



Why are the willows dying in Rocky Mountain National Park?



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1995



2004



2008



2010



Background on willows





male →



← female





Photo by Scott Woods

Importance of tall willows

- critical food source in different seasons
 - beaver, moose and elk
 - sapsuckers and other songbirds

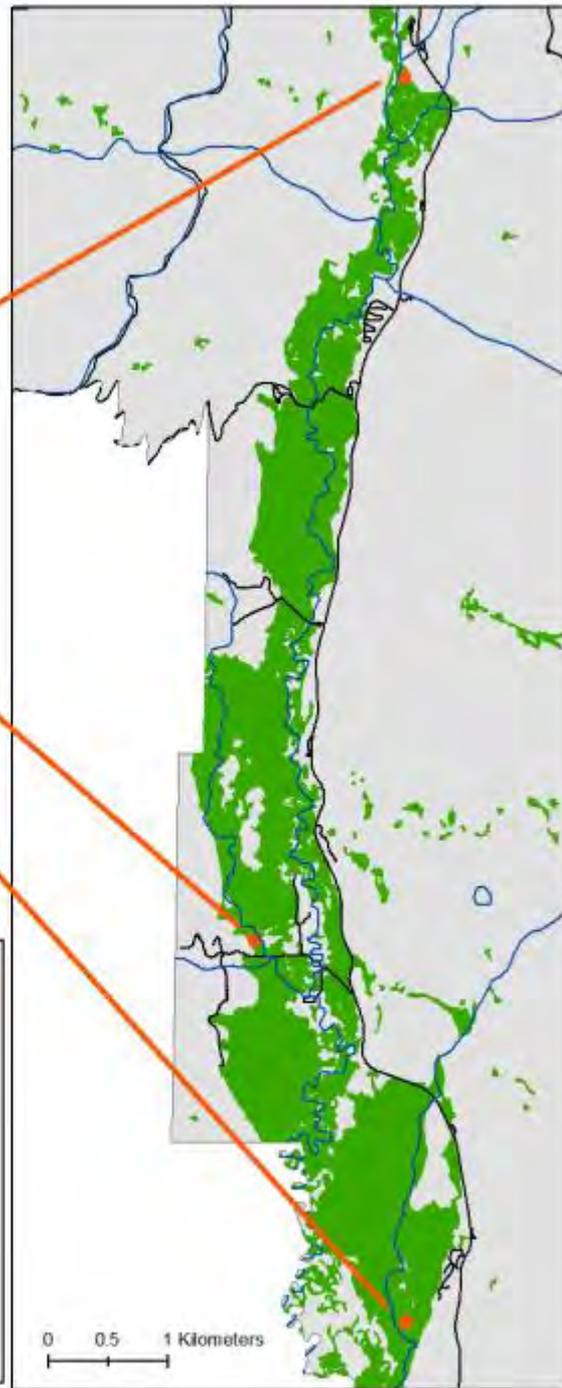
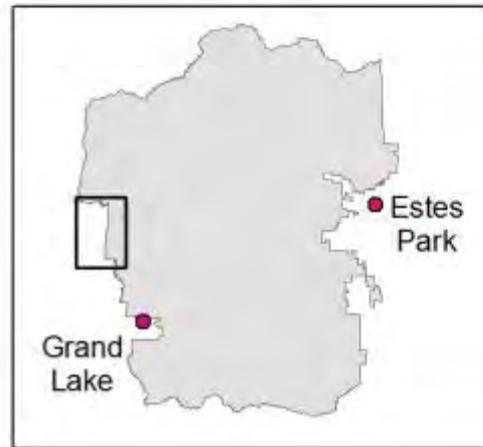


Importance of tall willows

- habitat for resident and migratory bird populations
 - songbirds



Kawuneeche
Valley
Exclosures



Questions

1. Did the dieback start because of changes in climate and streamflow?
2. What are the relative influences of elk and moose browsing, sapsuckers and fungi in the conversion from tall to short willows?



