

## Chronic Wasting Disease & the predator cleansing hypothesis

Slides 2-16: CWD, mountain lions & predator cleansing in Colorado

Slides 18-22: CWD & predator cleansing in wolves in Wisconsin

*Four lines of evidence support the CWD predator cleansing hypothesis*

### 1 - Predator-prey theory & predator-prey population modeling

- Idea & observation that apex predators preferentially target sick prey

### 2 - Negative spatial correlation between CWD prevalence or occurrence & apex predator distribution

#### a. Occurs at multiple spatial scales

- Continental e.g. mountain lions & gray wolves in North America
- State-level e.g. gray wolves in Wisconsin; mountain lions in Colorado
- Deer management unit for gray wolves in Wisconsin

#### b. Correlation (negative or positive) is not causation proof but it is a necessary precondition for causation i.e. correlation is necessary but not sufficient to prove causation.

### 3 - Experimental studies - limited; more research needed

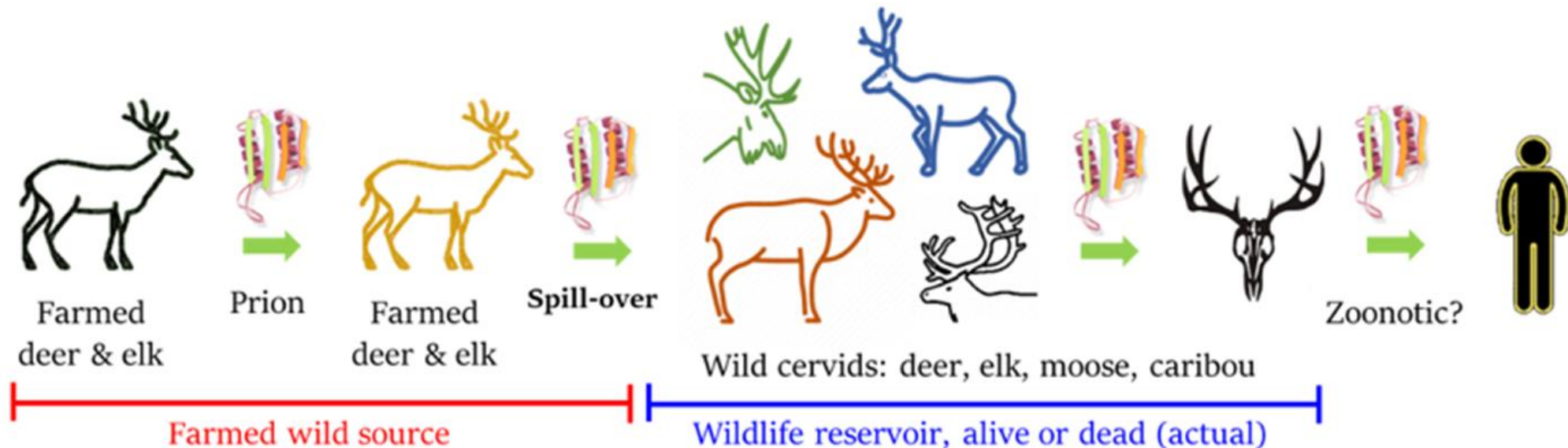
### 4 - Observational field studies - limited; more field research needed



## Chronic Wasting Disease (CWD) in game-farmed & free-ranging wild cervids

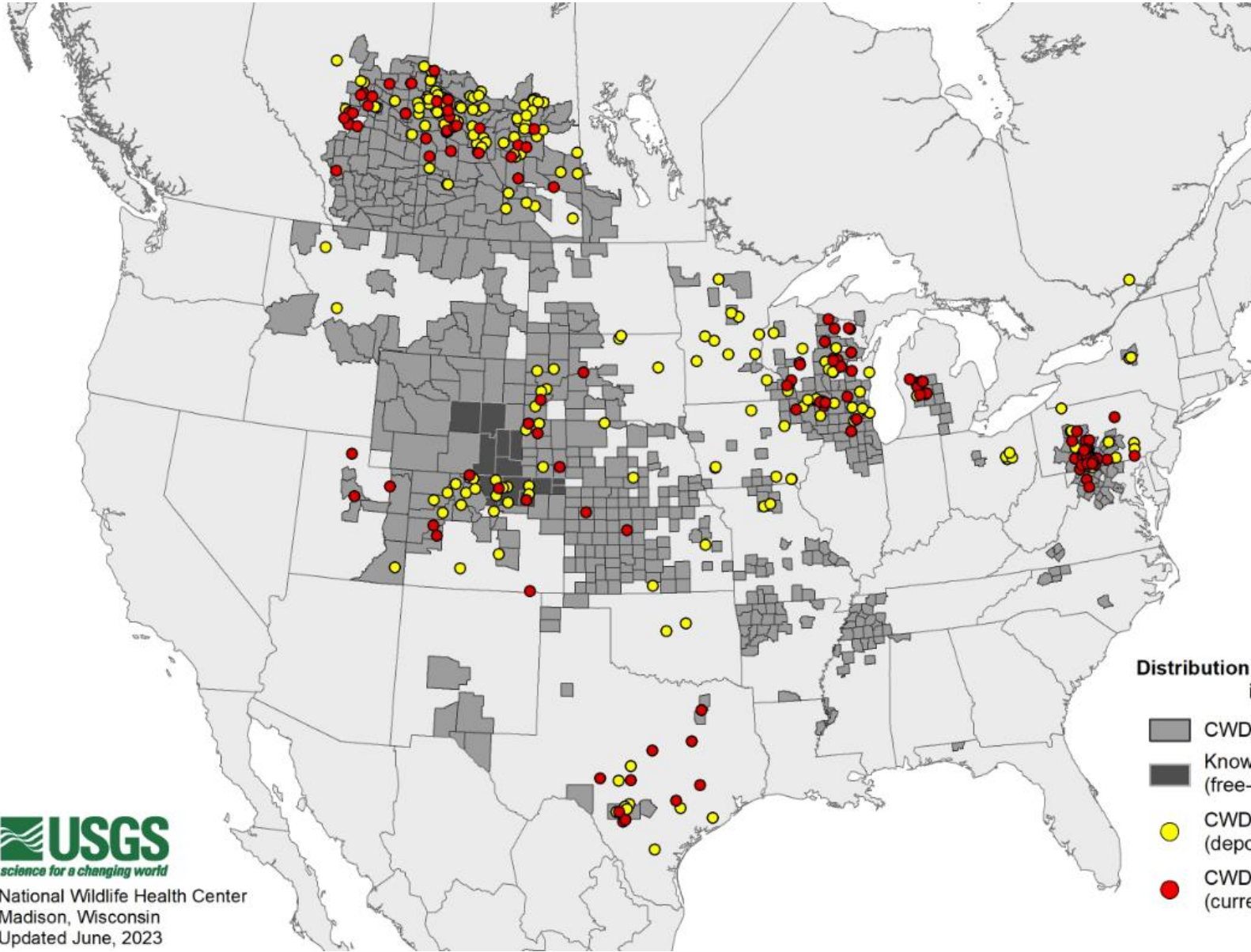
Best evidence suggests that CWD originated in a confined research mule deer herd in ~1967 in Fort Collins, Colorado that then spread (largely anthropogenically) locally, regionally and nationally via:

- (a) *Intra-state and interstate shipments (translocations)* of CWD-infected privately-owned farmed deer and elk (for breeding and hunting) and wild deer and elk translocations by wildlife agencies;
  - (b) *Fence-line infectious contacts* between infected farmed deer and wild free-ranging deer;
  - (c) *Environmental spread* via CWD-contaminated deer carcasses or hunter-translocated infected deer carcasses
  - (d) *Deer and elk bait stations and winter-feeding programs* that artificially congregate deer and elk at high densities and promote CWD spread
- To date, *there are no documented cases of zoonotic CWD infections of humans* from infected deer contact although this may change as the CWD prion protein could mutate to become human-adapted.





# Distribution of Chronic Wasting Disease in North America - June 2023



## Free-ranging cervids

- 31 states
- 410 counties

## Captive cervids

- 18 states

## Canadian provinces

- Alberta
- Saskatchewan
- Manitoba
- Quebec



## Distribution of Chronic Wasting Disease in North America

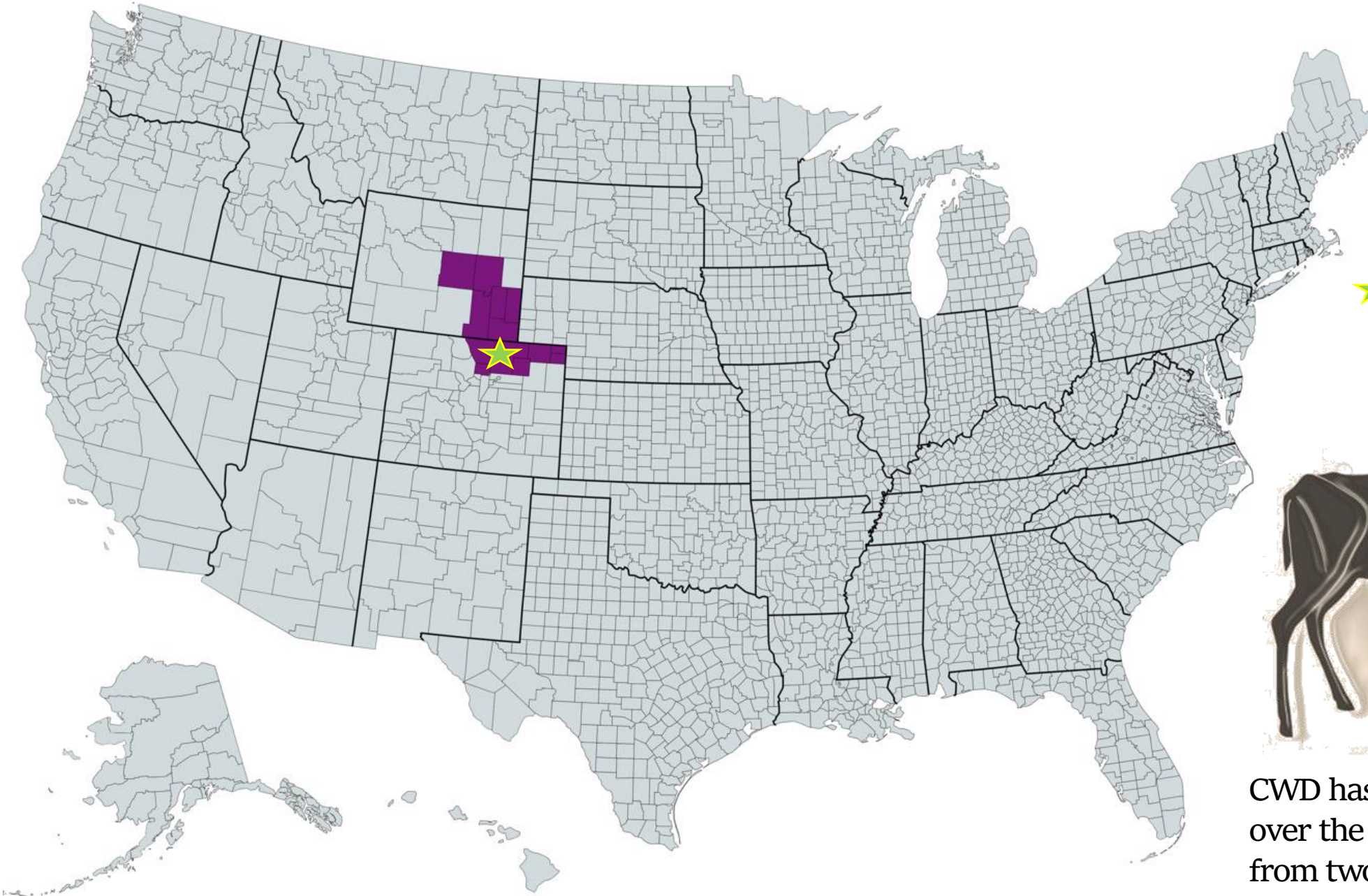
- CWD in free-ranging populations
- Known distribution prior to 2000 (free-ranging)
- CWD in captive facilities (depopulated)
- CWD in captive facilities (current)



