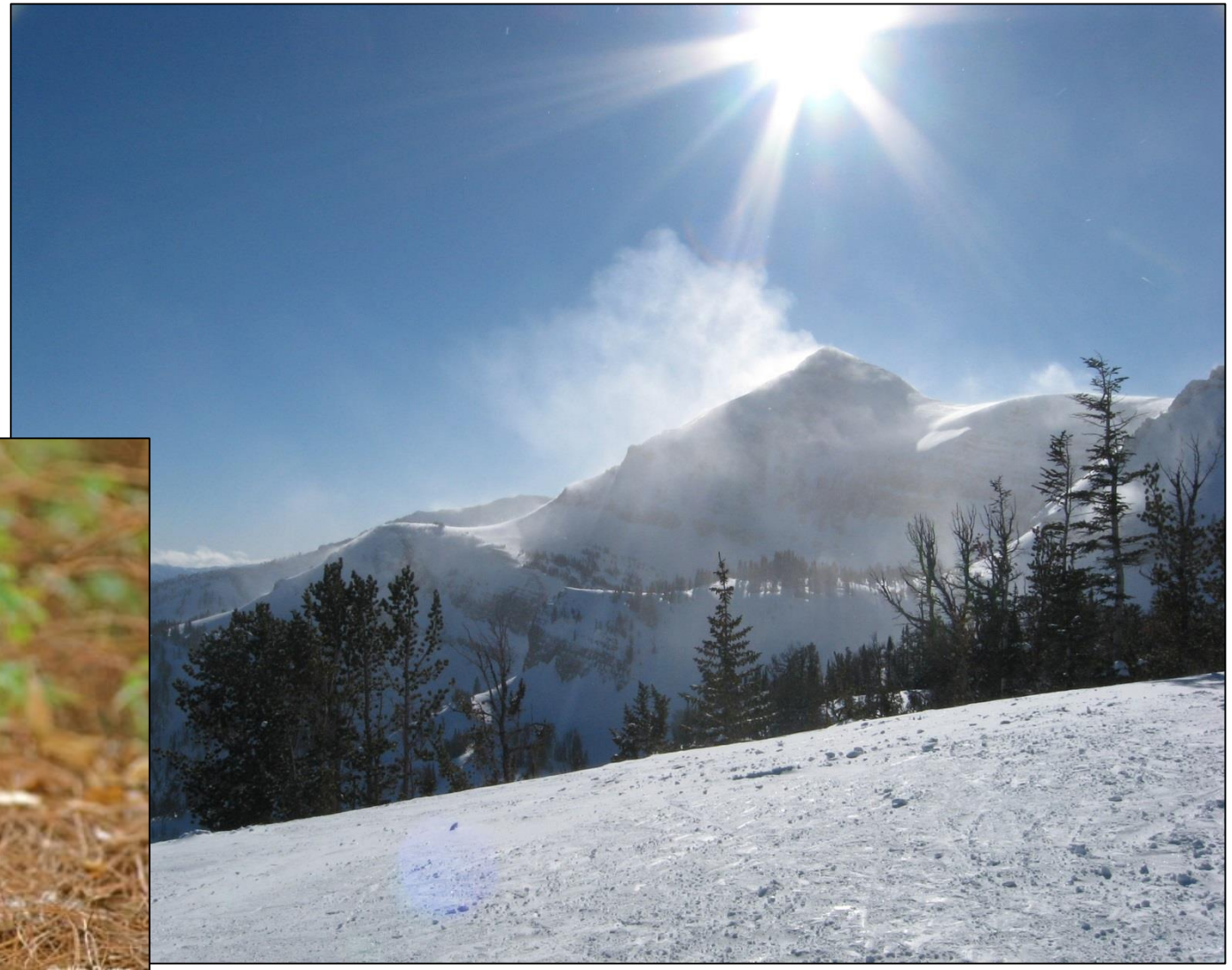
Key Considerations for Managing the Clark's Nutcracker-Whitebark Pine Mutualism

Taza Schaming
tazaschaming@gmail.com

Whitebark Pine & Clark's Nutcrackers

How is widespread habitat loss impacting Clark's Nutcrackers?

- Population status?
- Behavior?
- Life history?



Research Objectives

1) How stable & resilient is this keystone mutualism?

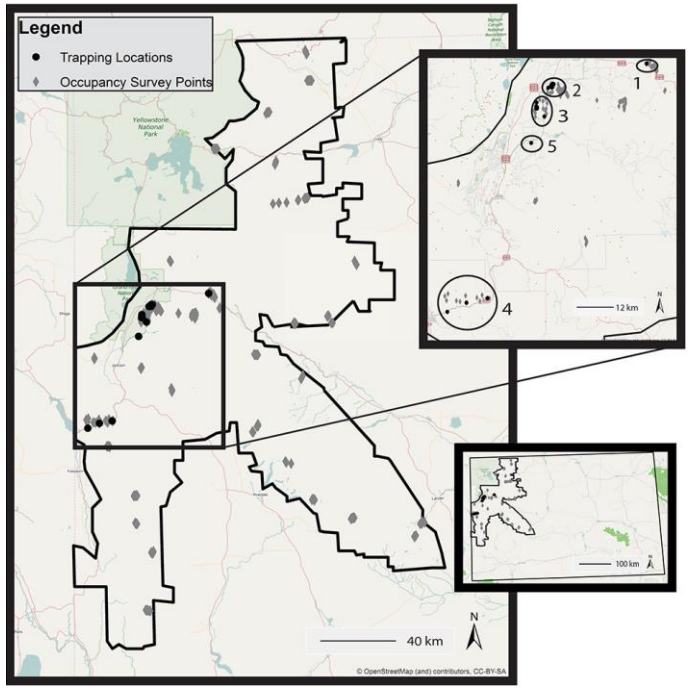
-> How is nutcracker demography & behavior associated with habitat type, quality & abundance?

- Breeding ecology & reproductive success
- Home range size
- Seasonal habitat selection
- Seasonal habitat use
- Foraging ecology
- Emigration/dispersal behavior

2) Suggest management strategies to promote stability & resilience

Methods (2009-2016)

