West Nile Virus

Stu Garrett, MD

- Residency OHSU, then 35 yrs family medicine in Bend
- Sub-specialty mosquito-born diseases
- London School of Tropical Medicine and CDC

WNV first described in Uganda 1933

Is an RNA Flavivirus

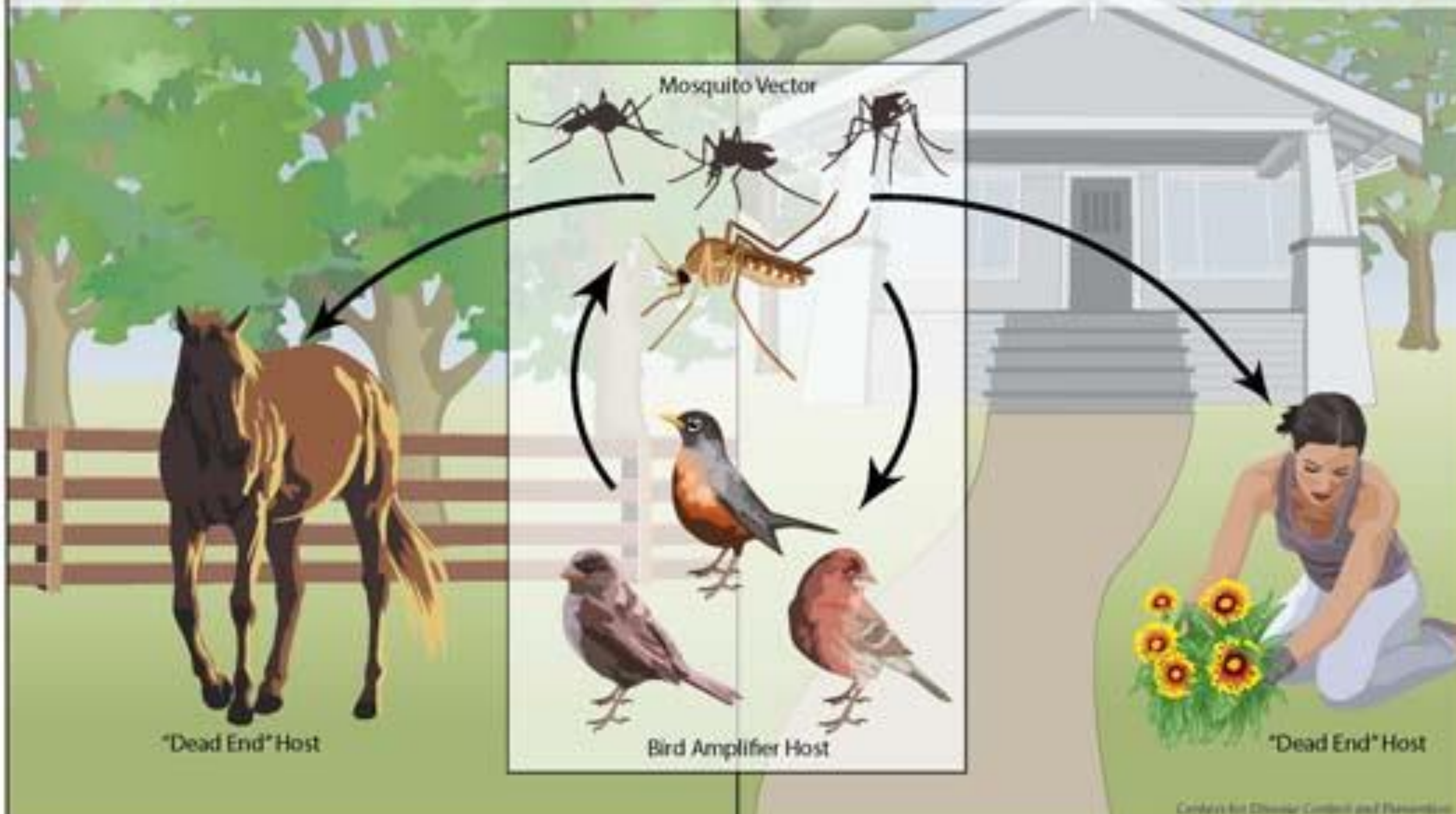
Related to:

Dengue Fever
Zika
Yellow Fever

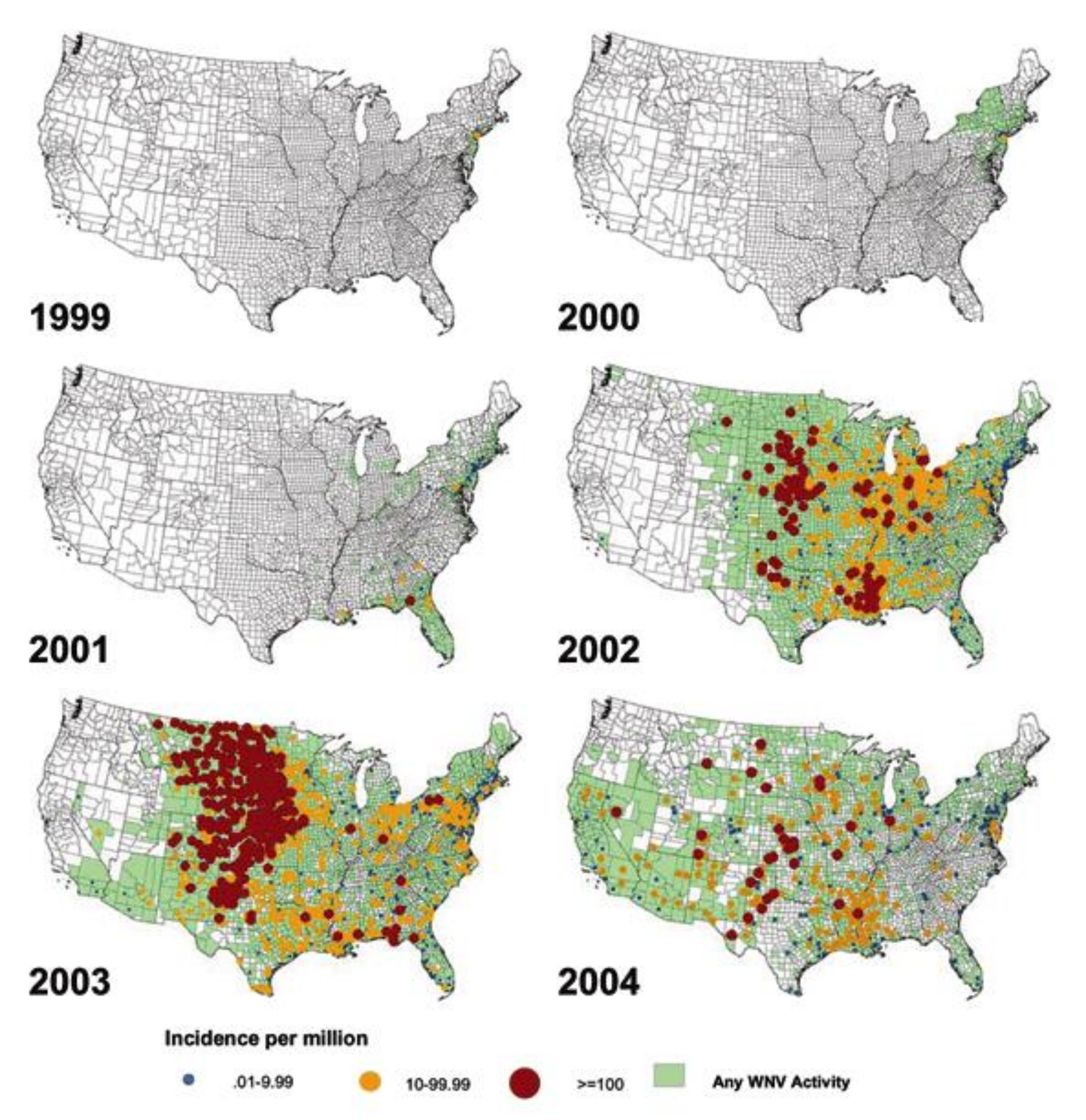
West Nile Virus Transmission Cycle

In nature, West Nile virus cycles between mosquitoes (especially *Culex* species) and birds. Some infected birds, can develop high levels of the virus in their bloodstream and mosquitoes can become infected by biting these infected birds. After about a week, infected mosquitoes can pass the virus to more birds when they bite.