National Wildlife Health Center  
Madison, Wisconsin  
Updated June, 2023



# Chronic wasting disease in free-ranging wild cervids (elk, mule deer & white-tailed deer) 1967 to 2000



- 2 states - WY & CO
- 13 counties

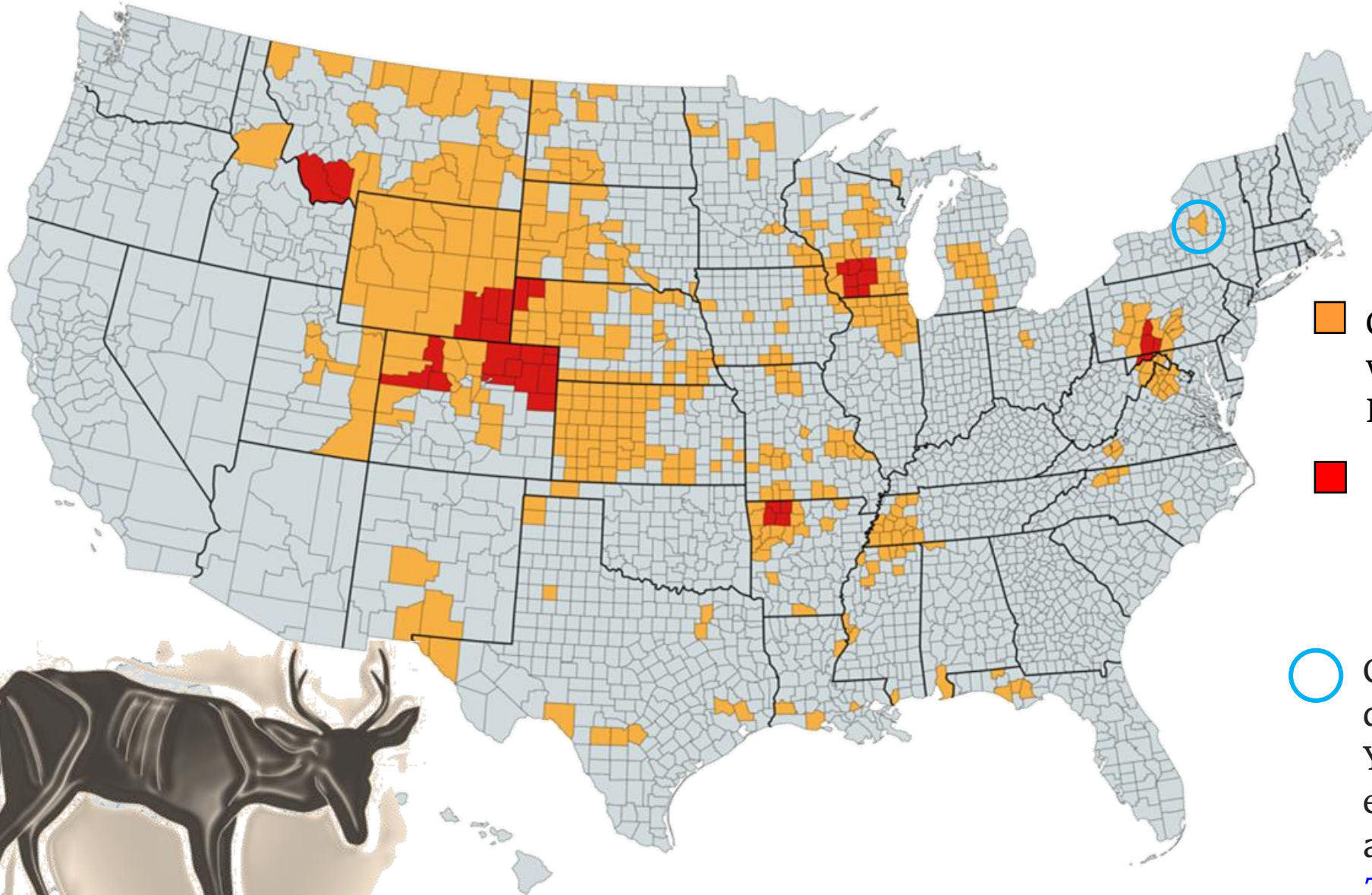
★ CWD first identified in 1967 in a captive mule deer research herd in Fort Collins CO