STUDY SITE
23,500km²



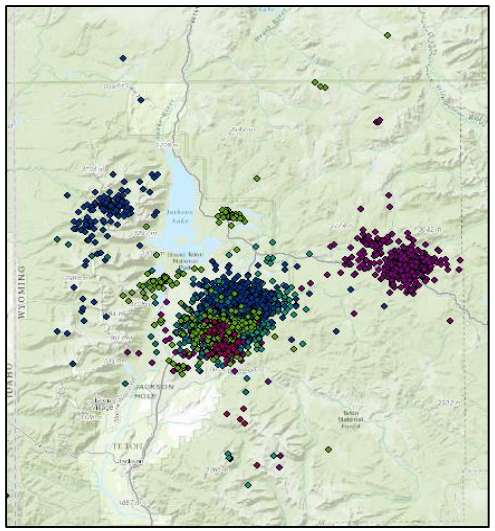
N = 187 trapped

N = 76 radio-tracked

N = 3,135 10 min Ψ surveys,
@ 238 random points

N = 74.5 hours
fledgling surveys

N = 7 satellite-tracked

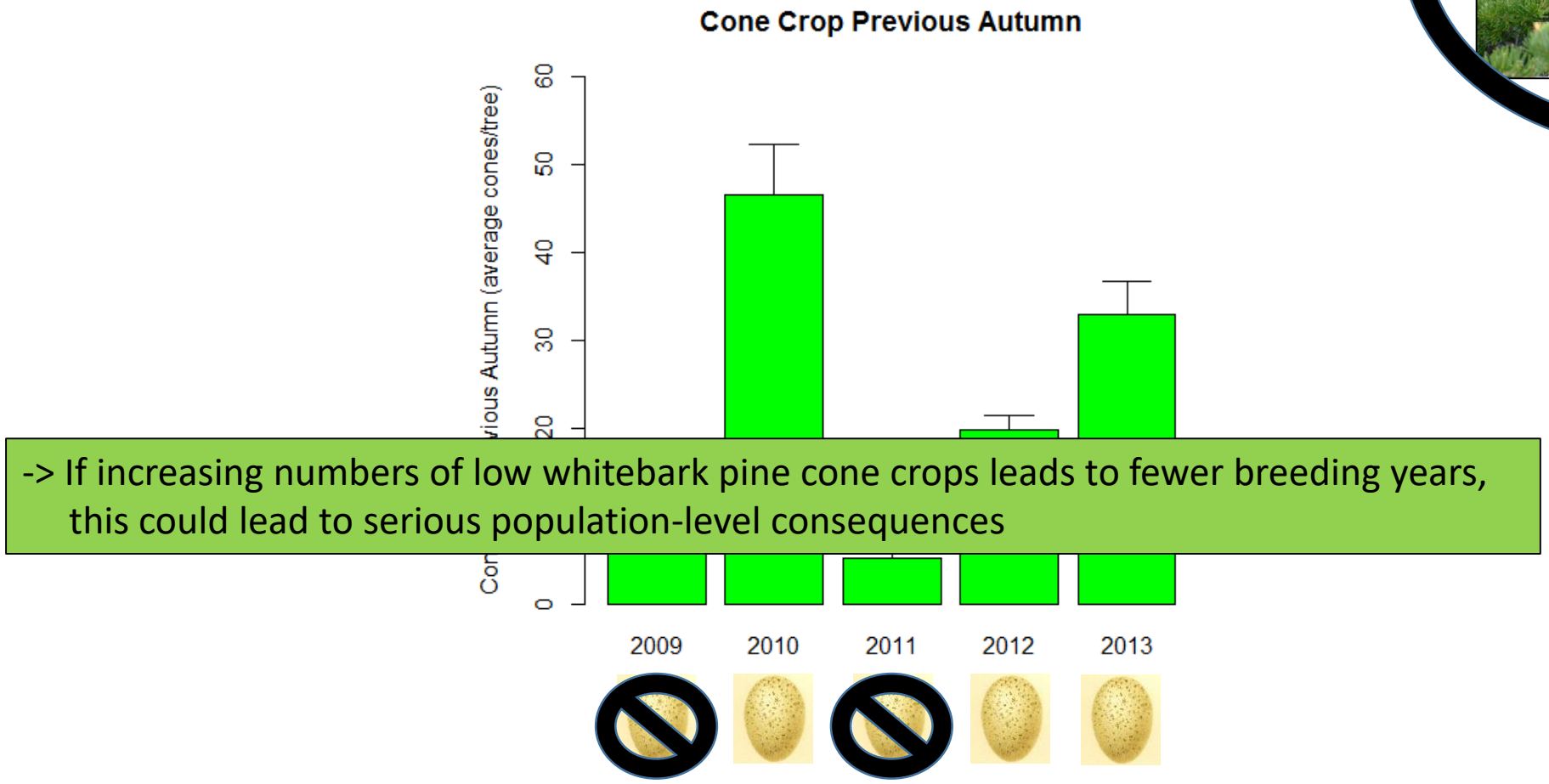


Highlighted Results

- Breeding ecology & reproductive success
- Home range size
- Seasonal habitat selection
- Seasonal habitat use
- Foraging ecology
- Emigration/dispersal behavior

Is reproductive success related to whitebark pine cone crop?

- **No breeding occurred population-wide in 2 years!**



-> If increasing numbers of low whitebark pine cone crops leads to fewer breeding years, this could lead to serious population-level consequences

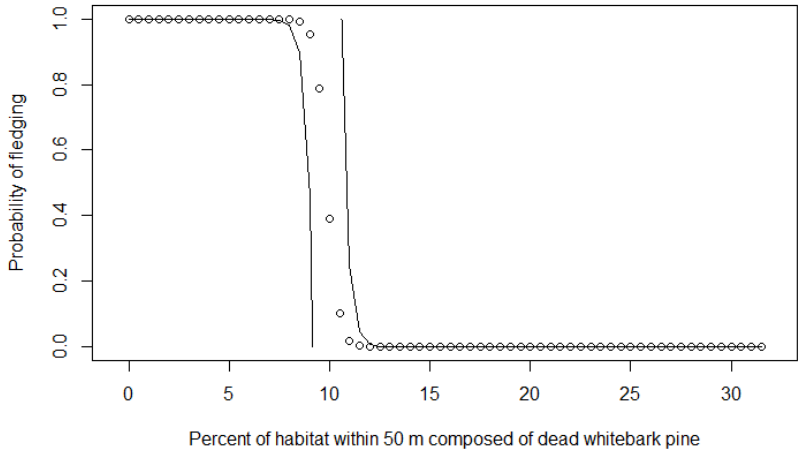
(Schaming 2015)

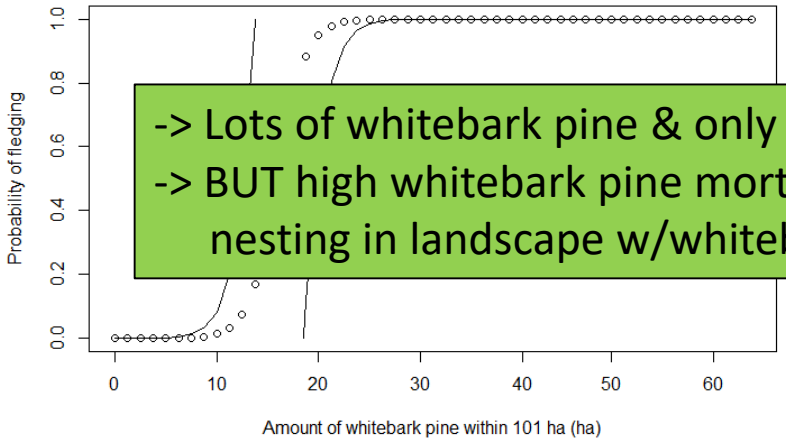
Is fledging success associated with habitat?

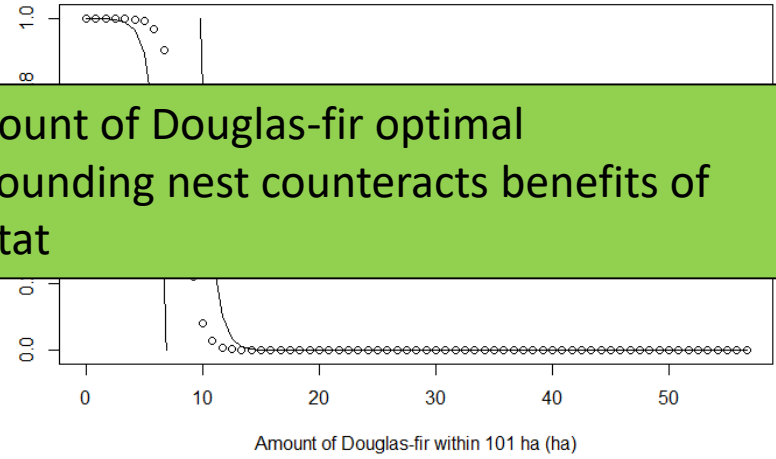
N = 29 (2012)

- 33 active nests
- 35% fledged

Habitat – nest site
– local area
– landscape scale
1st predictions
2nd classification tree: 20 fixed effects
3rd 16 mixed models: 4 fixed effects; AICc







-> Lots of whitebark pine & only small amount of Douglas-fir optimal
-> BUT high whitebark pine mortality surrounding nest counteracts benefits of nesting in landscape w/whitebark habitat

(Schaming 2016 Dissertation)

Highlighted Results

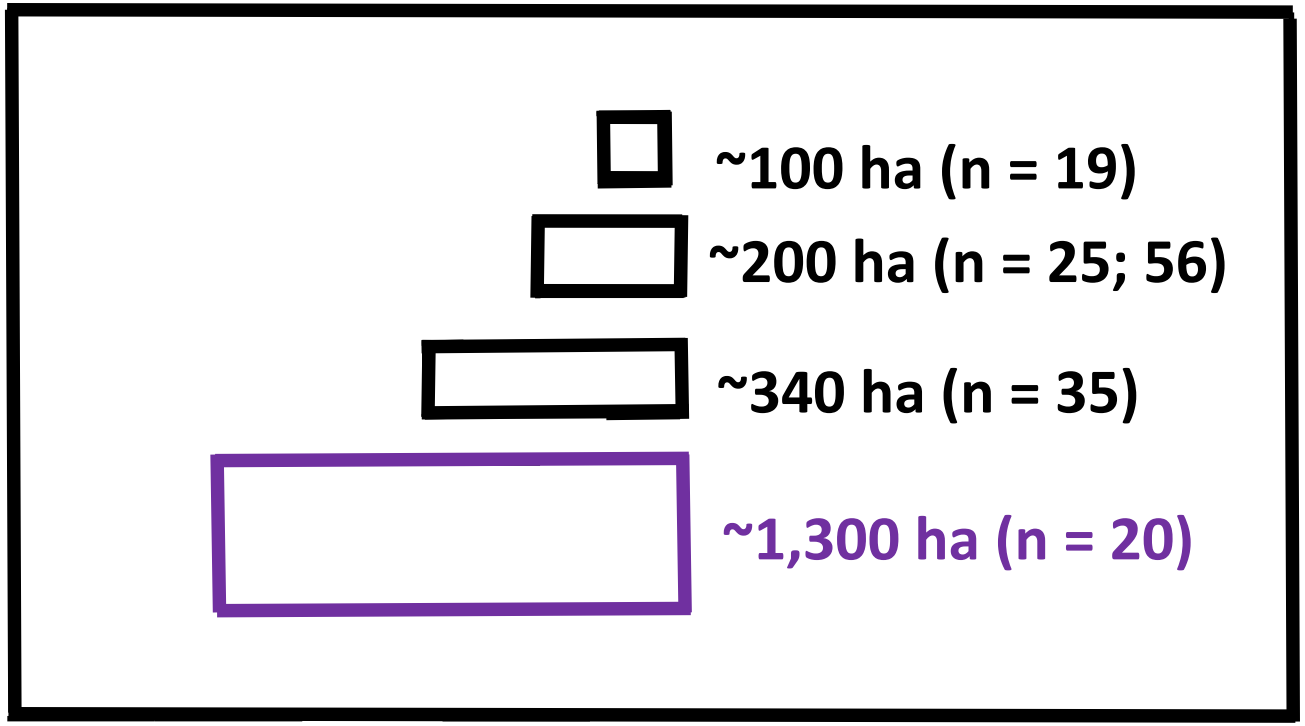
- Breeding ecology & reproductive success
- Home range size

