Ridge. Compared to the Bladen drainages studied, surprisingly little lithologic variation was observed. Both the Central and Jalisco contained shale/mudstone, limestone, bull quartz, fine to medium-grained sandstone with quartz veining, and hypabyssal or volcanic igneous rocks. None of the samples examined was silicified, in contrast to the Bladen, and no chert was recorded in the float. The hypabyssal or volcanic material contains thirty volume-percent crystals of euhedral K-feldspar and blue quartz, making for a distinctive appearance. None of this material was observed in the Bladen. A notable feature of the Central River drainage is the presence of very coarse-grained conglomerates, with cobble-size clasts and hematite or limonite cement. The clasts are matrix-supported and readily weather out, leaving large deposits of hematite and limonite.

The Esperanza pocket contains good materials for chopping tools, temper for pottery, and pigments but lacks any chert for cutting materials. The large deposits of hematite and limonite, however, are of sufficient quality and quantity that they could easily have been exported.

To recap, the 1994 lithic resource survey of the MMAP produced a variety of useful insights into the mineral resource potential of the Maya Mountains. We have now documented the presence of a number of important materials for grinding stones, pigments, chopping tools, and other uses in the upper Bladen and Rio Grande (Esperanza), results that expand upon and complement our previous discoveries. The existence of these materials in the region enhances its stature as a likely resource procurement area and underlines the probability that it served as a close-range source of numerous significant materials. Their linear sorting along the Bladen also conditions the patterns of exploitation, exchange, and settlement in that drainage, with individual procurement sites in each valley, rather than a single large center for the whole system. The larger centers downstream likely functioned as exchange centers.

**Conclusions**

The MMAP work in the Maya Mountains has provided a wealth of new insights into the nature of the ancient Maya presence there. The three sites found in 1994 reinforce indications from prior seasons that the region was relatively heavily occupied by the Classic Maya. While these sites are not huge and the density of settlement is still low compared to the Maya core, they are sizable and complex for the region, and virtually every habitable bit of land is occupied, as is the case with Chac Bolai and Saach'oil in the Esperanza and Snake Creek pockets. Even some parcels of inhospitable land were settled, with K'antulai situated in a high, dry craggy pass without much soil. The present uninhabited state of the range, which probably encouraged many to dismiss it as a little-occupied prehistoric backwater, belies its actual status in antiquity as a well-settled and centrally-placed source area for a multitude of key resources.
The Maya Mountains are unoccupied today because they are remote from contemporary population centers, the terrain is too rough for our modern modes of mechanized conveyance, and they are thought to contain few resources of commercial value for an industrialized world. We believe, however, that they were settled in prehistory in part because the opposite situation obtained then. With foothill centers like Uxbenka and Nim Li Punit, there were sizable pedestrian populations in the vicinity, and foot travel is the most effective means to penetrate the region. Furthermore, as we are in the process of demonstrating, the mountains harbor mineral and biotic resources that were of considerable utility to the Maya. The fact that they were occupied and that they contain these materials makes it highly likely that the resources were exploited and exchanged and that their primary significance lies in offering a close-range, internal source for a wide array of useful materials, ranging from utilitarian to elite.

The exact chronology and sequence of development for the Maya Mountains sites is still unclear, but at least two major scenarios can be advanced, based on the survey information now at our disposal. On the one hand, it is possible that the region was heavily inhabited from a very early date, although the surface remains are rather late and seem fairly unlikely to conceal much in the way of previous habitation. If the sites have early components, then these occupations probably exploited and exported the resources directly. On the other hand, it is also conceivable that the Maya Mountains sites may have been late offshoots from foothill and surrounding centers (e.g., Lubaantun), as populations mounted and the latter centers fell into decline and dispersed. In such an event, the resources may have been exploited and exchanged in earlier years by outside centers through the agency of temporary procurement parties. We hope that our future, more intensive investigations will clarify the situation.

In either case, an important part of the equation revolves around the degree to which the Maya Mountains sites were autonomous operators or dependencies of other centers. In the past, we have argued for a fair degree of autonomy on the part of mountain sites. This year, there is evidence that points in both directions. Several features might be interpreted as being compatible with dependency. The 1994 sites have no monuments. Their spectacular stonework, especially at K’antulai, is highly reminiscent of that of Lubaantun, the largest and closest major center. K’antulai and Chac Bolai are located along the Rio Grande canyon, linking them with Lubaantun. Nevertheless, they are sizable and complex in their own right and separated from Lubaantun by considerable distances and torturous terrain. Moreover, their causeway site plans differ markedly from the compact layout of Lubaantun, which itself lacks stelae. In the end, Lubaantun may not have ruled over its neighbors, but it may have controlled them indirectly. It certainly was in a position to have commanded access to and from them. They may have acted as nodes within a Lubaantun-dominated network of resource exploitation and exchange.

It is possible with the data at hand to begin trying to reconstruct the individual positions of the 1994 sites within the Maya Mountains resource system. Chac Bolai and Saach’olil, nestled within their respective resource-rich pockets, were very likely advance centers for extraction and perhaps primary processing. Situated in the Rio Grande headwaters, Chac Bolai probably served as a source site for materials exiting through Lubaantun. The outlet for Saach’olil is not so obvious. Materials could have flowed out either through the Rio Grande and Lubaantun or through the Bladen and its downstream sites (Ek Xux, Tiampihá, etc.). The latter lie in the same drainage, which provides another corridor to the east, even if the actual connection is underground. Located in the principal pass, K’antulai is almost certainly an intermediary center, managing traffic between the interior procurement sites and Lubaantun.
Lubaantun, along the closest stretch of navigable river, is a logical center for overseeing the final export of Maya Mountains materials to points beyond and the import of external materials.

