Perspectives on Bird-Aspen Relationships from the Tahoe Region

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Perspectives on Bird-Aspen Relationships from the Tahoe Region

- Habitat correlates of bird species richness and abundance

- Predator barrier experiment

- Habitat correlates of nest success

- Nest-site selection

Benefits of Aspen to Birds

- Greater avian species richness and abundance than adjacent veg. types

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Benefits to Birds

- Greater avian species richness and abundance than adjacent veg. types
- Abundance of nest sites for ground-nesting and cavity-nesting bird species
- Increased abundance and diversity of invertebrate prey
- Several bird spp. with strong aspen association

Warbling Vireo

Bird species richness, abundance, and nest success influenced by differences in vegetation and structural habitat:

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1. Affects resource availability
   - nest sites
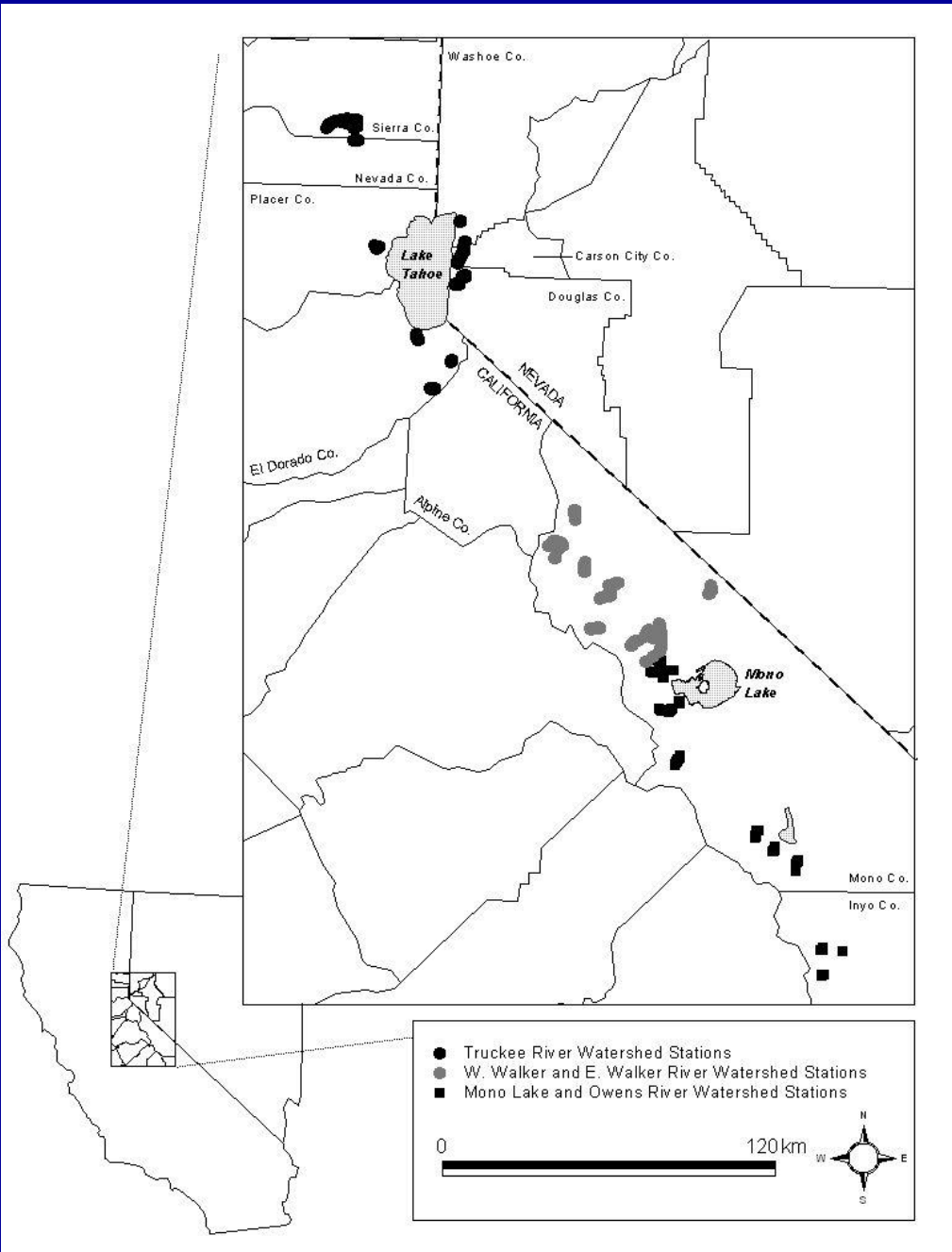   - food and foraging substrate

Bird species richness, abundance, and nest success influenced by differences in vegetation and structural habitat:

1. Affects resource availability
   - nest sites
   - food and foraging substrate

2. Partly determines number and species of predators birds face

Habitat Variables Affecting Avian Abundance and Species Richness in Aspen

2001-2004

462 point count stations

5-min. 50m fixed-radius counts

2-3 visits per season

Highly variable site contexts

<u>Sums of AIC weights for parameters from best models (Δ AIC<2.0), Truckee River Sites, 2002-2004.</u>

<u>Bird Species Richness</u>			<u>Total Bird Abundance</u>		
<u>Parameter</u>	<u>Weight</u>		<u>Parameter</u>	<u>Weight</u>	
Herbaceous Cov.	**1.00**	**+**	**Herbaceous Cov.**	**1.00**	**+**
Max. Tree Ht.	**1.00**	**-**	**Max. Tree Ht.**	**1.00**	**-**
Max DBH	1.00	+	Max DBH	1.00	+
Max. Aspen Ht.	**1.00**	**+**	**Max. Aspen Ht.**	**1.00**	**+**
Aspen Shrub Cov.	**0.70**	**+**	Willow Shrub Cov.	0.75	+
Aspen Tree Cov.	**0.61**	**+**			

- Bird species richness and bird abundance positively correlated with conditions consistent with pure, mature, self-sustaining aspen

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- Addition of conifers into aspen leads to decreased bird species richness and bird abundance
  - corroborates findings of:
    - Colorado   Finch and Reynolds (1988)
    - South Dakota   Rumble et al. (2001)
    - WY & MT   Hollenbeck (2007)

- Griffis-Kyle and Beier (2003)
  - no area or isolation effects of aspen stands on bird sp. richness or abundance
  - "several small stands may be more valuable than fewer, large stands."

