Barba Azul Nature Reserve
Annual report 2018

Barba Azul Nature Reserve is completing the long-awaited dining facility supported by American Bird Conservancy and International Conservation Fund of Canada, one of the remaining infrastructure constructions needed to complete our tourism offer. It is located looking over the beautiful Omi river and constructed extremely professionally in a way that it is generating a cool climate in the hot Beni savanna ecosystem.

Project photos can be downloaded from:
www.flickr.com/photos/128583429@N05/albums/72157657123371838

Conservation and development of the Barba Azul Nature Reserve in 2018 was supported by:

A grant from the Neotropical Migratory Bird Conservation Act

1. Highlights of 2018

Barba Azul Nature Reserve is now protected for 10 years. As conservation is being measured in decades, we can now finally see strong results. Numbers of Blue-throated Macaws are steadily increasing. Weekly monitoring data resulted in the second all-time high count of **130 Blue-throated Macaws** in July 2018. As cattle is now excluded from Barba Azul North and South, we see mammal abundances increasing, resulting in the **highest Maned Wolf** encounters this year. Our continues efforts in halting uncontrolled fires from entering the reserve give rise to a heterogeneity in savanna age-classes, with over **1,300 hectares of old savanna** habitat.

This year was also characterized by tremendous progress towards the reserve's sustainability. We are completing the dining facility, fully improved cabins and received large numbers of tourists. Also, we completed basic infrastructure for the "best practices" ranching model in Barba Azul East. Due to the extreme inaccessibility of Barba Azul, with only 3.5 months of sufficiently dry road conditions, we had to postpone the purchase of our own cattle herd to 2019.

To continue protecting Blue-throated Macaw habitat, Armonía purchased a new reserve called the **Laney Rickman Blue-throated Macaw Reserve**, protecting 681 hectares of important breeding habitat in the southern subpopulation. While at Barba Azul, we are increasing potential breeding habitat through mimicking breeding trees that were discovered in 2017 with an innovative nest box project.

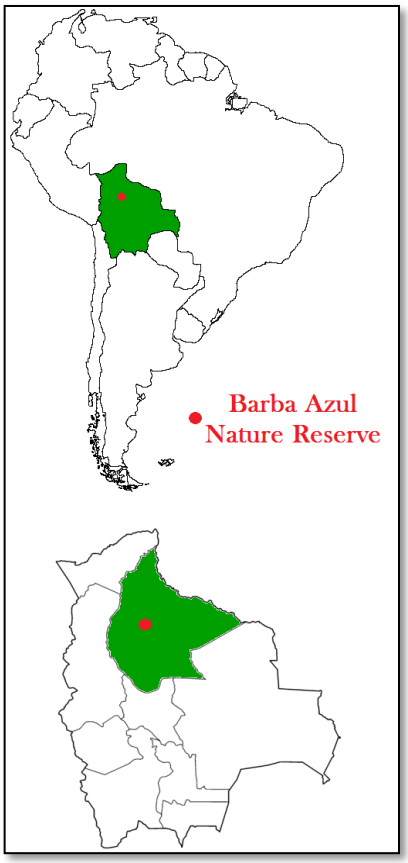


Figure 2. Southern Tamandua (*Tamandua tetradactyla*) resting in a small forest island in the open flooded savanna habitat within a tree trunk. Photo by Tjalle Boorsma.

2. Barba Azul Nature Reserve 2018 goals

Our main goals for 2018 to ensure a continuous development of Barba Azul Nature Reserve and its infrastructure were:

1. Establish Blue-throated Macaw breeding habitat at Barba Azul Nature Reserve

2. Establish living trees as fence posts

3. Complete tourism infrastructure.
    - Dining facility
    - Cabin improvements (interior and exterior design)

4. Maintain impenetrable firebreaks throughout the reserve.
    - Parallel backburn firebreaks for perimeter (60m width)
    - Establish firebreaks Barba Azul East

5. Research
    - Blue-throated Macaw movement and breeding site research
    - Savanna habitat research
    - Buff-breasted Sandpiper habitat improvement and research

6. Complete cattle ranching infrastructure
    - Paddock and perimeter fencing of Barba Azul East
    - Corral creation
    - Establish herd of 500 head of cattle

7. Establish solar energy

8. Barba Azul Nature Reserve infrastructure
    - Worker house for part-time staff and visiting construction workers
    - Maintenance of staff house, water system and field station

Figure 3. Blue-throated Macaws curiously observing field staff who area collecting monitoring data. A total of 130 individuals were observed using the Barba Azul Nature Reserve to forage and roost. We collected weekly monitoring data studying the presence/absence throughout the year. Photo by Bennett Hennessey

3. Summary

We have achieved many goals in 2018 to continue crucial protection and habitat improvements for the Critically Endangered Blue-throated Macaw. Beyond the goals of the Barba Azul Nature Reserve, Armonía created a second Blue-throated Macaw Reserve, the **Laney Rickman Blue-throated Macaw Reserve** (681ha/1683ac; proudly named after conservationist Laney Rickman). This reserve is protecting vital breeding habitat in the Southern subpopulation and was supported by **American Bird Conservancy, International Conservation Fund of Canada, IUCN-Netherlands** and **World Land Trust**.

http://armoniabolivia.org/2018/08/20/the-most-important-nesting-area-of-the-worlds-rarest-macaw-becomes-new-nature-reserve/

Within Barba Azul we made tremendous progress towards the reserve's sustainability. Even though 2018 was characterized by only 3.5 months of sufficiently dry road conditions to execute heavy machinery labor and transportation, we made significant construction improvements, gathered crucial data on the Macaws and their habitat and handled the second highest number of tourists while improving the tourism infrastructure.

1. Establish Blue-throated Macaw breeding habitat at Barba Azul Nature Reserve

With the support from **ARTIS Amsterdam Royal Zoo** and **IUCN-Netherlands**, we established new breeding habitat for the Blue-throated Macaw in the Barba Azul Nature Reserve. Based on the discovered breeding sites in 2017 (http://armoniabolivia.org/2017/03/17/armonia-discovers-new-breeding-area-for-the-critically-endangered-blue-throated-macaw/), we mimicked their preferred isolated high breeding trees by placing nest boxes on tall eucalyptus posts. We created 15 nest boxes, 5 have been positioned near a main Blue-throated Macaw dusk staging ground; 5 nests boxes will be placed further along their daily roosting path when the ground has dried, and 5 nest boxes will be placed at the discovered breeding sites in January (Yata region).

