

Neotropical Flyways Project

Final Report 2022-2023

Occupancy surveys in Honduras & Guatemala

Cerulean Warbler overwinter survival study

Golden-winged Warblers in Costa Rica

Corredor Azul



Presented to Missouri Department of Conservation July 2023

Background

The Neotropical Flyways Project was created in 2016 in order to address major gaps in our knowledge of stopover use by migratory birds in Central and South America. Between 2016 and 2021 the project has worked across five countries, generating thousands of records of migratory birds during the migration periods, which have been used to create unique spatial predictions of where likely stopover sites occur across the region. In 2022, the project arrived in Honduras and Guatemala, to continue the process of generating baseline information that feeds into priority setting processes and the subsequent development of conservation projects in key regions.

Parallel to these activities, SELVA's Migratory Ecology program has been studying overwinter habitat use and quality in focal species like the Cerulean Warbler and the Golden-winged Warbler. In 2022, an ambitious project to estimate overwinter survival and space use in Cerulean Warblers was launched and will continue for two years. In 2022, a pilot deployment of Motus nano tags on Golden-winged Warblers was also carried out and a second round of deployments was planned for 2023 to learn more about migratory connectivity, route use and departure dates from different habitats.

The research activities described above have already been generating actionable recommendations and in 2021, a conservation initiative called the "Corredor Azul" was established in Costa Rica to increase and enhance stopover habitat for Cerulean Warblers and other at-risk migratory landbirds. Activities under the Corredor Azul continue and for the period covered by this report, outreach and tree planting activities were designed to increase the footprint of the corridor.

In this report, we provide an overview of occupancy surveys carried out across Honduras and Guatemala, the study of overwinter survival and space use in Cerulean Warblers in the Andes of Colombia, the deployment of Motus tags on Golden-winged Warblers in Costa Rica and conservation activities in the Corredor Azul in Costa Rica.



Occupancy surveys across Honduras and Guatemala during fall migration 2022

During fall 2022, we established 15 surveys sites in Honduras and 6 in Guatemala (Fig. 1). Across all sites, a total of 220 one-hundred meter long transect routes were marked. Individual transects were surveyed passively on at least 24 occasions during six 10-day periods covering the main migration period (late August through October) and 6 times using playback. The transects were surveyed by 8 observers from Honduras, 4 from Guatemala and one from Colombia.

The surveys recorded **62,406 individuals of 90 migratory landbird species** across the two countries in 4,013 eBird lists in Honduras and 2,320 lists in Guatemala. Of note were the large number (337 records) of Golden-cheeked Warbler (VU) sightings from La Tigra National Park in Honduras and the same area also held a marked concentration of Cerulean Warblers (24 records). Given the presence of the later species from early September through mid-October, it would appear that this region provides stopover habitat for the species and warrants further investigation. There were also a number of records of Olive-sided Flycatcher (102 records) and other migrants of concern from La Tigra, suggesting it may hold importance for a broader community of migratory landbirds during fall migration.

Another area of interest was the Atlantic coast of Honduras that held large numbers of passage migrants such as Eastern Wood-pewee, Red-eyed Vireo, Prothonotary Warbler, Bay-breasted Warbler and Scarlet Tanager. Surveys across southern Guatemala revealed relatively low species richness and abundance and no clear evidence for stopovers by transient species.

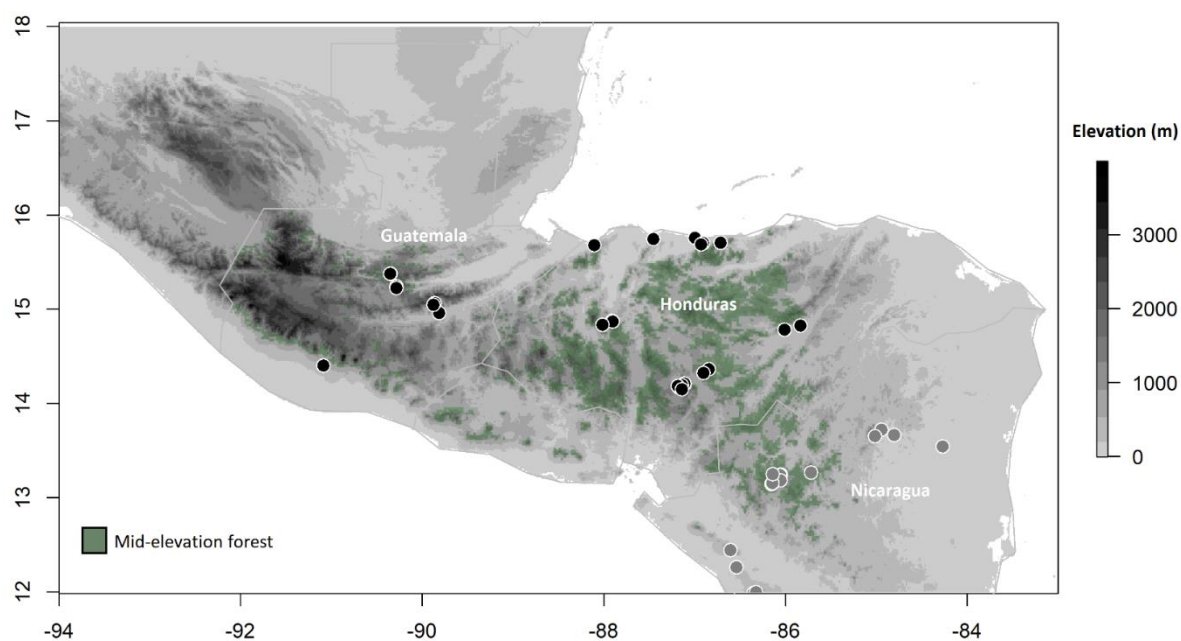


Figure 1. Distribution of survey sites across Honduras and Guatemala in relation to elevation and mid-elevation forests (green), the latter being considered a priority habitat for Golden-winged, Cerulean and Canada Warblers. Sites surveyed in Nicaragua in 2020 are also shown (gray circles).

Initial analyses of the data from La Tigra National Park (Fig. 2) by Stefany Flores, a Honduran ornithologist who participated in the surveys, revealed a diverse community of migratory landbirds (82 species; Fig. 3) but with species richness varying in such a way, that the most species rich habitats/areas were found at lower elevations in the buffer zone of the park (Fig. 4). Contrary to what might be expected, the dominant habitat in the buffer zone was premontane dry forest, a habitat that is not typically considered of high quality for migratory landbirds. Nonetheless, this finding matches discoveries in Colombia, where tropical dry forests are used by a wide range of migratory landbirds when the wet season coincides with the peak of the migration periods.