- What makes a "valuable" aspen stand?
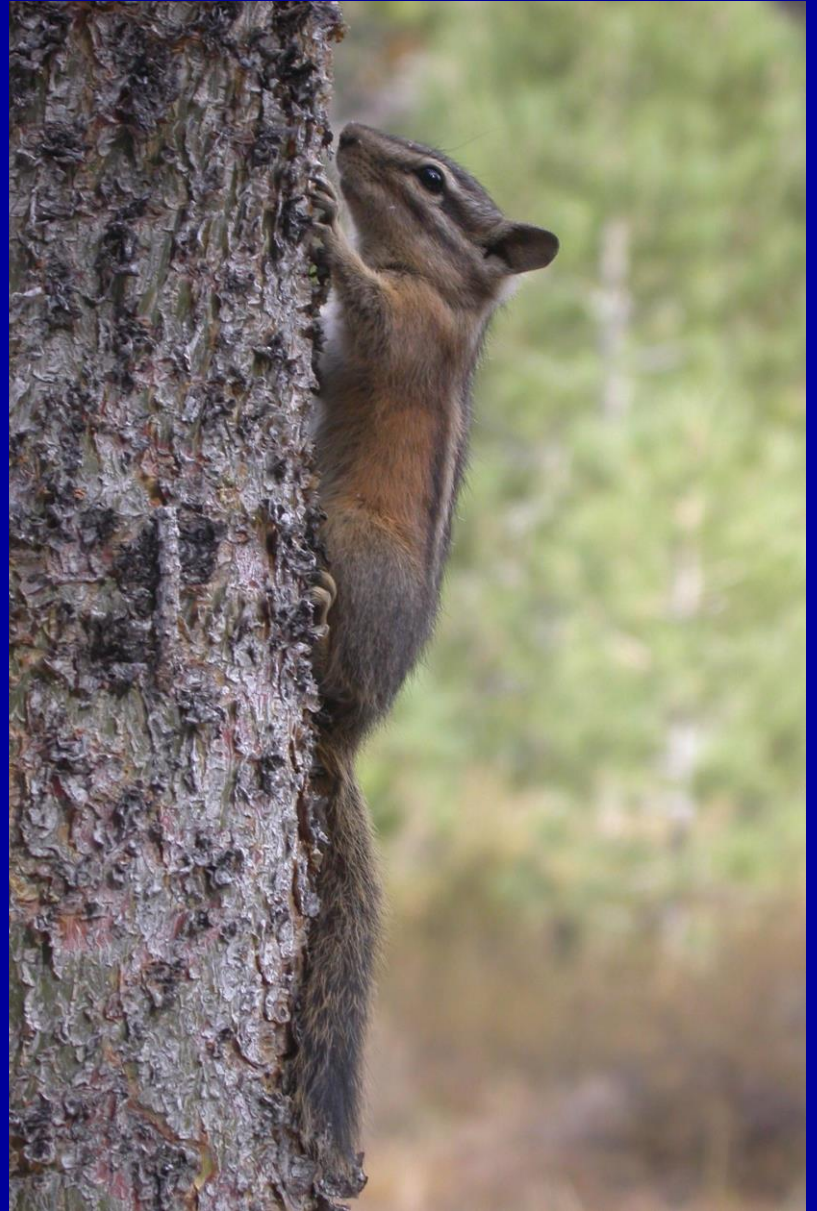
- Ascended pine with ease

- 102/105 attempts on aspen resulted in immediate slip and fall

- Mean max. height before falling:
  - 44 $\pm$ 13 cm (10 cm bole)
  - 56 $\pm$ 27 cm (25 cm bole)

Number of yellow pine chipmunks attempting to climb tree boles of aspen and pine. *P*-values refer to Fisher's Exact Test of Probability

	Quaking Aspen		Lodgepole Pine		
	Successful	Unsuccessful	Successful	Unsuccessful	*p* - value
Large boles (25 cm)	0	17	13	0	<0.0001
Small boles (10 cm)	0	16	18	0	<0.0001

Aspen bark may provide a barrier or impediment to small mammalian nest predators

Predator-barrier Hypothesis

Birds should select nest sites on substrates that impede or prevent access from predators

Nests associated with those substrates should have higher survival probability

Habitat Variables Affecting Nest Success in Aspen

Conifer - Predator Connection

- Several studies have suggested increased risk of nest predation by corvids or *Tamiasciurus* squirrels in association with coniferous vegetation types

  (Tewksbury et al. 1998, Sieving and Willson 1998, Song and Hannon, Willson et al. 2003 Cain et al. 2003, 2006)

# Mult. logistic regression from Truckee River dataset

TABLE 5. Maximum likelihood estimates, Wald Chi-Square statistics, and significance for parameters selected from multiple logistic regression models predicting occurrence of (A) Douglas's Squirrel and (B) Steller's Jay in aspen habitats, 2002-2004. Models built using forward selection on randomly assigned training dataset (67% of stations) and tested against independent validation dataset. Results of overall model are expressed as percent of stations correctly classified.

Variable	Estimate	Wald Chi-sq.	*P*
A. Douglas's Squirrel			
P < 0.001			
Correctly classified: 67.2%			
Shrub-class conifer cov.	0.1642	11.4932	<0.001
Shrub cov.	-0.0359	6.364	0.116
Tree-class fir cov.	0.0442	2.0529	0.152
B. Steller's Jay			
P <0.001			
Correctly classified: 63.5%			
Tree-class Lodgepole Pine Cov.	-0.1374	11.3010	<0.001
Shrub-class conifer cov.	0.0765	5.0183	0.025