2. Establish living trees as fence posts

The innovative live fencing project funded by **World Land Trust** has been an exciting though difficult experiment from the start. The goal is to plant 1,000 Aliso trees (*Vochysia divergens*) functioning as living fence post as this species is adapted to the harsh climate (fire and flooding) of the Beni Savanna Eco-region, and it is an important food source for the Critically Endangered endemic Blue-throated Macaw (*Ara glaucogularis*). We have planted 280 trees to study the appropriate method for transplanting Aliso trees functioning as living fence post in the future, with mixed results. In November 2018, we planted 150 small trees (20-120 cm in height) along an inundation gradient to study the best planting result. When the right method is found, 1,000 Aliso saplings will be transplanted at once covering approximately 7 kilometers of fencing.

3.1 Complete tourism infrastructure: Dining facility

The dining facility, that had to be postponed last year because of early rains cutting off heavy vehicle access to the reserve, has been developing well this year and should be completed before the end of the year. This project helps Barba Azul's sustainability through eco-tourism, and is funded by **American Bird Conservancy** and **International Conservation Fund of Canada**. This dining facility is beautifully located along the Omi river, strategically positioned and professionally constructed to assure a cool climate within the hot Beni savanna ecosystem. This area will function as a dining area, but also as information area where Armonía's conservation work is presented and where potential project support can be obtained, such as through **Friends of Barba Azul** (http://armoniabolivia.org/friends-of-barba-azul-nature-reserve/).

3.2 Complete tourism infrastructure: Cabin improvements

International Conservation Fund of Canada also helped supporting the 2018 cabin improvements to ensure a more comfortable stay for visitors at Barba Azul. Bad weather caused damage to the cabins in 2017 and had to be repaired. We decided to take advantage of these restorations to fully improve the cabins, extending and remodeling the bathroom, sanding and varnishing the woodwork, plastering the walls and placing a gas heated shower to ensure hot water.

4.1 Maintain impenetrable firebreaks throughout the reserve: Parallel backburn firebreaks

The most important firebreaks have been maintained and improved at Barba Azul North and no neighboring fires have entered. We purchased important fire management equipment to fight fires. Due to an extreme busy schedule and the mere 3.5 months of dry conditions, no parallel backburns were established. The Barba Azul team did participate in controlled burning activities implemented by Jo Kingsbury, and are now trained to establish backburns. This will be placed as a priority for 2019.

4.2 Maintain impenetrable firebreaks throughout the reserve: Establish firebreaks Barba Azul East

Over 13 kilometers of fire breaks have been established at Barba Azul East along newly placed fencing and borders. In addition, the Armonía tractor assisted the PhD project of Jo Kingsbury where approximately 10 kilometers of fire breaks have been established around 49 burn plots located in Barba Azul East, to study the impact of fire on tall grass savanna habitat.

5.1. Research: Blue-throated Macaw movement and breeding site research

Weekly monitoring of the main congregation sites and roost, resulted in the second all-time high count of 130 Blue-throated Macaw individuals observed by Harry Lavelle (UK volunteer). Numbers fluctuate throughout the year, but peaking in the dry season (May to November; fig.4). Very little is known about these fluctuations in numbers, therefore continues efforts have been made to capture Blue-throated Macaws to place GPS trackers to study their movements and mapping their breeding sites. This project was funded by **American Bird Conservancy** and **the Mohamed bin Zayed Species Conservation Fund**. Lisa Davenport, the leading researcher, collected crucial information on capturing methods and returns in 2019.

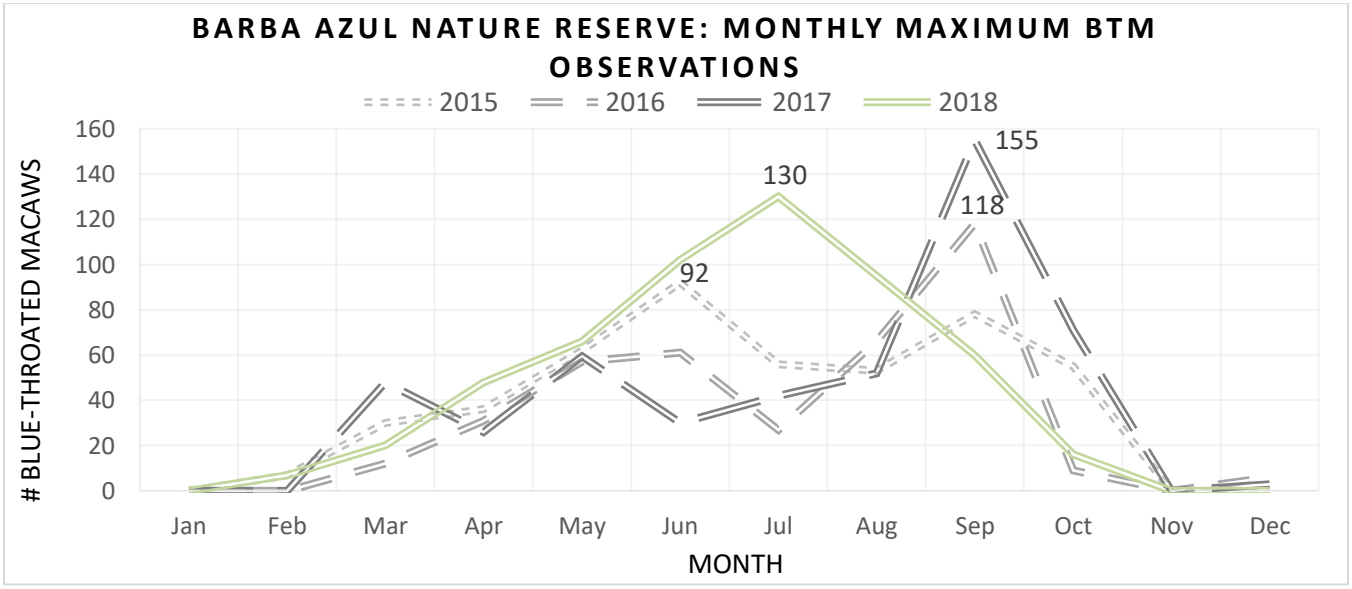


Figure 4: Maximum Blue-throated Macaw (BTM) observation at the Barba Azul Nature Reserve over the last 4 years. Grey colored dashed lines indicate historical maximum BTM observations of 2015 (92 in June), 2016 (118 in September), 2017 (155 in September) and green continuous line the Maximum BTM observations of this year (130 in July).