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1987



0 25 50 100 Meters

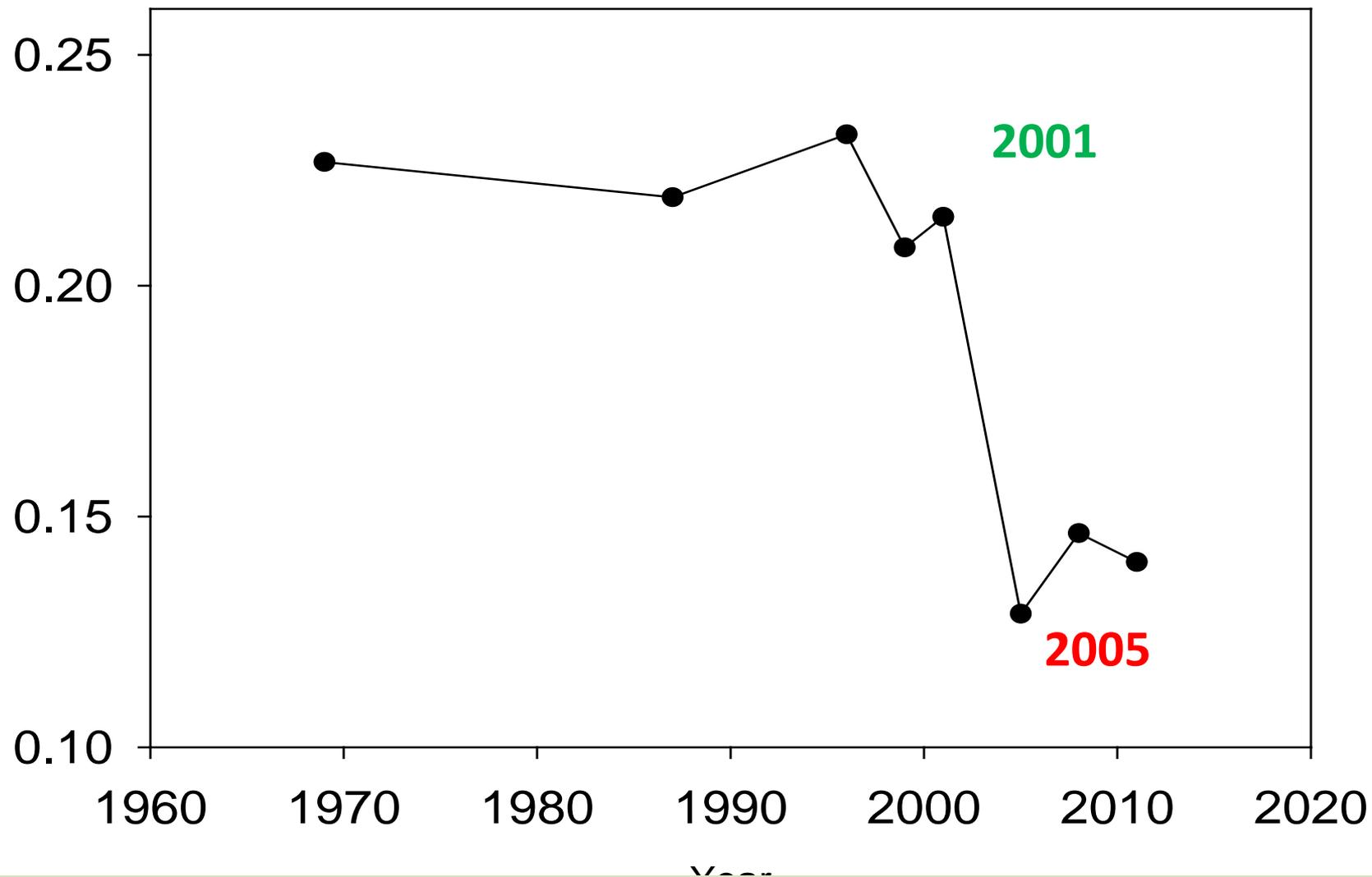