Our 1994 efforts have given us even further insights into the natural imperatives underlying the structure of resource-related settlement, exploitation, and exchange in the Maya Mountains. The revelation that each pocket contains a slightly different complement of mineral resources from that of the its neighbors may help explain why we find sites in every valley, including the most remote and inhospitable. Similar sorting occurs with the biotic materials, from one setting to the next. If such resources were distributed evenly across the range, settlements in one or a few easily accessible locations might have been able to supply enough materials to satisfy Maya needs. This lateral segregation means that a number of communities would be required to exploit the available useful resources and that no single site could readily control the entire resource system. That the pattern we are encountering fits these expectations fortifies our assessment of the resource significance of the region.

Following our initial forays into the range, we also raised questions concerning the ethnic mechanics of the Maya Mountains resource operation. It is appropriate, then, that we consider here briefly the relevance of our more recent findings in this regard. We commented in 1992 (Dunham et al. n.d.a) on the eccentric character of some of the remains in the Swasey and along the Trio. We wondered if there may have been a local population indigenous to the Maya Mountains that furnished labor for resource exploitation and exchange but was not fully schooled in mainstream Maya customs, while the mechanics of the operation were supervised by others (immigrants?) who were more thoroughly inured in the elite Maya ethos. Our 1993 finds (Dunham et al. n.d.b), though, with their typical Maya plazas, causeways, monuments, and such features, did not evince much of a dichotomy. Likewise, we feel that the 1994 discoveries do not point to any great cultural divide. They fall squarely within the Classic Maya tradition. We do not yet understand the contrasts evident to the east, but we hope they will be resolved by excavation and additional work in that area as our inquiries proceed.

Once more, some of the 1994 finds are evocative of broader connections. The axial causeway arrangement at K'antulai and Chac Bolai is similar to that of the upper Bladen sites. As mentioned before, it is also characteristic of a number of sites in the Maya heartland (e.g., Nakum, Poptún, and Itzá). The only obvious difference is that the Rio Grande sites do not have monument plazas at the ends of their causeways. They give way to large pyramidal constructions. The actual importance of this resemblance is uncertain. It may mean that there is some sort of relationship between Maya Mountains sites and their neighbors to the west, congruent with Hammond's (1975, 1981) idea of a southern Belize-Peten nexus, or that sites in both areas fulfilled analogous roles within their regions and hence exhibit parallel features.

Finally, we return to the matter of the Maya Mountains and their implications for the wider phenomena of resource exploitation and exchange in the Maya lowlands. The 1994 work has clearly supplied further support for the notion that they may have been a close-range internal source for the acquisition of important resources. They contain abundant, useful, and unusual mineral and biotic materials, along with numerous sites that are well positioned to exploit and exchange those resources. Such an interpretation is highly consistent with our original theoretical premise—that in multipolity or segmentary state systems like that of the Maya short-range endogenic exchange is a major factor contributing to complex development. The long-standing emphasis on the role of exotic distant trade in early complex societies may need to be tempered by refocusing attention on smaller scale interactions. We hope to intensify our efforts and provide even more illumination on this front in the coming years.
Acknowledgements

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As for the crew, students Marc Abramiuk, Pete Kostan, Claudia Paxton, Keith Prufer, and Tom Wulff of CSU and Brian Hahn of Heidelberg College sacrificed their blood, toil, sweat, and tears to make the 1994 season the terrific success that it was. There are no words sufficient to express our gratitude to these hearty souls, the very life of the MMAP. We also acknowledge the phenomenal assistance and friendship of Greg Conway, MMAP Director for Technology Development and official project minstrel, and Ken Karas, an independent filmmaker who was a truly a member of the team and a great asset in the effort.

We all wish to recognize especially the contributions of our guides from the villages of Big Falls, San Pedro Columbia, and Golden Stream. Their numbers have increased every season, and there now are too many to name each of them individually. It is they, however, who have handled with infinite grace many of the most difficult tasks of the work. They have shared with us their innumerable and indispensable rain forest skills. They have graced us with their friendship and their good humor. We appreciate, particularly, Vicente and Enrique Chocó, Silvestre "Besh" and Pedro Pop, Pablo "Mash" Rash, and Mónico Sho. We also give thanks to Maria Rash, who has the unenviable job of keeping our clothes clean.

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We dedicate this report to Bill Meurer and Claudia Paxton, who in their selfless sacrifices for the MMAP contracted *vivax* malaria.
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Figure 2: Map Showing 1994 Target Locales. MMAP teams reconnoitered western portions of the southern flank--the upper Bladen (including Cuyamel) and the Snake Creek and Esperanza (Central) pockets--complementing previous MMAP efforts to the east. Work was extended along the main divide to the eastern slopes of the Little Quartz Ridge. Each block is approximately 27 kms. on a side (from Directorate of Overseas Survey, Series 649/1, Sheet South, Edition 1-DOS 1980).
Figure 3: Map of Cuyamel Canyon. This gorge produced little in the way of archaeological significance: a few minor cave finds and a handful of modest platforms. It is smaller than the other Bladen pockets and not as well suited for settlement. Mineral resources here were not appreciably different from those at Ek Xux. Each block is 1 km. on a side (from Directorate of Overseas Survey, Series E755/4499, Sheet 38, Edition 6-GSGS and Series E755-MIL, Sheet 34, Edition 1-GSGS, 1993).
Figure 4: Map of Snake Creek Canyon. The northern half of the Snake Creek pocket yielded considerable settlement, with a small center, Saach’olil Ruin, beside the creek. The surrounding scarps were pocked with caves, including one in the southeast that contained a modeled globular olla painted in a Mixtec style. Each block is 1 km. on a side (from Directorate of Overseas Survey, Series E755-MIL, Sheet 37, Edition 1-GSGS, 1993).
Figure 6: Map of the Esperanza (Central) Canyon Area. The southeast portion of the Esperanza pocket was heavily settled, with a moderately sized creekside ruin, Chac Bolai. K'antulai, a larger site to the southeast, is situated in the main pass beside a huge sinkhole and rockshelter, Holomi Mash, that contains archaeological remains. Another such sink, La Cumbre, is still farther to the southeast. Each block is 1 km on a side (from Directorate of Overseas Survey, Series E755-M1I, Sheet 37, Edition 1-GSGS, 1993).
Survey of Primates in the Bladen Drainage, May 1994