5.2. Research: Savanna habitat research

A total of 49 burn plots of 30 by 70 meters were established in the Cerrado-Savanna gradient to study the impact of fire and cattle grazing on the tall grass savanna structure, comparing structural changes caused by fire to avian diversity and abundances. This is the second year **Jo Kingsbury** of the **Ohio State University** collected data, and returns in 2019.

5.3. Research: Buff-breasted Sandpiper habitat improvement and research

We conducted the 7th Buff-breasted Sandpiper migratory study with the continuous support from the **Neotropical Migratory Bird Conservation Act (NMBCA)** from the **US Fish and Wildlife**. Approximately 250 individuals were counted passing through Barba Azul. Numbers have been fluctuating over the years, possibly related to presence/absence of cattle. As we established multiple paddocks throughout Barba Azul East, we will be experimenting with different animal stocking rates, studying the "livestock/sandpiper stopover habitat" relation.

6.1 Complete cattle ranching infrastructure: Corral creation

The implementation of the "best practices" ranching model, infrastructure establishment and cattle purchase is part of the "Latin Americas Reserve Stewardship Initiative (LARSI)", which is a partnership between **March Conservation Fund** and the **American Bird Conservancy**. We completed the construction of the Barba Azul East corral. Cattle can now be examined, vaccinated, marked and studied. This is the most crucial structure managing livestock.

6.2 Complete cattle ranching infrastructure: Paddock and perimeter fencing of Barba Azul East

We completed a total of 12.5 kilometers of fencing, creating 7 paddocks in Barba Azul East for Armonía's "best practices" ranching model. These paddocks have an approximate size of 90 to 160 hectares, used to experiment with stocking rates and rotation times.

6.3 Complete cattle ranching infrastructure: Establish herd of 500 head of cattle

The purchase of cattle was planned for 2018, though is being postponed to 2019 due to delayed construction of ranching infrastructure in Barba Azul East, and mainly due to administrative struggles with the NMBCA funding (delayed reinstatement of government grant process). We would like to use the funds from LARSI and NMBCA at the same time to ensure a better negotiating position to purchase cattle.

7. Establish solar energy

We did not find financial support for this activity. It is a high priority for 2019. The total costs of establishing solar electricity is approximately US$ 17,000 (incl. transportation). This will provide electricity for all Barba Azul infrastructure, replacing the fossil fuel-based energy production through an old- and noisy- generator. This will also lower the transport of difficult to purchase gasoline from Santa Ana de Yacuma, lowering operational costs. It is clearly the best way forward for a sustainable nature reserve.

8.1 Infrastructure: Worker house for part-time staff and visitors

No funding was obtained to establish a part-time staff and visitor building. In 2019 we would like to change this goal into a staff building, professional ranching deposit area and a roofed-in tractor parking area for Barba Azul East. This basic infrastructure is crucial to start our sustainable ranching model. Approximately US$ 80,000 is needed.

8.2 Infrastructure: Maintenance of staff house, water tank and field station

We continue to search for financial support for these objectives. The priority maintenance activities for 2019 are replacing all electric wiring. These maintenance actions, new water system, and new underground wiring cost around US$ 25,000 USD.

Figure 5: Harry Lavelle, a Britch volunteer interested in conservation, visited Barba Azul to monitor together with our park ranger Carlos Roca the Blue-throated Macaw movements within the reserve. He took this picture of a Blue-throated Macaw pair with chick. Photo by Harry Lavelle.

4. Protection

! New Blue-throated Macaw Reserve !

We are extremely pleased to let you know that the Esperancita ranch where Armonía has been running the successful Blue-throated Macaw nest box program since 2005, was bought by Armonía in August 2018 and is now called the "Laney Rickman Blue-throated Macaw Reserve", named after our dearest friend and conservationist Laney Rickman. The most important breeding site for the southern subpopulation is now protected forever and we can freely continue the nest box work.

In 2018, again 5 Blue-throated Macaws successfully fledged these nest boxes, resulting in a total of 76 successfully fledged chicks. All the occupied nests found themselves within the reserve. The Laney Rickman Reserve is located 42 kilometers south of Trinidad (Beni department capital), and 213 kilometers southeast of the Barba Azul Nature Reserve. Barba Azul is located in the Northwestern subpopulation and Laney Rickman in the Southern subpopulation and there is no connection between these two subpopulations.

To honor and protect Laney's legacy, her family, the Bird Endowment, Asociación Armonía, and American Conservancy established the Laney Rickman Blue-throated Macaw Fund. Donations are welcome and provide vital long-term support for the Nido Adoptivo ™ nest box program, as well as habitat conservation and reserve management needed to help save the Blue-throated Macaw.

https://abcbirds.org/rickman-memorial-fund/

Figure 6. The Esperancita ranch is now purchased by Asociación Armonía and called the Laney Rickman Blue-throated Macaw Reserve to forever protect the most important breeding site for the southern Blue-throated Macaw subpopulation.

Barba Azul staff

The Barba Azul Nature Reserve team assuring full protection of the most important conservation site for the Critically Endangered Blue-throated Macaw is Carlos Roca (Barba Azul South park ranger), Hernan Lopez (Barba Azul East park ranger), Yuri Vaca (tourism attendance), Luis Miguel Ortega (Assistant coordinator for Armonía reserves), Tjalle Boorsma (Conservation Program Director & and reserves supervisor) and Bennett Hennessey (Development Director and overall supervisor). We are extremely thankful with all the support helping Armonía to execute our conservation and protection activities in the endangered savanna ecosystem of northern Bolivia.

