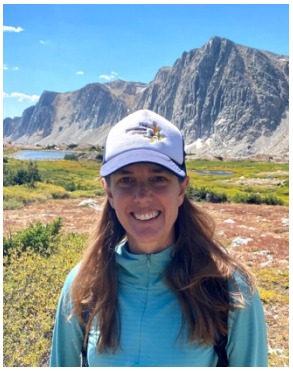
Bird Genoscape Project's Annual Newsletter

Issue 1, Fall 2020

Message from the Directors

Welcome to the Bird Genoscape Project's first annual newsletter!



Co-directors Kristen Ruegg, Tom Smith and their collaborators created The Bird Genoscape Project in 2014 with the goal of using recent advances in genomics to develop population-specific maps of migratory connectivity (coined 'genoscapes') for 100 species of North American migratory birds. From a single feather collected anywhere along the migration routes, Bird Genoscape Project researchers can determine the breeding population of that individual and use resulting information to help inform conservation efforts.

Since the 1990's, the Bird Genoscape Project has collected over 250,000 feather, blood, and tissue samples with your help! We are currently using these feathers to create genoscapes for ~20 species of North American migratory birds. Our newsletter is an opportunity for us to share the results of this collaborative effort with you. Because our focus is on strengthening partnerships across the full annual cycle, each newsletter will have a section dedicated to highlighting exciting new projects on the breeding grounds and the wintering grounds.

What is inside this issue?

Happy reading!

Sincerely,

Kristen & Tom

Kristen Ruegg Thomas B Smith

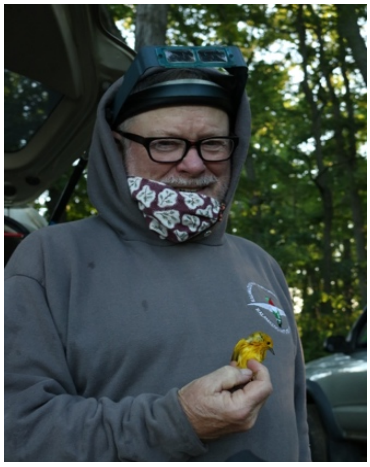
birdgenoscape@gmail.com

www.birdgenoscape.org

Collaborator Highlights

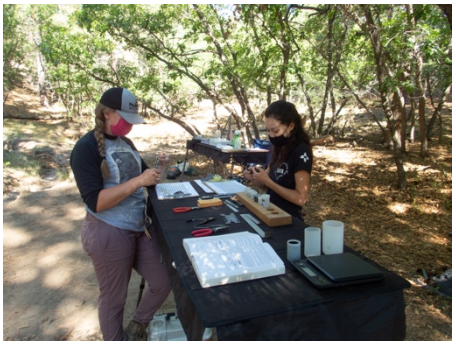
From the breeding grounds….

Despite obstacles presented by the pandemic, BGP scientist Marina Rodriguez and her collaborators were successful in launching a new study this summer focused on determining the extent to which climate change is impacting survival and fitness in yellow warblers. To carry out this study, Marina is following up on previous work by BGP scientist, Rachael Bay, who used genomics to identify which populations of yellow warblers will have the most trouble adapting to changing climate conditions (Bay et al. 2018). In contrast to Rachael's work, Marina will be asking, ***"Are populations predicted to have the most trouble adapting to future climate change already showing signs of climate-induced stress?"*** To answer this question Marina will use a novel proxy for stress and fitness in birds – the length of a yellow warbler's telomere.

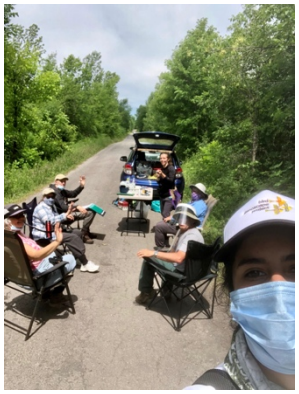


Rich Keith, from the MAPS station at Kalamazoo Bird Observatory in Michigan, with a Yellow Warbler in hand.

