BIRD SURVEY OF THE BOCAS DEL POLOCHIC WILDLIFE REFUGE AND SURROUNDING AREAS

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INTRODUCTION

Recent establishment of the Bocas del Polochic Wildlife Refuge (BPWR) has created protection for the largest wetland in Guatemala within the lifezone of subtropical wet forest (Cardona 1994, Villar 1992). This area was officially declared a national protected area by the Guatemalan Congress on 11 June 1996. It was also designated a Park in Peril by the Nature Conservancy and an international Ramsar site by the Bureau of the Convention on Wetlands of International Importance. The BPWR has been divided into four management zones (primitive, sustainable use, recuperation, and extensive use zones) by the National Protected Areas Council (CONAP), however, management plans for the refuge are still being developed.

The BPWR is located in the tropical lowlands of eastern Guatemala at the west end of Lake Izabal. It covers an area of 35 km by 18 km and consists of the Polochic river delta, a number of small bays, lagoons, and rivers that are surrounded by seasonally inundated forest. The BPWR contains a rich array of fauna and flora and represents one of the last relics of natural habitat in the area, however, it may be sensitive to human induced disturbances as it is an important resource for the inhabitants of El Estor and the surrounding indigenous communities. The people use the BPWR for commercial and subsistence fishing, extraction of firewood, cattle grazing, and the cultivation of crops. Because the people depend on this area, as few economic options exist, protection of the wetland and its ecological diversity are contingent upon creating economic alternatives and the education of sustainable use.

Currently, little information exists about the status of the avifauna in the BPWR. Four studies have been conducted within the refuge: (1) a technical study required by the protected areas law for the declaration of the refuge (Villar 1992), (2) a brief winter bird survey conducted in the Polochic delta and on the north shore of Lake Izabal (Dowell et. al. 1994), (3) Cardona (1994) compared the relative abundance of 17 aquatic bird species found within the four zones of management, and (4) Holtrop (1995) conducted an inventory of bird species found within the BPWR and surrounding areas. All four studies suggest that the BPWR may provide important habitat for a large number of resident and migrant bird species.

It has been estimated that approximately 184 bird species migrate annually from the temperate zone of North America to Guatemala (Nations et. al. 1988). Recent evidence suggests that nearctic migrant populations are declining and that these declines may in part be due to the reduction of habitats on their wintering grounds (Morton 1992, Terborgh 1989, Robbins et. al. 1989, Rappole et. al. 1983). Little research has been conducted on the effects of habitat reduction on neotropical resident species, but as a group they appear to be more sensitive to habitat disturbances than are nearctic migrants (Petit et. al. 1994). Therefore, continued research and the implementation of a long-term monitoring program for nearctic migrants as well as resident bird species are needed to assess the affects of various land uses on these species in the BPWR.

Between January 1996 and September 1997, we conducted a survey of the bird species in the BPWR and surrounding areas. The research objectives of the survey were: 1) continue to inventory bird species present to increase the data base on migrant and resident bird species using the BPWR and surrounding areas, 2) identify critical areas within the refuge to aid in the conservation of species, 3) provide baseline information for management strategies to be implemented within the refuge to benefit both resident and migrant bird species, 4) implement a long-term monitoring program for selected indicator bird species

that would aid in the development of management objectives and assess the consequences of these activities, and 5) train local Guatemalans to conduct the bird surveys for the proposed long-term monitoring program.

STUDY AREA

The BPWR is a seasonally inundated, palustrine swamp located within the tropical lowlands of eastern Guatemala at the west end of the countries largest lake, Lake Izabal (Figure 1). It is situated at the end of the Polochic river valley between two mountain ranges, the Sierra de las Minas to the south and the Sierra Santa Cruz to the north, and covers an area of 23,070 ha. It consists of a number of creeks, lagoons, and the lower reaches of the Polochic, Amatillo, and Oscuro rivers. All waterways flow into Lake Izabal which in turn drains to the Caribbean sea via the Rio Dulce.

The average annual temperature of the area is 27° C and relative humidity varies between 75 and 100% (Villar 1992). The annual precipitation ranges between 1700 mm and 2500 mm (Villar 1992) with the dry season being February through May.

We surveyed the five principle bodies of water within the BPWR (Figure 2):

Oscuro River - This area is located within the primitive zone of management at the south side of the refuge where it serves as a drainage for the Sierra de las Minas mountains. It is a wide, slow moving river bordered by dense, low secondary forest. This river serves as an important transportation route as well as an area of rice and corn cultivation for the indigenous communities that live along the base of the Sierra de las Minas. Due to these disturbances, the shores of the waterway have been heavily fragmented and little primary forest exists.

Amatillo River and Lagoon - This waterway is also located within the primitive zone of management. The headwaters consist of numerous small creeks which flow into a large lagoon. These creeks are bordered by tall, primary forest and were often inaccessible except during the rainy season when the aquatic vegetation was washed out. The lagoon is bordered by dense, second growth forest, along with reeds and other grasses. It supports the greatest diversity of both submergent and emergent aquatic vegetation in the refuge (Villar 1992). The dominant species include water nympha (*Nymphaea ampla*), water lettuce (*Pontederia* spps.), water hyacinth (*Eichornia* spps.), músico (*Montrichardia arborescens*) and little water lettuce (*Pistia stratiotes*). The lagoon feeds into the wide, slow moving Amatillo river which empties into Lake Izabal. The river is bordered by both secondary and primary forest. Although some woodcutting does take place along the river banks, there has been little cultivation and primary forest still exists. The mouth of the Amatillo River is shallow and covered with extensive amounts of emergent aquatic vegetation during the dry season.

Polochic River - This is the main river of the valley and is located in both the extensive and sustainable use zones of management. The Polochic River is responsible for transporting large amounts of sediment to its various mouths which constantly shift position as sediment is deposited. This dynamic process is extending the land surface further into the lake through the deposition of sandbars which are subsequently colonized by willow (*Salix* spps.). These mudflats provide a unique habitat in the BPWR for migrating shorebirds and other aquatic bird species. The Polochic river is an important transportation route up the valley and the banks have been extensively cleared for corn and rice cultivation as well as cattle production. Lining the river banks is a tall grass (*Typha domingensis*) that is

harvested for home and fence construction. The dominant tree species interspersed along the river banks is Pito (*Erythirina glauca*).

Los Lagartos - This area is located within the recuperation zone of management at the north side of the refuge where it drains water from the Sierra Santa Cruz mountains. It consists of numerous creeks that feed into a short river which empties into a small bay of Lake Izabal. Los Lagartos is the most accessible waterway to the community of El Estor and thus provides the main area for firewood extraction; the principal tree species used is icaco (*Chrysobalanus icaco*). This area has also been disturbed by agriculture and sections of it were heavily deforested for wood production in the 1970's. These areas now support dense secondary growth. Even though Los Lagartos is not a pristine area, it may receive substantial immigration of wildlife from the Sierra Santa Cruz mountains due to its proximity and lack of human disturbance between these two areas.

Lake Izabal - This area is located within the sustainable use zone of the BPWR. The lake covers an area of 717 km^2 and has an average depth of 11.6 m (Basterrechea 1991). It is heavily used by subsistence and commercial fisherman who harvest a variety of fish species with gill and cast nets.

Five additional areas were surveyed during the study (Figure 1):

Las Dantas - This area is located west of El Estor along the north shore of Lake Izabal. It is adjacent to a large airstrip, constructed by the Mineral Exploration Company of Izabal (EXMIBAL), where we conducted our surveys. The area consists of a number of different habitats including seasonally inundated medium height forest, shrub, and cattle pasture.

Sauce River - This river drains from the Sierra Santa Cruz mountains and enters the lake east of El Estor. It exits the mountains through a deep limestone canyon known as El Boquerón. Surveys were taken from this canyon south, along a 2 km stretch of gallery forest habitat. A tall forest corridor exists along the waterway, and is bordered by agricultural fields and cattle pasture.

Sierra Santa Cruz Mountains - These mountains are located directly north of El Estor. The lower elevations near El Estor have been deforested and support a brushy habitat. Undisturbed habitats at higher elevations and the protected watershed directly behind El Estor contain mature broadleaf forest. Pine savanna grows at lower elevations on south facing slopes. The mining company EXMIBAL has prevented cultivation of crops and colonization along the south side of the ridge west of El Estor, thus maintaining a contiguous area of forest cover. We conducted surveys along existing trails to an elevation of 960 m.

El Estor - This area contains disturbed habitats around the community of El Estor, including residential areas, shrubby fence rows, gardens, and roadside areas.

Selempin/Sierra de las Minas Mountains - This area lies at the foot of the Sierra de las Minas mountains on the south side of the BPWR. The Fundación Defensores de la Naturaleza has constructed a biological research station near the indigenous village of Selempin and is in the process of developing a biological corridor between the BPWR and the Sierra de las Minas Biosphere Reserve. Humid evergreen forest covers numerous limestone knolls and the north slope of the Sierra de las Minas. The flat low-lying areas between the BPWR and the Sierra de las Minas have been converted to cattle pasture while the accessible mountainside has been widely deforested to cultivate corn and beans by the

local indigenous communities. Our surveys were conducted at elevations between 10 and 750 m.

METHODS

BPWR Study Area - Following the design developed by Holtrop (1995), four strip transects (Ralph et. al. 1993) were established in each river system located in the BPWR (Figure 2). The length of each transect varied: Los Lagartos was 1.75 km, the Polochic River was 3.4 km, the Amatillo River was 2.0 km, and the Oscuro River was 2.4 km. All transects were censused in a canoe traveling at a speed of approximately 1 km per hour. The canoe was rowed by a local fisherman while we recorded data. We initiated our transects approximately 15 minutes to a half an hour after local sunrise and time of completion was documented. Two transects were censused a month; each individual transect was surveyed once every other month from February 1996 to August 1997. All birds heard or seen in the forest along the water course, in the water corridor, and those flying over the area were recorded. Notable behaviors (nesting, migrations, etc.) were recorded as well as sex and age if they could be determined.

In addition to surveying the four transects, we conducted area searches in all of the small tributaries along the major water courses. Searches were conducted from the canoe, however, the distance traveled was not defined as access varied widely depending on whether it was the dry or wet season. These more intensive searches allowed us to track down unfamiliar calls and observe the quieter, less conspicuous species. Area searches were conducted to develop a more complete species list for the refuge.

To develop a species list for the sustainable use zone within the lake, we recorded all species detected when traveling to and from the study areas.

Sierra Santa Cruz Mountains, Sauce River, and Las Dantas Study Areas - Area searches were conducted in these three study areas from January 1996 to January 1997. All searches were done on foot and were surveyed 15 minutes to a half an hour after local sunrise. We walked existing trails in the area and recorded all bird species seen or heard within the forest interior, along the trails, or flying over the area. Behavior of the species was noted along with sex and age if they could be determined. These sites were surveyed to supply inventory information; abundance data was not collected.

El Estor Study Area - A species list was compiled for all species detected in the village of El Estor from January 1996 - September 1997. All species observed incidentally during daylight hours were recorded.

Selempin/Sierra de las Minas Study Area - We conducted area searches along existing trails near the research station and the biological corridor from February 1996 to September 1997. In addition, we worked with a local biology student from the University de la Valle conducting a census of this area from 7 May to 18 May 1997. We followed the standard methodology used by Robbins and Dowell (1995) at Cerro San Gil, Guatemala. Mist nets and point counts were used to sample three sites. The first site was an ecotone between contiguous pasture land and lowland subtropical forest at an elevation of 10 m. The second site was located at an elevation of 600 m along the agricultural frontier between the nuclear zone and the sustainable use zone of the Sierra de las Minas Biosphere Reserve. The final site sampled was positioned 1 km from the agricultural frontier in mature humid evergreen forest located within the nuclear zone of the Sierra de las Minas Biosphere Reserve. This site was at an elevation of 750 m.

Twelve standard (12 x 2.6 m) nylon mist nets were set up along existing trails approximately 10 to 20 m apart depending on terrain. Nets were opened for three consecutive days in each site from local sunrise (0630) to near sunset (1630). All captured birds were banded with U.S. Fish and Wildlife Service numbered bands, species recorded, aged and sexed, reproductive condition noted, weighed to the nearest 0.01 gram, wing chord measured, and fat level recorded (Ralph et. al. 1993).

Because few canopy species are captured in mist nets, fixed-radius point counts (Robbins and Dowell 1995) were also used for the detection of species. Ten point count stations were positioned 100 m apart within the mist net array and conducted for a period of five minutes between 0630 to 0830. All bird species heard or seen within a 30 m radius were recorded. Point counts were conducted in each site during the same three days that the nets were opened.

Data analysis - Species lists were developed for each area surveyed. For each list developed, we included species detected during this study as well as in Holtrop (1995). Relative abundance was calculated for the BPWR study area due to the availability of transect data. To calculate relative abundance, we divided the number of times a species was detected along a transect by the number of times the transect was surveyed. This number was multiplied by 100 to convert it into a percent. For migrants that spend only part of the year in the BPWR or are transients, we calculated this percent for a period of six months during the over-wintering season. Bird species that were detected 75% of the time were defined as abundant, 50 - 74 % common, 25 - 49% uncommon, and rare if they were detected less than 24% of the time.