CWD has spread broadly & rapidly over the past 23 years, expanding from two states to 31 states



# Chronic wasting disease in free-ranging wild cervids (elk, mule deer & white-tailed deer) in 2023



- 31 states
- 410 counties
- 3 Canadian provinces

■ Counties w/ CWD-positive wild cervids 2000-2023. Prevalence usually at <5%

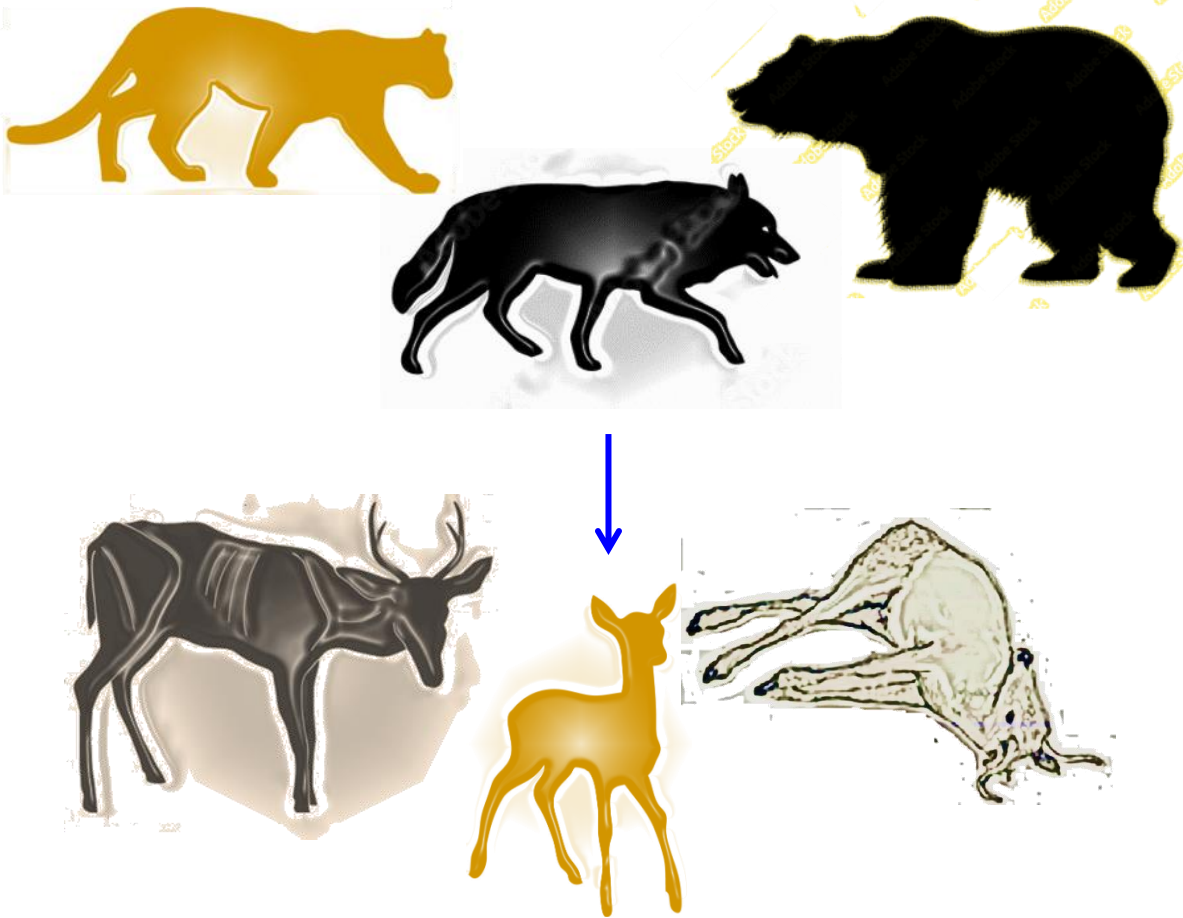
■ Counties w/ CWD-positive wild adult male deer prevalence at 20% or greater in 2022 (“*CWD hot spots*”)

○ CWD found in wild & captive deer in Oneida County, New York in 2005 & successfully eliminated by rapid and aggressive testing and culling  
*This is the only time* CWD has been extirpated from an infected wild cervid population.