What is a telomere you ask? Telomeres are caps at the end of DNA sequences that protect chromosomes from damage. Telomeres shorten with age as well as stress, and the rate of telomere shortening is highly correlated to survival (higher rate of shortening means lower expected lifespan). Because of this correlation, telomere shortening is often used as a proxy for fitness and survival in ecological studies. The link between telomere loss and environmental stressors in birds makes rate of telomere shortening an ideal measurement when evaluating climate vulnerability in yellow warblers. To calculate the rate of telomere shortening in yellow warblers over the course of a year, telomere length (measured from blood samples) will need to be measured twice, once in the summer of 2020, and again in the summer of 2021. As yellow warblers have a breeding distribution that extends across North America, collecting samples across the species' range is a large undertaking.



Audrey Sanchez and Elisa Abeyta from Los Alamos National Laboratory MAPS station in New Mexico taking measurements of Yellow Warblers.



Montée Biggar MAPS station crew social distancing while they process birds.

To collect the data required for the project and sample as many populations as possible, Marina is collaborating with numerous groups of dedicated bird banders who are as passionate about the conservation of birds as we are. These collaborators include the Institute for Bird Populations (IBP), the Bird Conservancy of the Rockies (BCR), and individual people who have donated their valuable time and effort to the project. Twenty stations began collecting samples this summer, from eleven different U.S. states plus two stations in Quebec, Canada. Even with Covid-19 causing many stations to limit their crew sizes, banders have persisted in their sampling efforts and have proven to be an invaluable asset to the study.

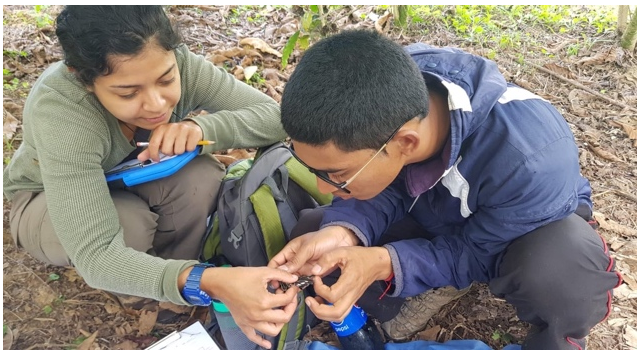
THANK YOU SO MUCH to all of the collaborators who have donated their time and skills to this effort. This project would be impossible without you, and we are lucky to have you on our team. We look forward to sharing the results of this work in a future edition of our newsletter so stay tuned!!

Collaborator Highlights

....to the wintering grounds

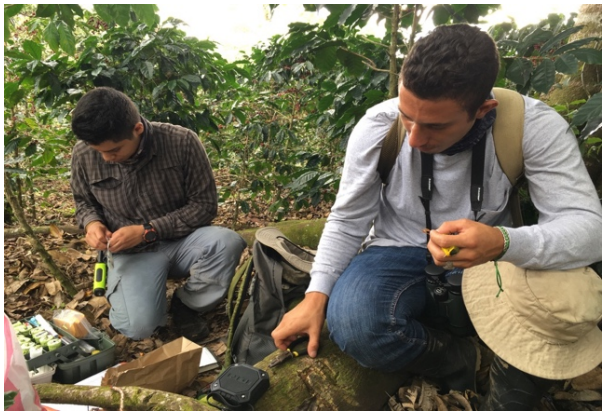
After the summer breeding season, BGP researchers have been following their feathered friends to South and Central America in order to study them on their tropical wintering grounds. For some migratory birds, loss and degradation of winter habitat may be the biggest problem they face. For example, one study authored by Drs. Caz Taylor (Tulane University) and Bridget Stutchbury (York University) found that forest loss in Central America was likely to be the primary cause of long-observed declines in Wood Thrushes (*Hylocichla mustelina*). This study piqued the interest of Honduran biologist, Fabiola Rodríguez, who, after reaching out to Dr. Taylor, is now a PhD candidate at Tulane University. The question that intrigues Fabiola is: "***If winter habitat loss, especially in Honduras, is the most population-limiting factor for some Neotropical migratory songbirds, what are the main drivers of population limitation?"***

