Cerulean Warbler Migration

A new migration strategy theory

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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.
This was not so for the CERW.
They seemed to depart the breeding grounds and mysteriously show-up on the wintering grounds with only a few records ever reported in between. The same was true in the spring.

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.

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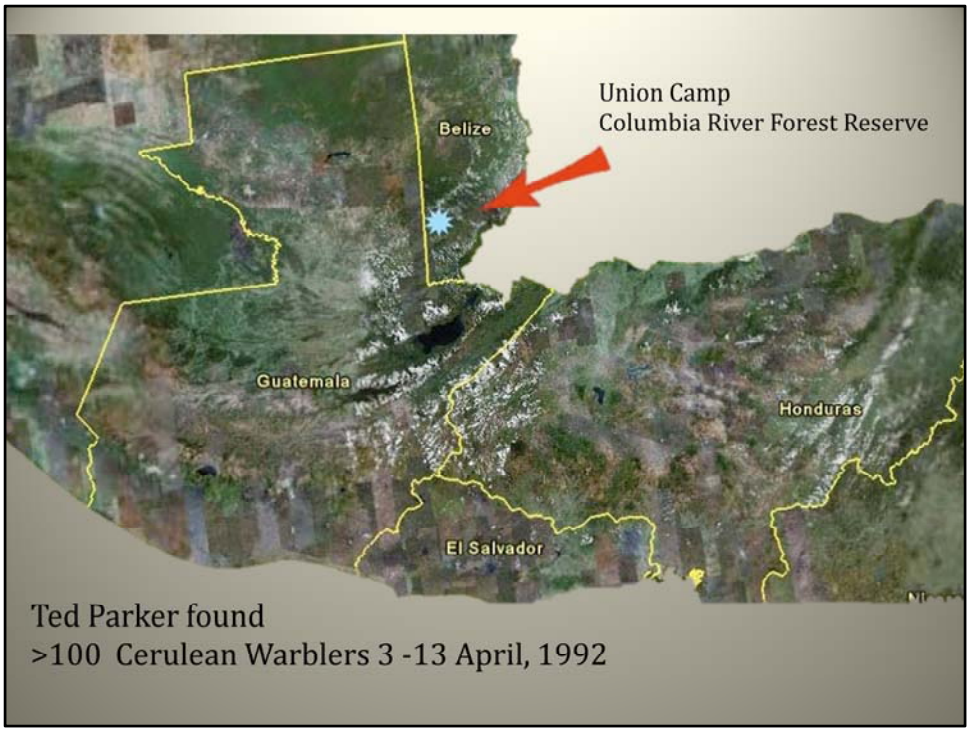
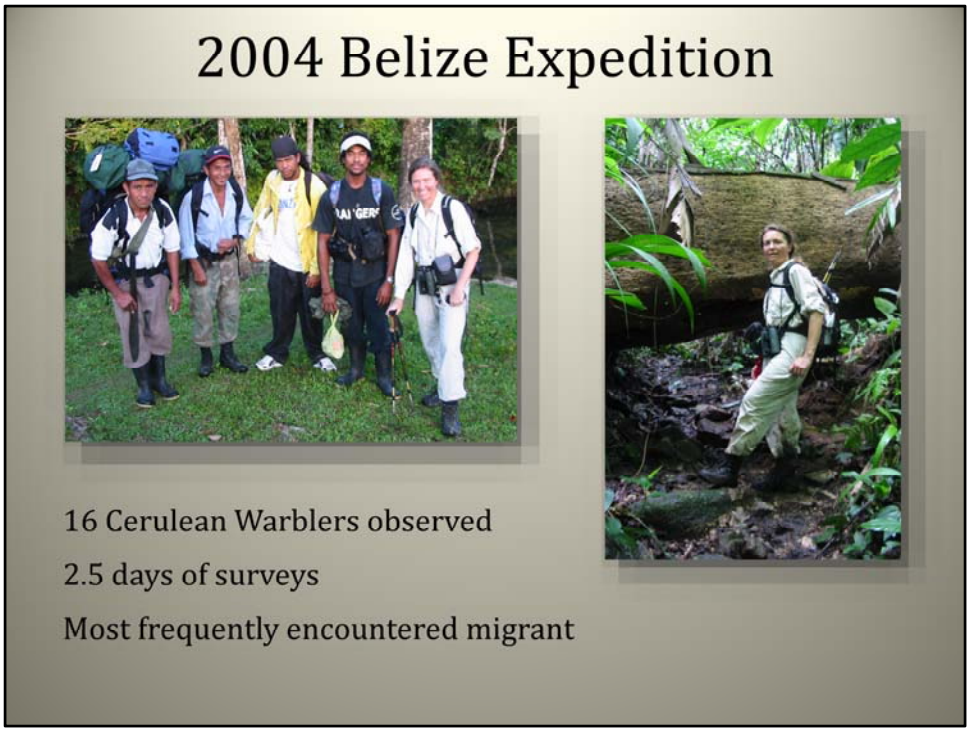
Importance of migration ecology

- 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

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

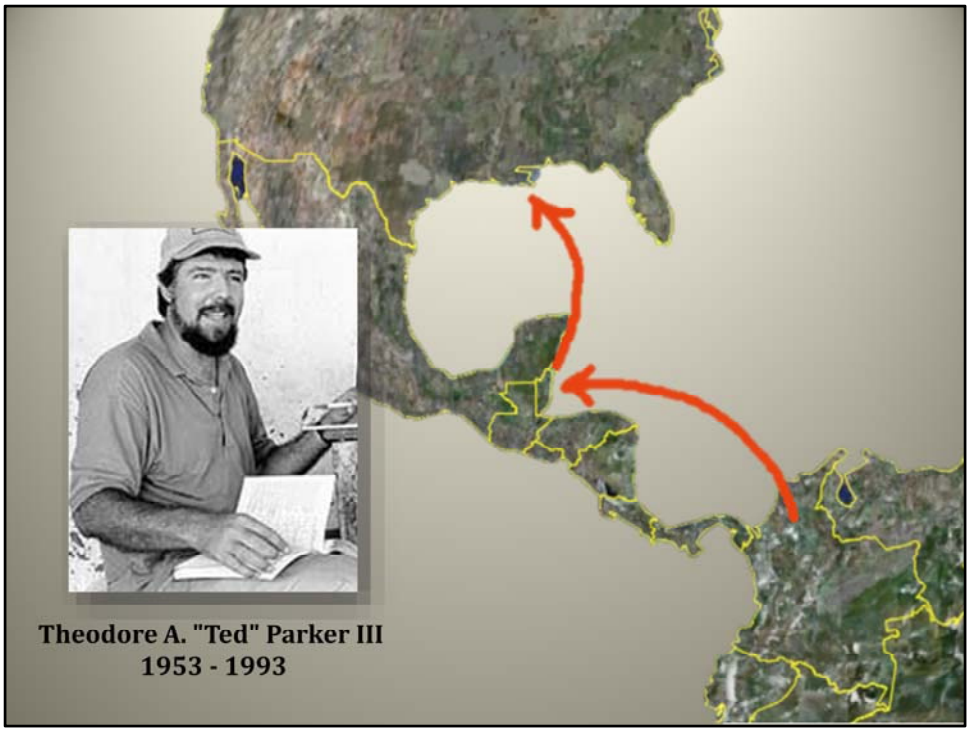


About the time that El Grupo Ceruleo was forming, Paul Hamel suggested that I re-visit the site where Ted Parker had recorded large #s of CERW in a remote highland area of Belize on the Guatemalan border.



I said “sure” and with funds cobbled together from TNC and ABC, I and some local guides and some trainees from a local NGO, made the arduous 3-day journey over hurricane tossed trees to Union Camp. (Parker took a US military helicopter)

I was there for 2.5 days (the guides failed to bring sufficient food so we dined on heart of palm stew and river snails).



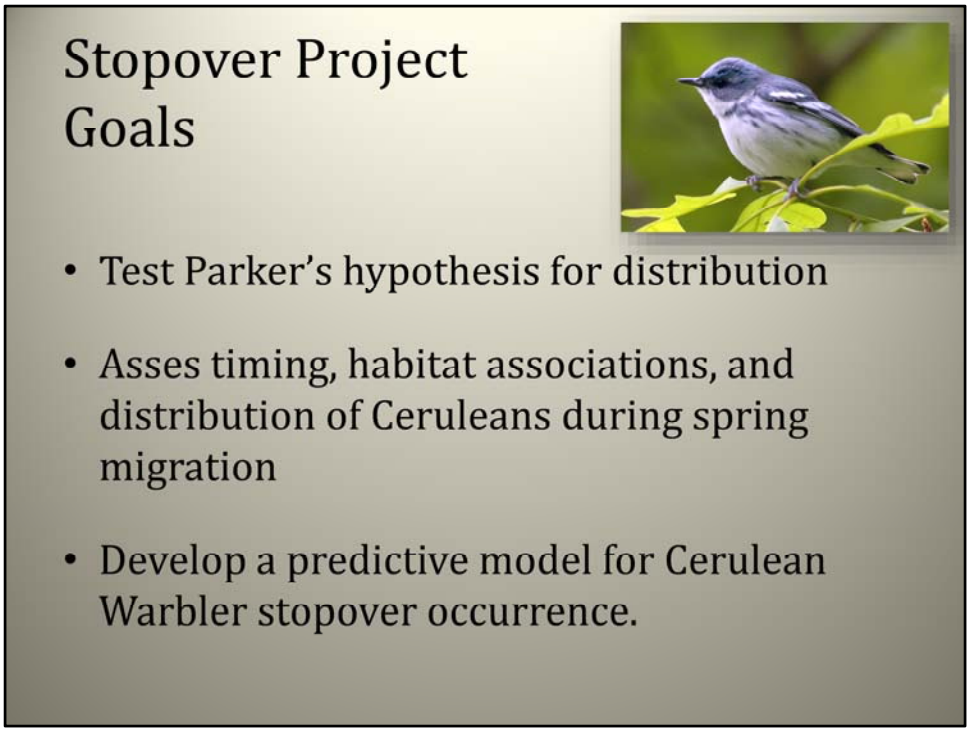
Ted Parker left us with much unfinished business but one of the things he did do before he left was publish a short article in American Birds on his Belize CERW experience

And he proposed a novel hypothesis for CERW migration

He suggested that most individuals make 2 over-water flights in the spring.

