

Cerulean Warbler Migration Strategy

The Next Frontier



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The migration period is the blackhole in our understanding of the mortality factors in the annual cycle of most migratory birds.

For many species we know something of their migration route from sight and banding records.

Not so for the CERW.

They seem to depart the breeding grounds and mysteriously show-up on the wintering grounds with few records in between.

Importance of migration ecology

- Up to 85% of annual mortality may occur during migration (Sillett and Holmes 2002)

We know that this is an important period and may hold the key to understanding the declining trends of many species.

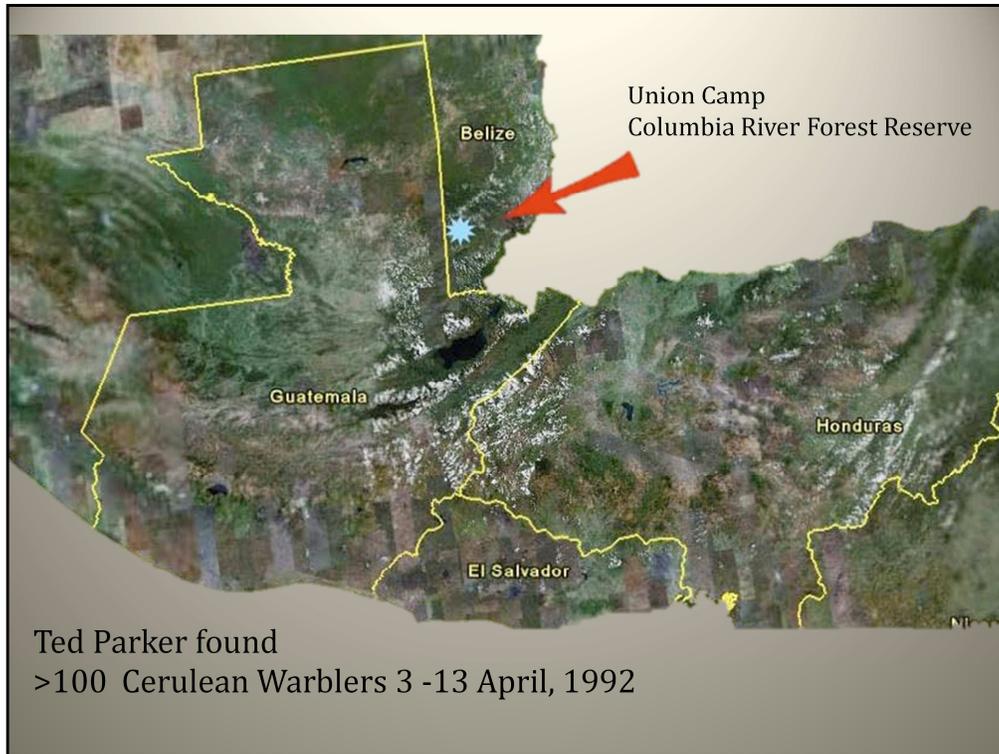
Importance of migration ecology

- Up to 85% of annual mortality may occur during migration (Sillett and Holmes 2002)
- As much as a quarter of the annual cycle is spent away from breeding/non-breeding grounds

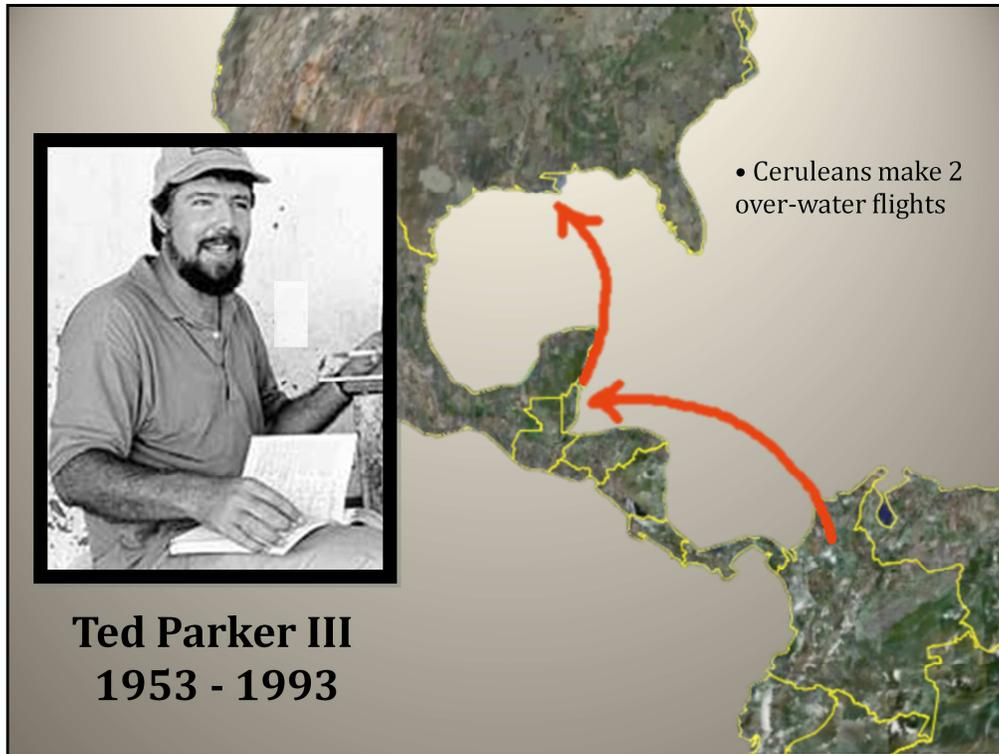
Importance of migration ecology

- Up to 85% of annual mortality may occur during migration (Sillett and Holmes 2002)
- As much as a quarter of the annual cycle is spent away from breeding/non-breeding grounds
- Conservation requires meeting species needs throughout the annual cycle

Being the fastest declining songbird in eastern N. A. conservation requires meeting species' needs throughout the annual cycle



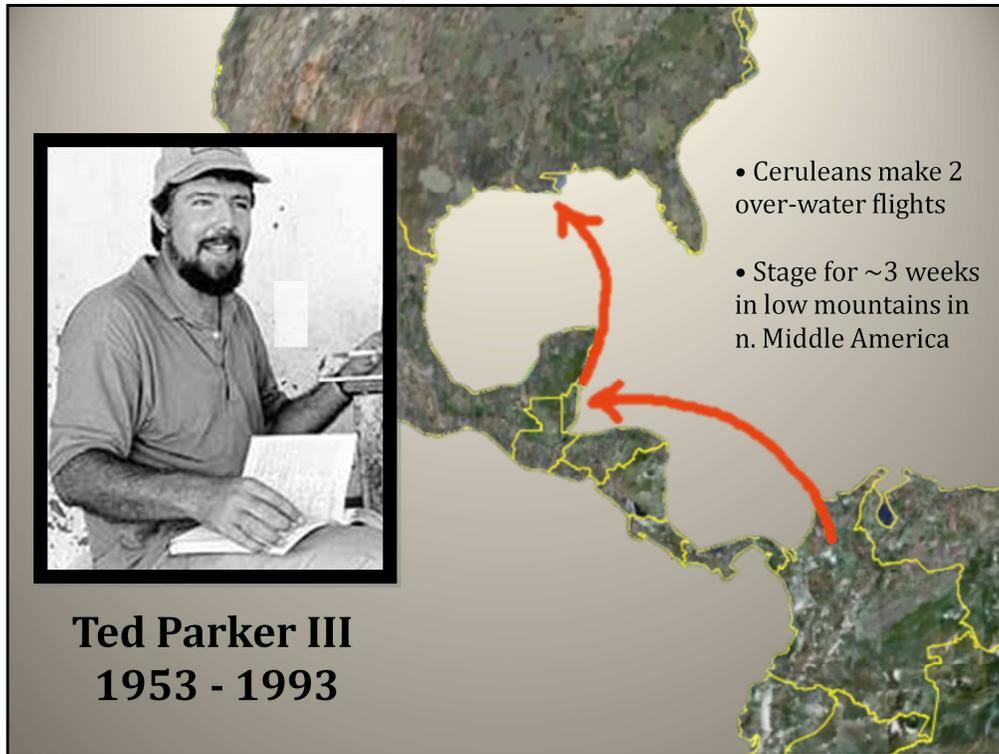
The only migration data we had was from a remote area in the Columbia River Forest of Belize
Where Ted Parker found over 100 CERW in mixed sp flocks over the course of 10 days