Negative trend in Steller's Jay following conifer thinning in Tahoe basin
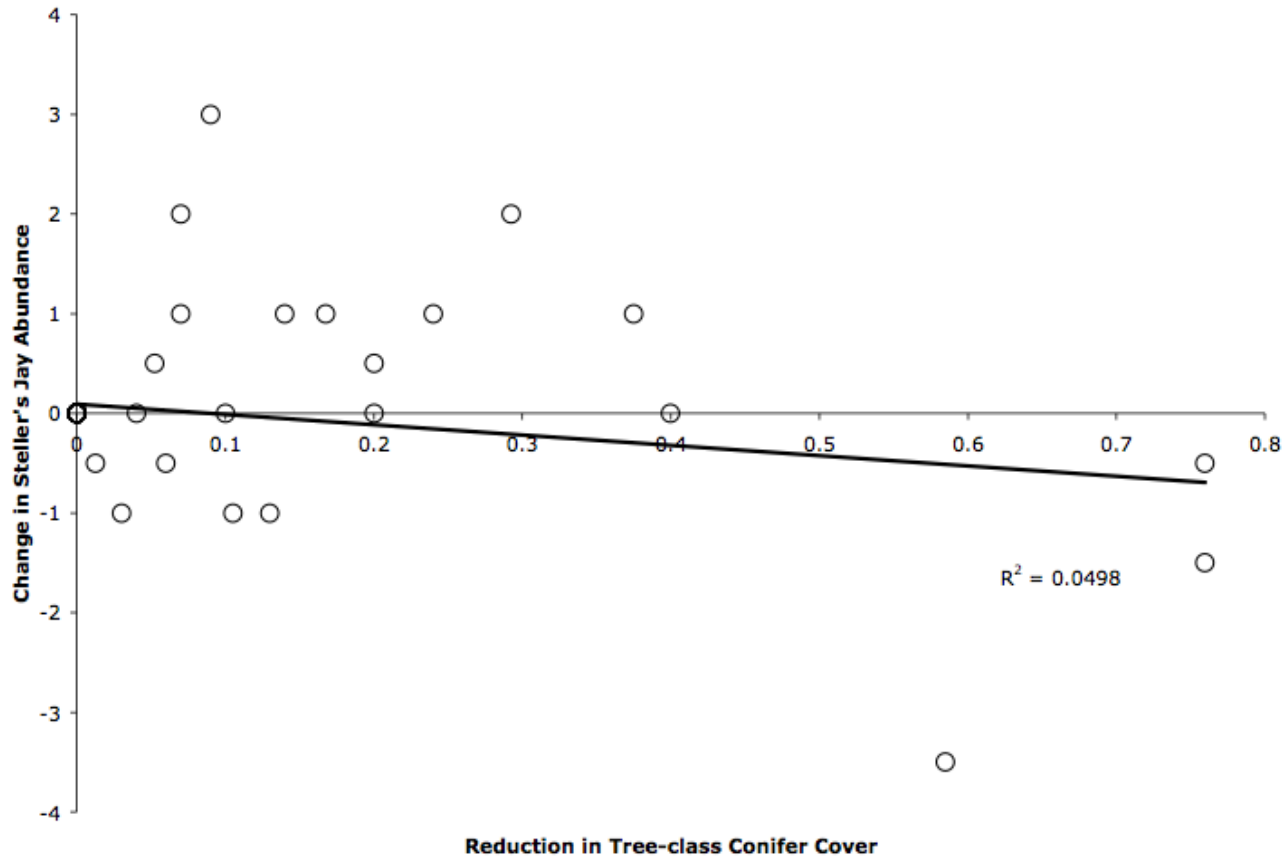
Conifer - Predator Connection

- As conifers encroach, conifer-associated predators should increase
  - numerically
  - space use

- Large, pure aspen stands may provide birds with refugia from these predators

Conifer - Predator Connection

Prediction:

Conifer density near nests should be negatively correlated with nest success

Predator-barrier Hypothesis

Predictions:

Nest success should be higher in aspen trees than non-aspen
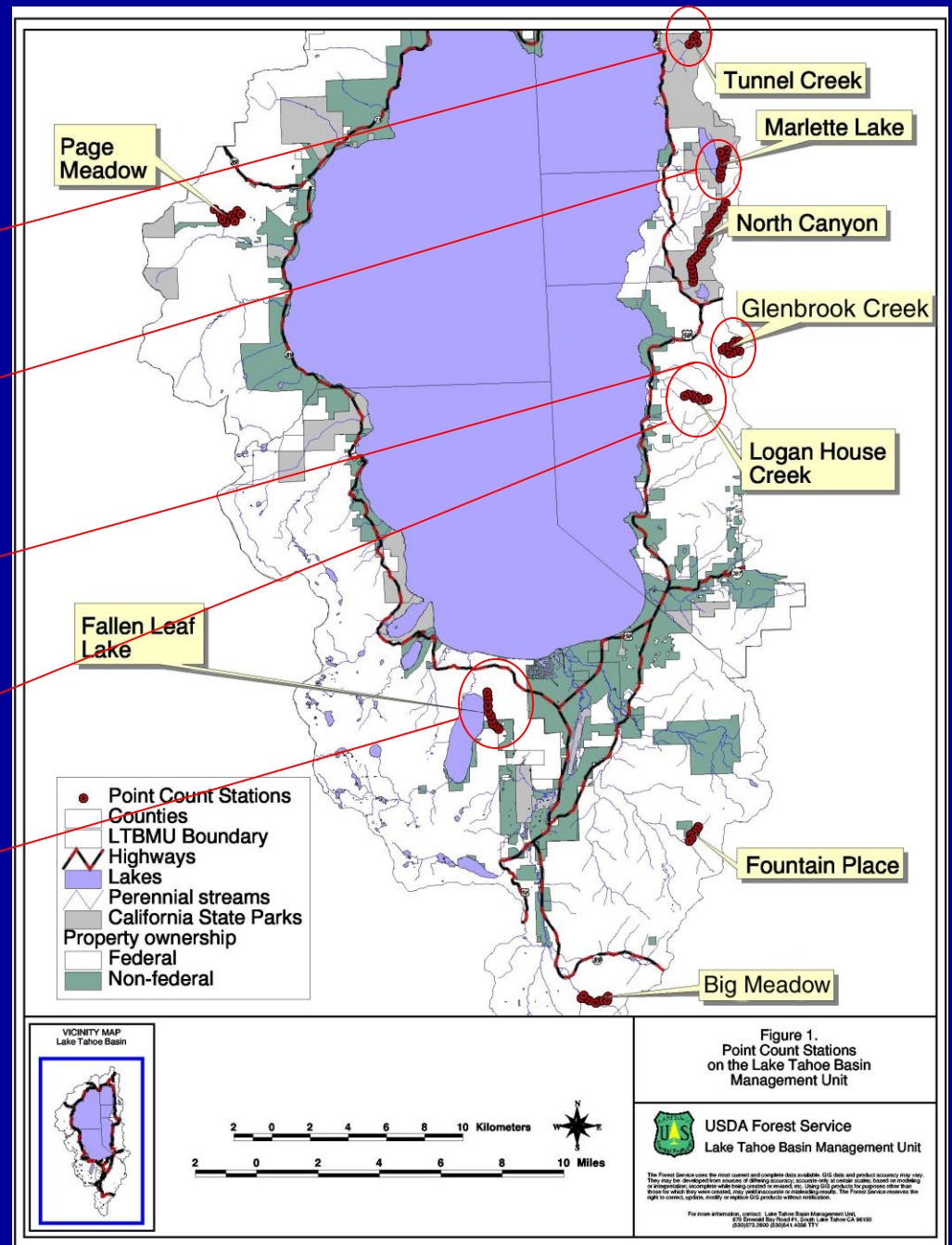
Five nest-monitoring plots (2003-2006):