First across the w. Caribbean – then they would stop to refuel for a few weeks – before the second leg of their trip across the Gulf

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



Test Parker's hypothesis as far as distribution

Survey locations 2005 - 2009

- Historic records
- Areas conforming to Parker's hypothesis: low montane wet forests on Caribbean-facing slopes
- Areas predicted by a preliminary Cerulean Warbler stopover model

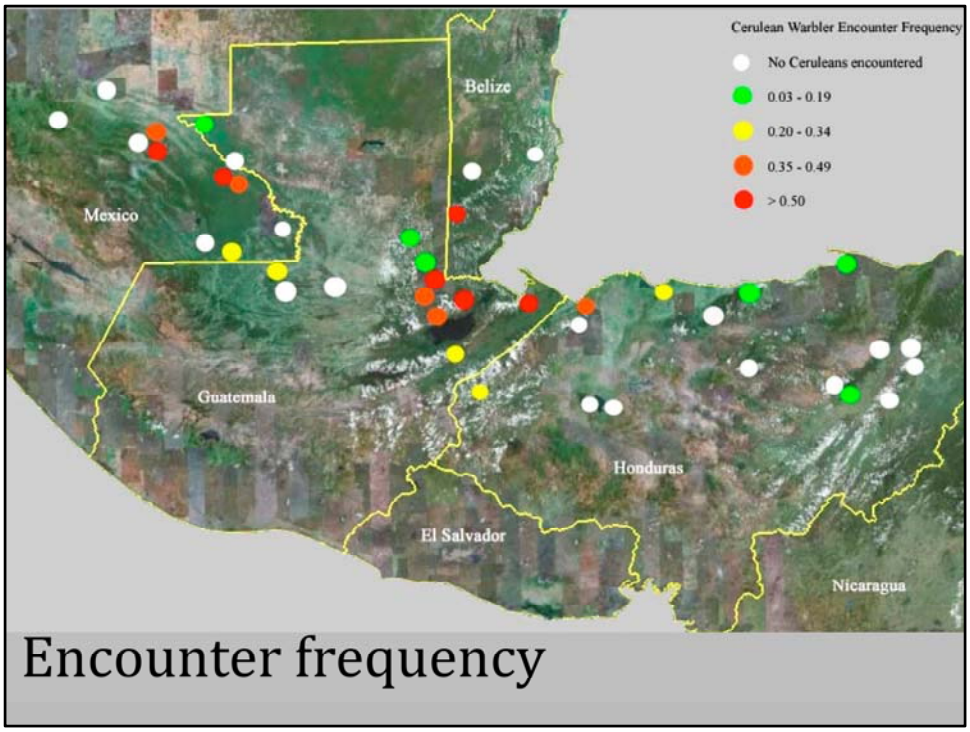
Survey methods

- One to six teams conducted simultaneous surveys between March 25 and April 22 in 2004 – 2009.

A survey team consisted of from one to four resident or foreign biologists, and a local guide.

Survey methods cont.

- Line transects 0.5 to 3.5 km
- Species composition recorded for each flock, additional data collected for CERW
- Playback used
  - Lesser Greenlet
  - Cerulean Warbler



What we found generally conformed to Parker's predictions.
One of our most interesting results was encounter frequency between sites (#CERW/survey)
We even returned to high-frequency sites and found CERW in subsequent years.

Results

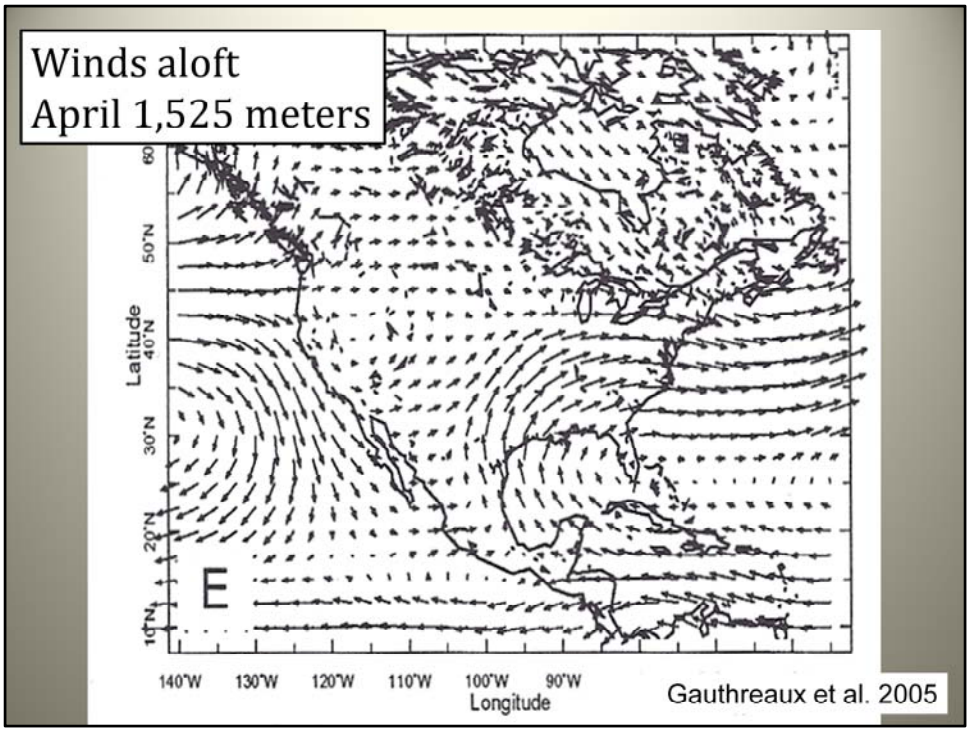
Country	Total surveys conducted	Hours of surveys	CERW observed
Belize	9	31	16
Honduras	79	302	31
Guatemala	70	262	62
Nicaragua	11	45	9
Mexico	19	62	16
Total	**177**	**702**	**134**

22 Additional CERW observed ad hoc

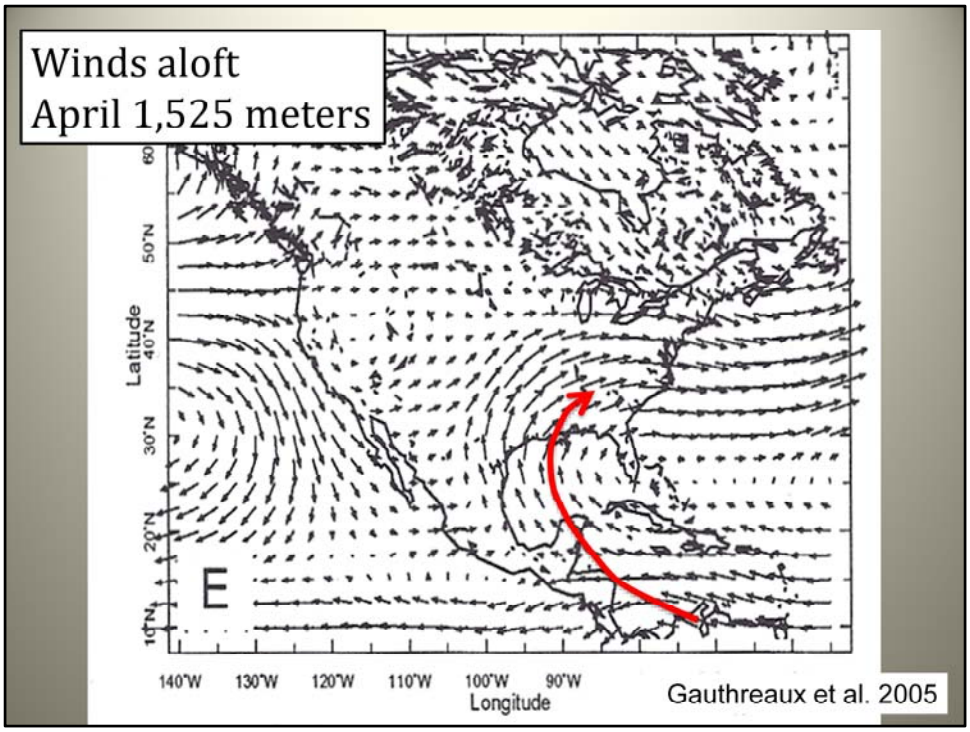
98 Male
35 Female
1 Unknown

Bottom line – we put in a lot of effort and found relatively few birds.
If the majority of CERW need to stop ½ way between South and North America, where are they?