Knowing home range size helps ensure management is carried out at the appropriate scale.

- Seasonal habitat use
- Foraging ecology
- Emigration/dispersal behavior

Home Range Size

-> Nutcrackers use an extensive area!
-> Is this normal in different years? In different quality habitats?



(Schaming 2016 Dissertation)

Highlighted Results

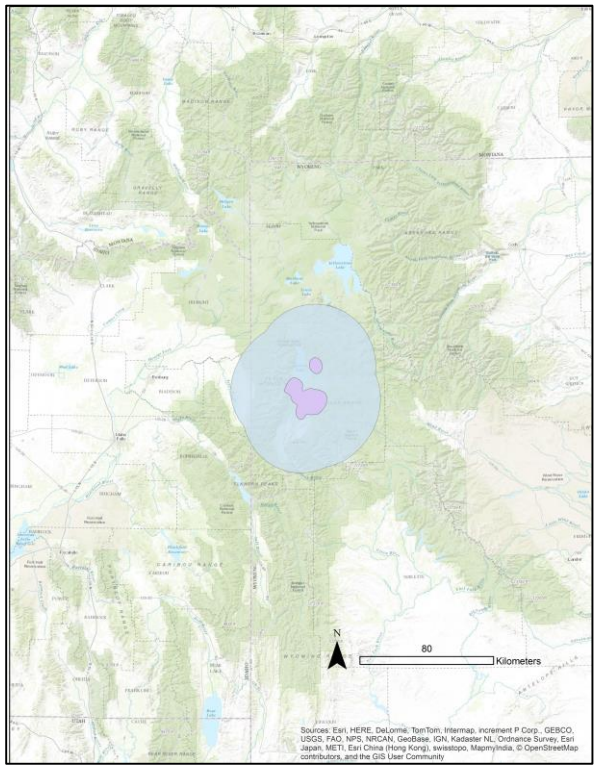
- Breeding ecology & reproductive success
- Home range size
- Seasonal habitat selection

Habitat selection = behavioral process by which individuals choose certain habitats to use from what is available.

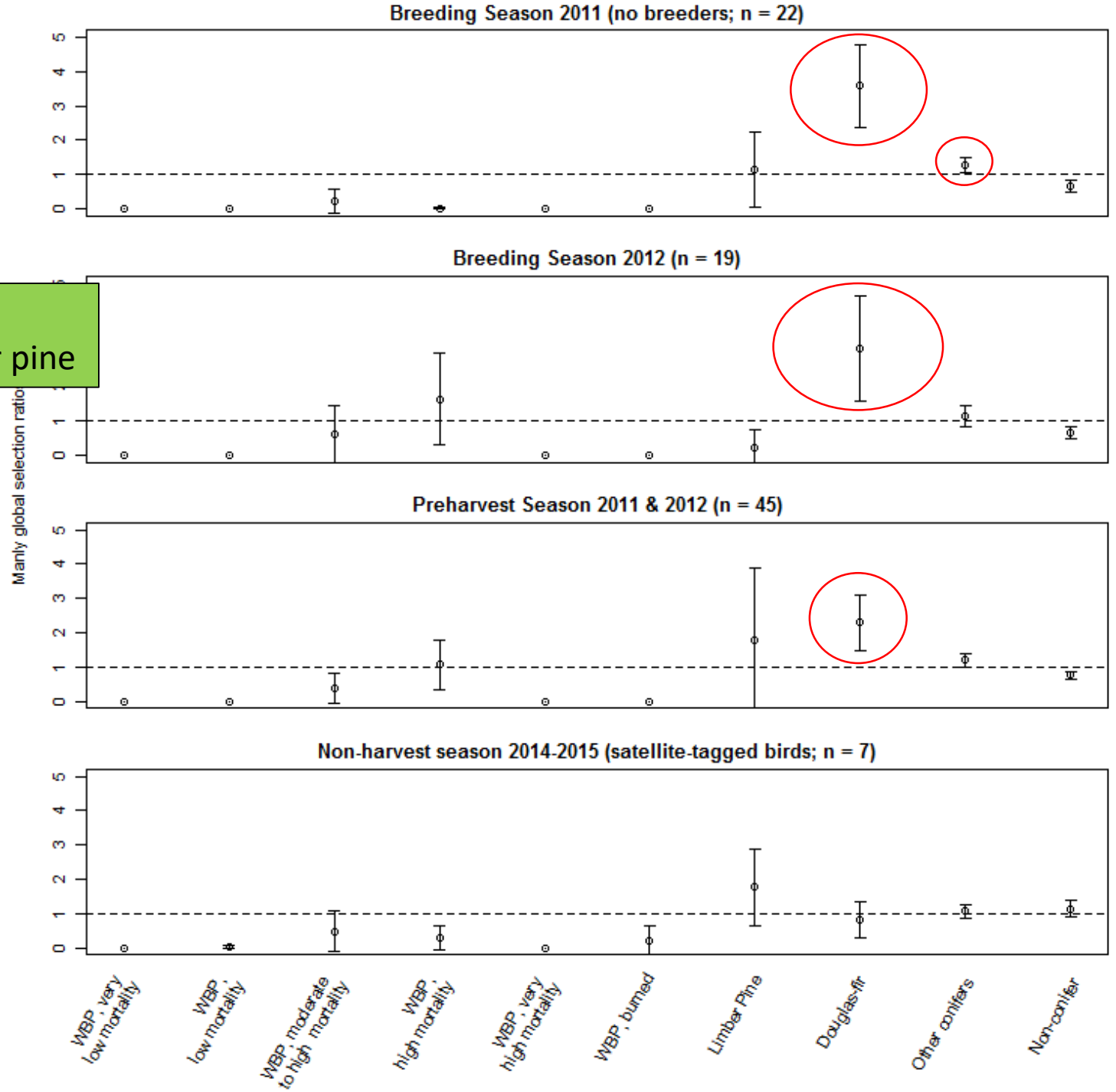
- Foraging ecology
- Emigration/dispersal behavior

Habitat Selection:
Home range
within available habitat

-> Optimal habitat mosaic includes
whitebark pine & Douglas-fir & limber pine



(Schaming 2016 PLOS ONE, Dissertation)

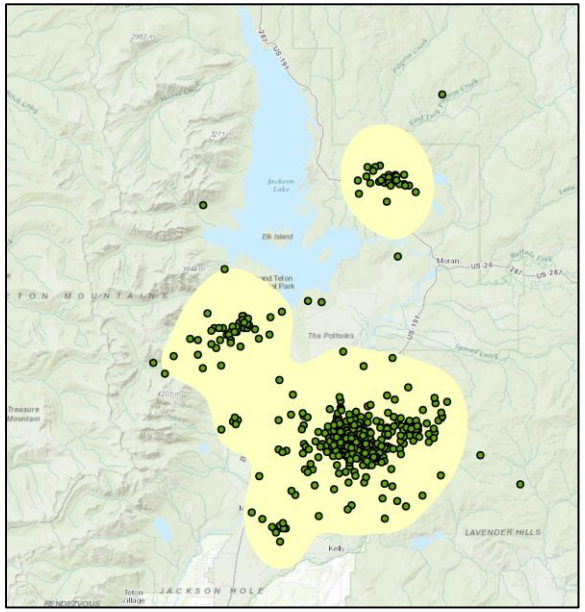


Habitat Selection:
Locations within home range

Satellite-tagged birds:

86% (n = 6) selected Douglas-fir
in a disproportionately high amount

-> Optimal habitat mosaic includes
whitebark pine & Douglas-fir



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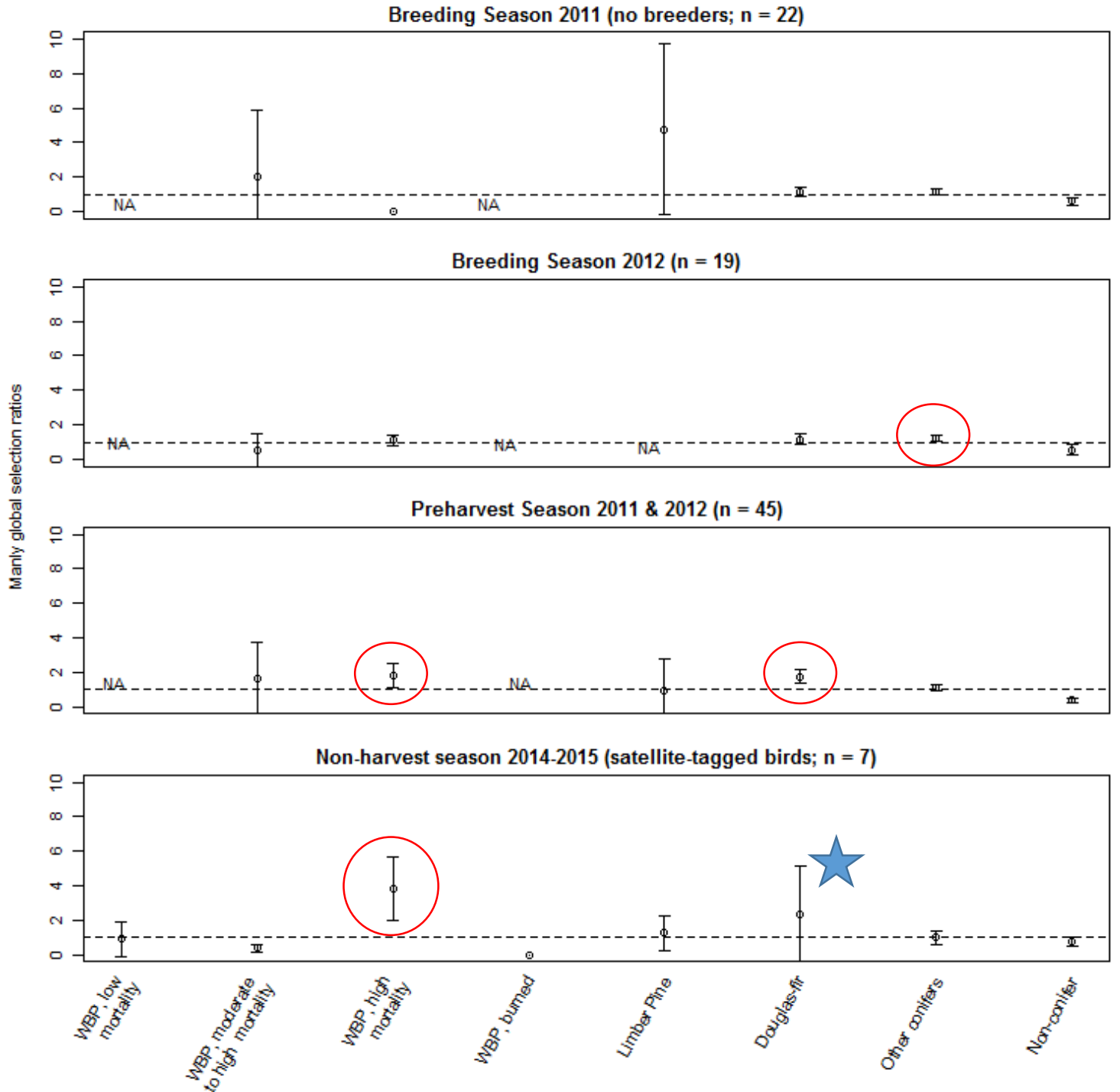


Highlighted Results

- Breeding ecology & reproductive success
- Home range size
- Seasonal habitat selection
- Seasonal habitat use

Habitat use ≠ choice, & observed pattern may be driven by external constraints (e.g. competition).

- Emigration/dispersal behavior

Seasonal Habitat Use: Occupancy Models

Which resources were important drivers of occurrence?

Nutcracker occurrence vs.

- Whitebark pine - cone crop: presence/absence *and* density
  - at local site: presence/absence *and* density
  - at landscape scale
- Douglas-fir - at local site: presence/absence *and* density
  - at landscape scale

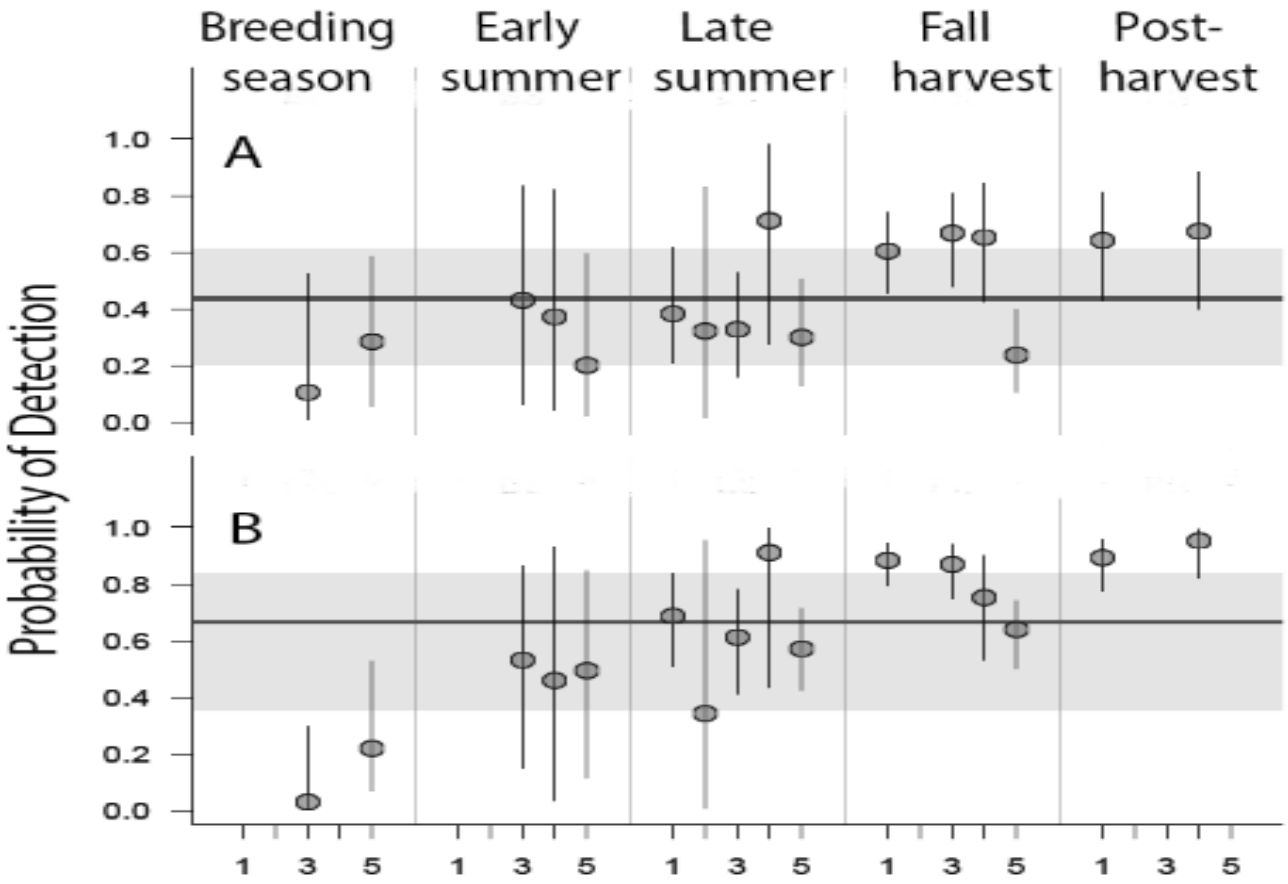
Detection vs.