New conservation/protection tool

Through the support from LARSI (March Conservation Fund and the American Bird Conservancy), Barba Azul purchased a Honda 4X4 quad bike. Not only does it significantly increase the movability through the reserve transporting luggage, fuel, food and other materials from the airstrip, it is assuring a quick response to fire threats and easy patrolling of the reserve. On two occasions, Carlos Roca (Barba Azul park ranger), was able to move quickly to fires near the border of Barba Azul South, preventing them from entering.

Figure 7. Carlos Roca with the newly purchased 4X4 quad bike at the Barba Azul Nature Reserve. Photo by Wendy Willis.

Fire control

In 2018, a total of 31.8km of firebreaks have been established (22.8km Barba Azul East) and improved (9km Barba Azul North), totaling 87 kilometers of firebreak in the Barba Azul Nature Reserve. No neighboring fire has entered the Barba Azul Nature Reserve. Only in Barba Azul South 2 fires came extremely close but did not crossover. With use of the plough and scarper blade we mainly created new firebreaks in Barba Azul East through rough terrain, crossing tallgrass savanna habitat where new fencing was placed (13 km; fig. 8), and we created firebreaks around 49 burn plots of 70m by 30m (9.8km) for the PhD research of Jo Kingsbury, studying the impact of fire and grazing on savanna structure. The improved firebreaks in Barba Azul North were around the Northwestern border, from where previous man-made fires, originated in neighboring farms, have entered the reserve. Due to the prevailing northwest winds, Barba Azul North is most prone to fires.

Figure 8. Establishing new firebreaks during the dry season to assure full protection of the Barba Azul Nature Reserve. These activities can only be executed in the heart of the dry season (July to November) as wet conditions prevent accessibility. Photo by Tjalle Boorsma.

Due to the extreme busy schedule of 2018, we were not able to establish raised firebreaks. Out of the total of 105 workable days (3.5 months) with heavy machinery, a minimum of 30 days was used to transport posts and corral material between Barba Azul and Santa Ana. An additional 7 days were spent on transporting dining construction material from Santa Ana, as trucks weren't able to reach Barba Azul. Also, the tractor was used to drill fence post holes and transport posts to the fencing location.

Therefore, most of the firebreak activities were focused at Barba Azul East where new fencing was placed (fig. 9). Also, the tractor and the Barba Azul field team, helped Jo Kingsbury creating her burn plots, as well as helping securely burning these plots. An unforeseen amount of time was used from the Barba Azul field team to help out in these activities, delaying crucial firebreak activities. Even though the tight schedule, the most important firebreak in Barba Azul North was maintained to prevent fires burning the most important foraging grounds of the Blue-throated Macaws.

Figure 9. Newly established firebreaks in Barba Azul East where new paddock fencing is being placed. These firebreaks still have to be scrapped to remove all dead grass residue. Photo by Wendy Willis.

5. Tourism

Dining construction

In 2017, we started the planning of building the dining facility, the final infrastructure for ecotourism at the Barba Azul Nature Reserve. Due to early rainfall, material could not be transported to the reserve. This year in July the first trucks arrived at Barba Azul. A total of 18 truckloads and 4 tractor loads were needed to transport all the material to the reserve. The dining facility is to be completed by mid-December. During the last supervision trip by Tjalle in November, tremendous progress was made. All plumbing has been established, electric wiring placed within the walls with strategic positioned outlets, connections for lamps, as well as a fully prepared basis for flooring. But most important, the dining facility received its roofing, assuring a dry work place to construct the details (fig.1).

The dining facility located along the Omi river, overviewing extensive marsh land, teeming with bird life. It is strategically positioned and professionally constructed to assure a cool climate within this hot Beni savanna ecosystem. Vertical slider windows were placed to assure a constant air flow throughout the dining as only half of the window will receive plexiglass to prevent rain from entering. The open areas will be fully closed with mosquito netting so no bug is able to enter. Due to the extreme height of the building, the Jatata roofing and openings in the top corner of the roof, warm air will be able to leave the building, assuring a pleasant climate (fig.10). In addition, the dining is positioned in such a way that the prevailing wind from the northwest enter the building.

Figure 10. Extreme height of the building and the open top corners assure warm air to leave the building, creating a comfortable climate within the dining facility. Carpenters are placing the window frames for the "vertical slider windows". Photo by Tjalle Boorsma

Additional feature to fully occupy space in the dining facility is a second floor above the kitchen and deposit area, to use as additional storage, located on the far right of the building (fig.1). A special outside sitting area is created like an open deck with wood like tiles, on the far left of the building (fig.1). This open deck area is partially roofed and partially open so it has a clear and open birding view over the river Omi and sky. Feeders will be placed near the deck to have optimal pleasure spotting birds close by.

Figure 11. Tiles being placed within the dining facility on a pre-prepared floor created by cut brick mixed with cement, and a finishing cement flooring. This to prevent possible creaking of the tiles. Photo by Tjalle Boorsma

Cabin improvements

Urgent improvements were necessary after severe weather caused damage to the cabin bathrooms in December 2017, but also completing the fine workmanship within the cabins to make them more comfortable and pleasant. The 2018 improvements contained the placement of a gas heater shower for hot water, enlarging the very small bathroom and repositioning the toilet, plastering of the interior walls, sanding and varnishing of inside timber and placing a double sealing to prevent Jatata roofing particles from falling down. We also repositioned the bathroom door, changing all door handles and cleaned the inside floor which contained cement stains. The gas heater is placed outside within a small roofed area that can be locked. These activities were finished in September 2018. As the contractors were simultaneously working on the new dinning facility, the minor adjustments that were noted by Tjalle Boorsma were finished by the end of November.

