

## SYMPOSIUM S-PIF-09

### MIGRATION STOPOVER IN THE NEOTROPICS: FILLING A BLACK HOLE IN FULL ANNUAL CYCLE CONSERVATION

To conserve migratory birds, we must understand their needs at all stages of their life cycle. We must also design conservation strategies that take into account when populations are most vulnerable and where actions can have the maximum positive impact on population dynamics. While our knowledge of carry-over effects and links between different stages of the life-cycle has been increasing exponentially, one major piece of the puzzle is missing. Migration strategies of birds passing through Neotropical regions, despite decades of research and recent technological advances, still remain poorly described, and our nascent knowledge of stopover regions, habitat use and quality, and their impact on population dynamics remain a barrier to full life-cycle conservation planning. At the PIF V conference in Snowbird UT, we convened a session to synthesize existing studies and launch the collaborative *Neotropical Flyways Project*. Today's symposium will focus on how critical knowledge gaps are being filled, showing how by combining results from tracking technologies, stable isotopes and on-the-ground observational and mark-recapture studies we can shed light on one of the least understood aspects of the lives of migratory birds. Presentations will highlight research advances on stopover behaviour/sites/regions within Mexico, Central and South America since the 2013 workshop at Snowbird. We will also facilitate a discussion on how to better coordinate research under the *Neotropical Flyways Project*, holding a networking session for participants from Central America, and how to better integrate research results into landscape-level conservation planning for migratory birds.

#### S-PIF-09-01. OPENING THE BLACK BOX OF MIGRATION STOPOVER: EMERGING PATTERNS IN THE NEOTROPICS

#### LLENADO LOS VACIOS DE INFORMACION DE LAS PARADAS MIGRATORIAS: PATRONES EMERGENTES EN EL NEOTROPICA

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Despite decades of avian research and recent advances in tracking technologies, our knowledge of migration routes, stopover sites, and even overwintering regions for long-distance Nearctic-Neotropical migratory birds remains poor. Efforts to conserve populations of declining migrants throughout their annual cycle are hampered by an incomplete picture of habitat needs and threats for birds passing through Central and South America, even though these Neotropical regions make up a majority of the complete migration route for many species. Recent studies in northern Colombia, combined with accumulating evidence from elsewhere in the Neotropics, have revealed previously unknown stopover regions and highlight the urgent need to identify and protect habitats that support significant refueling by large numbers of birds. Emerging patterns from these new results include: (1) many migratory songbirds exhibit strategies more similar to those of shorebirds, with relatively long stopovers at relatively few sites along the route; (2) single stopover sites used for refueling can have a disproportionately large effect on the success of migration; (3) small passerines may regularly make long, non-stop, inter-continental flights over the Caribbean Sea and Gulf of Mexico; and (4) the most important Neotropical stopover sites may be inland from the coast in native tropical pre-montane and dry forest habitats that are under severe threat. Expanding current research into new regions of northern South and Central America is a high priority and is the focus of the multi-national *Neotropical Flyways Project*, highlighted in this symposium. As we continue to open the black box of migration stopover, incorporating new results into regional conservation strategies will be crucial for preserving the spectacle of hemispheric bird migration.

## **S-PIF-09-02. THE SIERRA NEVADA DE SANTA MARTA OF COLOMBIA: A RESEARCH MODEL OF STOPOVER BEHAVIOR IN THE NEOTROPICS**

### **LA SIERRA NEVADA DE SANTA MARTA EN COLOMBIA: UN MODELO DE ESTUDIO DEL COMPORTAMIENTO MIGRATORIO EN EL NEOTRÓPICO**

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Identifying and protecting important stopover regions for Neotropical migrants is a conservation priority and it requires the use of a wide range of research tools. Since 2009, research in the Sierra Nevada de Santa Marta in northern Colombia has resulted in a compelling body of information illustrating how the region is used for multi-day stopovers by a variety of migratory landbirds during fall and spring, and how habitat quality can influence stopover strategies. Here, we summarize the main findings of this research trajectory. We first demonstrate how stopover use in this region varies by elevation, habitat and between seasons, with unique strategies among species. Next we examine the stopover behavior of our model species, the Gray-cheeked Thrush (*Catbarus minimus*), through a combination of intensive fieldwork including transects, capture-recapture, local and intercontinental telemetry, genetics and stable isotope analyses. The case of the Gray-cheeked Thrush highlights the critical importance of a single stopover site in influencing the outcome of migration, with automated intercontinental radio-telemetry demonstrating that birds leaving in poorer condition may take up to 30 days longer to migrate to Ontario - Canada. We finish by examining how varying habitat quality between forest and shade coffee plantations influences stopover durations and fuel loads, likely having grave carryover effects on subsequent legs of the migratory journey in both Gray-cheeked Thrush and Tennessee Warbler (*Oreothlypis peregrina*). These findings have major implications for the study, conservation and importance of stopover habitats within the context of the annual cycle and can serve as a research model for other regions.

