Monitoring and Protection Summary
Rio Bravo Conservation and Management Area FY 2017-2018

Below is a summary of the monitoring and protection program which aims to prevent any illegal activities and to preserve the biodiversity, environmental and cultural characteristics of the Rio Bravo Conservation and Management Area (RBCMA) owned and managed by Programme for Belize (PfB).

Programme for Belize is a private, non-profit, Belizean conservation organization established in 1988 dedicated to conserve the biodiversity and promote the sustainable development of Belize's natural resources through the proper management of the RBCMA and other lands entrusted to it. The RBCMA is the flagship project where PfB puts into practice its management principles based on the Man and Biosphere Reserve Principle. Approximately 60% of the reserve is managed as a strict preserve. Sustainable economic activities, such as tourism and sustainable timber harvesting, are being implemented in the remaining buffer area with the goal of demonstrating sustainable development and producing a sustainable stream of revenue that contributes to the management and protection of the entire reserve.

Resource Management and Protection[1]

In 2017 the PfB rangers conducted 439 patrols and related assignments which included Protection and Outreach activities and other administrative duties. Most of their efforts were invested in conducting patrols aimed at deterring illegal activities. A total of 180 patrols were dedicated specifically for preventing illegal logging and 45 patrols were specific for Yellow-headed Parrot (YhP) monitoring and protection. In practice, all patrols are designed to monitor for any unauthorized activity including illegal fishing and poaching. Given the increase of nocturnal illegal logging, a total of 112 patrols were night patrols to monitor and prevent illegal logging and illegal hunting. The patrols were conducted using two Hilux Pickup trucks, two All-Terrain Vehicles (ATV), two boat, aerial as well as foot patrols. The availability of two ATVs during the YhP breeding season (April to June) enabled a more efficient monitoring of parrot nests thus contributing to the successful fledging of the parrot chicks. Twenty four (24) boat patrols were conducted in the New River Lagoon and tributaries, such as Irish Creek, to deter illegal fishing and to monitor and prevent illegal logging. In addition to patrols, three permanent outposts (Guard Houses) continued to be manned by the rangers on a 24/7 basis, controlling access to the RBCMA on the major access roads.

Illegal Hunting/poaching:

During the year, the rangers conducted 89 patrols in the savannas to monitor for fires and monitor and prevent poaching of the YhP and other wildlife. There were nine incidents of poaching reported. The efforts of the poachers were twice interrupted by the ranger patrols. In

Figure 1 – Yellow-headed Parrot chicks rescued

these instances, the rangers rescued five Yellow-headed Parrots, two White-fronted Parrots and three Red-lored Parrots.

Illegal logging/Aerial Patrol/Illegal Cultivation[1]:

Illegal logging remains the largest threat to the RBCMA. A total of 180 were dedicated specifically to deterring illegal logging. A total of 14 patrols were Joint Patrols where PfB rangers were supported by the Belize Defence Force (BDF), the Police Department and the Forest Department. Illegal harvesting of trees was observed on 27 patrols resulting in the loss of 147 trees to illegal logging; thirty nine trees (39) were recovered by Programme for Belize.

On December 2017, a Joint Patrol surprised illegal loggers from Guinea Grass Village loading illegally cut logs on a truck: 7 logs were already loaded on the truck; 20 short logs and 6 trees were still on the ground. The logs were confiscated and the illegal loggers were arrested and charged at the Orange Walk Police Station.

The aerial patrols did not detect any illegal clearing or illegal cultivation within the Rio Bravo Conservation and Management Area.

Figure 2 – Logs recovered at Irish Creek –

Figure 3 Seven short logs loaded inside the truck

Figure 4 - Illegal Loggers arrested (from Guinea Grass)

Forest and Fauna Monitoring[2]

Growth rate, recruitment, and mortality rate are all important factors for determining and fine tuning a level of timber harvesting that is sustainable and environmentally sound. Programme for Belize is collaborating with the Government of Belize (GoB) in the long-term monitoring of forests in Belize with the goal of ensuring sustainable forest management. The GoB, through the Forest Department, has established several Permanent Sample Plots (PSPs) to collect long-term data on growth, recruitment and

mortality in order to determine appropriate levels of harvesting as well as silvicultural techniques needed for ensuring sustained harvesting.