Figure 12 & 13. Cabin 2 at the Barba Azul Nature Reserve before and after the 2018 improvements respectively. Improvements involved cleaning of floor, varnished wood, double sealing, plastered walls, gas heater shower for warm water positioned in roofed outside area, topped off by the remodeling and extension of the bathroom. Photos by Tjalle Boorsma

2018 visitors to Barba Azul Nature Reserve

Multiple groups have been visiting the Barba Azul Nature Reserve, resulting in the second-best year for tourism within the reserve. A total of 35 tourists visited Barba Azul, generating a total profit of US$ 11,000 that will be reinvested in 2019. Richard Hoyer guiding for WINGS scouted Barba Azul in 2017 and returned in October with a group of 7 incredible people (fig. 14). But also new tour agencies like Birding Buenos Aires and Peregrine Bird Tour have visited as they have heard positive comments about Barba Azul from past visitors. We are extremely pleased that with little promotion, Barba Azul is seen as an important birding and wildlife destination. We have had over 5 different groups observing the elusive Maned Wolf this year, a direct effect of halting cattle from roaming free in Barba Azul South. With over 315 different bird species, the new and improved tourism infrastructure, Barba Azul Nature Reserve is a must-see destination for nature lovers.

Figure 14. Richard Hoyer from WINGS returned with this amazing group of 7 visitors to the Barba Azul Nature Reserve. Tjalle Boorsma (far left) and Carlos Roca (far right) were happy being there with them. Photo by Richard Hoyer.

We are also extremely thrilled that through the funding from LARSI (collaboration of March Conservation Fund and American Bird Conservancy), Armonía will have a tourism coordinator for 2019, full time in charge of improving Armonía's on-ground tourism, promotion and developing a fully functioning tourism system.

6. Barba Azul cattle ranching

Establish paddocks for "best practices" ranching model

In 2017 we struggled to purchase fence posts in the Santa Ana region due to a lack of timber and other logistical problem. This was overcome by purchasing 2,000 posts and 50 corner posts all at once in Santa Cruz de la Sierra before the 2018 dry season. All the posts were transported to Barba Azul in the dry season with the Armonía tractor and its trailer. Part of these fence post (funded by World Land Trust) have been used to fully fence Barba Azul South in 2017, now completely cattle free.

Figure 15. Fence st bought in Santa Cruz de la Sierra, arrived at Barba Azul East from Santa Ana de Yacuma on the trailer purchased by World Land Trust in 2016. Posts were used to establish 7 paddocks for the "best practices" ranching model in Barba Azul East. Photo by Wendy Willis.

A total of 12.5 kilometers were used to establish 7 paddocks in Barba Azul East (fig. 16). From the total of 12.5km paddock fencing, 4.5km still have to be erected and is being accomplished in November and December, as most of the missing fencing is in higher elevated savannas with permanent dry areas.

The 7 paddocks presented in figure 16 are all connected to natural water sources of the river Omi. Five of these paddocks contain forested areas where cattle can hide during cold fronts, rainy days and at night. Paddock 3 and 7 have large areas of river-edge shortgrass, highly nutritious and perfect for recently born cattle. The ranch with the newly constructed coral finds itself strategically in the middle of these 7 paddocks, so cows can be easily moved around. Paddocks have a size of approximately 90

to 160 hectares, that can be sub-divided in the future with electric fencing in order to experiment with stocking rates and rotation times.

Paddock 1,2,5 & 6 are used by Jo Kingsbury to study the impact of different stocking rates of cows on grass growth and avian diversity/abundance. These paddocks will be used when Armonía's first cattle is being bought. With herd extension, additional paddocks will be established to ensure sufficient food supply.

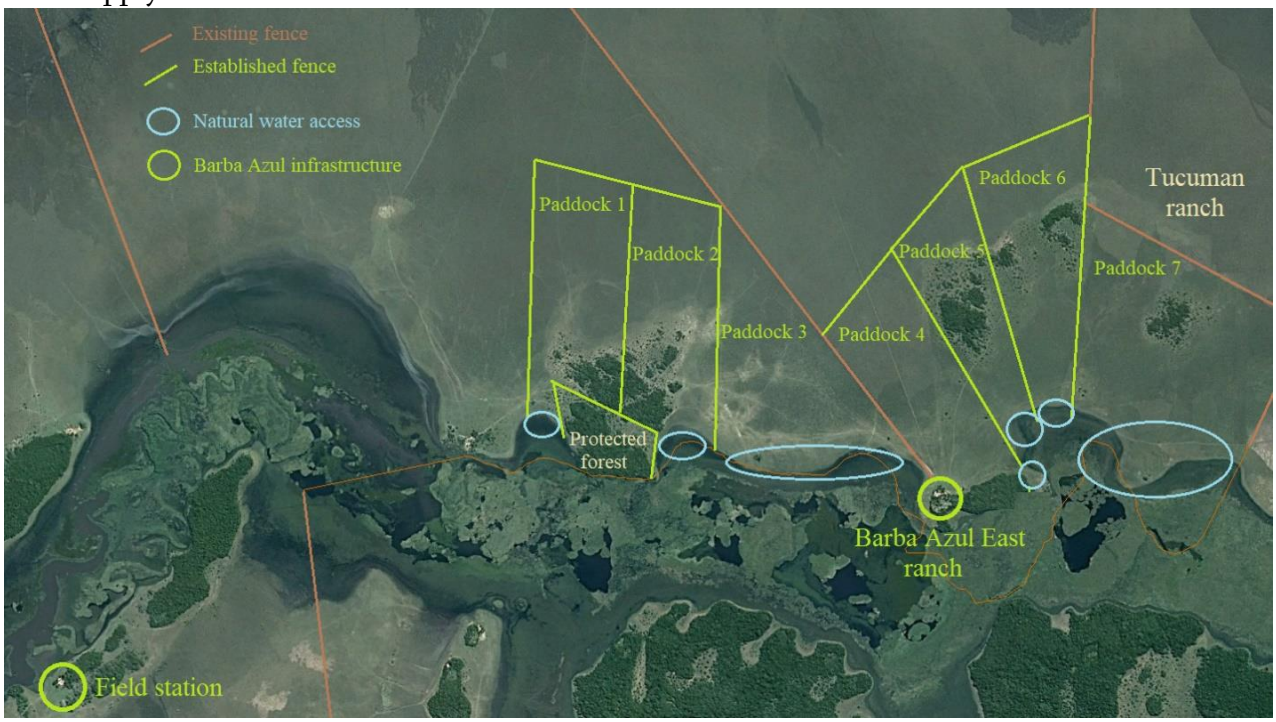


Figure 16. Paddock establishment in Barba Azul East. Light green fence lines are newly placed fencing. Brown lines are existing fences. All paddocks are connected to the river Omi to ensure year-round water supply. In the center of these paddocks you find the Barba Azul East ranch with the newly established corral. At the far east, Barba Azul borders with the Tucuman ranch where we repaired 3.5 kilometers of fence.