Research team

Honduras – Andrés Reyes, Angel Fong, Didey Urquia, Eduardo Rivera, Isis Castro, Jafeth Zablach, Jorge Diaz, José Paz, Martha Rubio, Olbin Bejerano, Alejandra Samara Martinez, Stefany Flores. **Guatemala** – Bianca Bosarreyes, Josué de León Lux, Myrna Galindo, Oliver Gereda, Rudy Botzoc.

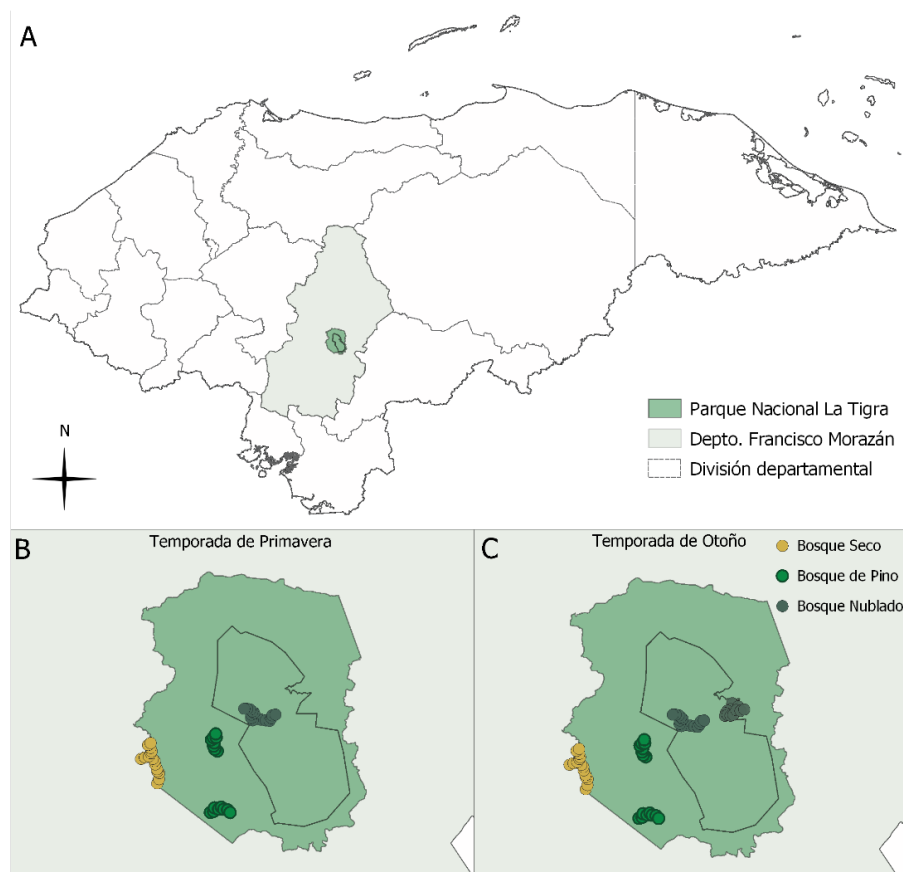


Figure 2. Location of La Tigra National Park (A) in Honduras and the location of transects during spring 2022 (B) and fall 2022 (C). Yellow circles indicate transects in pre-montane dry forest, green in pine-oak forest and gray in cloud forest.

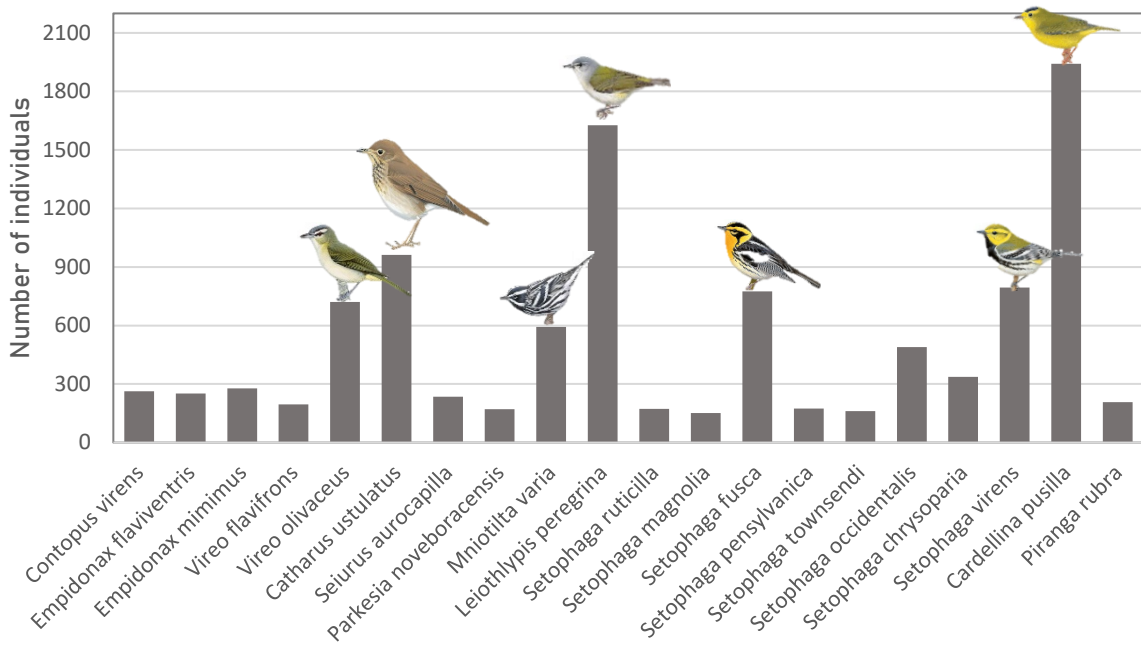


Figure 3. Most abundant migratory landbirds (>100 records) recorded in La Tigra National Park, Honduras, during fall migration.