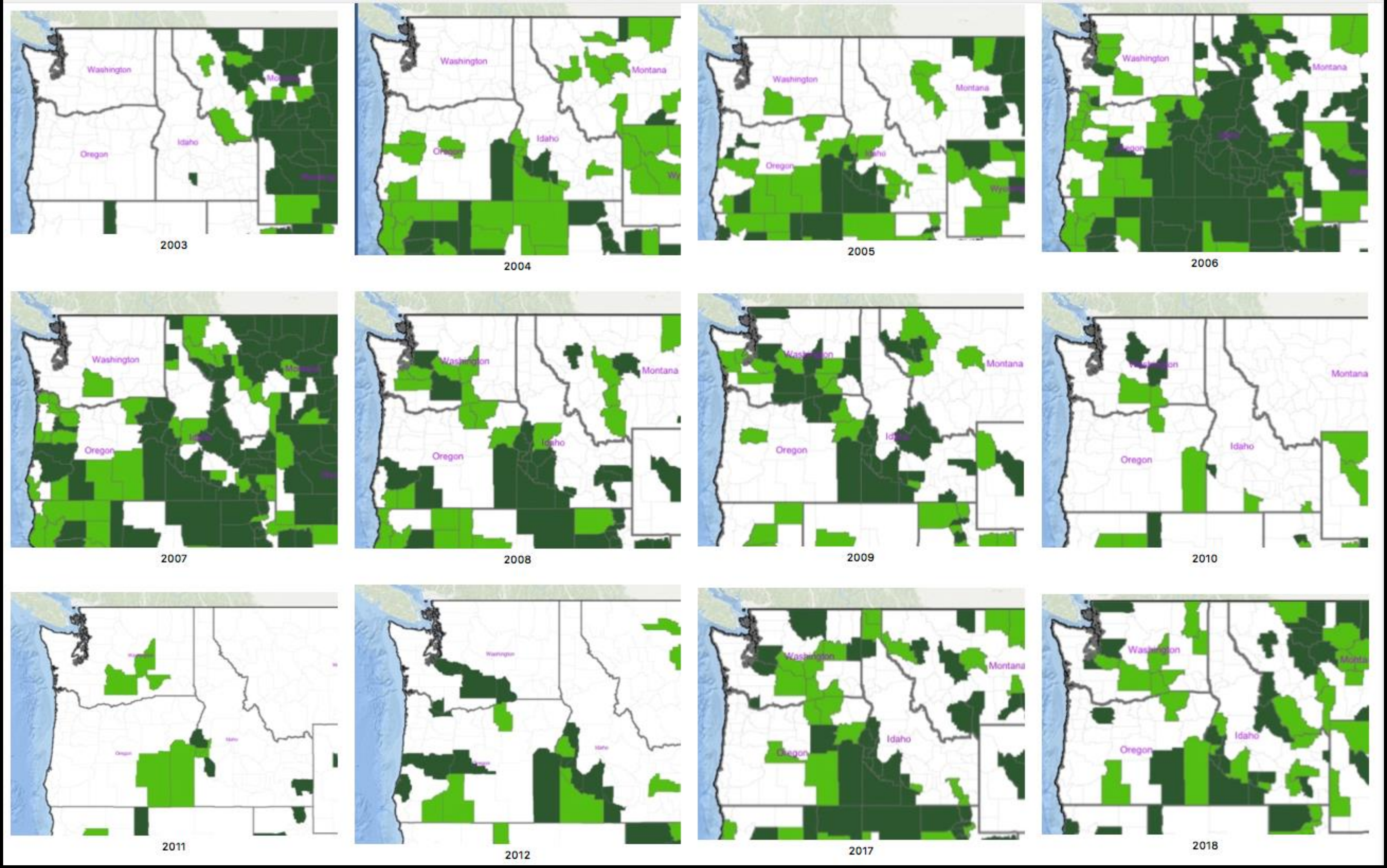
Mosquitoes with West Nile virus also bite and infect people, horses and other mammals. However, humans, horses and other mammals are 'dead end' hosts. This means that they do not develop high levels of virus in their bloodstream, and cannot pass the virus on to other biting mosquitoes.



Appearance and Spread of West Nile Virus



Spread of West Nile Virus in NW



Epidemic to Endemic

21 captured GSG, all died in 6 days

Journal of Wildlife Diseases, 42(1), 2006, pp. 14–22

SUSCEPTIBILITY OF GREATER SAGE-GROUSE TO EXPERIMENTAL INFECTION WITH WEST NILE VIRUS

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ABSTRACT: Populations of greater sage-grouse (*Centrocercus urophasianus*) have declined 45–80% in North America since 1950. Although much of this decline has been attributed to habitat loss, recent field studies have indicated that West Nile virus (WNV) has had a significant negative impact on local populations of grouse. We confirm the susceptibility of greater sage-grouse to WNV infection in laboratory experimental studies. Grouse were challenged by subcutaneous injection of WNV ($10^{3.2}$ plaque-forming units [PFUs]). All grouse died within 6 days of infection. The Kaplan-Meier estimate for 50% survival was 4.5 days. Mean peak viremia for nonvaccinated birds was $10^{6.4}$ PFUs/ml ($\pm 10^{0.2}$ PFUs/ml, standard error of the mean [SEM]). Virus was shed cloacally and orally. Four of the five vaccinated grouse died, but survival time was increased (50% survival=9.5 days), with 1 grouse surviving to the end-point of the experiment (14 days) with no signs of illness. Mean peak viremia for the vaccinated birds was $10^{2.3}$ PFUs/ml ($\pm 10^{0.6}$ PFUs/ml, SEM). Two birds cleared the virus from their blood before death or euthanasia. These data emphasize the high susceptibility of greater sage-grouse to infection with WNV.

Key words: *Centrocercus urophasianus*, experimental infection, greater sage-grouse, vaccine, West Nile virus.