Tunnel Creek

Marlette Basin

Glenbrook Creek

Logan House Creek

Fallen Leaf Lake Rd.

Figure 1.
Point Count Stations
on the Lake Tahoe Basin
Management Unit

USDA Forest Service
Lake Tahoe Basin Management Unit

- Monitored 843 active nests of 36 species

- In 2005, selected focal species

	2003	2004	Total
Warbling Vireo	42	63	105
American Robin	46	42	88
Oregon Junco	32	25	57
Western Wood-Pewee	22	33	55
Dusky Flycatcher	12	34	46
House Wren	22	14	36
Mountain Chickadee	14	12	26
Audubon's Warbler	9	7	16
Cassin's Finch	6	7	13
Wilson's Warbler	8	3	11
White-headed Woodpecker	5	5	10
Hairy Woodpecker	5	4	9
Red-breasted Sapsucker	5	4	9
Tree Swallow	5	2	7
MacGillivray's Warbler	4	3	7
Calliope Hummingbird	3	4	7
Mountain White-crowned Sparrow	3	3	6
Pygmy Nuthatch	2	4	6
Brown Creeper	2	3	5
Song Sparrow	4		4
White-breasted Nuthatch	1	3	4
Red-shafted Flicker	1	2	3
Fox Sparrow		3	3
Western Tanager		3	3
Downy Woodpecker	1	1	2
Black-headed Grosbeak		2	2
Green-tailed Towhee		2	2
Hermit Thrush		2	2
Northern Pygmy-Owl	1		1
Steller's Jay	1		1
Mourning Dove	1		1
Red-breasted Nuthatch	1		1
Clark's Nutcracker	1		1
Mountain Bluebird	1		1
Black-backed Woodpecker		1	1
Grand Total	260	291	551

- Sufficiently large sample sizes

- Aspen-associated species

- Open-cup nesting species

- Represent major veg. strata:

  - Canopy

  - Shrub

  - Ground

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White-breasted Nuthatch	1	3	4
Red-shafted Flicker	1	2	3
Fox Sparrow		3	3
Western Tanager		3	3
Downy Woodpecker	1	1	2
Black-headed Grosbeak		2	2
Green-tailed Towhee		2	2
Hermit Thrush		2	2
Northern Pygmy-Owl	1		1
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Mourning Dove	1		1
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Warbling Vireo
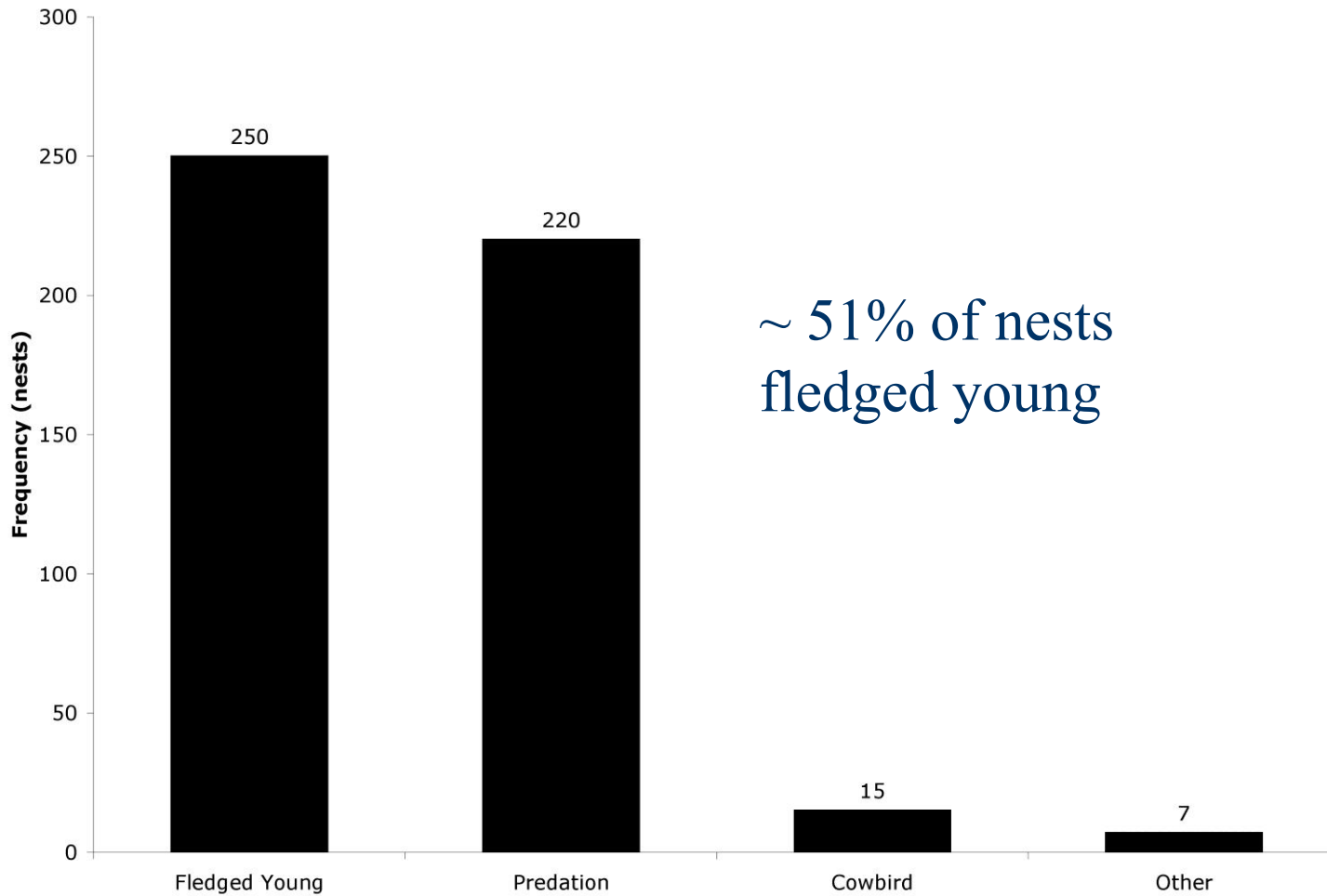(n=152)