2005



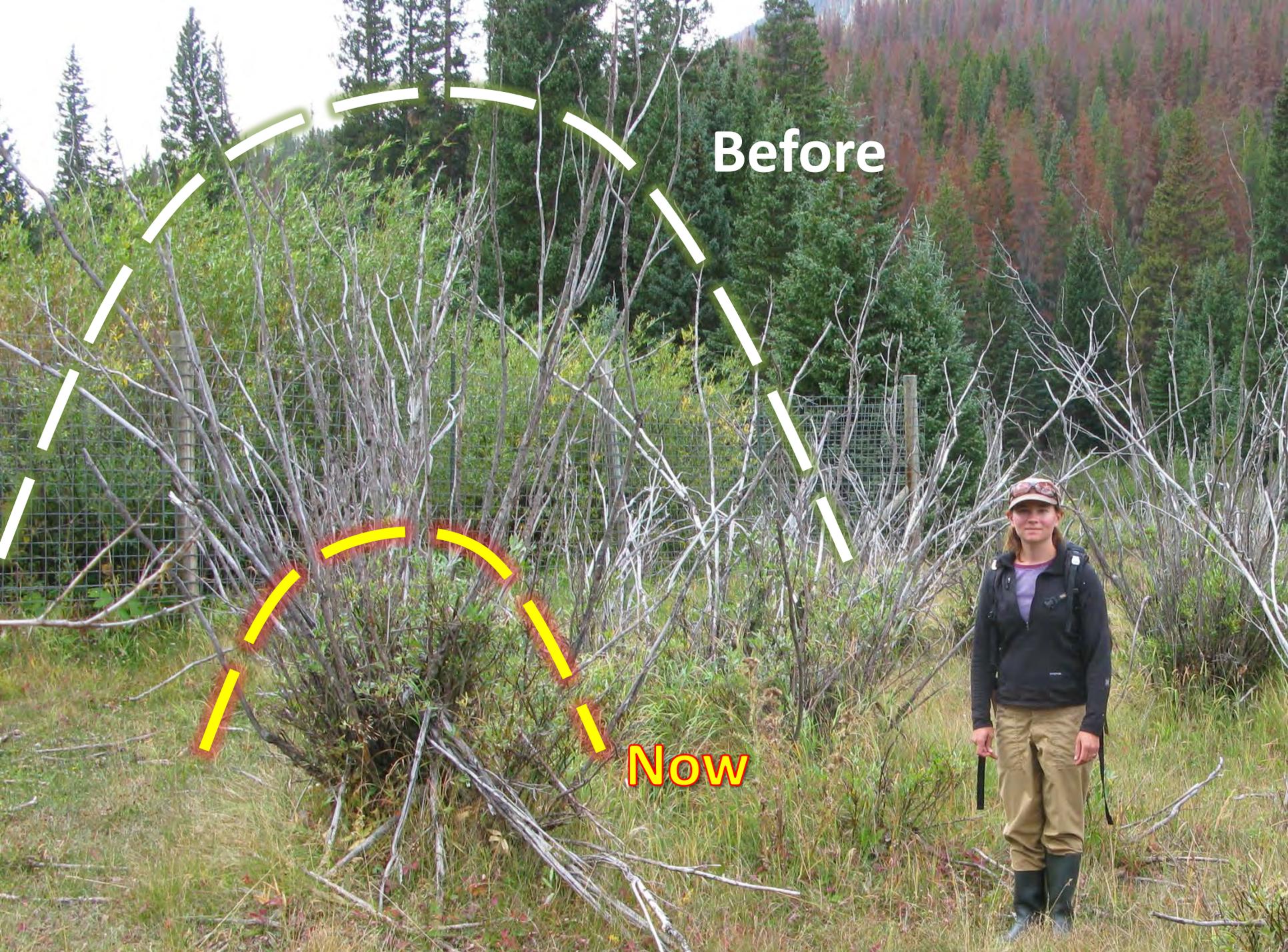
0 25 50 100 Meters



Willow Presence in Kawuneeche Valley



Ground truth 76% accuracy

