Season-long fecundity, brood parasitism and nest predation in the Cerulean Warbler in southwestern Michigan

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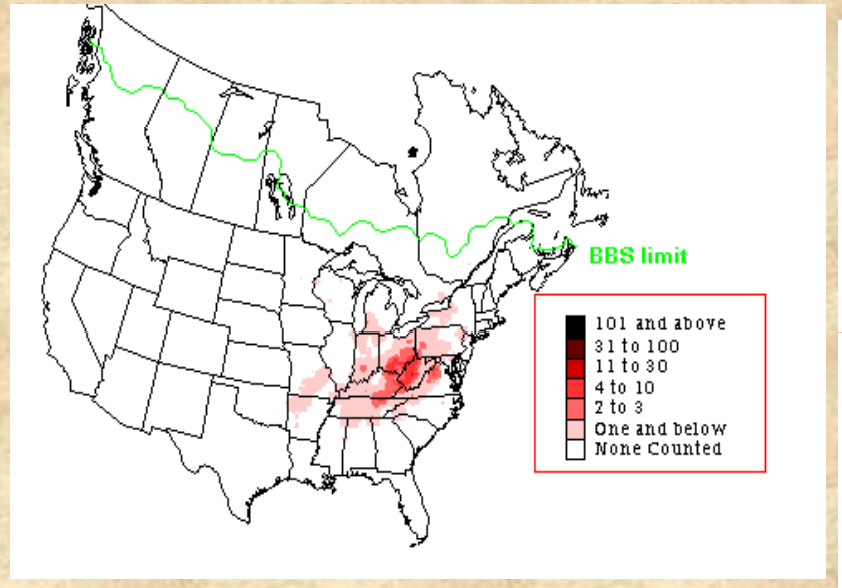
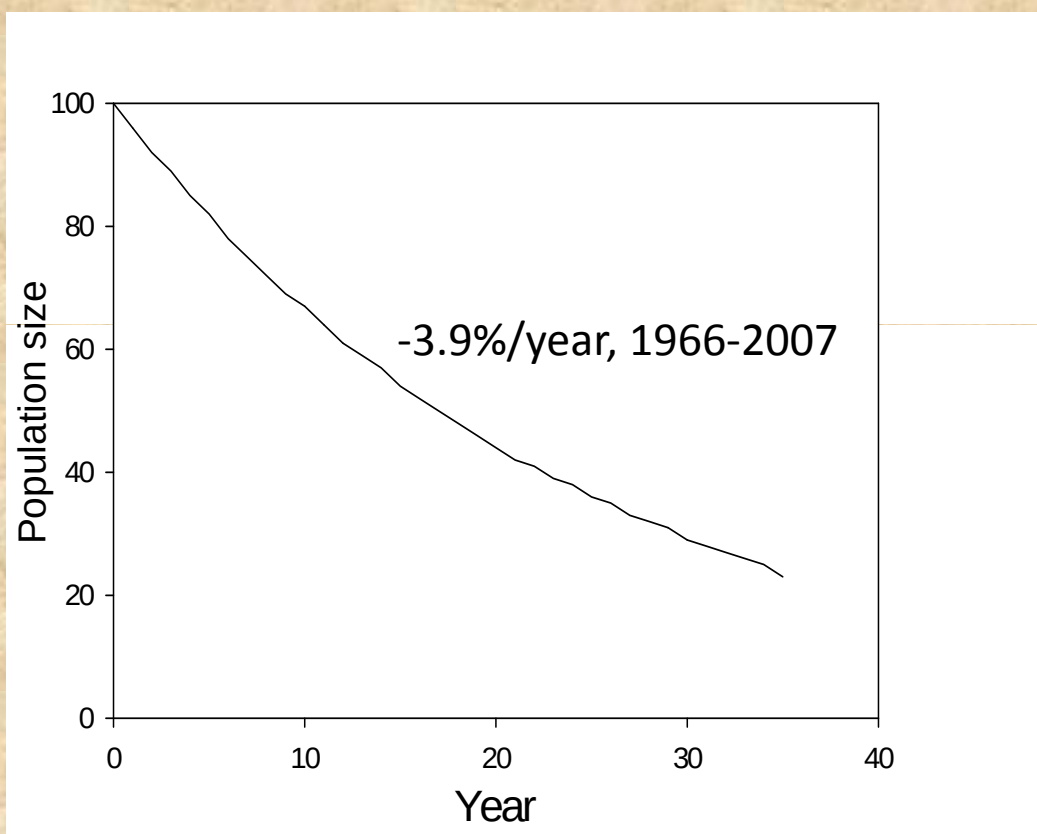
Cerulean Warbler life-history

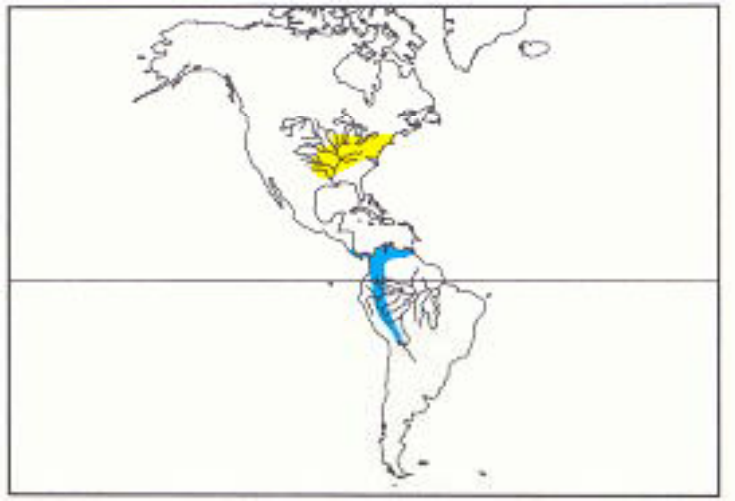
Body mass: 8-9 grams
Migration status: Neotropical migrant (long-distance)
Breeding habitat: open, maturing deciduous or mixed woodland with tall trees
Nest location: mid-story/canopy
Nest type: open-cup; bark, plant fibers, spider silk
Clutch size: 3-5 eggs
Length of incubation: 12 days
Days to fledge: 10-12
 # broods/year: usually 1; rarely 2
Diet: primarily insects, some vegetable matter
Males: defend all-purpose territories, feed young
Females: build nests, lay eggs, feed young
Breeding period: mid-May to late July

Long-term population decline of the Cerulean Warbler

Breeding Bird Survey (BBS)







Decline hypotheses

- **Breeding grounds hypothesis**: events on the breeding grounds, e.g. increased nest predation and/or brood parasitism, cause low annual reproduction

- **Wintering grounds hypothesis**: events on the wintering grounds, e.g. habitat loss/degradation, cause low annual survival

- **Migration hypothesis**: habitat loss/degradation of habitat used during migration cause low annual survival

Three related goals:

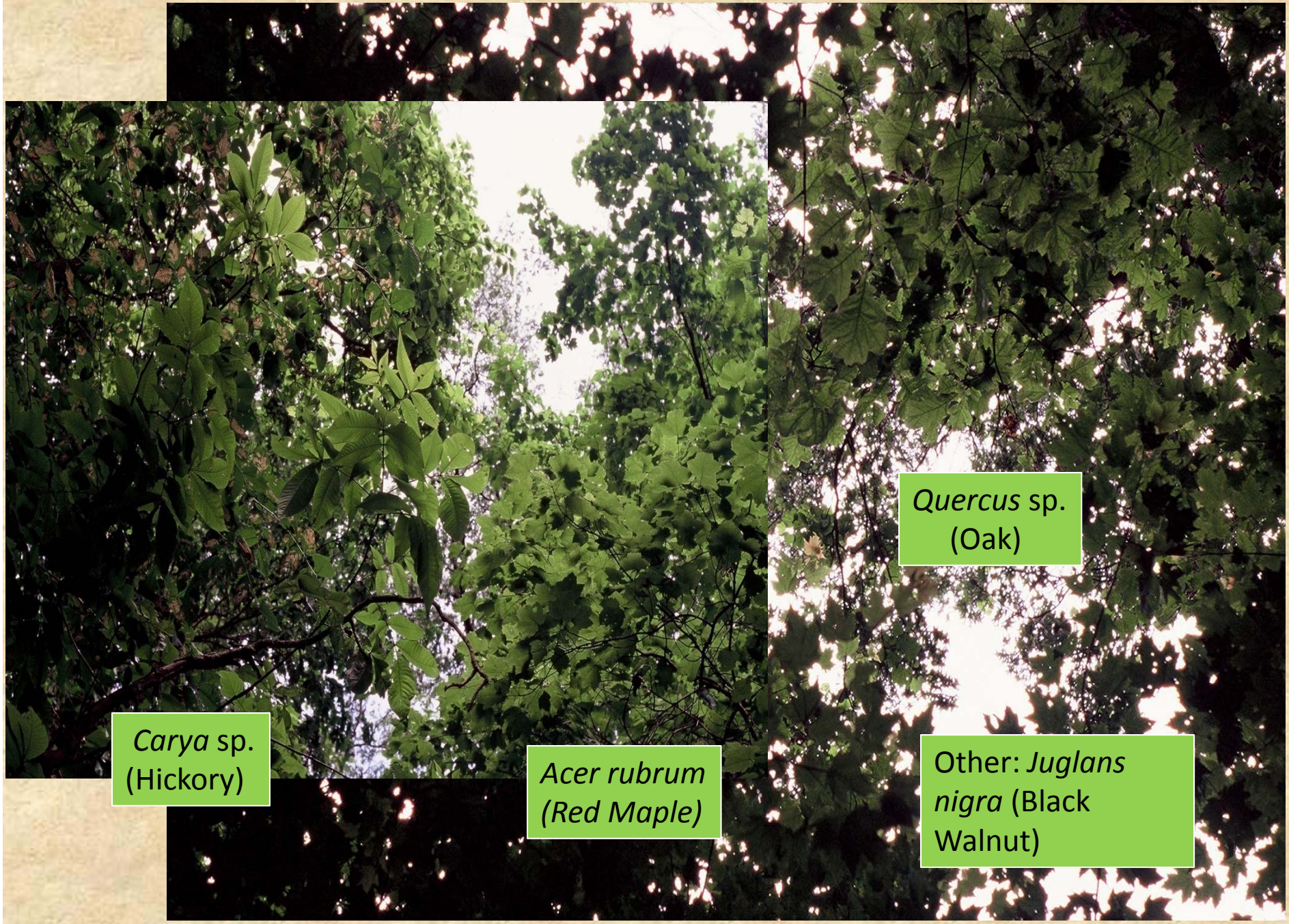
1. Present nest aspects in context of nest predation
2. Estimate population λ using season-long fecundity
3. Evaluate decline hypotheses

second year male

after second year male

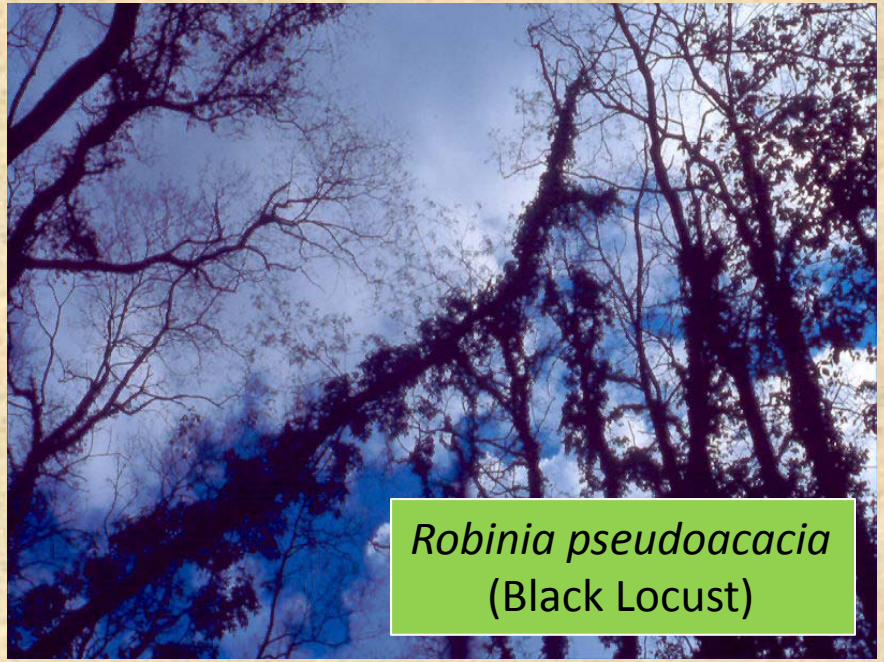
Barry State Game Area, Michigan

(season-long fecundity and nest biology aspects)


Quercus sp.
(Oak)
Carya sp.
(Hickory)
Acer rubrum
(Red Maple)
Other: *Juglans nigra* (Black Walnut)

Fort Custer Reserve Base

(supplementary nest data)