- Tree density
- Local whitebark pine

OR

(Schaming *in review*)

Results: Detectability



(Schaming *in review*)

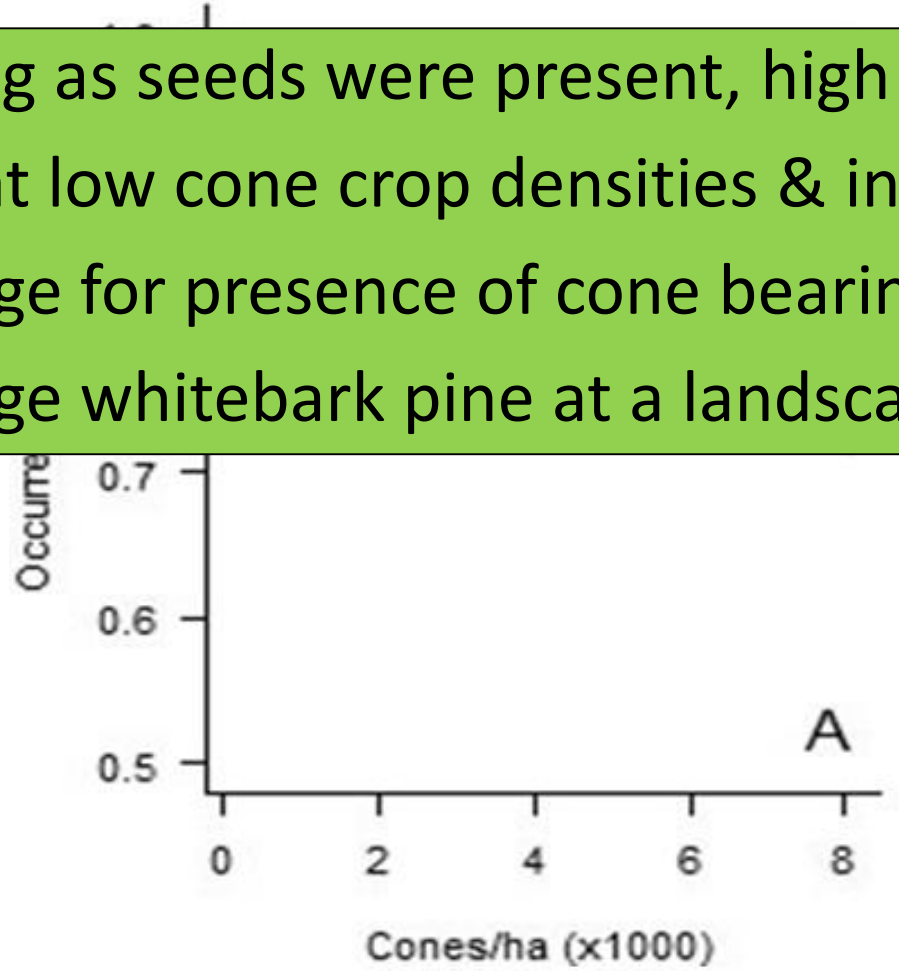
Habitat Use

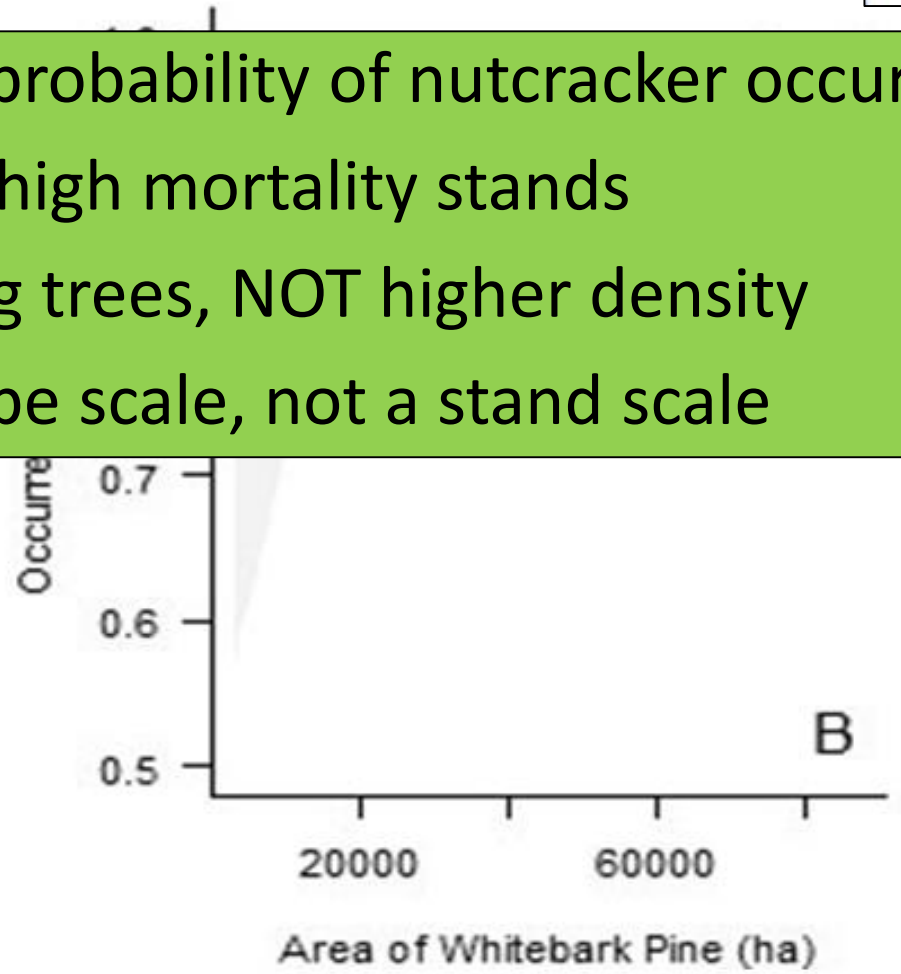
(Fall harvest season)

-> As long as seeds were present, high probability of nutcracker occurrence, even at low cone crop densities & in high mortality stands

-> Manage for presence of cone bearing trees, NOT higher density

-> Manage whitebark pine at a landscape scale, not a stand scale



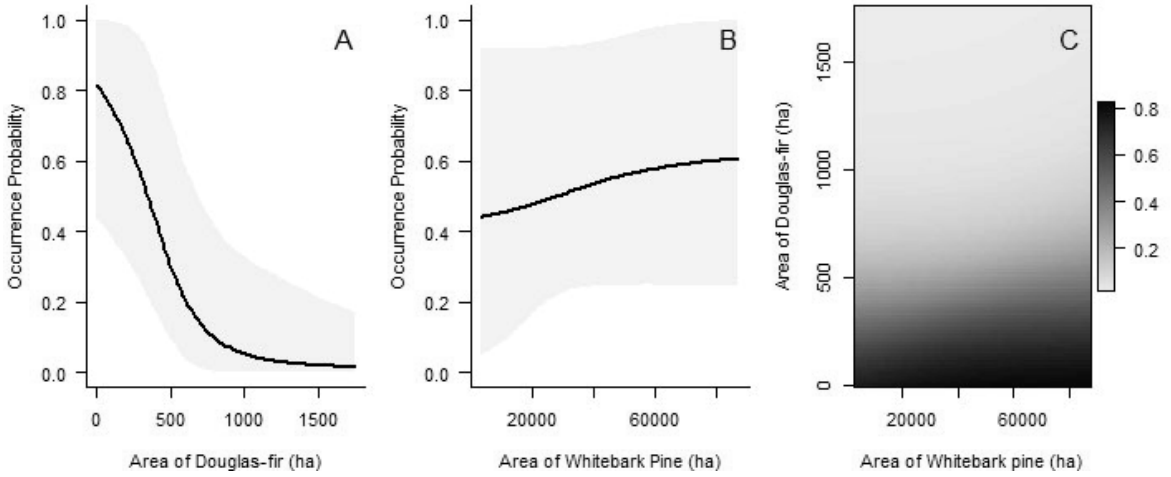


(Schaming *in review*)