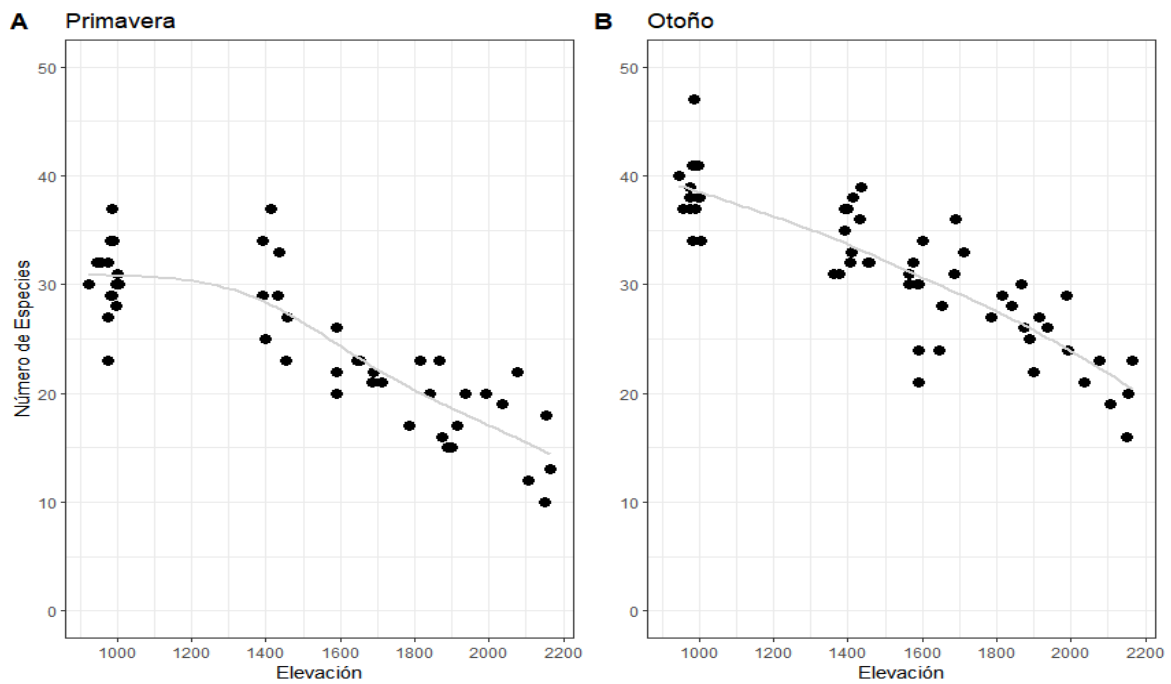


Figure 4. Species richness of migratory landbirds by elevation during A. spring migration and B. fall migration in La Tigra National Park, Honduras. Each point represents the species richness recorded in a 100-m transect through multiple surveys carried out across each migration period.

Cerulean Warbler overwinter survival and space use in the Andes of Colombia

Background

The Cerulean Warbler is a small migratory songbird that breeds in forested habitats across the eastern United States and southern Canada, and migrates to the tropical Andes of Venezuela, Colombia, Ecuador and Peru during the non-breeding season (Fig. 5). The species has experienced persistent declines since standardized monitoring began in 1970 and current estimates indicate a population decline of 73% over the last 50 years, and that the remaining population numbers just half a million birds [1]. As a result, it is listed as Vulnerable by the IUCN, is a U.S. Fish and Wildlife Service species of greatest conservation need (SGCN) and a Priority At-Risk Species for USFWS Region 5. In addition, it is listed as a priority species by four migratory bird Joint Ventures (JV) including the Lower Mississippi Valley JV and the Upper Mississippi and Great Lakes JV, and is categorized as a threatened species under the Missouri Bird Conservation Plan with a Missouri Concern Score of 18 out of 20 – the highest score for any species in the Plan.

The causes of decline are not fully understood but a number of authors have suggested that forest loss on the non-breeding grounds is an important factor [2,3]. This hypothesis is supported by information on migratory connectivity for the species, which links steeply declining Appalachian populations to heavily deforested areas in the Eastern Andes of Colombia, while more stable populations are linked to areas in Ecuador and Peru that still support considerable areas of forest [2,4]. Despite the likely role of deforestation in the tropical Andes, our knowledge of the species' ecology on the non-breeding grounds, especially of key demographic parameters, is incipient and was identified as a major knowledge gap by the Cerulean Warbler working group. To gain a better understanding of the factors limiting the species and causing declines, the working group is building a full life cycle model, however to do so, we first require estimates of vital rates between different regions and habitats on the non-breeding grounds.

This project was designed in collaboration with members of the Cerulean Warbler working group in order to fill these knowledge gaps. Specifically, the project aims to estimate non-breeding survival in two populations of Cerulean Warbler in the Eastern Andes of Colombia, and determine whether variation exists between habitats, males and females, and adult and first-year birds. Cerulean Warblers occupy a range of forested habitats on the non-breeding grounds, including mature forest, advanced secondary growth, shade-grown coffee and shade-grown cacao [3,5]. Much of the area occupied by the species today, has been deforested and shade-grown coffee is one of the few forest-like habitats that remain on the landscape. It is therefore essential to understand whether habitat use influences survival and subsequent recruitment to the breeding population.

In addition to understanding where population bottlenecks occur, a number of knowledge gaps exist for the non-breeding grounds, inhibiting the design of effective conservation measures. For example, it is unclear how many Cerulean Warblers a given area of habitat can support. To date density estimates for Cerulean Warblers in distinct non-breeding areas vary from 0.17 birds/ha to 2.7 birds/ha [5,6] but studies directly comparing native forest with shade-grown coffee, for example, are lacking. This information is key to understanding the relative importance of the habitats that the species occupies during the non-breeding period. In addition, we lack knowledge on the micro-habitat features that favor the species' presence, such as which tree species they use for foraging. Another

unknown, is whether birds occupy the same sites throughout the stationary non-breeding period or whether they move between sites during the northern winter months.