The reason for using presence data, instead of number of individuals recorded (frequency of observation), to calculate relative abundance was due to the fact that transects along a flowing water course had inherit biases. For example, because transects are not fixed plots, there may have been problems with recounting or failing to count individuals due to the constant movement. Although transects along water courses were a practical method to census birds in the BPWR, a bias existed for edge species. The quieter, less conspicuous species found in the interior habitats were often missed along the transect even though they may have been relatively abundant. Finally, because flocks of transient migrants are known to move through the area, a high count of individuals made during one survey may not be representative of the actual abundance that uses the BPWR.

The percent of nearctic migrants, local migrants, and summer residents using the BPWR and surrounding areas was calculated. For analysis purposes, a nearctic migrant was defined as any species of bird or population of the species that regularly breeds in North America and migrates south of the Tropic of Cancer during the northern winter (Hayes 1995). A local migrant was defined as a species that is known to have breeding populations south of the Tropic of Cancer, but may make local migrations due to post-breeding dispersal, altitudinal migration, or other factors (Howell and Webb 1995). Finally, summer residents were those species that breed in Northern Central America but migrate south for the northern winter (Howell and Webb 1995).

RESULTS

A total of 308 bird species were detected in all areas surveyed (Table 1). Two hundred and ten bird species were detected in the BPWR (Table 1). An additional six species, not detected during our surveys, were detected by Holtrop (1995). In the BPWR she detected Great Black Hawk (*Buteogallus urubitinga*), Common Ground-Dove (*Columbina passerina*), and Mourning Warbler (*Oporonis philadelphia*). In the surrounding areas she

detected Wilson's Plover (*Charadrius wilsonia*), Barn Owl (*Tyto alba*), and Northern Beardless Tyrannulet (*Comptostoma imberbe*). Dowell et. al. (1994) recorded an additional seven bird species that were not detected by our surveys or Holtrop (1995): Lesser Yellow-headed Vulture (*Cathartes burrovianus*), White-winged Dove (*Zenaida asiatica*), Inca Dove (*Columbina inca*), White-eyed Vireo (*Vireo griseus*) and Lesser Nighthawk (*Chordeiles acutipennis*) in the surrounding areas. At the Polochic delta they detected Semipalmated Plover (*Charadrius semipalmatus*) and Northern Parula (*Parula americana*). With all surveys combined, a total of 321 bird species have been detected at the BPWR and the surrounding areas with 215 species being detected in the BPWR.

In the total area surveyed, 29.0% (89 species) of the bird species we detected were migrants (Table 2). Twenty percent (61 species) of the total species we detected were nearctic migrants and 8.7% (27 species) were local migrants (Figure 3). Only one summer resident (Sulphur-bellied Flycatcher) was detected during the study. In the BPWR, 35.2% (74 species) of the bird species we detected were migrants. Twenty-three percent (48 species) of the species we detected were nearctic migrants, 12.0% (25 species) were local migrants, and one summer resident was detected (Figure 3).

Oscuro River - The Oscuro River was surveyed nine times during the study. It was sampled on 10 February, 10 March, 9 May, 22 August, 20 October, and 8 December in 1996. In 1997 it was sampled on 7 February, 8 April, and 30 June. One hundred and thirty-six species were detected in this area (Table 1). Ninety-eight (72.0%) of these species were residents, 22 (16.2%) nearctic migrants, 15 (11.0%) local migrants, and one summer resident (Figure 4).

Amatillo River and Lagoon - The Amatillo River and Lagoon were surveyed 10 times during the study. They were sampled on 17 February, 16 March, 22 May, 30 July, 11 September, and 6 November in 1996. In 1997 they were sampled on 12 January, 4 March, 21 May, and 18 July. One hundred and forty-one bird species were detected in this area. Ninety-five (67.4%) of these species were residents, 26 (18.4%) nearctic migrants, and 20 (14.2 %) local migrants (Figure 4).

Polochic River - The Polochic River was surveyed nine times during the study. It was sampled on 24 February, 7 April, 24 June, 26 August, 5 October, and 5 December in 1996. In 1997 it was sampled on 8 February, 9 April, and 29 June. One hundred and forty-three bird species were detected in this area. Eighty-six (60.1%) of these species were residents, 34 (23.7%) nearctic migrants, 22 (15.4%) local migrants, and one summer resident (Figure 4).

Los Lagartos - Los Lagartos was surveyed 12 times during the study. It was sampled on 2 March, 15 April, 25 June, 31 July, 7 August, 14 September, 5 November, and 17 December in 1996. In 1997 it was sampled on 18 January, 22 March, 20 May, and 17 June. One hundred and forty-eight bird species were detected in this area. One hundred and four (70.3%) of these species were residents, 28 (18.9%) nearctic migrants, and 16 (10.8%) local migrants (Figure 4).

Lake Izabal - Lake Izabal was surveyed on the way to each study site in the BPWR, thus it was sampled a total of 40 times. Twenty-three species were detected in the lake. Six (26.1%) of these species were residents, six (26.1%) nearctic migrants, and 11 (47.8%) local migrants.

Las Dantas - Las Dantas was surveyed 11 times during the study. It was sampled on 31 January, 20 February, 5 March, 24 March, 19 April, 11 May, 14 July, 8 September, 8 October, and 9 December in 1996. It was sampled one time in 1997 on 16 January. One

hundred and forty-four bird species were detected in this area. One hundred (69.4%) of these species were residents, 35 (24.3%) nearctic migrants, and nine (6.2%) local migrants (Figure 4).

Sauce River - The Sauce River was surveyed eight times during the study. It was sampled on 26 February, 13 March, 17 April, 2 August, 16 September, 24 July, and 10 October in 1996. In 1997 it was sampled one time on 20 January. One hundred and thirty-eight bird species were detected in this area. Eighty-seven (63.0%) of these species were residents, 41 (29.7%) nearctic migrants, nine (6.5%) local migrants, and one summer resident (Figure 4).

Sierra Santa Cruz Mountains - The Sierra Santa Cruz Mountains were surveyed 10 times during the study. They were sampled on 3, 19, and 29 February, 14 and 31 March, 20 April, 20 September, and 4 October in 1996. In 1997 they were sampled one time on 25 January. One hundred and twenty-three bird species were detected in this area. One hundred and one (82.1%) of these species were residents, 19 (15.4%) nearctic migrants, two (1.6%) local migrants, and one summer resident (Figure 4).

El Estor - This area was surveyed every month from January 1996 - September 1997. Seventy-five bird species were detected in this area. Forty-six (61.3%) of these species were residents, 24 (32.0%) nearctic migrants, and five (6.7%) local migrants (Figure 4).

Selempin/Sierra de las Minas Mountains - This area was surveyed from 7-18 May 1997. In addition, area searches were conducted from 6 - 8 February, 22 August, and 20 October in 1996. In 1997 area searches were conducted from 1-3 September. One hundred and seventy-three bird species were detected in this area. One hundred and forty-eight (85.5%) of these species were residents, 19 (11.0%) nearctic migrants, five (2.9%) local migrants, and one summer resident (Figure 4).

Some species in the BPWR have both resident and migratory populations. To determine population fluctuations of these species during the year, the average number of individuals detected per month was calculated (Figure 6). The Black-bellied Whistling Duck had the greatest number of individuals using the area between the months of May - September, the Great Egret from October - January, the Great Blue Heron from November - December, the Snowy Egret from October - January, the Little Blue Heron from November - March, and the Green Heron had the greatest number of individuals using the area from February - April, and in the month of October.

OBSERVATIONS OF SPECIAL INTEREST - The following observations are of special interest due to differences in distributions or dates of migration with Howell and Webb (1995). Included are notes on hawk and possible parrot migrations.

Blue-winged Teal - Individuals were detected in the mouth of the Oscuro River as early as 22 August 1997 which is earlier than dates given by Howell and Webb.

American Coot - Individuals were detected in the mouth of the Oscuro River as early as 22 August 1997 which is earlier than dates given by Howell and Webb.

Spotted Woodcreeper - One individual was banded on 16 May 1997 at the 750 m site sampled above Selempin. This area is east of the range shown by Howell and Webb.

Scissor-tailed Flycatcher - Individuals were detected on 20 February 1996 and 25 February 1997 at the Las Dantas study area. On 21 May 1997 they were detected at the Amatillo Lagoon. This is north of the range shown by Howell and Webb.

Wood Thrush - One individual was banded on 15 May 1996 at the 600 m site sampled above Selempin. This is later than dates given by Howell and Webb.

Mangrove Vireo - This species was found to be abundant in the Amatillo River system of the BPWR which is west of the range shown by Howell and Webb.

Tropical Parula - Two individuals were detected on 20 September 1996 in the Sierra Santa Cruz mountains north of El Estor which is east of the range shown by Howell and Webb.

Golden-cheeked Warbler - This endangered warbler was detected on 31 March 1996 in the pine savanna habitat on the south facing slope of the Sierra Santa Cruz mountains. This is east of the range shown by Howell and Webb.

Slate-throated Redstart - This species was detected on 14 March and 20 April 1996 in the Sierra Santa Cruz mountains which is north of the range shown by Howell and Webb.

Hepatic Tananger - This species was detected on 29 February in the pine savanna habitat of the Sierra Santa Cruz mountains. This location is southeast of the range shown by Howell and Webb.

Common Bush Tananger - This species was detected on 20 April in the Sierra Santa Cruz mountains at an elevation of 750 m which is east of the range shown by Howell and Webb.

Red-winged Blackbird - This species is not shown by Howell and Webb to be located in eastern Guatemala. However, they were found to be abundant year round in the marsh habitat at the mouth of the Polochic River and were also detected on 30 June 1997 at the Oscuro River.

Orchard Oriole - Individuals were detected in El Estor as late as 9 April which is later than the dates given by Howell and Webb.

Spot-breasted Oriole - This species was detected on 24 March 1996 and on 10 January 1997 in El Estor and at Las Dantas which are north of the range shown by Howell and Webb.

Altimira Oriole - This species was detected on 5 March 1996 and on 12 September 1996 in El Estor and at Las Dantas which are north of the range shown by Howell and Webb.

Mississippi Kite - On 11 September 1996, we observed a flock of approximately 100 migrating south over the BPWR. On 14 September 1996, two individuals were seen in Los Lagartos perched along the shore. On the morning of 2 September 1997, a kettle of approximately 150 kites were observed rising out of the Amatillo river area, and a kettle of approximately 500 individuals were observed on the morning of 15 September 1997 rising over Rio Oscuro.

Broad Winged Hawk - On 11 September 1996, we observed approximately 50 migrating south with Mississippi Kites over the BPWR.

Unidentified Raptor Migrations - On 22 March 1997, approximately 30 hawks were observed flying over Los Lagartos. Individuals were too far away to be identified.

Seasonal Parrot Migrations - We detected an increase in the number of Red-lored Parrots using the BPWR between the months of June and August. In June, an average of 22 Red-

lored Parrots were detected along transects; in July the average rose to 50, and in August the average was 32. Detection rates for this species averaged 10 individuals during all other months sampled. In addition, we detected an increase in the number of White-crowned Parrots, normally a rare species in the BPWR. On 24 June 1996 and on 29 June 1997 we detected large flocks with the high counts being 50 and 51 respectively in the Polochic River.

DISCUSSION

Guatemala is thought to host approximately 664 species of birds (Nations et. al. 1988). This survey increased the species list for the BPWR and the surrounding areas to 321 species or 48% of the total bird species thought to exist in Guatemala. In the BPWR alone, 32% of the country's avifauna was detected. It appears that a significant portion of Guatemala's bird species use this area and thus it is an important conservation site.

The study area was also found to be an important site for migratory birds. One hundred and eighty-four migrants use Guatemala as an over-wintering or stopover site (Nations et. al. 1988). We detected 89 species of migrants in the total study area, or 48.1% of the migrants known to occur in Guatemala. In the BPWR alone, 74 (40.2%) species of migrants were detected with 32 of these being water birds including herons, gulls, terns, gallinules, kingfishers, and ducks. Large flocks of Snowy and Great Egrets, American Coots, and Blue-wing Teals were common sights during the over-wintering period. In addition, 24 species of migratory wood warblers were detected. Sixteen of these species were detected in the BPWR. More nearctic wood warblers may use the BPWR than we detected. Further research in the interior forest habitat of the BPWR needs to be conducted before a complete list of wood warblers, as well as forest interior species, can be realized.

A number of threatened and endangered bird species were recorded during the study such as the Golden-cheeked Warbler, the Peregrine Falcon, and the Snail Kite; all three species are listed under the U.S. Endangered Species Act . In addition, species listed on Appendix III of CITES (Convention on International Trade of Endangered Species) were detected during the study. These species included the Great Curassow, Keel-billed Toucan, and the Plain Chachalaca.