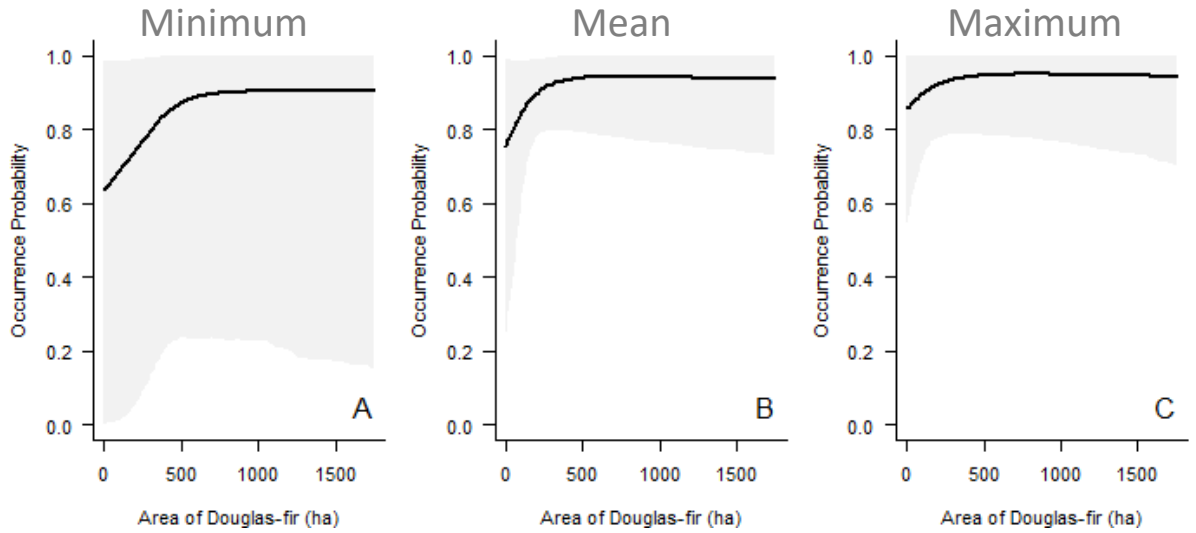
Habitat Use

(when whitebark pine cones not available)

BREEDING SEASON



POST-HARVEST SEASON



-> Optimal = habitat mosaic w/whitebark pine & low abundance of Douglas-fir

-> Preference & prevalence yield different conclusions

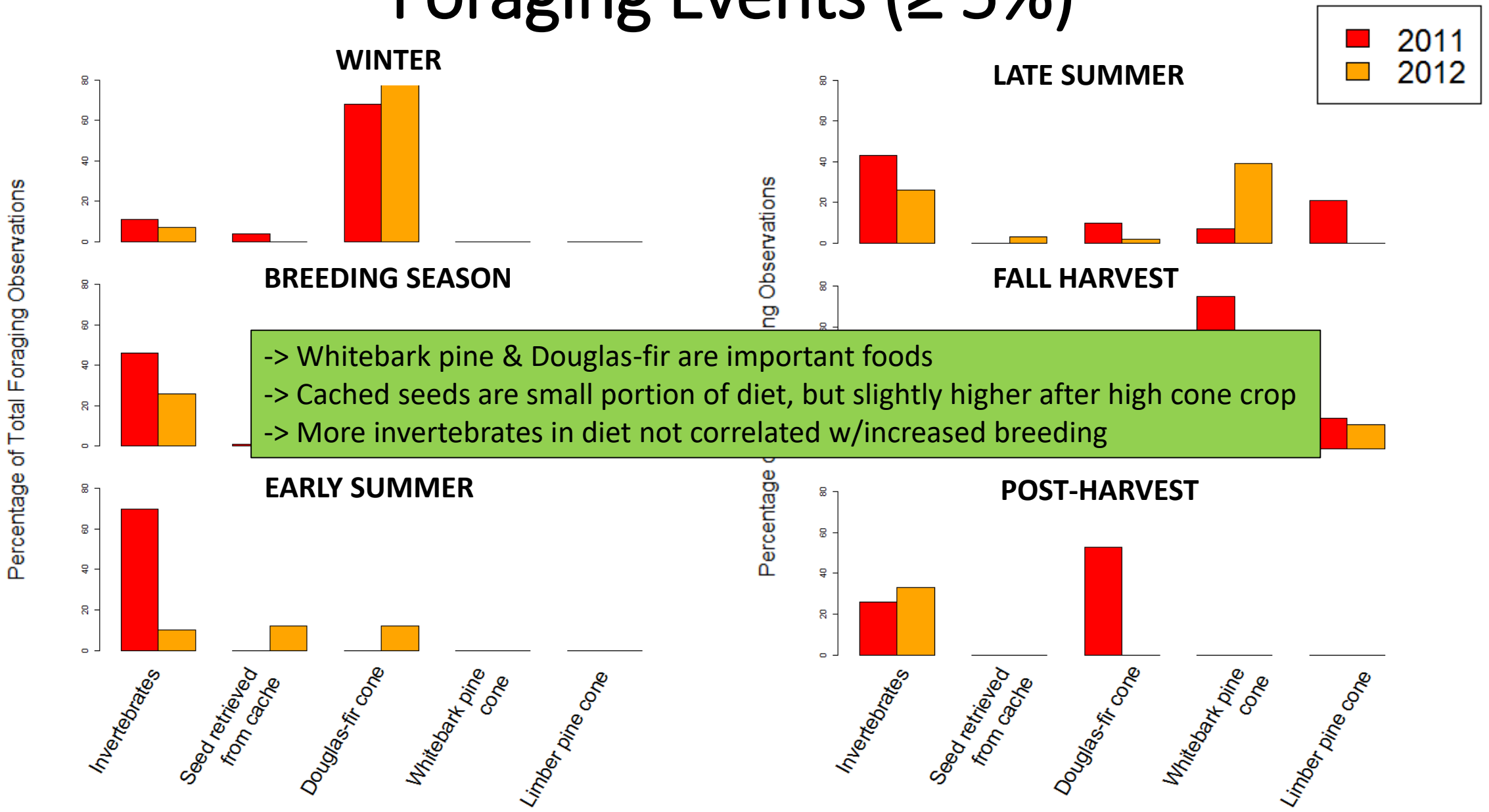
(Schaming *in review*)

Highlighted Results

- Breeding ecology & reproductive success
- Home range size
- Seasonal habitat selection
- Seasonal habitat use
- Foraging ecology

Understanding how foraging behavior varies under different environmental conditions & in different habitats enables better predictions of how animals will respond to environmental change.

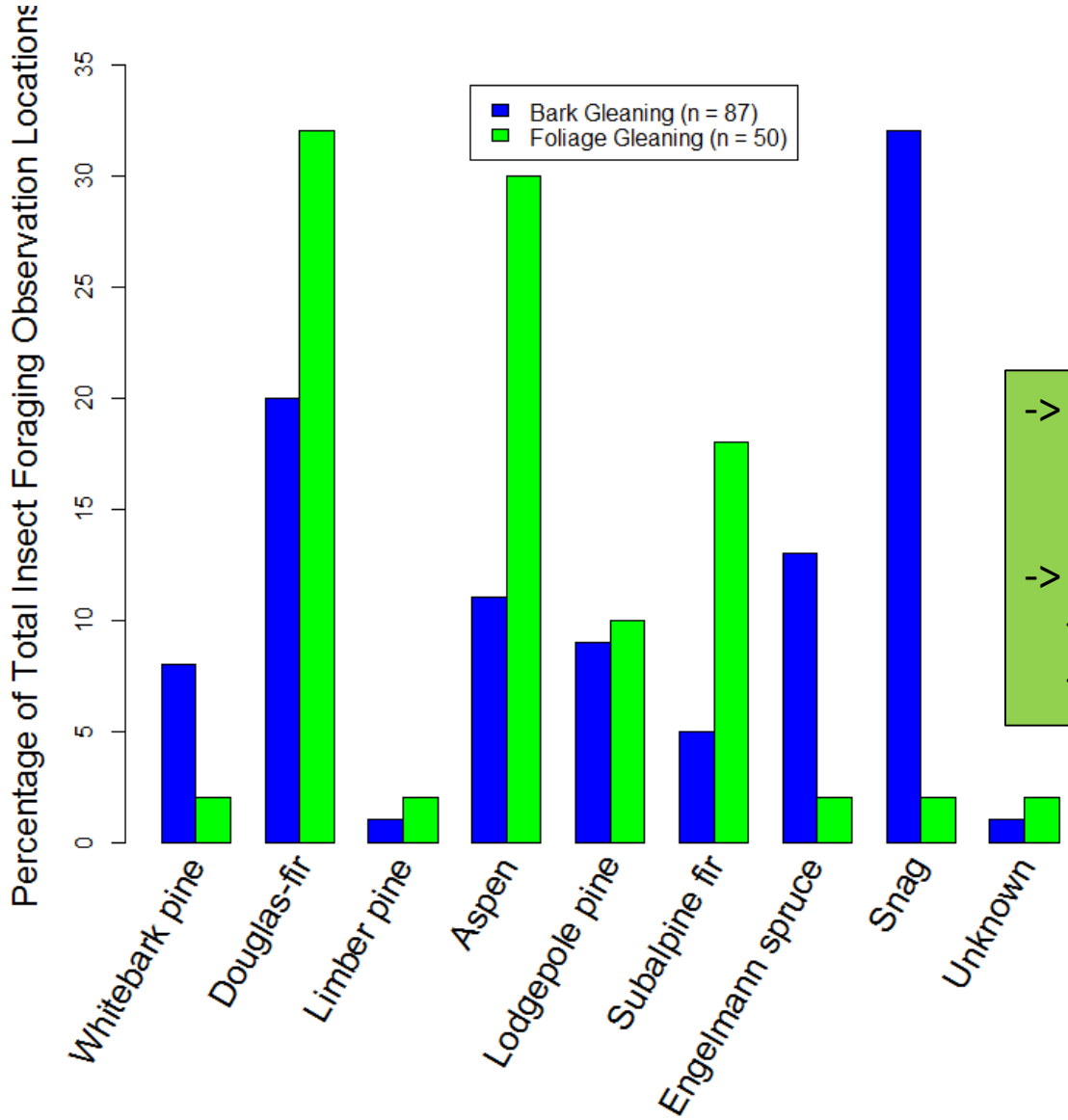
Foraging Events (≥ 5%)