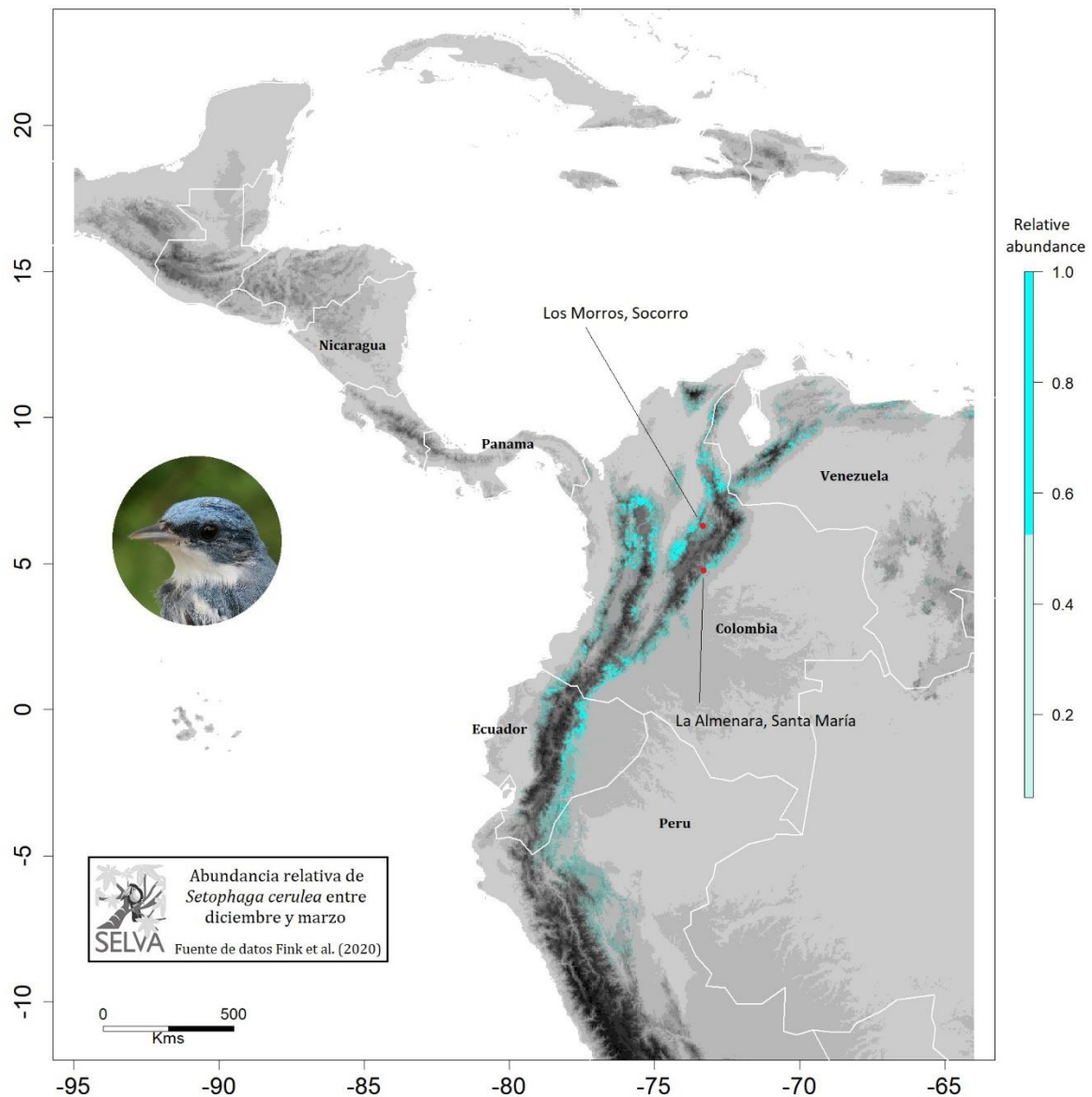


Figure 5. Location of study sites in relation to an abundance surface for the non-breeding distribution of the Cerulean Warbler (adapted from the eBird Status and Trends data products; [7]).

The Motus Wildlife Tracking Project (<https://motus.org>) is a global wildlife tracking system managed by Bird Studies Canada that works by detecting digitally-coded Motus tags on arrays of automated receiver stations as part of a collaborative network. Automated radio telemetry is a powerful tool for addressing questions regarding survival and space use, as it saves hundreds of man-hours to gain the same information through manual telemetry, while also providing unique information on when mortality or emigration events occur. Using manual telemetry it is almost impossible to distinguish between a mortality event and the departure of a bird from a study site. Automated telemetry solves this issue, as different events leave unique signatures in the detection history of a given bird.

To address knowledge gaps associated with the non-breeding ecology of Cerulean Warblers, this project set out to study two populations of Cerulean Warblers in Colombia through the deployment of radio-transmitters and the installation of Motus stations, while simultaneously carrying out manual tracking of individual birds and implementing a standardized observation protocol to identify tree species used by the species. The main goals of the project were to:

1. Estimate overwinter survival in two populations of Cerulean Warbler and determine whether survival probability varies by habitat, gender or age
2. Estimate home-range size and the density of Cerulean Warblers occupying native forest and shade-grown coffee
3. Determine whether birds remain at study sites throughout the non-breeding season
4. Evaluate tree use in a native forest and in a shade-grown coffee plantation
5. Infer habitat quality based on departure dates from the two study sites

Results to date

Project activities took place between November 2022 and April 2023 and were divided into a series of phases. Between November and December, efforts were focused on capturing Cerulean Warblers and installing long-duration (7 months) radio-transmitters appropriate for monitoring survival, as well as building the Motus stations at each study site. In January 2023, a second group of Cerulean Warblers was marked with short-duration (3 months) transmitters, suitable for carrying out manual tracking. Between January and March, we manually tracked birds to gather data for mapping home ranges. During the same period, transects and focal observations were carried out in order to understand tree use. Parallel to all these activities, we trained three members from local communities in data collection, in order to build local capacity for scientific research, as well as giving presentations to the wider community about the project.

Study sites

The two study sites were both in the Eastern Andes of Colombia but located on opposite slopes of the mountain range (Fig. 5). On the western slope, we worked at the Hacienda Los Morros, a 100 ha shade-grown coffee farm located near the town of Socorro in the department of Santander, with an average elevation of 1500 m. On the eastern slope, we worked at La Almenara, a forest reserve managed by AES Chivor, downstream of the hydroelectric dam managed by the same, within the municipality of Santa Maria in the department of Boyacá. The area of suitable forest at this site covered approximately 350 ha between 800 m and 1600 m.

Installation of radio-transmitters

During November and early December 2022, we captured 12 Cerulean Warblers at Hacienda Los Morros and 9 individuals at La Almenara. Each individual was fitted with a long-duration radio-transmitter expected to last at least 215 days or 7 months. A 10th individual was captured in the Almenara in early January, to ensure a minimum sample size of 10 long-duration tags at each site.

During January 2023, we captured a further 5 individuals at Hacienda Los Morros and 4 individuals at La Almenara, and fitted all nine birds with a short-duration transmitter suitable for use with manual telemetry. A final individual was fitted with a short-duration tag in March 2023 at Hacienda Los Morros.

In total, we deployed **32 transmitters** across the two sites (18 at Los Morros and 14 at La Almenara). Transmitters were divided equally between ages, with exactly 16 adults and 16 first-year birds. There were more males than females in our sample (11 females and 21 males).