In Honduras, the biggest driver of forest loss is conversion to coffee. Coffee production in the country has increased by 0.3 coffee bean tonnes per hectare/year over the last ~ 15 years while forest has declined from ~57% of the country's land area to ~ 41% in the same time period. Coffee is necessary to sustain the people of Honduras – it is the country's biggest and most valuable export – but forest is necessary too, not only to sustain birds and other wildlife, but to prevent runoff and maintain water supplies.



PhD candidate Fabiola Rodríguez (left) and David Murillo (MDI) evaluating tail feathers from a Magnolia Warbler to gauge age features.

In the coffee growing mountains of Yoro, Honduras, Fabiola and a team of Honduran biologists from the Mesoamerican Development Institute are exploring a coffee production method that preserves forest on private farms while still providing income from coffee. They have conducted multiple types of avian surveys, collecting data to evaluate different metrics that can reveal bird habitat use and quality. As an example, the team has monitored bird species found on the farms in order to investigate variation in sex- and age-specific habitat use the working landscapes. While some birds are easily sexed in hand due to their feather coloration, others remain a mystery such as the Wood Thrush. To solve this mystery, Fabiola is collaborating with Bird Genoscape Project (BGP) researchers Teia Schweizer and Dr. Kristen Ruegg (Colorado State University) to genetically determine the sex of all individuals that could not be sexed in the field. Feather samples from all species of interest have been contributed to the BGP and will also be used to improve our understanding of population-specific migratory routes for these coffee farm wintering birds. We look forward to future updates and collaborations with Fabiola and her team as her thesis research progresses!



Darío Alvarado (left) and Denis Velásquez (right), Mesoamerican Development Institute (MDI) researchers, collecting data from a Wilson's Warbler in a coffee farm study site in Honduras.

Updates

What have we been up to?

Dr. Marius Somveille was awarded 3 prestigous post-doctoral fellowships (only one of which he was able to accept) to continue his work with the Bird Genoscape Project, The Cornell Lab of Ornithology Rose Fellowship (declined), the Marie Curie Global Fellowship (declined), and the University of College London Excellence Fellowship (accepted). Way to go Marius!

Dr. Kristen Ruegg received a National Science Foundation CAREER award of $1.18 million to continue research on connecting the process of natural selection in migratory bird populations across their full migratory cycle.

Marina Rodriguez and **Matthew DeSaix**, doctoral students in the Ruegg lab, were awarded funding from the Colorado Field Ornithologists. Marina was additionally awarded the Hesse Award from the American Ornithological Society as well as a scholarship from the Biology department for her excellence in promoting diversity initiatives at Colorado State University.

Matthew DeSaix headed out on his first field season to fill in critical gaps in sampling for the American Redstart, a long-distance Neotropical migrant with broad wintering and breeding ranges. Matt's research aims to address whether there is a link between adaptive divergence and migratory connectivity, and whether that connectivity influences genomic vulnerability.

Dr. Ryan Harrigan, Dr. Kristen Ruegg, and Dr. Thomas B. Smith were awarded a 1.5 million dollar grant from the Department of Energy to continue work assessing the impacts of solar energy development on migratory birds.

Dr. Luz Zamudio and **Dr. Rafael Hernández** were awarded prestigious Mexican Postdoctoral Fellowships from the Autonomous University of Mexico (UNAM) to continue their work on the Bird Genoscape Project. Dr. Zamudio will focus on conservation genomics of the common yellowthroat, while Dr. Hernández will focus on conservation genomics of the painted bunting.

Ingrid Tello-Lopez, MS student at the Yucatan Center for Scientific Research, completed her first field season on yellow warblers on their Yucatan wintering grounds and is gearing up for her second. Ingrid's research question is: "Do yellow warblers with genotypes linked to wetter breeding areas select wetter wintering areas?" We look forward to future updates from Ingrid!