Ted Parker suggested that CERW move to n. Columbia; fly across the W. Caribbean; stage for ~ 3 weeks in low mountains in n. Middle America; then fly across the Gulf

this was a novel hypothesis that CERW were making 2 over water flights

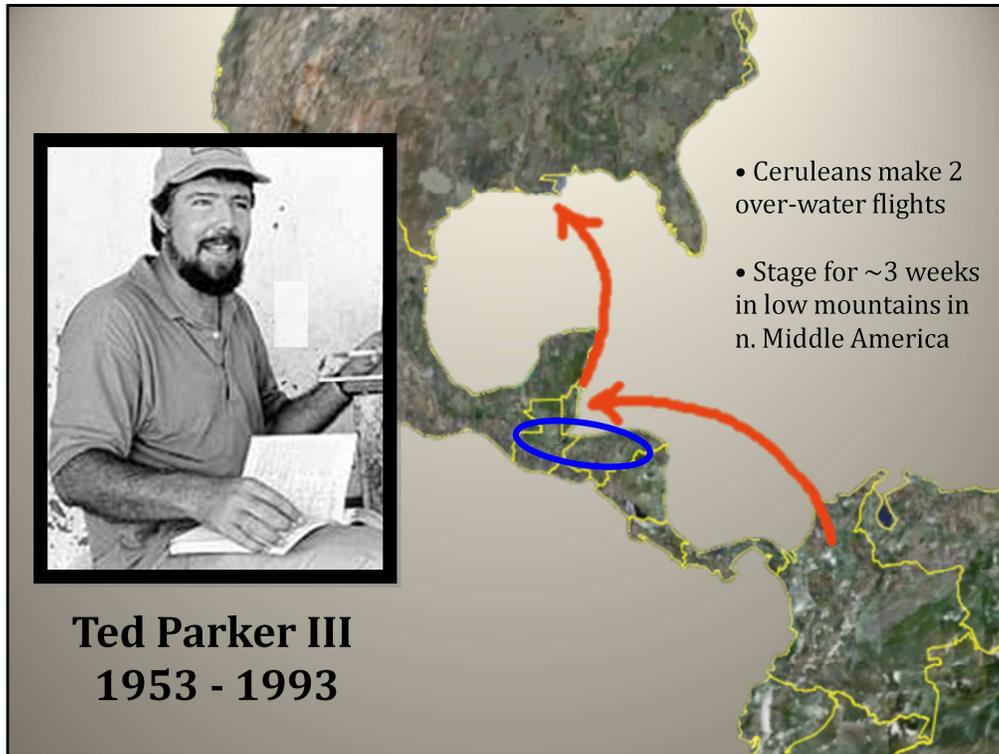
He suggested they would stop in a relatively small area from se Chiapas, Mexico, s. Belize, and Caribbean facing slopes of Guatemala, Honduras, and possibly Nicaragua



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2004 Belize Expedition



April 2 - 5, 2004



A small expedition was mounted into the site where Parker had made his observations. It was an arduous 3-day journey over and under hurricane-tossed trees to Union Camp. (Parker took a US military helicopter)

2004 Belize Expedition



April 2 - 5, 2004

Cerulean Warbler
was the most frequently encountered migrant

Stopover Project Goals 2005-2007

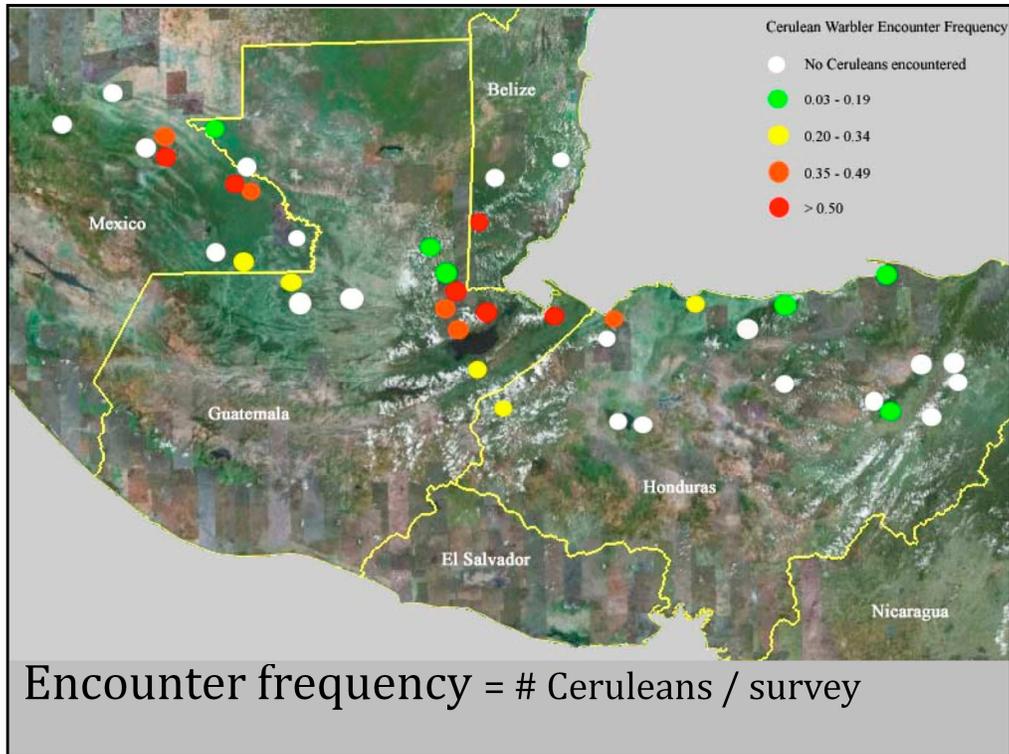


- Test Parker's predictions for timing and location of Cerulean "staging area."
- Develop and test a predictive model for Cerulean stopover occurrence

Surveys were conducted in areas where there were historic observations, Areas that conformed with Parker's predictions of low montane wet forests on Caribbean-facing slopes

In 2007, areas predicted to be CERW stopover areas

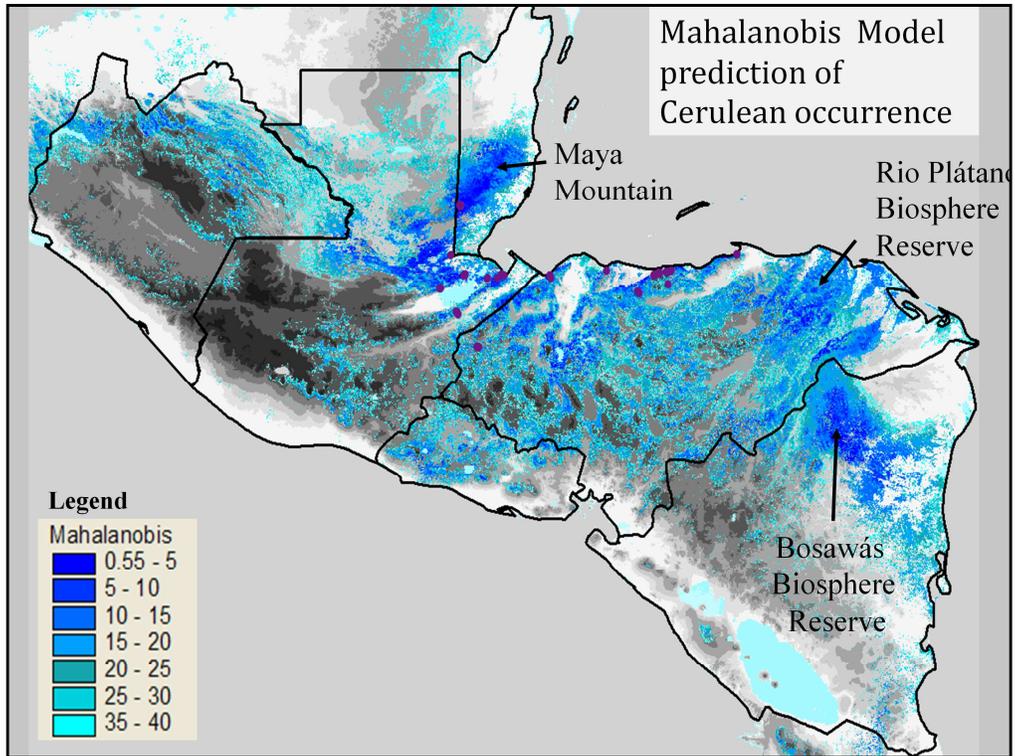
Several sites were visited more than once in a season or in subsequent years



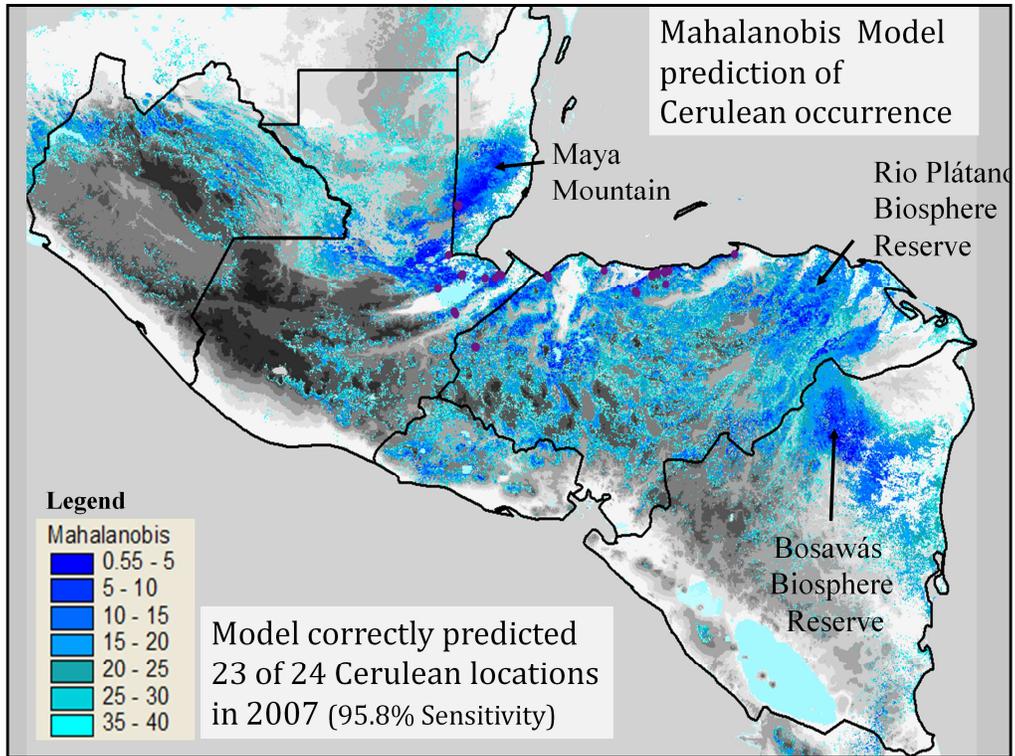
What we found generally conformed to Parker's predictions.