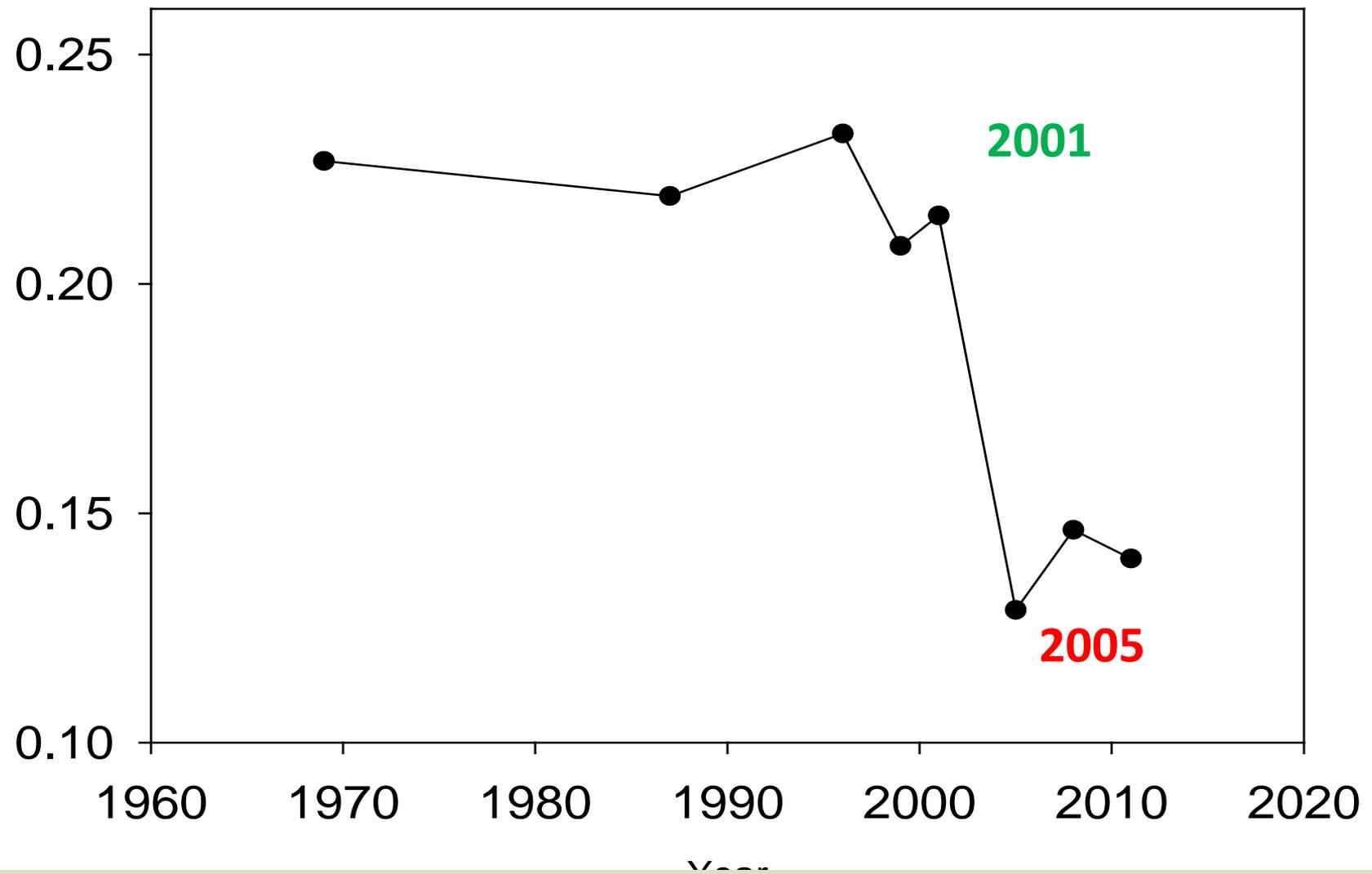


Before

Now



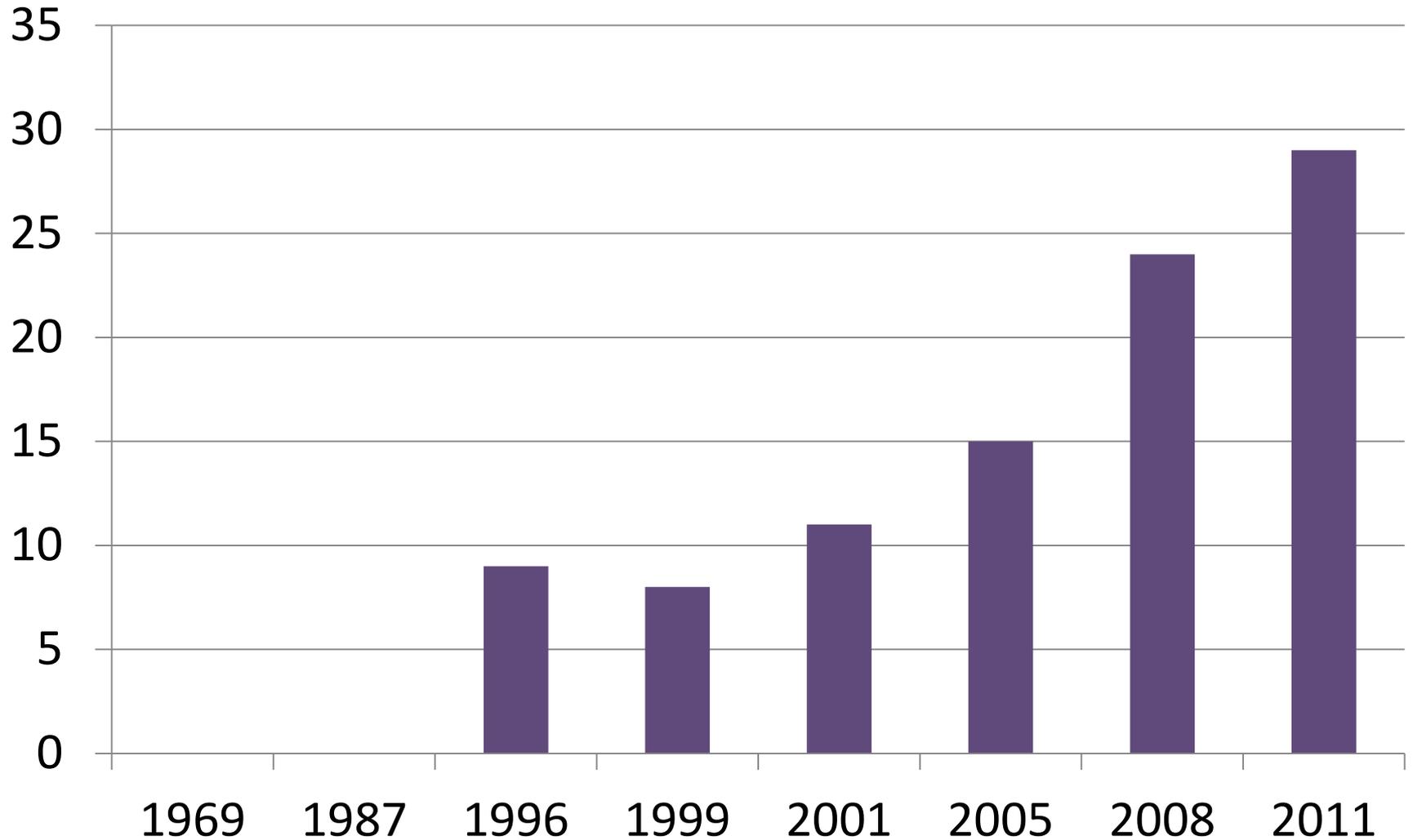