Taylor Bobowski, MS student in the Ruegg lab at Colorado State University has spent the past year using feathers collected by collaborators over the past two decades to analyze population-specific patterns in the timing of spring migration in common yellowthroats. Using genetic markers, he has been able to identify significant differences in migratory timing between populations.

Dr. Tom Smith received the Elliott Coues Achievement Award for outstanding and innovative contributions to ornithological research.

Genaro Rodríguez Otero, MS student at UNAM and **Caitlin Miller**, MS student in the Ruegg lab at Colorado State University joined the team this year to work on Wilson's warblers and Canada warblers, respectively. Welcome to the team Genaro and Caitlin!

Whitney Tsai Nakashima, PhD Student at UCLA, received a National Science Foundation Graduate Research Fellowship and a grant from the Latin American Institute at UCLA. Nice job Whitney!!

Updates

BGP in the news….

New York Times Magazine published an article featuring the Bird Genoscape Project's international feather collection efforts entitled, "How to Pluck a Feather" (https://www.nytimes.com/2019/12/05/magazine/how-to-pluck-a-feather.html)

National Wildlife Magazine highlighted the Bird Genoscape Project in an article focused on technological advances in bird-migration research entitled, "Going the Distance" (https://www.nwf.org/Magazines/National-Wildlife/2019/Oct-Nov/Conservation/Bird-Migrations)

The Bird Genoscape Project was featured in a **National Geographic Education** documentary entitled, "Tails of a Feather" (https://www.nationalgeographic.org/media/tales-tail-feather/). The goal of the documentary is to teach students in grades 8–12 about DNA and bird migration.

The Atlantic Magazine quoted BGP researcher, Dr. Kristen Ruegg, in an article about avian declines over the last 30 years entitled, "Quiet Disappearance of North American Birds" (https://www.theatlantic.com/science/archive/2019/09/america-has-lost-quarter-its-birds-fifty-years/598318/)

BGP researcher, Dr. Kristen Ruegg was interviewed on **NPR's, All Things Considered** about North American Bird Declines (https://www.npr.org/2019/09/19/762090471/north-america-has-lost-3-billion-birds-scientists-say)

Drs. Tom Smith, **Kristen Ruegg**, and **Rachael Bay** were featured in a live stream conversation on biodiversity for World War Zero, a website and magazine dedicated to reducing climate change (https://www.facebook.com/WorldWarZeroOrg/videos/349180502965820)

Publications

1. K. C. Ruegg, Ryan J. Harrigan, James F. Saracco, Thomas B. Smith, Caz M. Taylor. 2020. A genoscape-network model for conservation prioritization in a migratory bird. *Conservation Biology*. doi: 10.1111/cobi.13536.
2. R.A. Bay, D.S. Karp, J.F. Saracco, W.R.L. Anderegg, L. Frishkoff, D. Wiedenfeld, T.B. Smith, K.C. Ruegg. 2020. Genetic variation reveals individual-level climate tracking across the full annual cycle of a migratory bird. https://www.biorxiv.org/content/10.1101/2020.04.15.043331v1
3. Bay, R. A.**, R. J. Harrigan, W. Beurmann, V. L. Underwood, H. L. Gibbs, T. B. Smith, and K. C. Ruegg. 2018. Response to comment on "Genomic signals of selection predict climate-driven population declines." *Science*. 361(6401): 1-2, doi: 10.1126/science.aat7956
4. Ruegg, K. C., R. A. Bay**, E. C. Anderson, J. Saracco, R. J. Harrigan, M. Whitefield, E. H. Paxton, T. B. Smith. 2018. Ecological genomics predicts climate vulnerability in an endangered southwestern songbird. *Ecology Letters*. 21(7): 1085 – 1096.

