



State of the Protected Areas Report 2022

An assessment of Bladen Nature Reserve,
Golden Stream Corridor Preserve and Maya
Mountain North Forest Reserve

April 2023



Harmony between nature and human development for the benefit of both



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Lead Authors

Said Gutierrez - Protected Areas Program Director
Elizabeth Dorgay - Science Director

Contributors

Biodiversity Research & Monitoring
Florentino Chiac

Land Use Change
Dwayne Pech

Revision & Editing

Marvin Vasquez
Operations Director

Christina Garcia
Executive Director

Field work conducted by Ya'axché's ranger team

Anignazio Makin, Indian Creek Village
Andres Chen, Trio Village
Gerasimo Coc, Golden Stream Village
Rosendo Coy, Indian Creek Village
Vigilio Cal, Golden Stream Village
Ramon Sanchez, Big Falls Village

Juan Cal, Bladen Village
Junior Delbert Pop, San Marcus Village
Israel Canti, San Pablo Village
Roberto Tzib, San Ignacio Town
Marvin Pop, Golden Stream Village
Arturo Zuniga, Medina Bank Village

And supervised by

Protected Areas Management Program

Said Gutierrez
Protected Areas Program Director

Hilberto Rash
Protected Areas Manager

Science Program

Elizabeth Dorgay
Science Director

Florentino Chiac
Wildlife Officer

Diana Mai
Research Officer

Cover photo. Cacao Agroforestry Concession in the Maya Mountain North Forest Reserve, Ya'axché Conservation Trust

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Acronyms

ASPT-CR	Average Score Per Taxon- Costa Rica
BNR	Bladen Nature Reserve
BRIM	Biodiversity, Research, Inventory and Monitoring
BSR	Biodiversity Synthesis Report
CCAD	Central American Commission for Environment and Development
CRFR	Columbia River Forest Reserve
DBH	Diameter at Breast Height
EC	Electrical Conductivity
FD	Forest Department
GSCP	Golden Stream Corridor Preserve
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
MGL	Maya Golden Landscape
MMM	Maya Mountain Massif
MMNFR	Maya Mountain North Forest Reserve
NPAS	National Protected Areas System
NTFP(s)	Non-timber Forest Products(s)
NTU	Nephelometric Turbidity Unit
PAM	Protected Areas Management
PA(s)	Protected Area(s)
PAP	Protected Areas Program
PPA	Private Protected Area
PTA(s)	Priority Target Areas
SPAR	State of the Protected Area Report
SVAP	Stream Visual Assessment Protocol
TFCG	Trio Farmers Cacao Growers Limited
Ya'axché	Ya'axché Conservation Trust

Preamble

Ya'axché's programs have been undergoing rapid growth over the last 7 years with extensive development in capacity and strategic direction. Its current program structure is now far from its humble beginnings but always staying true to its roots and its vision for conservation and livelihoods in the Toledo District, and more specifically, the Maya Golden Landscape (MGL). Within the last 15 years, Ya'axché has been able to add two protected areas to its Protected Areas Program, a major achievement in its relentless effort to accomplish its vision of '*Harmony between nature and human development for the benefit of both*'.

As part of its drive for evidence-based decision making and adaptive management approach, Ya'axché first introduced biodiversity research and monitoring in 2009 as a pilot with its first assessment of biodiversity across the MGL published in 2010—the first Biodiversity Synthesis Report. The main objective of this report was to provide Ya'axché and the general public with a snapshot of the status of biodiversity across the landscape, which included a mosaic of Protected Areas (PAs) and community farmlands as study sites. Results of data analysis were then used to target priority areas for conservation action and/or education and awareness campaigns. This report had a 9-year run with its last issue published in 2019.

During the same time period, a number of changes took place within the Protected Areas Program (PAP) including the addition of more study sites and additional alignment with national priorities in research and monitoring. The research and monitoring program slowly transitioned to the Science Program within the wider PAP by having its own structure and program targets. Human resources gaps were filled, and the efficiency and effectiveness of management activities increased significantly. However, the only measure of efficiency and effectiveness in management of the PAs remained the Biodiversity Synthesis Report (BSR) with no publicly available information on other aspects of Protected Areas Management (PAM), such as enforcement and compliance activities. This gap is now addressed through the development of the first State of the Protected Areas Report (SPAR), which is now in its 3rd annual version.

To accommodate the growing need for management effectiveness assessments of its protected areas program, Ya'axché took the decision to incorporate a SPAR to its reporting framework and integrate the analysis of Biodiversity Research, Inventory and Monitoring (BRIM) as a tool to assess for status of PAs and the biodiversity within them. Notwithstanding the integration of the BSR into this report, research and monitoring activities outside the PAs will continue to be assessed and is presented as the Farmscape Biodiversity Report for 2022-2023 which will be out at the end of the first quarter of

2024. Note that information presented in this report in some cases may cover multiple years serving as a reference point for subsequent reports.

Executive Summary

Ya'axché privately manages the Golden Stream Corridor Preserve (GSCP) and co-manages the Bladen Nature Reserve (BNR) and the Maya Mountain North Forest Reserve (MMNFR) along with the Government of Belize. For the last 25 years, Ya'axché has been actively involved in Protected Areas Management (PAM) and has grown to become one of the leading organizations in Belize promoting sustainable livelihoods, as well as conservation of natural resources. With the growth of the organization came the need for adequate assessments of management effectiveness, particularly within the Protected Areas Program (PAP). This report is the first of its kind at the organization and is intended to provide a summary of the status of multiple target areas relevant to the management, monitoring and conservation of resources within the Protected Areas (PAs).

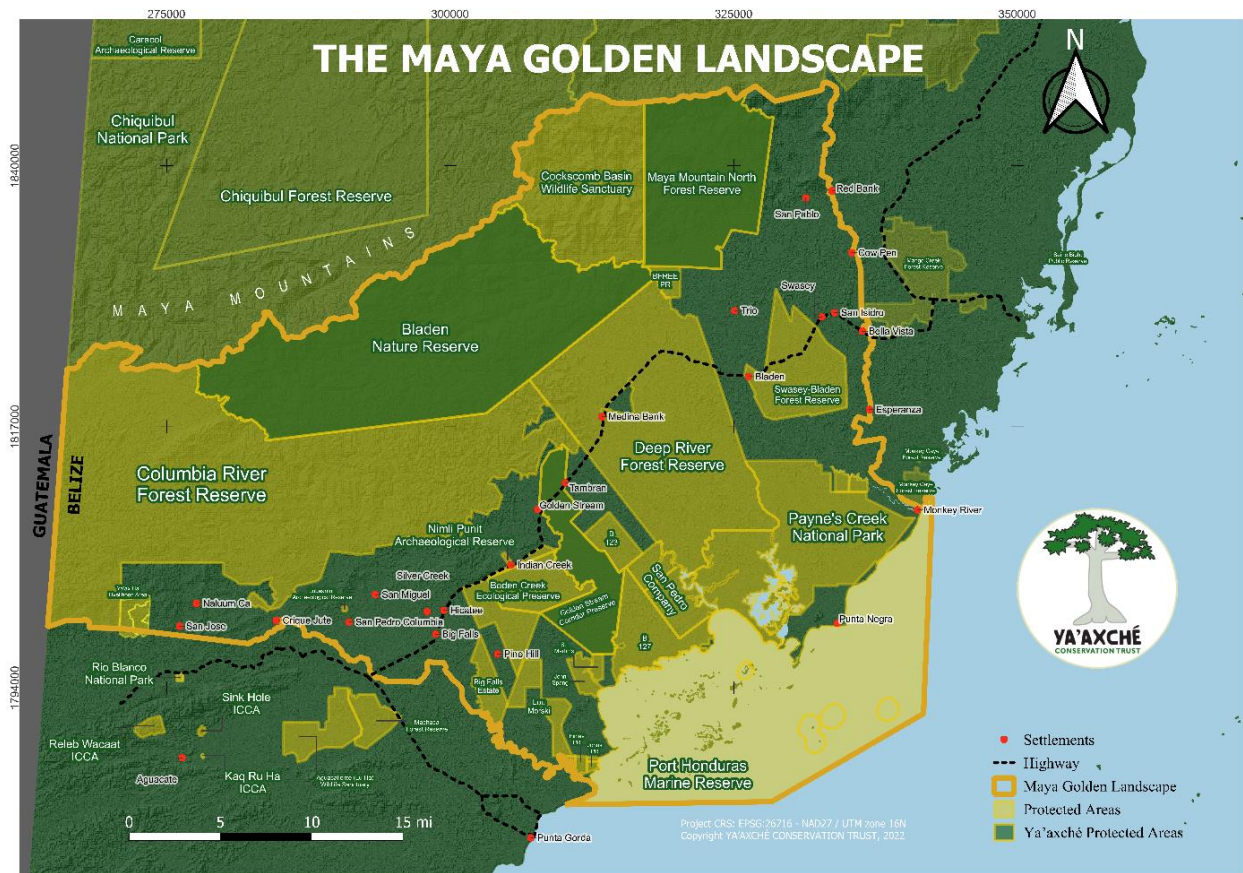
Seven (7) Priority Target Areas (PTAs) have been selected for this report. These target areas are not absolute and may include other targets of interest in future iterations of this report. For this report we include: (i) Habitat Indicators, (ii) Rare, Threatened, Socio-Economic, and Culturally Important Species, (iii) Broad Ecosystems and Land Use Change, (iv) Ecosystem Services, (v) Sustainable Natural Resource Use, (vi) Enforcement and Compliance, and (vii) Biodiversity Knowledge for Adequate Management. All seven PTAs were chosen based on their ability to indicate changes in conditions over time and whether there was data available and/or baselines in the process of being established. A combination of data analysis and expert opinion guided the assessment of conditions thereafter.

Based on the 2022 assessments, **Habitat Indicator Species** are in *good, but deteriorating condition* across all three PAs. This is a change in status from last year, in which all PAs were classified as *stable and in good condition*. Available data on **Rare, Threatened, Socio-Economic, and Culturally Important Species** suggests that these species remain in *good condition* at BNR and MMNFR but as of 2022 now *warrant moderate concern* at GSCP. **Broad Ecosystems and Land Use Change** show *negligible changes* for GSCP and BNR with *moderate concern in a deteriorating trend* for the MMNFR. **Sustainable Natural Resource Use** remains stable within *moderate concern* for the GSCP and is of *moderate concern with*

a *deteriorating trend* in MMNFR. **Enforcement and Compliance** is *stable and in good condition* for GSCP with *moderate concern* for BNR, but with *stable conditions* and *moderate concern with a deteriorating trend* for the MMNFR. **Biodiversity Knowledge for Adequate Management** has been improving within the protected areas with data providing sound evidence of good governance and conservation efforts for flora and fauna. The addition of camera surveys in the BNR has significantly improved the monitoring of important indicator species. For this reason and for the purposes of this report we consider the status in *good condition with an improving trend*.

The overall assessment of the PAs can be summed as follows: The **Bladen Nature Reserve** remains the most stable protected area with the vast majority of its forest cover intact and its biodiversity in *good condition*. The **Golden Stream Corridor Preserve** also remains *stable with some concern* over activities related to unauthorized extraction of NTFPs. The majority of its land area is currently forested, and its biodiversity is in *good condition*. The **Maya Mountain North Forest Reserve** is the *most unstable* protected area of the three. Most infraction and activities affecting its condition are concentrated in a small portion of the reserve which warrants *moderate concern* due to the deteriorating conditions observed. It still retains most of its land area under forest cover despite the concerns.

Introduction



Map 1. Protected Areas within the Maya Golden Landscape in the Toledo District.