## **S-PIF-09-03. EL CORREDOR NEOTROPICAL DE MIGRACIÓN: LA MIGRACIÓN DE PRIMAVERA EN EL BOSQUE SECO DEL CARIBE COLOMBIANO**

### **NEOTROPICAL FLYWAYS PROJECT: SPRING STOPOVERS IN THE CARIBBEAN DRY FORESTS OF NORTHERN COLOMBIA**

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Las estrategias migratorias de las aves que pasan entre Sur y Norte América son poco conocidas, a pesar de su importancia para determinar el éxito de la migración al cruzar el mar Caribe y para establecer la fecha de llegada en los sitios de reproducción. Después del primer año de investigación del proyecto Corredor Neotropical de Migración, se encontró que el bosque seco tropical al norte de Colombia sostiene altas tasas de ocupación para varias especies durante la migración de primavera. A raíz de este acontecimiento se estableció una estación de anillamiento en un fragmento de bosque seco rodeado por sistemas silvopastoriles. Se abrió la estación diariamente entre el 24 marzo y el 11 mayo 2017; además de anillar las migratorias, se marcaron 30 individuos de cuatro especies con radiotransmisores. Se capturaron 615 individuos de 23 especies de migratorias terrestres, generando 44 recapturas. De siete especies con más de 25 capturas, hubo evidencia de acumulación de grandes reservas energéticas en tres (*Coccyzus americanus*, *Vireo olivaceus*, y *Oreothlypis peregrina*), medianas a grandes en tres (*Empidonax alnorum*, *Setophaga petechia*, *Geothlypis philadelphia*) y medianas en una especie (*E. traillii*). Individuos de *S. petechia*, *O. peregrina* y *G. philadelphia* aumentaron su peso/reservas en un 40% entre capturas, lo que permite vuelos

sin escalas >2500 km. Las duraciones de paradas basadas en radiotransmisores reflejaban las reservas de energía, siendo en promedio de 6,3 días para *C. americanus*, 4,3 días para *G. philadelphia* y 1,7 días para *E. trailii*. Un resultado inesperado fue la captura de ocho *Setophaga cerulea*, lo que implica un rol potencial del bosque seco en su migración. En conclusión, encontramos evidencia para la acumulación de reservas energéticas importantes en varias especies, destacando la importancia de los remanentes del bosque seco en el norte de Colombia para sostener la migración de estas especies.

**S-PIF-09-04. FALL MIGRATION OF THE CERULEAN WARBLER (*SETOPHAGA CERULEA*) THROUGH COSTA RICA WITH NOTES ON ITS HABITAT PREFERENCE, BEHAVIOR, AND DIET**

**MIGRACIÓN SUREÑA DE LA REINITA CERÚLEA (*SETOPHAGA CERULEA*) EN COSTA RICA CON NOTAS SOBRE PREFERENCIA DE HÁBITAT, COMPORTAMIENTO Y DIETA**

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The Cerulean Warbler (*Setophaga cerulea*) (CERW hereafter) has been in the eye of conservationists for many years because of a steady decline in its population. This species covers one of the longest migrations of any small passerine from its breeding to non-breeding grounds, but the routes used to get from one area to the other are still unknown. Here we present the results of 12 years of research in Costa Rica, showing that specific areas on the Caribbean slope of this country are important stopover sites for CERWs during fall migration. Although CERWs were observed occasionally in other parts of the country, only three of our study sites consistently had high concentrations of this species during the last week of August and first two weeks of September, between 100-1000 m.a.s.l. on the NE slopes of Volcán Turrialba. Based on 875 records of CERW, the earliest arrival date was August 11 and the latest date was November 18. Most of our observations of behavior and diet are consistent with other publications, but CERWs were often seen feeding on the fruits of *Conostegia*, *Miconia* and the aril of *Casearia arborea*. The sites with highest concentrations of CERWs are areas under great pressure from human development, especially pineapple and banana plantations, housing developments and the construction of a large hydroelectric plant.