He did suggest that BLPW were returning in one flight but said the CERW apparently has a “propensity for making shorter flights and stopping over for days or weeks in Middle American forests.” Parker

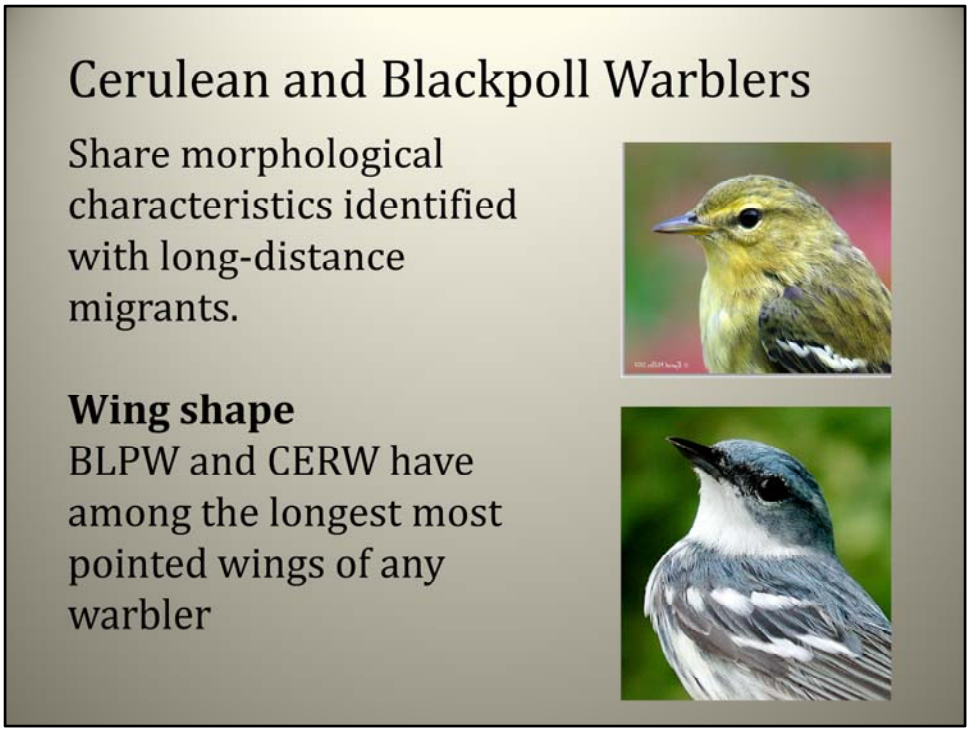


It was this map that appeared in Birds of Two Worlds in 2005 and an email from a bird-guide in Costa Rica that got me thinking that CERW may be using 2 strategies to get back and forth between wintering and breeding grounds - and neither were as Parker proposed.

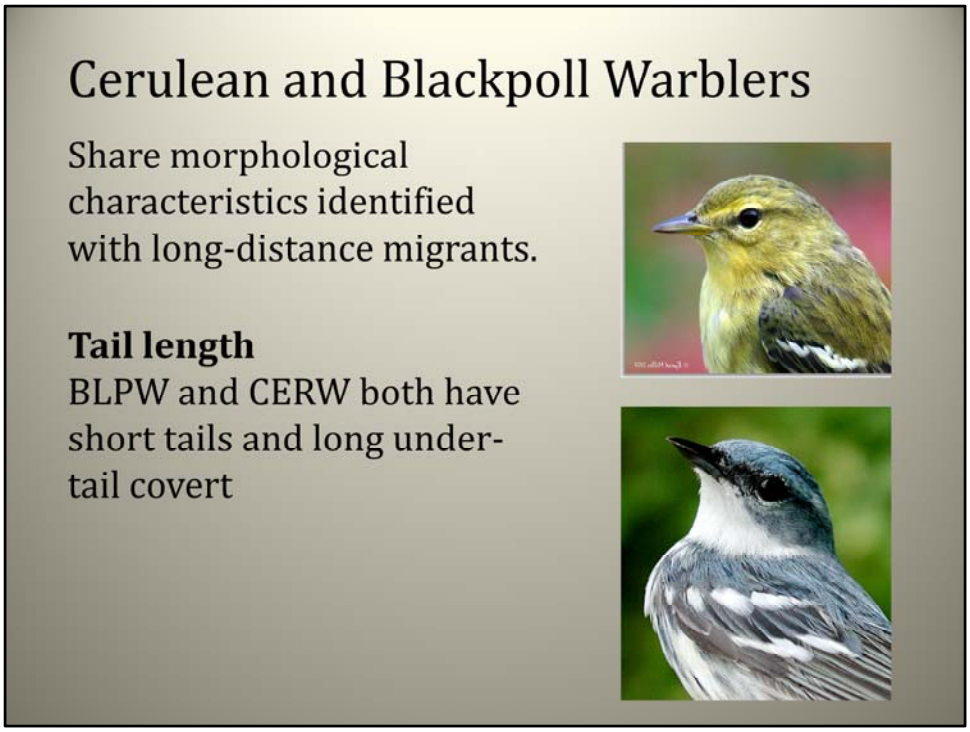


When looking at the prevailing winds aloft in spring, any bird able to take advantage of them from S. America would have a free shuttle to the North American continent.
A quick over-water route has obvious advantages
Avoid predators
Avoid unfamiliar habitats
Fast – if you have a good tail wind

So, I started looking into avian energetics.
The superstar of long-distance neotropical songbird migration is unquestionably the Blackpoll Warbler
These brave little guys head out over the w. Atlantic with a good tail wind, trusting that the northeasterly trade winds will bring them to the mainland of South America



Long-pointed wings are associated with long-distance migrants and faster migration times among individuals of the same species
Paul mentioned to me a paper from the early 1900s that measured warbler wing pointedness – and next to BLPW, CERW had next most pointed wings