Ya'axché's Protected Areas Management (PAM) efforts are focused in the conceptual area of scope referred to as the Maya Golden Landscape (MGL) in the Toledo District, Belize. The MGL is a mosaic landscape comprised of protected areas, private lands, indigenous communal lands and agriculture lands. Ya'axché currently manages and co-manages three (3) Protected Areas (PAs) with three (3) distinct protected area designations under Belize's National Protected Areas System (NPAS). These three (3) protected areas include the Golden Stream Corridor Preserve (GSCP), Bladen Nature Reserve (BNR) and the Maya Mountain North Forest Reserve (MMNFR) (Map 1).



The **Golden Stream Corridor Preserve** is a Privately Protected Area (PPA) in the Toledo District established in 1998 through the efforts of Ya'axché which at the time was comprised of a consortium of local community members and conservation experts, both national and international. The PA encompasses 15,000 acres of lowland broadleaf forests that connect the foothills of the Maya Mountains to the coastal lowlands of Toledo. Ya'axché is fully responsible for all management activities within this PA.



The **Bladen Nature Reserve** is Belize's largest nature reserve with this designation providing the highest level of protection for any PA under the NPAS Act. The PA spans approximately 100,000 acres in the core zone of the Maya Mountain Massif (MMM). The remoteness of the PA provides an excellent shield from most anthropogenic impacts that other protected areas are affected by. Ya'axché holds co-management of this reserve along with the Government of Belize having major responsibility for the daily operational activities.

the daily operational activities.

The **Maya Mountain North Forest Reserve** is an extractive reserve in the Toledo District



with a long history of management absence up until 2015 when Ya'axché took on co-management of the reserve. Until 2022, it had maintained no major extractive activities other than an agroforestry concession regulated by the Belize Forest Department (FD) and managed by Ya'axché on behalf of a community group from the Trio Village. The PA encompasses 36,000 acres, most of which is rugged terrain that remains forested landscape on the eastern flank of the MMM.

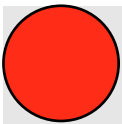

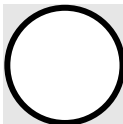

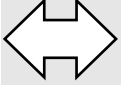
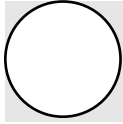
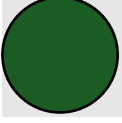

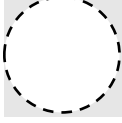
The purpose of this report is to assess the overall condition of all three (3) PAs under Ya'axché's management and to communicate protected area conditions to management partners, donors, stakeholders and the general public. The report also highlights priority areas under Ya'axché's Biodiversity, Research, Inventory and Monitoring (BRIM) strategy as well as the individual PAM plans. It also provides recommendations for future work particularly in the areas of concern as assessed through the process of developing the state of the protected areas reports, periodically.

Two previous reports, 2020 and 2021, cover a span of 12 years of data which was used to assess the status of the protected areas and their resources. Data encompassing the full 12 years is based heavily on biodiversity monitoring. This report takes the previous reports as reference points to assess the status of the Protected Areas for the period 2022. For other data such as land use change and enforcement and compliance, the assessment of status was based on data collected for the periods 2020-2022 and 2022 respectively. In synthesis, information briefs within the report will at times contain multi-year analysis of data with the assessment year for comparison.





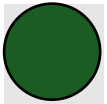
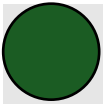
The SPAR is summarized in table format for seven target areas based on a synthesis of research and monitoring activities, management activities and effectiveness evaluations, and internal expertise. An Information Brief providing details of specific target areas with relevance to one or more of the three (3) PAs under Ya'axché's management mandate can be found at the end of each section assessment when data is available for publication.




Summary of State of the Protected Areas




In order to standardize the evaluation of condition and trend across target areas, we use the following evaluation key in the table below. The colors represent the condition status of the target area whether that be **significant concern**, **moderate concern** or **good condition**. Arrows represent the trend in conditions such as **improving**, **stable** or **deteriorating**. The confidence of the assessment is represented by bold solid circle for **high confidence**, solid line if **medium confidence** or dotted circle if **low confidence** in the assessment. If the organization is still gathering baseline data on a particular target or if data is in the form of a one-time inventory, the trend arrows are omitted. If a target area is **not yet measured** or is **not applicable** to the protected area, the condition is assessed as “Unknown” and “NA”, respectively.






Resource Condition		Trend in Condition		Confidence in Assessment	
	Warrants Significant Concern		Condition is Improving		High
	Warrants Moderate Concern		Condition is Stable		Medium
	Resource is in Good Condition		Condition is Deteriorating		Low




Summary of Condition and Trends of Priority Targets

Priority Targets	Condition Status/Trend			Rationale
	GSCP	BNR	MMNFR	
I. Habitat Indicator Species				<p>Ya'axché monitors indicator species on 12 transects distributed across a disturbance gradient within the MGL. On the 1-km long transects, point counts for 30 indicator birds and signs of 19 indicator mammals are recorded. The select birds and mammals belong to indicator groups that serve to reflect changes in habitat or underlying ecological conditions. Synthesis Reports with analyses for individual monitoring years can be found on Ya'axché's website.</p> <p>Transect data from GSCP and BNR since 2010 and from MMNFR since 2016 were analyzed for this report. Multiple indicator groups make up this target and each is scored separately. Trends in the index of abundance for most habitat indicators in each PA allude to "good" environmental conditions over time. However, game species and migratory birds are declining, triggering a change in status from stable to deteriorating in all PAs this year.</p>
II. Rare, Threatened, Socio-Economic, and Culturally Important Species				<p>The terrestrial ecosystems across GSCP, BNR, and MMNFR support at least 24 threatened birds and mammals, including Yucatan spider monkeys (<i>Ateles geoffroyi yucatanensis</i>), and white-lipped peccaries (<i>Tayassu pecari</i>) and keel-billed motmots (<i>Electron carinatum</i>). Eight (8) mammal and eight (8) bird species of conservation concern are monitored on biodiversity transects.</p> <p>Threatened birds are consistently low across all three reserves, with significant declines in the yellow-headed parrot (<i>Amazona oratrix</i>) in BNR since 2012. Threatened game birds are especially in poor condition, with several significant, negative trends becoming clear in 2022 and creating a status of critical concern for GSCP and moderate concern for BNR and MMNFR. The only species with a significant increase in abundance is the mealy parrot in MMNFR.</p>

Priority Targets	Condition Status/Trend			Rationale
	GSCP	BNR	MMNFR	
				<p>Trends vary for individual threatened mammal species in each reserve with the majority having low but stable indices of abundance over time. The abundance of pumas on GSCP and BNR transects has significantly increased since 2010, as has the abundance of Baird’s tapir in BNR. Meanwhile, jaguar detection on GSCP transects has significantly declined during the same timeframe.</p> <p>Across the three reserves, 23 rare, threatened, and/or culturally important plants have been subject to studies to improve knowledge of their distribution, population size, age structure, and phenology to inform better management practices at the local and national level. Beginning in 2021, a total of 24 native tree species have been propagated at Ya’axché’s Golden Stream nursery for out-planting into the MMNFR. As of December 2022, 910 seedlings from eight of those species were out planted to boost local populations and restore degraded areas in the PA.</p> <p>The mature forest of BNR supports at least 53 species of bats, while 34 species have been documented in the secondary forest of GSCP.</p>
<p>III. Broad Ecosystems and Land Use Change</p>				<p>Ecosystems within the PAs are considered intact for all protected areas. In the case of GSCP, ecosystems remain stable, and many areas are still recovering from historical heavy land use types such as cattle farming and from damages sustained from Hurricane Iris in 2001. The BNR is the most stable of all with all ecosystems intact and negligible changes brought about by natural occurrences, such as flood damage along the banks of the Bladen Branch. The remoteness of this protected area contributes significantly to its preservation. In MMNFR, the lowland broad-leaved wet forest ecosystem is under the most pressure from agriculture activities. However, the area under pressure is small relative to the size of the PA. All other ecosystems within the MMNFR are shielded by rugged terrain and difficulty accessing these.</p>

Priority Targets	Condition Status/Trend			Rationale
	GSCP	BNR	MMNFR	
				<p><i>Note:</i> All three PAs retain a large portion of their land mass under forest cover.</p> <p>The GSCP. Enforcement & compliance patrols continue to deter any major clearings within its boundaries. There are small areas that are being monitored where the protected area boundaries lines are shared with farmlands. While intentional clearing within the reserve along the boundary line is unlikely, the risk of fires from nearby farms is high during the dry months of the year. 2022 saw no incidents of fire escaping into or near the reserve.</p> <p>The BNR has most of its natural vegetation intact. Apart from negligible changes in forest cover along the banks of the Bladen Branch River, the reserve remains intact.</p> <p>In MMNFR just north of the agroforestry concession is an area under illegal cultivation which has degraded the forest conditions resulting in unsustainable use of an estimated 300 acres of land within the reserve. This area continues to be active and attracts more incursions and clearings contributing to the deteriorating trend in forest cover in the area.</p>
IV. Ecosystem Services				<p>In 2016-2017, a freshwater bio-assessment was conducted within four watersheds in the MGL (BoI, 2018). The study was done to develop baseline data and potential station sites for continuous monitoring in order to assess long-term trends of the stream condition. All sites ranked either as “good” or “excellent” based on integrated scores for stream physical, biological, and chemical parameters (using SVAP and ASPT-CR scoring criteria).</p>







Priority Targets	Condition Status/Trend			Rationale
	GSCP	BNR	MMNFR	
V. Sustainable Natural Resource Use		NA		<p>Resource use in the GSCP is restricted to sustainable extraction zones established for NTFPs. Extraction of cohune leaves within two extractions zones is seasonal and monitored by the ranger team. Requests by community leaders remain very low.</p> <p>The BNR, by virtue of its designation, cannot allow the use of resources within the reserve. As such, sustainable natural resource use is not applicable to this PA.</p> <p>The MMNFR is by designation an extractive reserve. Since 2015, Ya'axché along with the Trio Farmers Cacao Growers (TFCG) have been developing an agroforestry concession to produce shade-grown cacao. This development has seen the conversion of 936 acres of forested land into productive shade-grown cacao. Illegal logging was prevalent at a similar rate as that of 2021. A small number of permits were issued by FD for the extraction of timber species for personal use and eventually the FD declared that no "petty" permits were being issued towards the end of 2022. This coincided with the granting of a Long-Term Forest License to Hummingbird Furnishings, a furniture making company out of Belmopan.</p>
VI. Enforcement and Compliance				<p>The GSCP continues to enjoy a relatively high level of compliance with rules and regulations. The Golden Stream Field Station serves as a key site for deployment of patrols. Easy access to trail systems allows for near real time monitoring of activities within the protected area.</p> <p>The BNR conditions are stable. Patrol effort continues with increased efforts in the more remote reaches of the reserve. While an increase in activity within the far western portions of the reserve was evident, it does not pose any major impact. Increased presence in the area can reduce any escalation of illegal activities.</p>

Priority Targets	Condition Status/Trend			Rationale
	GSCP	BNR	MMNFR	
				MMNFR patrols continue to uncover evidence of increased illegal logging. An increased patrol effort was able to document illegal activities in a more comprehensive manner. Hotspots were identified and patrol presence resulted in several confiscations; one (1) case was prosecuted with court rulings still pending by the end of April 2023. The granting of a long-term sustainable logging license to a third party allowed for additional presence and a reduction of logging incidents in the later part of 2022.
VII. Biodiversity Knowledge for Adequate Management				Research, inventory, and monitoring at Ya'axché has grown significantly over the years, resulting in a dedicated field team for data collection and technical staff for the analysis of data and reporting. In 2022, the Science Program was formally established, placing more emphasis on the collection and use of data for PA management and livelihood support. As the program continues to grow, the knowledge of the biodiversity within the PAs continues to increase as well. Currently, information on invasive species presence and distribution in the PAs is lacking.







