High-resolution mapping of population specific flyways using DNA sequencing

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Challenge 1: To produce clean, renewable energy that will help reduce the pace of climate warming while having a minimal impact on natural populations.
Challenge 2: Few animals are more extensively impacted by renewable energy development than migratory birds, but understanding the population specific impacts of disturbance has been hampered by the lack of an efficient, reliable, and accurate methodology for identifying migrant populations.
Our Solution: High-Resolution Genetic Tags

Tissue at base of feather contains DNA

Identify unique genetic code that allows us to trace the breeding origin of migrants captured anywhere along their migratory trajectory.
How does it work?
Case Study - Yellow Warbler
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Case Study - Yellow Warbler

Little was known about *population specific* migration patterns.
Yellow Warbler - Conservation Status

IUCN status: Least concern
Yellow Warbler - Conservation Status

IUCN status: Least concern

Breeding Bird Survey Trends

- Increasing
- Slightly increasing
- Slightly decreasing
- Decreasing
Yellow Warbler - Conservation Status

IUCN status: Least concern

Patterns of declines in the Yellow Warbler are population specific
Yellow Warbler - Conservation Status

What we need is a population specific map of migration flyways

Patterns of declines in the Yellow Warbler are population specific
Step 1: Build a Map of Genetic Variation Across Geographic Space
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Identify base pairs that are unique to a particular population
Step 1: Build a Map of Genetic Variation Across Geographic Space

- Arctic
- Northwest
- Western US
- Central
- Eastern
Step 2: Trace the Origin of Migrants using DNA from Feathers
Center for Tropical Research Feather Collection

- >200,000 feathers
- >50 species
- >20 year time series
Step 2: Trace the Origin of Migrants using DNA from Feathers

Rapid Feather Screening Pipeline

- Can screen \(~800\) feather samples/week.
- Works well with low quantity and degraded DNA (97% reliability).
Step 3: Map Population Specific Migratory Flyways
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Total: 40 birds
Step 3: Map Population Specific Migratory Flyways
Goal: Map 50 species by 2020
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-> we are 20% of the way there!
Extension: Climate vulnerability

[Map of North America showing climate vulnerability levels with a legend indicating low vulnerability in blue and high vulnerability in orange.]
Extension: Climate vulnerability

![Map showing climate vulnerability across the United States with color coding for increasing, slightly increasing, slightly decreasing, and decreasing regions.]

- Increasing
- Slightly increasing
- Slightly decreasing
- Decreasing

Legend:

- Low Vulnerability
- High Vulnerability
Regions with high **vulnerability** have already experienced population **declines**.
Thank you to our funders:

And several anonymous donors