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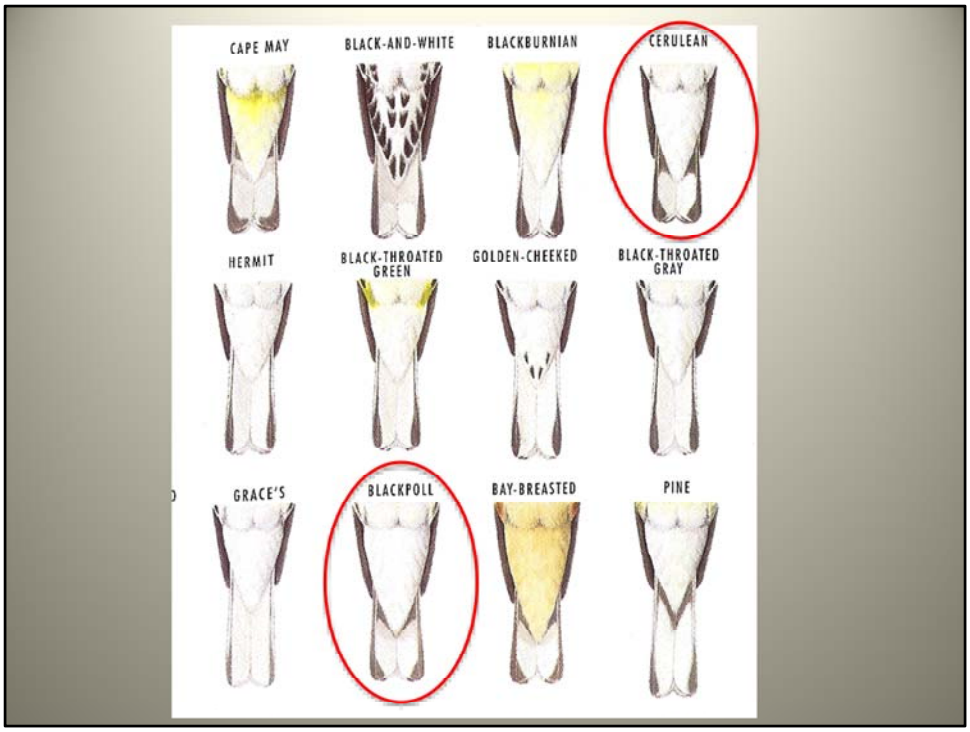
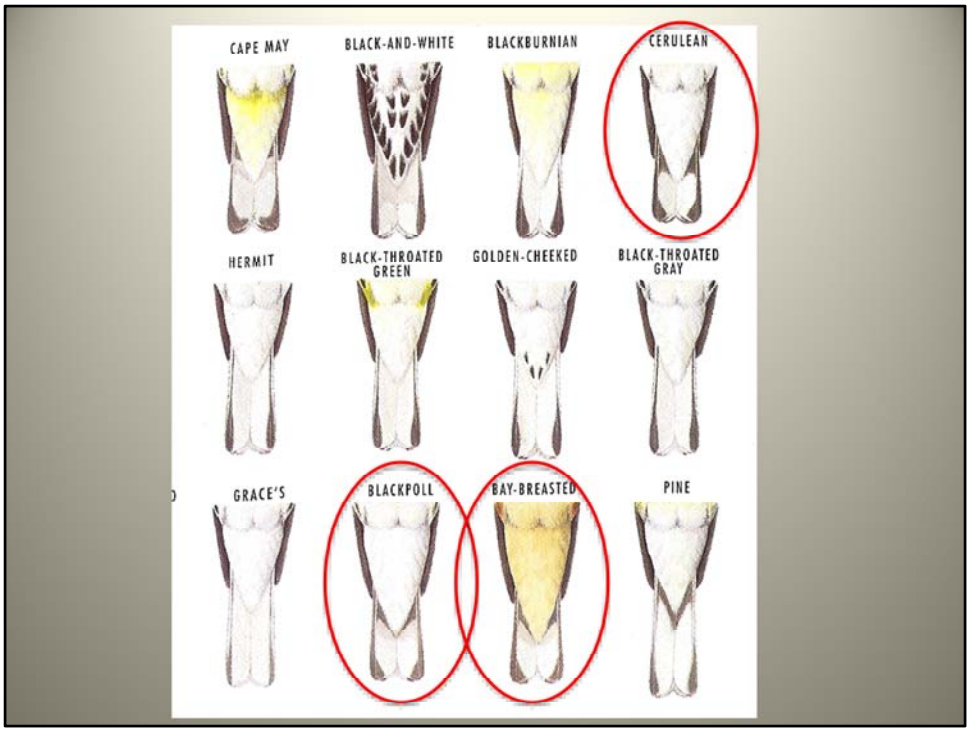
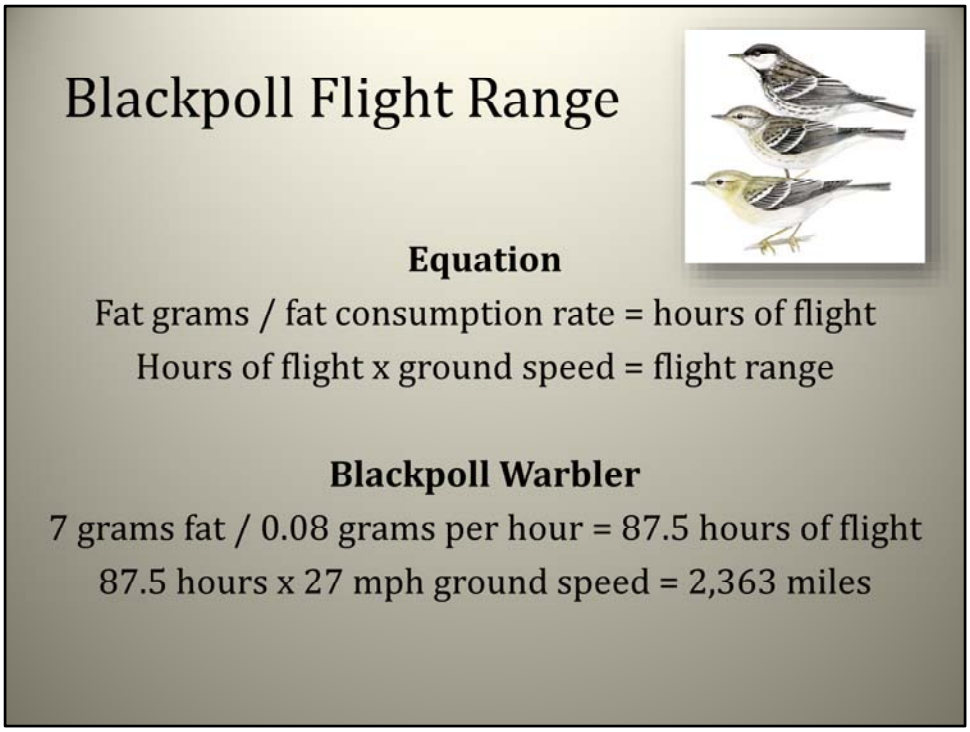


This is a visual comparison and I haven't done measurements but you can see how similar CERW are to BLPW
In both tail length and the length of the undertail coverts.

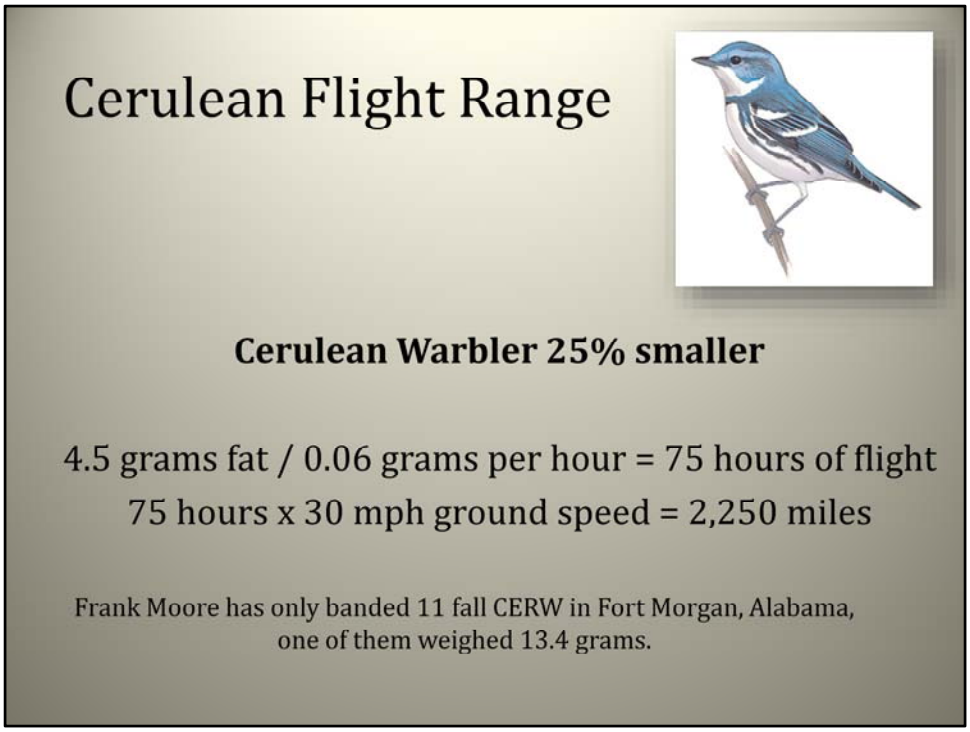
Anyone who has spent time in the field looking for these guys knows this is a good field character when identifying a bird in the canopy



And also to Bay-breasted Warblers, who also primarily winter in South America



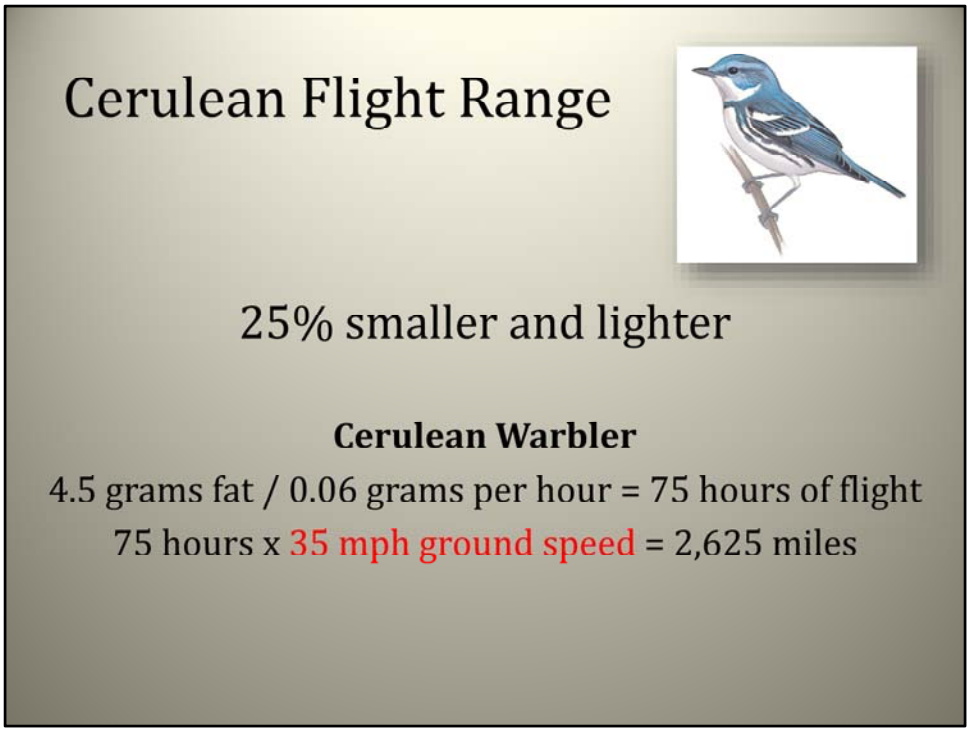
I then looked into flight energetics and found that a formula that would give you flight range had already been worked out for BLPW
Based on conservative measurements, the flight range potential for this species is within that required to make their 2,200 mile over-water journey