Willow Presence in Kawuneeche Valley



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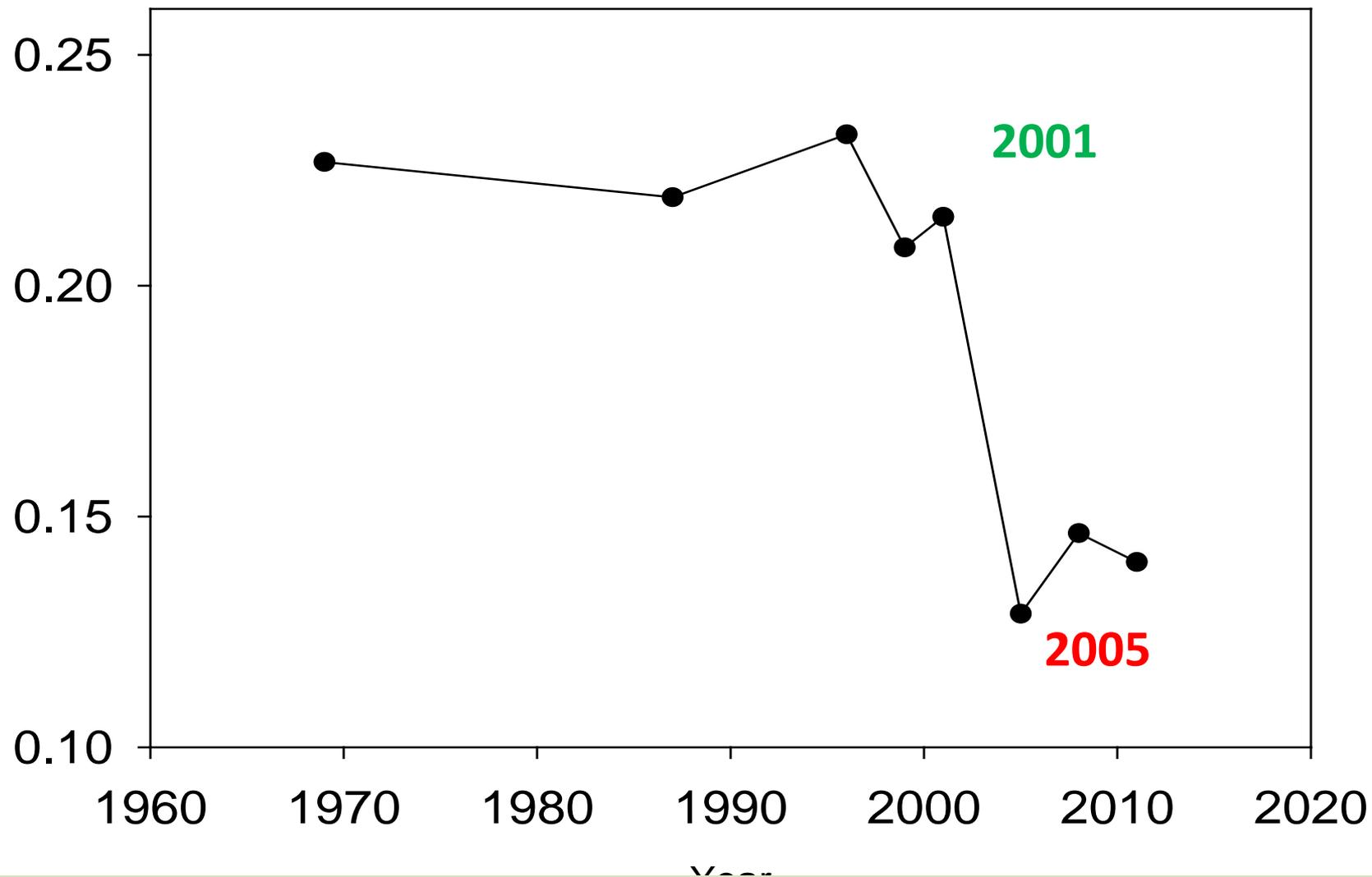