Documented GSG-WNV losses in Oregon

Malheur County first OR deaths in 2006 and 2007

Death of 60 GSG at Burns Junction area 2007

Confirmation of deaths Crane and Jordan Valley

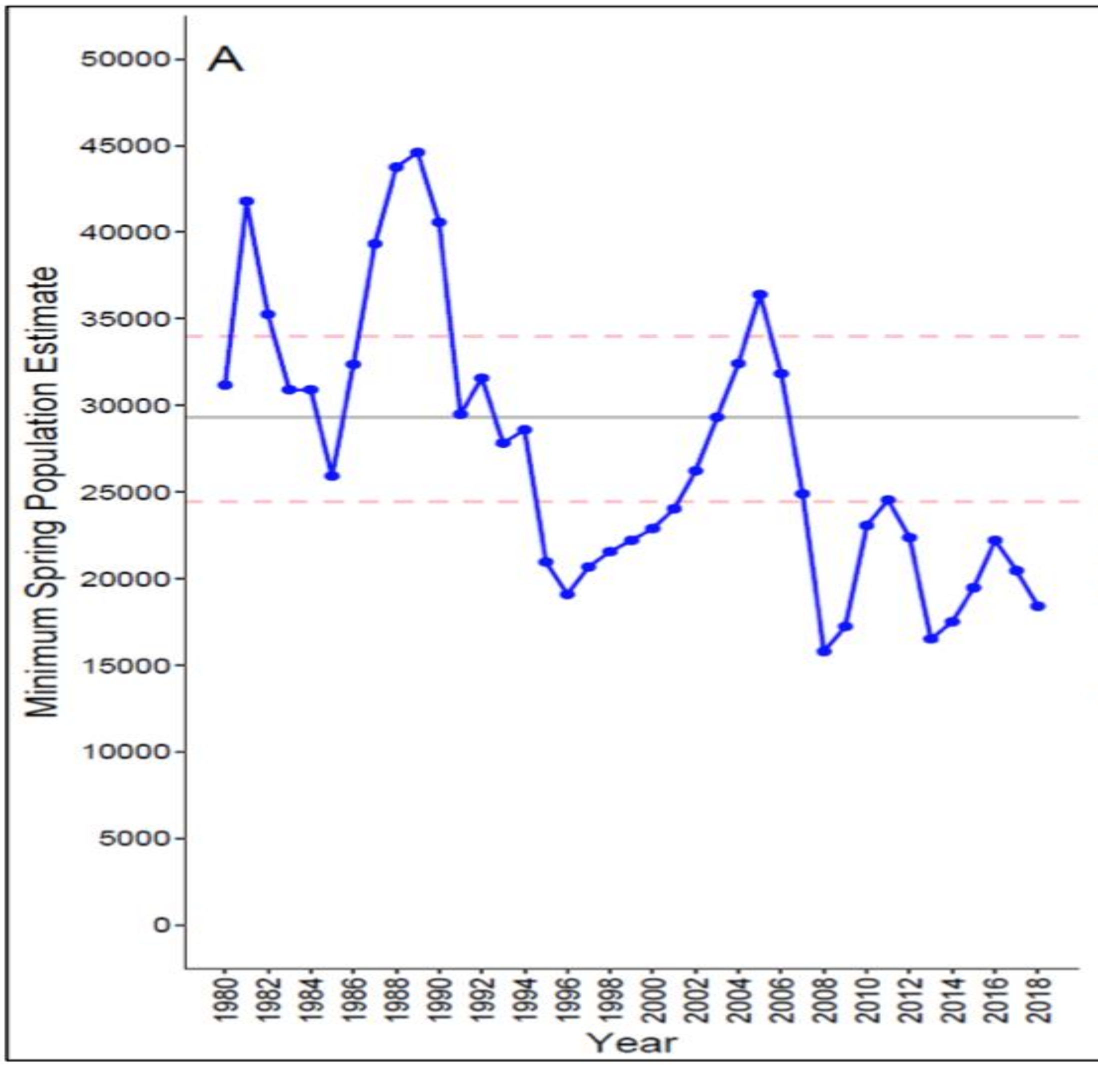
Cow Lakes positive 2006

Beulah Unit pos 2008

Harney County pos 2007

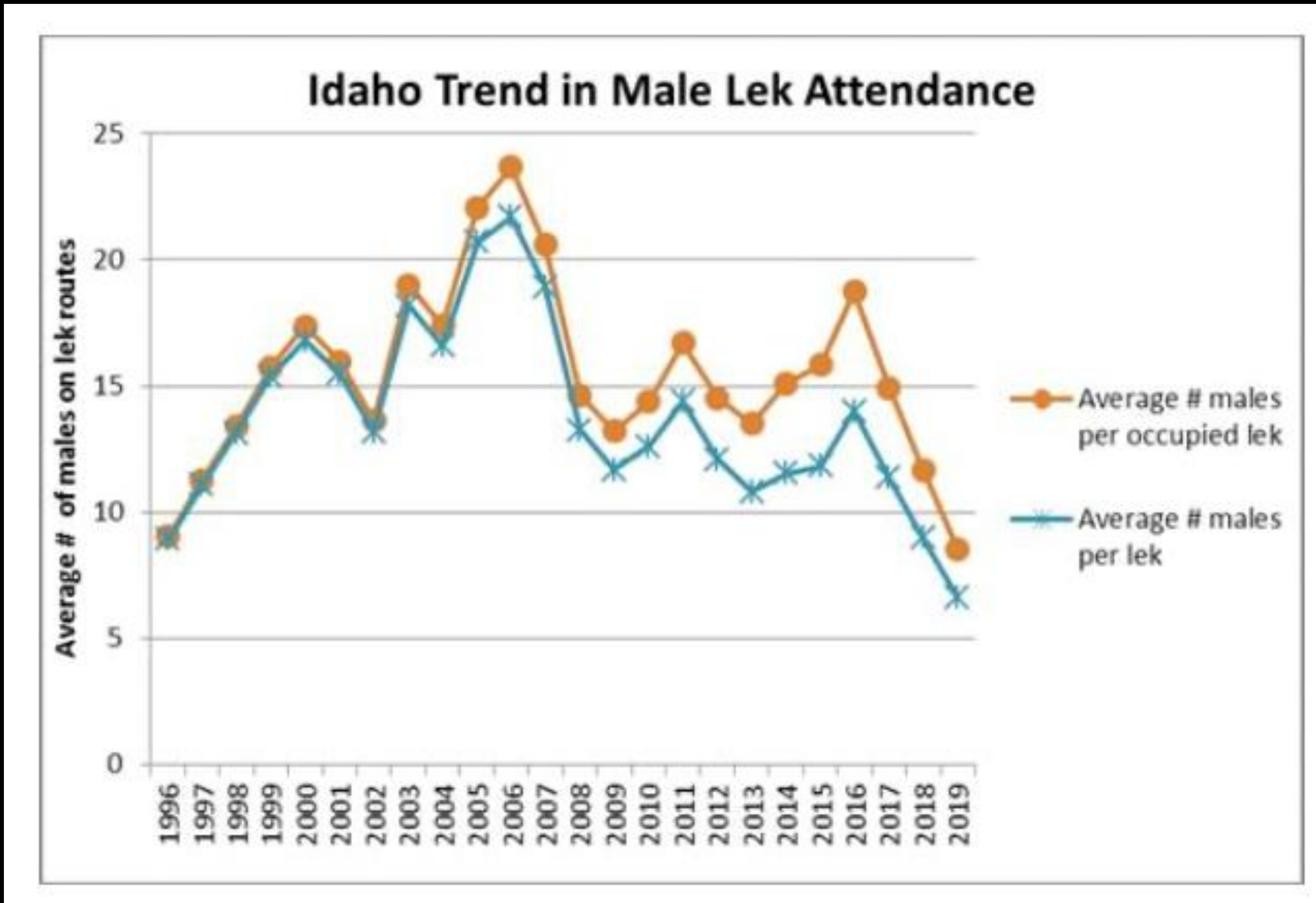
Dusek hunt study, 5 yrs of GSG blood…1 pos of 1800.