La Reinita Cerúlea (*Setophaga cerulea*) (en adelante CERW) ha estado en la mira de conservacionistas por años debido al constante declive en su población. Esta especie tiene una de las migraciones más largas de cualquier passeriforme pequeño entre sus sitios de reproducción y no-reproductivos, pero las rutas utilizadas para viajar entre un sitio y otro aún permanecen desconocidos. Aquí presentamos 12 años de investigación en Costa Rica que muestran que pequeñas áreas en específico en el Caribe de este país son sitios importantes de descanso y reabastecimiento para CERW durante su migración al sur. Aunque CERWs se observaron ocasionalmente en otros sitios del país, solo tres de nuestros sitios de estudio consistentemente mostraron altas concentraciones de esta especie durante la última semana de agosto y las primeras dos semanas de setiembre entre los 100 – 1000 m.s.n.m. en las faldas noreste del Volcán Turrialba. Basado en 875 registros de CERW, La fecha de arribo más temprano fue el 11 de agosto y el avistamiento más tardío el 18 de noviembre. La mayoría de nuestras observaciones de comportamiento son consistentes con otras publicaciones, pero observamos la CERW alimentarse frecuentemente de frutos de *Conostegia*, *Miconia* y el arilo de *Casearia arborea*. Los sitios donde observamos mayores concentraciones de esta especie están bajo gran presión por desarrollo humano, en especial plantaciones de piña y banano, desarrollo urbano y la construcción de una planta hidroeléctrica.

**S-PIF-09-05. GEOLOCATOR DATA REVEAL PROLONGED STOPOVERS BY GOLDEN-WINGED WARBLERS (*VERMIVORA CHYRSOPTERA*) IN MEXICO AND NORTHERN CENTRAL AMERICA DURING NORTHWARD MIGRATION.**

## **DATOS DE GEOLOCALIZADORES REVELAN PARADAS PROLONGADAS EN MEXICO Y EL NORTE DE CENTROAMERICA DURANTE LA MIGRACIÓN HACIA EL NORTE DE LA REINITA ALIDORADA (VERMIVORA CHYRSOPTERA).**

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Effective conservation of Nearctic-Neotropical migratory birds depends on linking populations through their breeding, migration, and nonbreeding life-stages. For the imperiled Golden-winged Warbler, population declines are thought to result from loss of both breeding and nonbreeding habitat and, to an unknown extent, events that occur during migration. In order to link breeding and nonbreeding populations and establish migratory pathways, we deployed geolocators on male Golden-winged Warblers at nine sites from Guatemala through Panama and one site in NY, USA in 2016. We recovered geolocators with useable data from 21 Golden-winged Warblers. The tracks show a tight link between the Central American wintering population and the Great Lakes breeding population. All individuals migrated north in spring along a more westerly route than in fall, consistent with a looped migration pattern following prevailing winds around the Gulf of Mexico. During northward migration within Mesoamerica, 16 individuals (76%) conducted at least one stopover lasting between 6 and 11 days before crossing the Gulf of Mexico. The four individuals traveling from the southernmost portion of the nonbreeding range all made two stopovers, while five individuals (24%) from the northernmost part of the nonbreeding range moved north to the Yucatan, MX before making a direct trans-Gulf flight to the USA with no significant refueling stops in Mesoamerica. Most stopovers occurred in Chiapas and Veracruz, MX and to a lesser extent in northern Guatemala and Belize, suggesting the existence of important and as-of-yet undescribed migration refueling sites for Golden-winged Warblers in those areas. Our data show prolonged refueling stops to be a dominant migration strategy for the Golden-winged Warbler. We recommend more precise techniques, such as standardized observational surveys and Motus tracking technology, be used to pinpoint important refueling sites and habitats within these areas.