I. Habitat Indicator Species




Habitat Indicator Species		Overall Condition			GSCP	BNR	MMNFR
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale		
		GSCP	BNR	MMNFR			
Migratory Birds	Index of Abundance				<p>Eight (8) bird species monitored on the biodiversity transects are generalist migrant species without specific habitat requirements in Belize. Declines in the abundance of these birds could indicate deteriorating conditions of their migration routes among other stressors. Since monitoring began in 2010, significant declines in migratory birds have been observed in GSCP, the nearby Columbia River Forest Reserve, BNR, and Indian Creek Village (<i>see the information brief following this section</i>). Because this trend is seen across many sites in the MGL, including the intact forest habitat of the Bladen Nature Reserve, it is likely that external pressures are driving the decline.</p> <p>GSCP. Migratory birds experienced a clear, significant decline in GSCP between 2010 and 2021. However, the migrant index of abundance on GSCP transects in 2022 was unusually high, breaking the trend from prior years. A similar spike in migratory birds was also captured at the nearby village transect and MMNFR transects in 2022.</p> <p>BNR. There has been a significant decline in migration route health indicators for BNR since 2010, though 2022 figures are slightly above average. Distinct habitats in BNR reflect different numbers of migratory birds. The decline of migrants is documented at the transect located in broadleaf forest; this trend is not observed in the savanna transect, which has experienced a lower but more stable abundance of migrants over the monitoring years.</p>		

Habitat Indicator Species		Overall Condition			GSCP	BNR	MMNFR
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale		
		GSCP	BNR	MMNFR			
					MMNFR. Trends are variable by year and no clear significant relationships have been documented. 2022 results are slightly higher than the average over the last three years and since monitoring began in 2016.		
Forest Birds and Mammals	Index of Abundance				Eleven (11) bird species and seven (7) mammal species are monitored as forest health indicators, as they are only found in primary forests or undisturbed secondary forests.		
					GSCP. Forest birds and mammals have remained stable in GSCP since 2010. The index of abundance for each group in 2022 is comparable to the average index of abundance since monitoring began.		
					BNR. Forest birds and mammals have been stable in BNR broadleaf habitat since 2010.		
					MMNFR. No linear trends exist for forest birds and mammals since 2016, indicating stability in the MMNFR forest. There is a noticeable decline in forest mammal index of abundance between 2016 and 2017, but it appears to stabilize between 2018-2022 though it remains low. This pattern might be caused by increasing human activity during the establishment of the cacao concession where the transects are located. Both the cacao and forested transects in MMNFR shared this pattern in forest mammal index of abundance.		
Savanna Birds	Index of Abundance	NA		NA	Three (3) of the monitored bird species are linked to pine savanna ecosystems and are considered indicators of the health of that habitat. Pine savannas in the MGL are threatened by increasingly frequent		

Habitat Indicator Species					Overall Condition	GSCP 	BNR 	MMNFR 
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale			
		GSCP	BNR	MMNFR				
					<p>wildfires, which could decrease pine regeneration and pine nesting sites for birds.</p> <p>GSCP. Not assessed. There is no savanna habitat within this protected area.</p> <p>BNR. The BNR savanna habitat experienced a significant decline in savanna birds from 2012-2021. Though as a group, savanna birds increased overall in 2022, breaking the trend, the yellow-headed parrot continues to show a critical decline giving reason for moderate concern. The yellow-headed parrot is a globally endangered species that is illegally trapped for the international pet trade. The two other pine savanna species have maintained low but stable numbers over time.</p> <p>MMNFR. Not assessed. There is no savanna habitat within this protected area.</p>			
Wetland Birds and Mammals	Index of Abundance				<p>Three (3) bird species are monitored as wetland indicators because of their link to healthy riparian or littoral habitat.</p> <p>Two (2) mammal species are monitored as indicators of riparian forest health. Between the two, the neotropical river otter is rarely recorded on the transects while the Baird's tapir is consistently recorded.</p> <p>GSCP. No trends are evident for wetland birds or mammals in GSCP. Abundances of wetland species appear stable across the protected area over time.</p>			

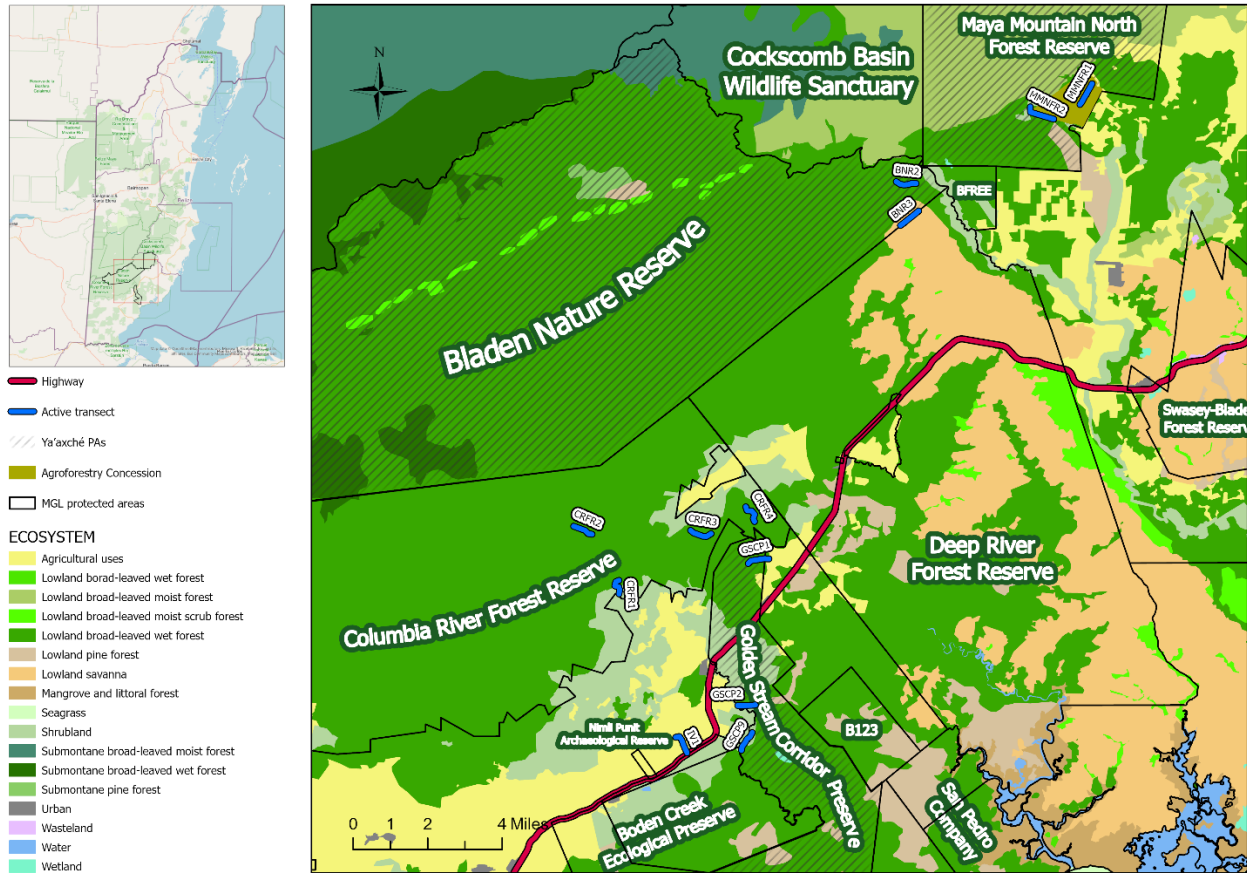
Habitat Indicator Species		Overall Condition			GSCP	BNR	MMNFR
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale		
		GSCP	BNR	MMNFR			
					<p>BNR. There is a significant positive trend in wetland mammal indicators. This is being driven by an increase in tapir detections in the Bladen savanna transect over time. The BNR transect locations historically record fewer wetland bird species than the transects in the other protected areas, but these birds have been unusually absent from both the forest and savanna transects of BNR in the last 2 years. No significant trends are evident yet for wetland birds, but this indicator group will be monitored in future years to see if the absence continues.</p> <p>MMNFR. Wetland mammals appear stable in MMNFR, with no significant changes in abundance since 2016. As in BNR, wetland birds are not especially abundant on the MMNFR transects but have been absent in the last 3 years. Continued monitoring will determine if this is an area of concern.</p>		
Disturbed Forest Birds and Mammals	Index of Abundance				<p>Three (3) bird species and one (1) mammal species are monitored as disturbance indicators. These species are known to tolerate and even thrive in fallow lands, forest gaps, and human impacted landscapes. Of the three (3), the bronzed cowbird and dickcissel have never been recorded on any transect since 2010, though citizen science records (available at eBird.org) show both species have been recorded at nearby locations. The results shared are for the plain chachalaca and jaguarundi.</p> <p>GSCP. GSCP and the neighboring CRFR have seen a significant decline in plain chachalaca since 2010. This indicates improved forest</p>		

Habitat Indicator Species					Overall Condition	GSCP 	BNR 	MMNFR 
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale			
		GSCP	BNR	MMNFR				
					<p>conditions over time. Jaguarundis are rarely recorded at the GSCP transects, and none were detected there in 2022.</p> <p>BNR. No trends have been detected within the broadleaf forest habitat, where plain chachalacas are not common and in many years, none are observed. In comparison, the savanna habitat has seen a significant decline in plain chachalacas over time. Detection of jaguarundis at the BNR transects has been rare since monitoring began, and 2022 is no different.</p> <p>MMNFR. Plain chachalacas and jaguarundis are rarely detected on the MMNFR transects, and no trends are evident yet.</p>			
Game Birds and Mammals	Index of Abundance				<p>Three (3) commonly hunted game bird species are monitored as indicators of hunting presence and sustainable use. Six (6) game mammals, including white-lipped and collared peccaries, paca, and agouti are also monitored.</p> <p>GSCP. As a group, there are no linear trends for game bird index of abundance, mostly because abundances have been very low since monitoring began in 2010. However, individual game bird species are facing serious declines (see more details under the next resource category, <i>II. Rare, Threatened, Socio-Economic, & Culturally Important Species</i>). Game mammals are more commonly recorded in GSCP, but no trends are seen for this group since 2010. In comparison, the CRFR has seen a significant decline in game mammals over 12 years, and zero game birds have been recorded in the nearby Indian Creek Village transect since 2012. The lack of game birds on the GSCP, CRFR, and</p>			

Habitat Indicator Species					Overall Condition	GSCP 	BNR 	MMNFR 
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale			
		GSCP	BNR	MMNFR				
					<p>Village transects is expectedly due to hunting pressures from the nearby communities.</p> <p>BNR. Game birds have significantly declined in the savanna since 2012 while no clear trends have been confirmed in the broadleaf forest. Game mammals do not show any linear trends over 12 years; however, this group should be monitored closely, as game mammal index of abundance in the last three years is lower than the average since monitoring began.</p> <p>MMNFR. After seven years of monitoring, trends have emerged for game birds in MMNFR. These indicators have significantly declined at the broadleaf forest transect since 2016. Within the cacao agroforestry habitat, game birds are rarely detected. However, zero game birds have been recorded at the cacao transect for the last four years in a row. Though not yet statistically significant, this condition is of moderate concern and will be monitored into the future.</p> <p>Game mammal trends are still variable by year, and no clear significant relationships have been documented. There was a noticeable decline in game mammal abundance between 2016 and 2017 which stabilized but remained low between 2018 and 2022.</p>			

Information Brief: Indicator Species and Biodiversity Transects

Indicator Species and Biodiversity Transects



Map 2. Transect locations and ecotypes.