The four major river systems surveyed in the BPWR provide a mosaic of habitats ranging from relatively pristine primary forest to heavily disturbed areas used for the cultivation of rice and corn. Therefore, these areas provide suitable habitat for a variety of bird species communities.

Species associated with interior forest habitats were detected more frequently in the Amatillo River and Los Lagartos. For example, the Great Curassow, Slaty-tailed Trogon, Collared Forest-Falcon, and the Stub-tailed Spadebill were only detected in these two areas. Because Los Lagartos and the Amatillo River contain the majority of mature, contiguous forest cover within the areas we sampled, they may provide the most appropriate habitat for these species.

Species generally associated with dense second growth, forest edge, and disturbed areas were found to occur more often in the Polochic and Oscuro Rivers. Some of the species found to be abundant in the Polochic River were the White-collared Seedeater, Blue-Black Grassquit, Golden-fronted Woodpecker, Plain Wren, Social Flycatcher, and Brown Jay. Disturbance tolerant species such as the Clay-colored Robin, Melodious Blackbird, Yellow-bellied Elaenia, and the Red-winged Blackbird were recorded only in the Oscuro and Polochic Rivers. These two rivers are the main agricultural areas for the local human population and have large tracts of cleared land in various stages of regeneration.

Therefore, these two areas may provide suitable habitat for edge and second growth species.

In the Amatillo lagoon we detected a large number of aquatic bird species. The prolific aquatic vegetation provides a unique habitat that many species use for foraging and cover. For example, Pied-billed Grebes were found to be abundant in the lagoon, but were rarely detected in the other major waterways of the BPWR. Moreover, Ospreys, Snail Kites, Jacanas, as well as large numbers of gallinules were common in the lagoon. This area is used heavily by local fisherman who string gill nets across the lagoon to harvest fish. We have observed aquatic bird species caught in these nets and thus they may cause problems for bird populations using the area.

The mudflats at the mouth of the Polochic River provide a unique habitat found nowhere else in the refuge. Many nearctic and local migrants, such as shorebirds, Black-necked Stilts, and Roseate Spoonbills use this area as a stopover foraging site. In addition, large flocks of gulls, terns, and ducks were detected using the mudflats for roosting sites.

The Sierra Santa Cruz and Sierra de las Minas mountain sites significantly increased the total number of species detected during this study. Many of the bird species found in these two areas were characteristic of subtropical interior forest and were not detected in the BPWR study area. For example, six species of woodcreeper were detected in the surrounding mountains while only the Ivory-billed Woodcreeper was detected in the BPWR. Other examples of species detected only in the Sierra Santa Cruz and Sierra de las Minas Study areas and not in the BPWR included the Nightingale Wren, Rufous Piha, Scaley-throated Leaftosser, Ruddy-tailed and Sulphur-rumped Flycatchers, Red-capped Manakin, and the Plain Antvireo. It is important to note that some of these species may not be located in the BPWR due to habitat requirements, not only lack of appropriate forest cover. For example, some of these bird species forage on the forest floor, therefore the seasonal inundation of the BPWR may not provide appropriate habitat for these species.

The total study area provided a variety of habitats that consequently supported a broad diversity of bird species. Some areas provide unique or limited habitats which support specific bird species and thus may be of special importance for the conservation of these species and avian diversity in the area. The following areas may be critical and require protection:

- The mouth of the Polochic River and its mudflats are important habitat for migrating ducks, shorebirds, gulls, terns, spoonbills, and stilts.
- The Amatillo River, lagoon, and creeks are located within the primitive zone of management and should have full protection. This area supports the majority of mature forest cover found along any water course within the refuge and therefore, many species that depend on this type of habitat. Additionally, the lagoon supports the greatest diversity of aquatic vegetation in the BPWR and provides habitat for large numbers of aquatic bird species.
- Los Lagartos also provides mature forest cover and due to its proximity to the Sierra Santa Cruz mountains, serves as an important component in the corridor between these mountains and the BPWR.
- Corridors on both sides of the BPWR should be maintained to insure interchange between the wetland and both the Sierra de las Minas and Sierra Santa Cruz mountains.

Management Recommendations

1. Identify present and future threats to the BPWR. Many people are dependent on the BPWR for their livelihood, and thus the degree to which humans are altering the wetland ecosystem needs to be evaluated with the aid of Geographic Information

Systems and yearly habitat measurements. The amount and location of firewood being cut, the quantity and quality of habitat being altered to plant crops and graze cattle, and the number and species of fish being harvested needs to be evaluated. Without knowing the amount of habitat disturbance occurring within the BPWR, effective management goals can not be determined.

2. Incorporate sustainable development into land use planning. Local people need to be educated on ways they can use the resources of the BPWR while minimizing their impact on the environment. Such sustainable use planning could include the development of permaculture in the BPWR, fishing regulations on the size and amount of fish that can be harvested, development of fish ponds for restocking the lake and reducing fishing pressure, expansion of community based ecotourism to provide other avenues of income, and replanting of tree species that are cut for firewood or building materials.

3. Continue to evaluate and monitor critical areas for bird species in the wetland. We determined that the majority of sensitive species, both residents and migrants, were found in Lagartos, the Amatillo River and Lagoon, and the mouth of the Polochic River. We highly recommend that these areas be given special consideration. We suggest that the Amatillo river and Lagoon and the upper creeks of Los Lagartos, where primary forest is most abundant, be protected from further human encroachment. The mouth of the Polochic river is an important stopover site for many nearctic migrant shorebirds and should be protected from any disturbances, especially during the over-wintering season. Additionally, preserving forested corridors between the wetland wildlife refuge and the two mountain ranges should be a priority.

4. Continue the implementation of the proposed long-term monitoring program which will be carried out by local Guatemalans from the Fundación Defensores de la Naturaleza (Appendix A).

5. Increase communication and collaboration with other scientists and land managers from Non-Governmental Agencies in Guatemala and neighboring countries to learn about the status of migrant bird populations and ways to improve management of the BPWR to benefit these populations. In addition, other countries can provide technical training and support environmental education efforts to promote a better understanding of the wetland ecosystem and ways to manage it effectively both for wildlife and the surrounding human population.

Because the BPWR provides valuable resources to the local people, it will continue to be deforested and degraded in the future. Protecting it as a national wildlife refuge was an important step in maintaining biological diversity and viable wildlife populations. It is imperative however, to consider conservation strategies as an integrated part of development policies. The preservation of the BPWR is dependent on the promotion of sustainable use by human populations so that their activities are compatible with the maintenance of the natural properties of the wetland ecosystem.

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	ENGLISH NAME	SCIENTIFIC NAME	Rio Oscuro	Rio Amatillo	Rio Polochic	Los Lagartos	Las Dantas	Santa Cruz	Rio Sauce	Selempin	El Estor	Lago Izabal
Tinamidae (3)												
1	Great Tinamou	*Tinamus major*				H	X	X		X		
2	Little Tinamou	*Crypturellus soui*						H		X		
3	Slaty-breasted Tinamou	*Crypturellus boucaedi*								X		
Podicipedidae (2)												
4	Least Grebe	*Tachybaptus dominicus*	R	C		R						
5	Pied-billed Grebe	*Podilymbus podiceps*	R	A		U						
Pelecanidae (1)												
6	Brown Pelican	*Pelecanus occidentalis*										X
Phalacrocoracidae (1)												
7	Neotropic (Olivaceous) Cormorant	*Phalacrocorax brasilianus*	A	A	A	A	X		X	X		X
Anhingidae (1)												
8	Anhinga	*Anhinga anhinga*	A	A	R	A						
Fregatidae (1)												
9	Magnificent Frigatebird	*Fregata magnificens*									X	X
Ardeidae (13)												
10	Least Bittern	*Ixobrychus exilis*		R	R							
11	Bare-throated Tiger-Heron	*Tigrisoma mexicanum*	A	A	R	A	X			X		
12	Great Blue Heron	*Ardea herodias*	C	C	A	C	X		X	X		X
13	Great Egret	*Egretta alba*	A	A	A	A	X		X			X
14	Snowy Egret	*Egretta thula*	C	C	A	U			X	X		X
15	Little Blue Heron	*Egretta caerulea*	U	A	A	C			X			
16	Tricolored Heron	*Egretta tricolor*	R	R	R	R	H					
17	Cattle Egret	*Bubulcus ibis*	A	U	U	R	X		X	X		
18	Green (Green-backed) Heron	*Butorides virescens*	A	A	C	C	H		H			

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19	Agami (Chestnut-bellied) Heron	*Agamia agami*	R									
20	Black-crowned Night-Heron	*Nycticorax nycticorax*	U	A	C	U						
21	Yellow-crowned Night-Heron	*Nycticorax violaceus*	R	R		R						
22	Boat-billed Heron	*Cochlearius cochlearius*	C	U		U	H					
Threskiornithidae (1)												
23	Roseate Spoonbill	*Platalea ajaja*			R							
Ciconiidae (1)												
24	Wood Stork	*Mycteria americana*	R	R		R		H		X		
Anatidae (4)												
25	Black-bellied Whistling-Duck	*Dendrocygna autumnalis*	A	C	A	A	X		X	X	X	X
26	Muscovy Duck	*Cairina moschata*	A	C	U	U	X		X	X		X
27	Blue-winged Teal	*Anas discors*	C	A	A	R						X
28	Lesser Scaup	*Aythya affinis*	R	R	R							X
Cathartidae (2)												
29	Black Vulture	*Coragyps atratus*	A	C	A	U	X	H	X	X		
30	Turkey Vulture	*Cathartes aura*	A	A	C	C	X	X	X			
Accipitridae (14)												
31	Osprey	*Pandion haliaetus*	R	A	U	U	X		H			X
32	Grey-headed Kite	*Leptodon cayanensis*			H	R						
33	Hook-billed Kite	*Chondrohierax uncinatus*		R								
34	White-tailed (Black-shouldered) Kite	*Elanus leucurus*					X		H			
35	Snail Kite	*Rostrhamus sociabilis*	C	A	C	U						
36	Mississippi Kite	*Ictinia mississippiensis*	R	R		R						
37	Crane Hawk	*Geranospiza caerulescens*		R								
38	Black-collared Hawk	*Busarellus nigricollis*				R	X					

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39	White Hawk	*Leucopternis albicollis*						X		X		
40	Common Black Hawk	*Buteogallus anthracinus*	R	R		R	X		H			
41	Grey Hawk	*Buteo nitidus*	H	H	R	H	X	X	X	X	X	
42	Roadside Hawk	*Buteo magnirostris*	A	C	A	C	X		H	X		
43	Broad-winged Hawk	*Buteo platypterus*	H	R	H	H	H	H	X			
44	Black-and-White Hawk-Eagle	*Spizastur melanoleucus*						X				
Falconidae (7)												
45	Laughing Falcon	*Herpetotheres cachinnans*	U	U	R	H	X		X	X		
46	Collared Forest-Falcon	*Micrastur semitorquatus*		R			X		X	X		
47	American Kestrel	*Falco sparverius*							H	X		
48	Merlin	*Falco columbarius*			R							
49	Bat Falcon	*Falco rufigularis*	C	U	H	U	H		X	X	X	
50	Orange-breasted Falcon	*Falco deiroleucus*	R		R							
51	Peregrine Falcon	*Falco peregrinus*			R						X	
Cracidae (3)												
52	Plain Chachalaca	*Ortalis vetula*	U	R	U	U	X	X	X	X		
53	Crested Guan	*Penelope purpurascens*		R						X		
54	Great Curassow	*Crax rubra*		R		R						
Rallidae (5)												
55	Ruddy Crake	*Laterallus ruber*	A	C	C	A	X		H	X		
56	Grey-necked Wood-Rail	*Aramides cajanea*	R			R				X		
57	Purple Gallinule	*Porphyrula martinica*	R	C	U	A						
58	Common Moorhen	*Gallinula chloropus*	R	A	U	R						
59	American Coot	*Fulica americana*	C	A	A	A						X
Heliornithidae (1)												

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60	Sungrebe	*Heliornis fulica*	A	C	C	A						
Aramidae (1)												
61	Limpkin	*Aramus guarauna*	C	A	A	R	X		H	X		
Charadriidae (1)												
62	Killdeer	*Charadrius vociferus*			R							
Recurvirostridae (1)												
63	Black-necked Stilt	*Himantopus mexicanus*		H	U							
Jacanidae (1)												
64	Northern Jacana	*Jacana spinosa*	A	A	U	A						
Scolopacidae (4)												
65	Spotted Sandpiper	*Actitis macularia*	R	H	R	R			X			
66	Western Sandpiper	*Calidris mauri*			R							
67	Least Sandpiper	*Calidris minutilla*			R				H			
68	Lesser Yellowlegs	*Tringa flavipes*			R							
Laridae (6)												
69	Laughing Gull	*Larus atricilla*			A		X					X
70	Herring Gull	*Larus argentatus*			R							X
71	Caspian Tern	*Sterna caspia*		U	A							X
72	Royal Tern	*Sterna maxima*		U	A							X
73	Black Tern	*Chlidonias niger*			C	R						X
74	Black Skimmer	*Rynchops niger*		H	R							X
Columbidae (10)												
75	Feral Pigeon (Rock Dove)	*Columba livia*									X	
76	Pale-vented Pigeon	*Columba cayennensis*	R	R	C	U	H				X	
77	Scaled Pigeon	*Columba speciosa*	R	R	R	U	X					