Western Wood-Pewee
(n=87)

American Robin
(n=115)

Dusky Flycatcher
(n=54)

Oregon Junco
(n=84)

Monitored 492 active nests of focal spp.

Absolute frequencies of nest outcomes, focal species, 2003-2006

~ 51% of nests fledged young
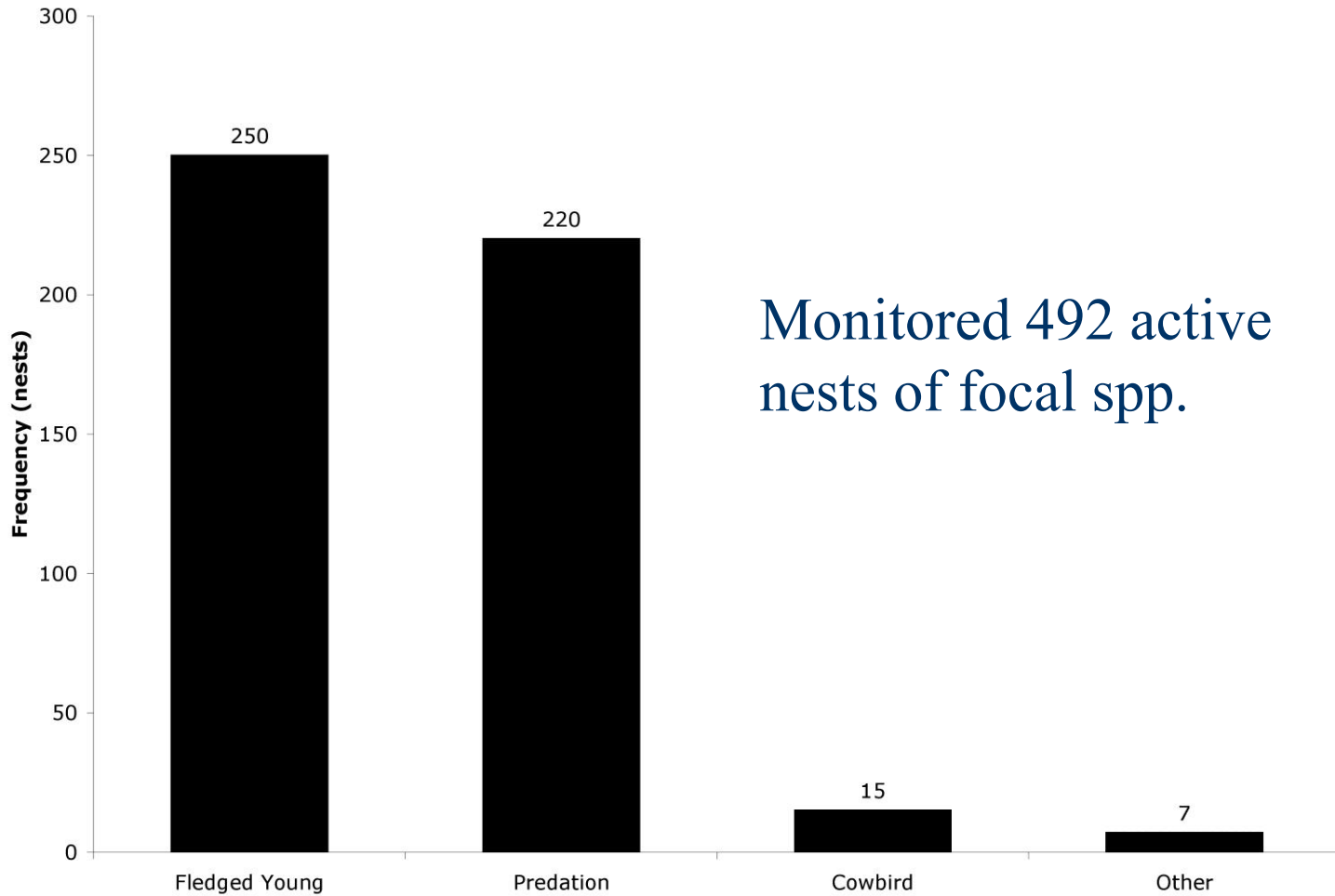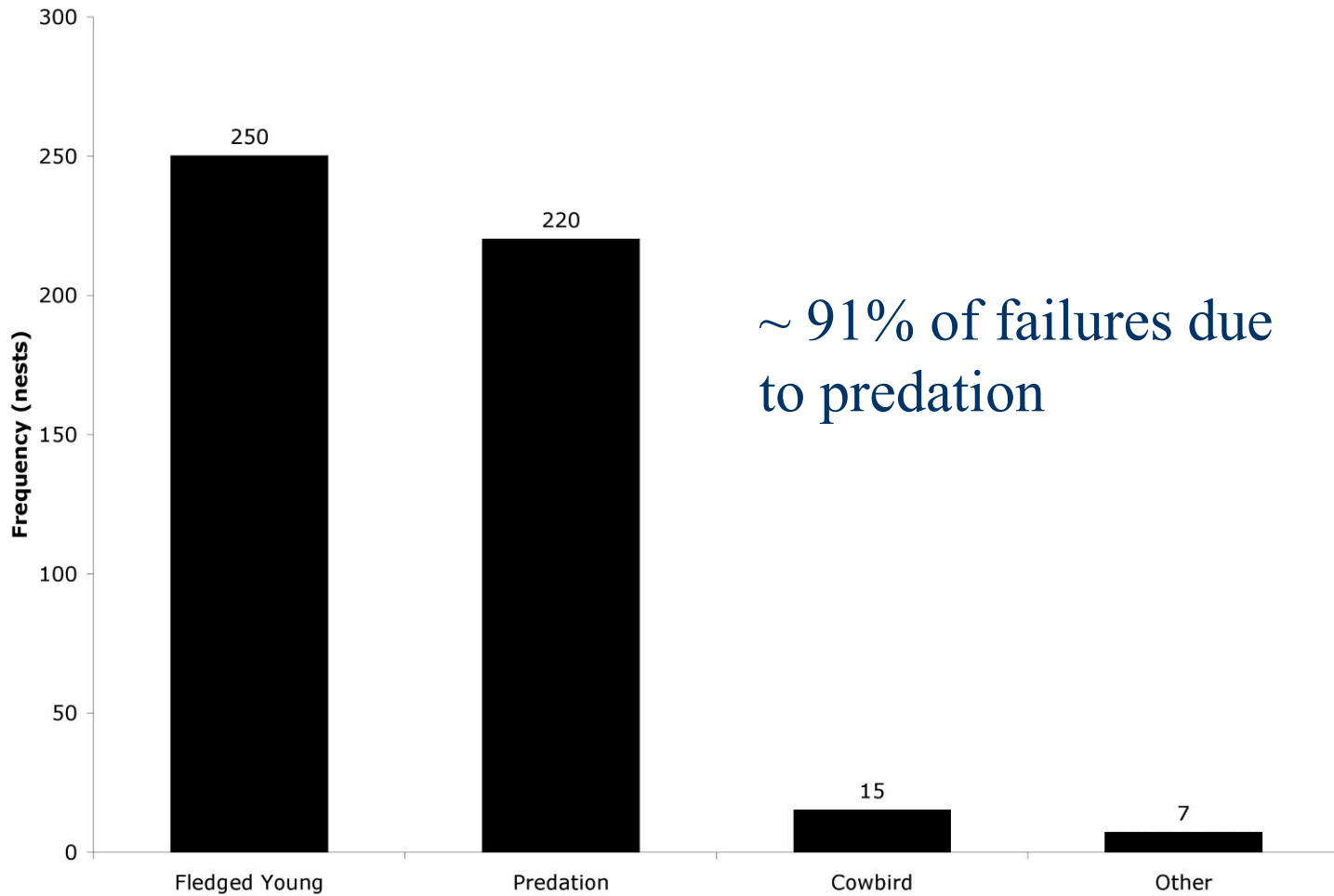
Absolute frequencies of nest outcomes, focal species, 2003-2006