In 1994, four PSPs were established on the RBCMA, each measuring one hectare (100 meters by 100 meters). Two plots were located in the Punta Gorda area of the reserve and the two other two were located in the East Marimba area. All trees ≥10 cm DBH were measured, tagged and a map of their relative positions was developed for future reference.

In 2012, one additional plot of the same size was established in the West Botes area, and re-measured in 2016.

In 2016, two additional plots of the same size were established in the reserve, one in the East Botes area and the other in the La Milpa area.

The total number of one hectare Permanent Sample Plots in the Rio Bravo Conservation and Management Area is now seven. These plots are spread out in the buffer area of the reserve and are considered sufficient for determining long-term growth, recruitment and mortality rates needed for fine-tuning and improving the sustainable harvesting of timber.

This report presents the results of analysis performed up to the 2016 measurements. This means that the analysis covers between 1997 to 2016 for PSPs 19 and 20; and 2011 to 2016 for PSPs 21 and 22; and 2012 to 2016 for PSP 37. Table 1 summarizes the findings with respect to growth, mortality and recruitment in the PSPs. The PSPs 38 and 39 were established in 2016 and therefore have no other data for comparison.

Table 1. *Results of analysis of growth, mortality and recruitment in the PSPs*.

PSP	Census period (yrs)	Avg. DBH 2016 (cm)	Avg. Ann. Inc. (cm yr-1)	Mortality (% ha-1 yr-1)	Recruitment (Stems ha-1 yr-1)
19	19	19.7	0.15	2.26	10.3
20	19	20.6	0.11	1.79	8.7
21	5	23.2	0.19	1.09	4.6
22	5	22.9	0.24	2.28	3.5
37	4	20.4	0.10	3.04	6.0
38	0	20.2	-	-	-
39	0	19.8	-	-	-

Interpretation of the above results should be taken with caution since there are a couple of disturbance regimes acting in the forest. Besides the logging events which took place years before (the historical logging activities), there is the effect of the hurricane 6 years ago that may be affecting the mortality rate in some of the plots.

None the less, a comparison of logging effects can be made looking at PSP 19 and 20 for example, paired and separated by only 200 metres, yet PSP 19 which was logged in 1995 underwent a significantly higher long-term mortality rate over the same period than did PSP 20, which was unlogged. Perhaps this higher mortality is a signal of the logging event, which would support previous findings elsewhere in tropical forest. PSP 19, however, has a higher recruitment rate. The question, which remains unanswered regarding logging effects, is whether the higher long-term mortality is offset by recruitment in the new space created by logging and the spark in growth of existing trees due to lessened competition. It can be

observed that annual increment in the logged over plot (PSP 19) was higher over the census period as was the number of new trees which recruited into the plot. An examination of the changes in biomass of the forest in the plots may help to reveal whether logging and its related mortality can be offset by new growth.

Table 2. *Results of the analysis of biomass change in the PSPs.*

PSP	Census period	Stems ha-1 2016	AGB (Mg ha-1) Past	AGB (Mg ha-1) Present	ΔAGB (Mg ha-1 yr-1)
19	1997 to 2016	494	143	163	1.05
20	1997 to 2016	537	180	193	0.68
21	2011 to 2016	471	204	208	0.77
22	2011 to 2016	401	157	160	0.58
37	2012 to 2016	544	181	166	-4.09
38	2016	474	-	140	
39	2016	596	-	190	

PSP 19 was logged in 1995 while PSP 20 was not. Neither plots were affected by hurricane during the intervening period up to 2016. Table 2 shows the results of the biomass change analysis. PSP 19 sequestered significantly more biomass than PSP 20 over the same period, at a rate of over 1 metric ton (Mg) per hectare per year compared to close to 0.7 metric tons (Mg) per hectare per year in unlogged PSP 20. This is despite the fact that PSP 20 had more stems per hectare. These results indicate that the spark in growth of trees in the plots at the time of the logging may contribute a large part of the relative increase in biomass over unlogged forest. However, more conclusive inferences can be made when additional plots are re-measured in the future.

