USING STABLE ISOTOPES & eBIRD TO ASSESS MIGRATORY CONNECTIVITY OF FALL MIGRATING RAILS

Auriel M.V. Fournier

PhD Candidate, Arkansas Cooperative Fish and Wildlife Research Unit, University of Arkansas

aurielfournier@gmail.com, 419.307.6261

Rails are among the least studied birds in North America, despite their declining populations and the increasing pressure being put on public wetlands to be managed for multiple species. The timing of Sora, Virginia Rail and Yellow Rail *(Porzana carolina, Rallus limicola, Coturnicops noveboracensis)* migration, and how their populations are connected are vital parts of understanding how wetland management impacts rails. My project is documenting the timing of rail migration across Missouri and has noticed differences in the timing of birds in western vs eastern Missouri. I hypothesize these differences are because Missouri straddles the Central and Mississippi Flyways so these birds are coming from different parts of the breeding range. Because of the low detectability of rails and the lack of large scale captures I believe stable isotopes provide a great way of assessing if these rails are coming from different parts of their breeding range.

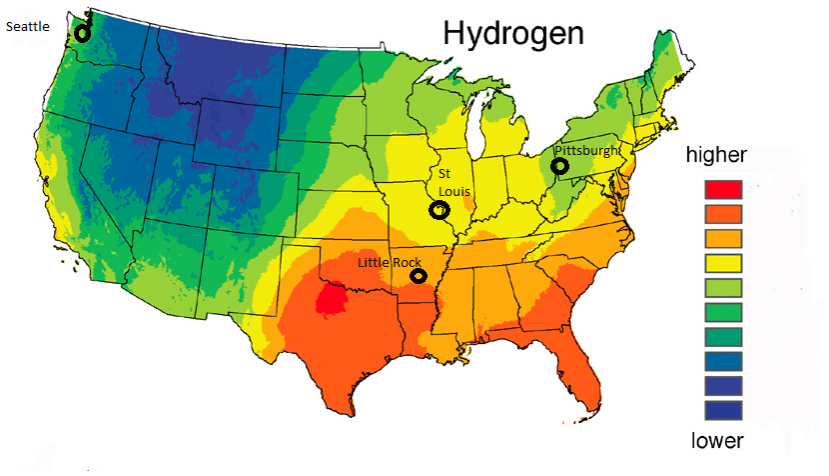

Figure 1. Hydrogen Isotope Basemap of the United States

Stable isotopes offer the main advantage of only having to capture an individual one time but the resolution of the geographic assignment is limited. While hydrogen isotope-based ($\delta 2H$)

assignments achieve good latitudinal resolution, broad longitudinal swaths of North America share similar $\delta 2H$ values (Sullivan et al. 2012). Rails breeding as close together as Little Rock and St. Louis will be isotopically distinct, while rails as geographically separate as Pittsburgh and Seattle will be indistinguishable (Figure 1). Assignments can be improved if other information, such as species distributions, are taken into account (Van Wilgenburg and Hobson 2011, Fournier & Sullivan (in prep)). I will use of eBird data to create a species distribution model to help inform isotopic assignment in a Bayesian framework. My project is an informative first step to understand the migratory connectivity of rails in the central United States. I propose using Yellow, Virginia Rail and Sora feathers collected in the summer in Saskatchewan Missouri to assess differences in breeding range between the eastern and western regions of the state. I will use summer feathers collected in Saskatchewan to ground truth isotopic valuesi.

METHODS

Capturing Birds

On the breeding grounds rails will be captured at night on foot with drag lines and hand nets. During migration they will also be caught with hand nets, but will be flushed from ATVs. Each rail will be banded and have their first primary feather taken. Yellow Rails will have morphometric measurements and a blood sample taken for the development of a morphometric model to predict their sex.

Stable Isotope Assignment

Feathers from the breeding grounds will be used to ground truth the hydrogen isotope map since they will have a known origin and hydrogen varies from year to year, so ground truthing the map with feathers collected the summer before is vital. I will capture Sora, Yellow and Virginia Rails in Saskatchewan in July 2015 and analyze the feathers in Keith Hobson's lab at the University of Saskatchewan. Feathers captured during migration in Missouri will be analyzed in the same way, but because their breeding ground origins are unknown I will use the ground truthed hydrogen map to assign them to an area. Due to sources of variation, the $\delta 2H_{feather}$ values expected

from any given site are best characterized as a distribution of potential values (Sullivan et al. 2012). Therefore, I will represent the summer origins of the bird as a normal density function to assign a probability that an individual originates from a pixel on the raster, given the expected mean of the pixel and the standard deviation of the residuals from the regression (Royle 2004).

