TCD Travel Grant Activities Report

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El Cairo, Valle del Cauca, Colombia

Breakdown of mutualistic flocking interactions across an Andean fragmentation gradient.

Project Overview and Research Questions

This summer I conducted three months of field work in the municipality of El Cairo, located in the Western Andes of Colombia, with the objective of understanding how at-risk cloud forest bird species are affected by forest fragmentation. The tropical Andes of Colombia are a biodiversity hotspot for many taxa, including birds, but have seen increasing habitat fragmentation for agriculture and cattle ranching over the past fifty years. Today, only 30% of Andean forests remain in Colombia, primarily in small patches embedded in human-dominated landscapes, yet our understanding of how habitat fragmentation affects montane wildlife is still fragmentary. Working in a fragmented landscape, we therefore surveyed for birds in forest fragments of different sizes but in the same altitudinal band (1700-2200 masl) in order to (1) determine how at-risk functional groups of birds are affected by fragmentation in the Andes and (2) determine how mixed-species foraging flocks, an important mutualistic species interaction for forest birds, are affected by landscape- and microhabitat-level changes.

Actions Performed

In order to cover the full range of fragment sizes for my study, we visited 10 forest fragments, ranging in size from 7 to 173 hectares, over the course of seven field visits (see Figure 1). We also visited a continuous forest site, the Cerro El Ingles Community Reserve, which served as a reference site for the avifauna of my study landscape. At each site, my field crew of four and I stayed on local coffee farms near the fragment in question, and spent a week conducting field work at the site. We established two 500-meter-long transects during each field trip (either in two different forest fragments or both within the same large fragment; Figure 1) that will constitute the sampling unit for future analyses. Along each transect, we (1) mist netted understory birds for two and a half days (as weather permitted), (2) performed three days of transect surveys for mixed-species foraging flocks and described their composition, (3) characterized the vegetation for each 100-meter section of the transect, and (4) performed playback surveys for forest owls.

For our mist net captures of birds, we deployed 12 nets along the transect, which were open from dawn to dusk. In total, we captured 828 birds belonging to 118 species over the course of the summer. We banded all captures (excepting hummingbirds) with metal bands containing a unique code. Species that participate in mixed-species flocks were additionally banded with a unique combination of plastic color bands in order to identify them during flock surveys using binoculars. We also took basic morphological data for each capture and aged and sexed individuals where possible. We also determined the breeding status of all individuals in order to help identify the breeding season for our poorly-known tropical bird species. Finally, we took high-quality photographs of all of our birds, including shots of spread wings that will be used in order to determine molt patterns in our study species. We also performed censuses for mixed-species flocks along each transect during times when this behavior is most common (e.g. 7:00-11:00 AM, 4:00-6:00 PM). Two observers walked along the transect and recorded the species

composition of all mixed-species foraging flocks encountered, along with the transect segment (divided into five 100-meter segments) and the time of day. Over the course of the field season, we encountered 250 flocks for which we were able to characterize the complete composition, with an average of about 15 flocks per transect.

We were also able to take measures of the vegetation, broken down into 100-meter segments, for 13 of our 16 transects (64 segments). For each vegetation transect, we quantified canopy height, canopy cover, and vertical complexity (presence and absence of vegetation in different height bands). We additionally quantified the densities of shrubs, vines, ferns, tree ferns, and trees of different size classes. These data will be ordinated for future analyses of microhabitat and used as predictor variables in analyses of foraging flock size and composition as well as species richness of mist netted birds. Finally, we performed three playback surveys per transect for all owl species expected at our field sites using recordings of the territorial song. We encountered four species of owl, including two species of conservation concern, during our nocturnal surveys.