Oregon statewide

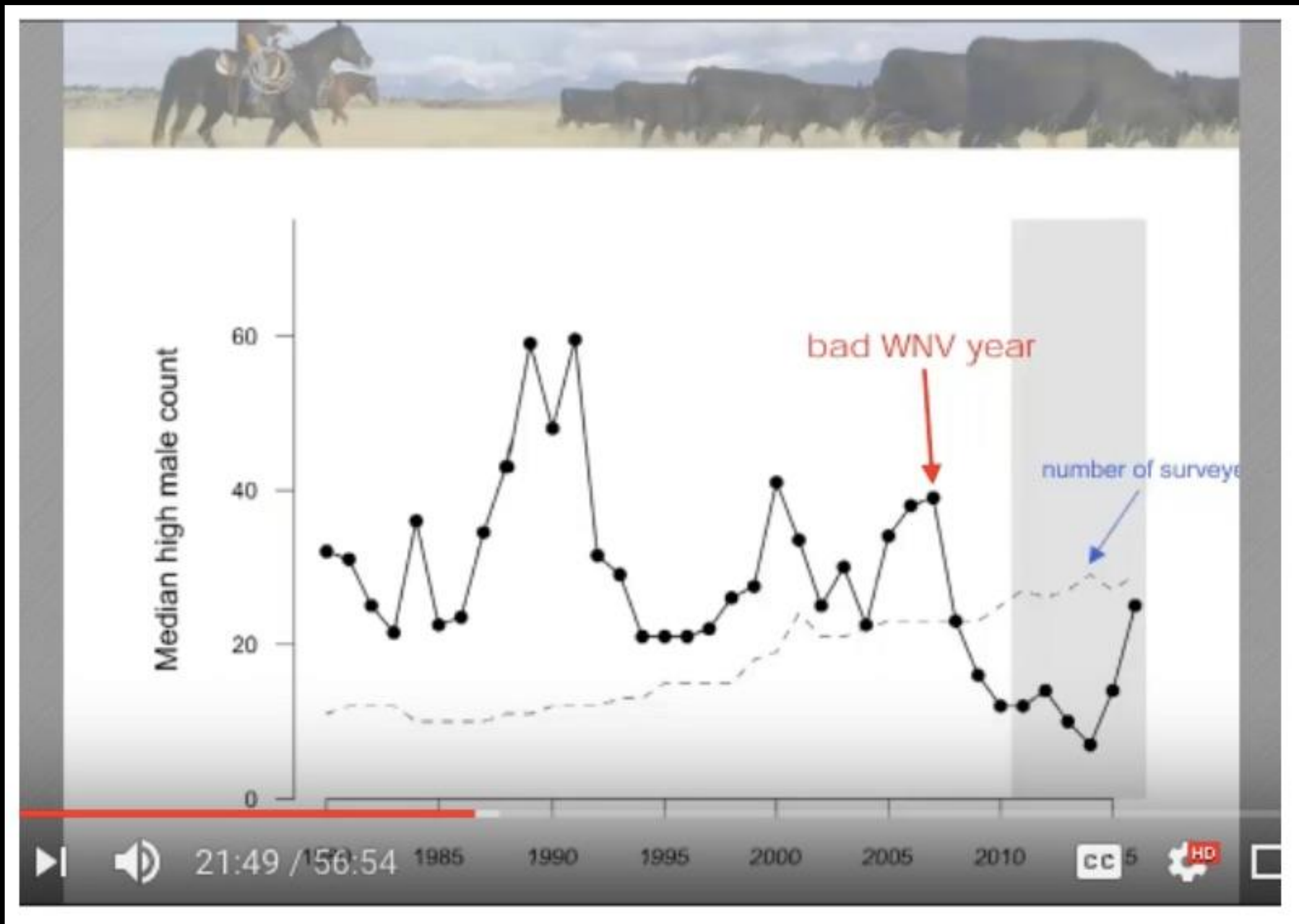


Greater sage-grouse population trends in **Oregon**, 1980 –

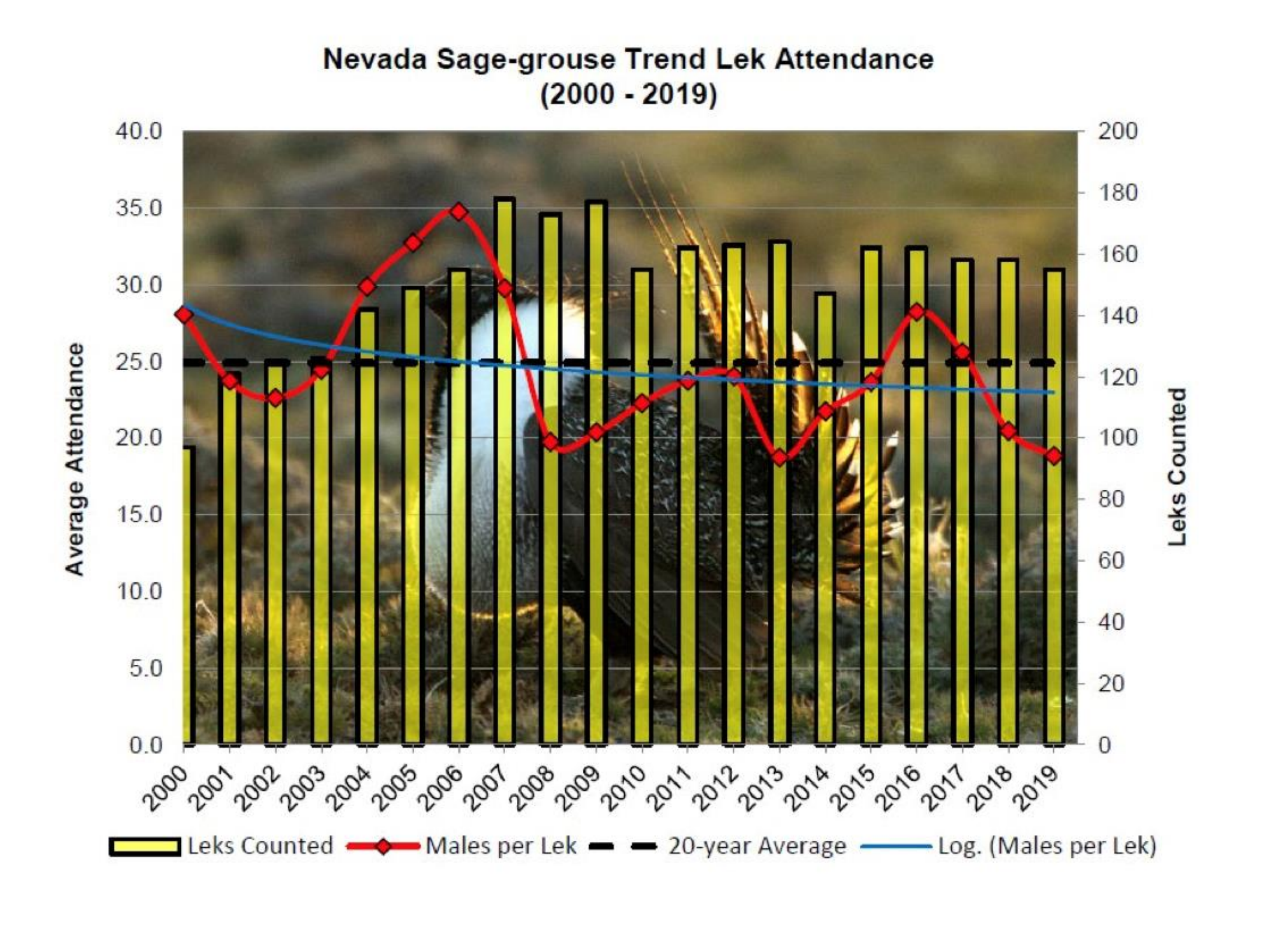
Idaho statewide



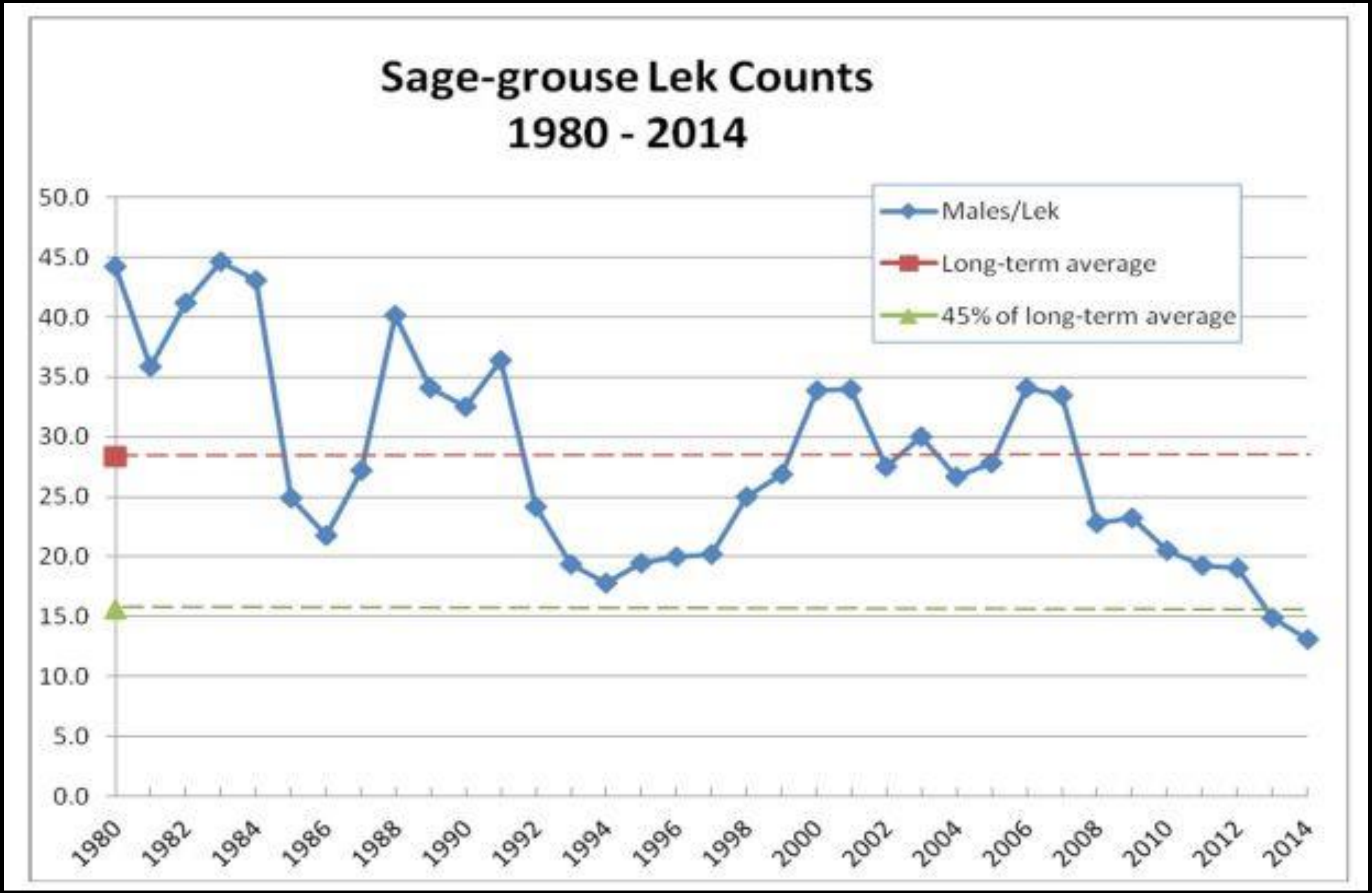
Wyoming statewide



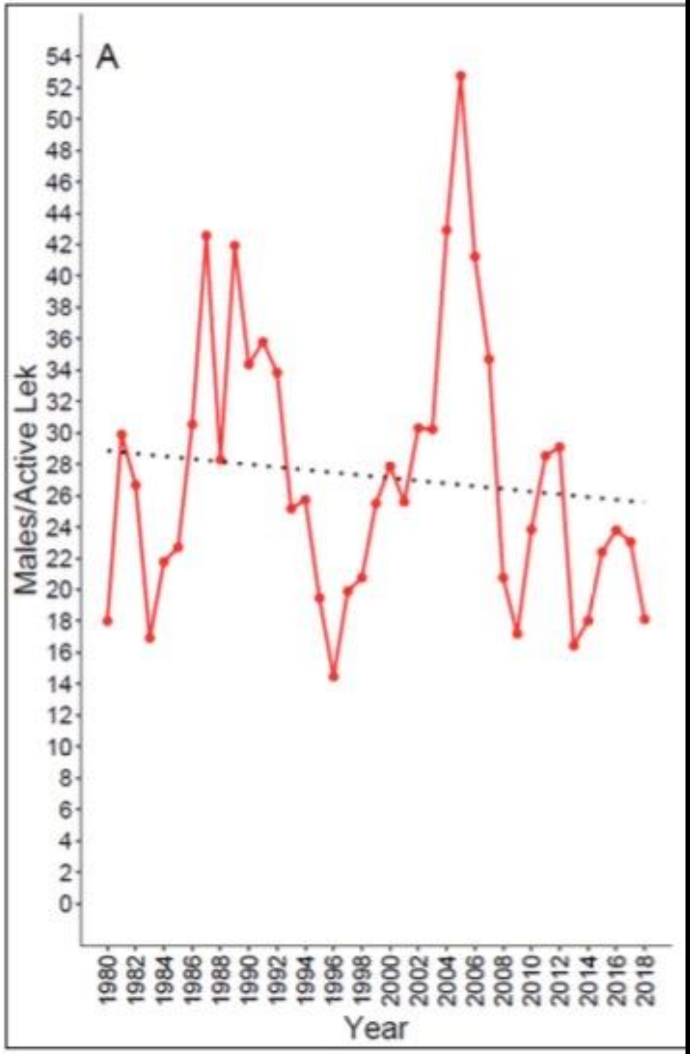