Encounter Frequency = #CERW / survey

We returned to several high-frequency sites and found CERW in subsequent years.



The location of each CERW observed from 2004-2006 was associated with remotely-sensed information on Habitat and climate. By relating these environmental variables to CERW occurrences, the model makes predictions at unsampled areas and generates a map of predicted CERW occurrence.



Model adequately predicts Cerulean Warbler presence

23 of the 24 locations where CERW were found in 2007 were correctly predicted by the model (**Sensitivity: 95.8%**)

There were 60 survey locations where no CERW were found but because of lack of survey time predicted absences could not be tested.

Results



Country	Total surveys conducted	Hours of surveys	CERW observed
Belize	9	31	16
Honduras	79	302	31
Guatemala	70	262	62
Nicaragua	11	45	9
Mexico	19	62	16
Total	177	702	134

22 Additional ad hoc CERW observations

98 Male
35 Female
1 Unknown

Still, we found relatively few birds.

If the majority of CERW need to stop $\frac{1}{2}$ way between South and North America, where are they?

Results



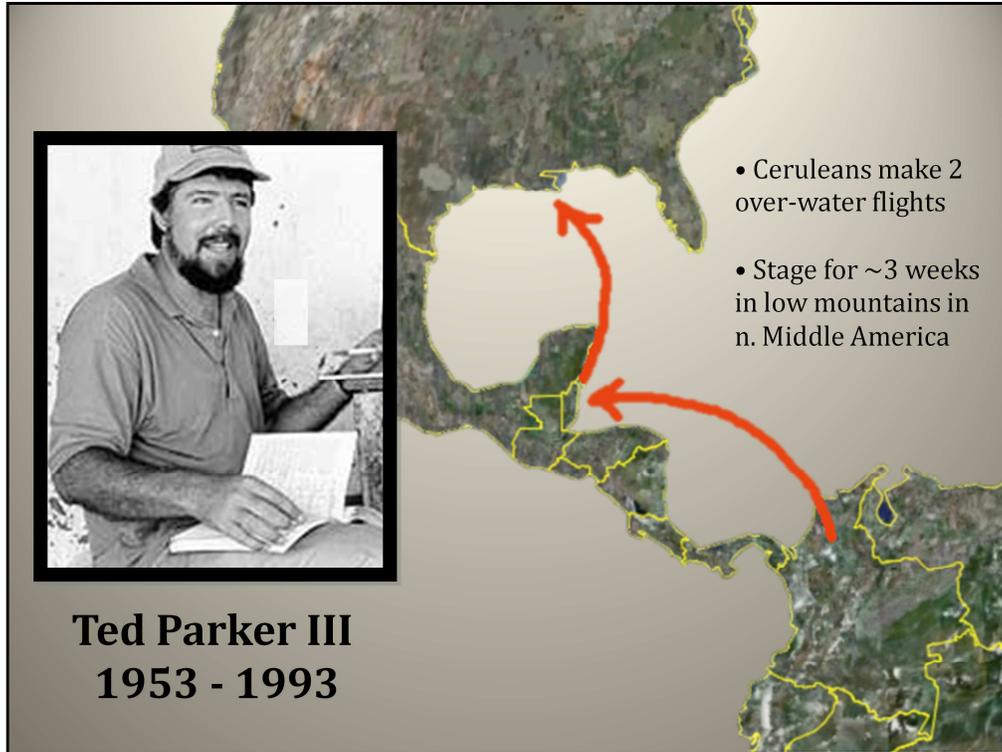
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If the majority of CERW need to stop $\frac{1}{2}$ way between South and North America, where are they?



Ted Parker suggested that CERW move to n. Columbia; fly across the W. Caribbean; stage for ~ 3 weeks in low mountains in n. Middle America; then fly across the Gulf

While Parker suggested that CERW apparently have a “propensity for making shorter flights and stopping over for days or weeks in Middle American forests.”

this was a novel hypothesis that CERW were making 2 over water flights

He suggested they would stop in a relatively small area from se Chiapas, Mexico, s. Belize, and Caribbean facing slopes of Guatemala, Honduras, and possibly Nicaragua

Parker suggested these warblers fly directly from S. to N. America in spring



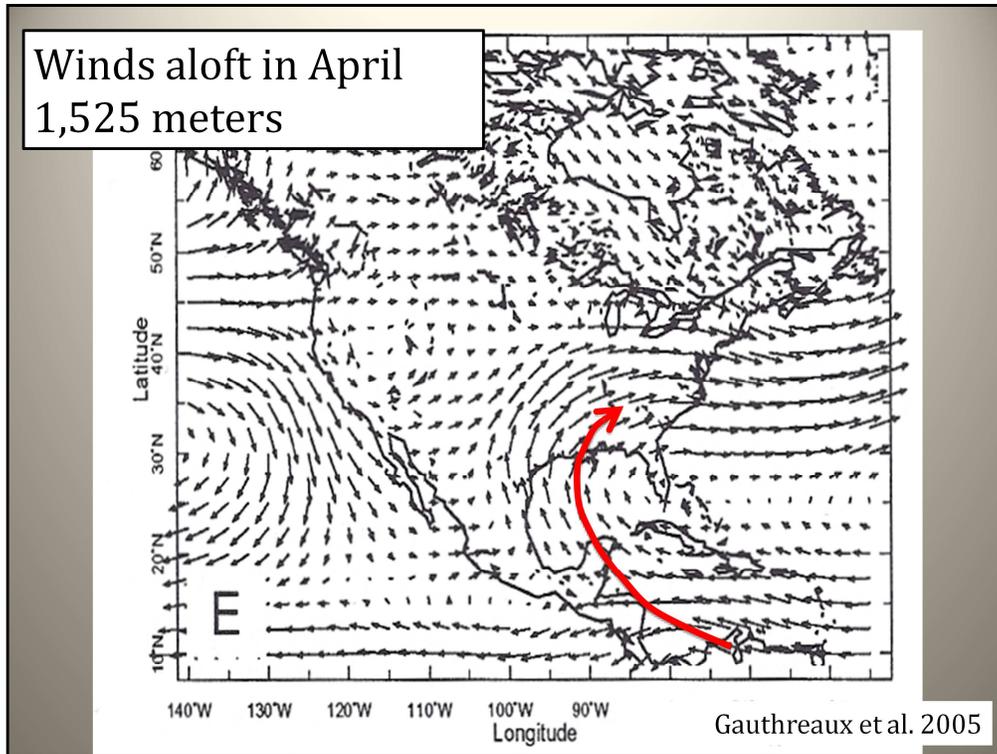
Blackpoll Warbler



Bay-breasted Warbler

Based on the lack of spring records in Middle America, Parker suggested “BLPW undertake an amazingly long spring flight over the w. Caribbean without making a landfall until they reach the Gulf coast of the US”.

He also suggested that Bay-breasted Warblers may “make one long flight from Panama (where they are known to fatten up on small fruits and are common until late April (R. Greenberg pers. com.) to the Gulf coast.



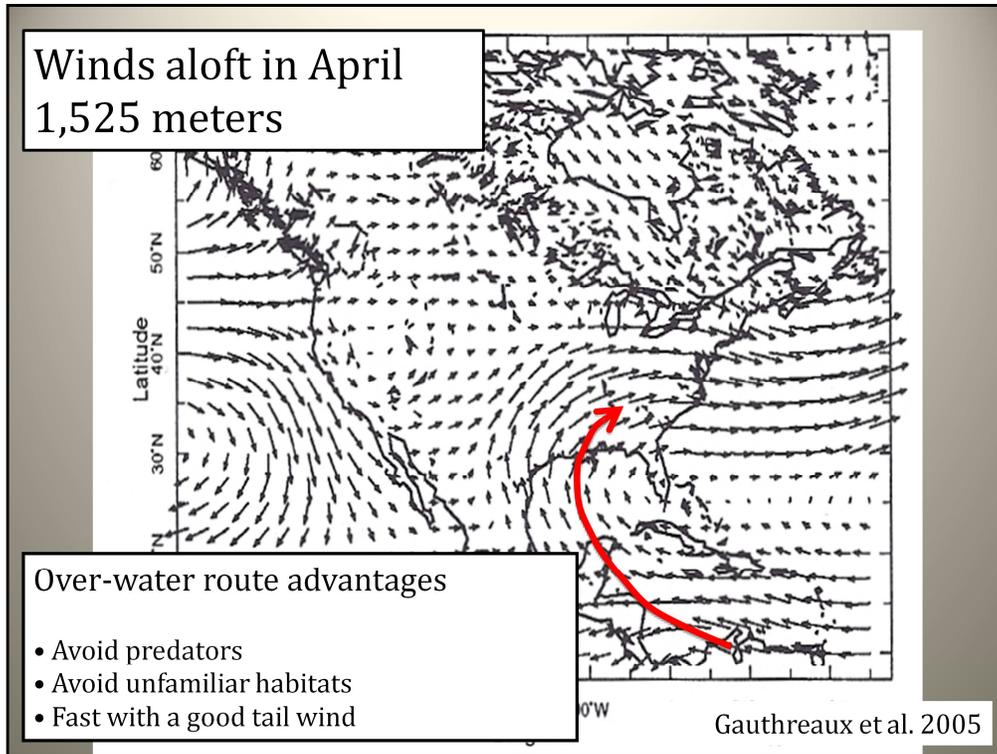
Clearly, any bird able to take advantage of spring winds aloft would have a free shuttle to the North American continent.