Ya'axché began monitoring biodiversity in 2006 using bird and mammal transects. Over the years, the monitoring program has grown to encompass new target taxa and methodology but transects have remained relevant for identifying long-term trends. As of 2022, twelve (12) transects exist across the MGL. These are point-count and sign transect, all 1km in length, with stopping points every 200m to observe and listen. Birds are detected using sight and sound cues, while mammals are detected using direct sightings, tracks and an array of different signs such as scat, smell, sounds and scratch marks.

Transect locations

Diverse habitats and a range of disturbance levels were chosen for transect locations to ensure that our monitoring program is representative of the land cover found across the landscape. Two (2) transects are located in BNR, four (4) in CRFR, three (3) in GSCP, one (1) in Indian Creek Village, and two (2) in MMNFR. The location and ecotype of the transects is depicted in **Map 2**. Details of each of the transects can be found in **Table 1**.

Indicator species

Target species include thirty-one (31) birds and nineteen (19) mammals, which are

Table 1. Description of transect disturbance levels and the year that consistent and consecutive monitoring was established. Any data recorded on the transects prior to the year listed below were not included in this

Transect	Year Est.	Disturbance
BNR2	2010	Minimal
BNR3	2012	Minimal
CRFR1	2010	Minimal; 0-20% hurricane damage (2001); proximity of agriculture
CRFR2	2010	Minimal; 0-20% hurricane damage (2001)
CRFR3	2010	Minimal; 0-20% hurricane damage (2001)
CRFR4	2010	Minimal; 0-20% hurricane damage (2001)
GSCP1	2010	60-75% hurricane damage (2001); proximity of village and agriculture
GSCP2	2010	60-75% hurricane damage (2001); proximity of agriculture
GSCP9	2012	60-75% hurricane damage (2001); proximity of agriculture
IV1	2012	60-75% hurricane damage (2001); proximity of highway and agricultural clearings
MMNFR 1	2016	Up to 40% thinning of overstory with cacao crop planted underneath
MMNFR 2	2016	Minimal

classified into six (6) indicator groups based on habitat preferences and ecology (Tables 2 & 3).

Species lists and indicator group assignment were based national and IUCN Red List conservation priorities, expert knowledge, ecological preferences as given in “Field Guide to the Mammals of Central America and Southern Mexico” (Reid, 2009) and “Birds of Belize” (Jones & Gardner, 2003), and validated by the local knowledge of Ya’axché’s field ranger team.

Indicator groups are considered when analyzing bird and mammal data and are used to facilitate making conclusions from the monitoring results. For example, an increase of “Disturbed Forest indicators” could indicate habitat degradation, whereas decreased “Game species” richness could indicate a high level of hunting pressure and/or habitat degradation.

Table 2. Target mammal indicator species (n=19).

Common Name	Class	IUCN Status
Agouti	G	LC
Baird's Tapir*	W	EN
Collared Peccary	G	LC
Jaguar	F	NT ↓
Jaguarundi*	D	LC ↓
Margay*	F	NT
Northern Naked-tailed Armadillo	NA	DD
Neotropical River Otter*	W	NT ↓
Nine-banded Armadillo	G	LC
Ocelot	F	LC
Paca	G	LC
Puma*	F	LC ↓
Red Brocket Deer	F	DD
White-lipped Peccary*	G	VU
White-nosed Coati	NA	LC
White-tailed Deer	G	LC
Yucatan Black Howler Monkey*	F	EN
Yucatan Brown Brocket Deer	NA	VU
Yucatan Spider Monkey*	F	EN

Table 3. Target bird indicator species (n=31).

Common Name	Migra-tory	Class	IUCN Status
American Redstart	Y	M	LC ↓
Black and White Warbler	Y	M	LC ↓
Blue-gray Gnatcatcher	Y	P	LC
Bronzed Cowbird	N	D	LC
Brown-hooded Parrot	N	F	LC
Cerulean Warbler	Y	F	NT ↓
Chestnut-sided Warbler	Y	M	LC ↓
Common Yellowthroat	Y	M	LC
Crested Guan	N	G	LC ↓
Dickcissel	Y	D	LC ↓
Golden-winged Warbler*	Y	F	NT ↓
Grace’s Warbler	N	P	LC ↓
Great Curassow*	N	G	VU
Great Tinamou*	N	G	NT ↓
Hooded warbler	Y	M	LC
Keel-billed Motmot*	N	F	VU ↓
Keel-billed Toucan	N	F	LC ↓
Kentucky Warbler	Y	F	LC ↓
Little Tinamou	N	F	LC ↓
Louisiana Waterthrush	Y	W	LC
Magnolia Warbler	Y	M	LC
Mealy Parrot*	N	F	NT ↓
Northern Waterthrush	Y	W	LC
Painted Bunting	Y	M	LC
Plain Chachalaca	N	D	LC
Prothonotary Warbler	Y	W	LC ↓
Slaty-breasted Tinamou	N	F	LC ↓
Swainson’s Warbler	Y	F	LC
Wood Thrush	Y	M	LC ↓
Worm-eating Warbler	Y	F	LC
Yellow-headed Parrot	N	P	EN ↓
*Assessed as part of the threatened bird or mammal indicator for the target “Rare, Threatened, Socio-Economic, & Culturally Important Species.”			
KEY: M = migration route health, P = pine savannah health, D = disturbed forest, F = forest health, G = game (hunting pressure), W = wetland health, NA = not assigned. LC = least concern, NT = near threatened, VU = vulnerable, EN = endangered, DD = data deficient. Arrow indicates trend in global populations.			

Three (3) mammal species are monitored but are not assigned to an indicator class and are reported as indicator group “NA”.

Methods

The core data collected in transects since 2010 were the number of species observed and the number of individuals observed per species. Birds were monitored twice daily: early morning and late afternoon. Large mammal monitoring was done simultaneously with bird monitoring, but signs and sightings were only recorded once during the day to avoid double counting. A more detailed description of the methodology used on the transects can be found in Ya’axché’s BRIM strategy document (Wicks, 2009). The number of transect visits per year averages 31.2 in BNR (8 visits in 2022), 31.8 in GSCP (16 visits in 2022), and 24.6 in MMNFR (6 visits in 2022).

Analysis

The number of indicator species recorded on the transects was standardized across years and reserves through the creation of an index of abundance for each indicator group and for each species of conservation concern.

The index of abundance gives an indication of the status of an animal population, based on the numbers of animals seen per unit of time or distance, in a particular area over several years. In this case, the indices were calculated as the number of individuals observed per 1000m.

Data from all GSCP transects were analyzed and reported together for a comprehensive score for that reserve. For each BNR and

MMNFR, data from transects were analyzed separately because the transects in those reserves have habitat and/or land use types that are distinct from each other. The CRFR and village transects are reported for comparison against the PAs managed by Ya'axché.

Indices of abundance over time were plotted and analyzed for trends using ordinary least squares regression techniques in PAST (Hammer et al. 2001).

Indicator group trends

Indices of abundance for each indicator group and PA can be found in **Table 4**. Regression equations and p values are reported below for groups with clear, significant trends.

Indicator groups having significant declines:

Migration Route Health Birds

- GSCP (2010-2021)
($y = -0.2507x + 6.2234$; $R^2 = 0.3816$; $p < 0.05$);
- BNR (2010-2022)
($y = -0.36117x + 6.2589$; $R^2 = 0.37542$; $p < 0.05$);
- CRFR (2010-2022)
($y = -0.23903x + 4.4117$; $R^2 = 0.66546$; $p < 0.001$);
- Village (2012-2021)
($y = -0.4273x + 6.5092$; $R^2 = 0.49196$; $p < 0.05$);

Savanna Habitat Birds

- BNR savanna (2010-2021)
($y = -0.30858x + 4.6585$; $R^2 = 0.5044$; $p < 0.05$);

Disturbed Forest Birds

- BNR savanna (2012-2022)

($y = -0.22884x + 2.1586$; $R^2 = 0.69087$; $p < 0.005$);

- Village (2012-2022)
($y = -0.65578x + 6.694$; $R^2 = 0.87031$; $p < 0.001$);
- GSCP (2010-2022)
($y = -0.26894x + 3.2252$; $R^2 = 0.73428$; $p < 0.001$);
- CRFR (2010-2022)
($y = -0.20198x + 2.3102$; $R^2 = 0.68303$; $p < 0.001$);

Game Birds

- MMNFR broadleaf (2016-2022)
($y = -0.26662x + 1.5655$; $R^2 = 0.56924$; $p = 0.05$);
- BNR savanna (2012-2022)
($y = -0.1047x + 1.0117$; $R^2 = 0.57537$; $p < 0.01$);

Game Mammals

- CRFR (2010-2022)
($y = -0.73487x + 10.813$; $R^2 = 0.72388$; $p < 0.001$);

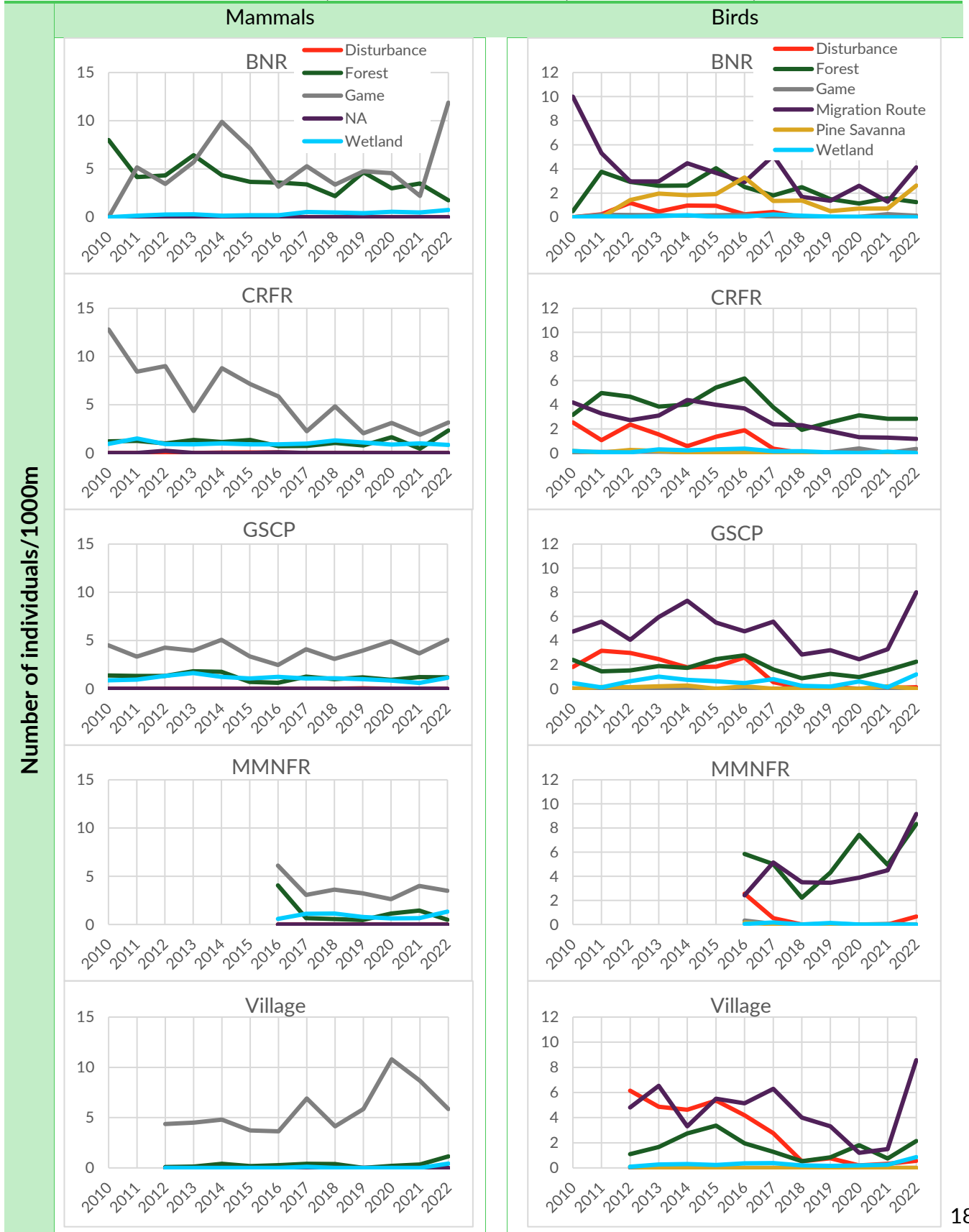
Indicator groups having significant increases:

- BNR wetland mammals (2010-2022)
($y = 0.0481x + 0.01586$; $R^2 = 0.77858$; $p < 0.001$);
- Village game mammals (2012-2022)
($y = 0.42621 + 3.1912$; $R^2 = 0.39225$; $p < 0.05$);

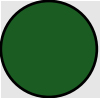
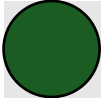






No other significant trends exist.