Nevada statewide



Montana statewide

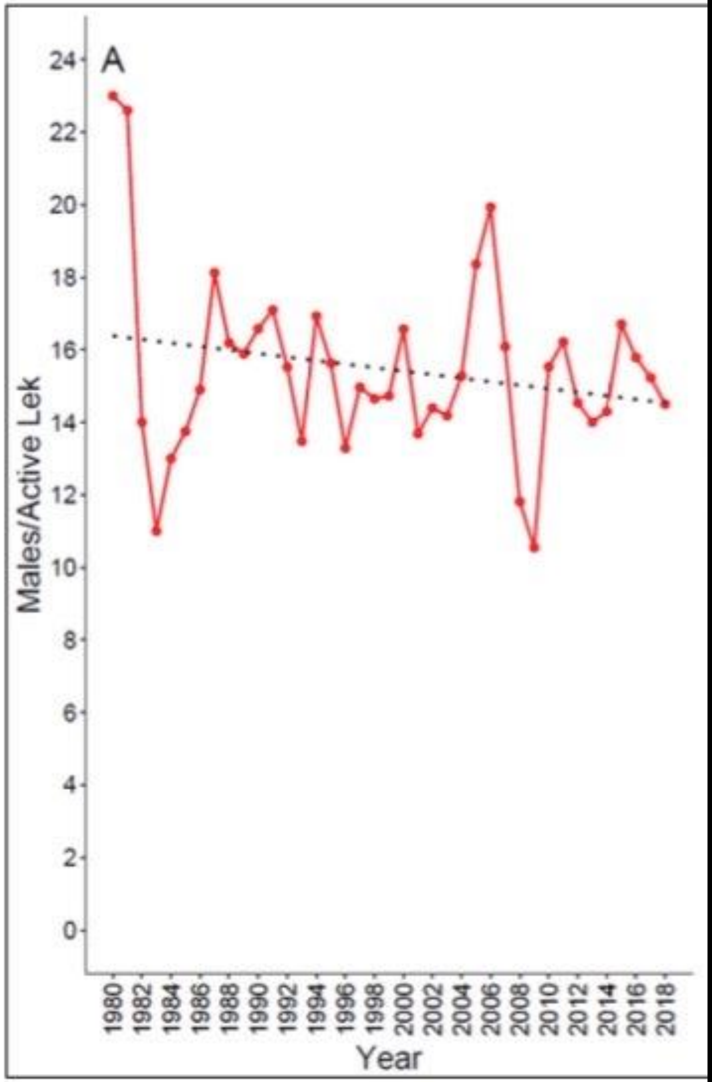


Lakeview District – Lee Foster



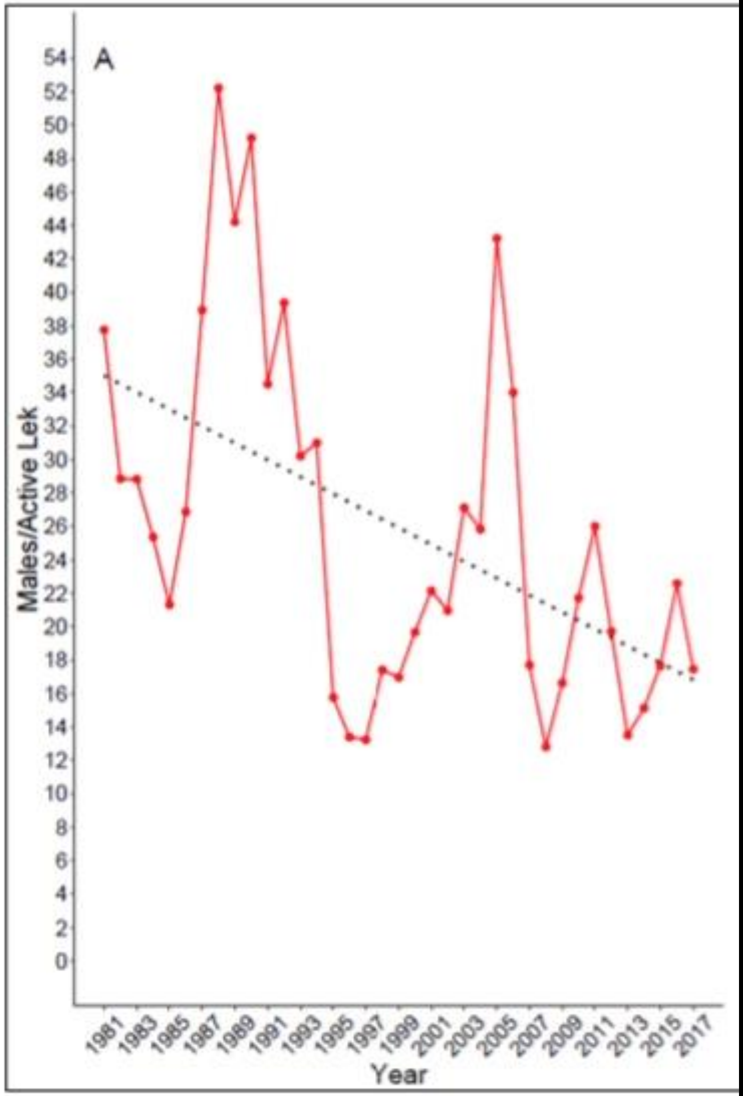
Greater sage-grouse population trend in the **Lakeview BL**
ouse lek complex size (males per active lek). B - Annual r