## CWD predator cleansing hypothesis vs cervid (deer, elk, moose) hunting

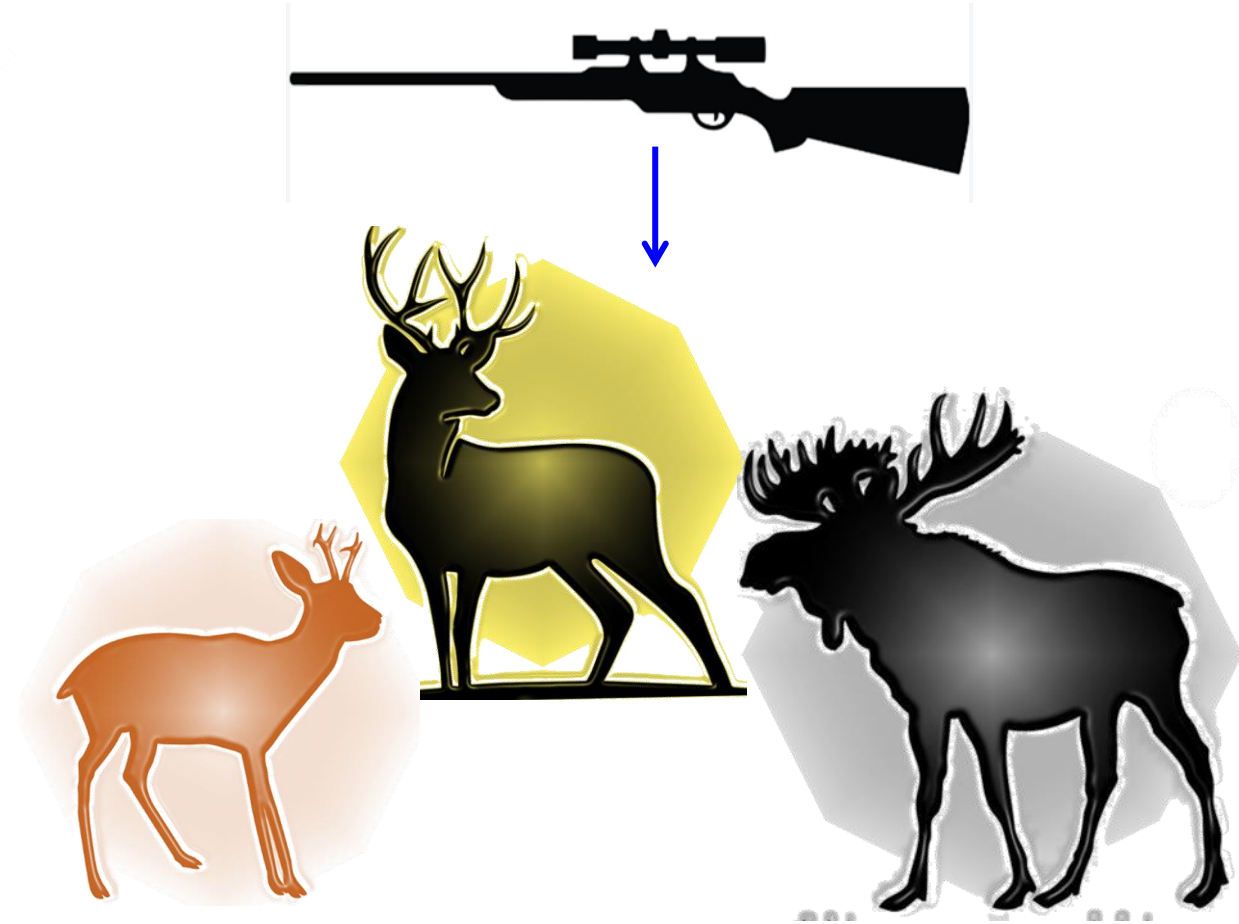
Apex predators – target *sick, weak, injured, very young, very old or otherwise vulnerable deer or elk* that are easiest to kill without injuring the predator



End result - *Healthier* cervid populations

- Survival of the fittest cervids

Hunters – target *healthy young deer* for venison (meat) & *large healthy antlered adult bucks* for trophies; avoid obviously sick deer



End result - *Less healthy* cervid populations

- Death of the fittest cervids



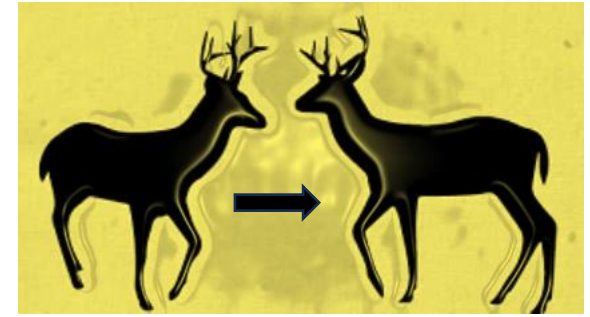
## Predator cleansing appears to operate by two distinct mechanisms

*CWD is spread among deer & elk in two ways:*

- 1 - Live infected deer-to-live uninfected deer by **direct deer-to-deer contact** e.g. mating, grooming, socializing. Bucks infected at double the rate as does.
- 2 - Contaminated environment-to-live deer: **indirect spread** via urine, feces, saliva, decomposing carcasses, soil & plants. The CWD infectious protein (prion) is extremely environmentally stable *likely for years*.

*Apex predators may reduce the probability of both types of CWD transmission:*

- 1 - Apex predators (wolves, bears, cougars, coyotes) target as prey cervids infected with CWD and *thus remove these sick animals as infection sources* for other deer and elk.
- 2 - Passage of CWD-contaminated deer or elk carcasses through the carnivore gastro-intestinal tract reduces the infectious titer (“infectiousness”) of CWD, thus *reducing the CWD environmental load*.