Table 4. Graphs of indicator group indices of abundance per protected area. Monitoring began in 2010 in BNR, CRFR, and GSCP; 2012 in Indian Creek Village; and 2016 in MMNFR.


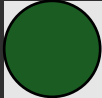

Note: Corrections were made to the wetland and pine savanna bird abundances for the year 2020—values were misreported in 2020-2021.














II. Rare, Threatened, Socio-Economic, & Culturally Important Species







Rare, Threatened, Socio-Economic, and Culturally Important Species		Overall Condition			GSCP	BNR	MMNFR
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale		
		GSCP	BNR	MMNFR			
Jaguars	Number of Individuals	Unknown					
<p>Jaguars are apex predators in jungles of the neotropics. A stable jaguar population over time indicates trophic integrity in the landscape. Camera trap surveys in BNR and MMNFR have allowed Ya'axché to capture, identify, and track the movement of individual jaguars in BNR and MMNFR since 2021 and 2019, respectively. More years of data are needed to assess trends. Time stamps of the photos, camera station numbers and jaguar rosettes were utilized to ensure certainty of individuals. Jaguar presence in both seasons denotes that the top predators remain active all year round.</p>					<p>BNR. Cameras during the 2022 dry season recorded two (2) male individuals for the dry season, while there was a recapture of two male individual for the wet season.</p>		
<p>MMNFR. In 2021, the MMNFR concession camera survey there was no jaguar detected by the cameras; however, there was a male and a female individual detected for the wet season.</p>							
Threatened Birds	Index of Abundance				<p>Eight (8) bird species monitored along the biodiversity transects are of <i>conservation concern</i> because they have either a threatened IUCN Red List status or a near-threatened status with decreasing global populations.</p> <p>These species include the cerulean warbler, golden-winged warbler, keel-billed motmot, great curassow, great tinamou, mealy parrot, and yellow-headed parrot. In 2022, the crested guan joined this list with</p>		




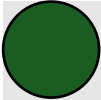
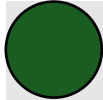
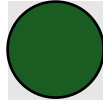
Rare, Threatened, Socio-Economic, and Culturally Important Species					Overall Condition	GSCP 	BNR 	MMNFR 
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale			
		GSCP	BNR	MMNFR				
					<p>an updated '<i>Near Threatened</i>' status. The cerulean warbler has never been recorded at any transect location in the MGL since monitoring began.</p> <p>GSCP. The keel-billed motmot has never been recorded on the GSCP transects since monitoring began in 2010. This species, along with the yellow-headed parrot are not expected at GSCP due to their range limitations and habitat preferences. Mealy parrots and golden-winged warblers are rarely recorded, and no clear significant relationships have been documented. The condition of threatened game birds in GSCP warrants significant concern. The great curassow has not been recorded at GSCP since 2012. The crested guan has experienced a significant decline since 2010 and has not been recorded there in the last five years. Great tinamous are declining in all other monitored PAs (BNR, MMNFR, and CRFR). This species has always been recorded in low numbers at the GSCP transects since 2010, so while the negative trend is also present here, it is not felt so strongly as in the other PAs. However, it is concerning that zero great tinamous have been recorded in GSCP for four years in a row.</p> <p>BNR. The golden-winged warbler was recorded on the BNR transects for the first time in 2022. Keel-billed motmots and mealy parrots do not show clear or significant trends, however, the indices of abundance for these species in the last 3 years are lower than average. Yellow-headed parrot numbers have experienced a critical decline giving reason for <i>moderate concern</i>. The yellow-headed parrot is</p>			




Rare, Threatened, Socio-Economic, and Culturally Important Species					Overall Condition	GSCP 	BNR 	MMNFR 
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale			
		GSCP	BNR	MMNFR				
					<p>facing threats of illegal poaching for the pet trade and habitat degradation from frequent fire.</p> <p>As with GSCP, threatened game birds warrant concern in BNR. Great curassow numbers are decreasing, and the species has not been observed in BNR transects in the last 3 years. Continued monitoring will determine if this becomes a significant trend. Crested guans have experienced a significant decline from the BNR savanna since 2012. This decline is also observed to a lesser extent in the broadleaf forest, though the trend is not yet significant. Finally, great tinamous have significantly declined from the BNR savanna, with a lesser, not-yet-significant decline occurring in the broadleaf forest.</p> <p>MMNFR. Yellow-headed parrots are rare but not expected at the MMNFR transects because these transects are not located near the parrots' preferred pine savanna habitat. The golden-winged warbler is rarely recorded and was not recorded in 2022. Keel-billed motmots are also rare and have not been recorded since 2016.</p> <p>After seven years of monitoring, trends have emerged for threatened game birds in MMNFR. Great curassow abundance has significantly decreased at the broadleaf forest transect. The species has never been recorded along cacao transect. Great tinamous are also facing significant declines from the broadleaf forest transect. Declines are also observed along the cacao transect where it is more rarely recorded, but these are not yet significant. Crested guans are rare at the MMNFR transects, and no trends have emerged yet, but zero birds have been recorded in the last five years.</p>			

Rare, Threatened, Socio-Economic, and Culturally Important Species					Overall Condition	GSCP 	BNR 	MMNFR 
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale			
		GSCP	BNR	MMNFR				
					Mealy parrots have seen a significant increase in index of abundance since 2016.			
Threatened Mammals	Index of Abundance				<p>Of the mammals monitored along the biodiversity transects, eight (8) species are of conservation concern: Yucatan black howler monkeys, jaguars, pumas, margays, tapirs, white-lipped peccaries, neotropical river otters, and Yucatan spider monkeys. The Yucatan brown brocket deer has never been recorded on a transect and was not assessed. The range for the species covers northern Belize and is not expected to extend into the Toledo District.</p> <p>GSCP. Neotropical river otters have never been recorded on the GSCP transects and are rarely detected at transects in other PAs; this is expectedly due to the distance of transects from large water sources. Yucatan spider monkeys, margays, and white-lipped peccaries have rarely been recorded since 2010, but all have stable indices of abundance since monitoring began (no trends).</p> <p>Since 2010, the number of Yucatan black howler monkeys detected on the GSCP transects has decreased, though not significantly. In the last five years, zero howlers have been recorded. This mammal is usually recorded in GSCP; this is the first time that no howlers have been recorded in consecutive years. This trend will be monitored closely. In comparison, the nearby CRFR has recorded howler monkeys in only one year since 2010.</p> <p>Jaguars significantly declined along GSCP transects between 2010 and 2021 ($y = -0.025773 + 0.55424x$; $R^2 = 0.34007$; $p < 0.05$); however, detections were higher in 2022, breaking the downward trend.</p>			

Rare, Threatened, Socio-Economic, and Culturally Important Species					Overall Condition	GSCP 	BNR 	MMNFR 
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale			
		GSCP	BNR	MMNFR				
					<p>The Baird's tapir is common in GSCP and appears stable year to year. Pumas have seen a significant increase in abundance since 2010.</p> <p>BNR. Neotropical river otters are rarely recorded at the transects due to the transect locations, and no trends are yet clear. Jaguars, Yucatan spider monkeys, Yucatan black howler monkeys, margays, and white-lipped peccaries are regularly recorded in BNR, and all species have stable indices of abundance since monitoring began (no trends). The Baird's tapir is increasing at BNR due to an increase of the species at the savanna transect. Pumas have also seen a significant increase in abundance since 2010.</p> <p>MMNFR. The neotropical river otter has never been recorded on a MMNFR transect. Margays, white-lipped peccaries and Yucatan spider monkeys are rarely recorded on the transects, and trends cannot yet be identified. Yucatan black howler monkeys, pumas, and Baird's tapirs are regularly recorded with stable indices of abundance. Jaguars have seen a slight increase in index of abundance since 2016, but this trend is not significant.</p>			
Bats	Number of Species, Relative Abundance			Unknown	<p>During a 2016 survey, 53 bat species were recorded through mist and harp netting and acoustic monitoring in BNR (Foxley & Gartzia, 2014). Thirty-four (34) species were recorded in GSCP. Both are likely underestimates of true species richness.</p> <p>Trapping results show a difference between bat assemblages in the mature forest of BNR and that of GSCP and between BNR and the agroforests and orange orchards outside of the reserves. BNR has the</p>			





Rare, Threatened, Socio-Economic, and Culturally Important Species					Overall Condition	GSCP 	BNR 	MMNFR 
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale			
		GSCP	BNR	MMNFR				
					highest species diversity, including a high number of rare species. It is dominated by <i>Artibeus jamaicensis</i> , which has been linked to continuous mature forest habitat. GSCP has the lowest overall species richness in the study, which may be due to the structure of the secondary forest which is recovering from Hurricane Iris damages in 2001. The species assemblage in GSCP is composed of bats more common in disturbed and open areas.			
Rare and Endangered Trees	Abundance & Age Structure				<p>GSCP. The broken ridge ecosystem type found in GSCP forms the ideal conditions for the growth of the Honduran rosewood (<i>Dalbergia stevensonii</i>). The reserve is considered one of the last remaining strongholds for the species due to deforestation elsewhere within its range. Populations have been monitored consistently since 2013 to track growth rates and phenology, which are critical for the creation of biologically relevant timber management plans at the national level. Propagation trials were conducted for the species at Ya'axché's nursery from 2017-2022 to learn best practices and growing conditions.</p> <p>BNR. A total of 227 tree species from 65 plant families have been recorded from the roughly 5,000 trees within 4 permanent sample plots in the BNR. Out of these, 72 species (32%) have distributions restricted to northern Mesoamerica. The BNR landscape, composed of limestone ridges, creates niche conditions that promote the evolution of species specialized to unusually high drainage, pH, and calcium levels compared to what is found in soils from more common substrata across the Neotropics. Notable rare, restricted, and/or ecologically important species include <i>Bartholomaea sessiliflora</i>, <i>Beilschmiedia hondurensis</i>, <i>Chiangi dendron mexicanum</i>, and <i>Guettarda</i></p>			