tags issued for moose hunting

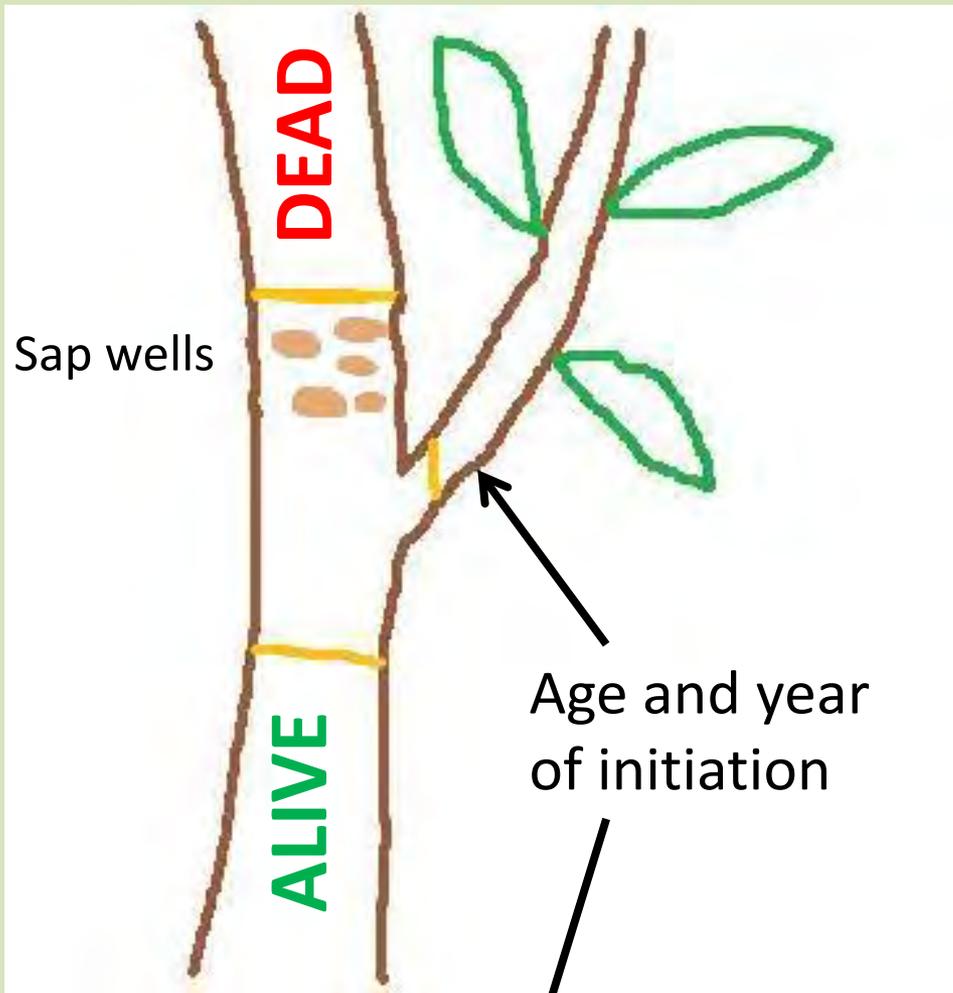




Willow Presence in Kawuneeche Valley



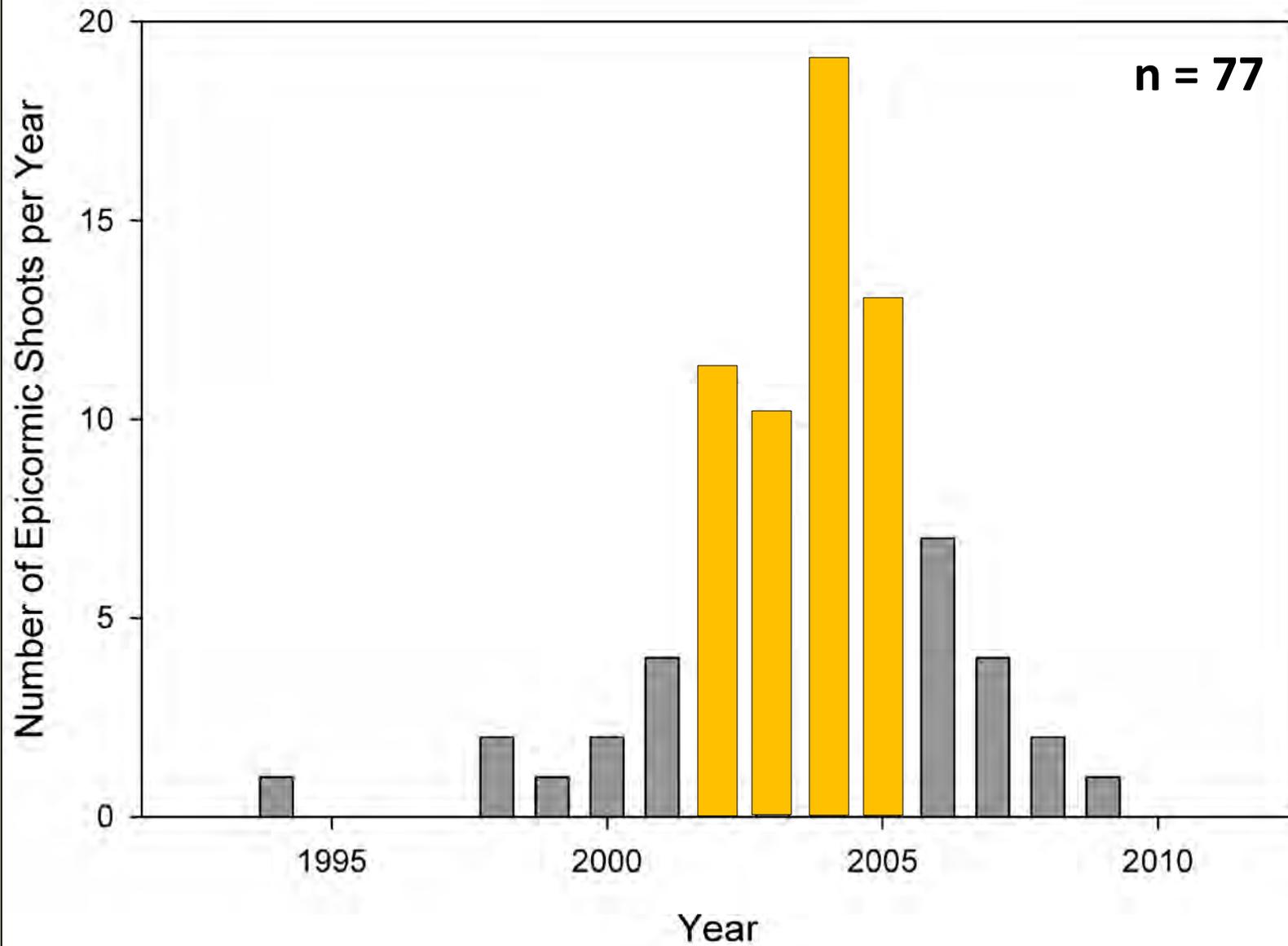
Ground truth 76% accuracy



A closer look....