### **S-PIF-09-06. IDENTIFYING STOPOVER SITES IN THE SOUTHERN GULF OF MEXICO**

#### **IDENTIFICANDO SITIOS DE DESCANSO AL SUR DEL GOLFO DE MÉXICO**

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The Gulf of Mexico (GOM) provides stopover habitat for Nearctic-Neotropical migratory landbirds. Extensive past and present research in the northern GOM coast has identified, mapped and evaluated stopover sites in spring and fall migration seasons. Valuable information has been generated regarding the use and selection of stopover sites in the southern GOM coast, but considerably less knowledge exists about their locations in this region. During fall migration, the Yucatan Peninsula represents the first landmass available for trans-gulf migrants that take off from the northern GOM coast west of the Florida panhandle; in spring, the Yucatan Peninsula is one of the platforms used to start or continue northward trans-gulf movements. With the goal of contributing to our knowledge of stopover habitat availability and selection around the whole GOM, we present here the first maps identifying stopover sites in the east and west coasts of the Yucatan Peninsula as detected by weather surveillance radar. We also discuss the scope and limitations on the use of this tool for ornithological research in Mexico. Identifying stopover sites in the Yucatan peninsula will allow creation of decision tools to inform conservation efforts in the region.

**S-PIF-09-07. STOPOVER BIOLOGY AND MIGRATORY CONNECTIVITY OF AVIAN POPULATIONS AROUND THE GULF OF MEXICO**

**BIOLOGÍA EN LAS PARADAS MIGRATORIAS Y CONECTIVIDAD MIGRATORIA DE POBLACIONES DE AVES ALREDEDOR EL GOLFO DE MÉXICO**

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During their twice annual journeys, the majority of the Nearctic-Neotropical migratory birds that breed in the US and Canada congregate in the barrier islands, beaches, marshes, forests and fill the airspace of the Gulf of Mexico. These coastal habitats comprise some of the most important resting and refueling areas for migrating birds. At the same time, coastal ecosystems worldwide are undergoing rapid loss, degradation, and change with unknown consequences for the billions of migratory birds that rely on them. These changes are only likely to increase with shifting global climate patterns and development pressure from growing human populations. Therefore, it is possible that rapid changes in resource availability and climate due to unprecedented human activity may be inflating the costs associated with migration. Understanding the role of regional stopover and airspace habitat in the demography of migratory birds requires information about the 1) distribution, abundance, timing and habitat affiliations of migrants, 2) quality of habitats and condition of migrants in areas where they occur, 3) threats to and current conservation status of key habitats and sites, and 4) how migratory populations are connected throughout the annual cycle. With the advancement of multiple tools, it is now possible to collect these data at a regional scale. We present first results of the regional distribution, abundance, and habitat affiliations of migrants, both on land and in the air, measured with weather radar, migratory connectivity of populations measured with stable isotopes in tissues, and habitat quality measured with long-term banding of migrants on the ground. We are also compiling the distribution of and changes to threats along the Gulf Coast. The objective of this work is to guide the identification and prioritization of habitat for conservation of migratory birds along the US coast of the Gulf of Mexico.

**S-PIF-09-08. INFERRING LOCAL TO CONTINENTAL MOVEMENTS OF INDIVIDUAL MIGRANTS AT STOPOVER SITES BY COMBINING INTRINSIC AND EXTRINSIC MARKERS**

**DETERMINANDO MOVIMIENTOS LOCALES Y CONTINETALES DE AVES MIGRATORIAS INDIVIDUALS EN SITIOS DE PARADA AL COMBINAR MARCADORES INTRINSICOS Y EXTRINSICOS**

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Understanding linkages between breeding and wintering regions and stopover sites used by migratory songbirds can better inform conservation planning. Stopover duration and time of departure from stopover locations are also aspects of stopover ecology of migrants that can be linked to stopover quality and migratory strategies. Over the last decade we have used a number of methods to track such migratory connections and behaviors for several species of Neotropical migrant songbirds using forest and shade coffee sites in Colombia. These methods have involved the use of intrinsic stable isotope markers ( $\delta^2\text{H}$ ,  $\delta^{13}\text{C}$ ,  $\delta^{15}\text{N}$ ) in feathers and blood and the use of extrinsic markers including MOTUS tags, light-sensitive geolocators and gps recorders. We review our approaches using examples primarily from Canada Warbler (*Cardellina canadensis*), Veery (*Catharus fuscescens*), Swainson's Thrush (*Catharus ustulatus*), and Gray-cheeked Thrush (*Catharus minimus*). We propose a strategy that combines these techniques at key stopover sites throughout the range of Neotropical migrants.