Rare, Threatened, Socio-Economic, and Culturally Important Species					Overall Condition	GSCP 	BNR 	MMNFR 
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale			
		GSCP	BNR	MMNFR				
					<p><i>dauidseorum</i>. The rough terrain of the BNR landscape also contributes to the protection of trees from illegal extraction.</p> <p>MMNFR. Surveys for threatened timber species in 2020-21 revealed previously unknown populations of <i>Zanthoxylum</i> species (Dorgay, 2021b). Due to a history of legal and illegal logging in the reserve, the age structure for several of the populations is skewed toward younger trees. These populations are now the target of conservation action through improved signage in the reserve, increased patrols, and out-planting and monitoring of saplings over the next few years. Between November 2021 - December 2022, 910 native saplings were planted to restore more than 6 acres of agricultural clearings in MMNFR and boost local populations. Species include those that are threatened, socio-economically important, and/or provide important resources for wildlife.</p>			
Native Bees	Number of Species				<p>Since June 2019, Ya'axché has actively captured and documented native bee species across the MGL protected areas and farms (reported in Dorgay, 2021a). To date, 52 bee species have been recorded. This is roughly 1/3 of the 148 known species documented for the country of Belize. Across all areas sampled, the majority of individuals captured come from the stingless bee tribe Meliponini. In total, 15 meliponine species are known across the MGL. Ten (10) of those have socio-economic value as honey producers. Numbers of species are reported here; subsequent years of native bee monitoring will establish trends. A native bee ID guide has been developed and made publicly available on Ya'axché's website.</p>			

Rare, Threatened, Socio-Economic, and Culturally Important Species					Overall Condition	GSCP 	BNR 	MMNFR 
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale			
		GSCP	BNR	MMNFR				
					<p>In GSCP, 13 native bee species from three (3) tribes have been identified. Eleven (11) species belong to the tribe Meliponini; one (1) of these is an endemic species (<i>Tetragona mayarum</i>) found in Mayan forests. Another bee, <i>Scaptotrigona pectoralis</i>, is especially susceptible to pesticides and can be considered an indicator of chemicals in its environment (de Souza Rosa et al., 2015). In comparison, only eight (8) species from three (3) tribes have been recorded in the nearby CRFR.</p> <p>In BNR, 34 species of native bees belonging to 11 tribes have been identified. Two (2) species are endemic to the region: <i>Tetragona mayarum</i> and <i>Paratetrapedia albilabris</i>. Two (2) species, <i>Melipona beechei</i> and <i>Scaptotrigona pectoralis</i>, are especially susceptible to pesticides and can be considered indicators of chemicals in their environment (Valdovinos-Nuñez et al., 2003). Two (2) bees, <i>Ancyloscelis apiformis</i> and <i>Epicharis lunulata</i>, are considered rare or uncommon (Michener, 1994).</p> <p>In MMNFR, 11 species of native bees from three (3) tribes have been identified. One (1) species, <i>Nannotrigona perilampoides</i>, is especially susceptible to pesticides and can be considered an indicator of chemicals in its environment.</p>			

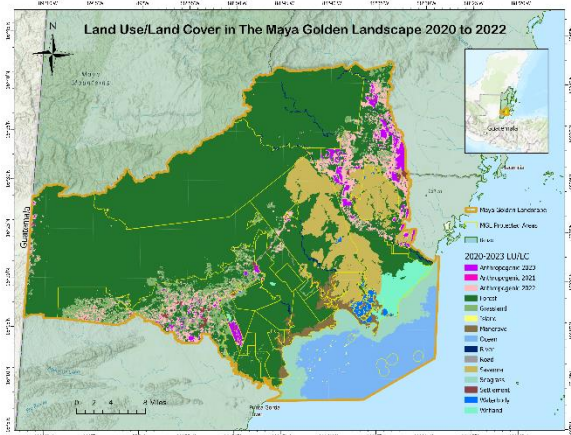
III. Broad Ecosystems and Land Use Change

Broad Ecosystems & Land Use Change			Overall Condition			GSCP	BNR	MMNFR
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale			
		GSCP	BNR	MMNFR				
Extent of Broadleaf Forest	Percent cover				The GSCP has for the most part benefitted from a stable relationship with the neighboring communities over the last two decades. As such, no incursions within the reserve have led to any major clearings within the boundaries of the reserve. GSCP retains an estimated 99.33% of its forest cover within 15,000 acres.			
					The BNR enjoys widespread protection via its location at the center of the Maya Mountains block of PAs. Restricted and patrolled access to the reserve ensures little opportunity for any forest areas to be cleared. The BNR retains 99.67% of its forest cover within an estimated 100,000 acres of reserve.			
					The MMNFR retains most of its forest cover. The larger expanse of the reserve is still well intact due to remoteness and rugged terrain making access for clearings nearly impossible. The MMNFR excluding the concession area retains 98.55% forest cover within an estimated 35,000 acres. The concession area retains 71% of forest cover from within the 936 acres under development.			
Extent of Deforestation	Percent cover				GSCP. Average forest loss between 2020 and 2022 stands at 0.011% of land cover. Conditions are good and stable.			
					BNR. No deforestation was detected in BNR in 2022. Conditions are good and stable.			

Broad Ecosystems & Land Use Change		Overall Condition			GSCP	BNR	MMNFR
							
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale		
		GSCP	BNR	MMNFR			
					MMNFR. 2022 saw continued clearings particularly for illegal cattle ranching and illegal farming. Up to an estimated 7.16 hectares (17.7 acres) of forest were under cattle and/or were cleared for agriculture accounting for an estimated 0.2% of the land cover of the PA. The total area under disturbances is approximately 1.5% of the land cover.		
Extent, Increase, and Impact of Agricultural Lands	Area of land cleared or under unsustainable development	NA	NA		No agriculture lands are found within the GSCP and the BNR, as such, this indicator does not apply to these two protected areas.		
					In MMNFR, the area of illegal land clearings within the vicinity of Governor Creek continues to degrade the forests near the eastern boundary line. Clearings extend to an estimated 2km into the reserve from the boundary line. An estimated 328 acres, give or take, is currently under unregulated and illegal cultivation. This trend continues to grow and warrants concern for future management of the area to avoid further incursions.		

Information Brief: Forest Cover within Ya'axché's Protected Area

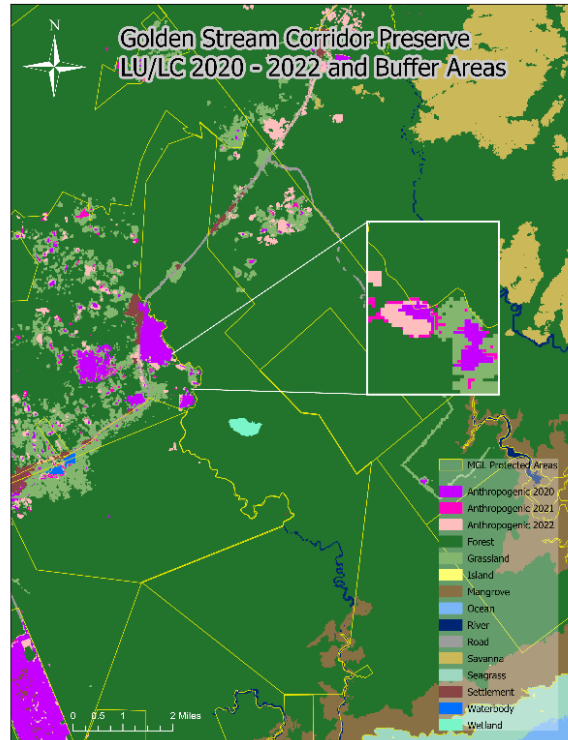
The total area of the MGL under terrestrial ecosystems measures approximately 275,416 hectares or approximately 680,568 acres. From this total terrestrial area, Ya'axché manages 61,152.15 hectares as protected areas under three different designations. Ya'axché-managed areas make up approximately 22% of the total area of the MGL encompassing the areas in the Golden Stream Corridor Preserve, Bladen Nature Reserve and the Maya Mountain North Forest Reserve. All three PAs fall under a different category of protection. The Golden Stream Corridor Preserve is a private protected area (PPA), the Bladen Nature Reserve is a strict nature reserve, and the Maya Mountain North Forest Reserve is a forest reserve with the lowest level of protection.



Map 3. Land cover classification in the MGL.

The GSCP functions as a structural corridor providing forest connectivity between the PAs in the Maya Mountains and the PAs in the lowland forest of the Toledo District. The PA lies in the middle of the agricultural landscape where the land uses have changed the landscape from a once forested area to an increasingly fragmented mosaic of traditional farmlands, monocrop agriculture and forest patches. As the farmlands continue to expand and develop, the accessible areas bordering the

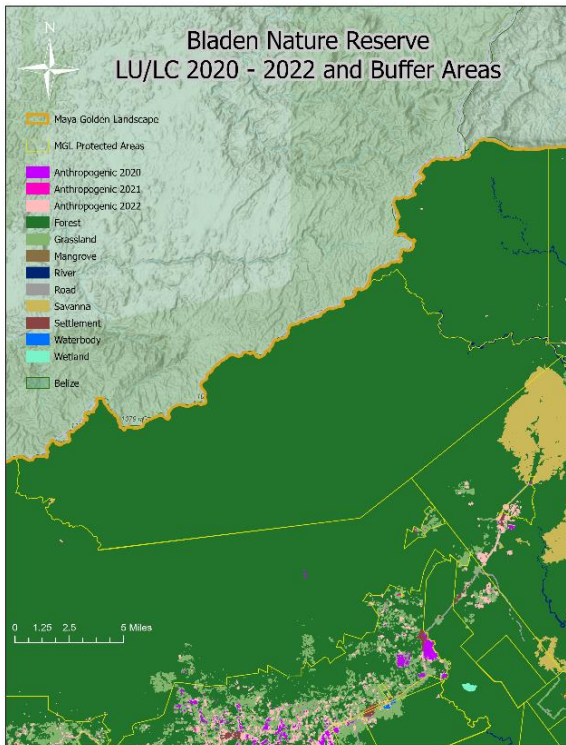
PA have been converted to some form of agriculture and are actively being used. The rate of conversion from forest to agricultural land in the buffer areas appears to be low and currently not cause for concern. Enforcement and compliance patrols and community engagement has kept this PA relatively intact.



Map 4. Land cover classification in the Golden Stream Corridor Preserve for the period 2020-2022.

The BNR as a strict nature reserve only allows education and research activities within its boundaries. Its remoteness serves as a primary layer of protection. Enforcement and Compliance patrols serve as this protected area's secondary layer of protection. For the period 2020-2022 negligible changes in the landscape were noted. These are assumed to be the cause of natural occurrences such as flooding and lightning fires. For the most part, the Bladen Nature Reserve maintains its forest nearly intact. Minor infractions reported between 2020-2022 in the western boundaries

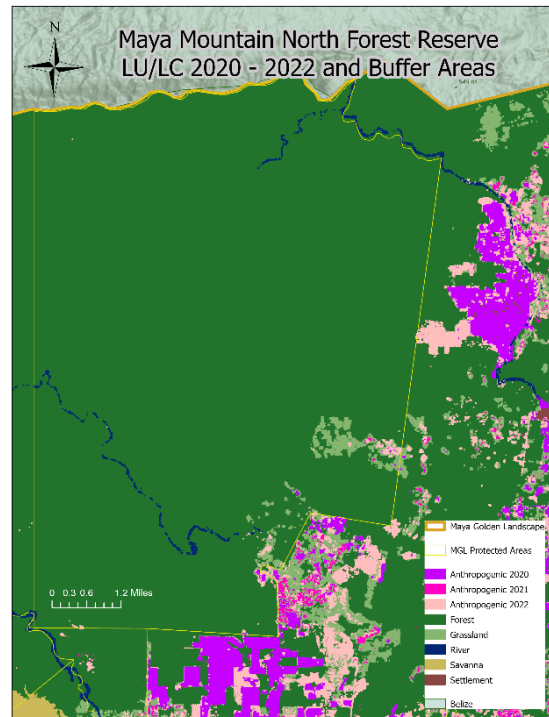
of the reserve have not had a significant effect on the forest cover, but it is contributing to the degradation of resources in the localized boundary area. Logging was the main infraction detected in the western boundary with secondary evidence of hunting.