Forest Silvicultural Research[3]:

In 2016 PfB entered into an agreement with the Food and Agriculture Organization (FAO) to establish 4 permanently marked sample plots with the objective of monitoring the effects of the silvicultural treatment over a long-term period under the FAO funded project entitled: Ensuring Long-Term Productivity of Lowland Tropical Forests in the Caribbean focused on the characterisation of the sample plots.

This research experiment was done in phases and the final tree data collection was completed until 2018. Thirty two (32) subsample plots (50 meters wide by 100 meters long or 0.5ha each) were installed within a 100 ha forest block and demarcated with permanently visible marker pegs.

Forest stand inventory including measuring, assessing, and mapping of trees inside the 100 ha sample plots, including mapping of terrain features was conducted once the plots were established.

Then the evaluation and analysis of the inventory data was carried to determine the function of all the trees inventoried and what role these trees play in the experiment to determine which sample plots would serve as controls and which plots the silvicultural treatment would be directly applied to. The trees were assigned a specific role (classification function) based on selection criteria of tree species economic value and future worth (commercial or non-commercial species) to the forest management regime.

After all trees inventoried were assigned a classification (function) and control plots were determined, the final phase of the experiment was to release (cut down) competitor trees that posed a threat to the survival of tree species considered to be of future commercial value. The threat to future crop and seed tree survival include competition for nutrients, space and light. Data was also collected on the time and cost for implementing these silvicultural practices with the goal of determining the feasibility of applying these silvicultural measures in a sustainable forest harvesting regime.

In the long-term, PfB and forest researchers will be able to study how the trees inside the treatment plots are reacting and developing over the years due to the silvicultural intervention and compare that information attained with the growth and mortality and recruitment process of trees inside forest plots that did not receive the treatment.   It should provide important information for ensuring the long-term sustainable productivity of the timber forest of the Rio Bravo Conservation and Management Area.

Figure 5 - Yellow-headed Parrot Chicks

Yellow-headed Parrot Monitoring and Research[4]:

The Rio Bravo Conservation and Management Area is the stronghold for Yellow-headed Parrots (YhP), *Amazona oratrix belicensis* in Belize. As such, Programme for Belize dedicates a significant amount of efforts to monitor and protect the Yellow-headed Parrots during the breeding season to protect it from poaching and to ensure a successful breading. Data on the nesting population of Yellow-headed Parrot was collected by researcher Flavio and his team of 3-4 volunteers along with PfB rangers. Ranger Elias Romero was hired in December 2017 and underwent training to be able to carry out his duties at East Gate and with the Yellow-headed Parrot Monitoring Project, which includes monitoring nest cavities, recording fledging dates and general protection.

The 2018 results show a more successful breeding season compared to the 2017 breeding season. Both poaching and predation were lower in 2018. However, predation was still significant in 2018 resulting in the loss of 11 nests. The total number of eggs monitored was similar to last year; however more chicks hatched (44) in 2018 compared to 2017 (22). This increased egg to chick hatching may have buffered the effects of predation allowing many more chicks to fledge in 2018 compared to 2017. A total of 29 chicks fledged in 2018 compared while only eight (8) chicks fledged in 2017. The increased ranger patrols and overnight camping contributed to the fledging success of this year.