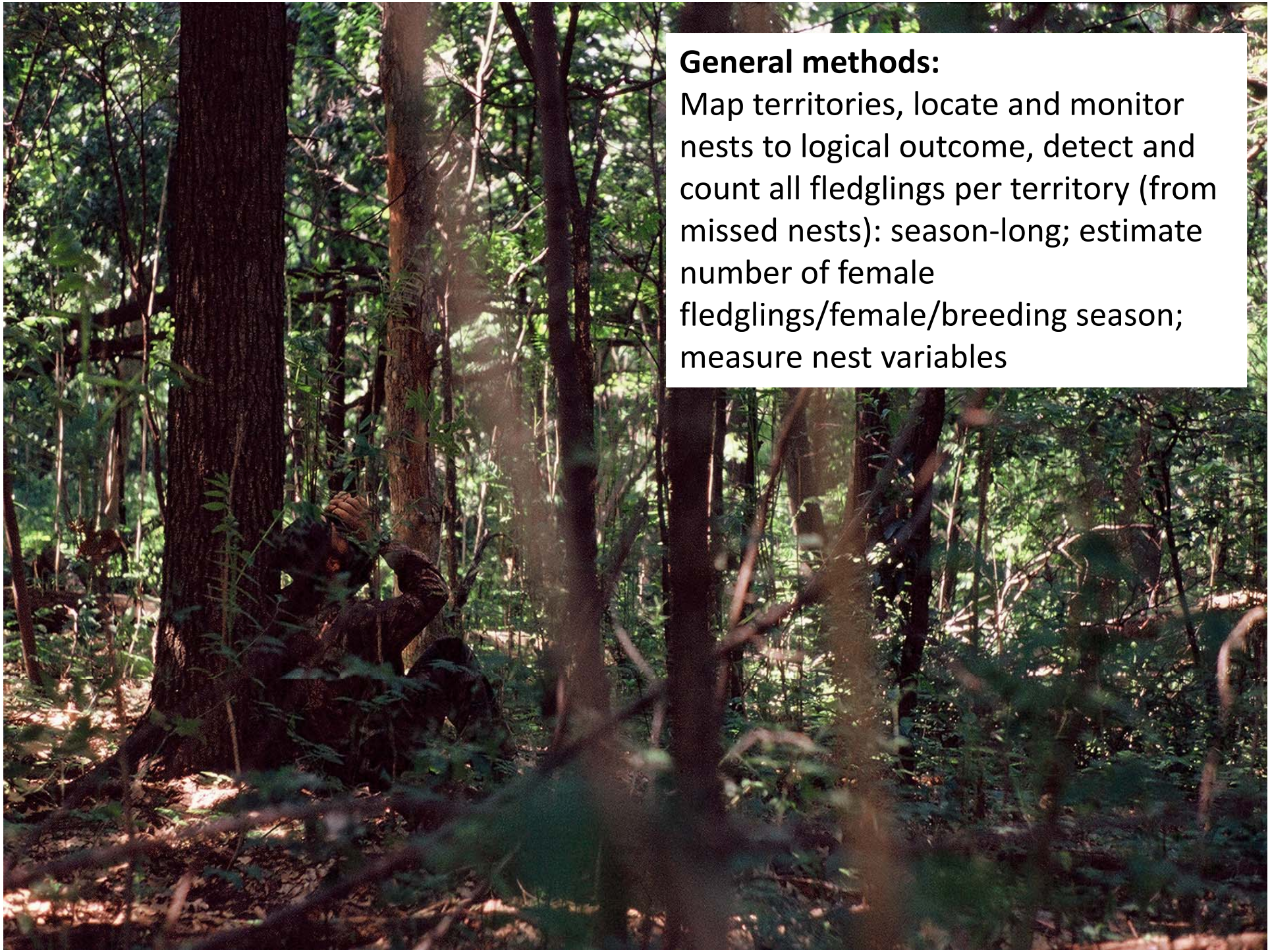


Other: *Prunus serotina* (Black Cherry), *Quercus* sp., *A. rubrum*

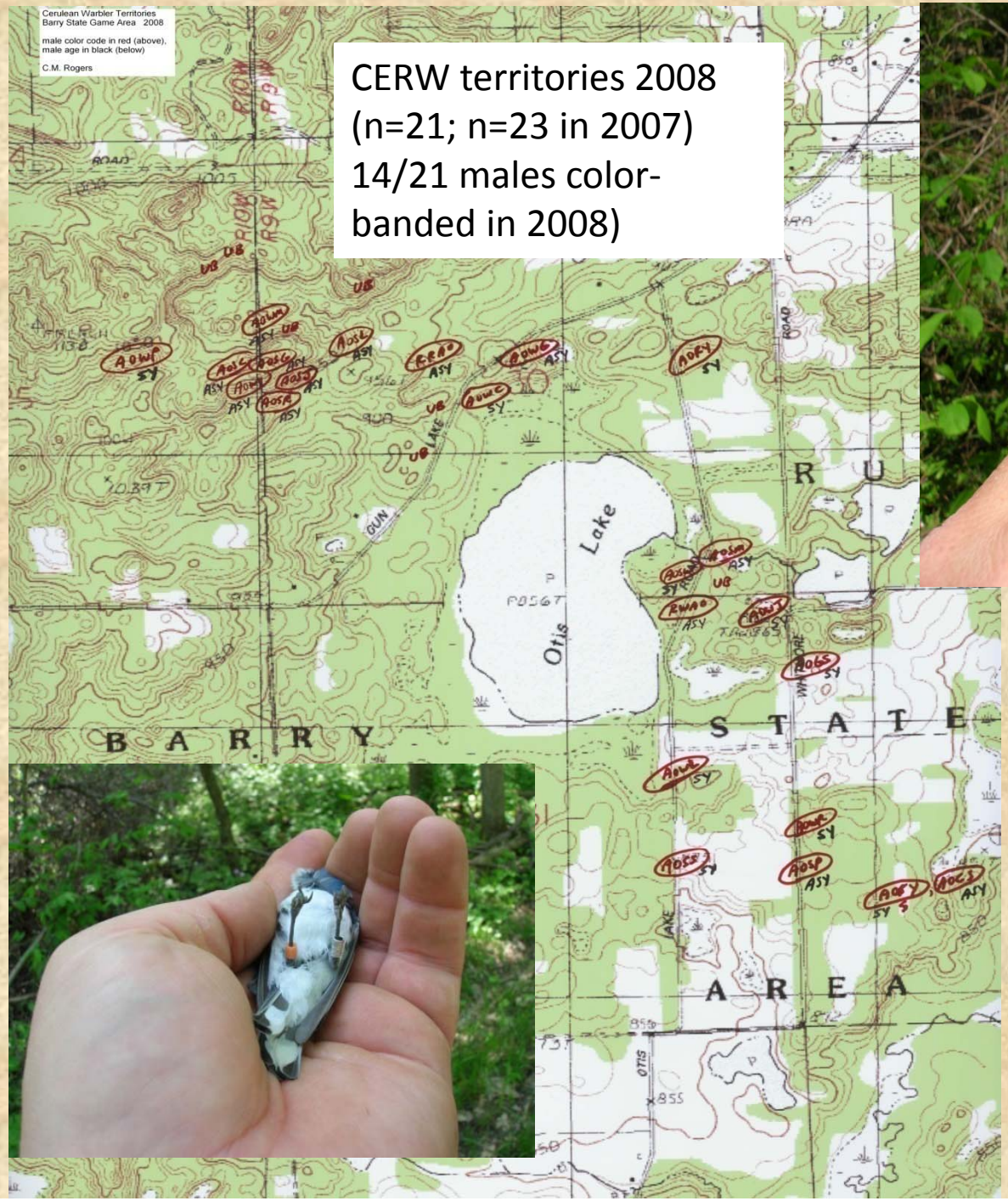
unannounced logging

agriculture (food, biofuels)

continued exurbanization



General methods:
Map territories, locate and monitor nests to logical outcome, detect and count all fledglings per territory (from missed nests): season-long; estimate number of female fledglings/female/breeding season; measure nest variables