Map 5. Land cover classification in the Bladen Nature Reserve for the period 2020-2022.

The MMNFR is by definition an extractive reserve. Since 2015, the development of a cacao agroforestry concession has seen the conversion of semi degraded areas inside the reserve into productive cacao plantations. The core, northern and western sections of the reserve are relatively intact owing to its rugged terrain that starts at the foothills and gradually rises to the upper elevations of the Maya Mountains. Both large scale industrial and traditional agriculture flank the reserve to the east and the south where degradation and conversion have been persistent during the 2020-2022 period. Between 2021 and 2022 most of the forest loss within this reserve was related to illegal and in some cases legal

agriculture. Clearings in the vicinity of the Trio Branch River are associated with the established cacao agroforestry concession which allows annual crops to be grown for a limited time. The clearings to the northeast of the southeast corner of the reserve are illegal clearings mostly for annual crops. Large scale monocrop areas are clearly visible to the east of the boundary line associated with a Mennonite community.



Map 6. Insert Text

Forest cover changes continue to be relegated to the buffer areas of the reserves for the most part. Of the three protected areas, the BNR is the most intact with little to no changes in forest cover. The GSCP ranks second considering most of its forest cover is still under regeneration from past conversion. The trend of forest loss and habitat degradation is expected to continue as the landscape outside the reserves continues to develop into productive landscapes. This trend will require additional support from the farming community to promote sustainable practices that will minimize the detrimental

effects of high rates of forest loss in the surrounding areas of the PAs of the MGL.







IV. Ecosystem Services

Ecosystem Services					Overall Condition	GSCP	BNR	MMNFR
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale			
		GSCP	BNR	MMNFR				
Freshwater Quality	Macro-invertebrate assemblages				<p>All freshwater quality statuses in this report are from the most recent assessments done in 2016. Assessments need to be repeated to increase confidence in the condition and confirm trends.</p> <p>At sites across four (4) watersheds in GSCP, BNR, and MMNFR, macroinvertebrates were collected from diverse riparian habitats and identified to family level. Macroinvertebrate assemblages were scored by assigning a sensitivity value from 1-10 to each family collected at the streams. The very pollutant tolerant families are assigned a value of 1, while the very sensitive intolerant families are assigned a value of 10. The sum of these is divided by the number of scoring taxa collected from each sample to obtain the Average Score Per Taxon- Costa Rica (ASPT-CR) index value. Higher ASPT scores indicate the stream to be of higher ecological status, while lower scores indicate a stream of degraded ecological status.</p> <p>An ASPT value greater than six [> 6] indicates high ecological status of the stream. All sites scored between 4-6 indicating waters with regular quality and medium contamination, which is rated as “good” on the scale.</p>			
	Dissolved oxygen				GSCP. Dissolved oxygen at one of two sites sampled in the Golden Stream watershed was 3.25 mg/L, below the 5 mg/L Mexico standard for aquatic life in warm surface waters.			

Ecosystem Services					Overall Condition	GSCP	BNR	MMNFR
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale			
		GSCP	BNR	MMNFR				
					BNR and MMNFR. Dissolved oxygen in waterways were within the ideal range.			
	Turbidity				Turbidity for all sites in all three (3) reserves ranged from 0.1-10.2 NTU, which are within Mexico (<10NTU) and Costa Rica (<25NTU) standards for water quality.			
	Electrical conductivity				Salinization of freshwater resources, both from natural and man-made sources, is a growing water quality challenge. Salinity can negatively impact sectoral water use, health, biodiversity, and ecosystem services. Electrical Conductivity (EC) is a commonly measured parameter to assess salinity.			
					The EC values for each tributary vary based on the substrate material and season. Calcareous sites on GSCP and BNR have higher values, while siliceous sites in MMNFR are expectedly lower in comparison. Conductivity in rivers generally ranges from 50-1500 µS/cm with ideal values below 500 µS/cm (Conductivity, 2012).			
					GSCP. Electrical conductivity of the sites in the Golden Stream watershed ranges from 337-428.3 µS/cm in both seasons.			
					BNR. Sites on the Bladen Branch of Monkey River range from 266-245 µS/cm in both seasons. This is significantly higher than the electrical conductivity at either of the sites in MMNFR that are part of the same watershed.			

Ecosystem Services					Overall Condition	GSCP	BNR	MMNFR
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale			
		GSCP	BNR	MMNFR				
					MMNFR. Electrical conductivity is 107.4-122.4 $\mu\text{S}/\text{cm}$ for the sites on the Trio River Branch of Monkey River during both seasons. Electrical conductivity is significantly lower for sites on the Governor’s Creek Branch of Monkey River at 31.9 – 69.8 $\mu\text{S}/\text{cm}$ during both seasons.			
	Temperature				GSCP. The water temperature for sampled sites in the Golden Stream watershed ranges from 23°C - 26°C in both wet and dry seasons. BNR & MMNFR. The water temperature of the sites on the Monkey River watershed for the wet season ranges from 23°C – 26°C and slightly increases in the dry season from 27°C - 32°C.			
	pH				The pH for all sites sampled was near neutral within range of 7-8.7.			
	Stream physical condition				The Stream Visual Assessment Protocol (SVAP) is a qualitative scoring criterion of the different physical attributes of a stream, including channel condition, riparian zone, shade (canopy), bank stability, hydrologic alteration, pools, water appearance, nutrient enrichment, sedimentation, insect/invertebrate habitat, in-stream fish cover, barriers to fish movement, fishing pressure, presence of garbage and manure presence. The scores of each attribute are average to result in an overall site score. In 2016, all sites in all three reserves scored either in either the “good” or “excellent” range for stream physical condition.			




V. Sustainable Natural Resource Use

Sustainable Natural Resource Use					Overall Condition	GSCP 	BNR NA	MMNFR 
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale			
		GSCP	BNR	MMNFR				
Knowledge	Up-to-date documentation for resource use is available in communities eligible to harvest resources in the reserve		NA		GSCP. Current knowledge of NTFPs remains unchanged. Community forums were still kept at a minimum by Ya'axché following the lifting of restrictions associated with the COVID19 pandemic.			
		This section does not apply to BNR.						
						MMNFR. The TFCG under a renewed conservation agreement and management plan for the concession continue the development of the concession. This agreement allows the group to understand the rules of the reserve including the rules governing extraction of resources.		
Opportunity for Subsistence Activities	Subsistence users are engaged in subsistence management	NA	NA		MMNFR continued to provide access to farmers for the small-scale subsistence production of annual crops within the agroforestry concession. A small number of farmers continued to cultivate up to 2 acres per farmer in the fertile flood banks of the Trio Branch River. Cultivation here is only possible outside of the rainy season when crops can be at risk of flash flooding.			
	Proportion of permits that are approved for subsistence use		NA	NA	The GSCP extraction zones have benefited buffer communities who request extraction of construction material for traditional home building. All materials are NTFPs which were identified in consultation with the communities. This extraction process is guided by an outdated sustainable extraction plan. Funding was secured in 2022 for the development of a new NTFP extraction plan that will be tentatively available in early 2025.			

Sustainable Natural Resource Use			Overall Condition		GSCP 	BNR NA	MMNFR
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale		
		GSCP	BNR	MMNFR			
Extent of Legal vs. Illegal Natural Resource Use	Incidence				GSCP. Overall, extraction in the reserve has been under permits for NTFPs; 1 request was documented for cohune leaf extraction, but the extraction was not carried out in the end. No incident of logging was recorded in 2022 showing a significant reduction in illegal activities for that year.		
					The BNR remains stable. There is no legal extraction that is permitted in the reserve. Evidence of illegal logging was once again documented in 2022. All indications are that the illegal activities are of a transboundary nature and all timber products are transported across the Belize/Guatemala border via a network of horse trails. The main targets continued to be mahogany (<i>Swietenia macrophylla</i>) and rosewood (<i>Dalbergia stevensonii</i>). This activity is restricted to the boundary area of BNR and CRFR.		
					MMNFR saw continued illegal activity as documented the previous year. Illegal hunting, illegal timber extraction and illegal land clearings were the major concerns in 2022. Three (3) incidents of illegal logging were reported in 2022 with the targets being Salmwood (<i>Cordia alliodora</i>), Prickly Yellow (<i>Zanthoxylum spp.</i>) The cacao concession entered its 7 th year of development and production. A total of 120,761 lbs. of wet cacao bean were harvested by the TFCG for the 2022 season.		

VI. Enforcement & Compliance

Enforcement & Compliance		Overall Condition			GSCP	BNR	MMNFR
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale		
		GSCP	BNR	MMNFR			
Effectiveness of Patrols	Number of patrols				<p>Patrols within GSCP remained constant during 2022. The location of the field station and proximity to patrol routes allows for ease of access and wide coverage of the priority areas for patrols and deters illegal entry into the reserve. A total of 181 patrols were deployed in 2022.</p> <p>The BNR generally enjoys the benefits of its remoteness. A further increase in patrols in 2022 from an increase the previous year netted a total of 224 patrols. This was a considerable increase in patrols with 38 more patrols than the year before. Hotspot areas were monitored more effectively as a result.</p> <p>Patrol effort in MMNFR was increased in 2022. However, people were still able to evade patrols and get away with illegally harvested timber. Despite increased efforts, most illegal activity occurred during the night when patrols were few and detection was nearly impossible. There were 37 more patrols in 2022 than there was the previous year. Strategic patrolling led to one arrest and prosecution in partnership with the Forest Department. A total of 207 patrols were deployed in 2022.</p>		
					<p>The GSCP documented one (1) infraction related to illegal extraction of NTFPs in 2022. Compared to the two years prior, 2022 was a very quiet year.</p> <p>The BNR documented nine (9) infractions in 2022 which was a significant decrease from 27 the year before. Six (6) infractions were hunting incidents, two (2) were illegal entries, and one (1) was logging. The logging infraction is still related to the transboundary incursions that are now established at the border with CRFR and BNR.</p>		

Enforcement & Compliance		Overall Condition			GSCP	BNR	MMNFR
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale		
		GSCP	BNR	MMNFR			
							
					The MMNFR recorded a total of 20 infractions. 14 of the recorded infractions were associated to illegal logging and timber extraction. 2 instances hunting, 2 instances of illegal entry, 1 illegal entry and 1 possession of wildlife.		

Information Brief: Enforcement and Compliance Patrols - Incidents

During the first weeks of 2022, the enforcement and compliance teams were on high alerts following reports of illegal logging occurring in the vicinity of the MMNFR and Roseville Mennonite community boundary line. The teams began monitoring the situation and one surveillance patrol in early 2022 yielded evidence of sustained entry and extraction in the area. With enough evidence gathered, Ya'axché's team planned a joint operation with the Savannah Forest Station of the Forest Department to try and apprehend the illegal loggers.

On February 4 of 2022, a joint patrol was deployed to the Roseville general area in search of illegal timber extraction. Shortly after arriving to the boundary line of the reserve, the patrol detected chainsaws being used a distance further into the reserve. The patrol was able to capture the logging operation occurring and the illegal loggers were cautioned after resisting arrest by the Forest Department. The team documented the equipment used, the species harvested and the names of the individuals in the group.

The main species being targeted by the loggers were Sapodilla (*Manilkara sapota*) and Barbajolote (*Cojoba arborea*). The two (2) trees harvested were in various stages of conversion to flitches, planks and logs. The group of loggers were cautioned with the Forest Department informing the group of intended prosecution. The group was instructed to leave the area and the equipment was confiscated by the Forest Department. All the timber was left at the site since the patrol was not prepared to extract any confiscated material other than the chainsaws. Following this incident, the Forest Department formally charged the members of the group for illegal timber extraction without a permit. That

matter is before the courts as of the time of writing and will continue to be spearheaded by the Forest Department. Typically following any arrest or detention for illegal infractions, the instances of illegal activities decrease drastically. This pattern was short lived in the case of 2022 dry season which saw the displacement of illegal logging to other areas not monitored by Ya'axché's enforcement team. As patrol efforts were spread out to increase the chances of catching others in the act, more areas were documented with evidence of illegal logging having occurred the year before.