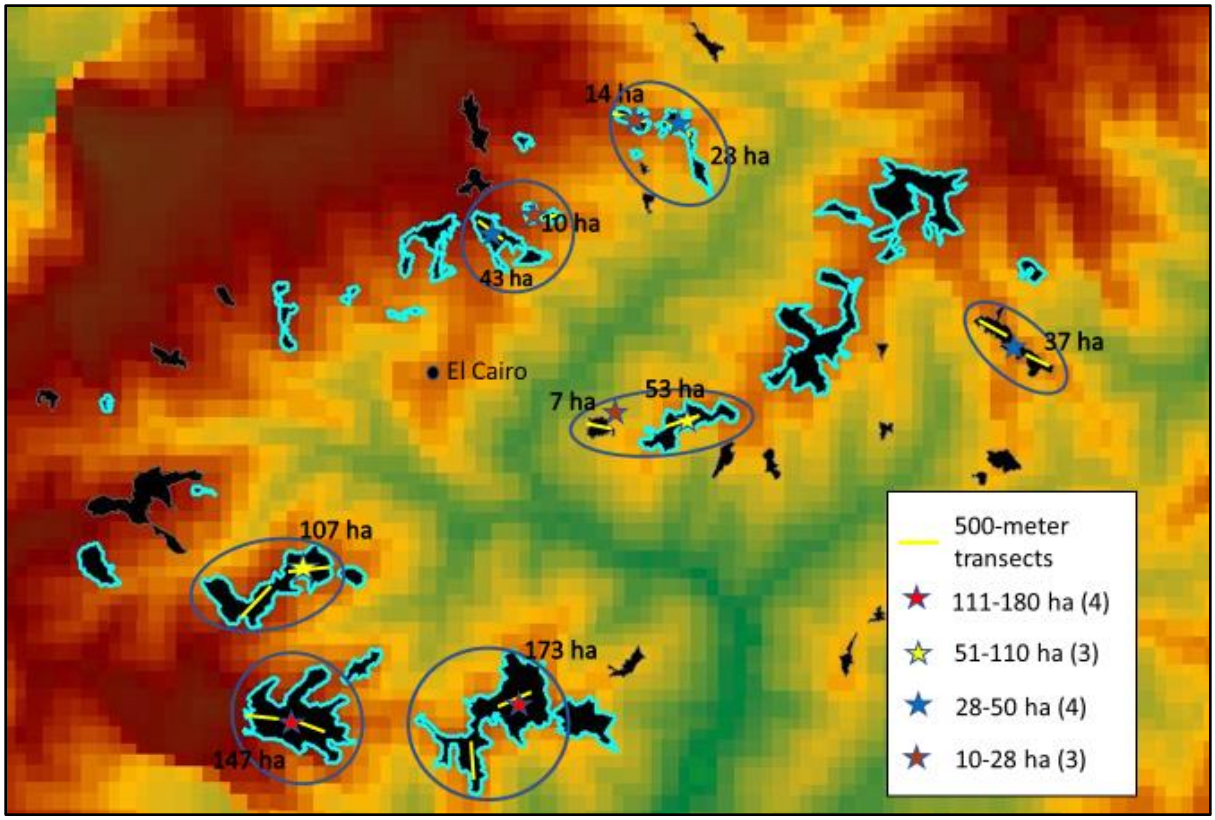

Figure 1. Map of forest fragments visited for bird censuses in the El Cairo municipality, Colombia during summer 2017. Fragments visited during the same field trip are circled in blue, while the size category of the fragment is denoted with a colored star. Yellow lines indicate the positioning of 500-meter study transects within a fragment; the number of transects surveyed for each size category is indicated in parentheses. The black circle indicates the location of the town of El Cairo.

Preliminary Results

Our preliminary results suggest that Andean bird species are strongly affected by both habitat fragmentation as well as changes to the vegetation structure within habitat patches. We documented extensive selective logging, both in the recent past and ongoing, in many of our

study sites. Selective logging appears to target specific tree species known for the quality of their timber, as well as larger (> 40 cm dbh) trees. We observed extensive effects of this practice, which not only changes the species composition and age distribution of trees within forest fragments, but also disturbs the understory by creating treefall gaps. The resulting vegetation structure contained more canopy gaps as well as reduced densities of understory shrubs and ferns. As such, and because forest fragments were privately-owned by multiple smallholders, forest fragments tended to be heterogenous in the vegetation structure as well as conservation state for Andean birds.