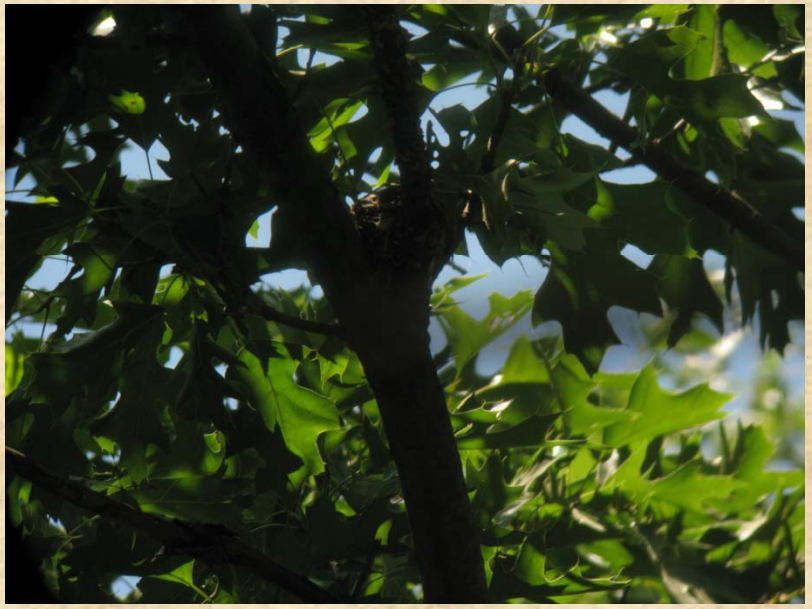


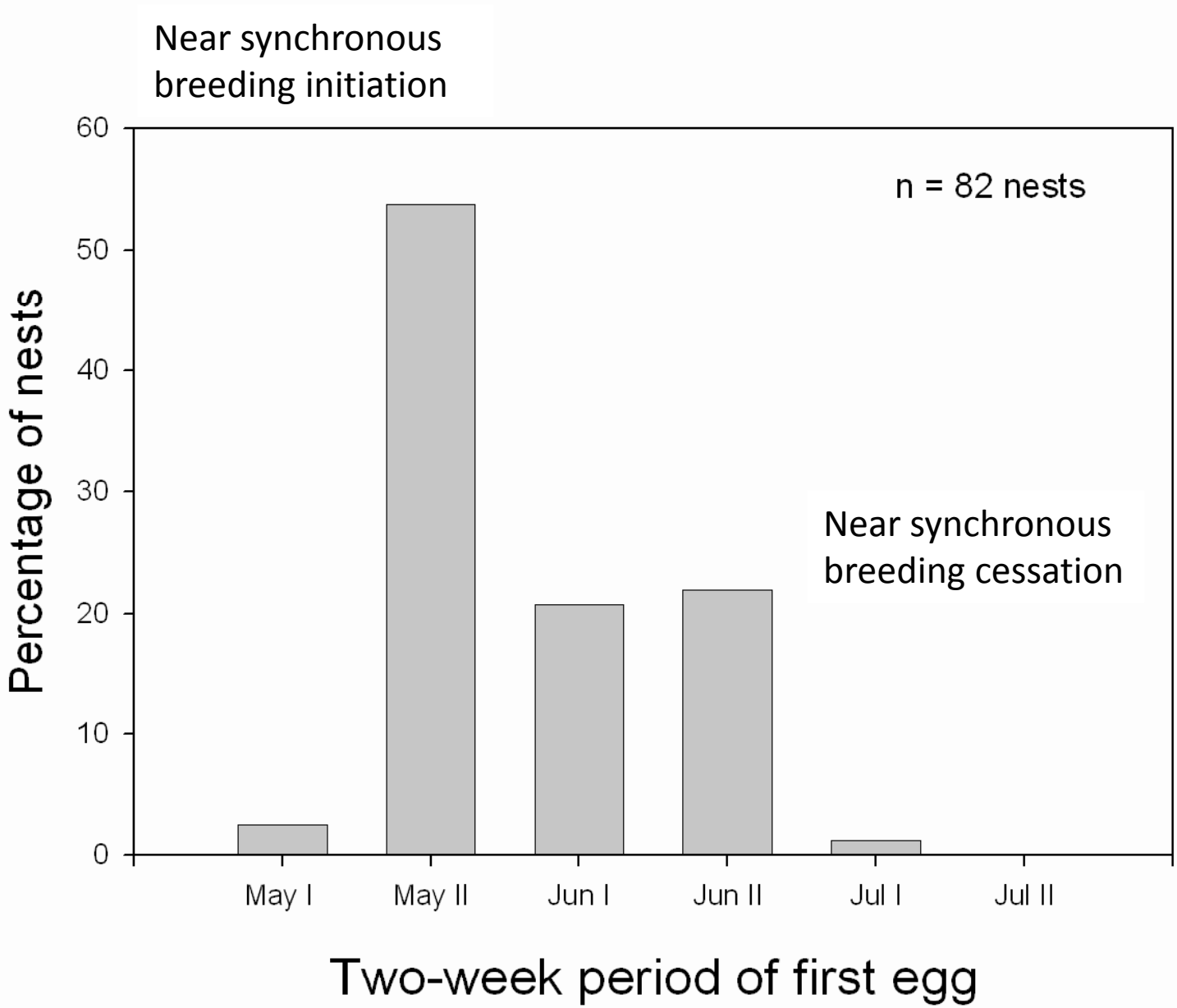
CERW territories 2008
(n=21; n=23 in 2007)
14/21 males color-banded in 2008)

inferential color-coding system
(rapid identification in canopy)

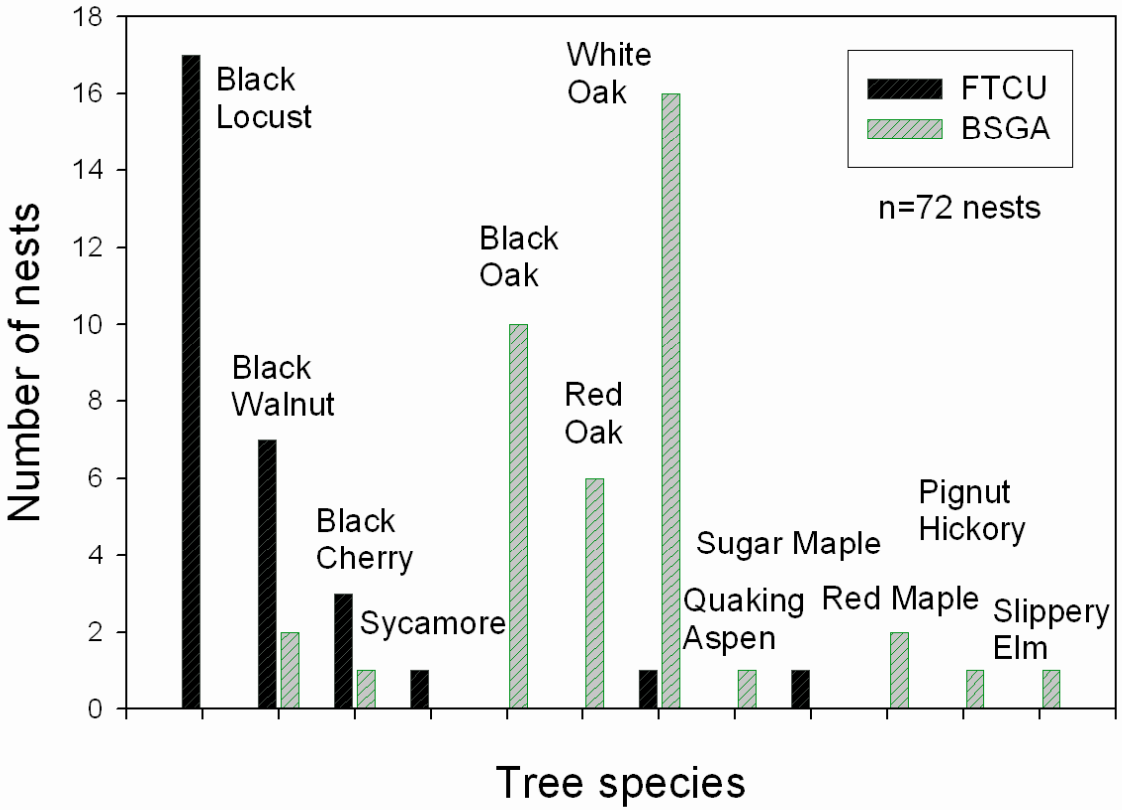
incubating female
near fledgling

Cerulean Warbler nests - Michigan




Near synchronous
breeding initiation
n = 82 nests
Near synchronous
breeding cessation
Percentage of nests
60
50
40
30
20
10
0
May I
May II
Jun I
Jun II
Jul I
Jul II
Two-week period of first egg