A male Cerulean Warbler at Los Morros – the antenna of a transmitter can be seen extending beyond its tail

Installation of Motus stations

At Hacienda Los Morros, a permanent Motus station had been installed during August 2022. An additional station was installed in November 2022 in order to maximize coverage of the site. At La Almenara, two Motus stations were installed during November 2022 to cover different areas of the forest. The stations collected data on a daily basis between November 2022 and May 2023 and proved to be highly effective at monitoring the presence and activity of individual Cerulean Warblers. A summary of the information is available on the Motus website through the following links.

Morros 1 – <https://motus.org/data/receiverDeployment?id=8853>

Morros 2 – <https://motus.org/data/receiverDeployment?id=9223>

Almenara 1 – <https://motus.org/data/receiverDeployment?id=9212>

Almenara 2 - <https://motus.org/data/receiverDeployment?id=9215>



A Motus station looks towards the La Almenara study site (the forested mountainside in the near distance)



Manual tracking of Cerulean Warblers

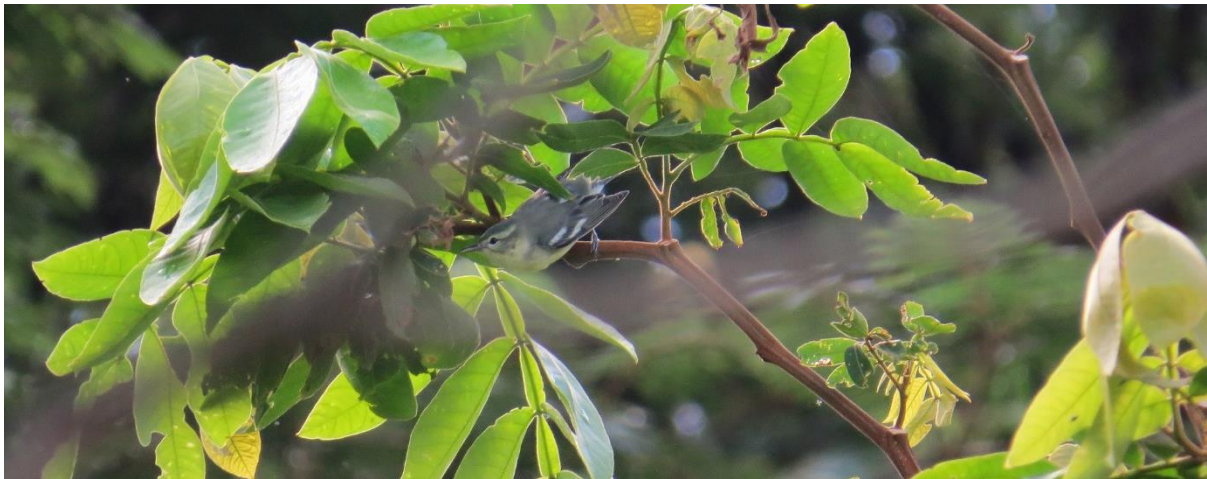
Manual tracking was successful at both sites and at least 30 locations were obtained for each individual, which is above the minimum number of points required to generate an accurate estimate of home range. Further manual tracking will be carried out during 2024, with the aim of having 10 home range estimates for each site-habitat.



Noteworthy preliminary results

Habitat preferences differ between males and females

While we did not set out to determine whether males or females had different habitat preferences, we discovered a marked difference between our two study populations. At the forest site, we captured 13 males and 1 female, while at the shade-coffee site we captured 10 females and 8 males. This striking result warrants further investigation and suggests that conservation strategies must take into account habitat use by both sexes in order to be successful.

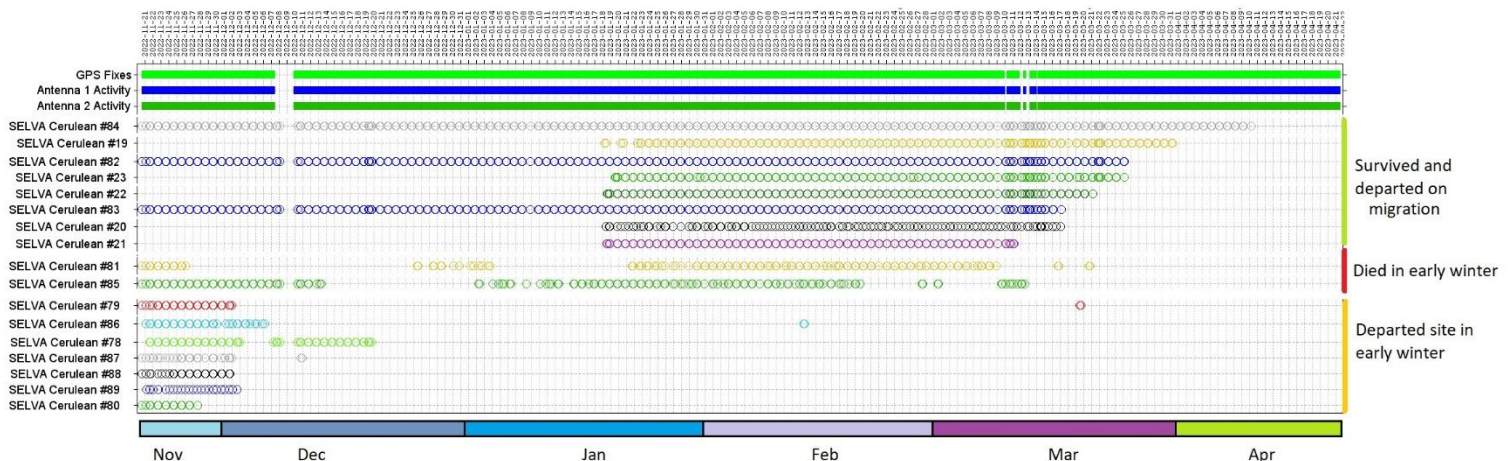


A female Cerulean Warbler forages in a shade tree in a coffee plantation at Hacienda Los Morros

Cerulean Warblers make within season winter movements

To date there is no evidence suggesting that Cerulean Warblers make within winter movements or that they use more than one non-breeding site. Based on the detection history of 22 birds marked between November and December 2022, 13 (59%) birds appeared to leave our study sites, with most movements occurring from early-December through early January (Fig. 6). Departures coincided with the onset of the dry season throughout much of the Andes of Colombia, suggesting that these movements may be a direct response to a reduction in resources associated with the dry season. Notably, all 9 birds captured in January 2023 remained at the study sites till departing on migration. Again, this crucial and unknown aspect of the non-breeding ecology of the species, is expected to have an important influence on the design of effective conservation measures.