A quick over-water route has obvious advantages

Avoid predators

Avoid unfamiliar habitats

Fast – if you have a good tail wind



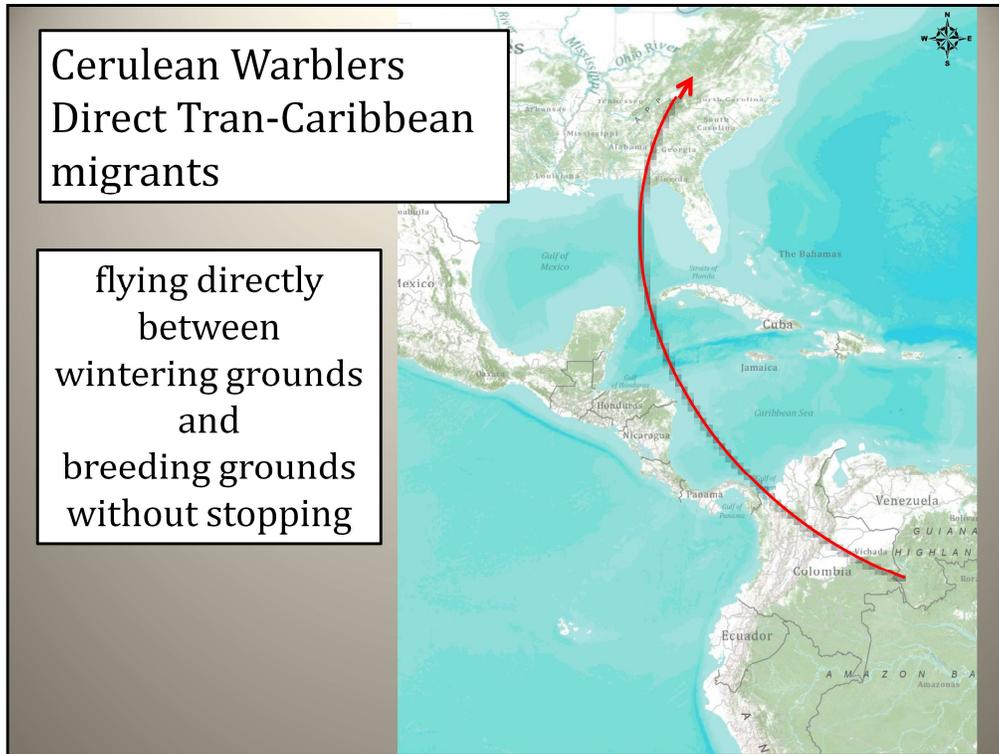
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Cerulean Warblers
Direct Tran-Caribbean
migrants

flying directly
between
wintering grounds
and
breeding grounds
without stopping

Here's what I propose

The migration route a bird uses depends on which part of the winter range it occupies
Birds in eastern Colombia and Venezuela take the free shuttle to north Georgia or the
Cumberland Mountains of Tennessee

The birds in the western part of the range take an overland route through Central America
until they can take advantage of the favorable winds.

BLPW make short overland hops of 150 to 250 miles/night

Flying 5 – 8 hours per night

Blackpoll Warbler Migration Superstar



Migrate 2,200 miles (1,367 km)
across western Atlantic Ocean in fall

The superstar of long-distance neotropical songbird migration is unquestionably the Blackpoll Warbler

In fall these birds fly west out over the Atlantic and catch northeasterly trade winds that bring them to the mainland of South America

Like CERW winters almost exclusively in S. America

Long-distance migrant morphological characteristics

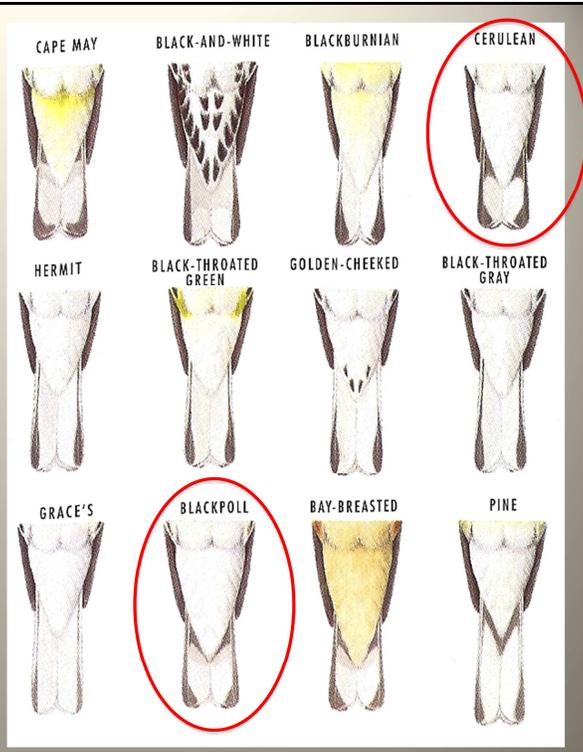
Wing shape - pointed
Tail length - short

Wing shape:
BLPW and CERW
have among the
longest most pointed
wings of any warbler



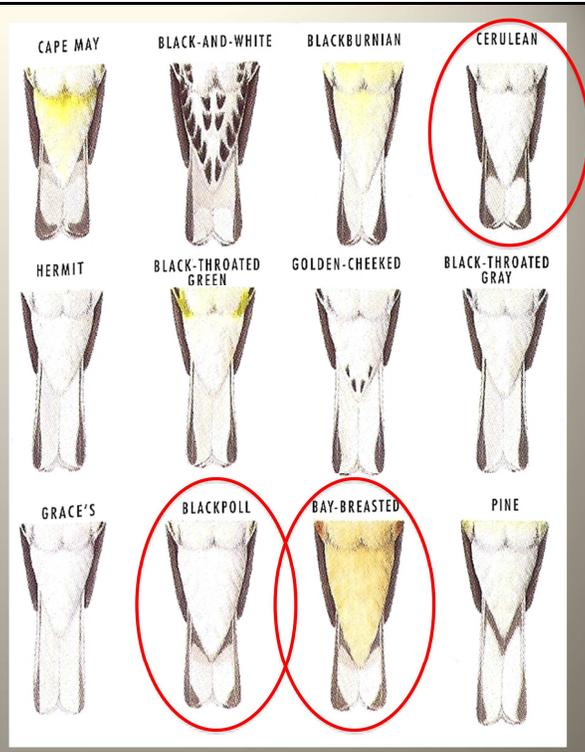
Long-pointed wings are associated with long-distance migrants and faster migration times among individuals of the same species

Tail length:
BLPW and CERW
both have short
tails and long
under-tail covert



In both tail length and the length of the undertail coverts.

Tail length:
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Bay-breasted Warblers share this characteristic and they Winter from Panama though NW S. America

Blackpoll Flight Range



Equation

Fat grams/fat consumption rate = hrs of flight

Hours of flight x ground speed = flight range

Blackpoll Warbler

9 grams fat/0.08 grams per hour = 112.5 hrs of flight

112.5 hours x 25 mph ground speed = 2,812 miles

Nisbet, I. C. T., W.H. Drury, J. Baird (1963)
Bertyholf (1975, 1996)

Based on conservative measurements, the flight range potential for this species is well within that required to make their 2,200 mile over-water journey

Nisbet, I. C. T., W.H. Drury, J. Baird. 1963. Weight-loss during migration. Part I: Deposition and consumption of fat by the blackpoll warbler (*Dendroica striata*). *Bird-Banding* 34:107-138.