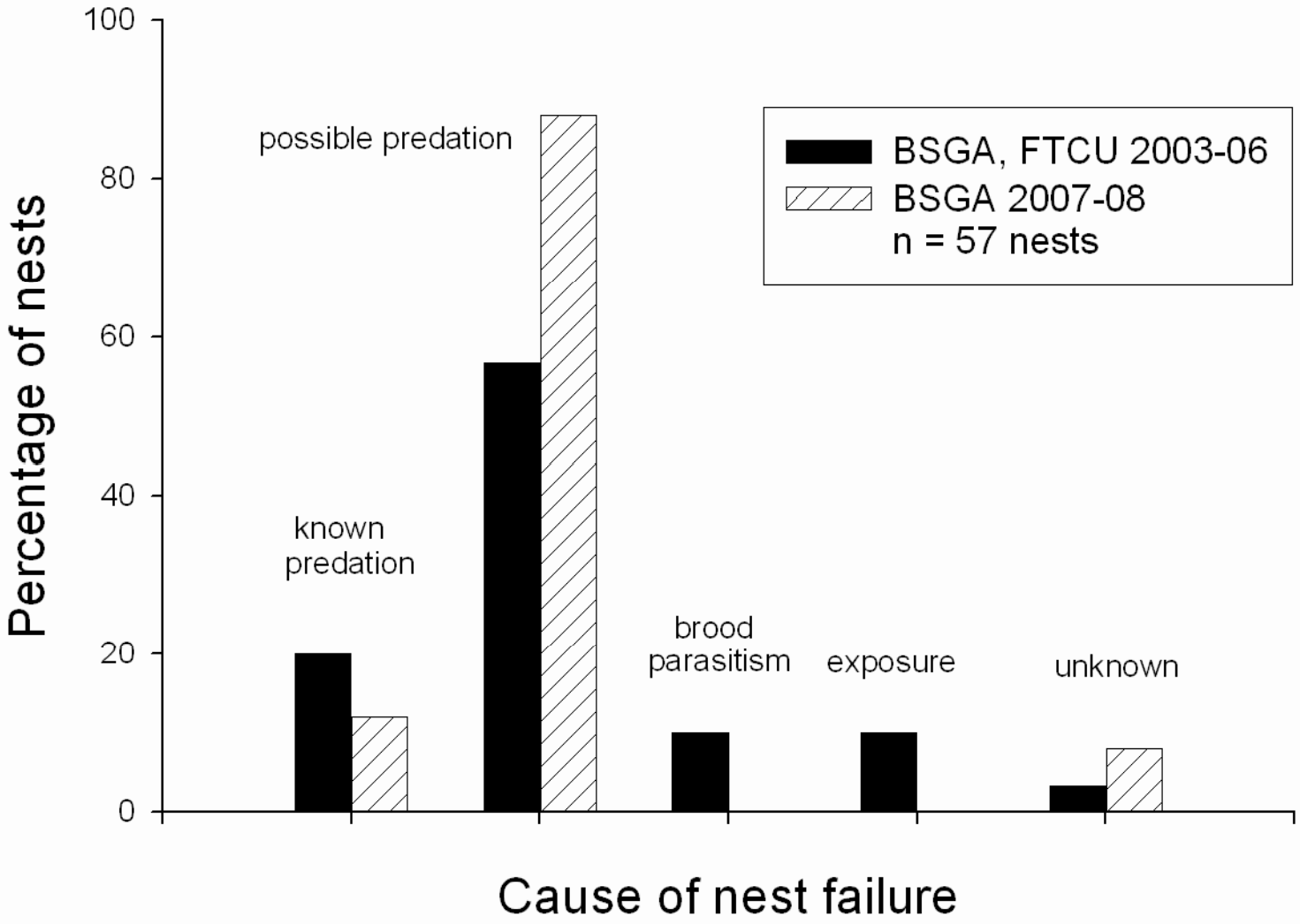
Cerulean Warbler
Tree species selected for nest
Two Michigan study sites, 2003-08



Cerulean Warbler nest location variables, two sites, 2003-2008
southwestern Michigan

Site	Nest tree: dbh in	Nest tree: height m	Nest height m	Nest height/ tree height %	Bole distance m	Foliage distance m	Gap distance m
BSGA (n = 42 nests)	16.9	24.1	19.1	79.3	6.2	4.5	8.9
FTCU (n = 28 nests)	15.9	26.4	19.7	73.4	3.9	6.7	2.4

Forest gap types: light, sand road, paved road, wetland, meadow, unknown


100
80
60
40
20
0
Percentage of nests
possible predation
known
predation
brood
parasitism
exposure
unknown
BSGA, FTCU 2003-06
BSGA 2007-08
n = 57 nests
Cause of nest failure

ancova, # fledglings leaving nest: gap distance P = 0.056; gap type, gap type x gap distance n.s. (more fledglings farther from gap)

Diurnal predator survey: BSGA

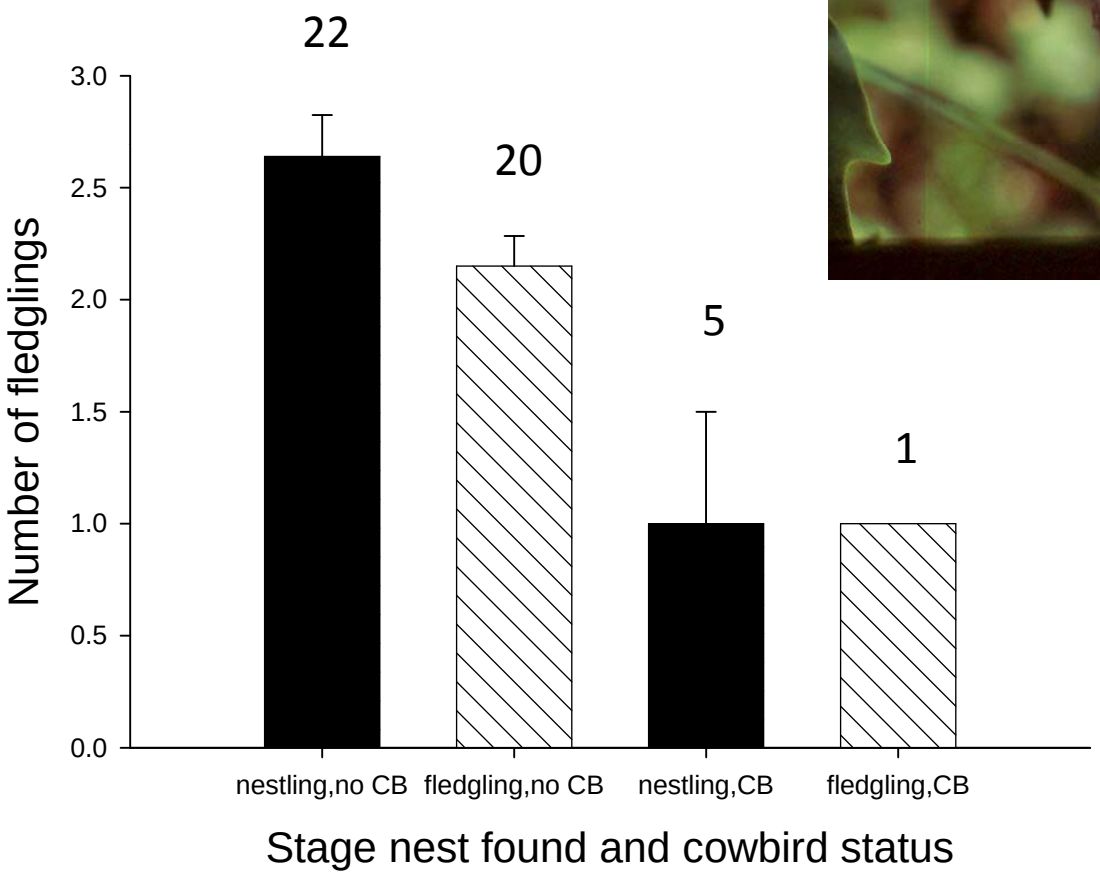
2007: 176 45-minute observation periods in CERW territories; 0.23 predators/hour; Blue Jay 55% of total (others: 3 squirrel sp., American Crow, Cooper's Hawk)

2008: 242 45-minute observation periods in CERW territories; 0.15 predators/hour; Blue Jay 100% of total (Barg et al. 2006)