Figure 6. Detection histories of Cerulean Warblers at Los Morros, revealing early-winter movements.



Overwinter survival is high based on preliminary data

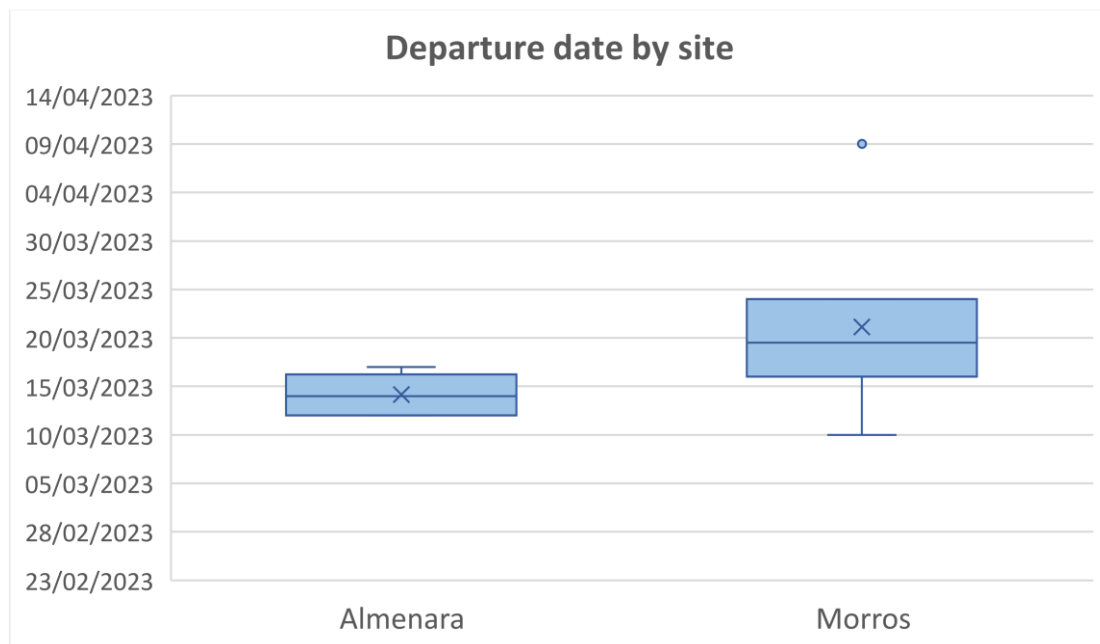
We were able to confirm that three individuals died while at our study sites and the data from the Motus stations suggest that a fourth individual died as well (Fig. 7). Excluding the individual that was captured in March, at the end of the non-breeding season, this is equivalent to an apparent survival probability of **0.87** (27/31) or a monthly survival probability of **0.96**. This is similar to overwinter survival estimates for other migratory landbirds [8,9] and suggests that the results from the study will be highly informative about survival during the non-breeding season. Notably, deaths were split equally between the two study sites.

Figure 7. Examples of the detection histories of individual Cerulean Warblers at local Motus stations at the Hacienda Los Morros in Santander. **A.** An adult female marked in late November that remained at the study site till departing on migration in late March. **B.** Detection history of an adult female marked in January, showing a strong pattern of diurnal activity but few or no nighttime detections, implying the bird roosted out of “sight” of the Motus stations. **C.** Adult male that appeared to die 12 days after being marked in November but whose tag remained active, giving a signal with low variation in strength, before being physically recovered along with the bird’s bands in late March.



Birds at the forest site initiated spring migration earlier relative to birds in shade coffee

Migration departure dates have been used in several studies to infer the relative quality of habitats, under the assumption that birds will leave earlier when food availability allows birds to fuel up quickly [10]. However, under certain circumstances birds will leave food poor habitats earlier in search of resource rich sites [11]. We found a marked difference in departure dates between our two sites, with birds departing earlier from the forest site. This may be linked to higher resource availability and therefore quality in native forests, however, it may also be a direct result of the differences in sex ratios described above. In most species, males initiate migration prior to females, so later departures from shade-coffee may be due to later departing females, rather than a lack of food.



Next steps

The results from the first year of data collection have provided a number of novel insights into the ecology of Cerulean Warblers, as well as raising further questions. From its conception, this project was designed as a two-year project and in the coming non-breeding season we will repeat the methodology and tagging protocol reported on above, in order to confirm and strengthen the findings from year 1. The combined data from the two years of data will then be used to inform the full life model, and hopefully lead to a better understanding of the factors driving the persistent declines experienced by Cerulean Warblers over the past half century.

Acknowledgements

We are extremely grateful to Hacienda Los Morros and AES Chivor (La Almenara) for allowing access to their respective properties and general logistical support. The SELVA team, Jeyson Sanabria, Ernesto Carman and Paz Irola helped make this study a success, along with the local field team, Erick Gutierrez (Morros), Adrian Pinzon and Diana Catherine Acosta (Almenara), whose dedication was key to gathering information on space use and tree use. Additional funds were provided by Audubon chapters via the Missouri Conservation Heritage Foundation and from USFWS (transmitters).