Bertyholf 1975, 1996 Blackpolls can almost double their mass (from an average of 11g to 21g)

an extra gram of fat increases the flight range to 3,125 miles

Cerulean Flight Range

25% smaller and lighter



Cerulean Warbler 80% weight gain

6.9 grams fat / **0.06** grams per hour = 115 hrs of flight

115 hours x 25 mph ground speed = **2,875 miles**

Cerulean Warbler 60% weight gain

5.2 grams fat / **0.06** grams per hour = 86.7 hrs of flight

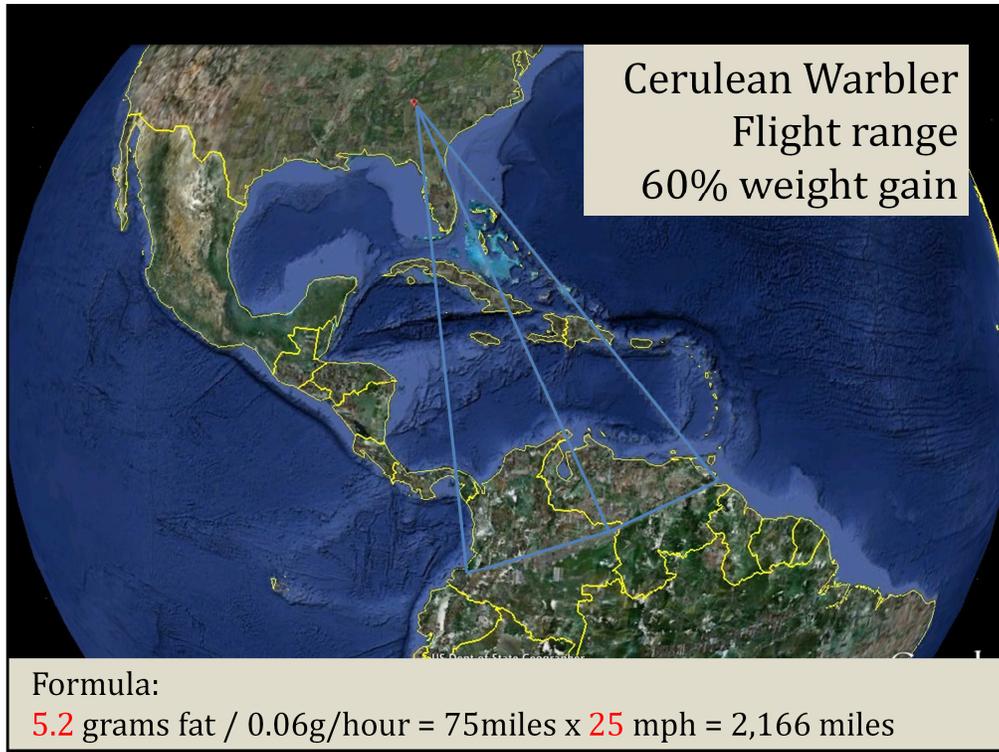
86.7 hours x 25 mph ground speed = **2,166 miles**

CERW is 25% smaller and lighter - after consulting others working on avian energetics we scaled down the metabolic rate also by 25%.

The average mass of a CERW is ~ 8.6 grams - 80% weight gain = 6.9 grams of fat

Few CERW caught at departure weight

Frank Moore banded only 11 fall CERW in Fort Morgan, Alabama, one of them weighed 13.4 grams.



A CERW could fly from well inland in North America to northern South America

Kennasaw Mtn, Georgia illustrated

Changing the amount of fat or ground speed will dramatically affect the flight range

Cerulean Flight Range

25% smaller and lighter



Cerulean Warbler 60% weight gain

5.2 grams fat / 0.06 grams per hour = 86.7 hrs of flight

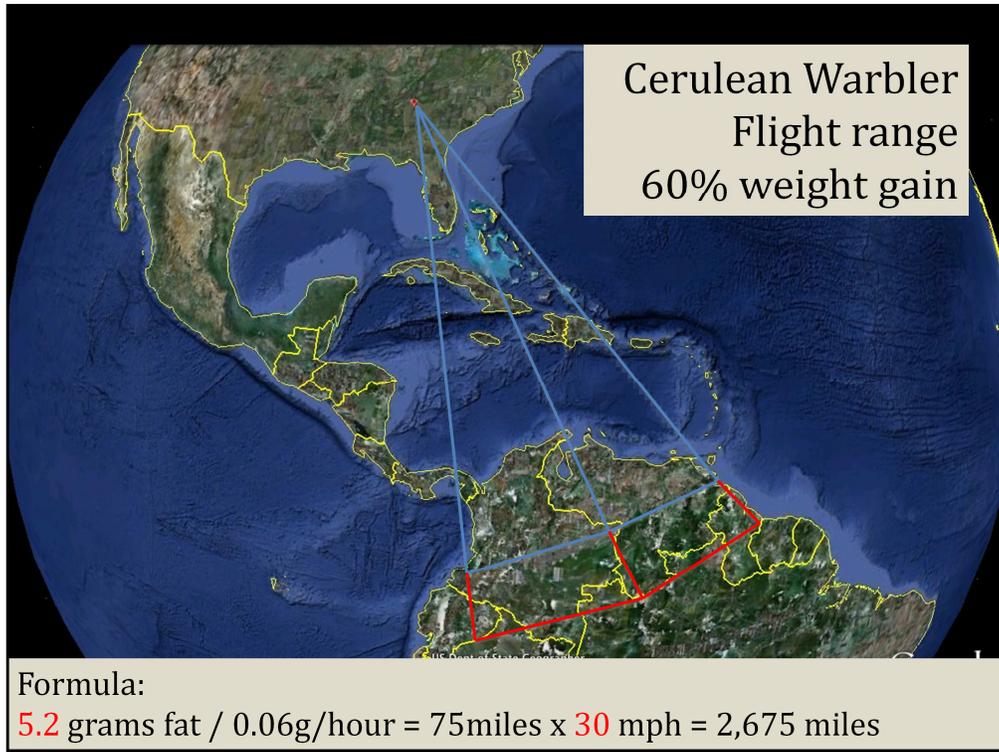
86.7 hours x 30 mph ground speed = 2,601 miles

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Kennasaw Mtn, Georgia

With a little more fat the bird would be able to deal with adverse winds or soaking rain for part of the trip.

If you add a little more wind or a little more fat you can increase the range by a few 100 miles

Predictions



- Cerulean Warbler should arrive directly on the breeding grounds in spring, and disappear from there in fall.

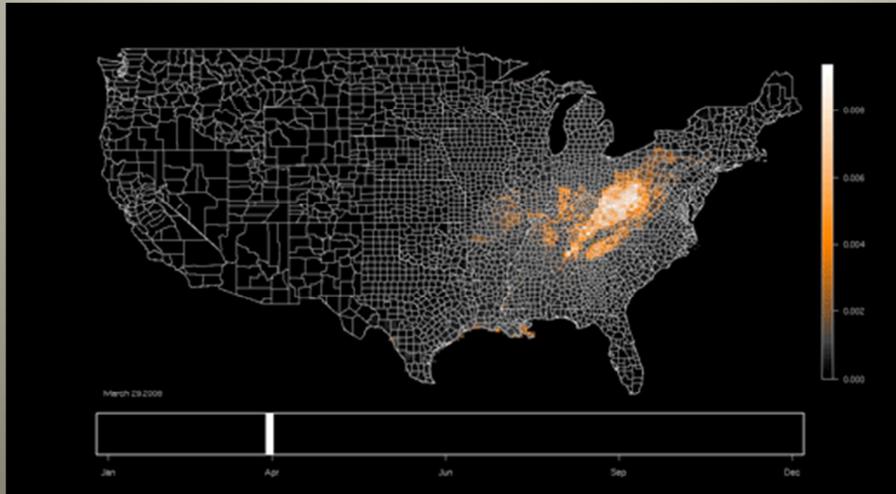
Overland migrants are not flying for very long or very far on a given night. If there is survival advantages to stopping in familiar locations to fatten-up for over-water flights, there may be important stopover sites. WITH OBVIOUS CONSERVATION IMPLICATIONS.

Given the dramatic topography of Central America, there may be certain passes through the mountains in Costa Rica or Panama that are used by CERW in both spring and fall

Other species with similar winter distribution may be using this same strategy and perhaps some of the same stopover sites.

40 out of 160 Neotropical migrant landbirds winter primarily south of Panama

Late March



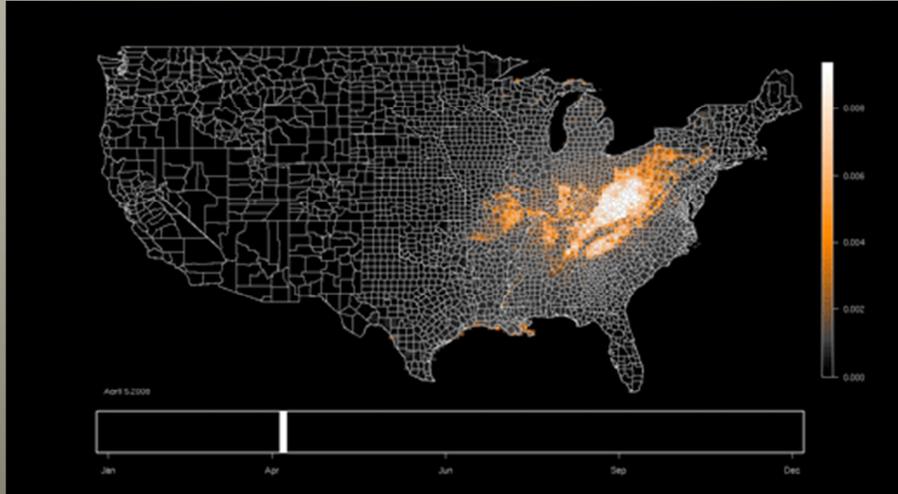
eBird Occurrence Maps

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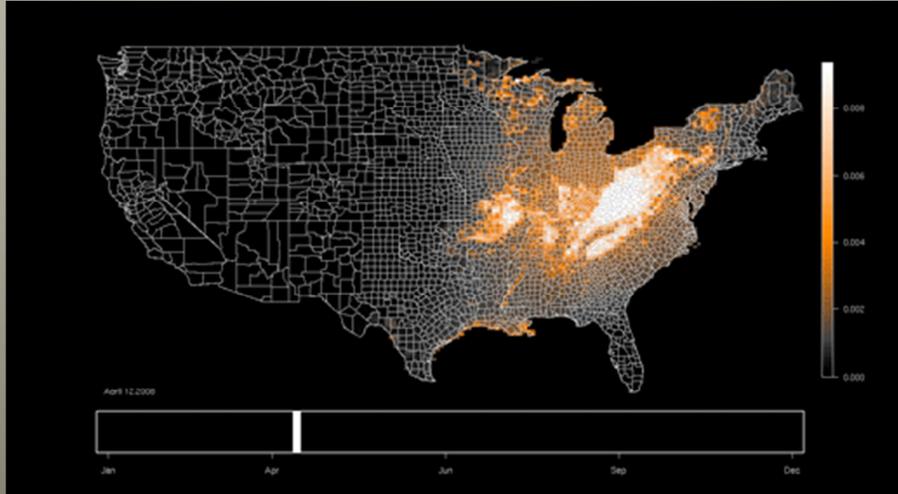
Location of each checklist reporting a CERW is associated with a number of remotely sensed habitat and climate data.