-> Whitebark pine & Douglas-fir are important foods
-> Cached seeds are small portion of diet, but slightly higher after high cone crop
-> More invertebrates in diet not correlated w/increased breeding

(Schaming 2016 PLOS ONE, Dissertation)

Location of Aboveground Insect Foraging Events



-> Douglas-fir, aspens & snags are important foraging locations

-> Negative association between dead trees & fledging, BUT snags are great for foraging

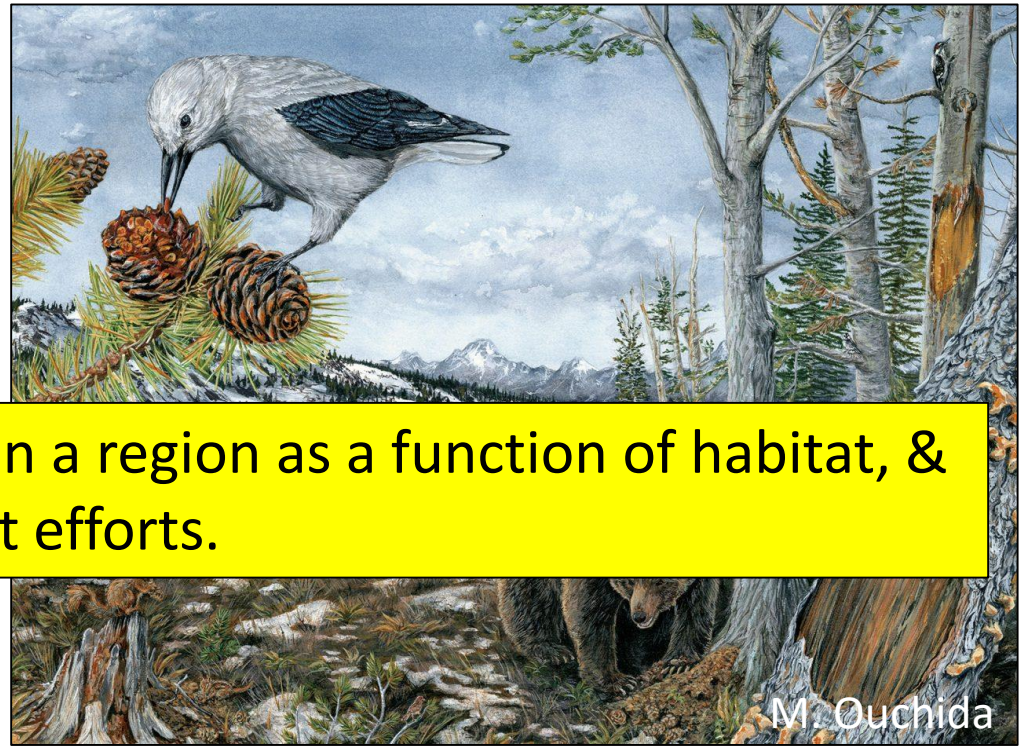
(Schaming 2016 Dissertation)

Highlighted Results

- Breeding ecology & reproductive success
- Home range size
- Seasonal habitat selection
- Seasonal habitat use

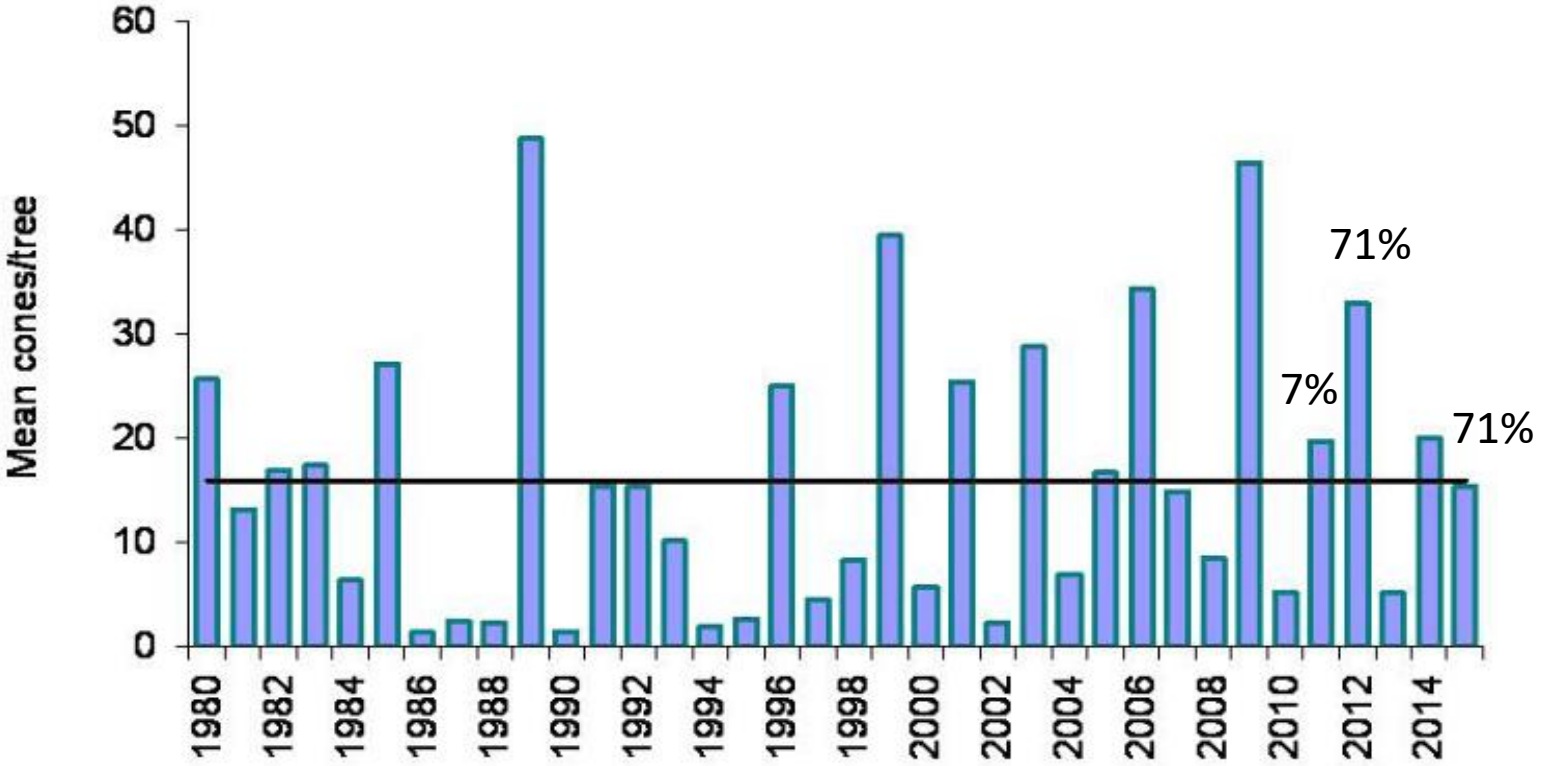
Understanding helps evaluate population viability in a region as a function of habitat, & determine the scale at which to focus management efforts.