References

1. Partners in Flight. 2021 Avian conservation assessment database scores, version 2021. See <http://pif.birdconservancy.org/ACAD> (accessed on 12 December 2021).
2. Jones J, Norris DR, Girvan MK, Barg JJ, Kyser TK, Robertson RJ. 2008 Migratory connectivity and rate of population decline in a vulnerable songbird. *Condor* **110**, 538–544.
3. Colorado GJ, Hamel PB, Rodewald AD, Mehlman D. 2012 Advancing our understanding of the non-breeding distribution of Cerulean Warbler (*Setophaga cerulea*) in the Andes. *Ornitol. Neotrop.* **23(Suppl)**, 309–317.
4. Raybuck DW *et al.* 2022 Cerulean Warblers exhibit parallel migration patterns and multiple migratory stopovers within the Central American Isthmus. *Ornithol. Appl.* **124**, duac031. (doi:10.1093/ornithapp/duac031)
5. Bakermans MH, Vitz AC, Rodewald AD, Rengifo CG. 2009 Migratory songbird use of shade coffee in the Venezuelan Andes with implications for conservation of Cerulean Warbler. *Biol. Conserv.* **142**, 2476–2483. (doi:10.1016/j.biocon.2009.05.018)
6. Jones J, Perazzi PR, Carruthers EH, Robertson RJ. 2000 Sociality and foraging behavior of the Cerulean Warbler in Venezuelan shade-coffee plantations. *Condor* **102**, 958–962. (doi:10.1093/condor/102.4.958)
7. Fink D *et al.* 2021 eBird Status and Trends, Data Version: 2020; Released: 2021. (doi:10.2173/ebirdst.2020)
8. Sillett TS, Holmes RT. 2002 Variation in survivorship of a migratory songbird throughout its annual cycle. *J. Anim. Ecol.* **71**, 296–308.
9. Rushing CS, Hostetler JA, Sillett TS, Marra PP, Rotenberg JA, Ryder TB. 2017 Spatial and temporal drivers of avian population dynamics across the annual cycle. *Ecology* **98**, 2837–2850.
10. Studds CE, Marra PP. 2007 Linking fluctuations in rainfall to nonbreeding season performance in a long-distance migratory bird, *Setophaga ruticilla*. *Clim. Res.* **35**, 115–122. (doi:10.3354/cr00718)
11. González AM, Bayly NJ, Hobson KA. 2020 Earlier and slower or later and faster: Spring migration pace linked to departure time in a Neotropical migrant songbird. *J. Anim. Ecol.* **89**, 2840–2851. (doi:https://doi.org/10.1111/1365-2656.13359)



The team focused on fitting a Cerulean Warbler with a Motus tag at Los Morros

Golden-winged Warbler Motus project in Costa Rica

The Golden-winged Warbler is a steeply declining migratory landbird that winters throughout mostly mountainous regions of Central America and northern Colombia. The species is experiencing different population trajectories across its range and both its breeding and non-breeding distribution are in a state of flux. This situation presents considerable challenges when it comes to prioritizing given regions for conservation action and creates a pressing need for a finer scale understanding of migratory connectivity between wintering and breeding populations, as well as, a need to better understand variation in habitat quality at more regional scales.

To address these needs, this component of the project aimed to study several different wintering populations of Golden-winged Warblers using Motus technology, in a core area of their non-breeding grounds in Costa Rica. Specifically, the goals for activities in 2023-2024 were to 1) define fine-scale connectivity patterns, 2) use departure dates from non-breeding areas distributed across a precipitation gradient to gain an understanding of habitat quality and 3) determine whether non-breeding habitat use influences migration speed, provided sufficient detections could be obtained in the Motus automated telemetry array.

Results/activities carried out to date

Study sites

5 primary study regions were identified in Costa Rica (Fig. 8) covering the precipitation gradient found within the non-breeding distribution of the Golden-winged Warbler in the country. Within each region, one or two study sites were selected for the capture and fitting of warblers with Motus tags.

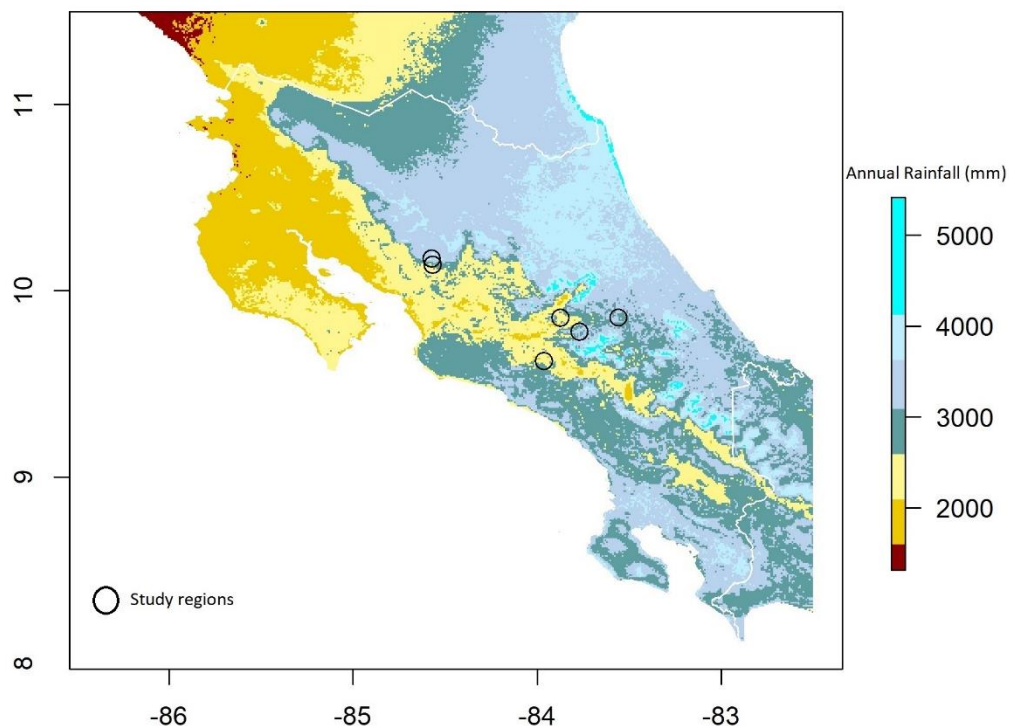


Figure 8. Golden-winged Warbler study regions in relation to precipitation gradients across Costa Rica.

Capture and fitting of Golden-winged Warblers with radio-transmitters

A multi-national team from Canada, US, Colombia and Costa Rica led the capture effort between late February and late March 2023. The goal was to install 10 Lotek nano-tags (NTQB2-1-M) in each of the study regions shortly before birds departed on migration in early April. A total of 51 nano-tags were deployed in the following regions (Fig. 9), with a pulse rate of 15.7 seconds and an expected duration of 107 days (> 3 months):

San Ramon-La Paz (11 tags)

Paraíso (10 tags)

Orosí-Rio Macho (10 tags)

Turrialba (10 tags)

Santa María-Cerro de la Muerte (10 tags)

The sample of birds fitted with tags included 28 adult and 23 immature birds, and 47 males and just 4 females.



Figure 9. Tagging locations for Golden-winged Warblers in Costa Rica in 2023.

Installation of local Motus stations

To gather information on departure dates of tagged birds from each site, a local Motus station was set up in each study region. In some cases, two stations were set up, due to the complexity of the topography and the ability to cover the capture locations.

Preliminary Results

A preliminary check of the data from the Motus stations, suggests that around 70 or 80% of the tagged Golden-winged Warblers have a consistent detection history allowing for the determination of departure dates. Fewer individuals were detected beyond Costa Rica, with somewhere between 30 and 40% of individuals from each site having detections in North America, including several birds that

were detected as they migrated through Missouri, highlighting the importance of the state in the migration flyway of the species.