Photo 1. One of two confiscated chain saws.









Photo 2. Barbajolote tree converted to planks.

VII. Knowledge of Biodiversity for Adequate Management

Knowledge of Biodiversity for Adequate Management		Overall Condition			GSCP	BNR	MMNFR
							
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale		
		GSCP	BNR	MMNFR			
Baseline Data	Comprehensive species lists of key taxa				<p>Since 2009, plants and bats have been surveyed thoroughly in GSCP and BNR and species lists are in use in the management of those reserves.</p> <p>The list of known mammal species for BNR prior to 2021 was compiled from the reports of multiple, external research projects, the data from which was not held by Ya'axché. In 2021, Ya'axché established a camera grid in eastern BNR to create its own baseline data on species presence and abundance. Through this effort, one (1) previously unrecorded species, the Northern naked-tail armadillo (<i>Cabassous centralis</i>), was confirmed for the PA.</p> <p>In MMNFR, which Ya'axché began managing more recently, bats have not yet been studied.</p> <p>In 2021, Ya'axché – along with research partners Round River Conservation Studies – conducted bird and tree surveys across the southern third of the PA in order to update the known species lists for those taxa.</p> <p>In addition, camera surveys have been running in the reserve since 2019 to document mammals and additional wildlife.</p>		
	Accurate ecosystem maps with descriptions				Ecosystem maps for all three reserves come from larger ecosystem maps for Belize that were produced as part of the Central American Ecosystems Map project (Worldbank/CCAD) in 2001 (Meerman and Sabido). The Belize maps were improved		

Knowledge of Biodiversity for Adequate Management		Overall Condition			GSCP	BNR	MMNFR
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale		
		GSCP	BNR	MMNFR			
					<p>by Meerman using ground-truthed vegetation data in 2004 (Meerman, 2005). However, the resolution of the ecosystem maps could be improved for the MGL through the integration of on-the-ground survey data and drone classification of vegetation. Ya'axché is exploring the use of drones for ecotype mapping during since 2021.</p> <p>An aquatic ecosystem map for Belize is available, though the national aquatic ecosystems concept is a work in progress and is pending validation with field data (Esselman et al. 2005).</p>		
	Accurate lists of threatened, socio-economically important and invasive species				<p>Species lists of threatened and socio-economically important bird, mammal, bee, and tree species are up to date for the three PAs.</p> <p>In all reserves, recent information on invasive species is lacking. <i>Gmelina arborea</i> and tilapia are two invasive taxa identified as potential threats in Belize, though a lower population and lower rates of urbanization and encroachment into forests of the MGL compared to other areas make invasive species less of a threat here. Surveys in 2009 did not identify <i>Gmelina</i> in BNR or GSCP, but follow-up surveys should be done to confirm that it has remained absent, and that other invasive species remain absent.</p>		
	Accurate understanding of NTFP harvest limits		NA	NA	<p>Cohune palm leaves are one of the most commonly used NTFPs by community members buffering the reserves. The leaves are harvested from the standing palm and used for thatch.</p> <p>GSCP has two (2) sustainable use zones where cohune leaves can be extracted by villagers after they make a request and</p>		

Knowledge of Biodiversity for Adequate Management		Overall Condition			GSCP	BNR	MMNFR
							
Indicators of Condition	Specific Measures	Condition Status/ Trend			Rationale		
		GSCP	BNR	MMNFR			
					obtain a permit from Ya'axché. In 2018, Ya'axché conducted a study on cohune leaf regeneration rates under different harvest intensities to identify the level of harvest (maximum number of leaves per tree) that is sustainable in GSCP, i.e., allows for continued reproduction and leaf regeneration of the species for long-term harvest. The resulting ideal harvest intensity was integrated into the management practice of the extraction zones.		
	Accurate understanding of priority species life cycles and population dynamics				Priority species for life cycle and population dynamic studies in GSCP, BNR, and MMNFR are certain rare, threatened, data deficient, and/or timber trees that are lacking management plans at the national level. Since 2013, Ya'axché has gathered monthly phenology data on seven (7) tree species. Honduran rosewood (<i>Dalbergia stevensonii</i>) is also the subject of a stump regeneration study in MMNFR.		

Information Brief: Wildlife Camera Trapping in BNR and MMNFR

Camera traps have been widely utilized as an indispensable tool to monitor the diversity, distribution, and activity patterns of wildlife. Ya'axché began monitoring wildlife via transect sampling method and subsequently evolved in using innovative tools such as camera traps in two (2) co-managed PAs, MMNFR and BNR. Wildlife monitoring allows us to understand the presence of species, particularly target species that have cultural, socio-economic, and ecological importance for Belize.

Bladen Nature Reserve

BNR recorded 52 species (22 mammals, 29 birds, 1 amphibian) during the dry season, with 21 indicator species (12 mammals and 9 birds) as listed in Ya'axché's BRIM Strategy. The wet season recorded 50 species (22 mammals and 28 birds), with 19 indicator species (11 mammals and 8 birds).

The 2022 camera trap survey in BNR provided valuable data on the species richness and abundance index of species during the dry and wet seasons. It appears that majority of the carnivorous species, prey species and game birds overlapped during both seasons when compared with the 2021 camera trap survey. There was also a high detection rate of white-lipped peccaries and the great curassows in BNR, both of which are forested species sensitive to disturbance and are considered vulnerable under the IUCN Red List of Threatened Species.



Photo 3. A flock of the great curassows in BNR during the wet season.



Photo 4. A squadron of white-lipped peccaries in BNR during the dry season.

Maya Mountain North Forest Reserve Cacao Concession

MMNFR during the dry season recorded 61 species (19 mammals, 37 birds, 3 reptiles and 2 amphibians), with 20 indicator species (10 mammals and 10 birds) as listed in Ya'axché's BRIM Strategy. The wet season recorded 44 species (21 mammals, 22 birds, and 1 amphibian), with 18 indicator species (11 mammals and 7 birds).

The 2022 camera-trap survey yielded remarkable findings on species richness and abundance index of species for both the dry and wet seasons. In comparison to the 2020-2021 camera-trap surveys, wildlife activity patterns remain active across the cacao concession given that majority of the carnivorous and prey species overlapped in

both seasons. The cacao concession as an agricultural landscape entrenched in a forest reserve, continues to support the level of biodiversity relatively equivalent to an undisturbed landscape.

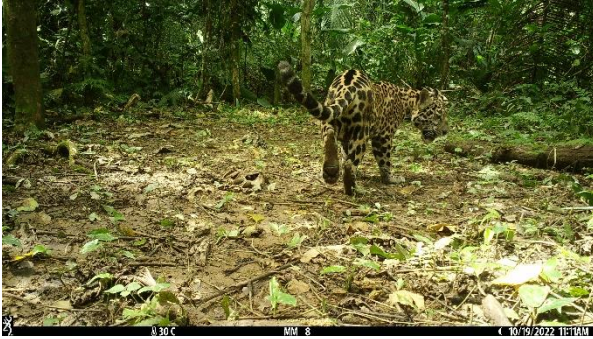


Photo 5. A female jaguar detected in one of the camera stations in MMNFR Concession.



Photo 6. Margay and her cub detected in one of the camera stations in MMNFR Cacao Concession.

Implication of Camera Trapping Effort

Wildlife Camera Trapping in both PAs for the dry and wet seasons has yielded significant results on species diversity and relative abundance. Wildlife detected by the cameras include five (5) of the wildcats, six (6) games species, five (5) games birds alongside opportunistic sighting of resident and migrant birds, amphibians and reptiles. Most of the species detected are species of conservation concerns and are important

environmental indicators of forest health, prey base, disturbance, and migration. Notably, the activity pattern of predators and preys reflects a healthy forest where there is minimal human disturbance and relatively intact trophic level. Additionally, a significant observation for this 2022 camera-trap surveys is photographic evidence of diverse species reproducing, which was crucial to ensure population growth. For BNR, there was additional species detected and hasn't been detected from previous monitoring effort in this protected area, which includes jaguarundi, kinkajou, gray fox, gray-four-eyed opossum, and long-tailed weasel. Although these species which are tolerant of both disturb and undisturbed habitats were detected within the cacao concession. For MMNFR cacao concession, these species richness remain steady when compared to the 2020-2021 camera-trap survey. This cacao concession has a unique setting as a conserved landscape with sustainable agriculture activities which continues to support a prominent level of biodiversity. Continuous monitoring in these PAs will also allow us to better understand the fluctuation of indicator species in their community structure and to detect changes of ecosystem health overtime.

Conclusions

Conditions across all three (3) PAs did not change significantly from the previous reporting period. An increase in effort has had a marked impact on the amount of data collected for both enforcement & compliance and research & monitoring work. While the pandemic prevented adequate interagency collaboration, the times there was collaboration proved essential in planning ahead.

Golden Stream Corridor Preserve

Minor infractions related to NTFP extraction continue to be the only issue of concern documented in the reserve. The stability of activities allowed for increased presence in the other two (2) PAs. There are ample opportunities to strengthen the sustainable use of resources for traditional use and Ya'axché needs to widely disseminate its current approach to allowing access to these resources. Education and awareness efforts were unfortunately not very frequent due to restrictions but were effective in their purpose.

Wildlife monitoring in GSCP generally indicates stable habitat conditions over the past 13 years. However, threatened game birds, jaguars, and migratory birds at the reserve transect locations has significantly declined. Ongoing camera monitoring in the farmscape surrounding GSCP may assist in showing wider trends for jaguars and game species across the landscape and help estimate the number of individuals present.

Bladen Nature Reserve

The BNR remained the most intact and undisturbed of the three (3) PAs under Ya'axché's mandate. The remoteness of this reserve provides an opportunity to ensure adequate management of the area. Illegal timber extraction was still a concern for the western sector of the BNR and will require additional interagency collaboration to stem the flow of illegal timber across our borders.

Camera data suggests that biodiversity in the BNR is doing well with many incredible records including a rare Northern naked-tailed armadillo. However, despite the reserve having vast, intact stretches of forest, significant declines in migratory birds have been documented since 2010. Threatened birds have also been declining in the BNR savanna in recent years. These trends are not exclusive to BNR and may reflect wider changes in the landscape outside the reserve. Reports of other monitored species groups and ecosystem service indicators in BNR suggest stable and healthy forest condition. This offers more reason for increased surveillance of the BNR resources.

Maya Mountain North Forest Reserve

The MMNFR once again proved to be the most challenging PA to monitor in 2022. Illegal logging continued despite an increase in patrol presence in the reserve. The pressure only slowed once the presence of a new logging concession was established in the last quarter of the year. Areas of interest have been identified through the use of

remote sensing. Early detection of illegal clearings using satellite imagery proved effective at addressing an escalating matter once again. At least one case was taken to the courts and is still under review.

Biodiversity research and monitoring since Ya'axché gained co-management in 2016 indicates mostly stable habitat quality and the continued presence of threatened and culturally important species. Water resources in the reserve were of high quality in 2017 despite an agricultural presence within and immediately outside the reserve. This assessment needs to be repeated to detect any changes to water quality since that time. Tree species of timber and wildlife value are of moderate concern in the forest reserve, but patrols and planting activities are expected to reduce threats and boost populations.

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Ya'axché Conservation Trust
P.O. Box 177, #3 Ogaldez Street,
Punta Gorda, Toledo District, Belize

Phone: (+501) 722-0108
E-mail: info@yaaxche.org
Web: yaaxche.org