Prineville District



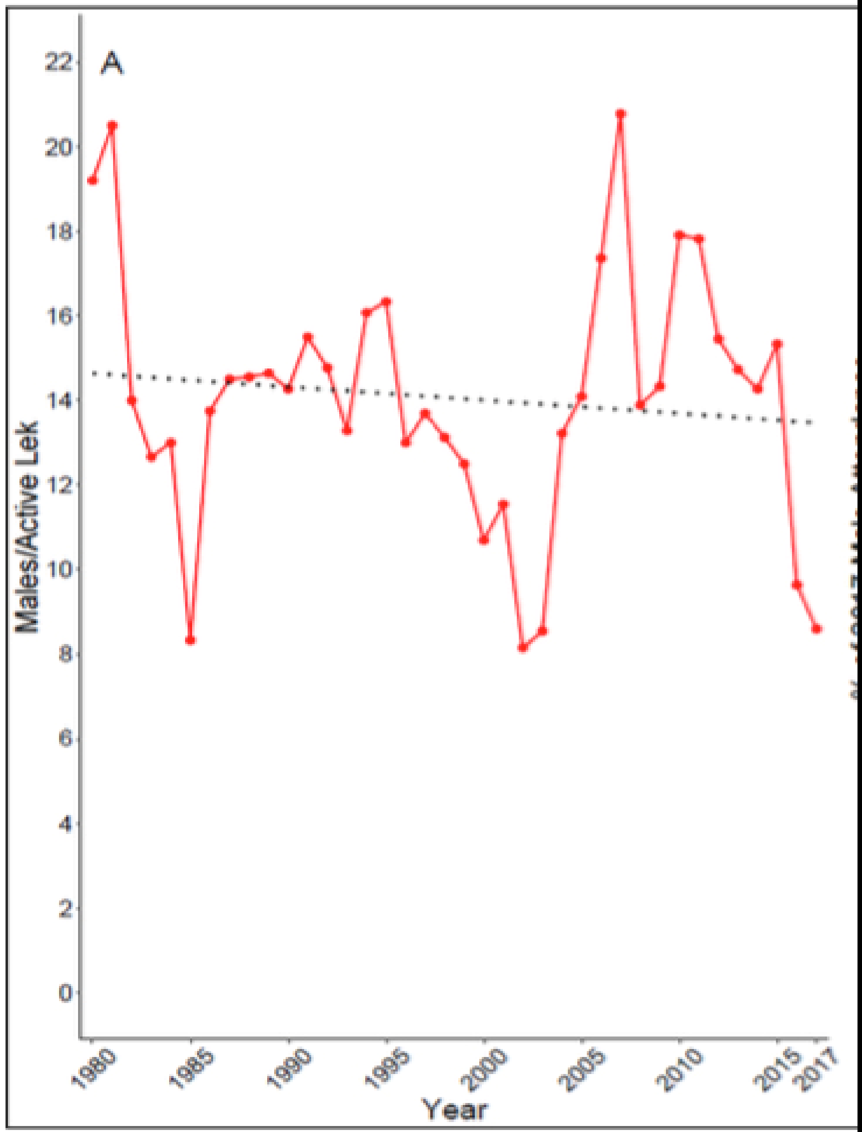
1. Greater sage-grouse population trend in the **Prineville BI**
grouse lek complex size (males per active lek). B - Annual ra
percentage of 2018 male attendance; annual rate of change i

Burns District



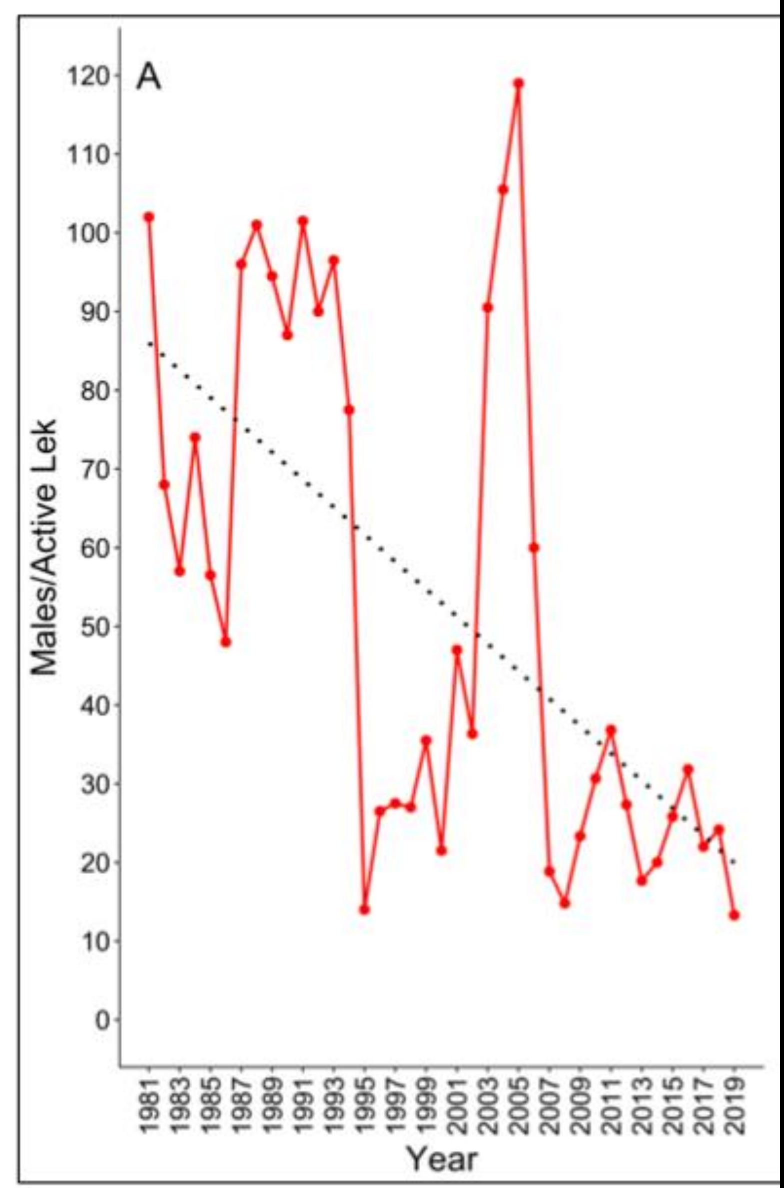
Greater sage-grouse population trend in the **Burns BLM I**
k complex size (males per active lek). B. Annual rate of c