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78	Red-billed Pigeon	*Columba flavirostris*	U	C	C	C	X				X	
79	Short-billed Pigeon	*Columba nigrirostris*	H	H		U	X			X		
80	Ruddy Ground-Dove	*Columbina talpacoti*	R		R		X		X		X	
81	Blue Ground-Dove	*Claravis pretiosa*	U	C	U	A	X			X		
82	Gray-headed Dove	*Leptotila plumbeiceps*	U	U	U	U	X		X	X		
83	Grey-chested Dove	*Leptotila cassinii*				R				X		
84	Ruddy Quail-Dove	*Geotrygon montana*								X		
Psittacidae (5)												
85	Aztec (Olive-throated) Parakeet	*Aratinga astec*	U	R	R	U	X	X	X	X		
86	Brown-hooded Parrot	*Pionopsitta haematotis*		R	H	U				X		
87	White-crowned Parrot	*Pionus senilis*	R	R	U	R	X	X		X	X	
88	Red-lored (Yellow-cheeked) Parrot	*Amazona autumnalis*	A	A	A	A	X	H	X	X	X	
89	Mealy Parrot	*Amazona farinosa*								X		
Cuculidae (6)												
90	Yellow-billed Cuckoo	*Coccyzus americanus*			H	R	X		X			
91	Mangrove Cuckoo	*Coccyzus minor*									X	
92	Squirrel Cuckoo	*Piaya cayana*	C	C	R	U	X	X	X	X		
93	Striped Cuckoo	*Tapera neavia*	R							X		
94	Pheasant Cuckoo	*Dromococcyx phasianellus*						X				
95	Groove-billed Ani	*Crotophaga sulcirostris*	A	R	A	A	X		X	X	X	
Strigidae (3)												
96	Ferruginous Pygmy-Owl	*Glaucidium brasilianum*					X	X			X	
97	Mottled Owl	*Strix virgata*								X		
98	Black-and-White Owl	*Strix nigrolineata*								X		
Caprimulgidae (2)												

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99	Common Nighthawk	*Chordeiles minor*							X		X	
100	Pauraque	*Nyctidromus albicollis*								X		
Apodidae (2)												
101	White-collared Swift	*Streptoprocne zonaris*	C	A	R	A	X	X	X	X	X	
102	Vaux's Swift	*Chaetura vauxi*	U	U	U	U	X	X	X			
Trochilidae (14)												
103	Long-tailed Hermit	*Phaethornis superciliosus*	R	R				X	X	X	X	
104	Little Hermit	*Pygmornis longuemareus*					X	X	X	X		
105	Scaley-breasted Hummingbird	*Phaeochroa cuvierii*							X			
106	Violet Sabrewing	*Campylopterus hemileucurus*		R				X		X		
107	White-necked Jacobin	*Florisuga mellivora*		R		R		H	X	X	X	
108	Green-breasted Mango	*Anthracothorax prevostii*	R	R	R	R	H	H	H		X	
109	Brown Violet-Ear	*Colibri delphinae*						X				
110	Black-crested Coquette	*Lophornis helenae*						X				
111	Crowned Woodnymph	*Thalurania colombica*						H		X		
112	White-bellied Emerald	*Amazilia candida*	H	R		R	H	X	H	X		
113	Azure-crowned Hummingbird	*Amazilia cyanocephala*								X		
114	Rufous-tailed Hummingbird	*Amazilia tzacatl*	C	U	U	U	X	X	X		X	
115	Stripe-tailed Hummingbird	*Eupherusa eximia*								X		
116	Ruby-throated Hummingbird	*Archilochus colubris*									X	
Trogonidae (4)												
117	Black-headed Trogon	*Trogon melanocephalus*	A	C	C	A	X	X	X	X		
118	Violaceous Trogon	*Trogon violaceus*						X		X		
119	Collared Trogon	*Trogon collaris*						X		X		
120	Slaty-tailed Trogon	*Trogon massena*		C		C		H	X	X		

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Momotidae (3)												
121	Tody Motmot	*Hylomanes momotula*						X		X		
122	Blue-crowned Motmot	*Momotus momota*	H				X	X		X		
123	Keel-billed Motmot	*Electron carinatum*								X		
Alcedinidae (5)												
124	Ringed Kingfisher	*Ceryle torquata*	A	A	A	A	X		X	X	X	
125	Belted Kingfisher	*Ceryle alcyon*	C	C	C	C	X		X	X		
126	Amazon Kingfisher	*Chloroceryle amazona*	U	R	R	U	H		X			
127	Green Kingfisher	*Chloroceryle americana*	A	R	A	A	H	X	X	X		
128	Pygmy Kingfisher	*Chloroceryle aenea*	A	R	R	U			X	X		
Bucconidae (2)												
129	White-necked Puffbird	*Notharchus macrorhynchos*				R				X		
130	White-wiskered Puffbird	*Malacoptila panamensis*								X		
Galbulidae (1)												
131	Rufous-tailed Jacamar	*Galbula ruficauda*						X		X		
Ramphastidae (2)												
132	Collared Aracari	*Pteroglossus torquatus*		H		A	H		X	X		
133	Keel-billed Toucan	*Ramphastos sulfuratus*	R		H	H	X	X	H	X		
Picidae (8)												
134	Olivaceous Piculet	*Picumnus olivaceus*								X		
135	Black-cheeked Woodpecker	*Centurus pucherani*								X		
136	Golden-fronted Woodpecker	*Centurus aurifrons*	C	R	A	R	X	X	X	X	X	
137	Smoky-brown Woodpecker	*Veniliornis fumigatus*								X		
138	Golden-olive Woodpecker	*Piculus rubiginosus*						X				
139	Chestnut-colored Woodpecker	*Celeus castaneus*				R		X		X		

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140	Lineated Woodpecker	*Dryocopus lineatus*	R	C	A	A	X	X	X	X	X	
141	Pale-billed Woodpecker	*Campephilus guatemalensis*	R	R		R			X	X		
Furnariidae (4)												
142	Rufous-breasted Spinetail	*Synallaxis erythrothorax*	A	R	C	R	X	X		X		
143	Buff-throated Foliage-Gleaner	*Automolus ochrolaemus*								X		
144	Plain Xenops	*Xenops minutus*		H				X		X		
145	Scaley-throated Leaftosser	*Sclerurus guatemalensis*								X		
Dendrocolaptidae (7)												
146	Tawny-winged Woodcreeper	*Dendrocincla anabatina*						X		X		
147	Ruddy Woodcreeper	*Dendrocincla homochroa*								X		
148	Olivaceous Woodcreeper	*Sittasomus griseicapillus*						X		X		
149	Wedge-billed Woodcreeper	*Glyphorynchus spirurus*						X	X	X		
150	Barred Woodcreeper	*Dendrocolaptes certhia*						X		X		
151	Ivory-billed Woodcreeper	*Xiphorhynchus flavigaster*	A	A	A	A	X	X		X		
152	Spotted Woodcreeper	*Xiphorhynchus erythropygius*								X		
Formicariidae (5)												
153	Barred Antshrike	*Thamnophilus doliatus*	A	U	U	C		X				
154	Plain Antvireo	*Dysithamnus mentalis*								X		
155	Dot-winged Antwren	*Microrhopias quixensis*	R							X		
156	Dusky Antbird	*Cercomacra tyrannina*	A	A	C	A	X		H	X		
157	Mexican (Black-faced) Antthrush	*Formicarius moniliger*								X		
Tyrannidae (31)												
158	Yellow-bellied Tyrannulet	*Ornithion semiflavum*	C	U	R	U	X	X		X		
159	Greenish Elaenia	*Myiopagis viridicata*						X				
160	Yellow-bellied Elaenia	*Elaenia flavogaster*			R				X		X	

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	ENGLISH NAME	SCIENTIFIC NAME	Rio Oscuro	Rio Amatillo	Rio Polochic	Los Lagartos	Las Dantas	Santa Cruz	Rio Sauce	Selempin	El Estor	Lago Izabal
161	Ochre-bellied Flycatcher	*Mionectes oleaginus*					X	X		X		
162	Sepia-capped Flycatcher	*Leptopogon amaurocephalus*								X		
163	Northern Bentbill	*Oncostoma cinereigulare*	U	R		U	X	X		X		
164	Slate-headed Tody-Flycatcher	*Todirostrum sylvia*						X	H		X	
165	Common Tody-Flycatcher	*Todirostrum cinereum*	R		R	H	X		X			
166	Eye-ringed Flatbill	*Rhynchocyclus brevirostris*						X				
167	Yellow-olive Flycatcher	*Tolmomyias sulphurescens*						X		X		
168	Stub-tailed Spadebill	*Platyrinchus cancrominus*		R		R				X		
169	Royal Flycatcher	*Onychorhynchus coronatus*	R					X	X	X		
170	Ruddy-tailed Flycatcher	*Terenotriccus erythrurus*								X		
171	Sulphur-rumped Flycatcher	*Myiobius sulphureipygius*					X	X		X		
172	Eastern Peewee	*Contopus virens*	R		U	R	X		X	X	X	
173	Tropical Peewee	*Contopus cinereus*			H	R	X		X			
174	Yellow-bellied Flycatcher	*Empidonax flaviventris*		H	R	H	X		X	X	X	
175	Least Flycatcher	*Empidonax minimus*	U	U	C	U	X	X	X			
176	Black Phoebe	*Sayornis nigricans*							X			
177	Bright-rumped Attila	*Attila spadiceus*	A	A	U	A	X		X	X		
178	Rufous Mourner	*Rhytipterna holerythra*						X		X		
179	Dusky-capped Flycatcher	*Myiarchus tuberculifer*	C	U	U	U	X	X	X	X	X	
180	Great-crested Flycatcher	*Myiarchus crinitus*	R	H	H	R	X		X		X	
181	Brown-crested Flycatcher	*Myiarchus tyrannulus*		R		R	X		X			
182	Great Kiskadee	*Pitangus sulphuratus*	C	C	C	A	X	X	X	X	X	
183	Boat-billed Flycatcher	*Megarynchus pitangua*			H		X	X	X			
184	Social Flycatcher	*Myiozetetes similis*	A	C	A	C	X	X	X	X	X	
185	Sulphur-bellied Flycatcher	*Myiodynastes luteiventris*	H		R			X	X	X		

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	ENGLISH NAME	SCIENTIFIC NAME	Rio Oscuro	Rio Amatillo	Rio Polochic	Los Lagartos	Las Dantas	Santa Cruz	Rio Sauce	Selempin	El Estor	Lago Izabal
186	Tropical Kingbird	*Tyrannus melancholicus*	C	A	A	A	X		X	X	X	
187	Eastern Kingbird	*Tyrannus tyrannus*			R		X					
188	Scissor-tailed Flycatcher	*Tyrannus forficatus*		R			X		X			
Cotingidae (8)												
189	Thrushlike Mourner (Manakin)	*Schiffornis turdinus*	R	C		C		X				
190	Cinnamon Becard	*Pachyramphus cinnamomeus*								X		
191	White-winged Becard	*Pachyramphus polychopterus*								X		
192	Rose-throated Becard	*Pachyramphus aglaiae*						X				
193	Masked Tityra	*Tityra semifasciata*	R			R	X	X	X	X		
194	Black-crowned Tityra	*Tityra inquisitor*					X			X		
195	Rufous Piha	*Lipaugus unirufus*								X		
196	Lovely Cotinga	*Cotinga amabilis*								X		
Pipridae (2)												
197	White-collared Manakin	*Manacus candei*	U	C	H	C	X	X		X		
198	Red-capped Manakin	*Pipra mentalis*						X		X		
Hirundinidae (5)												
199	Grey-breasted Martin	*Progne chalybea*			R		X		X			X
200	Tree Swallow	*Tachycineta bicolor*		R	R		X		X			X
201	Mangrove Swallow	*Tachycineta albilinea*	R	R	A	U	X		X		X	X
202	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	R	R	R	R	X		X			X
203	Barn Swallow	*Hirundo rustica*		R		R	X		H			X
204	Cliff Swallow	*Hirundo pyrrhonota*		R								
Corvidae (2)												
205	Green Jay	*Cyanocorax yncas*				H	X	X		X		
206	Brown Jay	*Cyanocorax morio*	C	C	A	R	X	X	X	X	X	