Updates

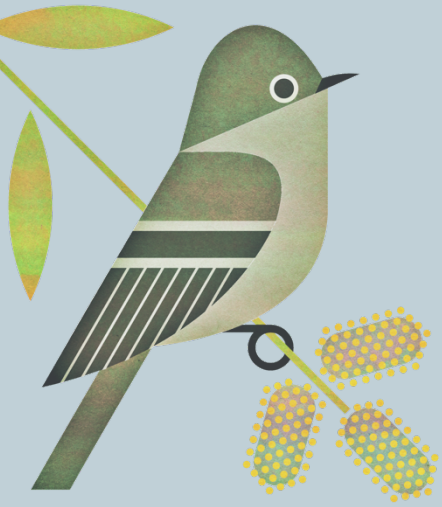
Publications continued…

5. K. C. Ruegg, Michaela Brinkmeyer*, Christen M. Bossu**, et. al. 2020. The American Kestrel Genoscape (*Falco sparverius*): Implications for Monitoring, Management, and Subspecies Boundaries. *Ornithology*. 138.
6. Kelly Barr, Beichman, A, Kalhori, P., Rajbhandary, J., Bay, R., Ruegg, K., and Smith, T. 2020. Persistent Panmixia Despite Extreme Habitat Loss and Population Decline in the Threatened Tricolored Blackbird (*Agelaius tricolor*). *Evolutionary Applications*. https://doi.org/10.1111/eva.13147
7. Funk, Erik R., G.M. Spellman, K. Winker, J.J. Withrow, K.C. Ruegg, E. Zavaleta, S.A. Taylor. 2020. Phylogenomic data reveal widespread introgression across continental islands in an alpine specialist. *Systematic Biology*. https://doi.org/10.1093/sysbio/syaa071
8. Contina, A., R.A. Bay, V. L. Underwood, T. Smith, J. Kelly, E. Bridge, K.C. Ruegg. 2019. Characterization of SNP markers for the Painted Bunting (Passerina ciris) and their relevance in population differentiation and genome evolution studies. *Conservation Genetics Resources*. 11(1): 5-10.
9. Contina, A., J. L. Alcantara, E. Bridge, J. D. Ross, W. F. Oakley, J. Kelly, K.C. Ruegg. 2019. Genetic structure of the Painted Bunting and its implications for conservation of migratory populations. *IBIS*. 161(2): 372-386.

Sampling update

In 2019, we received 3,490 blood and feather samples. We're still working through 2020 samples, but it looks like we are off to a great start. Thank you so much to all of our amazing collaborators and contributors!!

THANK YOU TO OUR AMAZING CONTRIBUTORS!



Emily Cohen
Anjolene Hunt
Julie Heath
Brice Leech
Chuck Hathcock
Debra Chromczack
Diane Luck
Eric Soehren
Gigi Gerben
Jeff Port
Jodi Isaacs
Kristina Mitchell
Lori Walewski
Sarah Milligan
Scott Rush
Solny Adalsteinsson
Stacey Hayden

Tim Brown
Darlene Woodbury
Paul Fehringer
Venna Boccadori
Esteban Martínez Pastur
Cyndi Smith
Patricia Ortiz
Fabi Vasquez
Lynne Trulio
Walter Sakai
Jill Deppe
Colin Woolley
Al Sherkow
Cathy Pohl
Danielle Kaschube
David Toews
Jeffrey Larkin

Junior Tremblay
Kate Slankard
Lauren diBiccari
Bob Frey
Lauren Helton
Mary Whitfield
Matthias Bieber
Nick Kerlin
Patti Wohner
Rafa Rueda
Rheanna Neidinger
Stefanny Villagomez
Krysta Rogers
Peter Marra
Peter Copainolo
Andrea Contina
Judy Woods

Greg Levandoski
Ian Stewart
Fabiola Rodriguez
Cathy Nowak
Tim Kita
Andrea Patterson
Rich Keith
Clifford Berek
John Loegering
Simon Duval
Heidi Carlisle
Robert Thobaben
Merideth McBurney
Shannon Mendia
Richard Lewis
Gordon Howard
Dusti Becker