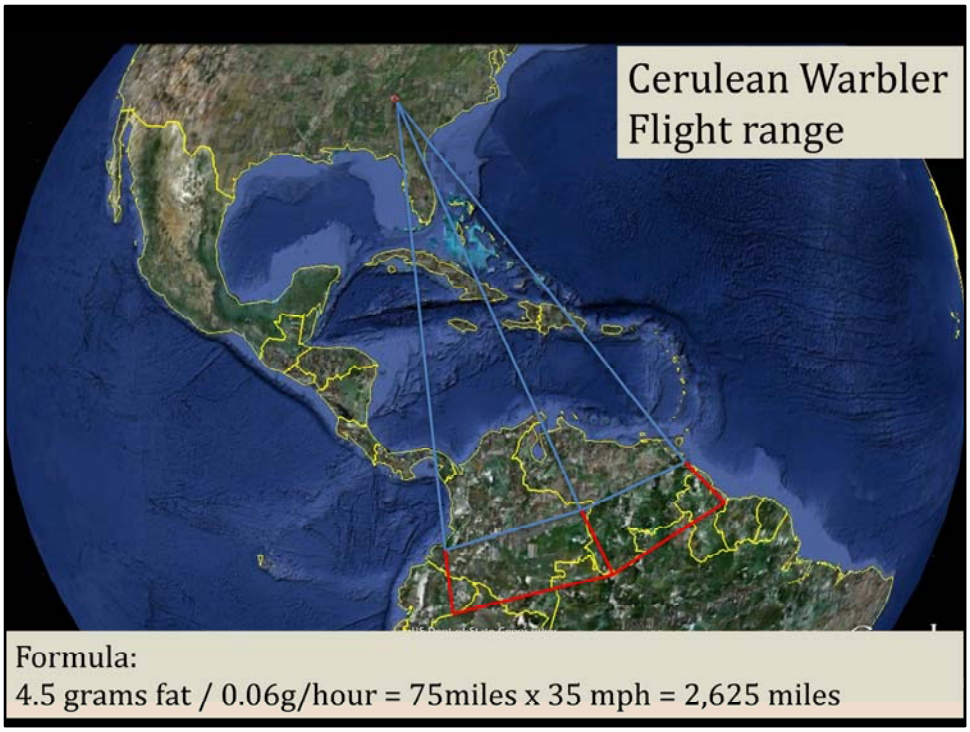
So after consulting several folks working on avian energetics, we determined that it was reasonable to scale down the metabolic rate also by 25%
We know that BLPW will put on 50% to 80% of their body wt. in fat prior to departure
Even though Frank Moore has only banded 11 fall CERW in Fort Morgan, Alabama, one of them weighed 13.4 grams.
Based on fat-free weights, this bird was carrying 3.5 to 7 grams of fat!
Using a conservative estimate of fat, the lower metabolic rate, and a modest tail wind . .

A CERW could fly from well inland in North America to northern South America
Kennasaw Mtn, Georgia

With a slightly better tail wind allowing 35mph ground speed

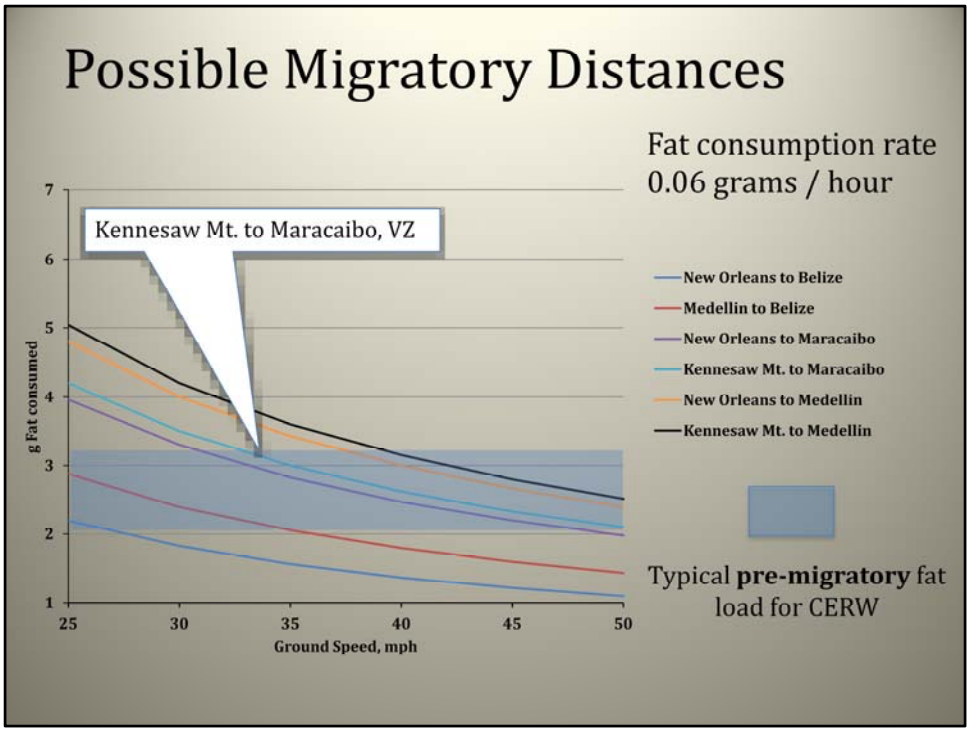


Keeping same conservative weight gain
And increasing ground speed by just 5 mph (S. Gauthreaux suggested 25 – 50 mph was reasonable)
Increases range 375 miles

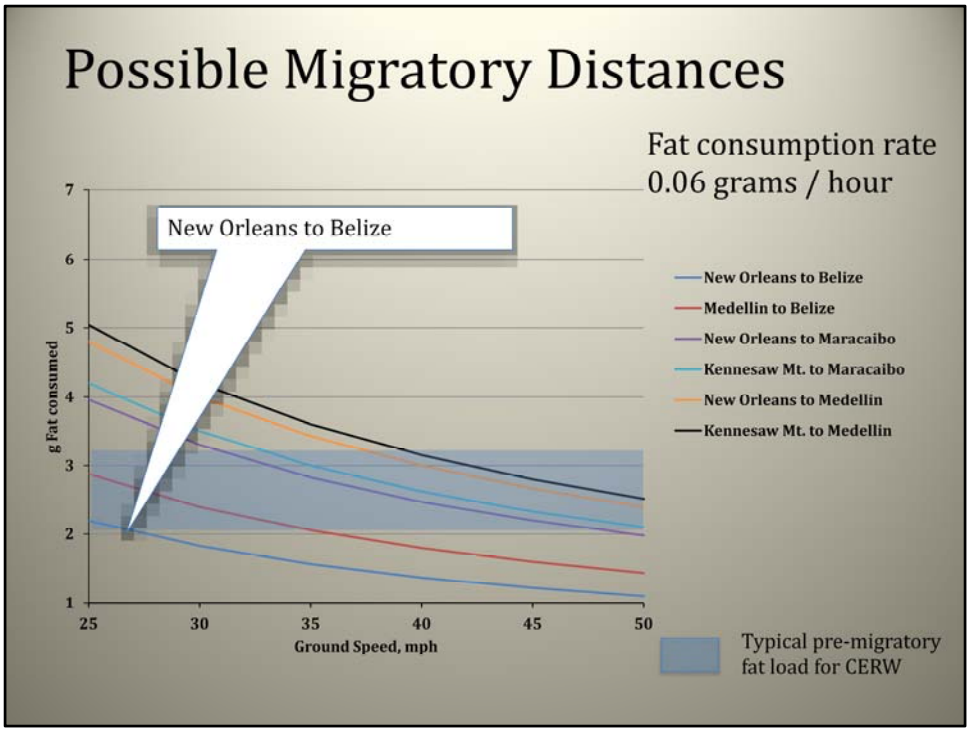


4.5g/0.06g/hr=30mph ground speed = 2,250 miles
Kennasaw Mtn, Georgia

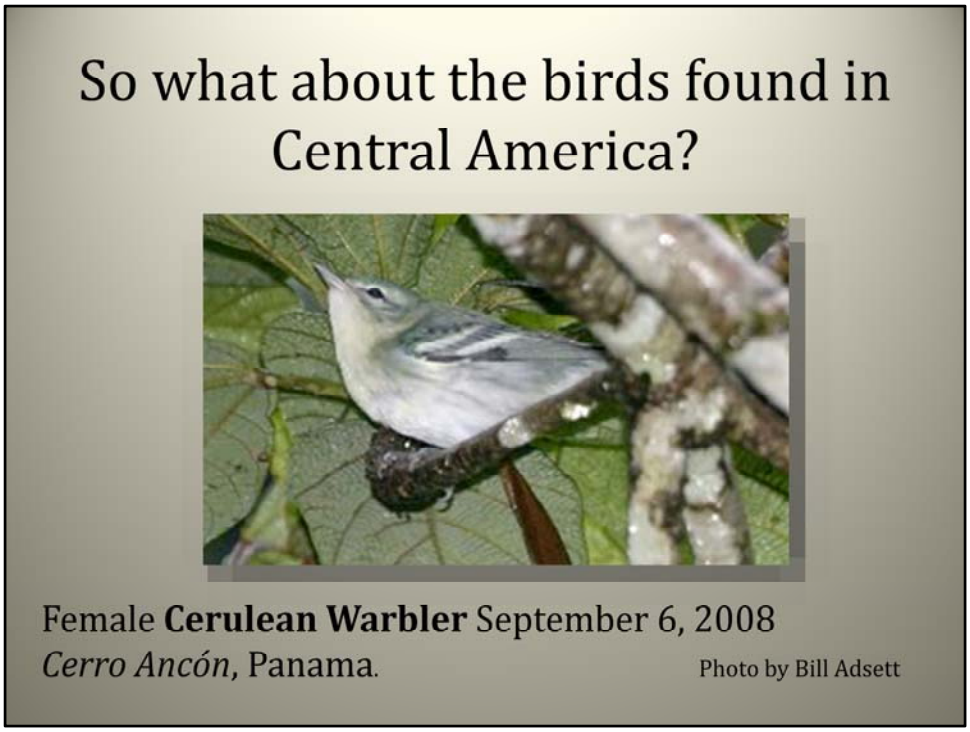
With a little more fat the bird would be able to deal with adverse winds or soaking rain for part of the trip.