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	ENGLISH NAME	SCIENTIFIC NAME	Rio Oscuro	Rio Amatillo	Rio Polochic	Los Lagartos	Las Dantas	Santa Cruz	Rio Sauce	Selempin	El Estor	Lago Izabal
Troglodytidae (7)												
207	Band-backed Wren	*Campylorhnchus zonatus*								X		
208	Spot-breasted Wren	*Thryothorus maculipectus*	C	A	C	A	X	X	X	X		
209	Rufous-and-White Wren	*Thryothorus rufalbus*			H					X		
210	Plain Wren	*Thryothorus modestus*	A	U	A	C			X			
211	Southern House Wren	*Troglodytes aedon*			H		X		X		X	
212	White-breasted Wood-Wren	*Henicorhina leucosticta*		R						X		
213	Nightingale Wren	*Microcerculus philomela*						X		X		
Sylviidae (3)												
214	Long-billed Gnatwren	*Ramphocaenus melanurus*	A	C		C	X	X	X	X		
215	Blue-grey Gnatcatcher	*Polioptila caerulea*		H	R	R	X				X	
216	Tropical Gnatcatcher	*Polioptila plumbea*				R	H	X	X	X		
Turdidae (6)												
217	Slate-colored Solitaire	*Myadestes unicolor*								X		
218	Grey-cheeked Thrush	*Catharus minimus*								X		
219	Swainson's Thrush	*Catharus ustulatus*				H		X	X	X	X	
220	Wood Thrush	*Catharus mustelinus*				H		X		X	X	
221	Clay-colored Robin	*Turdus grayi*	R		H		X	H	X	X	X	
222	White-throated Robin	*Turdus assimilis*								X		
Mimidae (1)												
223	Grey Catbird	*Dumetella carolinensis*	C	A	U	A	X	X	X	X	X	
Bombycillidae (1)												
224	Cedar Waxwing	*Bombycilla cedrorum*		R								
Vireonidae (7)												
225	Mangrove Vireo	*Vireo pallens*	H	A	R	H				X	X	

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226	Yellow-throated Vireo	*Vireo flavifrons*		R			X	X	X		X	
227	Philadelphia Vireo	*Vireo philadelphicus*					X	X	X			
228	Red-eyed Vireo	*Vireo olivaceus*					X			X		
229	Tawny-crowned Greenlet	*Hylophilus ochraceiceps*								X		
230	Lesser Greenlet	*Hylophilus decurtatus*	A	A		U	X	X	X	X		
231	Green Shrike-Vireo	*Vireolanius pulchellus*								X		
Emberizidae (64)												
232	Blue-winged Warbler	*Vermivora pinus*				R	H		X			
233	Golden-winged Warbler	*Vermivora chrysoptera*			H				X			
234	Tennessee Warbler	*Vermivora peregrina*	R		R		X	X	X		X	
235	Tropical Parula	*Parula pitiayumi*						X				
236	Yellow Warbler	*Dendroica petechia*	U	U	C	C	X		X		X	
237	Chestnut-sided Warbler	*Dendroica pensylvanica*	U		R	R	H	X	X	X		
238	Magnolia Warbler	*Dendroica magnolia*	A	C	R	C	X	X	X	X	X	
239	Black-throated Green Warbler	*Dendroica virens*						X	H	X		
240	Golden-cheeked Warbler	*Dendroica chrysoparia*						X				
241	Blackburnian Warbler	*Dendroica fusca*									X	
242	Yellow-throated Warbler	*Dendroica dominica*						X				
243	Cerulean Warbler	*Dendroica cerulea*							X		X	
244	Black-and-White Warbler	*Mniotilta varia*	R		U	R	H	X	X		X	
245	American Redstart	*Setophaga ruticilla*	U	U	C	C	X	X	X	X	X	
246	Prothonotory Warbler	*Protonotaria citrea*	U	R	R	R	H			X		
247	Worm-eating Warbler	*Helmitheros vermivorus*				H	H	X	X			
248	Ovenbird	*Seiurus aurocapillus*		H			H	X	X	X		
249	Northern Waterthrush	*Seiurus noveboracensis*	H	R	H	H	H		X	X		

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250	Louisiana Waterthrush	*Seiurus motacilla*	R	U					X	X		
251	Kentucky Warbler	*Oporornis formosus*				H	H		X	X		
252	Common Yellowthroat	*Geothlypis trichas*	A	U	U	U	X		X	X	X	
253	Grey-crowned Yellowthroat	*Chamaethlypis poliocephala*		R			X	X	H			
254	Hooded Warbler	*Wilsonia citrina*					H	X	X		X	
255	Wilson's Warbler	*Wilsonia pusilla*						H	X			
256	Canada Warbler	*Wilsonia canadensis*							X	X		
257	Slate-throated Redstart	*Myioborus miniatus*						X				
258	Golden-crowned Warbler	*Basileuterus culicivorus*						X		X		
259	Rufous-capped Warbler	*Basileuterus rufifrons*						X				
260	Yellow-breasted Chat	*Icteria virens*	U	R	R	R	X	X	X		X	
261	Bananaquit	*Coereba flaveola*	R					H		X		
262	Golden-hooded Tananger	*Tangara larvata*						X				
263	Green Honeycreeper	*Chlorophanes spiza*							X			
264	Red-legged Honeycreeper	*Cyanerpes cyaneus*			H	R	X	X		X		
265	Blue-crowned Chlorophonia	*Clorophonia occipitalis*								X		
266	Scrub Euphonia	*Euphonia affinis*	H	H	H	H	X	X	X	X		
267	Yellow-throated Euphonia	*Euphonia hirundinacea*	C	A	H	A			X	X	X	
268	Olive-backed Euphonia	*Euphonia gouldi*		R			X	X		X		
269	White-vented Euphonia	*Euphonia minuta*									X	
270	Blue-grey Tananger	*Thraupis episcopus*	R	U	U	H	X		X	X	X	
271	Yellow-winged Tananger	*Thraupis abbas*					X		X	X	X	
272	Black-throated Shrike-Tananger	*Lanio aurantius*						X				
273	Red-crowned Ant-Tananger	*Habia rubica*	R			R	X	X	X	X		
274	Red-throated Ant-Tananger	*Habia fuscicauda*	U	R		R	X	X		X		

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275	Hepatic Tananger	*Piranga flava*						X				
276	Summer Tananger	*Piranga rubra*	H				X	X	X		X	
277	White-winged Tananger	*Spermagra leucoptera*						X				
278	Crimson-collared Tananger	*Phlogothrauapis sanguinolenta*							X	X	X	
279	Scarlet-rumped Tananger	*Ramphocelus passerinii*	R		R	R					X	
280	Common Bush-Tananger	*Chlorospingus ophthalmicus*						X				
281	Grayish Saltator	*Saltator coerulescens*	R		U					X		
282	Buff-throated Saltator	*Saltator maximus*	R	R		R	X		X	X		
283	Black-headed Saltator	*Saltator atriceps*					X	X	X	X		
284	Black-faced Grosbeak	*Caryothraustes poliogaster*		H			X	X		X		
285	Rose-breasted Grosbeak	*Pheucticus ludovicianus*			R		X		X		X	
286	Blue-black Grosbeak	*Cyanocompsa cyanoides*	R	U	R	R	X	X		X		
287	Blue Grosbeak	*Passerina caerulea*						X	X			
288	Indigo Bunting	*Passerina cyanea*			H		X	X	X		X	
289	Painted Bunting	*Passerina ciris*					X		X		X	
290	Orange-billed Sparrow	*Arremon aurantiirostris*								X		
291	Green-backed Sparrow	*Arremonops chloronotus*					X	X	X	X		
292	Blue-black Grassquit	*Volatinia jacarina*	H	R	C	R	X		X	X	X	
293	Variable Seedeater	*Sporophila aurita*	R	R	C	U	X	X	X	X		
294	White-collared Seedeater	*Sporophila torqueola*	U	C	A	U	X	X	X	X	X	
295	Thick-billed Seed Finch	*Oryzoborus funereus*	R		R	H	X		X		X	
Icteridae (12)												
296	Red-winged Blackbird	*Agelaius phoeniceus*	R		A							
297	Melodious Blackbird	*Dives dives*	R		A	R	X	X	X	X	X	
298	Great-tailed Grackle	*Quiscalus mexicanus*			R	R	X		X	X	X	

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299	Giant Cowbird	*Scaphidura oryzivora*				R					X	
300	Black-cowled Oriole	*Icterus dominicensis*			R	R				X		
301	Orchard Oriole	*Icterus spurius*	H		C	R	X		X		X	
302	Yellow-tailed Oriole	*Icterus mesomelas*	R		U					X		
303	Spot-breasted Oriole	*Icterus pectoralis*					X				X	
304	Altamira Oriole	*Icterus gularis*					X				X	
305	Baltimore (Northern) Oriole	*Icterus galbula*	C	U	A	A	X	X	X		X	
306	Yellow-billed Cacique	*Amblycercus holosericeus*		H			X			X		
307	Montezuma Oropendola	*Psarocolius montezuma*	A	A	A	A	X			X	X	
Passeridae (1)												
308	House Sparrow	*Passer domesticus*									X	

Table 2. Inclusive dates of nearctic migrants (NM), local migrants (LM), and summer residents (SR) in the BPWR and surrounding areas, 1/96 - 9/97.

	ENGLISH NAME	SCIENTIFIC NAME	FIRST DETECTED	LAST DETECTED	HIGH COUNT	MIGRANT
1	Pied-billed Grebe	*Podilymbus podiceps*	19-Sep	22-May		LM
2	Magnificent Frigatebird	*Fregata magnificens*	6-Nov	30-Jun		LM
3	Least Bittern	*Ixobrychus exilis*	22-May	29-Jun		LM
4	Great Blue Heron	*Ardea herodias*			25 on 8-Dec	LM
5	Great Egret	*Egretta alba*			120 on 20-Oct	LM
6	Snowy Egret	*Egretta thula*			200 on 20-Oct	LM
7	Little Blue Heron	*Egretta caerulea*			10 on 24-Feb	LM
8	Tricolored Heron	*Egretta tricolor*	5-Oct	4-Mar		LM
9	Green (Green-backed) Heron	*Butorides virescens*			22 on 7-Feb	LM
10	Black-crowned Night-Heron	*Nycticorax nycticorax*			8 on 12-Jan	LM
11	Roseate Spoonbill	*Platalea ajaja*	17-Dec	17-Jan		LM
12	Wood Stork	*Mycteria americana*	20-Oct	17-Jan		LM
13	Black-bellied Whistling-Duck	*Dendrocygna autumnalis*	17-Jan	5-Oct	105 on 11-Sep	LM
14	Blue-winged Teal	*Anas discors*	22-Aug	9-Apr	325 on 24-Feb	NM
15	Lesser Scaup	*Aythya affinis*	6-Nov	9-Apr	10 on 9-Apr	NM
16	Osprey	*Pandion haliaetus*	11-Sep	15-Apr		LM
17	Mississippi Kite	*Ictinia mississippiensis*	11-Sep	14-Sep	500 on 15-Sep	NM
18	Broad-winged Hawk	*Buteo platypterus*	11-Sep	22-May	50 on 11- Sep	NM
19	Merlin	*Falco columbarius*		9-Apr		NM
20	Peregrine Falcon	*Falco peregrinus*		1-Mar		LM
21	Purple Gallinule	*Porphyrula martinica*	17-Jan	21-May	20 on 21-May	LM
22	Common Moorhen	*Gallinula chloropus*	6-Nov	22-May	42 on 21-May	LM
23	American Coot	*Fulica americana*	22-Aug	22-May	1500 on 7-Feb	LM
24	Killdeer	*Charadrius vociferus*		20-Oct		LM
25	Black-necked Stilt	*Himantopus mexicanus*	17-Jan	9-Apr	14 on 8-Feb	LM

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	ENGLISH NAME	SCIENTIFIC NAME	FIRST DETECTED	LAST DETECTED	HIGH COUNT	MIGRANT
26	Spotted Sandpiper	*Actitis macularia*	31-Jul	17-Apr		NM
27	Western Sandpiper	*Calidris mauri*	26-Aug	8-Feb	25 on 8-Feb	NM
28	Least Sandpiper	*Calidris minutilla*	17-Jan	8-Feb	60 on 17 -Jan	NM
29	Lesser Yellowlegs	*Tringa flavipes*		17-Jan		NM
30	Laughing Gull	*Larus atricilla*	17-Jan	24-Jul	100 on 17-Jan	LM
31	Herring Gull	*Larus argentatus*	20-Oct	9-Apr		NM
32	Caspian Tern	*Sterna caspia*	5-Nov	17-Jul	25 on 9-Apr	NM
33	Royal Tern	*Sterna maxima*	19-Sep	17-Jul	76 on 9-Apr	LM
34	Black Tern	*Chlidonias niger*	8-Apr	21-Sep	50 on 11-Sep	NM
35	Black Skimmer	*Rynchops niger*		9-Apr	25 on 9-Apr	LM
36	Yellow-billed Cuckoo	*Coccyzus americanus*	10-Oct	11-May		NM
37	Common Nighthawk	*Chordeiles minor*		17-Apr		NM
38	Ruby-throated Hummingbird	*Archilochus colubris*		21-Jan		NM
39	Belted Kingfisher	*Ceryle alcyon*	15-Sep	17-Apr		NM
40	Eastern Peewee	*Contopus virens*	8-Sep	10-May		NM
41	Yellow-bellied Flycatcher	*Empidonax flaviventris*	16-Sep	7-Apr		NM
42	Least Flycatcher	*Empidonax minimus*	19-Sep	19-Apr		NM
43	Great-crested Flycatcher	*Myiarchus crinitus*	8-Sep	25-Feb		NM
44	Sulphur-bellied Flycatcher	*Myiodynastes luteiventris*	17-Apr	26-Aug		SR
45	Eastern Kingbird	*Tyrannus tyrannus*	2-Sep	19-Apr	25 on 19-Apr	NM
46	Scissor-tailed Flycatcher	*Tyrannus forficatus*	20-Feb	21-May		NM
47	Tree Swallow	*Tachycineta bicolor*	19-Sep	27-Apr	150 on 5-Oct	NM
48	Barn Swallow	*Hirundo rustica*	15-Sep	11-May	25 on 22-Mar	NM
49	Cliff Swallow	*Hirundo pyrrhonota*		19-Sep		
50	Blue-grey Gnatcatcher	*Polioptila caerulea*	14-Sep	22-Feb		LM