limitation: nocturnal predators not sampled

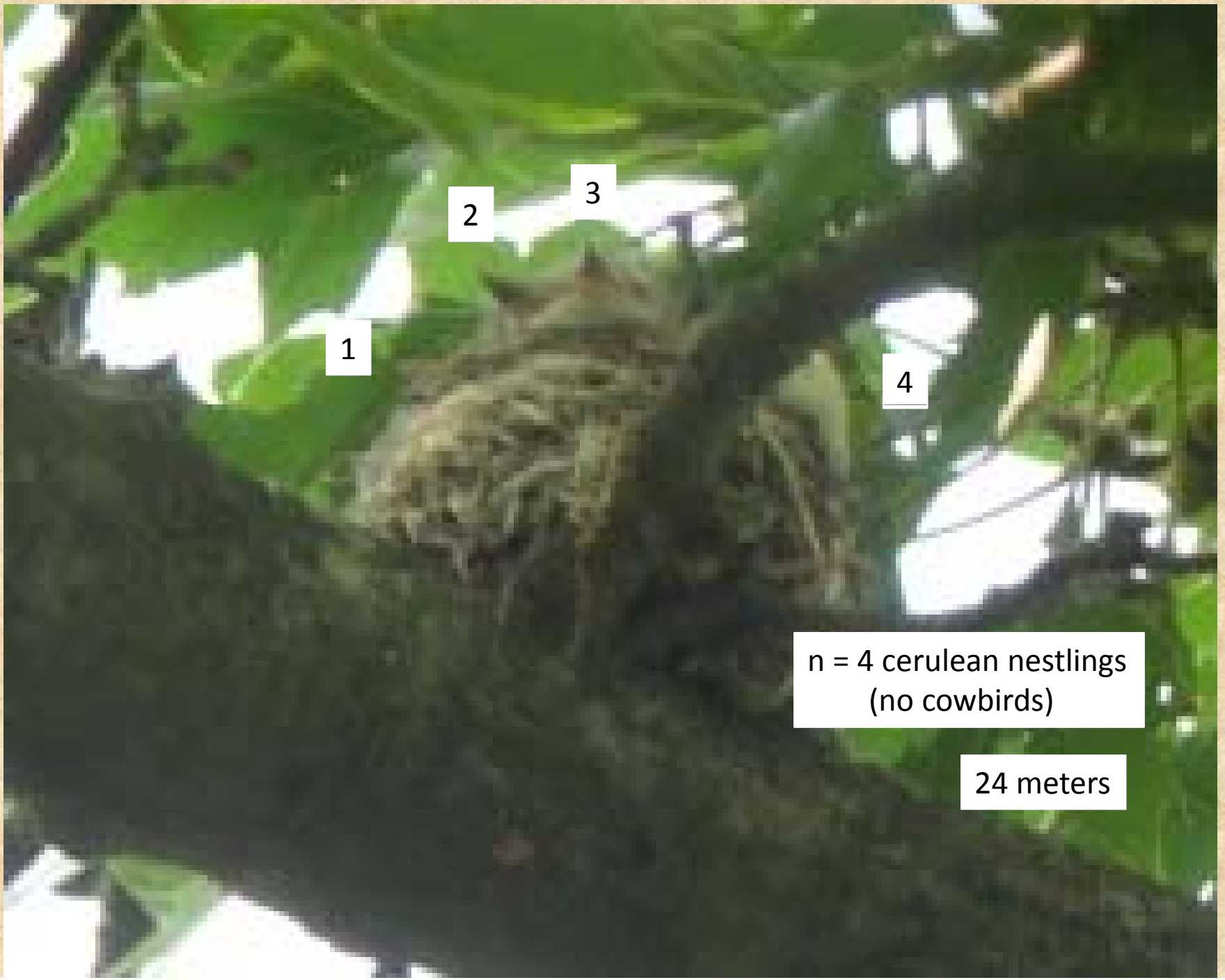
2003-2008

mean ± 1 SE
ANOVA: stage P > .05,
cowbird status P < .05
interaction n.s.



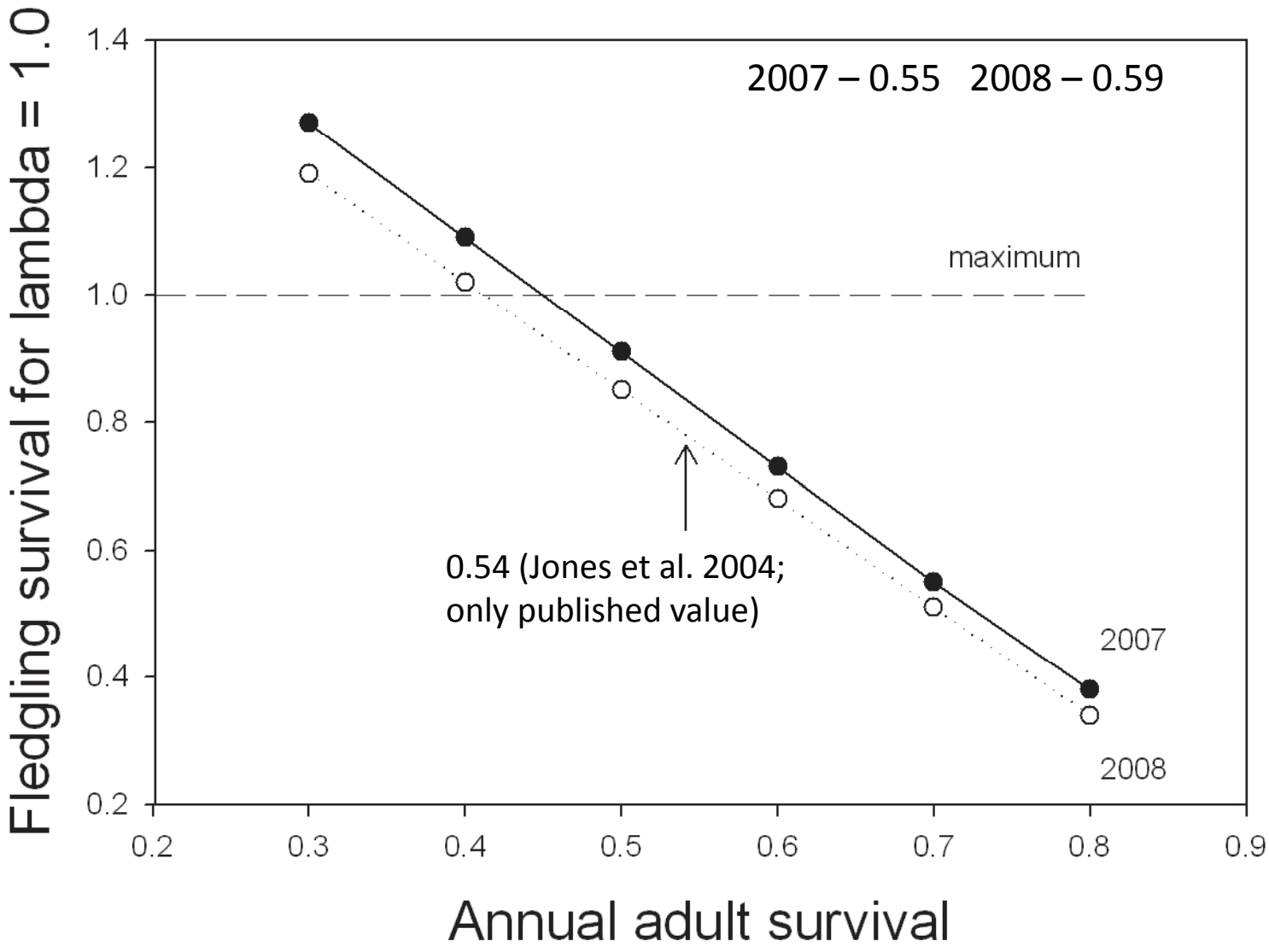
Additional nest aspects

- **materials:** main – spider silk (from ground in early spring), later Eastern tent caterpillar tent silk; plant fibers (e.g. grape vine bark); nest outline broken up using contrasting materials, e.g. light plant materials)
- **vines** – regularly used to hide nests
- **reuse of nest materials during renesting**: occasional
- **interspecific interactions:** both sexes usually social subordinates to other forest/edge parulids (*D. cerulea* is smallest-bodied *Dendroica*); are Cerulean Warblers in a marginal food/nesting habitat?
- **incubating and brooding females** very attentive to nest sanitation, including background invertebrates