Generally, we detected major differences in the species composition and abundances (number of mist net captures) for understory birds across the fragmentation gradient. Larger and less-isolated fragments contained greater number of understory insectivores, while more disturbed sites tended to contain lower densities of species as well as increased numbers of nectarivores and edge specialists. Generally, suboscine birds in the ovenbird (Furnariidae), tyrant flycatcher (Tyrannidae), and tapaculo (Rhynocryptidae) families appeared to be most vulnerable to disturbance and did not persist in small fragments. Frugivorous species, especially tanagers (Thraupidae) and certain finches (Genus *Euphonia*; Fringilidae) appeared to be less vulnerable to fragmentation, and many may preferentially use small fragments and disturbed or regenerating habitats which appeared to have a greater concentration of fruit. In more isolated sites which experienced a loss of montane forest species, we also noted an upslope movement by species typically found at lower elevations, possibly due to lack of competition with upslope competitors.

The ecology of mixed-species flocks also responded strongly to fragmentation, with important changes to the encounter rate and species composition of flocks. Flocking behavior in the Andes appears to be at least partially resilient to fragmentation, as this behavior was observed in even the smallest (7 ha) fragment. However, important species turnover occurs between continuous forest, large fragments, and small fragments. In continuous forest, multiple types of foraging flocks exist (understory flocks, tanager-dominated flocks, flycatcher-dominated flocks), yet many of these flock types are lost in even large fragments. Flock composition becomes increasingly homogenized in smaller fragments, and changes to species composition mirror those observed from mist net captures (see above). The number of flocks encountered also decreases with fragment size, suggesting that there are fewer flocks available for forest birds to join. This can result in the formation of large 'megaflocks' in fragments, yet on average the number of participating individuals and species decreases across the fragmentation gradient (Figure 2).

Finally, we encountered a number of endemic and at-risk bird species over the course of our censuses. In many cases our work constituted the first ornithological survey for the site. We recorded Multicolored Tanager (*Chlorochrysa nitidissima*; Vulnerable), Star-chested Treerunner (*Margarornis stellatus*; Near Threatened), Purplish-mantled Tanager (*Iridosornis porphyrocephala*; Near Threatened), and Rufous-crested Tanager (*Creurgops verticalis*; Vulnerable in Colombia) in mixed-species flocks, and will model the conditions, both in terms of flock variables and habitat variables, under which these species occur in flocks. We also captured Yellow-headed Manakin (*Chloropipo flavicapilla*; Vulnerable) in mist nets in several fragments, marking the first record of this species in our study area in 20 years. Finally, we also recorded the presence of two at-risk owls, Colombian Screech-owl (*Megascops colombianus*; Near Threatened) and Cloud-forest Pygmy-owl (*Glaucidium nubicola*; Vulnerable) in our study habitat, representing both new localities as well as an eastward expansion of their known range in Colombia.