Refugio del Vida Silvestre Bocas del Polochic
Fundación Defensores de la Naturaleza

BOLETA DE MONITOREO

TRANSECTO:_____ TIEMPO: INICIO: _____ SOL: _____ LLUVIA: _____

FECHA: _____ FIN: _____ NUBE: _____ FRIO:_____

NOMBRE:_____ VIENTO: _____ CALOR:_____

	ESPECIE	NOMBRE LOCAL	No. POSANDO	No. VOLANDO	No. NADANDO	TOTAL
1	*Phalacrocorax brasilianus*	Malache				
2	*Anhinga anhinga*	Pato Aguja				
3	*Tigrisoma mexicanum*	Garza-tigre				
4	*Ardea herodias*	Garzon				
5	*Egretta alba*	Garza Real				
6	*Egretta thula*	Garza Blanca				
7	*Egretta caerulea*	Garza Gris				
8	*Butorides virescens*	Garza verde				
9	*Nycticorax nycticorax*	Garza-nocturna				
10	*Dendrocygna autumnalis*	Pijije				
11	*Cairina moschata*	Pato de Monte				
12	*Anas discors*	Pato Aliazul				
13	*Rostrhamus sociabilis*	Gavilan Caracolero				
14	*Crax rubra*	Pajuil				
15	*Heliornis fulica*	Pajaro Cantil				
16	*Gallinula chloropus*	Gallineta Comun				
17	*Fulica americana*	Gallareta				
18	*Aramus guarauna*	Margarita				
19	*Jacana spinosa*	Gallito de Agua				
20	*Mycteria americana*	Coco				
21	*Cervle torquata*	Martin Pescador				

APPENDIX C. Data sheet for the long-term monitoring program for the Bocas del Polochic Wildlife Refuge.

EXTRACCION Y USO DE FAUNA O FLORA	No. DE INDIVIDUOS	TOTAL	DESCRIPCION DE LA OBSERVACION
Lenadores			Lena Postes Madera
			Tipo de arbol -
Pescadores			Malla Ataraya Anzuelo
Cazadores			Tipo de animal -
Agricultores			Limpiando Quemando Sembrando
			Tipo de cultivo -
Turistas			Ballero Otro -
OBSERVACIONES DE OTROS ANIMALES	**No. DE INDIVIDUOS**	**TOTAL**	**DESCRIPCION DEL ACTIVIDAD**
Zaraguates			Comiendo Descansando
			Tipo de Arbol -
Lagarto			Nadando Comiendo Descansando
Nutria (Perro de Agua)			Nadando Comiendo Descansando
Iguana			Nadando Comiendo Descansando
Tortugas			Nadando Comiendo Descansando
Otros -			

APPENDIX C. cont. Data sheet for the long-term monitoring program for the Bocas del Polochic Wildlife Refuge.

Table 2. Inclusive dates of nearctic migrants (NM), local migrants (LM), and summer residents (SR) in the BPWR and surrounding areas, 1/96 - 9/97.

	ENGLISH NAME	SCIENTIFIC NAME	FIRST DETECTED	LAST DETECTED	HIGH COUNT	MIGRANT
51	Grey-cheeked Thrush	*Catharus minimus*		9-May		NM
52	Swainson's Thrush	*Catharus ustulatus*	20-Sep	15-May		NM
53	Wood Thrush	*Catharus mustelinus*	22-Feb	15-May		NM
54	Grey Catbird	*Dumetella carolinensis*	20-Oct	11-May		NM
55	Cedar Waxwing	*Bombycilla cedrorum*		12-Jan	6 on 12-Jan	NM
56	Yellow-throated Vireo	*Vireo flavifrons*	20-Jan	19-Apr		NM
57	Philadelphia Vireo	*Vireo philadelphicus*	25-Feb	20-Apr		NM
58	Red-eyed Vireo	*Vireo olivaceus*	8-Sep	10-May		NM
59	Blue-winged Warbler	*Vermivora pinus*	14-Sep	13-Mar		NM
60	Golden-winged Warbler	*Vermivora chrysoptera*	10-Oct	13-Mar		NM
61	Tennessee Warbler	*Vermivora peregrina*	10-Oct	20-Apr		NM
62	Yellow Warbler	*Dendroica petechia*	8-Sep	19-Apr		NM
63	Chestnut-sided Warbler	*Dendroica pensylvanica*	10-Oct	20-Apr		NM
64	Magnolia Warbler	*Dendroica magnolia*	10-Oct	20-Apr		NM
65	Black-throated Green Warbler	*Dendroica virens*	20-Oct	14-Mar		NM
66	Golden-cheeked Warbler	*Dendroica chrysoparia*		31-Mar		NM
67	Blackburnian Warbler	*Dendroica fusca*	4-Oct	25-Apr		NM
68	Yellow-throated Warbler	*Dendroica dominica*		29-Feb		NM
69	Cerulean Warbler	*Dendroica cerulea*	11-Sep	10-Oct		NM
70	Black-and-White Warbler	*Mniotilta varia*	10-Oct	9-Apr		NM
71	American Redstart	*Setophaga ruticilla*	5-Oct	17-Apr		NM
72	Prothonotory Warbler	*Protonotaria citrea*	14-Sep	9-Apr		NM
73	Worm-eating Warbler	*Helmitheros vermivorus*	20-Sep	20-Apr		NM
74	Ovenbird	*Seiurus aurocapillus*	10-Oct	15-May		NM
75	Northern Waterthrush	*Seiurus noveboracensis*	16-Sep	15-May		NM

Table 2. Inclusive dates of nearctic migrants (NM), local migrants (LM), and summer residents (SR) in the BPWR and surrounding areas, 1/96 - 9/97.

	ENGLISH NAME	SCIENTIFIC NAME	FIRST DETECTED	LAST DETECTED	HIGH COUNT	MIGRANT
76	Louisiana Waterthrush	*Seiurus motacilla*	2-Aug	17-Apr		NM
77	Kentucky Warbler	*Oporornis formosus*	1-Sep	5-Nov		NM
78	Common Yellowthroat	*Geothlypis trichas*	20-Oct	17-Apr		LM
79	Hooded Warbler	*Wilsonia citrina*	20-Jan	13-Mar		NM
80	Wilson's Warbler	*Wilsonia pusilla*		14-Mar		NM
81	Canada Warbler	*Wilsonia canadensis*	16-Sep	10-May		NM
82	Yellow-breasted Chat	*Icteria virens*	17-Sep	19-Apr		NM
83	Summer Tananger	*Piranga rubra*	20-Sep	16-Jan		NM
84	Rose-breasted Grosbeak	*Pheucticus ludovicianus*	25-Feb	17-Apr		NM
85	Blue Grosbeak	*Passerina caerulea*	13-Mar	17-Apr		LM
86	Indigo Bunting	*Passerina cyanea*	16-Jan	24-Mar		NM
87	Painted Bunting	*Passerina ciris*	13-Mar	24-Mar		NM
88	Orchard Oriole	*Icterus spurius*	5-Oct	9-Apr		NM
89	Baltimore (Northern) Oriole	*Icterus galbula*	4-Oct	17-Apr		NM

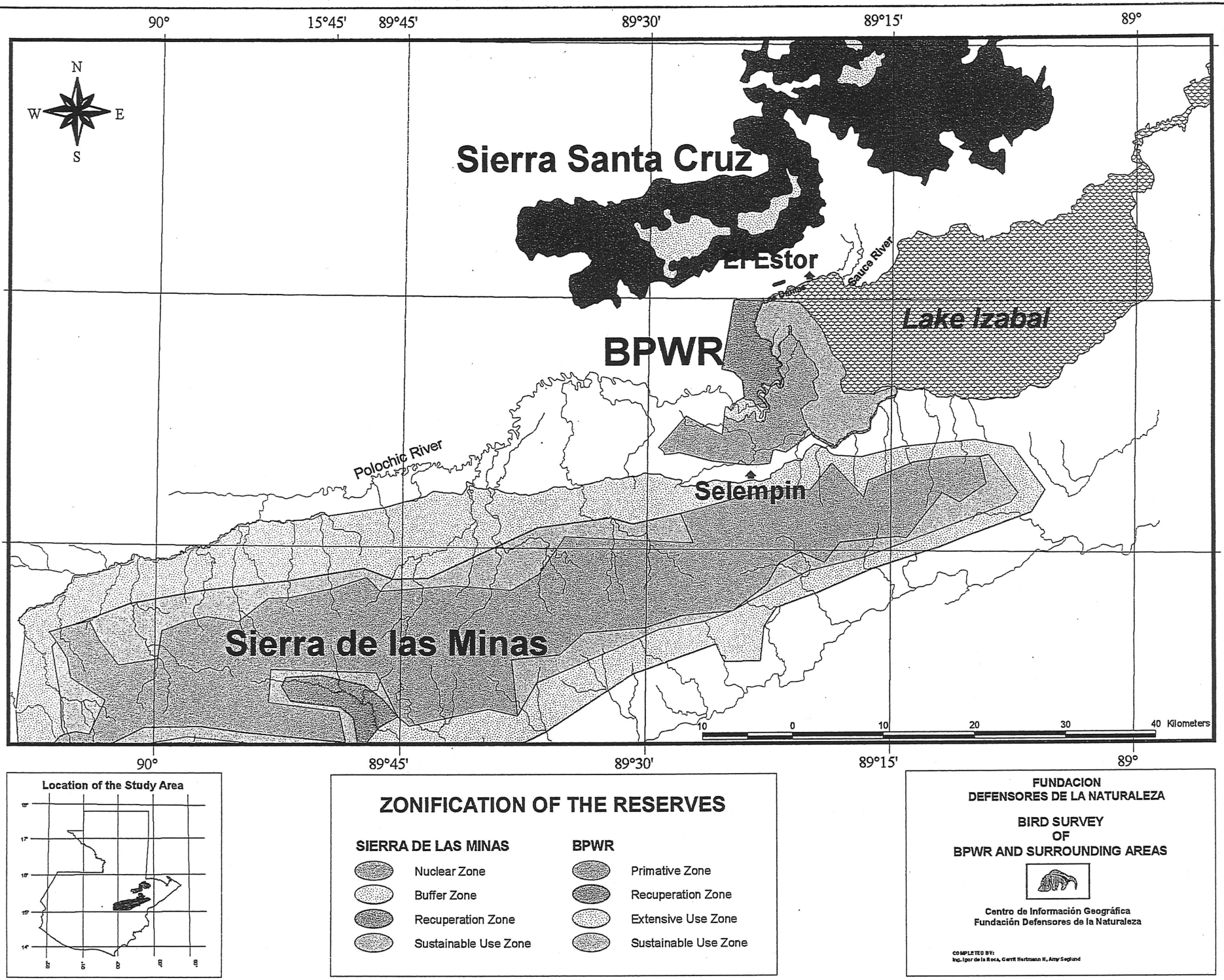


Figure 1. Study area for the bird survey of the Bocas del Polochic Wildlife Refuge and surrounding areas, 1/96 - 9/97.

Figure 2. Locations of strip transects used in the bird survey of the Bocas del Polochic Wildlife Refuge, 1/96 - 9/97.