Jaguar Population-Remote Camera Monitoring Project[5]

In 2017, researcher Dr. Marcella J. Kelly from the Department of Fish and Wildlife Conservation, Virginia Tech University, USA, conducted jaguar surveys from May 29th to December 6th at the La

Figure 6 - Jaguar recorded in RBCMA

Milpa area (non-logged area) and at the Hill Bank area (logged area) in the Rio Bravo Conservation and Management Area. Camera traps were installed to capture pictures of jaguars to determine Jaguar densities and count of number of Individuals within the RBCMA. Densities in 2017 were almost identical for Hill Bank and La Milpa. Jaguar density across sites ranged from 1.8 to 3.0 jaguars per 100 km^2. Using an established 23 camera stations in La Milpa and 35 in the Hill Bank area of the reserve, it was determined that jaguars occurred at 87.0% of La Milpa's camera stations and 66.7% of Hill Bank's camera stations. The number of unique jaguars photo-captured was 15 at La Milpa and 15 at Hill Bank. Jaguar density in 2017 was highest at La Milpa at 2.99 jaguars per 100km^2 but not significantly different from the jaguar density at Hill Bank (2.91 jaguars per 100km^2).

Table 3. Summary of number of individual jaguars captured and sex of individuals within sites and across all sites combined for the 2017 camera-trapping survey in Belize, Central America. *column total do not include jaguars that cross over from one site to the next					
Site	Individual Jaguars Captured	Jaguar Males	Jaguar Females	Jaguar Unknown Sex	New Individuals in 2017
Hill Bank	15	12	3	0	3
La Milpa	15	9	6	0	7
Totals	30*	21*	9*	0	10

Capacity Building and Training[6]:

A Fire Management workshop was held on the 17 - 23 February 2018. The participants learnt the basic uses of fire tools, setting up teams and planning a controlled burn plan. The PfB rangers, three community rangers and two Forest Department officers also participated in this training.

Figure 7 – Rick explaining the Fire Triangle

Figure 8 – Crew getting ready for fire practical

Figure 9 – SMART Admin Training

During the April/May 2018, Rangers and other PfB staff participated in six days of training to learn how to use the SMART system and equipment, a tool used to collect date and to establish a database of the patrols carried out in the reserve. The teams use smart phone or GPS devices to document patrol information using the CyberTracker App which is then uploaded to a field computer with the SMART program; creating a database that can then be queried and reports produced for any period or any information that was collected in the field.

Fire Detection and Suppression[7]:

From October 2017 to March 2018 only two fire incidents were observed by the rangers who ensured that it does not affect the reserve. Between April and May 2018, rangers responded to 20 fire incidents, mostly in the Savannas where hunters set fire to attract deer as the vegetation sprouts.   Seven fires were detected inside the pine savannas affecting approximately 55 acres; the broad-leaf forest was not affected.
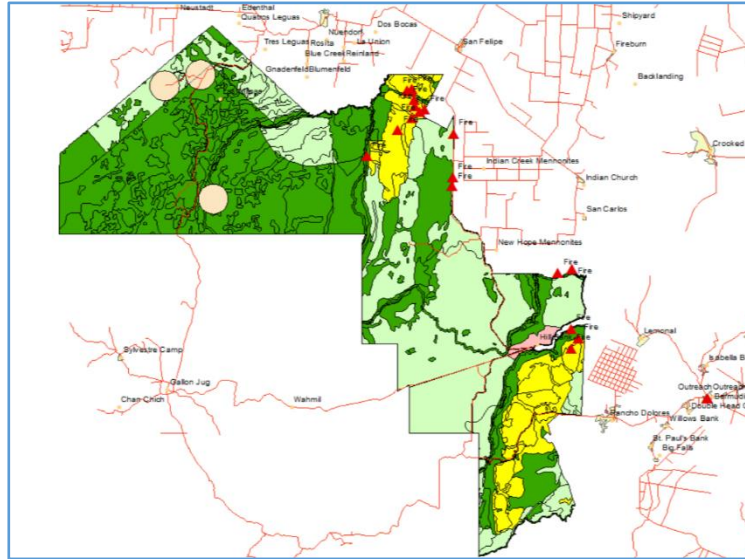

Figure 10 – Fire Points (red triangles) reported by rangers

All fires that persisted for a day or more were attended, controlled and suppressed by the rangers when necessary thus minimizing the area burnt and preventing damage to the Broad-leaf forest.