Establish corral

In August 2018 we completed the construction of the corral at the Barba Azul East ranch. Cattle can now be examined, vaccinated, marked and studied. This is the most crucial infrastructure managing livestock. It took two years to gather all the material to construct the corral. Like with the fence posts, all the material was gathered before the dry season in Santa Ana, and was transported with use of the Armonía tractor to Barba Azul. More than 10 trips had to be made to ensure all the fencing and corral material to be in the reserve (minimum 3 days/trip Barba Azul-Santa Ana-Barba Azul), resulting in approximately 30 transportation days. The 2018 dry season only counted 105 days of sufficiently dry road conditions to travel.

Once all the material arrived at Barba Azul Don Pachi Calderon, Santa Ana's most experienced corral builder, completed the construction in approximately 45 days. According to the expert, additional activities have to implemented: Roofing over corral (durability of material), improve gathering pens, establish gates between gathering pens, replace posts and elevate land (can be easily done by tractor).

A total of 8 animals can be gathered within the corral for handling, being separated by several moveable gates. The elongated gathering part is followed by a special area with handles to trap a single animal and tighten wooden bars around the neck and hips, so the livestock can't move, therefore safely handling the animal, checking for impregnation and other control measures. This meets the sustainable ranching requirements to safely handle cattle with the least amount of stress. At the far end, 4 separate doors are constructed to divide the animals in different pens when necessary (separating bull from cows, pregnant cows from non-pregnant cows etc.).

Figure 17. The new corral has been finally established to ensure all cattle handling activities at Barba Azul East to manage the Barba Azul herd. This has been a difficult activity as timber is scares and these activities can only be executed in the dry season when other protection activities are being implemented. Photo by Tjalle Boorsma.

Barba Azul herd and further action

Important infrastructure construction steps have been made to start the sustainable "best practices" ranching model at Barba Azul East. Through funding from LARSI as well as NMBCA, Armonía will purchase its first herd. The purchase of cattle was planned for 2018. This is being postponed due to delayed construction of infrastructure in Barba Azul East, but mainly due to administrative struggles with the NMBCA funding. Ex Armonía administration allowed the government grant key to expire and it took 4 months to be activated (re-activated 15/11/2018). We would like to use the funds from LARSI and NMBCA for cattle purchase at the same time, to ensure a better negotiating position.

Future funding for our ranching model is needed for the following activities according priority:

1. Worker house (6 rooms, 6 bathrooms, 2 kitchens) for 3 families (overseer, assistant, tractor conductor) and 3 visitor rooms (Armonía staff/students)
2. Proper deposit area (storage of livestock medication, horse equipment and tractor)
3. Roofing for corral & improving gathering pens with proper gates
4. Old fence replacement (12km) (Tucuman and Barba Azul North border)
5. Electric fencing for small rotation divisions

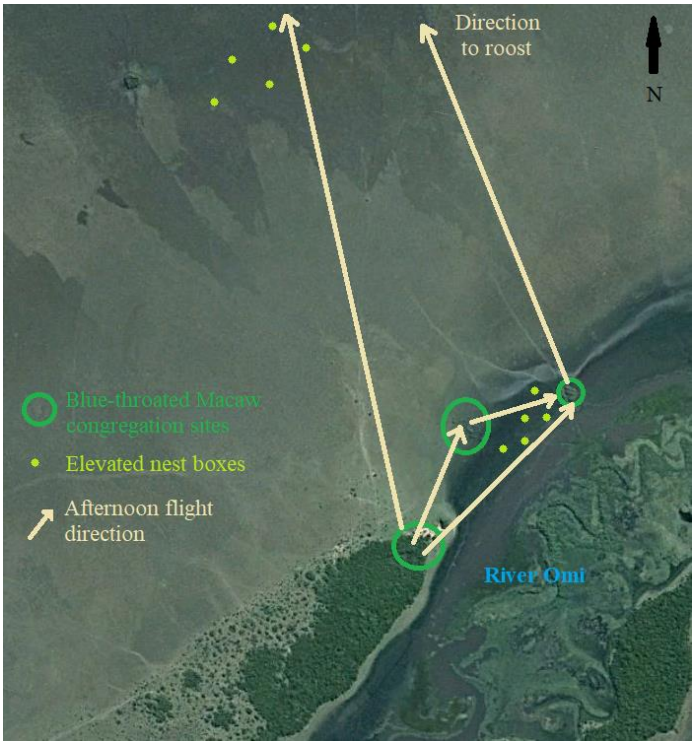
Items	***Estimated* budget**
Worker house	55,000*
Storage area and tractor parking	25,000*
Roofing corral	2,500
Improve gathering pens	6,000
Fencing replacement Tucuman (4km)	8,600
Fencing replacement Barba Azul North (8km)	17,200
Electric fencing (15km)	11,350
Total	**125,650**

*including transportation

7. Management

Blue-throated Macaw breeding habitat development

In May 2018 we constructed 15 nest boxes, five more than the planned proposal due to lower timber prices. Ten nest boxes for the Barba Azul Nature Reserve, and five nest boxes for the region where we discovered breeding Blue-throated Macaws. In August we purchased 10 Eucalyptus posts, each 12 meters in height. The posts and nest boxes were transported to Barba Azul by the end of August (heart of the dry season) with use of the Armonía tractor and trailer in two trips due to the heavy weight of the Eucalyptus posts. The arrival of all the material during this mere 3.5-month dry period and busy schedule was a big result on its own.



In September 2018, we placed five of the 10 nest boxes on 12-meter high Eucalyptus posts and were erected closest to the river Omi (fig. 18). The five northern elevated nest boxes were ready to be erected, though early rainfall made it impossible to drill the 1.5-meter holes, as after 4 days of rain the savanna was flooded. With use of the Armonía tractor, mechanical drill to create holes and manpower (8 people), the nest boxes were raised (fig. 19 & 20).