Summary

by

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A focus of one group of workers in the Bladen Branch drainage was the identification and assessment of the populations of monkey (Primates, Cebidae). This effort was led by Dr. J.F. Dahl (JD) who set out to clarify the presence or absence of Capuchin monkeys (Cebus capucinus limitaneus), spider monkeys (Ateles geoffroyi (=vellerosus) yucatanensis), and Howler monkeys (Alouatta pigra luctuosa). This effort was primarily aided by Dr. J. Wilson (JW) who had the secondary objective of assessing the avifauna in relation to biodiversity. Critical assistance was provided by: 1) Ms. S. Latola (SM), a natural historian, and her Mopan Indian Field Guide, Mr. G. Cho (GS); 2) Mr. M. Meadows (MM) in his capacity as a forester with a long, first-hand familiarity with Belizean hard-wood forests and avifauna; 3) Ms. L. Baker (MB), a graduate student in Anthropology who studies Cebus in Costa Rica. A crew of Kekchi Indians led by Mr. Sylvestre Pop provided much critical man-power, skill, and experience. The team was accompanied by a freelance photographer (Mr. Kurras) for part of its work.

The team (n = 9) was active in the Bladen area (Maps 1 and 2) from May 10 to May 27 (18 days) but some team members were present for 11 days (MM, SM, IS) or 8 days (MB). The total effort was about 75 person-work-days (MM, SM, IS, and MB left May 20/21), but days surveying in the forest were less than his due to injury, sickness, or the necessity of taking rest. The primary working base was made at Teakettle Camp, and a trail system was established over a minimum distance of about 24 km as shown in Map 2. Due to persistent thunder showers over a seven-day period, a second base (Chin Heesh) was established 3.5 kms below Quebrada-de-Oro on May 24. Surveys were conducted in the immediate vicinity and into Quebrada-de-Oro where the main archaeological site was visited and found to have been subject to additional looting activities since it was visited in 1993. ([An ancient Mayan pottery water flask with a ceremonial hole(s) in it was found in a small cave near Chin Heesh (see photo sheets [e] & [f]). It measured approximately 40 - 40 cm, had a broken flange to the main opening and a stamped design on its shoulders]).

The cumulative minimum distance surveyed by JFD (with one or more members of the crew) totalled a little more than 150 km (an average of 8.34 km/day) of which 101 km were outward bound surveys and 49 kms consisted of returning over trail travelled on the outward part of a days survey. On a majority of the 11 days the full crew was present, at least one other crew of observers surveyed over similar distances covering approximately 11 x 8.34 km or 92 km.
and a third crew was active on five days (5 × 8.34 = 42 km). A second crew during the final seven days averaged about 5 km/day (35 km). A reasonable approximation of the cumulative minimum distance surveyed totals 319 km although the actual distance covered probably exceeded this by 15-25%. The majority of the trail used was located at the edges of valley floors and included the ecotones at the edge of rivers, disturbed forests standing on flood plains, and the edge of mature, high, hardwood forest occurring on the steep slopes bordering the valley bottoms. In addition, significant distance was covered and time spent in the sink systems and hills proximate to Ramos Quebrada, the Bladen Branch, and Teakettle Creek.

Populations of Monkey.

There were no sightings of Cebus, and the sole vocalization heard that might have been produced by this monkey could not be recorded, and was not noted again. Habitat resembling that used by these monkeys in Costa Rica was frequently encountered throughout the trail system, and tree species known as sources of food for these monkeys elsewhere were present. Interviews with two guides who were thought to have seen Cebus revealed that they did not recognize Cebus. When presented with color illustrations of a wide range of ceboids, they identified the subjects they had seen as either Ateles or Alouatta.

In contrast to the absence of contacts with Cebus, 18 contacts were made with associations of Ateles; 11 were sightings while 7 involved detection of vocalizations only. The size of associations varied from 2 to 13 and were bimodally distributed as expected for monkeys that are characterized as having a fission-fusion or network social organization. Six associations averaged 3 individuals (SD = 1.1; range = 2-5 individuals) compared to an average of 10 (SD = 1.9; range = 8-13 individuals) for the larger associations, but from 2 to 4 of subjects in these larger associations were immature. Females that appeared to be in an advanced state of pregnancy were seen in three associations from widely different localities. The locations and times where contacts were made, the nature of the activity seen, and the known home range sizes for the genus, suggest that the associations were members of 6 or 7 groups.

The appearance of a majority of the Ateles seen and photographed was consistent with descriptions of A. "g" (= vellerosus) yucatanensis, i.e. they had a silvery-white pelage over the ventral surfaces of the torso, and the lower part of the back was brown. The extent and shade of brown on the back and tail appeared to vary considerably, but glimpses of the dorsal surface of subjects were rare. Several subjects from different groups lacked the silvery-white chest and belly, and the pelage of this area was a much more nondescript dirty-white or grey; this variant has been noted for yucatanensis, however. It is almost certain that it was this species of Ateles that was tentatively identified as a Capuchin monkey by MMAP workers in 1993.

Vocalizations of Alouatta were not heard in either the Teakettle/Ramos Quebrada area or around Chin Heesh, but they were noted from Forest Hill (MB). It transpires that two observations of these monkeys were made at Richardson's Creek and near Quebrada-de-Oro caves (called Midnight Mountain
Bladen Primate Report - Dahl

2w-Boy) by Dr. Dunham and K. Pruf er in 1993. The population is likely to be
a very low density; we did not hear vocalizations despite at least five
afternoons in the Midnight Mountain Cow-Boy region, and listening at times of
ight when these animals frequently vocalize elsewhere in Belize.

vifafauna.