Willow Epicormic Shoot Initiation Years





preliminary statistics

Biological Variables

- **Elk population**
- **Previous year elk population**
- **Moose hunting tags issued**

Climate Variables

- Average streamflow
- Average streamflow – 1
- Peak streamflow
- Peak streamflow – 1
- Accumulated precipitation
- Accumulated precip – 1
- **Growing season length**

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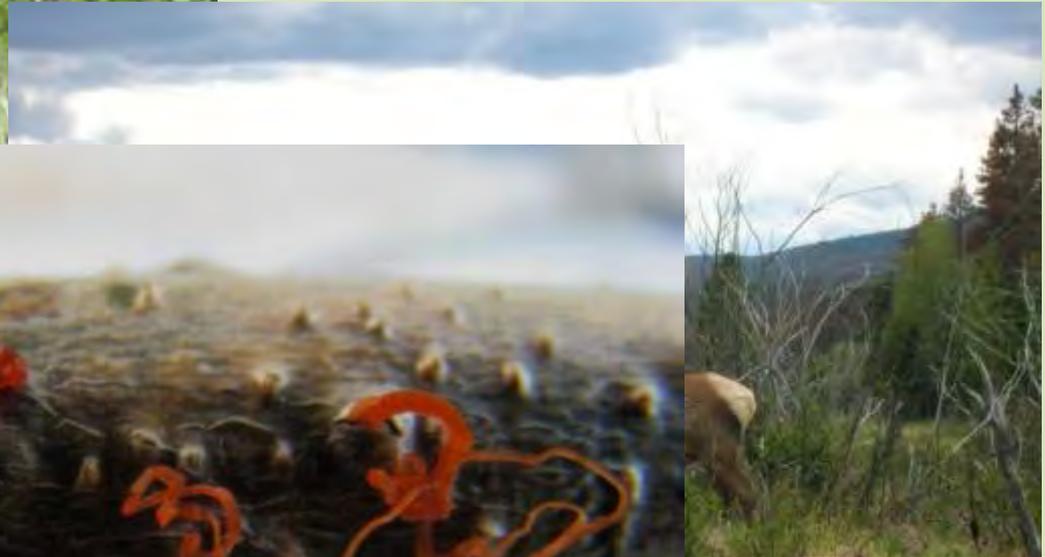
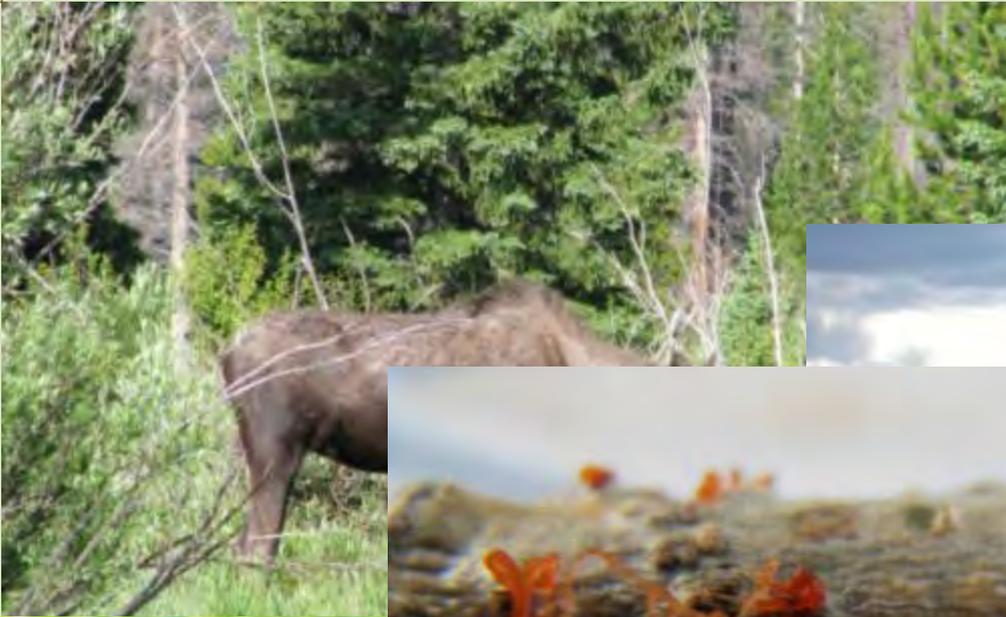
the biotic stressors