Figure 18 (above). Location of elevated nest boxes in the Barba Azul Nature Reserve. The nest boxes are located in flooded savanna habitat mimicking the macaws strategic natural breeding habitat.

Figure 19 & 20: Erecting Barba Azul's elevated nest boxes in flooded savanna near the river Omi. Photos by Carlos Roca

We placed the nest boxes at a strategic Blue-throated Macaw fly-way location to increase to detection possibility (fig. 18). Information collected during annual monitoring of local Blue-throated Macaw movement, revealed 3 important congregation sites in the late afternoon just before the birds fly to their roosts.

Three out of the five located nest boxes are already occupied by bird species: American Kestrel (*Falco sparverius*), White Woodpecker (*Melanerpes candidus*) and Chopi Blackbird (*Gnorimopsar chopi*). Breeding has not yet confirmed. As the Blue-throated Macaw have had little chance to discover the nest boxes, we expect usage from 2019 onwards. As Macaws are highly intelligent birds, we expect that once they discovered this breeding possibility, their traditional behavior can be changed and will successfully use this new breeding possibility. This has been clearly shown in the southern subpopulation (Loreto), where the Blue-throated Macaws are now using Armonía's nest boxes for over a decade.

Figure 21: Tjalle Boorsma beside the new elevated nest box model for the northern Blue-throated Macaw subpopulation, based on the breeding strategy he discovered in January 2017. Photo by Wendy Willis.

Aliso live fencing program

The initial idea of the Aliso live fencing project was to translocate trees of already significant size that will function directly as post. This we have tried in November 2017 right at the start of the rainy season. Here we translocation 40 medium size to large Aliso trees as well as 40 large Aliso trunks (DBH between 5 and 10 centimeters). In June 2018 we evaluated the success rate of this translocation and to our deepest disappointment, none of the trees survived. Even though we were able to take out the trees with a complete root system, we believe that the most important "fine-root systems" got damage during this transplantation. These fine-roots are of utmost importance to take nutrients and water from the soil.

Figure 22: Marc Meeuwes, Dutch volunteer who returned to Barba Azul Nature Reserve for the fourth time, helps out with the innovative Aliso life fencing project where we planted a total of 150 small Aliso trees in November 2018, 75 in flooded river-edge habitat and 75 along the flooded to dry savanna gradient. We used the newly purchased quad bike and repaired trailer to transport the trees. Photo by Tjalle Boorsma.

Therefore, we decided to transplant smaller trees where the "fine root system" could still stay intact. A total of 150 small Aliso trees (between 20 to 120 cm in height) from the Barba Azul South natural nursery, have been transplanted in November along the newly placed fencing of the eastern most border of Barba Azul South. This fence has been placed in 2017. A total of 75 individuals were planted in flooded river-edge short grass, and 75 along the flooded to dry savanna gradient (fig. 22). Together with the 130 Aliso trees transplanted from last year, a total of 280 trees (28% of total amount) have been used to experiment, to discover the appropriate form to successfully translocate Aliso trees that will function as living fence posts.

8. Research

Buff-breasted Sandpiper habitat improvement and research

In 2018 a total of 250 Buff-breasted Sandpipers used Barba Azul during their southern migration. We do not understand the migration variation between years as of yet (fig. 23). Marcia Mireya Salvatierra from the Cochabamba University and an upcoming leading young conservationist in Bolivia, wrote her thesis on Buff-breasted Sandpiper migration with the 7-year data collected at Barba Azul in order to produce a manuscript for publication. She will study the important factors influencing Sandpiper abundance. She completed a new and extended version of the "Buff-breasted Sandpiper monitoring protocol" that has been used during the 2018 monitoring.

In 2018 we collected data on the presence/absence and abundance of grazing animals, differentiating between cattle and horses. Cattle stocking rate was related to number of animals observed as well as the number of dung piles (followed by daily counts of new dung piles per plot). Additionally, in comparison to other years, Marcia collected important data on grass cover and length, distance to trees and forests (predator related), and calculating the potential size of foraging habitat where the Buff-breasted Sandpiper were coming down. In 2019 we will experiment with different stocking rates, following a clear methodology using the Armonía's own cattle and horses.