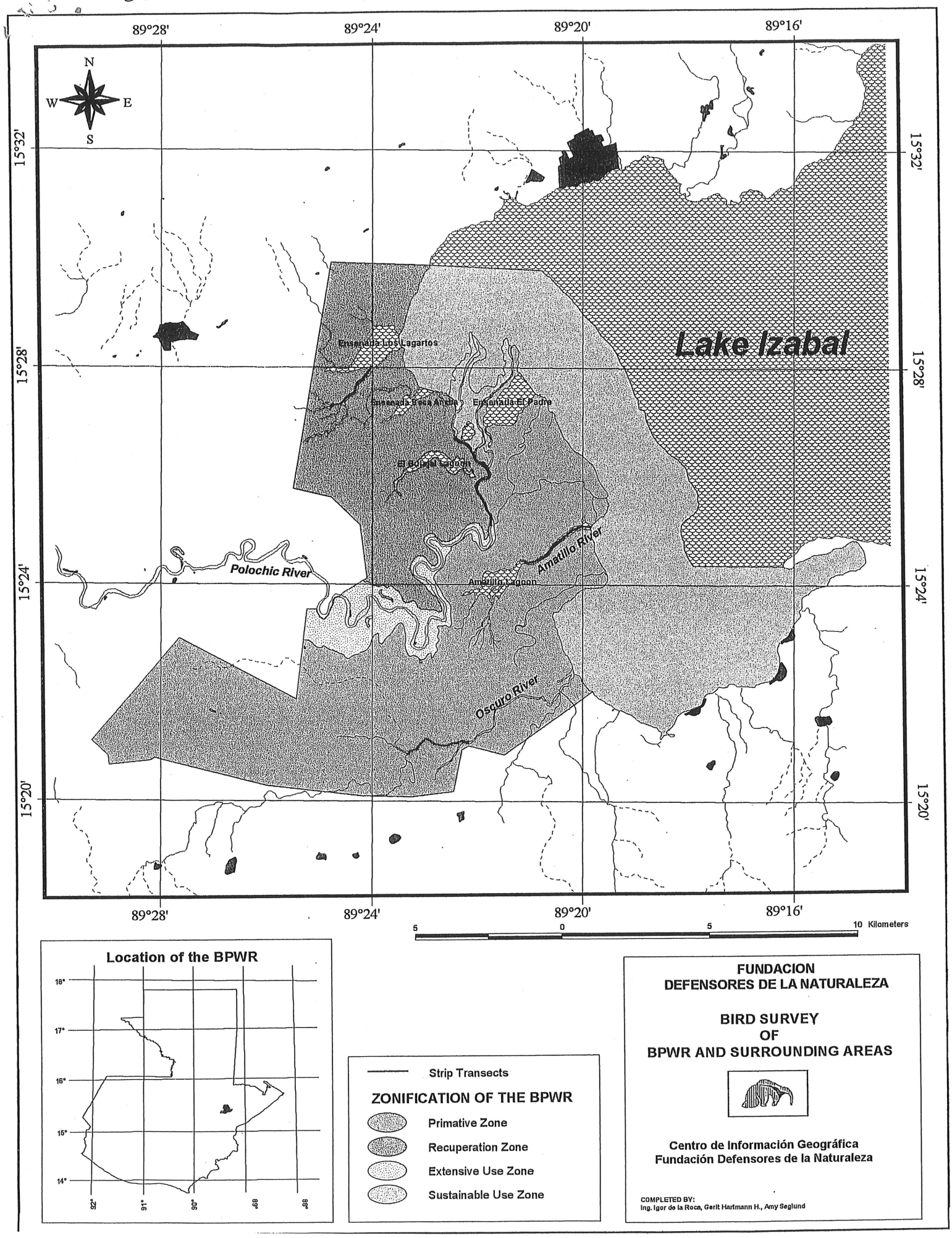


Figure 3. Number of species detected in the BPWR and the total area surveyed, 1/96 - 9/97.

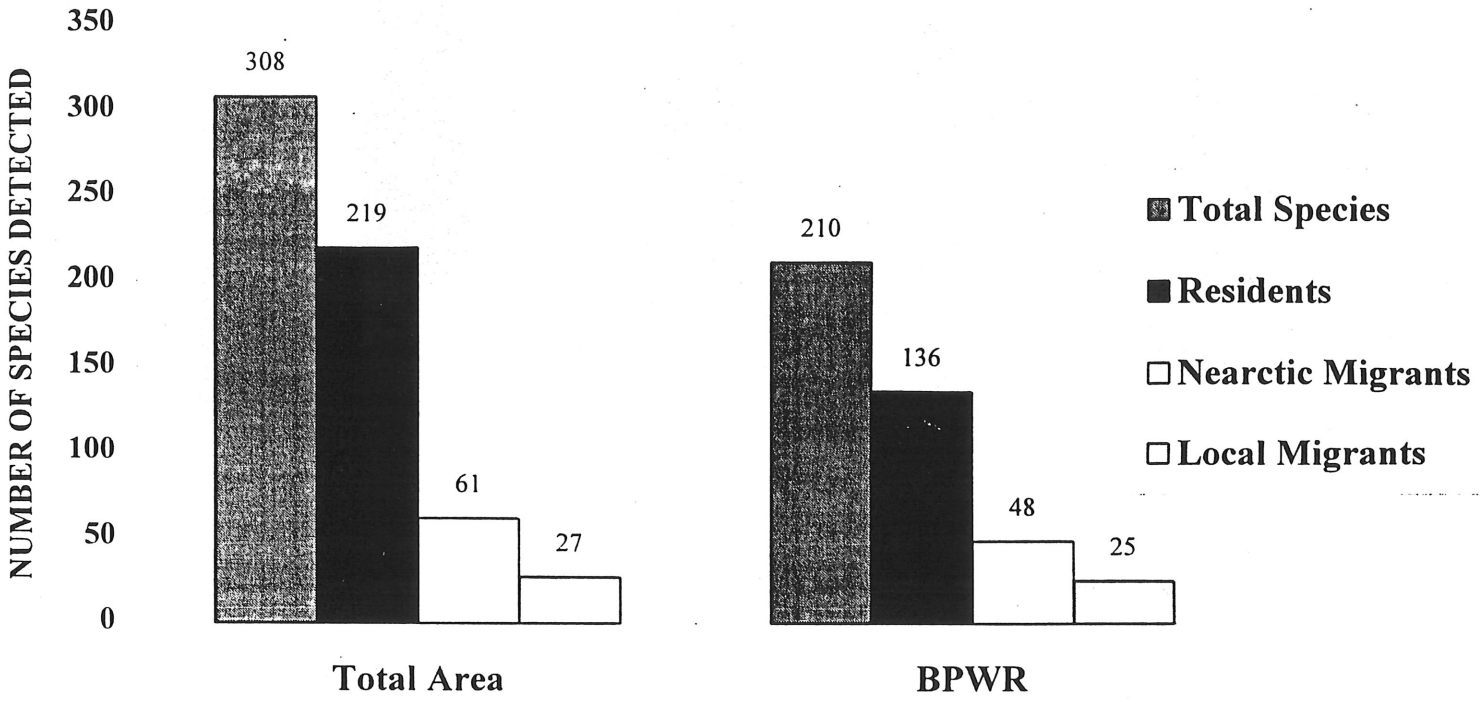
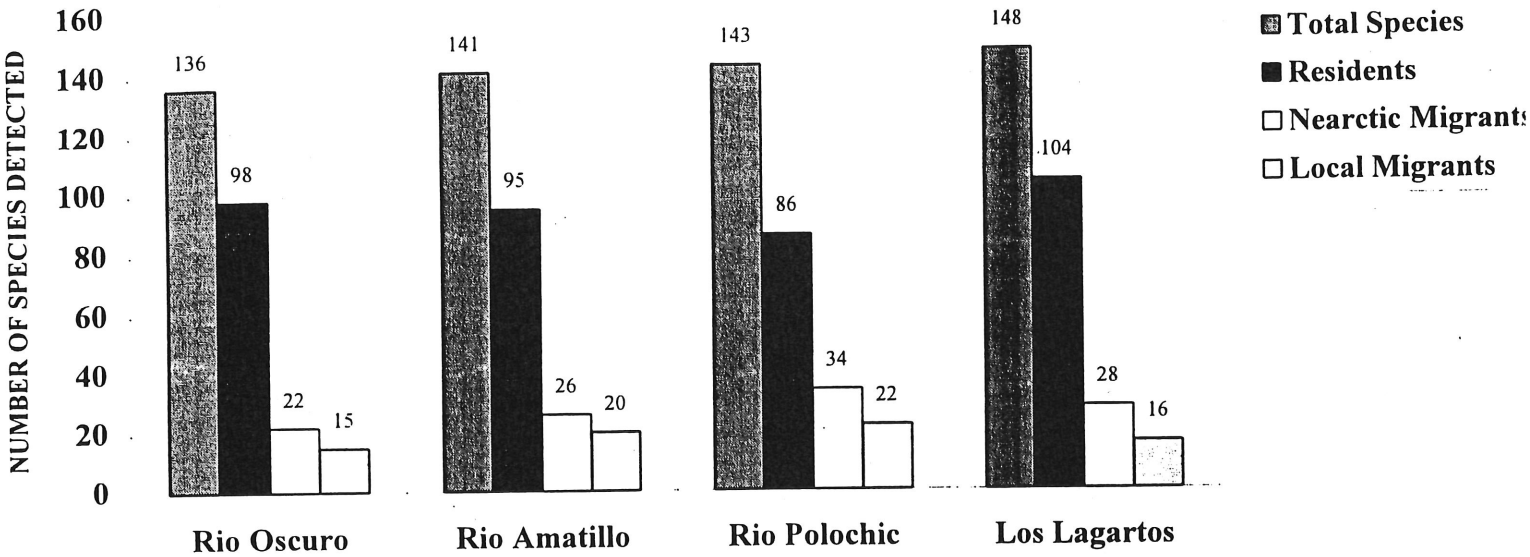


Figure 4. Number of species detected in the four areas of the BPWR and in the five areas surrounding the refuge, 1/96 - 9/97.