Ornithological observations confirm the relatively high biodiversity of
the region. There are 368 species of land bird noted for Belize9 of which 91
are immigrants, i.e., there are approximately 277 native land species. We
identified 131 of these species while in the Bladen drainage (118 species by
and MM, an additional 12 species by MM, and the Harpy Eagle seen by Mr.
p and JFD) [Appendix 1]. At least four of these 131 were migrants (there
are many more migrants at other times of year), giving a maximum number of
27 native land species. It follows that the relatively small area surveyed
we worked in a maximum of 31 km² blocks) contributes to the support of about
3% of native, landbird species of Belize. Moreover, the presence of
ertain species indicate extensive areas of undisturbed mature forest, which
is consistent with this level of diversity. Such species include the Harpy
agle, the Black and White Hawk Eagle, the Ornate Hawk Eagle, the Keel-Billed
mot, the Strong-Billed Wood Creeper, the Russet Antshrike, the Lovely
tinga, the Nightingale Wren, and the Chestnut-Headed Oropendola.

ther data.

Valuable data on ambient temperature, cloud cover, and illumination level
were obtained by JFD on 560 occasions throughout the 18 days and during both
ay and night. The precipitation recorded indicates that the area is
likely to experience a regular dry season with months receiving less than
00 mm. Attempts were made during both the first and second parts of the
ight to document the nocturnal mammals and birds. Approximately 12 hours of
udio-tape recordings of the forest sounds, including vocalizations of
teles, were made. A total of 266, 35 mm color slide photographs were taken
JFD) including 46 of spider monkeys [Appendix 2] from five of the six or
even groups; JW obtained some photographs of individuals in a group not
photographed by JD. Duplicates of 36 of these slides and of slides taken in
83 are enclosed with the report, as well as 16 prints made from color
ter-negatives (Sheets [a] through [f]). Included are two photographs of a
el-Billed Motmot (from inter-neg, slide by JD), and six prints with the
cient Mayan water pot as subject (by JW).

Evidence of hunting activity as well as the looting of Mayan ruins
uggest that a major effort to regulate use of the region is needed to
protect what is one of the more important forest biomes in Belize. During a
etically short, local survey from Chin Heesh, three strongly built shelters
were found that had clearly been used for illegal activities, and one had
tocks of food and cooking utensils.

The biological importance of this part of the Bladen drainage is
consequent in part to the limited logging in the area. This has combined
with the way the topography acts to limit damage by hurricane (but produce
ome of the highest rainfall in Belize) to preserve relatively intact quite
arge patches of older, humid forest. This general area is argued to have

3
een one of five principal, rain-forest refugia in northern Central America; it constitutes a critical part of a natural center of endemism for both fauna and flora that has diverged from that in southern Central America. From a practical perspective, moreover, the limited access to the Bladen drainage or humans and the topography of the region lends itself to a protection program while permitting faunal and floral links with other reserve areas by way of the Mayan Divide. A meeting was held with representatives of the Ekchi Council of Belize to discuss the development of a protection and management plan, and a commitment made to design such a program and find financial support for it.

NOTES

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Supported solely by personal means; Dr. Wilson is a Member of the National Audubon Society of the United States.

Director of the Belize Zoo and Tropical Education Center (see separate sport with Martin Meadows).

Department of Anthropology, University of California, Riverside.

Minimal distances are calculated from an enlarged version of the most recently issued 1:50,000 maps using a rolling-point distance calculator using the lines of travel plotted on the map as shown in Maps 1 and 2. Actual round covered was almost certainly further, particularly when team members hiked over steep terrain.


Data from Roosmalen and Klein, 1988.

The systematics of Ateles is generally acknowledged as in need of revision, and Froelich et al. (1991 [Amer. J. Prilatol. 25:1-22]) re-organize the South American forms on the basis of morphometric analyses. They consider one small population of Central American monkey from Panama in their analysis Ateles Geoffrovi Grisescens so the revision does not adequately treat the Central American forms. Dahl (in prep.) shows that on both morphological and biogeographic grounds the Ateles from northern Central America and Mexico above latitude 13°N) are best treated as Ateles vellerosus Gray, 1866 and ot as populations of Ateles Geoffrovi Kuhl, 1820 which occur to the south of Central America and interbreed with A. "fusciceps".


Map 1: Topographical map showing the principal directions of between Forest Hill (circle to the east and Teakettle Camp (circle to the west) during the survey (adapted from the 1:50,000 Series E755). The approximate location of Chin Heesh is indicated by the shaded triangle (pointing up), and of Midnight Mountain Cow Boy [the Quebrada-de-Oro Caves] by the shaded triangle (pointing down).
Map 2: Topographical map showing the approximate position of trails that were developed and used while at Teakettle Camp (shaded circle) [adapted from the 1:50,000 Series E755].
APPENDIX 1

List of bird species seen or heard

This is a preliminary list and identification to species is by common name only. Entries for JW are numbered in approximate chronological order. The principal sources used to confirm identifications were:


The audio tapes have yet to be analyzed. Numbers of bird calls were recorded, however, including those of the Keel-billed Motmot and the Nightingale Wren.

KEY:

Locations

FH = Forest Hill to Richardsons Creek
O = Bladen between Richardsons creek to 1km above Ramos Quebrada
R = Within the secondary drainages of Ramos Quebrada and Teakettle Creek