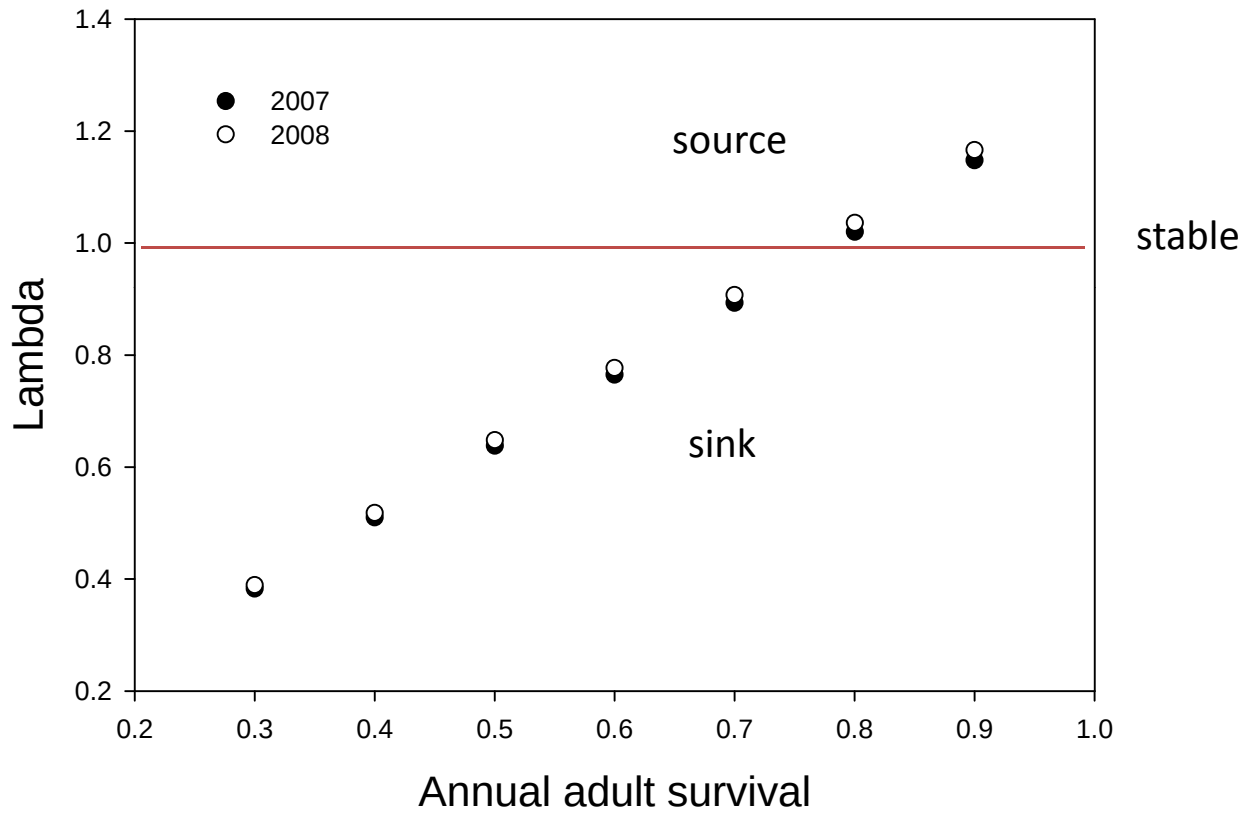

3
2
1
4
n = 4 cerulean nestlings
(no cowbirds)
24 meters

Based on season-long fecundity: BSGA

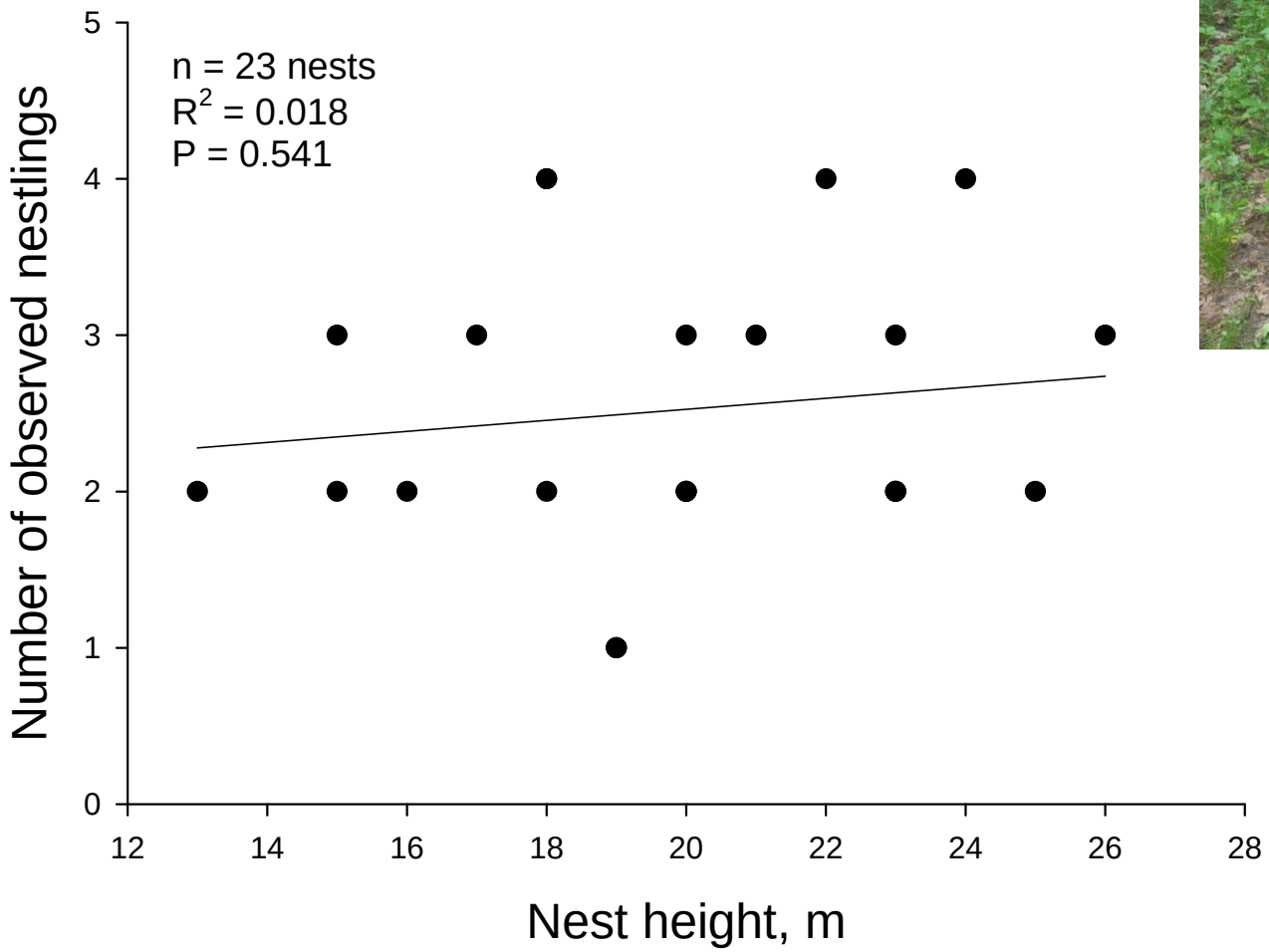
λ = adult annual survival + fledgling survival (# female fledglings/female)