- Emigration/dispersal behavior



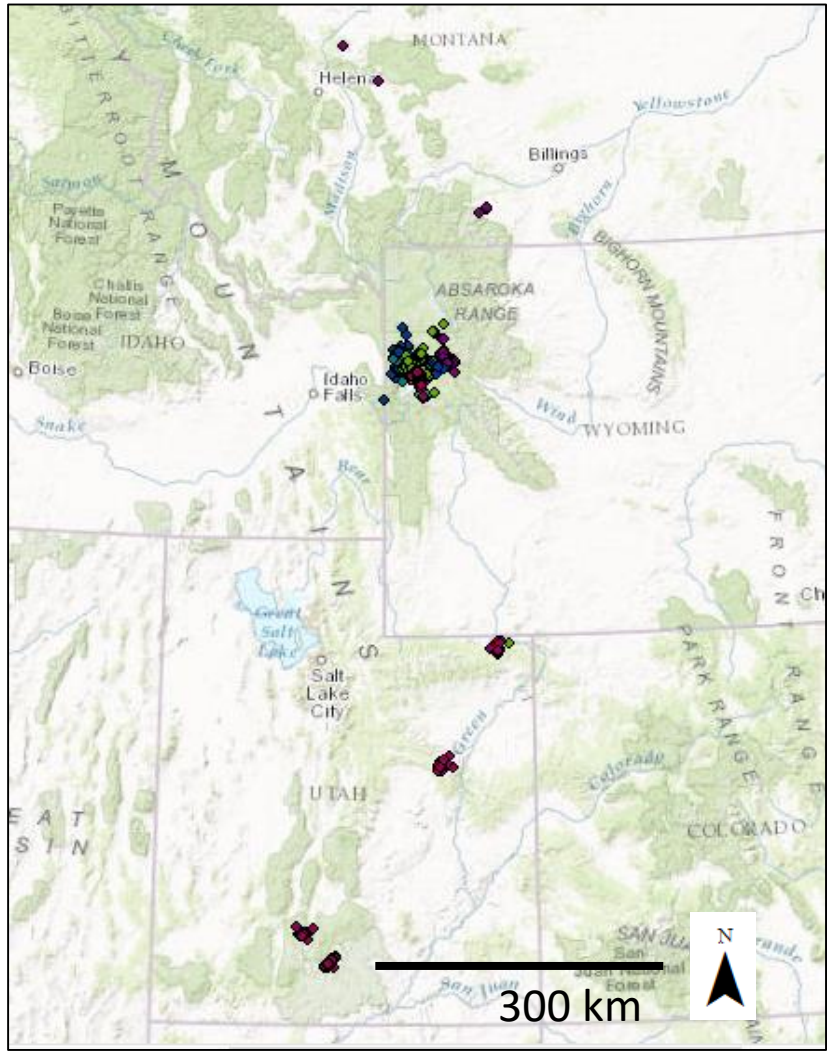
Results: Dispersal

When do nutcrackers disperse? Where do they go?



-> A high proportion disappeared during moderate to high cone crops

-> Moved over considerable distance



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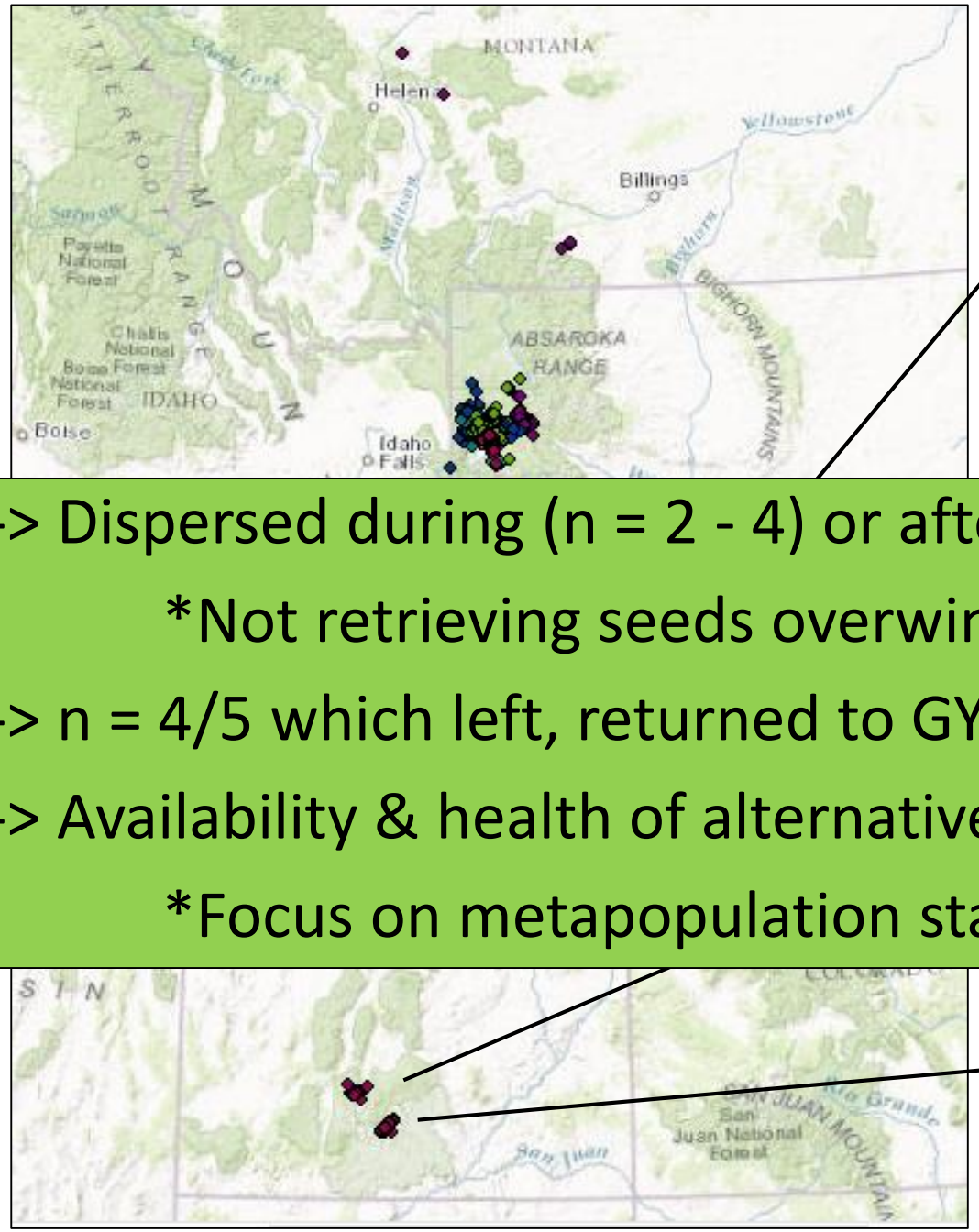

FLEW SOUTH (btwn 8/24/15 & 9/26/15)

&

BACK TO WY
mid-June 2016

FLEW SOUTH (btwn 8/8/15 & 1/10/16)

&

-> Dispersed during (n = 2 - 4) or after (n ≤ 2) the whitebark pine seed harvest

*Not retrieving seeds overwinter

-> n = 4/5 which left, returned to GYE (4 overwintered in Utah)

-> Availability & health of alternative habitats is important to GYE nutcrackers!

*Focus on metapopulation stability & resilience!

FLEW SOUTH (btwn 8/10/15 & 9/9/15)

&

BACK TO WY
btwn 6/30/16 and 7/3/16

Broad Recommendations

for effective conservation of the Clark's nutcracker-whitebark pine mutualism

1 – Long-term, range-wide studies (preference & prevalence)

- Understand metapopulation stability as conditions change

2 – Adaptive management approach

- Behavior & population vary w/density of species & habitats
- Monitor as conditions change & management implemented

3 – Managing for persistent, stable local populations

- Conservation tool: present = available to disperse seeds

  (≠ dispersing seeds & ≠ persistence)

- Resident birds disperse seeds further

4 – Effective conservation may depend on protection of a network of key habitats

(Schaming 2016 Dissertation)

Acknowledgements

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Questions?


L. Rentz


M. Meyers


T. Schaming

Seed Energy

A nutcracker needs **~12,000 Cal** for winter survival

Species	Cal/seed	# seeds/winter
Whitebark pine	1.23	~10,000
Limber pine	0.58	~20,000
Douglas-fir	0.06	~200,000
Engelmann spruce	*0.24*	*NA*
Lodgepole pine	*0.02*	*NA*
Subalpine fir	*0.92*	*NA*

Conclusions

* When designing a conservation plan for plant-animal seed disperser mutualisms, consider seed dispersers':

    1: Population status & behavioral plasticity at **appropriate scale**

    2: In relation to **all** of the habitats on which they depend

    3: Under **variable & changing** environmental conditions

    4: Preference **&** prevalence