Frequency of observations

C = Three or more records (Commonly noted)
I = Recorded only twice (Infrequently noted)
R = Recorded once (Rarely noted)
<table>
<thead>
<tr>
<th>BIRD</th>
<th>FREQ.</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grey-headed dove</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Little tinamov</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Dusky antbird</td>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>Green kingfisher</td>
<td>C</td>
<td>0, FH, R</td>
</tr>
<tr>
<td>Black phoebe</td>
<td>C</td>
<td>0, FH</td>
</tr>
<tr>
<td>Blue-crowned motmot</td>
<td>C</td>
<td>0, FH, R</td>
</tr>
<tr>
<td>Violaceous trogon</td>
<td>C</td>
<td>0, R</td>
</tr>
<tr>
<td>Rough-winged swallow</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Spot-breasted wren</td>
<td>C</td>
<td>0, FH</td>
</tr>
<tr>
<td>Orange-bill sparrow</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Ruddy quail-dove</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Citreoline sparrow</td>
<td>C</td>
<td>0, R</td>
</tr>
<tr>
<td>Citreoline trogon</td>
<td>C</td>
<td>0, FH</td>
</tr>
<tr>
<td>Great tinamov</td>
<td>C</td>
<td>0, FH</td>
</tr>
<tr>
<td>Black-headed saltator</td>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>White-fronted parrot</td>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>Royal flycatcher</td>
<td>C</td>
<td>0, R</td>
</tr>
<tr>
<td>Northern waterthrush</td>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>Currasow</td>
<td>C</td>
<td>0, R</td>
</tr>
<tr>
<td>Long-tailed hermit</td>
<td>C</td>
<td>0, FH, R</td>
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<tr>
<td>Wedge-tailed sabrewing</td>
<td>C</td>
<td>0, R</td>
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<tr>
<td>Chestnut oropendela</td>
<td>C</td>
<td>0, R</td>
</tr>
<tr>
<td>Collared aracari</td>
<td>I</td>
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</tr>
<tr>
<td>Brown-headed parrot</td>
<td>I</td>
<td>0, R</td>
</tr>
<tr>
<td>Giant cowbird</td>
<td>I</td>
<td>0, R</td>
</tr>
<tr>
<td>Swallow-tailed swift</td>
<td>R</td>
<td>0</td>
</tr>
<tr>
<td>Black &amp; white hawk-eagle</td>
<td>R</td>
<td>0</td>
</tr>
<tr>
<td>Black-cheeked Woodpecker</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Red-legged honeycreeper</td>
<td>C</td>
<td>0, FH, R</td>
</tr>
<tr>
<td>Band-back wren</td>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>Keel-billed toucan</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Slaty-tailed trogon</td>
<td>C</td>
<td>0, FH</td>
</tr>
<tr>
<td>Buff-thr. foliage-gleaner</td>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>Black-faced antthrush</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Vaux swift</td>
<td>R</td>
<td>0</td>
</tr>
<tr>
<td>Jacamar</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Lesser greenlet</td>
<td>I</td>
<td>0, R</td>
</tr>
<tr>
<td>Keeled-pill motmot</td>
<td>C</td>
<td>0, R</td>
</tr>
<tr>
<td>Short-billed pigeon</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Tawny-crowned greenlet</td>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>Smoky-brown woodpecker</td>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>Dot-wing antwren</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Grey hawk</td>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>Sulfur-rumped flycatcher</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Russet antshrike</td>
<td>R</td>
<td>0</td>
</tr>
<tr>
<td>White-whiskered puffbird</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Plain xenops</td>
<td>I</td>
<td>0, R</td>
</tr>
<tr>
<td>Thraustlike manakin</td>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>Cinnamon becard</td>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>Piratic flycatcher</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Yellow-winged tanager</td>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>Grey-headed tanager</td>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>Purple-crowned fairy</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Violet sabrewing</td>
<td>C</td>
<td>0, R</td>
</tr>
<tr>
<td>Mottled owl</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>BIRD</td>
<td>FREQ.</td>
<td>LOCATION</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------</td>
<td>----------</td>
</tr>
<tr>
<td>Great-crested flycatcher</td>
<td>I</td>
<td>savannah</td>
</tr>
<tr>
<td>Wh-breasted woodwren</td>
<td>C</td>
<td>0</td>
</tr>
<tr>
<td>Red-capped manakin</td>
<td>C</td>
<td>0, R</td>
</tr>
<tr>
<td>Tody flycatcher</td>
<td>R</td>
<td>0</td>
</tr>
<tr>
<td>Anhinga</td>
<td>R</td>
<td>0</td>
</tr>
<tr>
<td>Rufous-tailed jacobin</td>
<td>R</td>
<td>0</td>
</tr>
<tr>
<td>Clay-colored robin</td>
<td>R</td>
<td>FH</td>
</tr>
<tr>
<td>Black vulture</td>
<td>R</td>
<td>FH</td>
</tr>
<tr>
<td>King vulture</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>Rough-wing swallow</td>
<td>C</td>
<td>0</td>
</tr>
</tbody>
</table>

Additional birds on Martin's list (MM)

- Boat-billed heron
- Bat falcon
- Spotted wood-quail
- Aztec parakeet
- Vermiculated screech owl
- Lesser swallow-tailed swift
- Tody motmot
- Olivaceous woodcreeper
- Great-tailed grackle
- White-winged becard
- Green-winged vireo
- Golden-crowned warbler

Additional bird documented by JD

- Harpy Eagle
Appendix 2:

Mammal, Bird, and Floral Surveys on the Upper Bladen, May 1994

Sharon Matola, Director, and Martin Meadows
The Belize Zoo and Tropical Education Center
P.O. Box 1787
Belize City
Belize, Central America
INTRODUCTION

Our natural history team was organized and coordinated by Jeremy F. Dahl, PhD of Yerkes Primate Research Institute of Emory University. Dr. Dahl has had extensive field experience in Belize throughout the past decade. Martin Meadows, a professional forester, has lived in Belize for over fifteen years and is known for his expertise in the field of ecology. Sharon Matola, a naturalized Belizean, has had ample field experience spanning a period of ten years, and plays an active role in conservation activities in Belize. Greg Sho, a Maya Indian from Maya Centre, is knowledgeable about the flora and fauna of Belizean tropical forests.

Over a period of eight days, our team surveyed the area north of Teakettle Camp, the Ramos Quebrada area and the Bladen Branch area which stretches east-west between these two regions. We concentrated primarily in documenting primate populations, in particular, the possible presence of *Cebus capucinus*, the white-faced capuchin monkey. During the 1993 dry season, a sighting of a small group of *Cebus capucinus* had been reported. The Maya guide who reported this sighting, Fidel Chun, accompanied us on some of our surveys.