Model then makes predictions about CERW occurrence in unsampled areas and times.

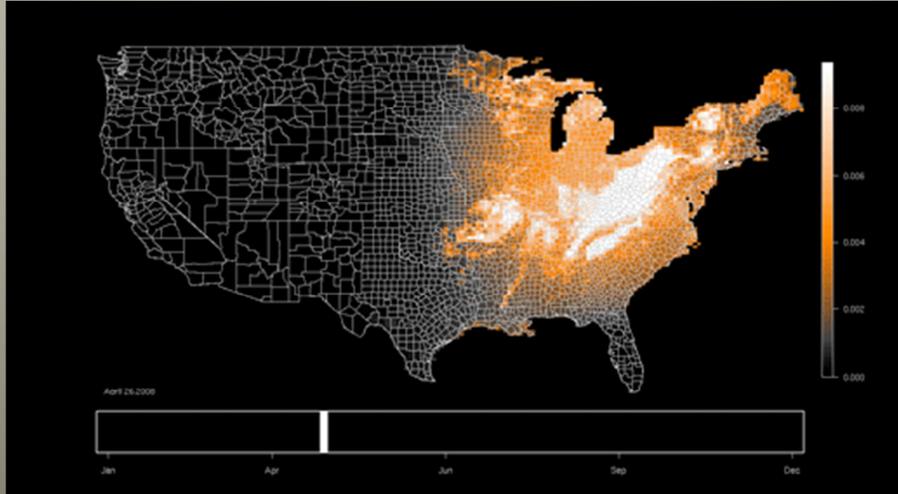
Early April



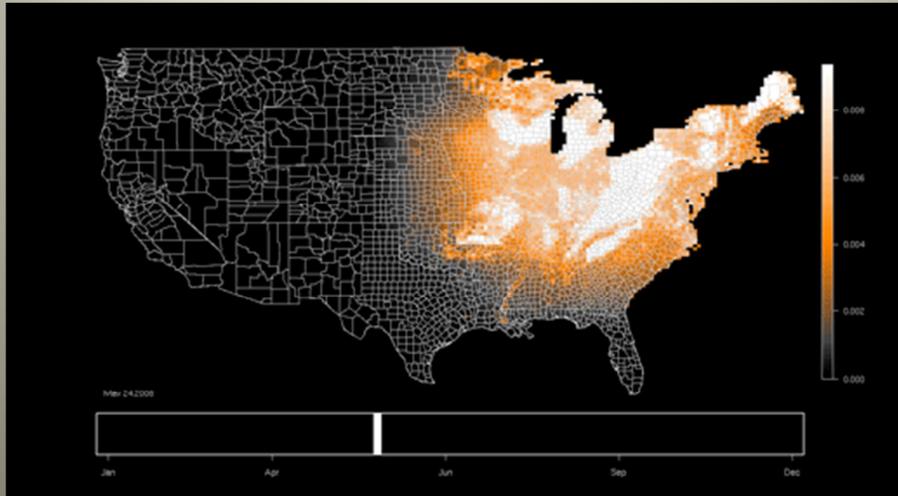
Mid-April



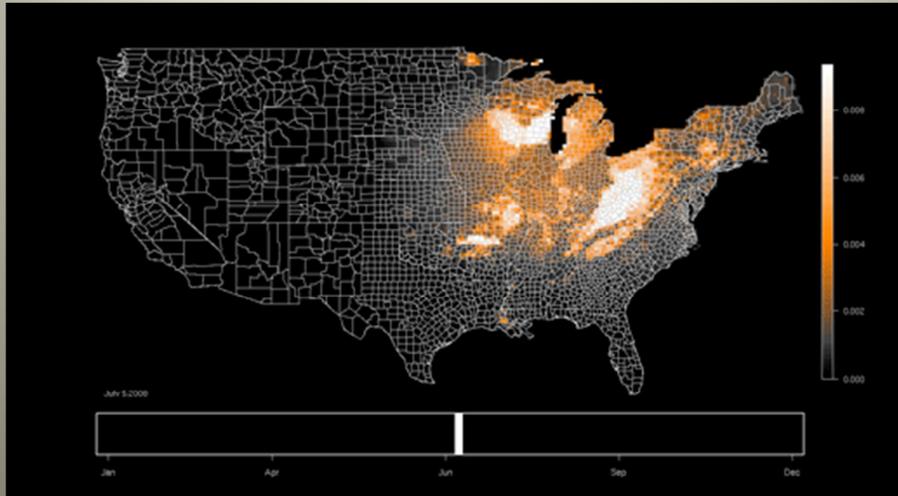
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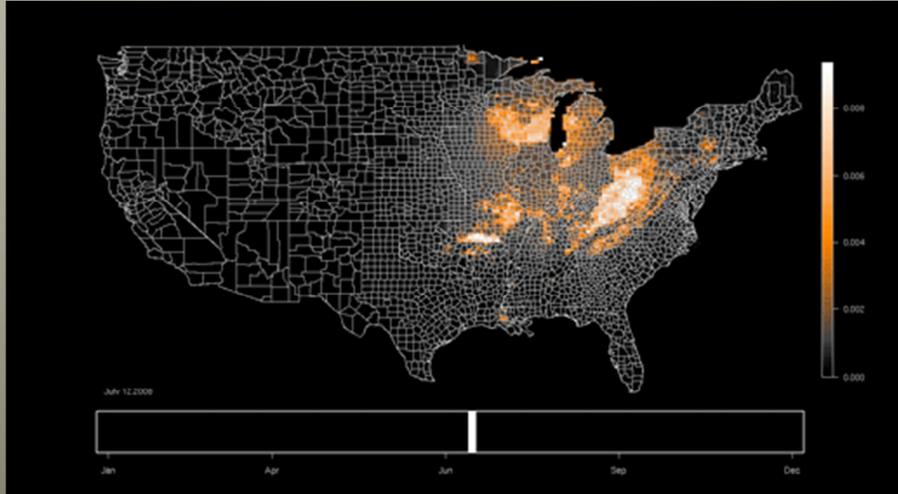
Early May