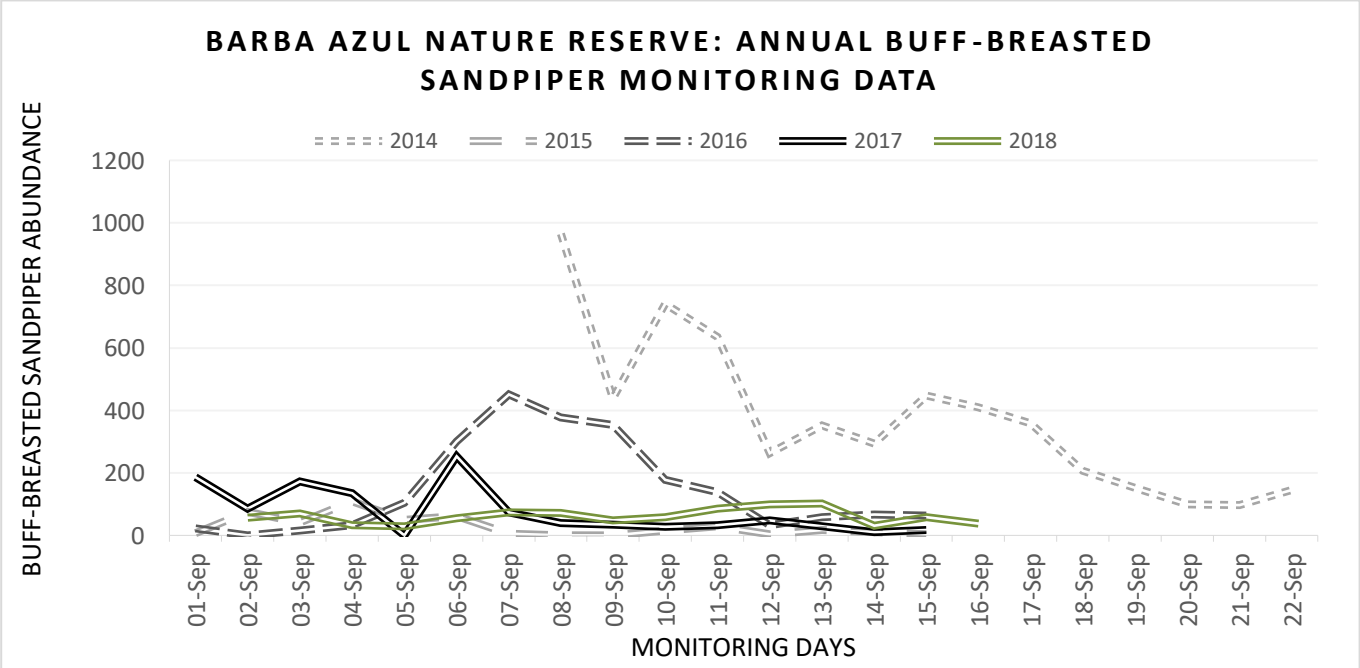


Figure 23. Buff-breasted Sandpiper daily observations during monitoring since 2014 showing extreme fluctuations in numbers yet to be explained. In 2014 the largest number of Buff-breasted Sandpipers were counted during monitoring, while 2016 has the highest ever count of over 1400 individuals, though not within the actual monitoring. Grey scale dashed lines show historical data while green line presents 2018 data.

Blue-throated Macaw GPS tracking study

In 2017, Armonía discovered the breeding habitat of the northwestern Blue-throated Macaw subpopulation. This is the largest subpopulation of which over 155 individuals use the Barba Azul Nature Reserve during the dry season. From November onwards, the Macaws leave Barba Azul to their inaccessible breeding areas. During the 2017 expedition, only a small portion of Macaws were observed. The aim of this project is therefore to use satellite telemetry ("tracking") with a few wild Macaws from Barba Azul to help locate breeding grounds of the population using the reserve.

Over the past couple of years, we have tested a number of capturing methods, attempting to minimize any possibility of injuring the birds. We tested various trapping techniques and studied their efficacy on-site with varying degrees of success. We have discovered which trapping methods have the highest probability of capturing the birds with minimal possible injury. As we have defined our techniques, Lisa Davenport, the leading researcher in this project, will return in 2019 to hopefully capture 3 macaws and place these satellite trackers.

Figure 24. Lisa Davenport and Carlos Roca studying the Macaws behaviour to test for appropriate capturing techniques. Photo by Tjalle Boorsma.

Figure 25. First ever documentation of Blue-throated Macaws coming down to drink water in river-edge short grass habitat. Large groups of over 40 individuals were observed coming down together with the Blue-and-yellow Macaw to drink in the late afternoon within the Barba Azul Nature Reserve. Photo by Tjalle Boorsma

Figure 26. Incredible observation made by Harry Lavelle of a Maned Wolf feeding on an armadillo. We expect 3 pairs roaming through the Barb Azul Nature Reserve and more than 5 different visiting groups have observed this elusive species. Photo by Harry Lavelle.

Savanna habitat research

PhD student Jo Kingsbury from the Ohio State University returned for her second data collection year to Barba Azul where she worked tremendously hard to establish 49 burn plots, collecting avian presence/absence data, gathering located flood loggers and training staff and assistants to do prescribed burns. The aim of her study is developing a better understanding of how bird communities are influenced by vegetation structure and composition across the cerrado-grassland gradients of the Beni savannah ecosystem. She wants to understand how these vegetation physiognomies are shaped by ecological and agricultural disturbances, like fire, flooding and cattle grazing.

Figure 27 & 28. A total of 49 burn plots have been established for the PhD study of Jo Kingsbury, burning 70m by 30m plots to study the impact of fire on grasses in the cerrado-savanna gradient, correlating her results to bird diversity and abundance. Photos by Bennett Hennessey and Tjalle Boorsma respectively.

Masters research

Four master students from the Wageningen University (Netherlands) visited Barba Azul to collect data for their thesis projects. Leam Martes continued the Motacu research started in 2016 where Iris Hordijk created permanent sample plots. Lotte studied Motacu dispersal by small mammals, Robin looked at tree characteristics along the forest-cerrado gradient, and Maud looked at the relation between tree species diversity and historical human influences.

Figure 29. FLTR; Leam Martes, Lotte Uijtendaal, Robin Kampert and Maud Moes from the Wageningen University collected data for their Master research thesis. Photo by Tjalle Boorsma

Figure 30. Pampas deer buck hiding in tallgrass savanna of the Barba Azul Nature Reserve. Photo by Harry Lavelle.

9. Barba Azul Nature Reserve 2019 Goals

Armonía is extending in 2019 the Blue-throated Macaw conservation actions to other regions in the Beni Savanna ecoregion. Armonía will develop and protect the Laney Rickman Blue-throated Macaw Reserve, working towards its sustainability and improving the artificial nest box program. We will start working within the Yata region where we discovered breeding Macaws in 2017, supported by Toyota grand and Vogelbescherming Nederland (Dutch Birdlife partner).

For 2019 we will continue to conduct protection, research, monitoring activities and working towards the sustainability of the Barba Azul Nature Reserve. We have set the following goals to ensure a continuous development of Barba Azul.

1. Establish solar electricity system

2. Complete raised firebreak system with backburns (Barba Azul North & South)

3. Complete tourism infrastructure
    - New water tank with filtration system
    - Underground electric wiring
    - Complete interior design cabins
    - Complete trail system and signage
    - A multi-resource bird feeder attraction

4. Complete cattle ranching infrastructure (Barba Azul East)
    - Complete worker house, deposit area and roofed tractor parking
    - Complete corral improvements (gathering pens & gates)
    - Establish herd of 500 head of cattle

5. Establish 7-kilometer live fencing

6. Stocking rate experiment to study livestock/sandpiper relationship

7. Camera trap monitoring system in each habitat type

8. Research
    - Blue-throated Macaws (3) with GPS tracker
    - Continue savanna habitat research
    - Continue Buff-breasted Sandpiper monitoring
    - Fenced exclusion zones in each habitat