We monitored spider monkey groups, *Ateles geoffrovi*, as much as was possible during the eight day stay at Teakettle Camp. Opportunistic records of all mammal sightings, tracks, or scat were kept. An account of bird sightings was kept by Dr. Jim Wilson of Emory University, and attention was given to sightings and vocalizations of birds which suffer population decreases due to hunting pressure: Cracids and Tinamous. We also kept records of sightings and vocalizations of the rare keel-billed mot-mot, *Electron carinatum*.

This field data could supplement the data taken in the Bladen Nature Reserve (BNR) by Brokaw and Lloyd-Evans; 1987, and Iremonger and Sayre; 1993, adding further documentation of the importance of this forest for threatened and endangered species of Belizean fauna.

The present fauna of Central America is a mixture of families that evolved in the northern and southern hemispheres. Approximately seven million years before present time, Central America became a land bridge between North and South America, when the Isthmus of Panama rose above sea level (Emmons 1990). The mammals in Belize
are a result of this geological event, which became the "great faunal interchange" between hemispheres.

The Maya Mountains are viewed as an area of undisturbed lands serving as a refuge for many wild animals. Animals which are endangered in neighboring countries have large populations in Belize, e.g. all five wild cat species, jaguar, puma, ocelot, margay and jaguarundi, are common (Hartshorn et al., 1984).

The BNR plays an important role in providing refuge for rare species of fauna found in Belize. It is the largest area of land, 350 km², to be given the designation of "Nature Reserve", the strictest category of protection afforded to lands under the National Parks Act of Belize (1981). Through proper management, the Bladen Nature Reserve can continue to provide a sanctuary for Belizean wildlife into the 21st century.

METHODS

A trail system was flagged beginning at the steep confluence of a dry creek bed (referred to as "Teakettle Creek"), and the Bladen Branch. Every 100, 500, and 1000 meters, flagging was attached until a point approximately two kilometers from the confluence. At this point, a flagging trail continues west by line-of-sight. The trail continues into a large limestone sinkhole system, continuing into the Ramos Quebrado camp where extensive archaeology field work has been undertaken. The trail continues south, approximately 300 meters extending along the dry creek bed, including the area where the Cebus capucinus sighting occurred in 1993. The trail joins with an east-west trail which leads to the Bladen Branch approximately 300 meters from Teakettle Camp. (see map approximation)

Approximately a total of ten km of trail was established for the purpose of walking and observing primate populations.

Approximate hours spent walking this trail system by day was +/- forty-five hours.

All mammal activity was noted, as were sightings of any cracids or tinamou. Vocalizations of the keel-billed mot-mot are distinctive and were also noted.
RESULTS

Primate activity recorded in the area of Teakettle Camp:

*Ateles geoffroyi*, spider monkey

<table>
<thead>
<tr>
<th>May</th>
<th>Time</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>1600</td>
<td>GP 045271</td>
<td>1 male, 2 females. One of the females appeared to be pregnant. Monkeys were aggressive; tearing branches, dropping in our direction.</td>
</tr>
<tr>
<td>13</td>
<td>1140</td>
<td>GP 025288</td>
<td>Heard monkeys &quot;barking&quot;; they disappeared before we could make observations.</td>
</tr>
<tr>
<td>15</td>
<td>1415</td>
<td>GP 025285</td>
<td>Leaving final portion of limestone sink hole system came across a group of three. 1 male, 2 females. One of the females appeared to be pregnant. Much aggressive vocalization. Reaction to our presence, thunder, or both.</td>
</tr>
<tr>
<td>18</td>
<td>1129</td>
<td>GP 041275</td>
<td>Heard spider monkey &quot;barks&quot;, but never established contact for observations.</td>
</tr>
<tr>
<td>1540</td>
<td>GP 038279</td>
<td>Heard spider monkeys as we descended from sinkhole system to Teakettle Creek.</td>
<td></td>
</tr>
<tr>
<td>1620</td>
<td>GP 045271</td>
<td>Heard spider monkeys as we came upon travertine limestone pools.</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>1125</td>
<td>GP 008273</td>
<td>Nearby caves, 7 adults with 1 pregnant female and 3 young. Continual vocalizations, tree/branch shaking, group splitting up, then re-grouping.</td>
</tr>
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</table>
### B. Evidence of Additional Mammals

<table>
<thead>
<tr>
<th>Species</th>
<th>Count</th>
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</thead>
<tbody>
<tr>
<td>Nasua narica</td>
<td>Coatimundi</td>
</tr>
<tr>
<td>Potos flavus</td>
<td>Kinkajou</td>
</tr>
<tr>
<td>Lutra longicaudus</td>
<td>Southern river otter</td>
</tr>
<tr>
<td>Panthera onca</td>
<td>Jaguar</td>
</tr>
<tr>
<td>Tapirus bairdii</td>
<td>Tapir</td>
</tr>
<tr>
<td>Tapirus pecari</td>
<td>White-lipped peccary</td>
</tr>
<tr>
<td>Tayassu tajacu</td>
<td>Collared peccary</td>
</tr>
<tr>
<td>Mazama americana</td>
<td>Red brocket deer</td>
</tr>
<tr>
<td>Odocoileus virginiana</td>
<td>White-tailed deer</td>
</tr>
<tr>
<td>Sciurus deppei</td>
<td>Deppe's squirrel</td>
</tr>
<tr>
<td>Agouti paca</td>
<td>Paca</td>
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</table>

### C. Cracids

<table>
<thead>
<tr>
<th>Species</th>
<th>Count</th>
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</thead>
<tbody>
<tr>
<td>Crax rubra</td>
<td>Great curassow</td>
</tr>
<tr>
<td>Penelope purpurascens</td>
<td>Crested guan</td>
</tr>
</tbody>
</table>

### D. Tinamou

<table>
<thead>
<tr>
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<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tinamus major</td>
<td>Great tinamou</td>
</tr>
<tr>
<td>Crypturellus boucardi</td>
<td>Slaty-breasted tinamou</td>
</tr>
</tbody>
</table>

### E.

<table>
<thead>
<tr>
<th>Species</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electron carinatum</td>
<td>Keel-billed mot mot</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DISCUSSION

From our survey work, we recorded twelve species of mammals. Of these, nine were by sightings, the remaining three by tracks or scat.