With funding from the local Protected Areas Conservation Trust (PACT), PfB purchased new firefighting equipment, including a water bowser, to improve PfB's capacity to manage and control fires. The PACT grant also allowed PfB to hire community rangers that detected and suppressed fires in the Belize River Valley before they became a threat to the reserve as well as to implement a fire awareness campaign which enabled PfB to reduce the threat and incidences of fires.

Conclusion:

The protection program maintained a protection team of 12 rangers, and training, equipment and logistical support was provided to the rangers to increase their capacity and ensure an efficient protection program.

The Rangers' training in Fire Management, Policing Tactics, the use of the SMART System and the provision of two aerial drones, equipment and ranger gears have greatly enhanced the protection capacity of Programme for Belize and improved the efficiency of the rangers. The investment in training in fire management, the hiring of three community rangers, and the community fire awareness campaign were successful in protecting the RBCMA and the Belize River Valley from the fire threats. The night patrols as well as the overnight, 24/7-camping patrols were successful in reducing illegal logging and in preventing the poaching of Yellow-headed Parrots.

The graph below provides a summarized comparison of the illegal activities reported from 2015 to 2018. The trend shows a decrease in the number of illegal activities encountered.

Chart 1: Statistics of Recorded Infractions 2015 – 2018
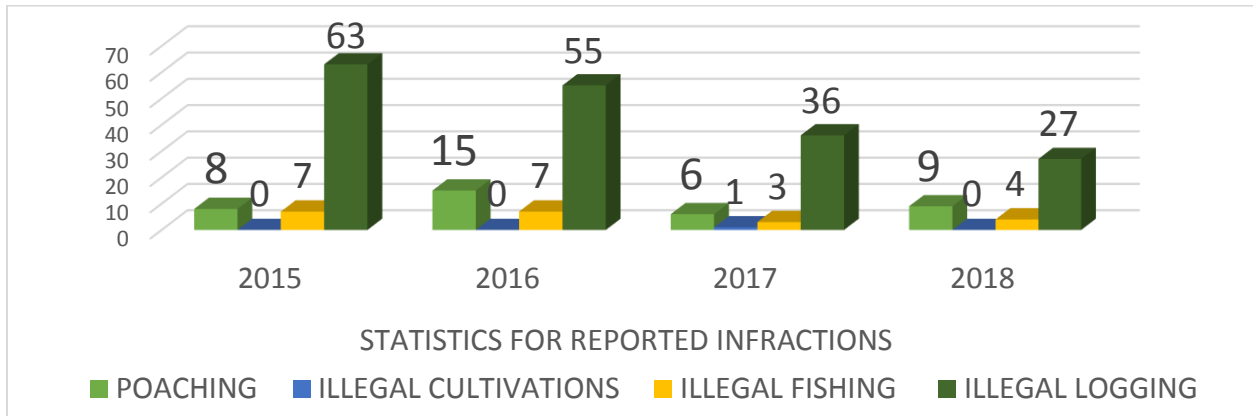
References
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2. Report of Forest Monitoring Activities for 2016 using Permanent Sampling Plots (Dr. Percival Cho. Belize Forest Department)

3. Terms of Reference – Pre-Harvest Forest Stand Inventory (Sebastian Gräfe Institute for World Forestry University of Hamburg)

4. Yellow-headed Parrot Nest Monitoring Report 2018 (Belize Bird Conservancy Charles Britt & Fabio Tarazona & PfB Protection Quarterly Report 2018)

5. Progress Report - Update on Jaguar Population status across a multi-use landscape Rio Bravo Conservation and Management Area. (Marcella J. Kelly & Brogan E. Holcombe - Virginia Tech. USA)

6. PfB's TFCA CONGRESS REPORT 2018