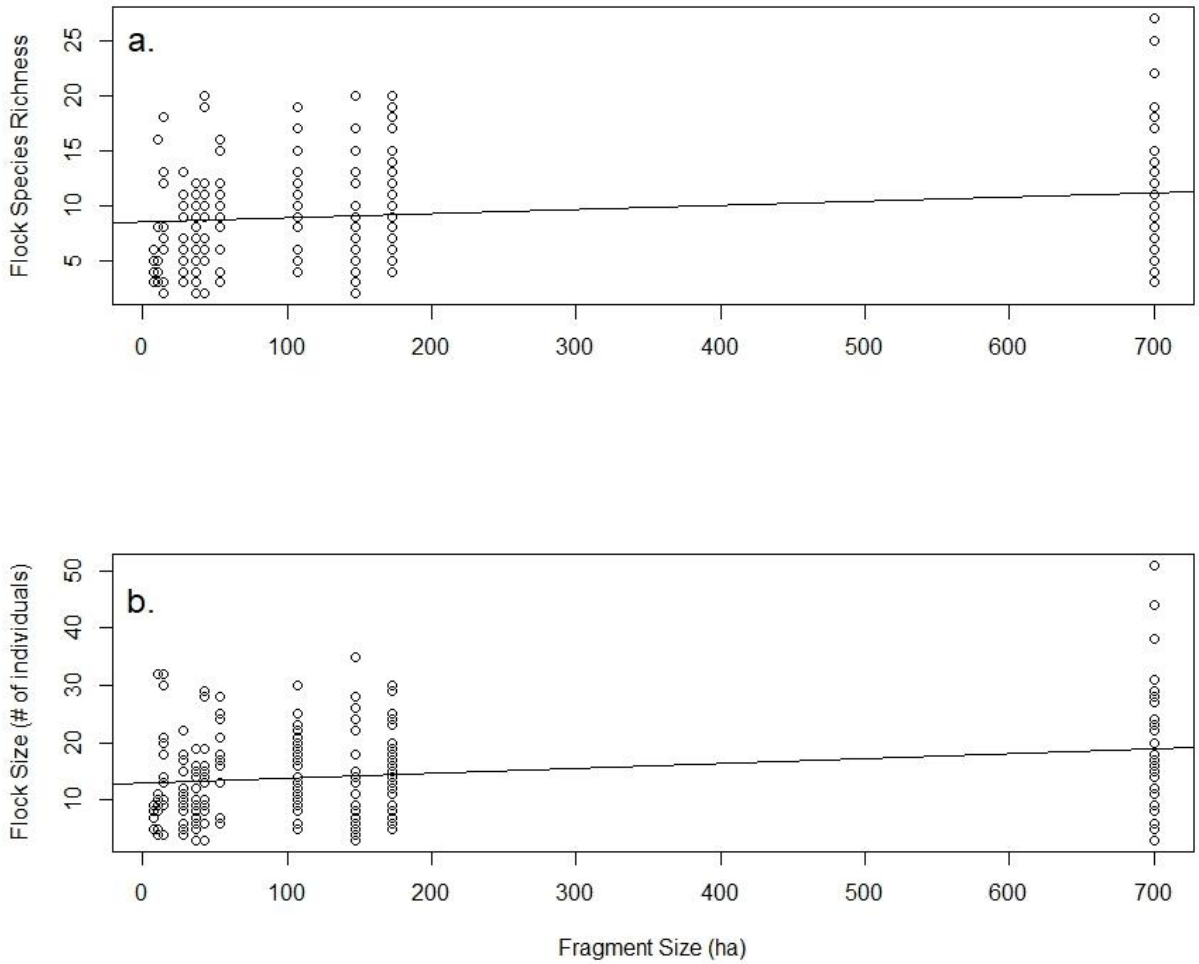

Figure 2. Preliminary data showing reductions in species richness (A) and number of individuals (B) along my fragmentation gradient. Each data point represents an individual flock; trend lines were both statistically significant.

Project Outreach and Mentoring

Over the course of the summer, I was able to engage with local Colombian coffee farmers and a local not-for-profit conservation organization, Serraniagua, in order to further conservation efforts in my study landscape. During each field site visit, my field team and I stayed at local coffee farms and payed local farmers to provide food for us. At each site, we stressed the basic elements of our research, the importance of conserving local forests, and the important diversity of birds and other organisms present at the site through informal conversations. We shared photos of birds captured in our mist nets to showcase species that are generally unknown to local farmers. We also invited all local farmers and their families to visit our banding station in order to see birds in the hand and learn about how we collect scientific data. We were able to share species lists for each of the localities that we visited directly with Serraniagua; many of these sites constitute private nature reserves or are in the process of being classified as such. Our data help the NGO provide scientific evidence for the diversity of species present at each site, a prerequisite for private reserve creation in Colombia. We will be sharing the preliminary results of the research in writing with Serraniagua when analyses are completed, and have already

organized an outreach talk on these results which will be given to the general public in El Cairo in January.

Furthermore, this summer's field work directly helped to advance the research of two Master's students and a Colombian undergraduate student. Blood samples collected from our mist net captures will form the basis of Katye Totten's (Wayne lab, Biology Department, University of Florida) Master's thesis on the prevalence of Flaviviruses in birds in fragmented and unfragmented landscapes. Katye was able to participate in field work in a tropical setting for the first time and learn how to capture and band birds using mist nets. I was also able to help mentor a Colombian field technician, Julio Bermudez, who will be starting a Master's program in Dr. Oscar Murillo's lab at the Universidad del Valle in Cali, Colombia within the next year. We discussed potential research topics and performed some pilot playback experiments looking at whether birds were attracted to the calls of a 'leader' species in the foraging flock. Finally, morphological data on beak size from our mist net captures will be used by another field assistant, Felipe Castro, as part of his undergraduate thesis on animal-plant relationships (seed dispersal by birds) in the El Cairo cloud forest system.

Summer 2017 field crew at Altamira private reserve