Absolute frequencies of nest outcomes, focal species, 2003-2006

- Used Program MARK to
  - derive estimates of daily nest survival rate (DSR)
  - identify important parameters affecting nest predation
- Logit-link function and AIC_c

Nest Phase (days)	DSR	± SE	95% CI	Period ϕ
A. Western Wood-Pewee (n = 86)				
Laying+Incubation (18)	0.9875	0.0048	0.9734 - 0.9942	0.8179
Nestling (16)	0.9642	0.1227	0.9305 - 0.9820	0.5589
Total nest period (34)	0.9766	0.0603	0.8584 - 1.0948	0.4457
B. Dusky Flycatcher (n = 52)				
Laying+Incubation (19)	0.9797	0.0101	0.9470 - 0.9923	0.7197
Nestling (16)	0.9389	0.0295	0.8486 - 0.9768	0.3647
Total nest period (35)	0.9610	0.0190	0.9238 - 0.9982	0.2468
C. Warbling Vireo (n = 138)				
Laying+Incubation (16)	0.9819	0.0031	0.9747 - 0.9870	0.7460
Nestling (15)	0.9795	0.0041	0.9698 - 0.9861	0.7327
Total nest period (31)	0.9807	0.0036	0.9737 - 0.9877	0.5466
D. American Robin (n = 114)				
Laying+Incubation (16)	0.9864	0.0029	0.9807 - 0.9920	0.8029
Nestling (13)	0.9617	0.0068	0.9457 - 0.9730	0.6016
Total nest period (29)	0.9753	0.0047	0.9662 - 0.9844	0.4831
E. Oregon Junco (n = 80)				
Laying+Incubation (16)	0.9927	0.0031	0.9867 - 0.9988	0.8899
Nestling (11)	0.9770	0.0087	0.9522 - 0.9891	0.7743
Total nest period (27)	0.9863	0.0054	0.9758 - 0.9968	0.6891

Dusky Flycatcher (n = 52)

Parameter	Weights of Evidence	β	SE	LCI	UCI
Phase	1.00				
Year	1.00				
8-23 cm trees $\leq$ 11.3 m	1.00	-0.4092	0.1166	-0.6377	-0.1807
DBH^{-1}	1.00	-0.3902	0.1024	-0.5909	-0.1895
5+m conifers $\leq$ 20m	0.31	-0.0186	0.0279	-0.0733	0.0362

Year effects were quite strong:

Period	Proportional Nesting Success
2003-2004	25%
2005-2006	80%

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- Pooled nest fates of 12 arboreal cup-nesting species:

Species	n
Mourning Dove	1
Calliope Hummingbird	10
Western Wood-Pewee	86
Dusky Flycatcher (nest ht $\geq$ 5m)	16
Warbling Vireo	138
Clark's Nutcracker	1
American Robin	114
Yellow-rumped Warbler	15
Western Tanager	3
Black-headed Grosbeak	1
Pine Grosbeak	1
Cassin's Finch	7

Proportional nesting success of 12 arboreal cup-nesting species. Numbers represent total numbers of nests per cell (Fisher's exact test; p = 0.009)

Nest Tree	Fledged Young	Depredated	Total	% Successful
Aspen	202	168	370	54.6
Non-aspen	6	17	23	26.1

- Nest success is relatively high
- Evidence that nesting in aspen trees may decrease predation risk:
  - Dusky Flycatcher
  - Proportional nesting success - all arboreal spp.
- Near-nest conifer density negatively correlated with DSR (4 spp.)
- Conifer density at larger scale positively correlated with DSR (3 spp.)