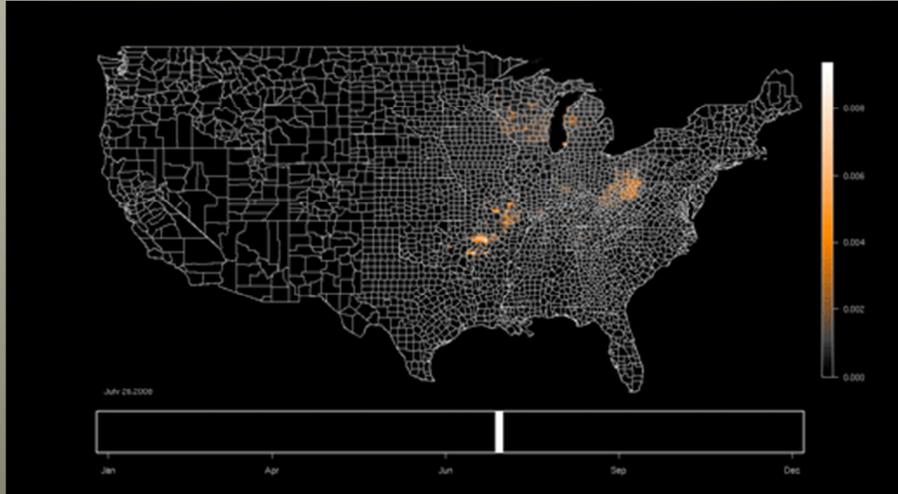
Late June



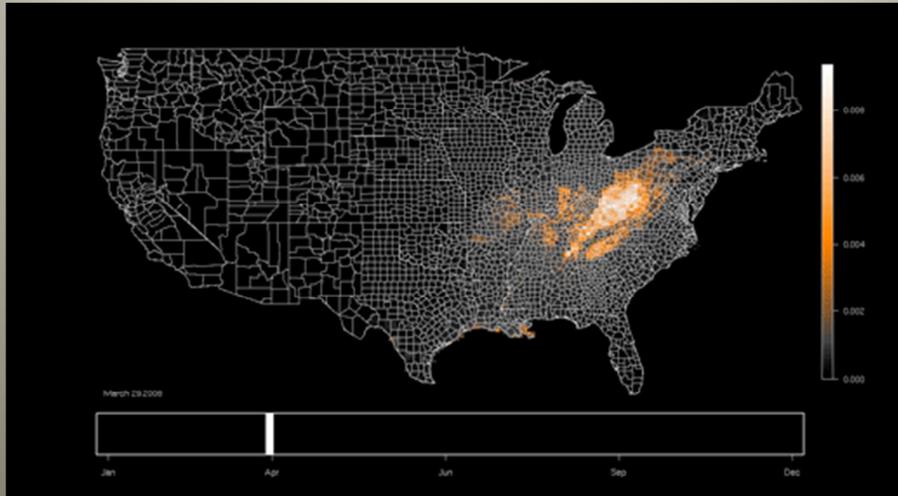
Early July



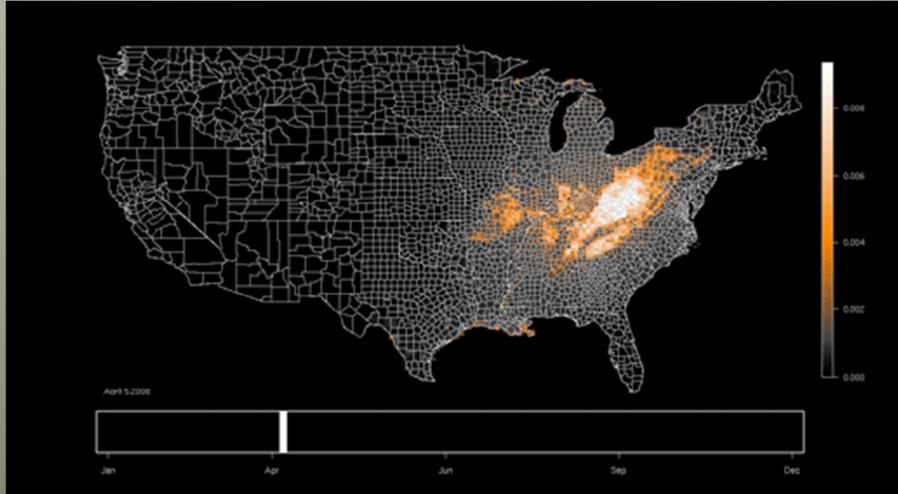
Late July



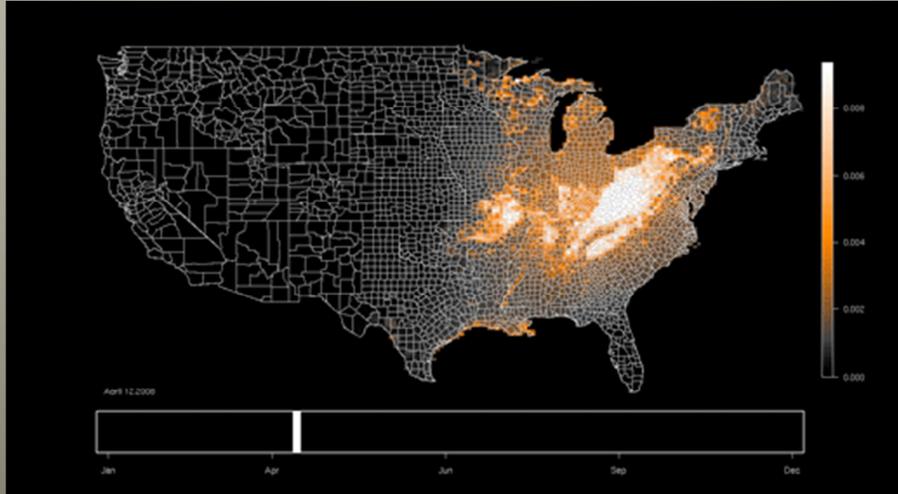
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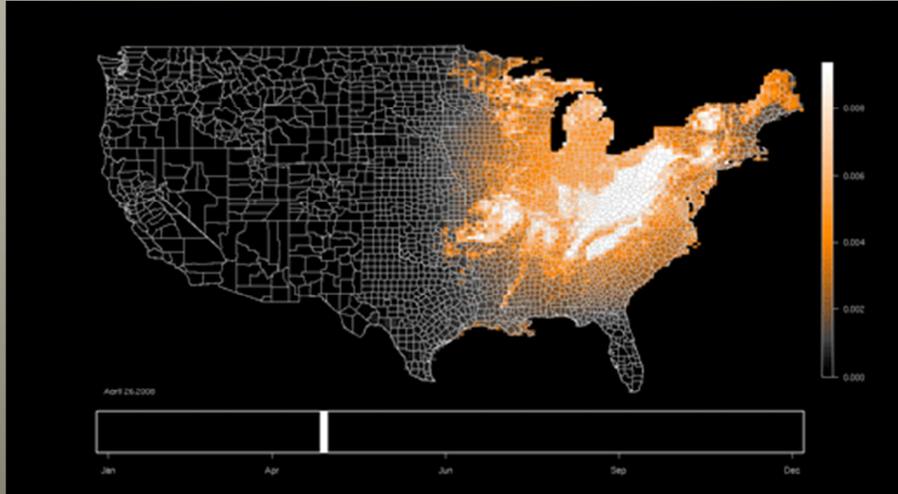
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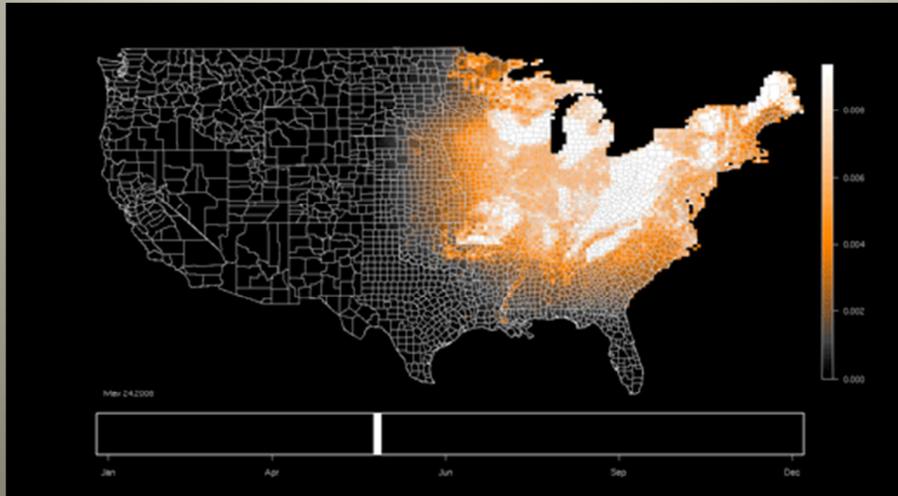
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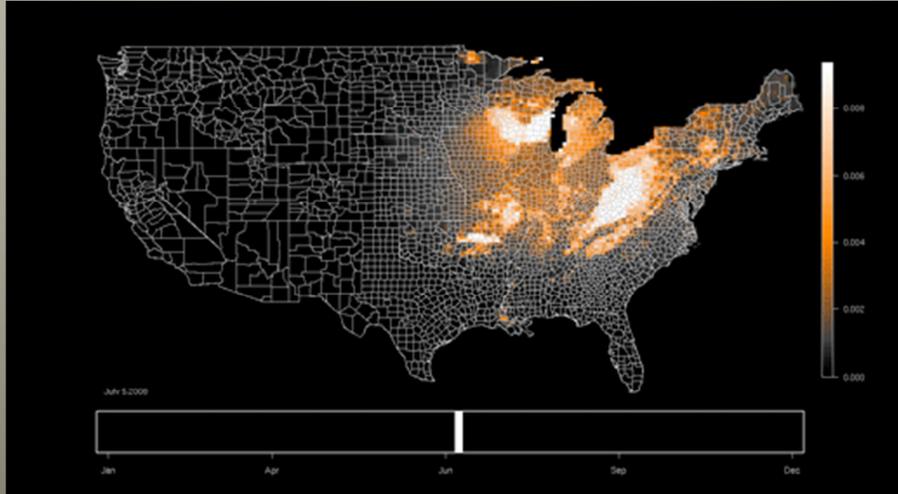
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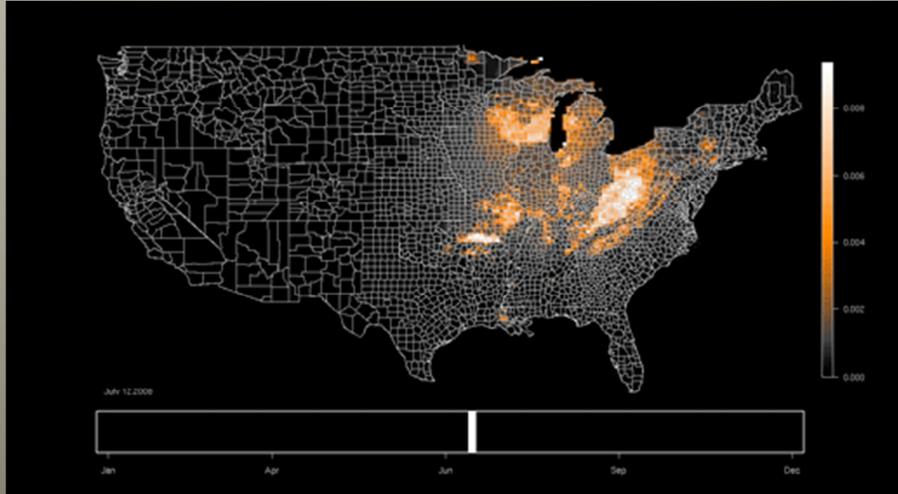
Early May



Late June



Early July



Late July



Predictions



- Cerulean Warbler should arrive directly on the breeding grounds in spring, and disappear from there in fall
- Departure weight birds would have 60% to 80% increased mass (if you could catch them)

Overland migrants are not flying for very long or very far on a given night. If there is survival advantages to stopping in familiar locations to fatten-up for over-water flights, there may be important stopover sites. WITH OBVIOUS CONSERVATION IMPLICATIONS.