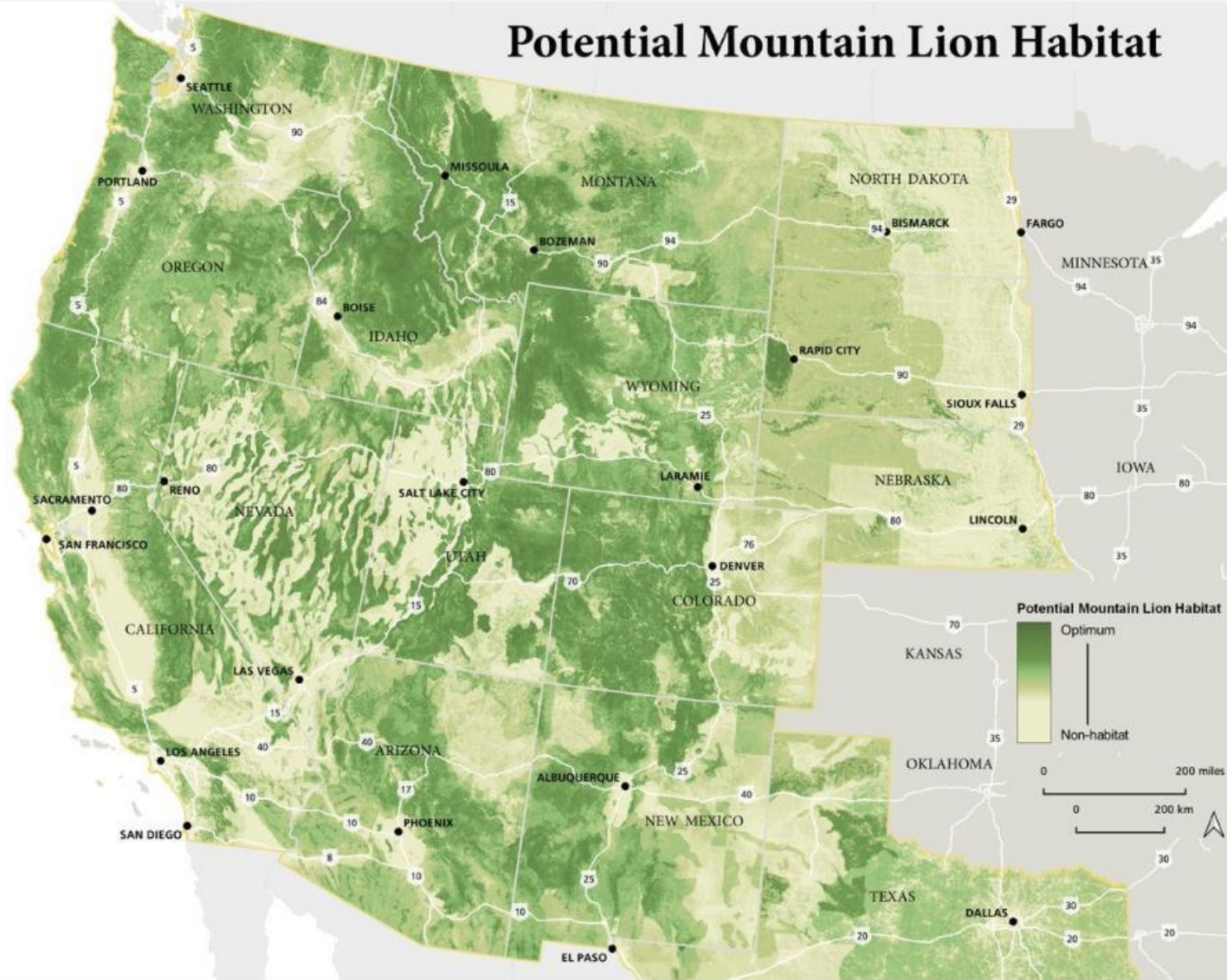


High  
CWD  
intake  
→  
pre-  
digestion



Lower  
CWD  
output  
post-  
digestion

# Potential Mountain Lion Habitat



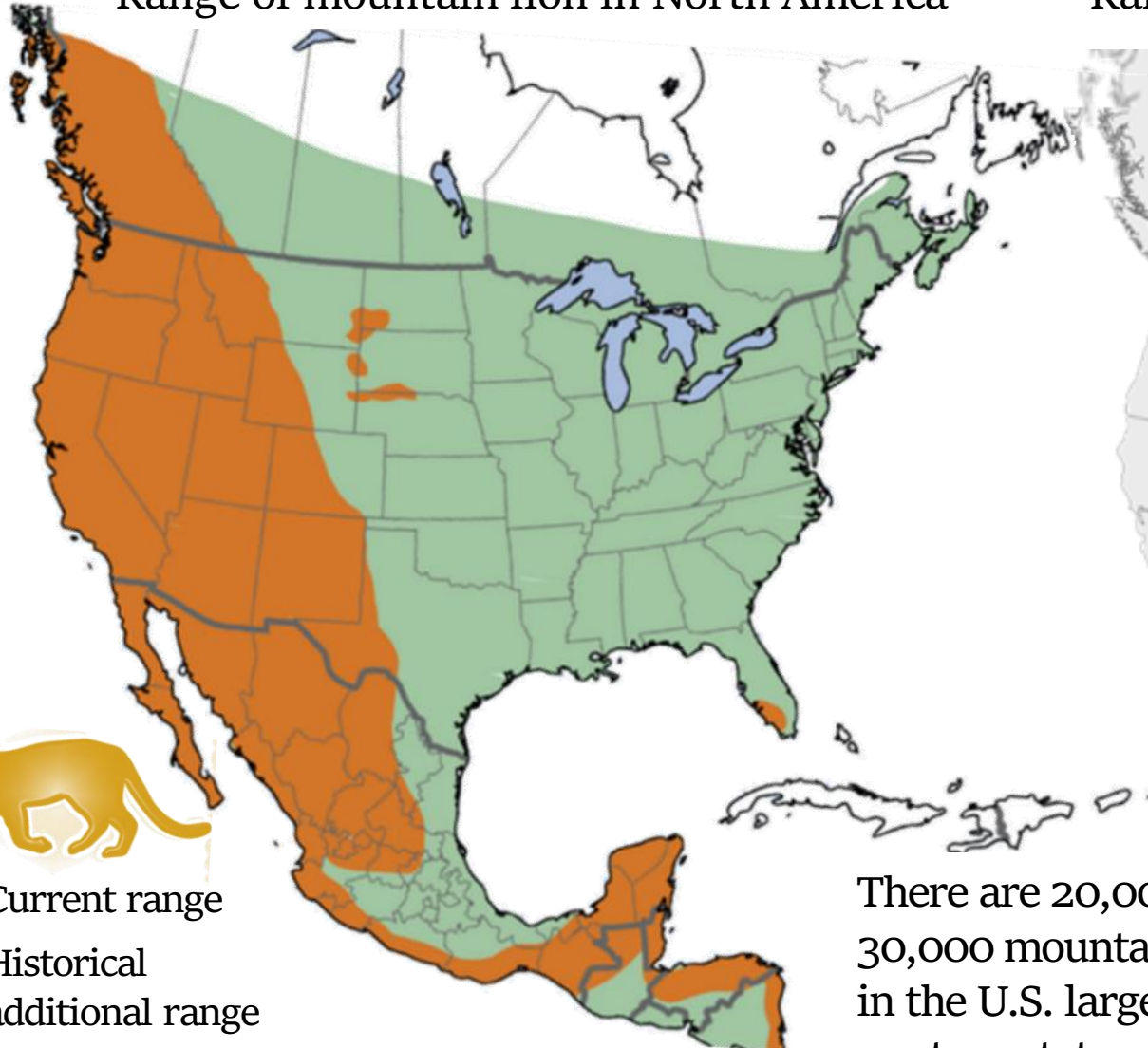