Possible Explanations:

- Bird use and nest density is highest away from the aspen-conifer ecotone

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- Bird use and nest density is highest away from the aspen-conifer ecotone
  - Increased agonistic interactions - greater disturbance at nest
  - Functional response in predators

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- Conifer density at 50m scale may be correlated with other factors

Possible Explanations:

- Bird use and nest density is highest away from the aspen-conifer ecotone

- Conifer density at 50m scale may be correlated with other factors
  - Conifer density is highest along watercourses
  - Brood parasitism

Potentially obscuring clear conifer-associated pattern of nest predation:

- None of the stands in this study was sufficiently large or pure to be free from conifer-associated predators

- Presence of predators not associated with conifers may have added statistical noise to overall patterns of predation

Know Thine Enemy -

Sciurid Squirrels?

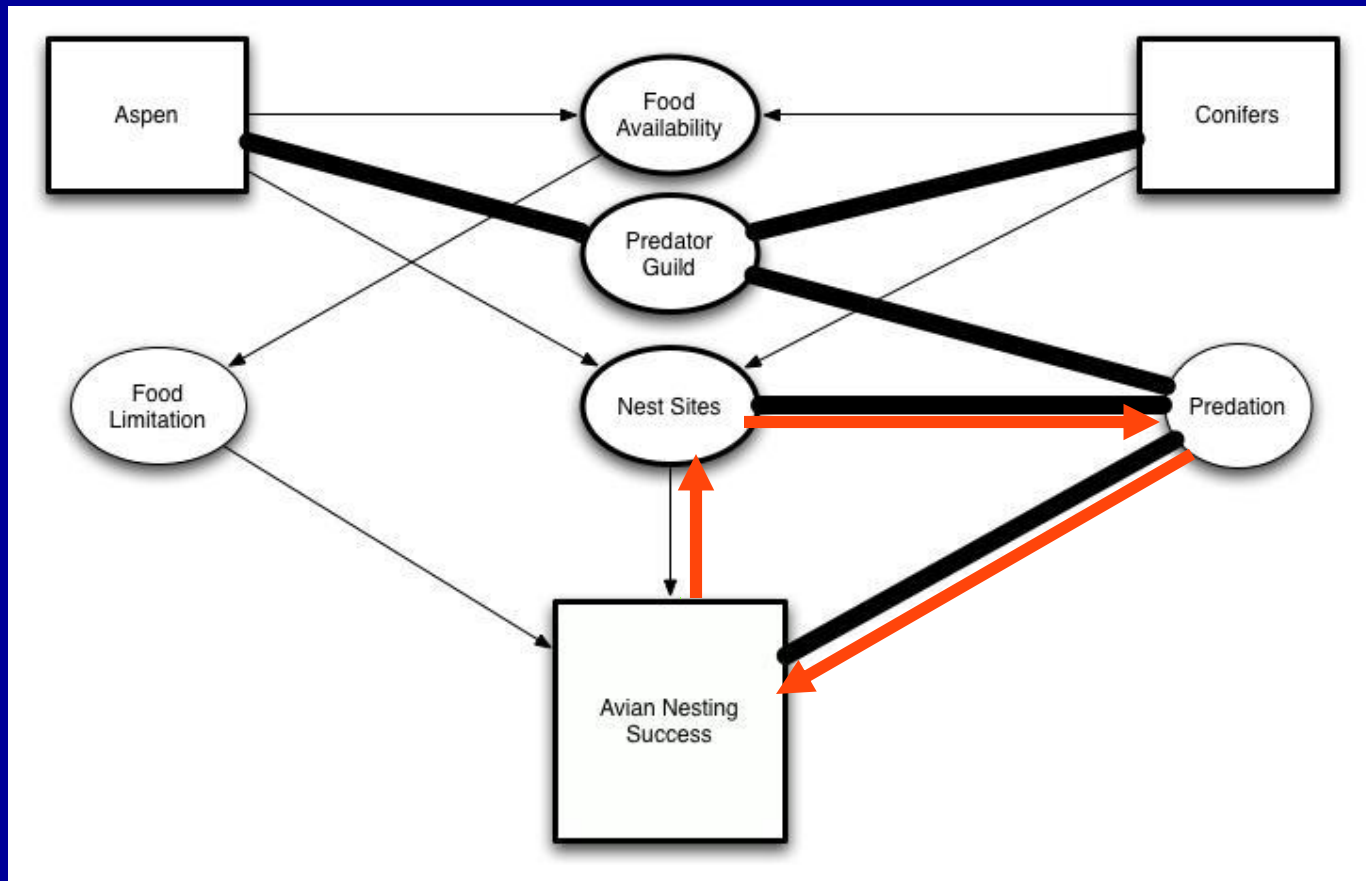Corvids??

Steller's Jay

Owls

Accipiters

Weasels

Avian Nest-site Selection in Aspen

Are patterns of predation, as related to conifers and aspen, affecting nest site selection?

Predictions

- Nests should be placed at locations with lower than random conifer density

  - Arboreal nests should be preferentially placed in aspen, versus other species

  - Dusky Flycatchers should place their nests in aspen trees, versus shrubs

Nest site preferences reported for P ≤ 0.1. n.d. = no difference
(P > 0.1)

Species	Conifer Density
Western Wood-Pewee (n = 117)	greater 0.007
Dusky Flycatcher (n = 54)	n.d.
Warbling Vireo (n = 152)	n.d.
American Robin (n = 115)	n.d.
Oregon Junco (n = 84)	n.d.

Predictions

- Nests should be placed at locations with lower than random conifer density

- ## Arboreal nests should be preferentially placed in aspen, versus other tree species

- Dusky Flycatchers should place their nests in aspen trees, versus shrubs

Nest tree species preference. Nest site trees were those available within 11.3 m of nests. Additionally, approximately 30 random, non-use trees were sampled at each study site. *P*-values refer to Fisher's Exact Test of Probability

	Nest Tree		Nest Site			Random		
	Aspen	Non-aspen	Aspen	Non-aspen	P	Aspen	Non-aspen	P
Western Wood-Pewee	86	1	1718	355	< 0.001	127	22	< 0.001
Dusky Flycatcher	16	0	325	56	0.143	102	17	0.221
Warbling Vireo	151	1	3470	661	< 0.001	127	22	< 0.001
American Robin	107	8	2844	298	0.419	127	22	0.052

- Dual Benefits:
  - Consistent with *predator-barrier hypothesis*
  - Also consistent with *potential-prey site hypothesis*