Brothers PAC



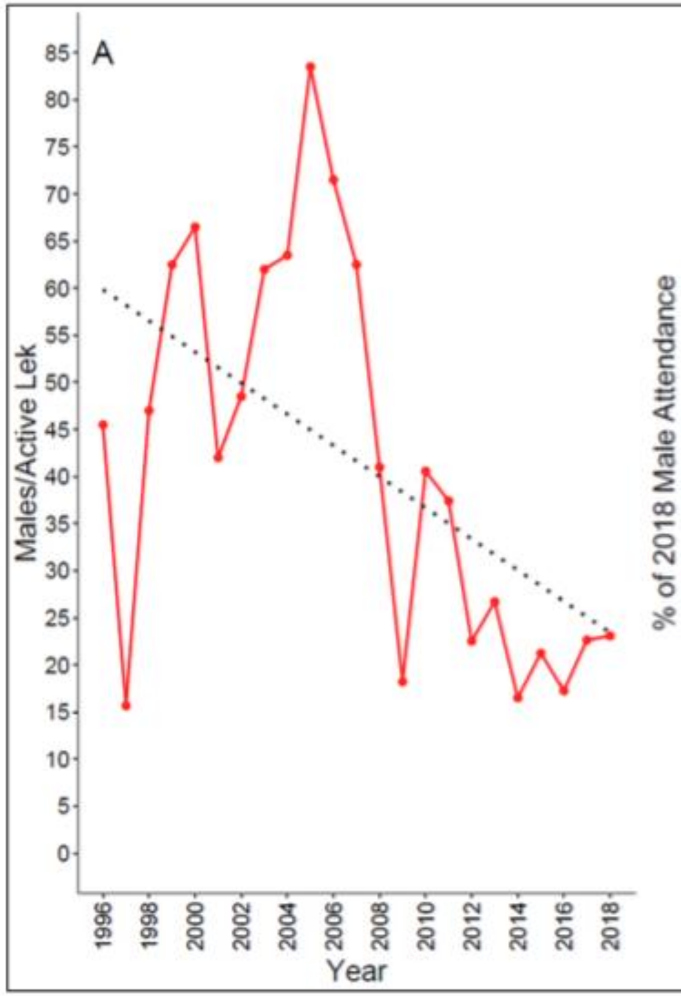
Greater sage-grouse population trend in the **Brothers/N.**

Steens



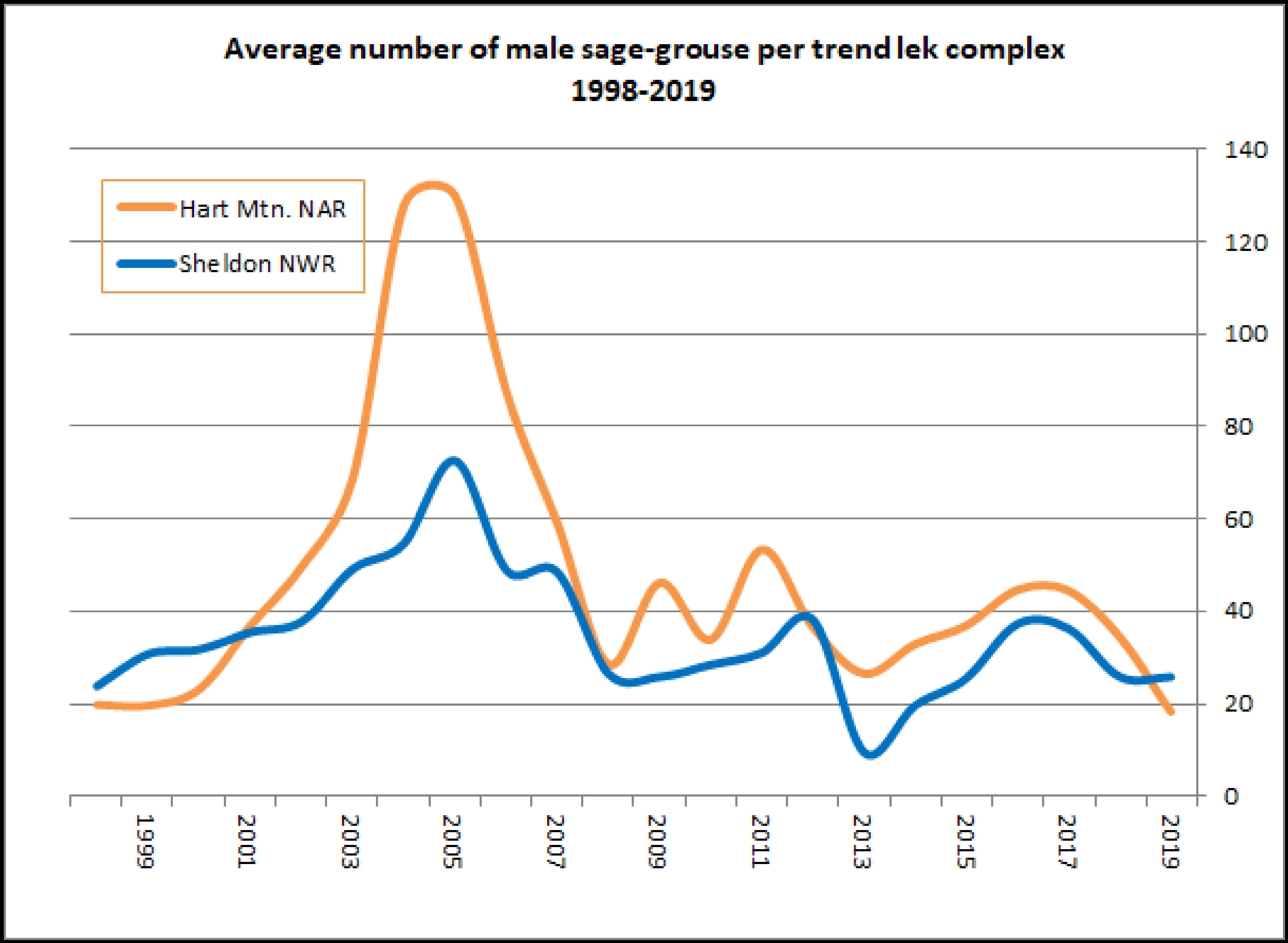
Greater sage-grouse population trend in the **Steens PA**