<https://mapsontheweb.zoom-maps.com/post/668038228777091072/potential-mountain-lion-habitat-in-the-western-us>



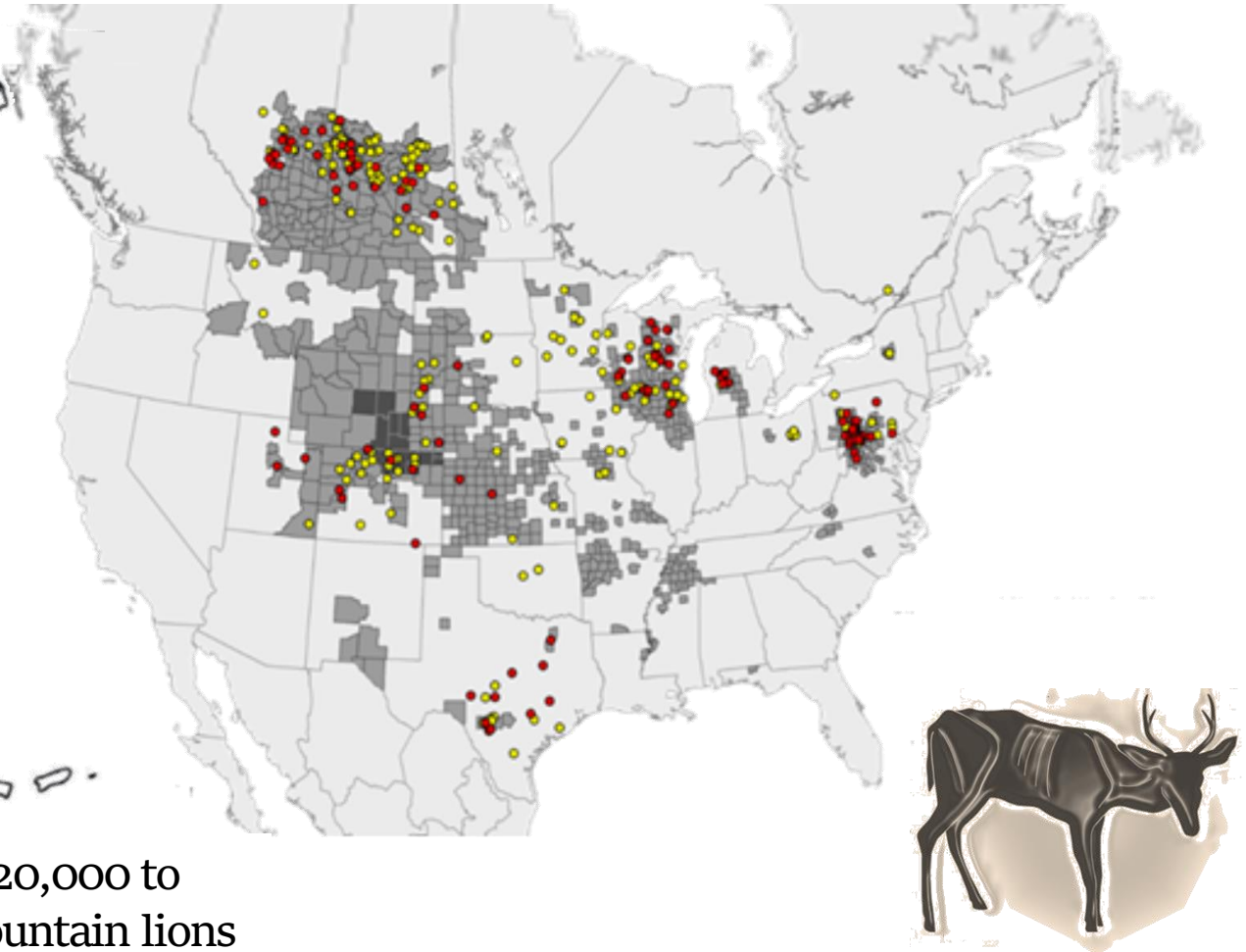
## Negative spatial correlation between mountain lion range & CWD occurrence in North America