the biotic stressors



Cytospora chrysosperma



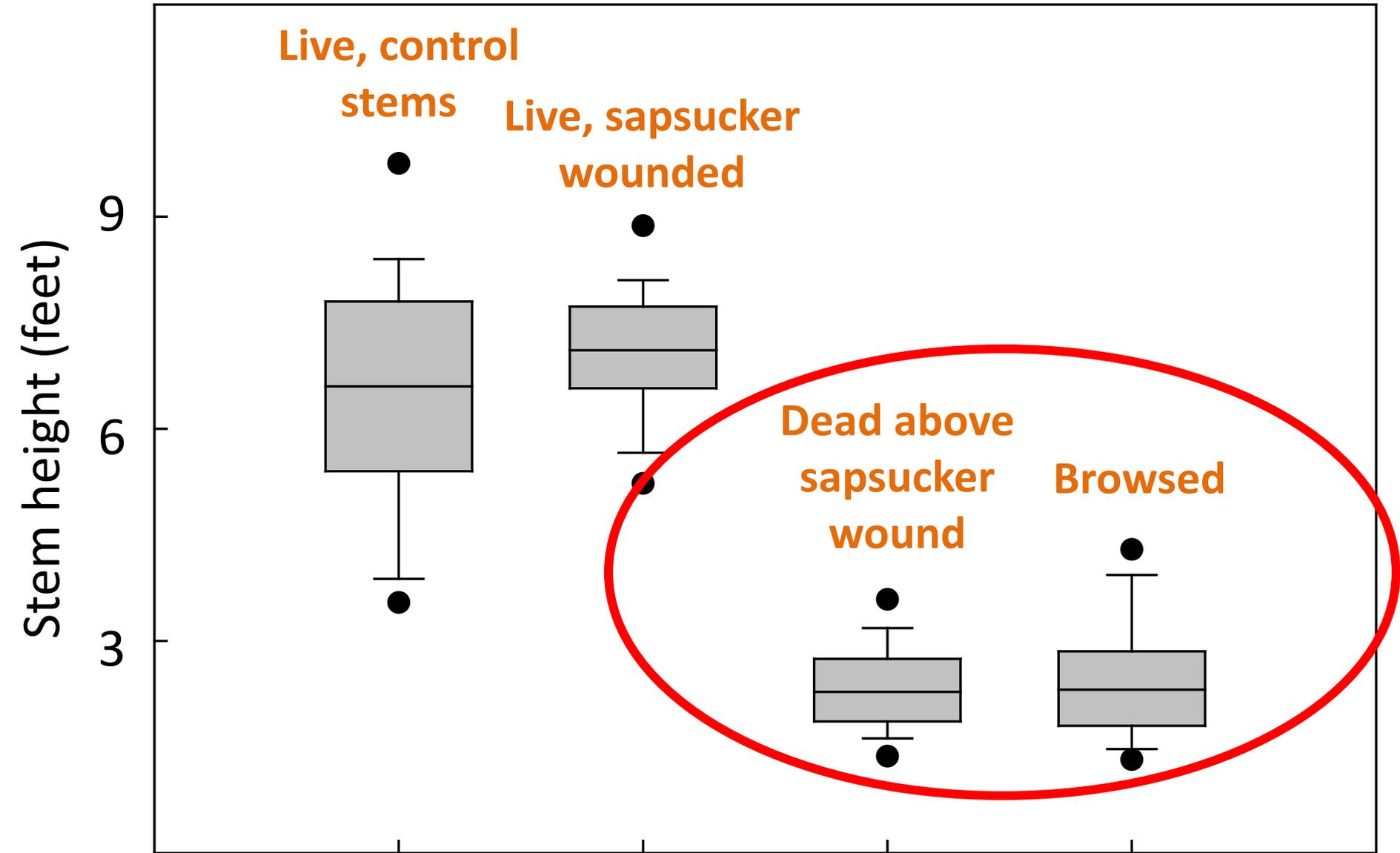
Infected stem

non-infected stem

- native fungus
- transported by wind, rain, insects, birds, people
- requires a wound
- secondary stressor fungus
- doesn't allow water to flow through the stem
- also affects Aspens and Poplars

after 3 years of research....





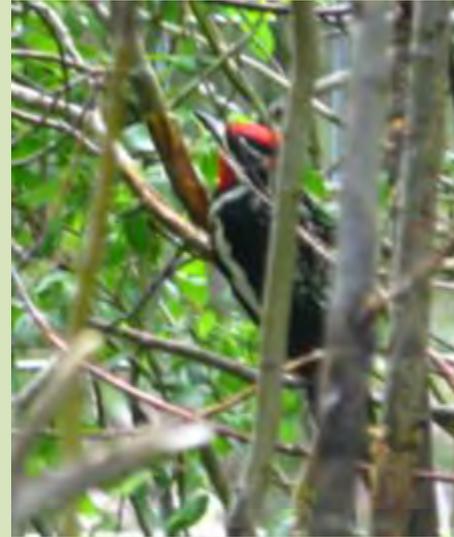
Beavers + high elk browsing = short willow community (Baker et al., 2005)



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Sapsuckers (+ fungi) + high elk/moose browsing = short willow community



Sapsuckers (+ fungi) + high elk/moose
browsing = short willow community



Conclusions

- **Aerial photo analysis demonstrated that increasing moose populations may have had a large effect on the onset of the decline**
- **We propose that sapsuckers played a large, *up until now unidentified*, role in the decline of willows**

Continued research

- Effects of moose summer browsing on willows
- Testing our hypothesis in Wild Basin



Acknowledgements

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Colorado
State
University





Questions?