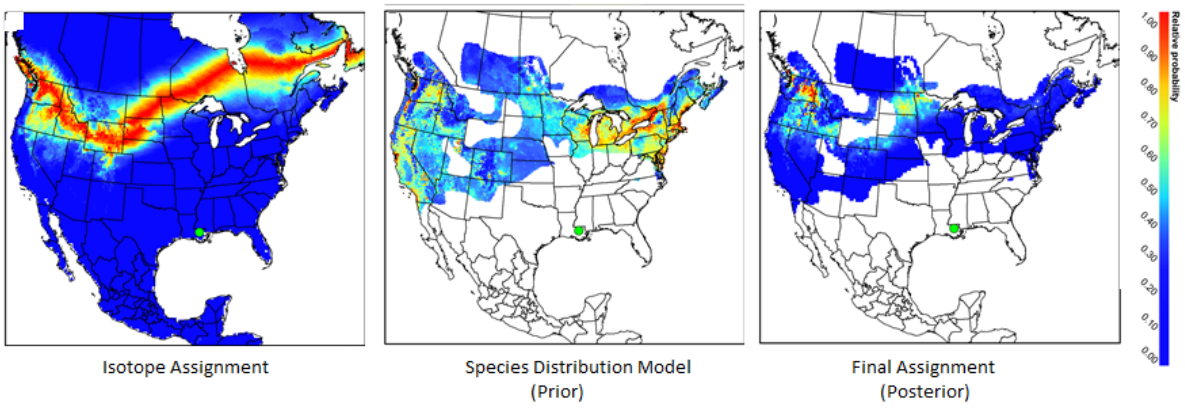

Figure 2. Assignment of Virginia Rail Captured in Louisiana - Fournier & Sullivan et al (in prep)

Species distribution model

Maximum entropy species distribution models (SDMs) use georeferenced presence-only data and environmental variables (e.g. mean annual temperature, precipitation) to predict the potential distribution of a species (Phillips et al. 2006). The maximum entropy method finds the constraints imposed by the environmental variables through regression and restricts the uniform probability subject to these constraints. The importance of environmental variables are assessed through leave-one-out jackknifing. Presence data for each rail species will be crowd-sourced from the citizen-science eBird database (Sullivan et al. 2009).

Bayesian analysis

SDMs do not contain information regarding the specific individual (Figure 2 middle) while $\delta 2H$ models are naive to ecology and may predict high probability of occurrence in places where rails are unlikely to live (Figure 2 left). Thus, I will incorporate the SDM as prior information for the stable isotope assignment using Bayes' rule, where the posterior probability that a given pixel on

the raster represents the origins of the focal bird is modeled from the probability of Sora occurrence based on the maximum entropy SDM, and the $\delta 2H$ assignment (Figure 2 Right).

MANAGEMENT IMPLICATIONS

Understanding the connectivity of rails across the state of Missouri will allow us to better understand how rails move in the Central and Mississippi Flyways, this combined with the timing information gathered by my project, the wetland management experiments my project is completing and the population estimates that will soon be available from the National Marshbird Monitoring Program managers will be able to make science based decisions about wetland management and rail conservation.

FACILITIES

Dr. Keith Hobson of the University of Saskatchewan has agreed to process my feather samples in his lab. The Arkansas Cooperative Fish and Wildlife Research Unit provides the vehicles and equipment to access the sites. Missouri Department of Conservation and the U.S. Fish and Wildlife Service have agreed to give us access to the properties in Missouri. I have access to areas in Saskatchewan through Dr. Keil Drake of Bird Studies Canada.

Table 1. Time Table

July 2015	Collect breeding ground feathers in Saskatchewan
August - October 2015	Collect fall migration feathers
November - December 2015	Prepare feathers for analysis
January - February 2016	Run samples at University of Saskatchewan
March - May 2016	Analyze and write up results & Submit for publication
July 2016	Defend dissertation

Table 2. Proposed Budget 2015-2016 Academic Year

	EBBA Research Grant	USFWS Webless Gamebird Program	University of Arkansas
Status of Funding	Requested	Secured	Secured
Technician Salary		3000	
Graduate Student Salary		3500	23000
Vehicle (gas) for Fall Field Work		4000	
Mass Spec ($15 x 66)	990		
Totals by Funding Source	**990**	**10500**	**23000**

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