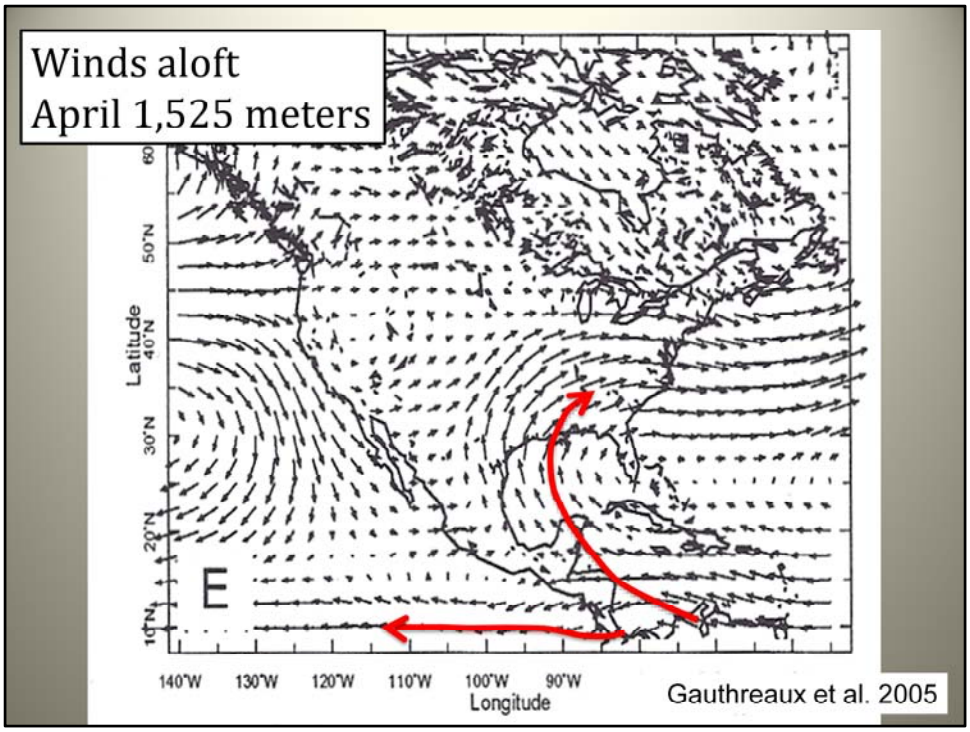
This is a chart that Paul Hamel worked out.
It shows the relation between ground speed, averaged over the duration of a flight, and fat consumed, assuming 0.06g-fat/hr, for migrating Cerulean Warblers.
Blue rectangle shows typical pre-migratory fat load for a Cerulean Warbler.
Astonishingly, to me, given the optimistic conditions of 0.06g/hr at 50 mph, a Cerulean Warbler with typical fat load would be able to fly from Atlanta, Georgia to Medellin, Colombia, in a single flight.



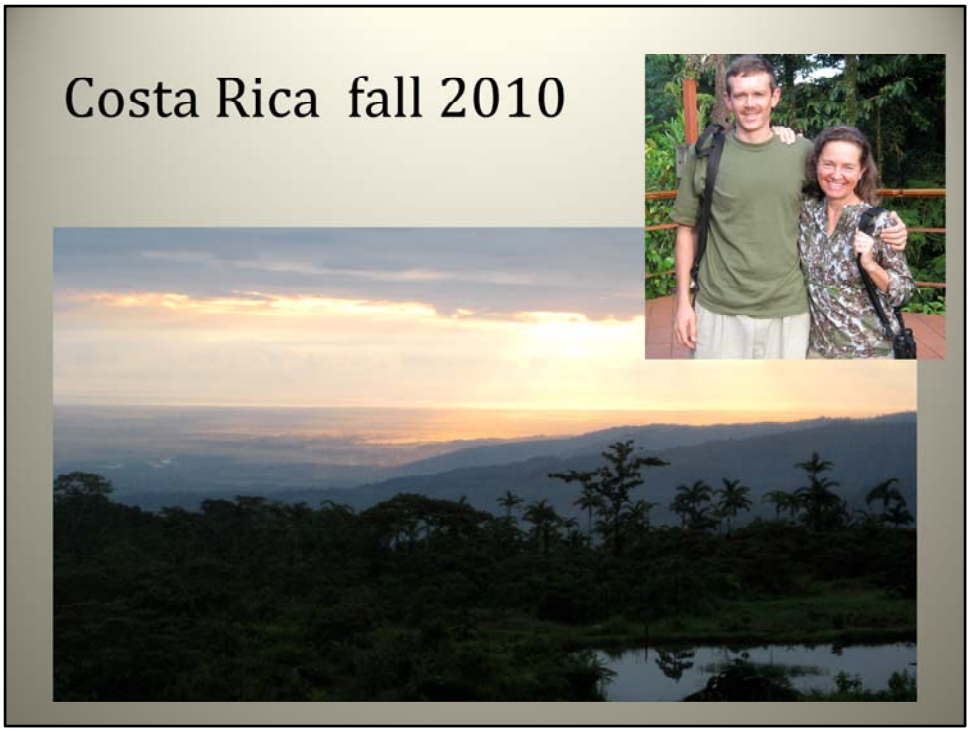
Even more astonishingly to me, even a minimally fat Cerulean Warbler could fly the Gulf of Mexico at virtually any of the listed ground speeds.

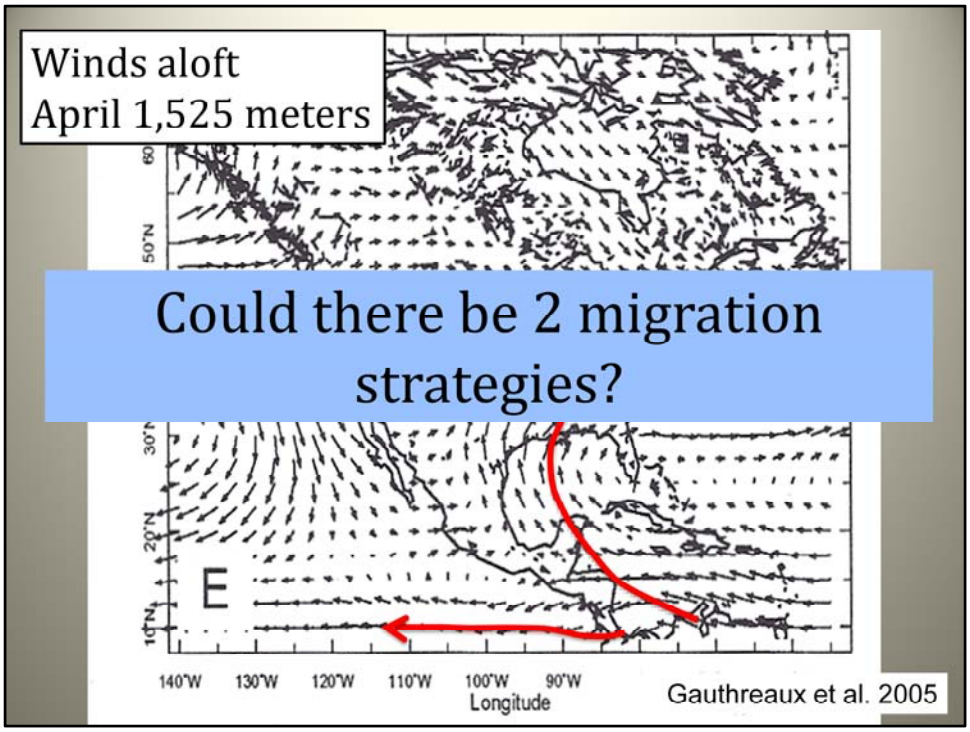


Last fall I got an invitation from bird-guide Ernesto Carmen to join him for some CERW surveys on the Caribbean slope of the mountains east of San Jose.
I saw flock after flock with 3 to 6 CERW
So, I got thinking