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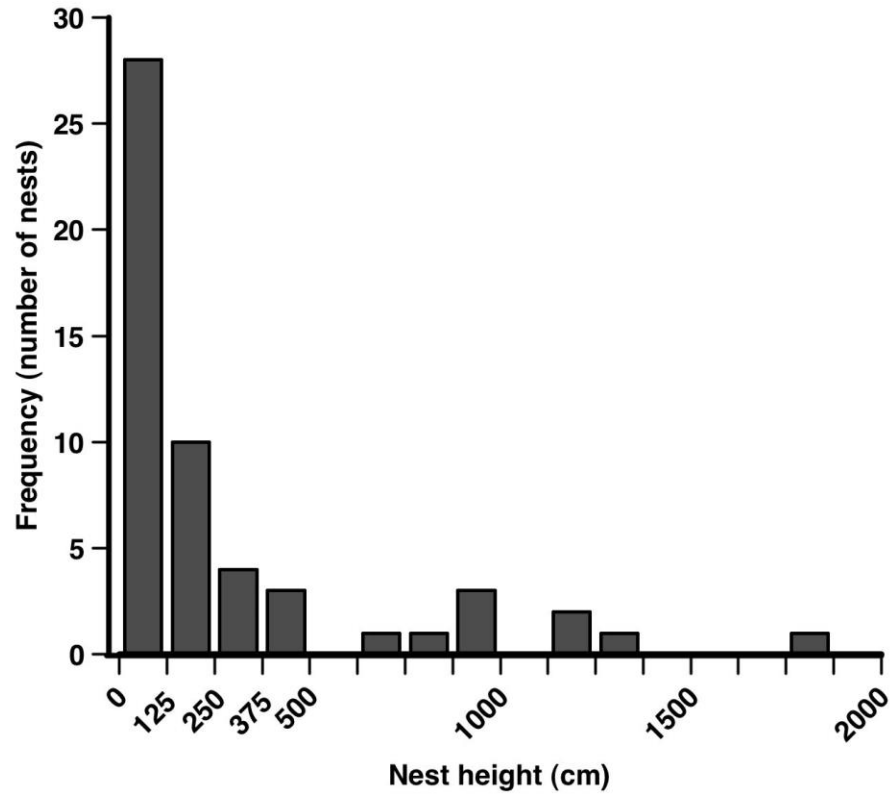
Dusky Flycatcher nest heights

Why?

- Nest placement may be constrained by regionally evolved preferences
- May be an adaptive trait from adjacent habitats

Photo by Kevin Crouch

Why?

- May be constrained due to interspecific competition with Western Wood-Pewees
  - Wood-pewees numerically and behaviorally dominant
  - Appear to partition the forest vertically for both nesting and foraging
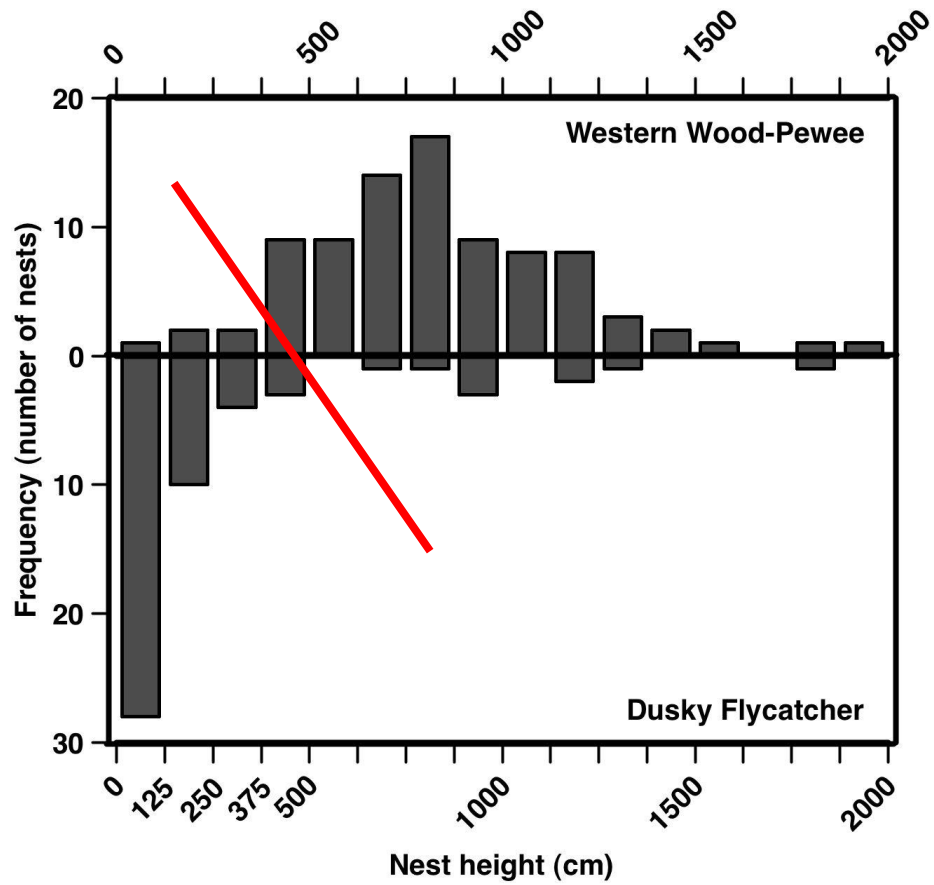
Limited evidence for nest-site selection as response to nesting success as it relates to aspen

- Sub-optimal sites chosen by subordinate or inexperienced breeders

Limited evidence for nest-site selection as response to nesting success as it relates to aspen

- Trade-offs between predation risk and other factors
  - resource avail.
  - territory defense
  - brood parasitism
  - risks of adult predation
  - microclimatic conditions

Limited evidence for nest-site selection as response to nesting success as it relates to aspen

- Annual variation in environment

- Gene flow over larger spatial scales

Summary

- Pure, mature aspen are best for avian species richness and abundance

- Aspen bark may be a barrier to small mammalian nest predators

- Conifers predict presence of suspected nest predators

- Near-nest conifer density negatively correlated with nest success

- Nest placement in aspen trees increases probability of nest success

- Differences in predation may be affecting nest-site selection relative to tree species but not conifer density