A preliminary examination of departure dates between sites, suggests that there are differences which can tell us something about habitat quality. Between the three regions on the Caribbean slope of Costa Rica (Paraiso, Turrialba, Orosí-Rio Macho), for example, birds departed earliest from Paraiso and latest from Orosí-Rio Macho. This pattern follows the precipitation patterns at the sites, with Orosí-Rio Macho being the wettest site and Paraiso the driest. It also follows the pattern of habitat transformation, with Paraiso being the most transformed and Rio Macho the least. Together, these data suggest that birds may depart later from high quality sites (e.g. Rio Macho), where potentially there are more resources, allowing birds to accumulate larger energy reserves and migrate faster. We will examine this hypothesis using the data from the international detections.

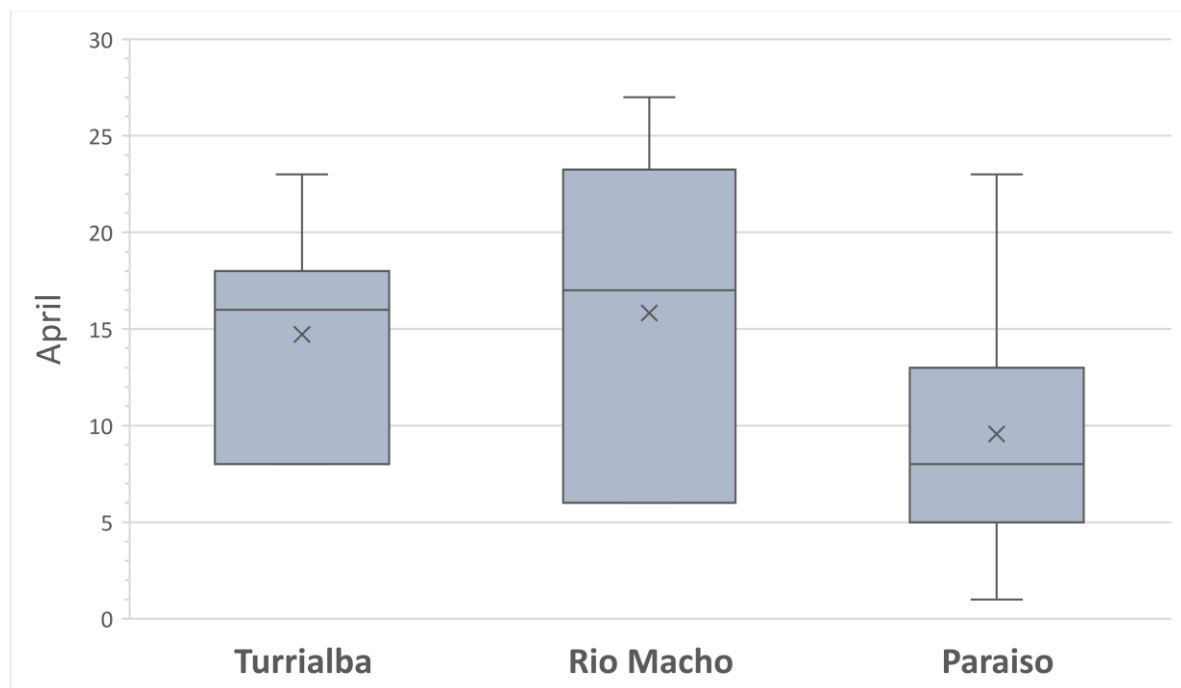


Figure 10. Departure dates varied between three of the study sites examined thus far, with earlier departures from Paraiso and later departures from Rio Macho. Box plots represent the median value and inter-quartile ranges and “x” marks the mean.

Next steps

A further and more detailed analysis of the detection data for the Golden-winged Warblers will be carried out in the next 6 months and is expected to generate important insights into the relative quality of different regions in Costa Rica for wintering Golden-winged Warblers and how they are connected to breeding areas. Based on the preliminary analyses, it would appear that the results will be sufficient for a scientific publication.

Acknowledgements

Tags for this project were provided by USFWS and we are very grateful for the participation of the following individuals in the capture effort: Adam Smith, Andy Forbes, Sarah Kendrick, Mike Wells and Stuart Mackenzie. The SELVA team included Ernesto Carman, Paz Irola, Yuly Caicedo and Nick Bayly.

Corredor Azul – conservation corridor on the Caribbean slope of Costa Rica

Conservation activities under the Corredor Azul initiative on the Caribbean slope of Costa Rica continued but have been delayed due to competing priorities for the Costa Rica team. To rectify this issue, a new project coordinator has been taken on, who will accelerate activities in the second semester of 2023 to achieve the expected results. Below we detail the main advances towards the project's goals.

Maintain the tree nursery established in 2020 and generate an additional production of at least 2000 saplings

850 new seedlings were established and the bags for another 500 were prepared but propagation has been put on hold while the team evacuates other trees from the nursery to make space.

Continue planting/restoration activities with Corredor Azul partners over an area covering 150 ha

An additional 950 trees were planted across eight different properties in the footprint of the corridor. 350 of these trees served to replace previously planted trees that succumbed to either cows, drought or leaf-cutter ants.

Contact additional landowners and provide an updated database of landowners

On reflection, the decision was taken not to contact new landowners, as the project did not have the physical or financial capacity to take on more landowners without affecting the quality of the assistance provided to landowners already participating. For that reason, efforts were focused on maintaining relations active, carry out maintenance in planted areas (e.g., clearing grass and removing vines that strangle young trees) and fertilizing existing trees to boost their chances of survival. The team in Costa Rica felt this was an important step to take, as the drive to include more landowners was detracting from other project activities.

Carry out education activities with three schools and provide photographic record

A group of 12 students and three teachers attended a workshop at Las Brisas Nature Reserve where they spent the morning observing the banding of Neotropical migrants, taking a guided walk along the trails and receiving a presentation about the importance of the area for Neotropical migrants and other wildlife. Setting up a schedule for visiting schools took longer than hoped but a schedule has now been agreed between the SINAC (National Conservation Areas system) and Subcorredor Destierro-Barbilla for visiting schools during the second semester of 2023.





Deliver two presentations to local landowners and continue outreach activities, including pursuing proposed activities with key stakeholders: Fresh del Monte and EARTH university
This activity has not been carried out yet but is still planned for the second semester of 2023.



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