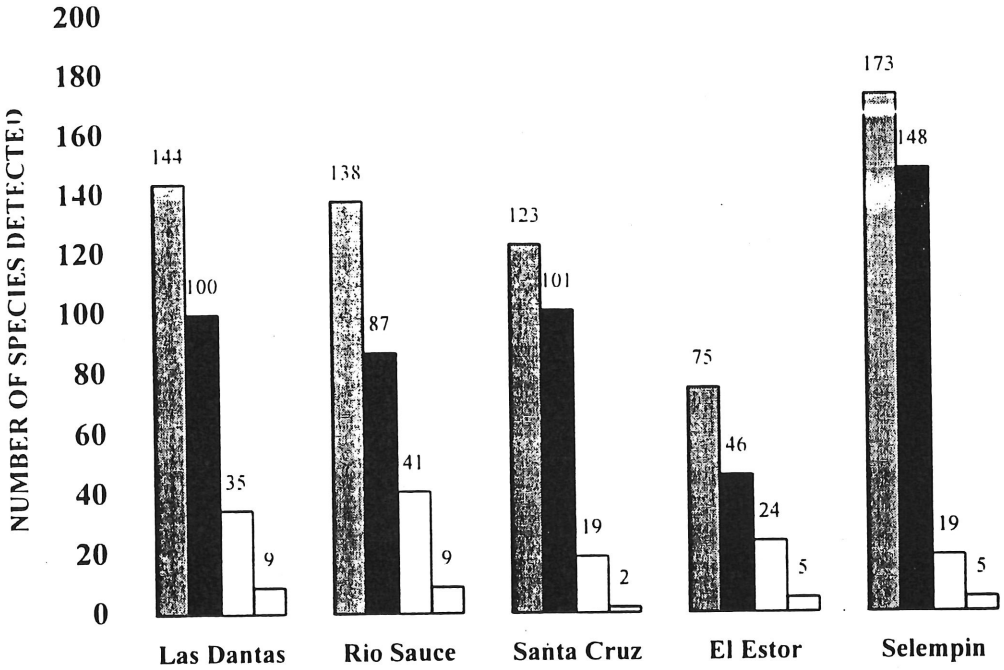
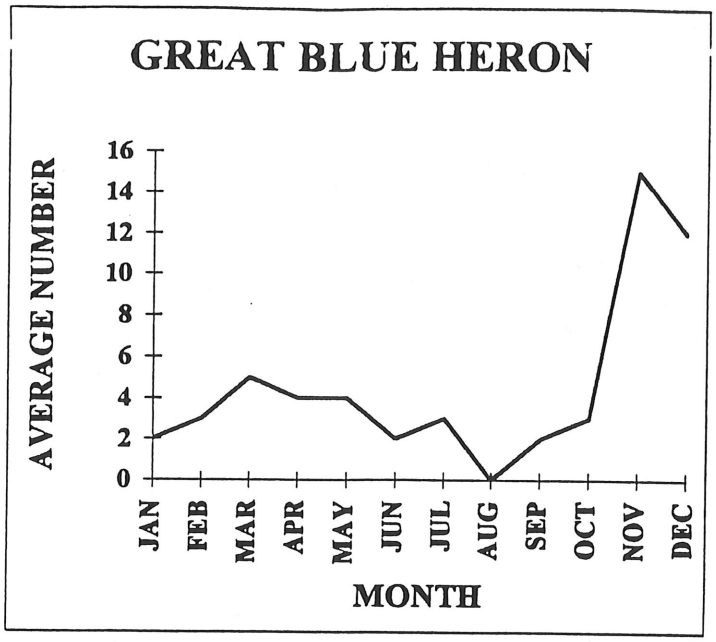
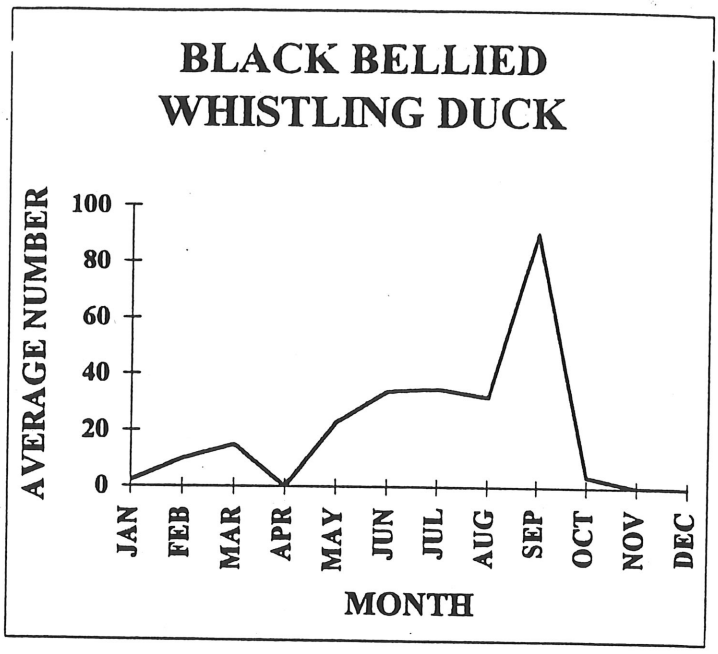
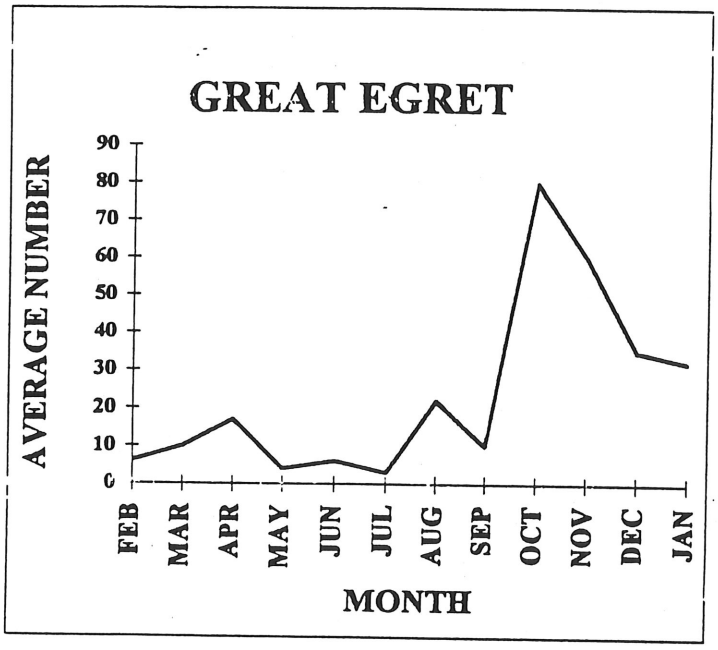
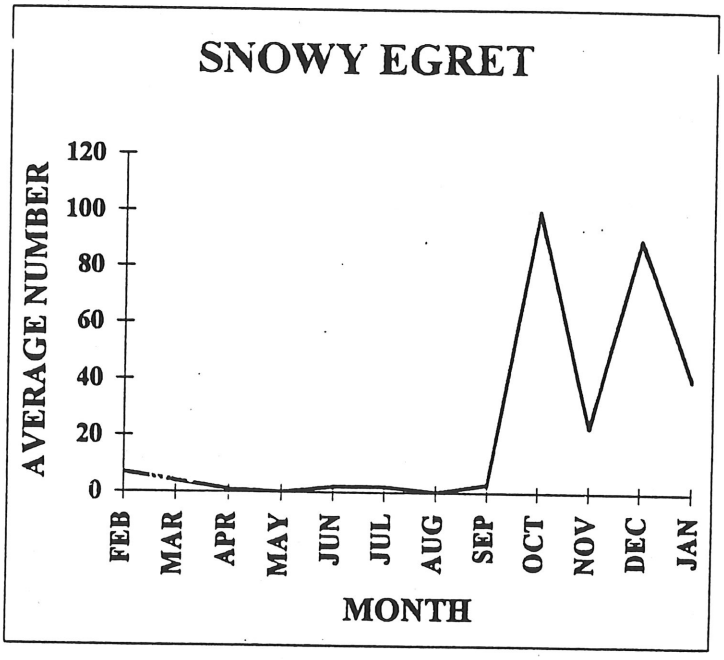


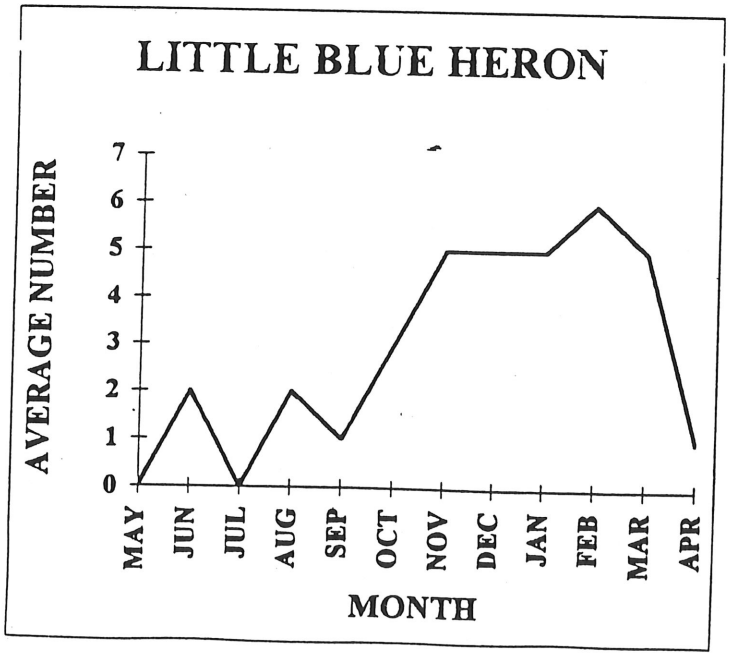
Figure 5. Average number of individuals detected per month of species that had both resident and migrant populations in the BPWR, 1/96 - 9/97.

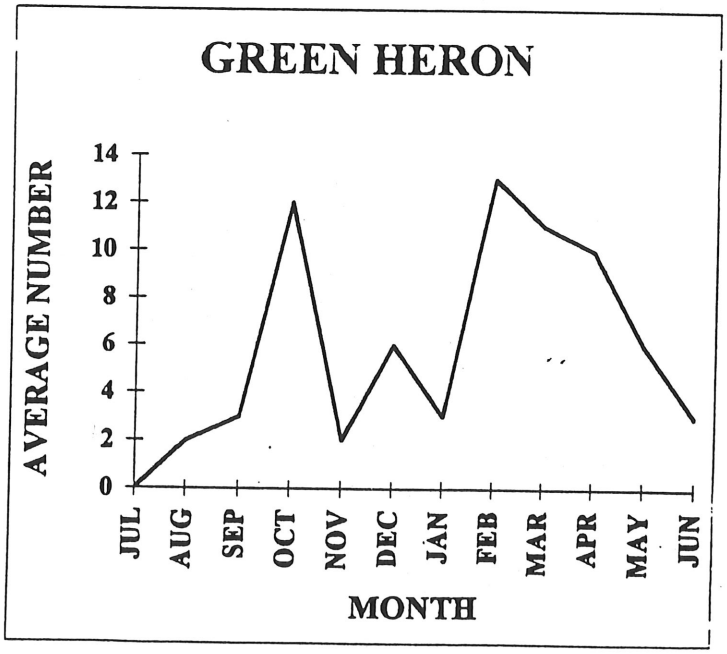












APPENDIX A. Monitoring plan for the Bocas del Polochic Wildlife Refuge.

Objectives:

1. Implement a long-term monitoring program (>10 years) for selected bird species that will aid in the development of management objectives for the wetland and assess the consequences of these management activities.
2. Determine relative abundance and distribution of selected bird species within the BPWR and examine population trends over time.
3. Capacitate local rangers (guardarecursos) of Fundación Defensores de la Naturaleza to carry out surveys for the long-term monitoring program.

Justification:

* Provide baseline information for management strategies to be implemented within the refuge.
* Aid in the evaluation of population trends in the BPWR and whether fluctuations in the population sizes warrant shifts in management activities.
* Identify critical areas for the conservation of species.

Study Area:

The Bocas del Polochic Wildlife Refuge is located on the west end of Lake Izabal, where the delta of the Polochic river creates the largest wetland within the lifezone of subtropical wet forest. This wetland contains a rich array of fauna and flora and is one of the last relics of natural habitat in the area. The area is also an important resource for the local people surrounding the lake who use this area for firewood extraction, commercial and subsistence fishing, cultivation of crops, and cattle grazing.

Methods:

1. Strip transects will be used to census 21 bird species. Each transect will be 2.0 km in length and positioned to provide systematic sampling within all habitat types represented along the waterways in the BPWR (Appendix B). Transects will be censused once a month during the wintering period (January-February), breeding season (May-June), and the fall migratory period (September-October). Transects will be censused in a canoe traveling at approximately 1 km per hour along the shore. One ranger will record designated species while another rows the canoe. Transects will be censused 15 minutes to a half an hour after local sunrise. The time that the transect begins and when it is completed will be recorded.

2. Fifteen species of aquatic birds, determined by Cardona (1994) to be indicator species of wetland habitats, will be recorded along each transect. In addition, six other species that may be indicators of water quality and forest degradation will be surveyed. These species are as follows:
   Neotropic Cormorant (*Phalacrocorax brasilianus*), Anhinga (*Anhinga anhinga*), Bare-throated Tiger Heron (*Tigrisoma mexicanum*), Green Heron (*Butorides virescens*), Little Blue Heron (*Egretta caerulea*), Snowy Egret (*Egretta thula*), Great Egret (*Egretta alba*), Black-crowned Night Heron (*Nycticorax nycticorax*), Great Blue Heron (*Ardea herodias*), Limpkin (*Aramus guaruana*), Wood Stork (*Mycteria americana*), American Coot (*Fulica americana*), Purple Gallinule (*Gallinula chloropus*), Sungrebe (*Heliornis fulica*), Northern Jacana (*Jacana spinosa*), Black-bellied Whistling Duck (*Dendrocygna autumnalis*), Muscovy Duck (*Cairina moschata*), Blue-winged Teal (*Anas discors*), Ringed Kingfisher (*Ceryle torquata*), Great Curassow (*Crax rubra*), and Snail Kite (*Rostrahamus sociabilis*).

APPENDIX A. Cont. Monitoring plan for the Bocas del Polochic Wildlife Refuge.

3. In addition to monitoring bird species, the rangers will be required to document information on fishing, woodcutting, agriculture, and tourism occurring along each transect. This will provide data on the extractive use of the area and how habitats are being altered. Because little information exists on the mammal species that use the BPWR, the rangers will also record all mammal species encountered along transects.

4. For each transect sampled, relative abundance will be calculated for the 21 species. Frequency of observation (number of individuals recorded along each transect) will be used to estimate relative abundance. Because all 21 bird species are conspicuous and easy to identify, frequency of observation will be a more appropriate measure than presence data. Population trends between years will be statistically compared with the use of linear regression. A z test ($P < 0.05$) will be used to determine if there is a significant change over time. This analysis will help evaluate the health of the ecosystem and therefore, the management strategies required to maintain the conservation of species.

Implementation (June - September 1997):

1. Developed data sheets (Appendix C) that could easily and reliably be completed by the local rangers. Created a bird guide containing the 21 species that the rangers are required to identify. This guide contains the local Spanish names as well as scientific names and was laminated to enable rangers to use them in inclement weather.

2. Conducted a workshop with two rangers hired by Fundación Defensores de la Naturaleza. In this workshop we trained the rangers to identify the 21 species of birds, how to use binoculars, how to complete data sheets, provided basic education on resident and migratory birds, the importance of the wetland, and the conservation of its resources.

3. After the workshop, the rangers were trained in the field. They were shown the transects and how to survey them in a canoe. They were evaluated on their abilities to identify birds and to correctly complete data sheets.

Conclusion:

The basis for selecting the 21 bird species to be used as a monitoring tool was due to the fact that they may be indicators to the health of the wetland. In addition, because these species are conspicuous and easy to identify, local workers will be qualified to conduct surveys without further foreign assistance. Because the focus of the monitoring plan is very specific, errors due to misidentification can be minimized and confidence in data obtained can be realized.

Currently, a complete bird list of the area exists from three years of inventories done by biologists from the Peace Corps. Thus, information on the composition and distribution of the avifauna within the wetland has been documented. The next step, therefore, is to implement a management plan and a long-term monitoring program to assess management activities on bird species in the wetland.

APPENDIX B. Locations of strip transects for the long-term monitoring program for the Bocas del Polochic Wildlife Refuge.