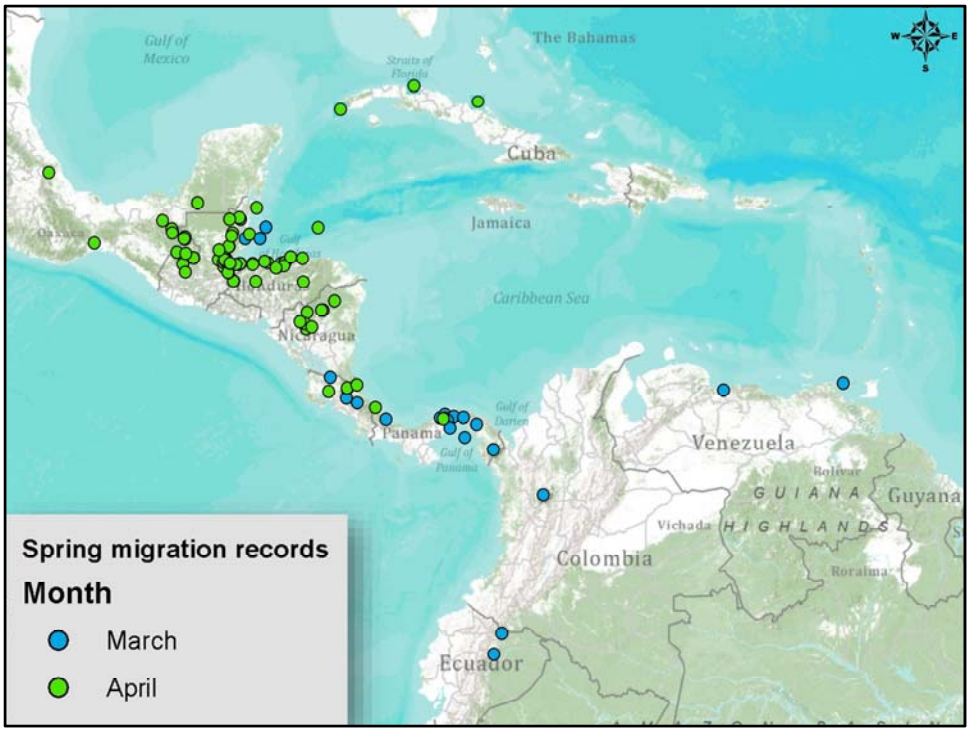
If a CERW wintering in western Colombia, Ecuador or Peru tries to use winds aloft to aid their migration, they're going to end up in Fiji

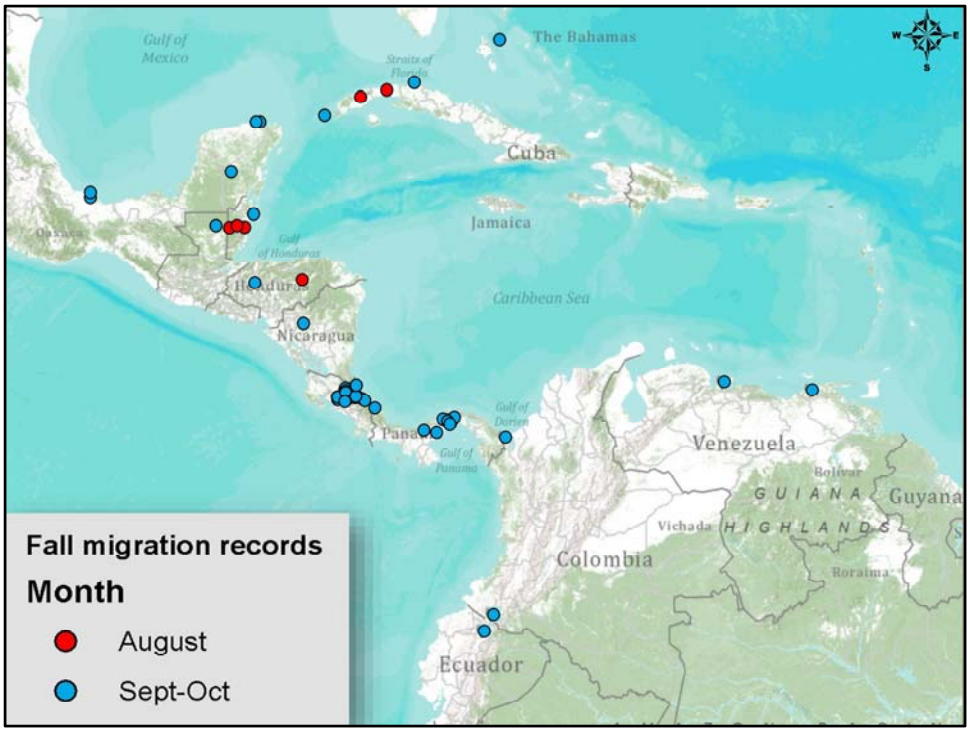

Costa Rica fall 2010


Winds aloft
April 1,525 meters
Could there be 2 migration strategies?
E
140°W
130°W
120°W
110°W
100°W
90°W
Longitude
Gauthreaux et al. 2005

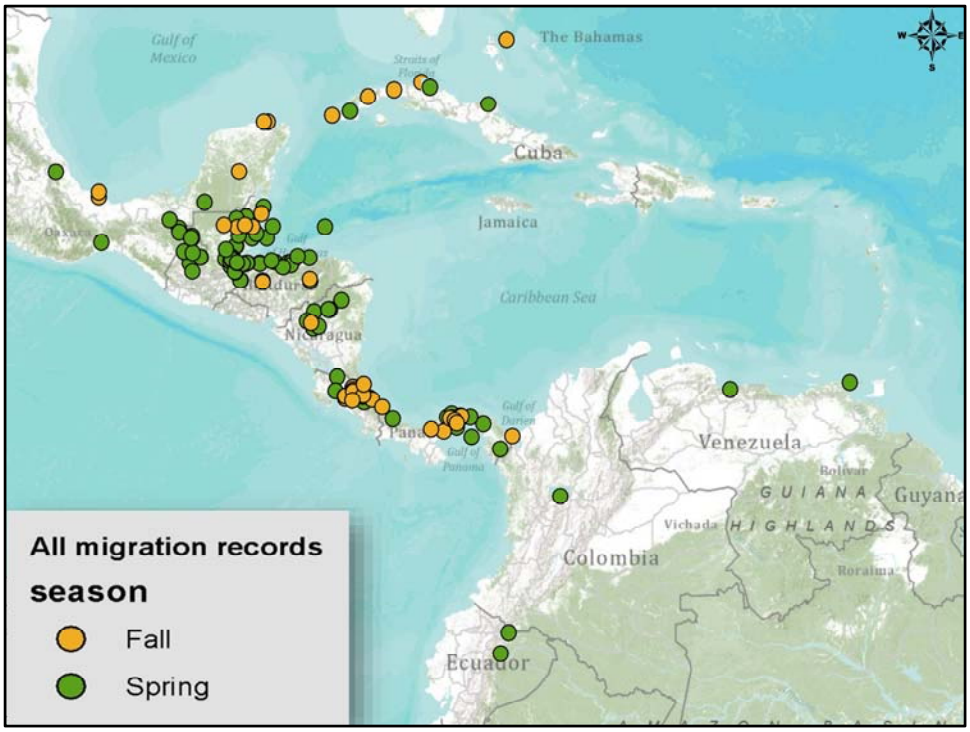
April 1,525 m

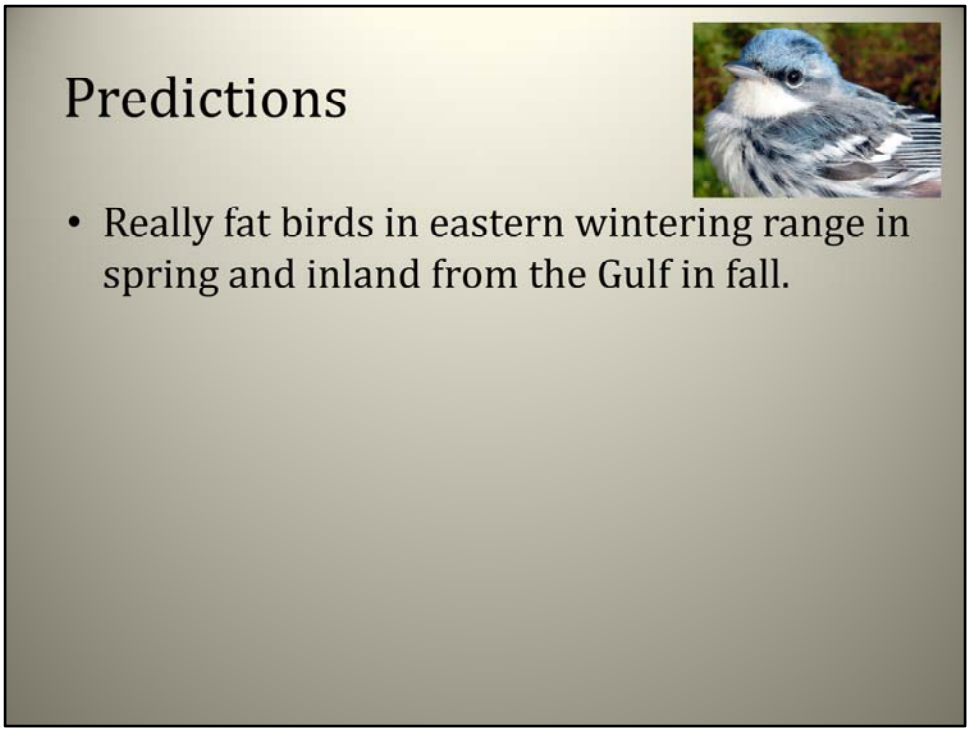
Here's what I propose
The migration route a bird uses depends on which part of the winter range it occupies
Birds in eastern Colombia and Venezuela take the free shuttle to north Georgia or the Cumberland Mountains of Tennessee
The birds in the western part of the range take an overland route through Central America until they can take advantage of the favorable winds.
BLPW overland short hops 150 – 250 miles/night
Flying 5 – 8 hours per night


Gulf of Mexico
The Bahamas
Straits of Florida
Cuba
Jamaica
Caribbean Sea
Honduras
Nicaragua
Panama
Gulf of Darien
Gulf of Panama
Venezuela
Bolivar
GUIANA
Guyana
Vichada
HIGHLANDS
Colombia
Roraima
Ecuador
Spring migration records
Month
March
April



When Ted Parker did his work there were 15 recoreds


All migration records
season
Fall
Spring
Gulf of Mexico
The Bahamas
Cuba
Jamaica
Caribbean Sea
Nicaragua
Venezuela
Guyana
Colombia
Ecuador
GUIANA HIGHLANDS



If this strategy were true, what would be some of the predictions?
Building from early March and dropping off by late April. Large influxes would be Trans Caribbean-Trans Gulf migrants falling out due to weather events
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.
Other species with similar winter distribution may be using this same strategy and perhaps some of the same stopover sites.