Out of the eight days spent walking trails, we encountered spider monkeys on five of those days.

There are sixteen recognized subspecies of *Ateles geoffroyi* (Konstant 1985), and according to the literature, the subspecies recognized in Belize, *Ateles geoffroyi yucatanensis*, exists in small forested areas of Mexico, Guatemala and Belize. These populations are fragmented due to the amount of deforestation which has occurred during the past twenty-five years in Central America.

It should be noted that there are questions regarding the sub-species of *A. geoffroyi* found in Belize. While *Ateles geoffroyi yucatanensis* has been recorded as the sub-species here, some field researchers believe that *Ateles g. velerosus* is the correct sub-species found in Belize (R. Mittermeier, Lorena Calvo, pers. comm.). Specimens in museum collections and DNZ/chromosome work should be undertaken to resolve this matter (J. Dahl, pers. comm).

In Belize, the black howler monkey, *Alouatta pigra*, is more commonly found, due to its tolerance to live within areas disturbed by humans. Spider monkeys prefer undisturbed habitat (Eisenberg 1976). They are a good "indicator species" of healthy forest systems.

Accumulating evidence from a number of field studies and surveys indicates that spider monkeys may be among the most endangered in the entire neotropical region (Dahl 1984; Daugterty 1972; Estrada 1983; Freese 1976). The BNR is an important area in Belize for sustaining populations of *Ateles geoffroyi*. And while spider monkeys mature and breed at a slow rate (Eisenberg 1976), a protected and growing population of spider monkeys in the BNR could allow for future migrations into adjacent protected areas, e.g. the Columbia River Forest Reserve.

Spider monkeys were present in the Columbia River Forest Reserve until approximately fifteen years ago. They are considered extirpated there (Emmons 1993).
Sightings of tapir, *Tapirus bairdii*, are also encouraging. This is an endangered species, extinct in parts of its range (SPECIES 1988), but still occurs in Belize. *T. bairdii* is the largest neotropical terrestrial mammal, growing to 200-300 kg. Large animals such as the tapir require a large home range to get the food they need, and they are most susceptible to habitat destruction. Radio-collared tapirs in Costa Rica were found to have a range, on the average, of 6.35-4.15 km² (Williams 1984). As Belize develops and land use patterns change, the BNR will become increasingly important as a refuge for this endangered species.

The remaining mammal species listed would be expected to occur in a lowland humid or evergreen broadleaf forest in Belize. The southern river otter, *Lutra longicaudus*, is an endangered species whose population status is unknown. They favour clear, fast-flowing rivers and streams (Emmons 1990).

**Birds Noted With Regard to Hunting Pressure**

The great curassow, *Crax rubra*, the crested guan, *Penelope purpurascens*, and species of Tinamou are birds which are frequently hunted. The presence of fair numbers of these species suggests that the hunting pressures around Teakettle Camp area are not excessive. Both the Cracids and the tinamou are extremely vulnerable to hunting pressure. At this time, their populations within the area which we investigated, appear to be in healthy numbers. Without guardianship, this status could change rapidly.

**Keel-billed mot-mot, Electron carinatum**

Keel-billed mot-mots are under consideration for listing as endangered in the IUCN/ICPB Red Data Book. They have not been seen in Mexico for twenty years, and only two records exist for Guatemala. The existence of a small population in Honduras is unverified. Records from Costa Rica may be confused with the more common Broad bill mot-mot (Mallory 1991). This species has been reduced in number as a result of massive deforestation within its small geographical and ecological range (Collar et al 1992). The BNR in the area of Teakettle Camp, appears to be an important area for these rare birds. On five different occasions,
our group heard their distinctive vocalizations, and two close sightings occurred during the eight day period.

As a group, we follow the recommendations of past field investigators in strongly suggesting that a sound management plan be put in place to insure that the rich biodiversity of the BNR does not diminish.
THE BLADEN-RAMOS VEGETATION

The Bladen lies in the subtropical moist zone bordering on the upper northwest catchment hills with the subtropical lower montane wet forest zone.

EDAPHIC VARIATIONS (Iremonger and Sayre 1993)

A. Plant Communities.

1. Communities over alluvium.
   * a. Bottomland alluvial forest.
   * b. Streamside vegetation
   c. abandoned milpa
   d. pine-palmetto forest

2. Communities over limestone.
   * a. Limestone hill forest.
   b. Limestone knoll forest.
   c. Jagged limestone forest.
   d. Mountain limestone scrub forest.
   * e. Limestone sinkhole forest.

3. Communities over granitic-volcanics.
   * a. Mountain thatch palm forest.
   b. Mountain pine scrub forest.
   c. Disturbed herbaceous vegetation.

* Areas most important to the Maya.

la. Bottomland Alluvial Forest.

This forest occupies most of the floor of the Ramos valley above the flash flood zone.

It has a relatively fertile deep soil supporting tall forest (canopy 15-25 m+) of many species with a continuous canopy, predominantly palm understory.

Certain areas are predominantly cohune palm (Orbignya cohune), in other areas this species was absent. Fruiting trees were abundant including Pouteria sapota (Mammee apple), Dialium guianense (Ironwood or wild tamarind), Spondias mombin (Hogplum), and a large Annonaceae tree with small "custard apples".
Uses to the Maya.

This area would have been their only extensive agricultural area owing to its soils and level-rolling topography. The above cohune palm distribution is interesting as old milpas (slash and burn agriculture) are easily spotted by abundant cohune palm regeneration. The fallen leaves of these palms, as ground cover, make sapling hardwood regeneration difficult.

A small flat area about 30m across, approximately 500m to the NNE of the Ramos ruin site, was solid with a ground palm, Calyptrogyne ghiesbreghtiana otherwise not seen elsewhere. Possible historic "improved garden".