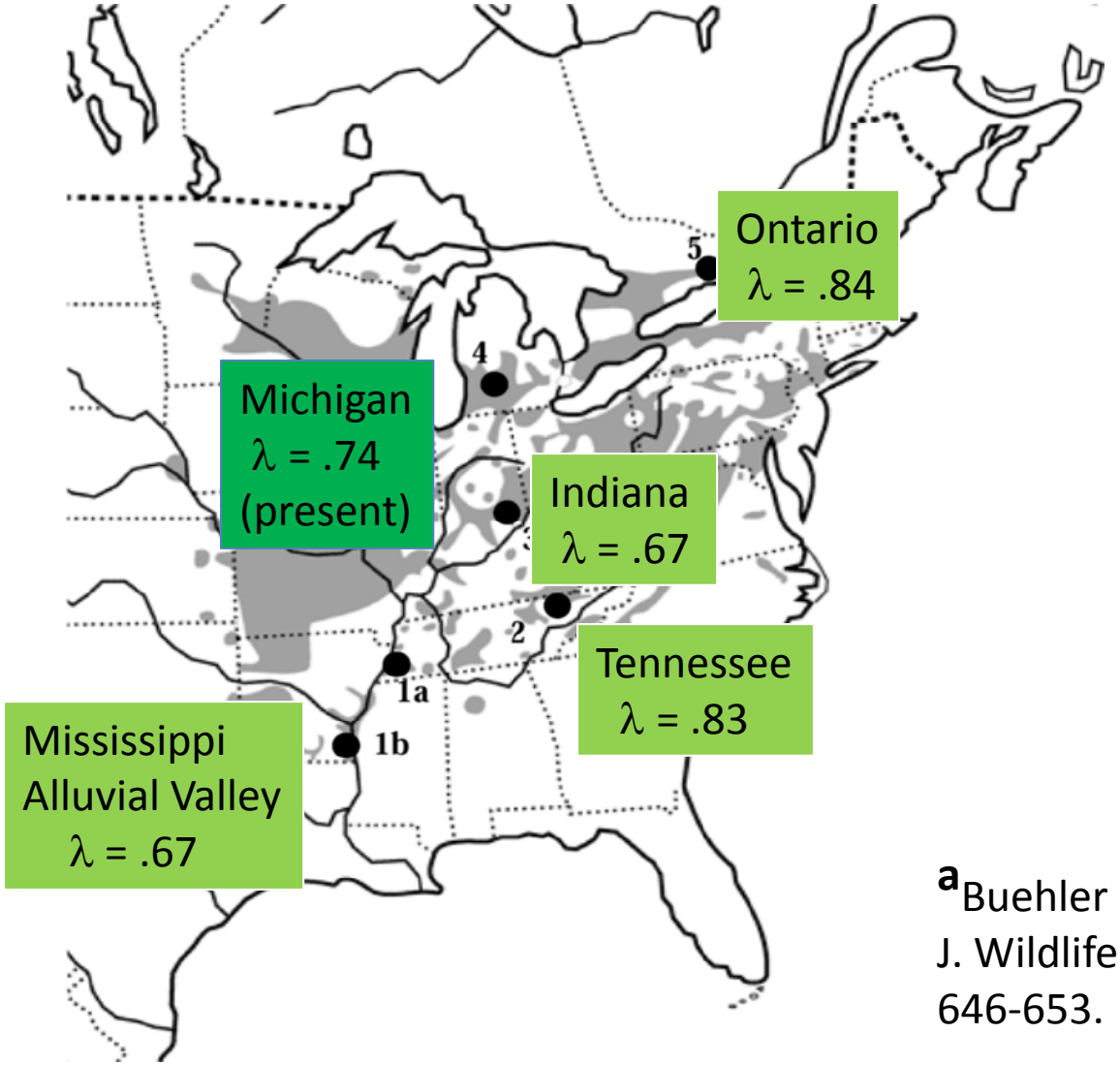
At fledgling annual survival
rates @ half of those of adults



Is there measurement error in # fledglings/successful nest?



improbable sustainability also found by modeling of within-season sampling of Mayfield nest success, female fledglings/female[a]



[a]Buehler et al. (2008): J. Wildlife Manage. 72: 646-653.

Decline hypothesis evaluation

- for the wintering grounds and/or migration habitat hypotheses(is) to explain the long-term population decline, survival would have to have declined historically (since at least 1966) from atypically high passerine levels

- in contrast, the breeding grounds hypothesis requires only historically degraded (since at least 1966) forest habitat on the breeding grounds
- possibly resulting from effects of forest loss/fragmentation:
  - increased exposure to nest predators (corvids?)
  - decreased food supply/tree health?

Conclusions – southwestern Michigan Cerulean Warblers

- Nesting biology
  - breed in a wide diversity of tree species
  - breeding initiation and cessation are near-synchronous, with a short nesting season (mid-May to early July)
  - female preference for nesting near forest gaps may expose nests to high nest predation, but not to high brood parasitism
  - nest predation is the main source of nest failure, and the Blue Jay may be an important diurnal nest predator
  - a subordinate forest species possibly occupying a marginal nesting (high predation) and food (low) microenvironments

- Demography
  - show annual adult survival typical of nondeclining parulids (though more data are needed; Rogers 2008 – 2010: annual male adult survival in .40 - .62 range; PRELIMINARY)
  - a stable population is first reached at atypically high combinations of adult and fledgling annual survival rate (low reproductive output ⟸ high nest predation)
  - ultimately, improving breeding grounds productivity will be needed for successful Cerulean Warbler conservation
  - importantly, such a conservation effort will depend critically on maintaining current survival rates via winter and migration habitat protection: **What is one without the other?**

Current and future

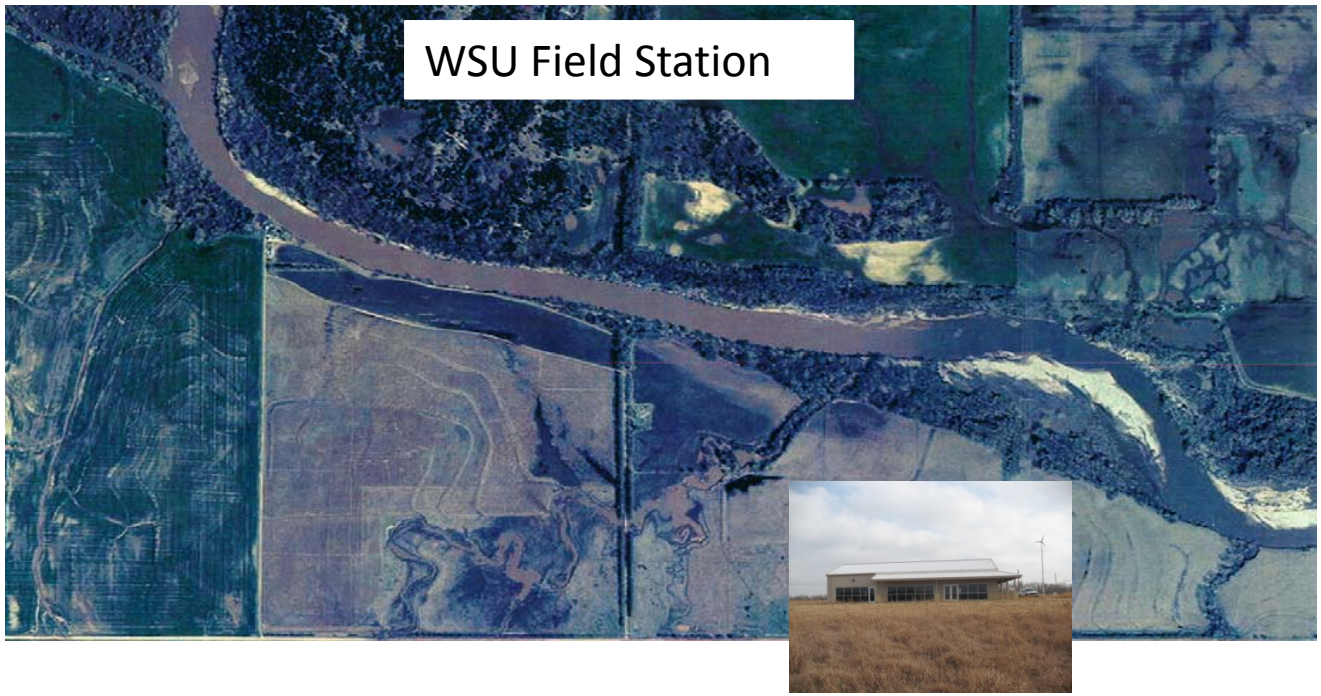
- evaluate relationship between forest area and: (1) reproductive rate, (2) nest predation rate

  What does reforestation hold? What kind of forest management will be important?

- obtain more estimates of annual adult survival from more locations and years
- comparative demography:

Blue-gray Gnatcatcher vs. Cerulean Warbler (just underway in Kansas):
If annual survival is similar to Cerulean Warbler, what is reproductive output?
Prediction: higher

Factors affecting: clutch size, hatching success, nest success and nest predation, brood parasitism, *renesting persistence*
obtain: # female fledglings/female/year



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