#### **S-PIF-09-09. NEOTROPICAL FLYWAYS PROJECT – MAPPING MIGRATORY STOPOVER SITES THROUGH COORDINATED OCCUPANCY SURVEYS IN CENTRAL AND SOUTH AMERICA**

##### **EL CORREDOR NEOTROPICAL DE MIGRACIÓN – MAPEANDO LAS PARADAS MIGRATORIAS A TRAVES CENSOS COORDINADOS EN CENTRO Y SUR AMERICA**

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Individual stopover sites can have a disproportionate effect on the outcome of migration, determining migration duration, timing of arrival at breeding and wintering grounds, and influencing population dynamics through elevated rates of mortality. Yet the routes and stopover sites used by billions of migratory birds in the Neotropics remain largely undescribed. To fill this major knowledge gap, the Neotropical Flyways Project will map migratory stopovers in Central America and northern South America. In 2016, occupancy surveys were carried out at 16 sites across northern Colombia during fall and spring migration, covering the main elevation, vegetation and precipitation gradients through 242 individual transects. Through 3,324 transect repetitions in fall and 4,091 in spring, 20,303 individuals of 67 species and 14,090 individuals of 65 species were recorded respectively. In fall, many species wintering in the Andes showed high occupancy rates in the NW, where the Darién of Colombia and Panama meet. Several species wintering deep in South America made stopovers further east, having apparently crossed the Caribbean Sea, with evidence for a major stopover by Blackpoll Warbler in the dry scrub of the Guajira Peninsula. In spring, three major stopover regions were identified: humid montane and lowland forests in the NW (Bay-breasted Warbler, Swainson's Thrush); lowland dry forest in the central Caribbean (Yellow-billed Cuckoo, Barn Swallow, Willow and Alder Flycatcher, Mourning Warbler); montane forests in the Sierra Nevada de Santa Marta in the NE (Gray-cheeked Thrush, Blackburnian Warbler, Scarlet Tanager). Strong habitat associations included Northern Waterthrush in coastal mangroves and Yellow Warbler in lowland dry forest. These findings, aside revealing previously unknown stopover sites for species of concern like Yellow-billed Cuckoo and Blackpoll Warbler, highlight the complexity of routes and stopover site use along Colombia's Caribbean coast. Future work will expand surveys to Central America.

#### **S-PIF-09-10. PROTECTING MIGRATION STOPOVER SITES AND HABITATS WITHIN ABC'S CONSERVATION COAST BIRDSCAPE**

## **PROTEGIENDO SITIOS DE PARADA Y HABITATS ADENTRO DEL “BIRDSCAPE” DE LA CONSERVATION COAST**

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Now that new information is emerging about the most important stopover sites and habitats to sustain migratory birds on their journeys through the Neotropics, it is vital that this information be incorporated into broader regional bird conservation efforts. One such initiative is American Bird Conservancy's BirdScapes, a new approach to conserve migratory birds across the Western Hemisphere resulting from the efforts undertaken in the 5<sup>th</sup> Partners in Flight International Meeting in Snowbird, Utah. These landscape-scale areas provide, or could provide, habitats that sustain or recover one part of the annual life-cycle of migratory birds in focal geographies. Generally, 75,000 to 1 million ha in size, BirdScapes are landscapes critical as breeding, wintering, or stopover habitats and where conservation actions can have measurable results for targeted migratory bird species. To impact the number of acres required to sustain the great phenomenon of migration, and reverse the decline of many migratory bird species BirdScapes require many partners who share a commitment to conservation actions at a landscape level. American Bird Conservancy has begun to identify BirdScapes in both Latin American and North America. One of the first places where ABC is focusing conservation efforts at a landscape level is in the Conservation Coast of Caribbean Guatemala. Together, with the local NGO FUNDAECO, ABC is working to promote the implementation of bird friendly production systems that can facilitate the restoration and protection of habitat used by migratory bird for stop over and wintering habitat while providing an economic incentive for local landowners. During this session, we will introduce the concept of BirdScapes and provide an example of how strategies and advances underway in the Conservation Coast of Guatemala can protect vital stopover sites for millions of migratory birds.