Cohune palm uses include roofing (where thatch palm is absent), cooking oil, edible nuts, charcoal from nut shells, fly whisks (from fruiting stem), hearts of palm, and bedding.

lb. Streamside Vegetation

This area would have been useful to the Maya for seasonal vegetables and for water, fish, shrimp, crabs, and water snails (still eaten by the Maya today).

Pioneer flood resistant tree species include Ceiba pentandra (cotton tree) which is the sacred tree of the Maya, and Ochroma lagopus (balsa). Both trees produced kapok for stuffing pillows.

Riverine fruiting trees include Inga spp. (Bri-bri), and Licawia platypus (Monkey apple).

2a. Limestone Hill Forest

This forest is widespread on rolling limestone areas where the soil is not too shallow, canopy is usually 15-24m high. Sabal morrisiana (Thatch palm), Calophyllum brasiliensis (Santa maria), Manilkara zapota (Sapodilla), are common trees. In one small area, there was a large Swietenia macrophylla (mahogany), four sapodilla and two Pimentia dioca (Allspice). These trees were found growing within 25m of each other; all useful trees to the Maya.

The understory contains two spiny palms, Astrocaryum mexicanum (Warree cohune), and Chrysophila argentea (Give and take). The leaves of C. argentea are used for brooms by the Maya.
Vines/lianas are common, and include *Vitis* spp. (water vine), used for obtaining water, and *Dioscorea* spp. which is used by some Amerindians as a birth control method and also as a blood tonic.

Parts of this area could have been used for agriculture by the Maya. Common here were chicle, mammee apple and custard apple.

2e. **Limestone Sinkhole Forest.**

Areas may have been suitable for agriculture in the flat bottoms of some of the large sinkholes.

Soils were variable according to whether they were derived from limestone and/or non-limestone alluvial bedrock. Soils were also variable with regard to the degree the sinkhole could transport eroded soil.

3b. **Mountain Pine Scrub Forest.**

This forest type was seen on the ridge to the north of the Ramos Quebrada Maya site.

Fat pine heartwood is important today in Central America as fire kindling and is known to have been used for torches by the ancient Maya for visiting caves.

**SUMMARY**

The area investigated could and did supply many of the needs of the Maya settlements (small settlements). However, ground truthing this theory is difficult, especially with regard to the time restrictions. One possible alternative "proofing" could be cave deposit pollen analysis.

Soil disturbance by tree falls, burrowing animals and natural erosion makes soil analysis difficult.

Areas requiring further investigation are those with "odd" vegetation. It should be noted that five generations of long-lived trees could go back to the times of the ancient Maya.
LITERATURE CITED


SPECIES: Newsletter of the species survival commission/IUCN. No. 11, November 1988.

Appendix 3:  
List of Biological Specimens Collected in 1994

Each vertebrate was identified in the field at least to the level of genus. Species and subspecies identifications will be finalized in the laboratory, with the help of specialists. It is possible, and even likely, that previously unknown species or varieties are represented in this collection. Records of collection locations are kept by MMAP biologist Murray. Herpetological specimens are transferred to Dr. Robert Reynolds of the Smithsonian Institution; ichthyological specimens transferred to Dr. James Thomerson of Southern Illinois University and the Field Museum of Natural History in Chicago.

<table>
<thead>
<tr>
<th>Genus/species</th>
<th>Common Name</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fish</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Rhamdia guatemalensis</em></td>
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<tr>
<td><em>Astyanax fasciatus</em></td>
<td>Banded Tetra</td>
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<tr>
<td><em>Heterandria bimaculata</em></td>
<td>Pseudohelleri</td>
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<tr>
<td><em>Xiphophorus helleri</em></td>
<td>Green Swordtail</td>
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<tr>
<td><em>Poecilia mexicana</em></td>
<td>Shortfin Molly</td>
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<tr>
<td><em>Rhamdia laticauda</em></td>
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<tr>
<td><em>Cichlosoma urophthalmus</em></td>
<td>----</td>
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<tr>
<td><em>Synbranchus marmoratus</em></td>
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<tr>
<td><strong>Snakes</strong></td>
<td></td>
<td></td>
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<tr>
<td><em>Micrurus diastema</em></td>
<td>Coral Snake</td>
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<tr>
<td><em>Porthidium nummifer</em></td>
<td>Jumping Tommygoff</td>
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<tr>
<td><em>Leptodeira frenata</em></td>
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<tr>
<td><em>Coniophones bipunctatus</em></td>
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<tr>
<td><em>Elaphe triaspis</em></td>
<td>Ratsnake</td>
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<tr>
<td><em>Sibon nebulata</em></td>
<td>Snail-Eating Snake</td>
<td>1</td>
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<tr>
<td><em>Ceptophis mexicanus</em></td>
<td>----</td>
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<tr>
<td><em>Ninia sebae</em></td>
<td>Red Coffee Snake</td>
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<tr>
<td><em>Coluber sp.</em></td>
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<tr>
<td><em>Thamnophis sp.</em></td>
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<tr>
<td><strong>Lizards</strong></td>
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<tr>
<td><em>Anolis sp.</em></td>
<td>Brown anole</td>
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<tr>
<td><em>Eumeces sp.</em></td>
<td>Skink</td>
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<tr>
<td><strong>Amphibians</strong></td>
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<tr>
<td><em>Hyla sp.</em></td>
<td>Treefrogs</td>
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<tr>
<td><em>Pseudacris sp.</em></td>
<td>Groundfrogs</td>
<td>10</td>
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<tr>
<td><em>Bufo marinus</em></td>
<td>Toad</td>
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<tr>
<td><em>Bufo terrestris</em></td>
<td>Southern Toad</td>
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<tr>
<td><strong>Ticks</strong></td>
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<tr>
<td><em>Argas sp.</em></td>
<td>Bird Tick</td>
<td>21</td>
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<tr>
<td><em>Dermacentor sp.</em></td>
<td>&quot;Dog Tick?&quot;</td>
<td>9</td>
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<tr>
<td><strong>Spiders</strong></td>
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<tr>
<td><em>Theraphosidae sp.</em></td>
<td>Tarantula</td>
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</table>