Given the dramatic topography of Central America, there may be certain passes through the mountains in Costa Rica or Panama that are used by CERW in both spring and fall

Other species with similar winter distribution may be using this same strategy and perhaps some of the same stopover sites.

40 out of 160 Neotropical migrant landbirds winter primarily south of Panama

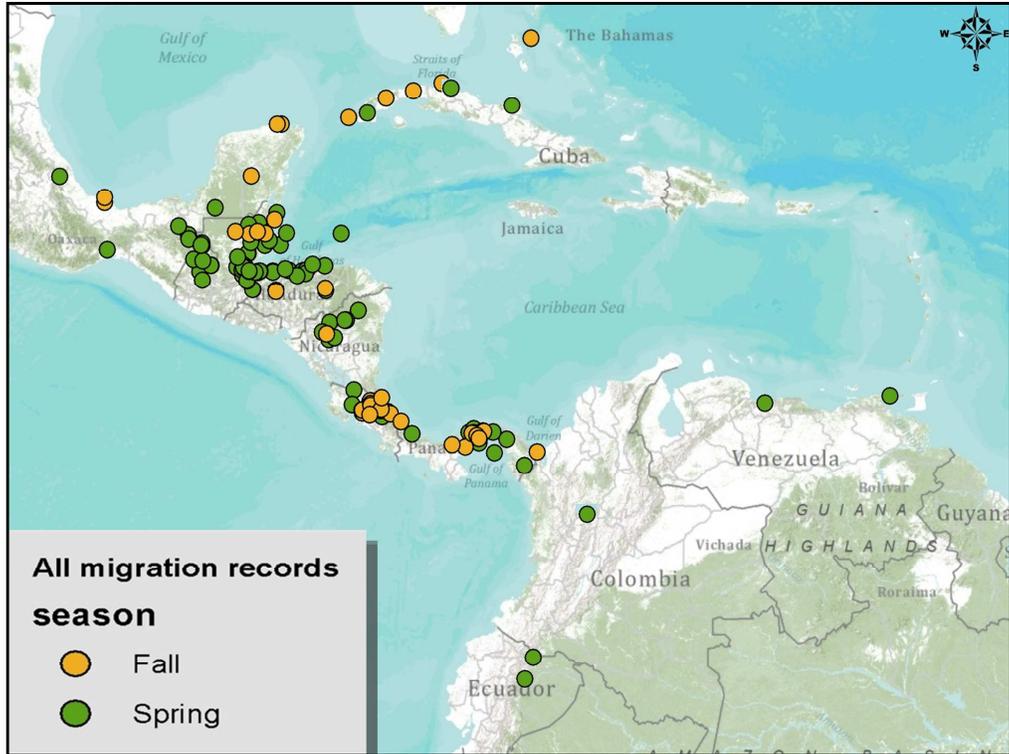
So what about Central American observations?



September 6, 2008 *Cerro Ancón*, Panama.

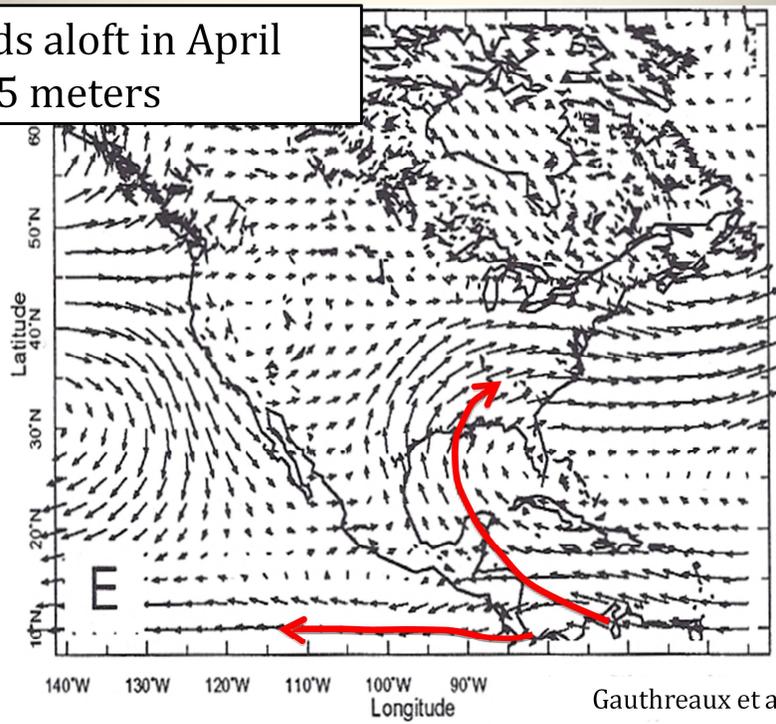
Photo by Bill Adsett

This still doesn't explain why we were seeing as many CERW as we were year after year in Central America.

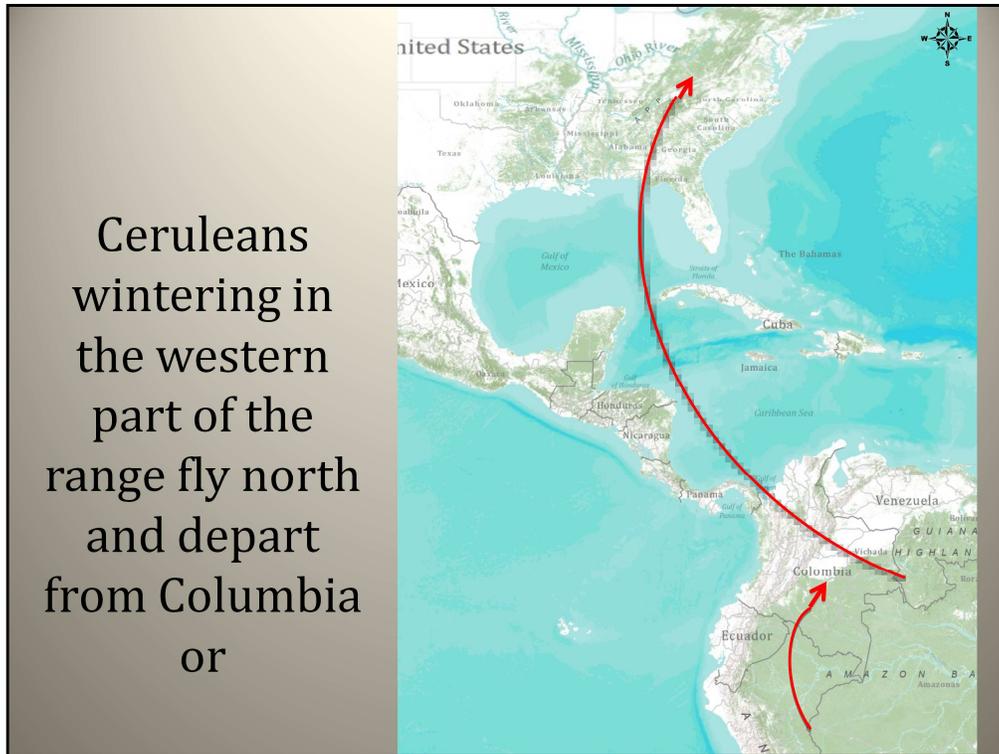


These are the records of fall and spring together.
 We do know that the same spring and fall stopover locations are used year after year.
 Ernesto says that he does not find birds in the spring in the locations where he finds them
 in the fall

Winds aloft in April
1,525 meters



Gauthreaux et al. 2005



Ceruleans
wintering in
the western
part of the
range fly north
and depart
from Columbia
or

Here's what I propose

The migration route a bird uses depends on which part of the winter range it occupies
Birds in eastern Colombia and Venezuela take the free shuttle to north Georgia or the
Cumberland Mountains of Tennessee

The birds in the western part of the range take an overland route through Central America
until they can take advantage of the favorable winds.

BLPW make short overland hops of 150 to 250 miles/night

Flying 5 – 8 hours per night

Fly to Panama,
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- Stopover sites would be used year after year

Overland migrants are not flying for very long or very far on a given night. If there is survival advantages to stopping in familiar locations to fatten-up for over-water flights, there may be important stopover sites. WITH OBVIOUS CONSERVATION IMPLICATIONS.

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What's next?

- Monitor Cerulean occurrence at one migration hotspot throughout spring migration
- Revisit / refine occurrence model
- Identify important stopover areas not protected

Acknowledgements

- All of the biologists and field assistants that helped gather the stopover data in Belize, Honduras, Guatemala, Nicaragua, Costa Rica, and Chiapas, Mexico
- Sid Gauthreaux, Ian Nisbet, and Frank Moore for advise
- Cornell eBird and USFWS Bird Banding Lab



NMBCA



Preguntas?