Bully Creek PAC

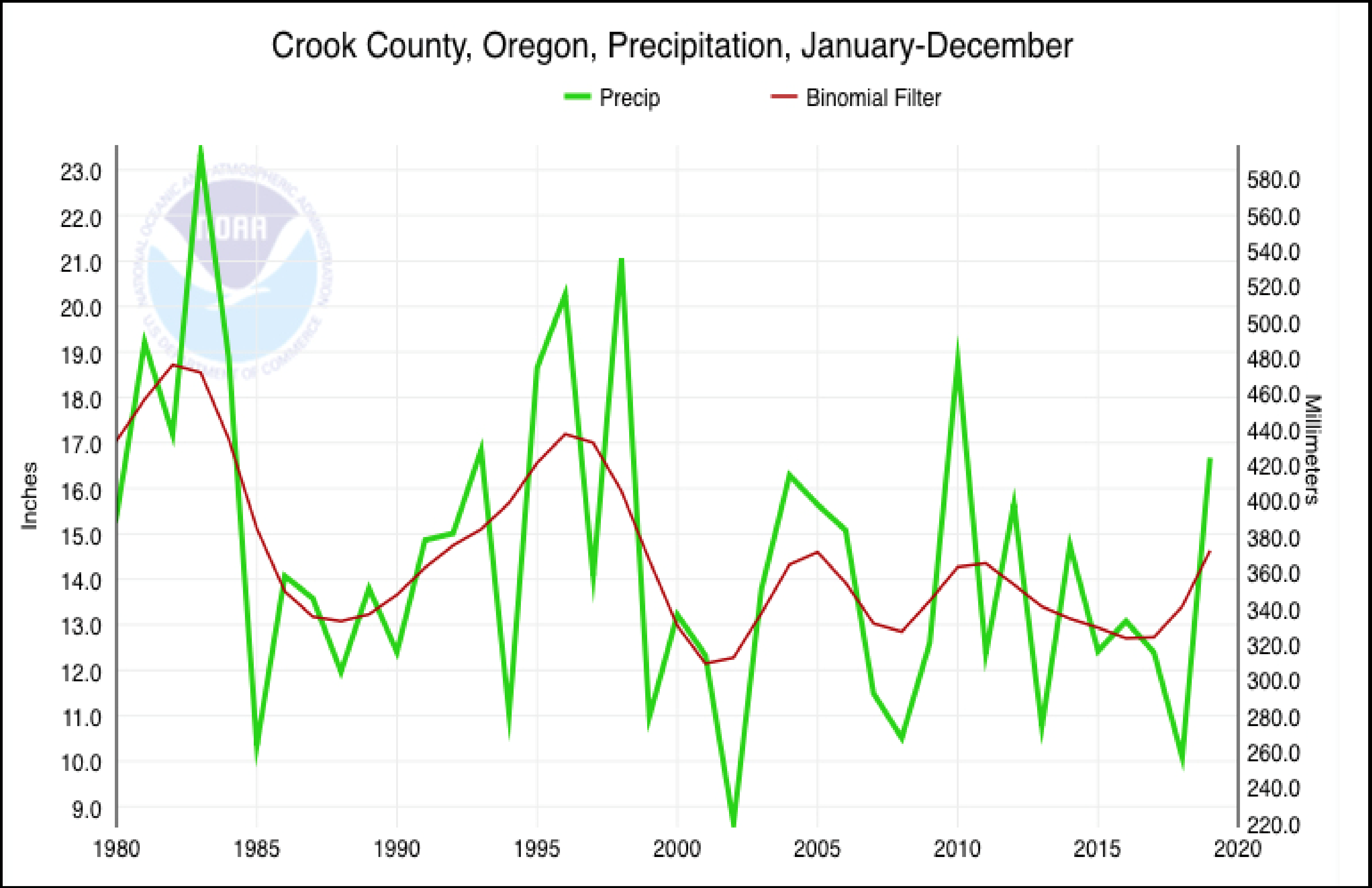


). Greater sage-grouse population trend in the **Bully Creek PA**
plex size (males per active lek). B - Annual rate of change in
e attendance; annual rate of change in male lek complex atten
2018

Hart Mountain Antelope Refuge



Crook Co precip 1980-2019



Correlation is not always causation…
but it can be suggestive.

CDC epidemiologist, Ft. Collins
“suspicious”

What the drop is probably not due to....
What happened after 2004?

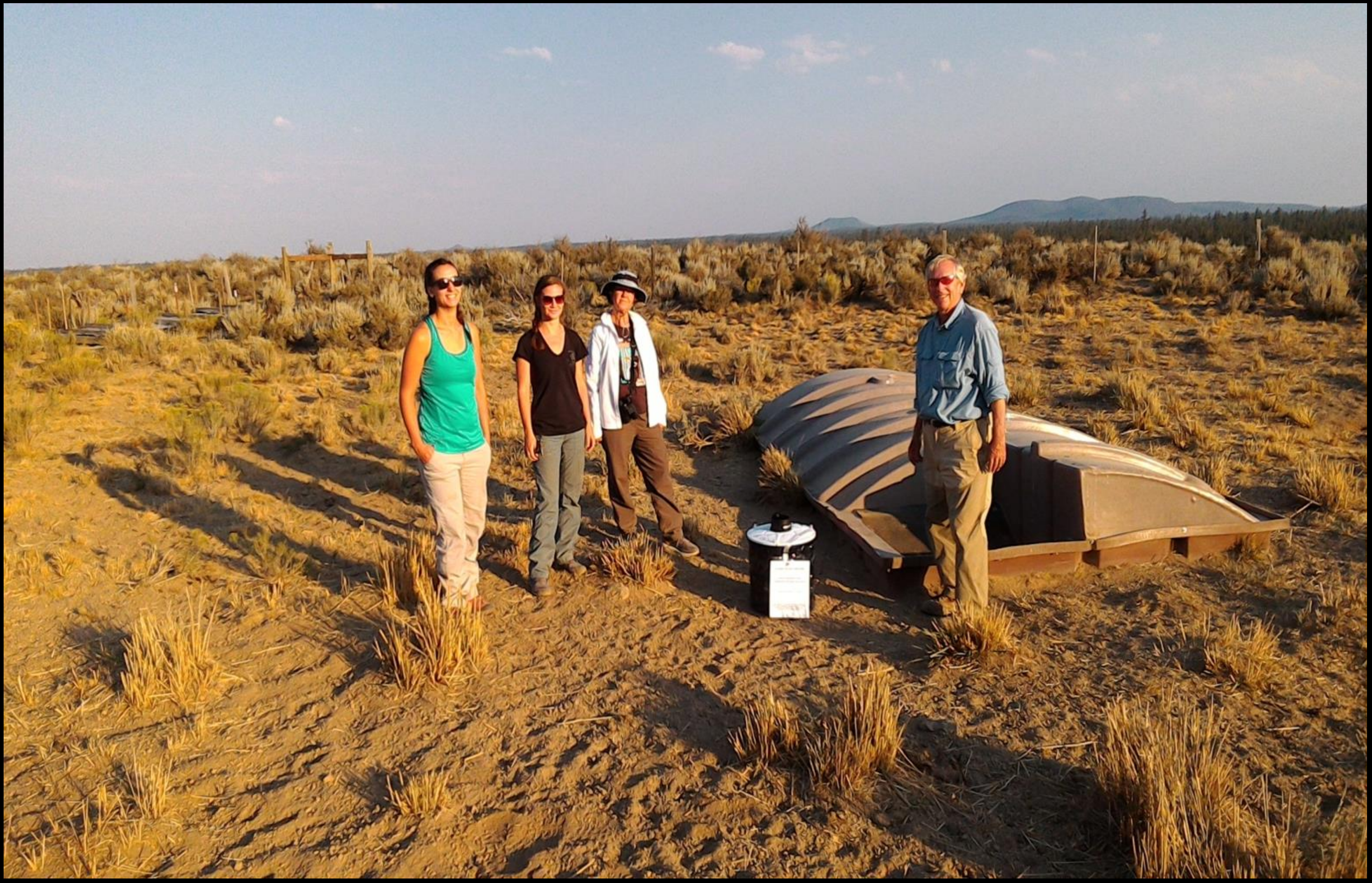
- Juniper increase
- Understory depletion
- Predation
- Hunting
- Roads, power lines, subdivisions, etc

<u>The pattern is what Disease would look like</u>

Avian genetic development of viral resistance

- Dendritic cells
- Natural Killer cells
- Interferon production
- Single nucleotide polymorphisms
- RNA interference
- Toll-like receptors
- Oligoadenylate synthetase activity
- Adaptive T and B cell sustained immune response
- ANPEP (an aminopeptidase)

Agency and ECAS Mosquito Trapping 2017-18 no positives, no WNV in CO in 2018 – Emily W.



BT i studies

BACILLUS THURINGIENSIS SEROVARIETY *ISRAELENSIS* AND *BACILLUS SPHAERICUS* FOR MOSQUITO CONTROL

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KEY WORDS *Bacillus thuringiensis* serovar. *israelensis (Bti)*, *Bacillus sphaericus*, binary toxin, factors affecting efficacy, resistance, mode of action, structure, safety, ecotoxicology, integrated mosquito control

ABSTRACT. Since the discovery of *Bacillus thuringiensis* (Berliner) serovariety *israelensis* de Barjac (*Bti*) and efficacious isolates of *Bacillus sphaericus* Neide, formulations of these bacteria have become the predominant non-chemical means employed for control of mosquito larvae at several locations in the United States and other countries. An overview of developments in the past 20 years is presented in this chapter regarding the toxins of *Bti* and *B. sphaericus*, their modes of action, efficacy and factors that affect larvicidal activity, development of resistance, safety, and their roles in integrated mosquito control. The efficacy of *Bti* formulations has been demonstrated in a variety of habitats against a multitude of species of mosquitoes. *B. sphaericus* formulations have been utilized predominantly in organically enriched habitats against *Culex* species, but they are also active in a variety of habitats having low organic enrichment, against numerous species, and across several genera. *Stegomyia* spp. are not susceptible to practical doses of *B. sphaericus* formulations. *B. sphaericus* has been shown to persist longer than *Bti* in polluted habitats and, under certain circumstances, can recycle in larval cadavers. A disadvantage of *B. sphaericus* has been the development of

Bacillus thuringiensis v. israelensis

Guzzlers/tanks only <u>surface</u> water

Stock tanks

Takeaways

- West Nile virus had a lethal impact
  habitat- wide from 2004 on
- WNV has gone from epidemic to endemic
- Will reappear irregularly
- Should be on everyone's threat list
- 16 years later Grouse are slow to adjust
- Also hits humans
- An effective, safe, and inexpensive larvacide is available

- Bti is sprinkled in standing water and ingested by mosquito larvae. The pH in the larval digestive tract causes the bacteria to release an endotoxin that crystallizes on the spot, forming a tiny obstructing stone that bores a hole in the larval gut.