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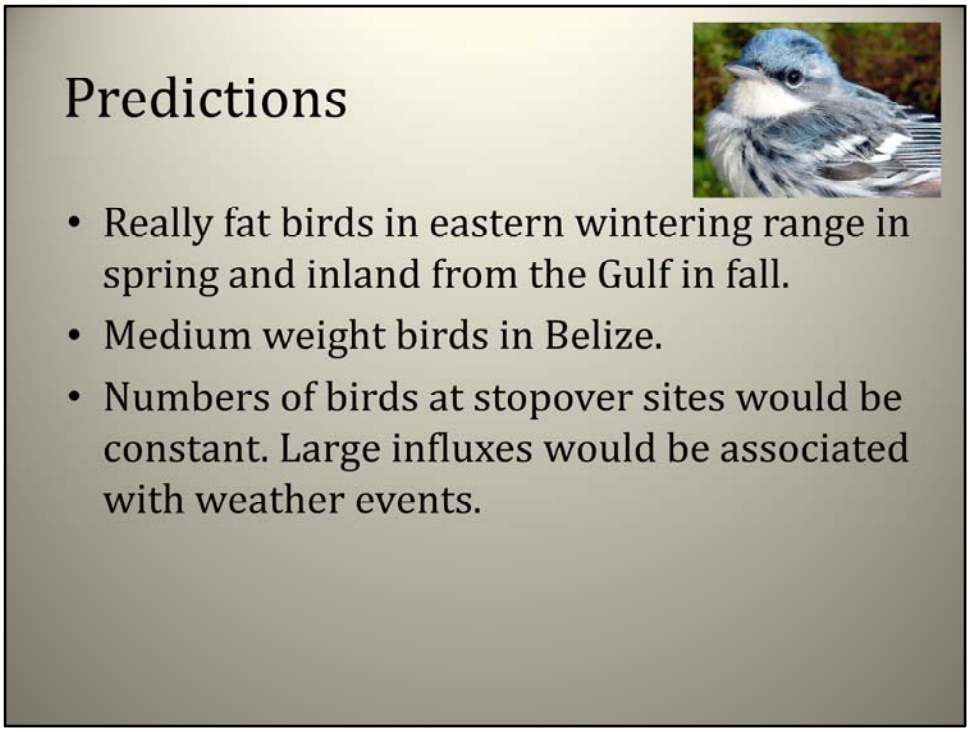

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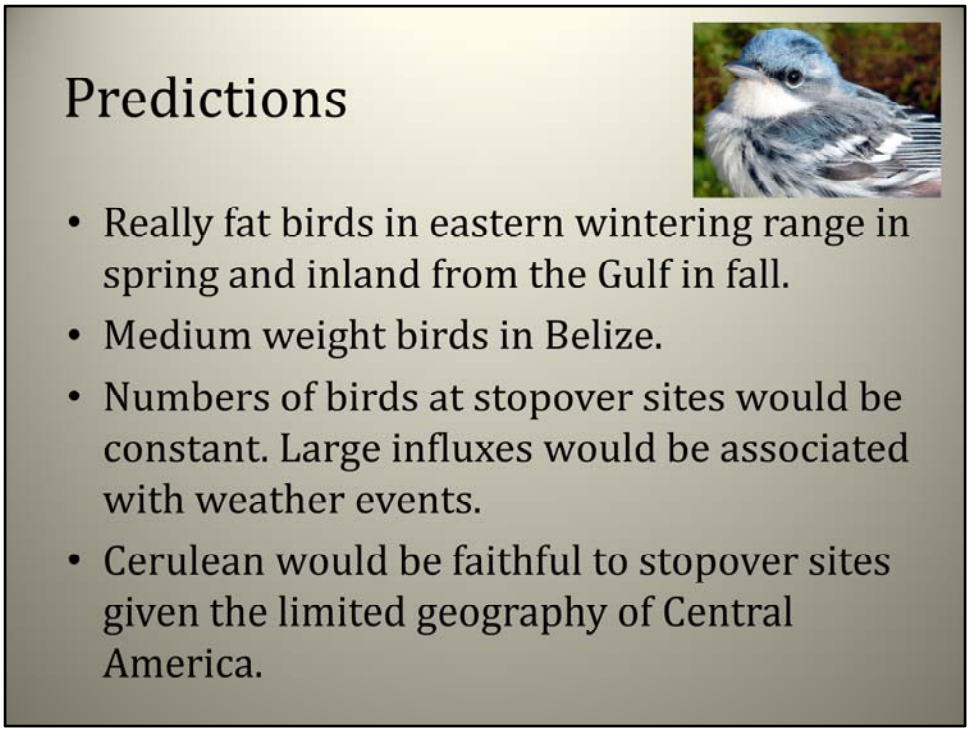

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One more idea

- Spring migration may be easier on the birds that fall migration
  - Spring has more predictable winds
  - Fall migration more often associated with weather events to provide a tail wind, meaning birds have to maintain departure weight while waiting

Acknowledgements

- Paul Hamel has nurtured by thinking in all things Cerulean
- Sid Gauthreaux, Ian Nisbet priceless experience and advise.
- Frank Moore wisdom and data
- Rich Blaha, ABR Inc. Environmental Research and Services. For the beautiful maps
- Data from both Cornell eBird and USFWS Bird Banding Lab
- All of the biologists and field assistants that helped gather the stopover data in Belize, Honduras, Guatemala, Nicaragua, Costa Rica, and Chiapas, Mexico
- And many more

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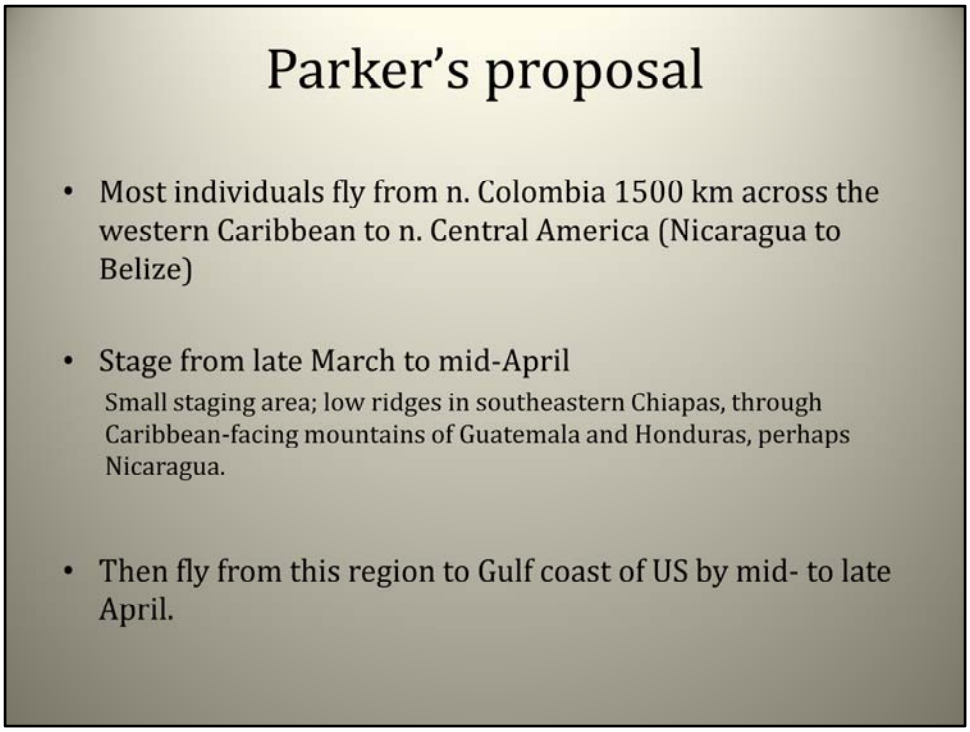
Questions?



CERW move north along the E slope of the Andes to N Colombia
They fly >500 miles across the W. Caribbean to the coast of Nicaragua to Belize
Continue inland to lower montane forest in low Caribbean facing mtns.
Spend up to 3 weeks
Staging area is small from low ridges of SE Chiapas, SE through Guatemala and Honduras
Fly from there over Gulf