- Observation: Areas with a mountain populations tend to have a low CWD prevalence & vice versa

Range of mountain lion in North America

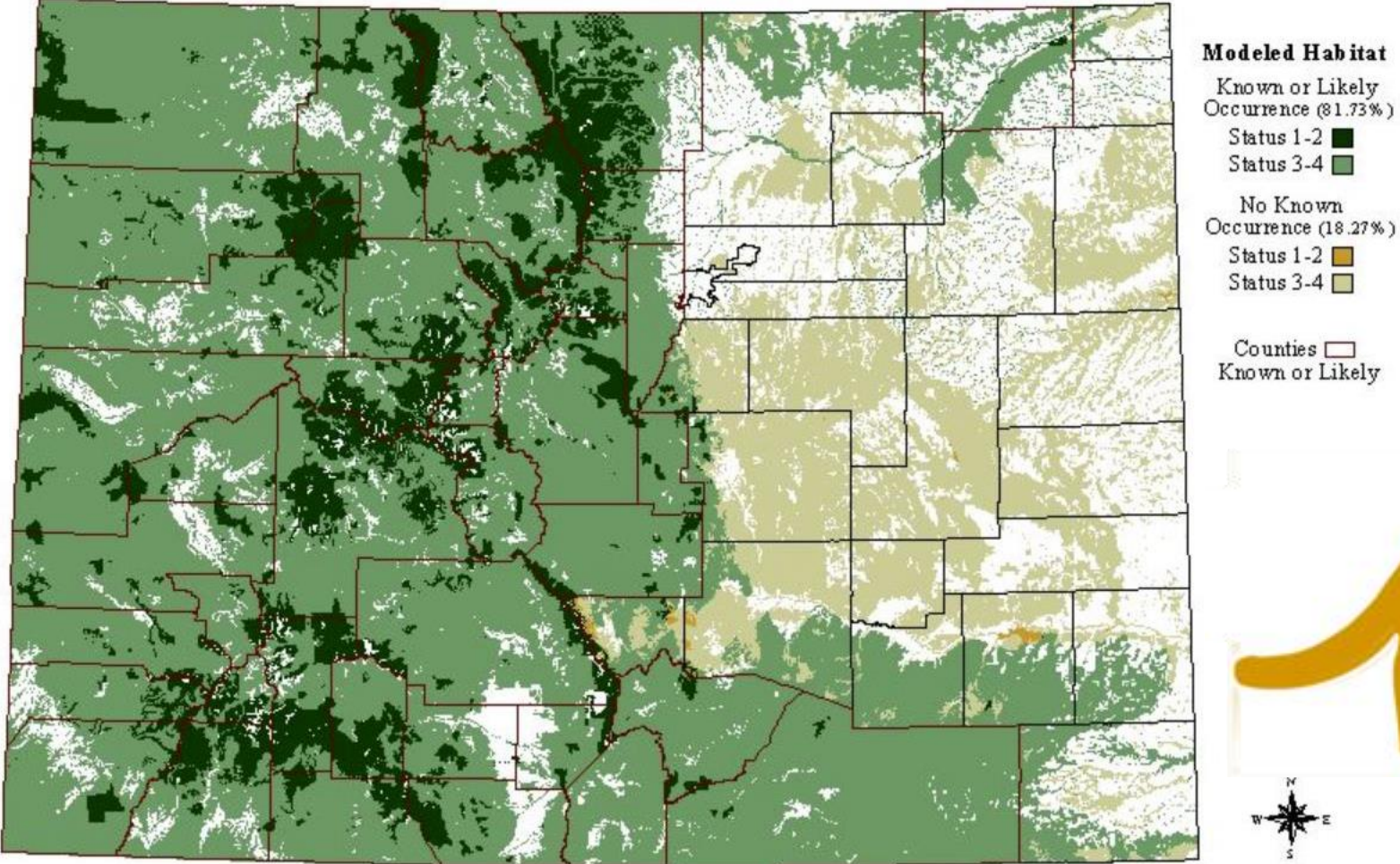


Range of CWD in wild & captive cervids in North America



Mountain lion habitat occurs in 82% of Colorado

Mountain Lion (*Felis concolor*)

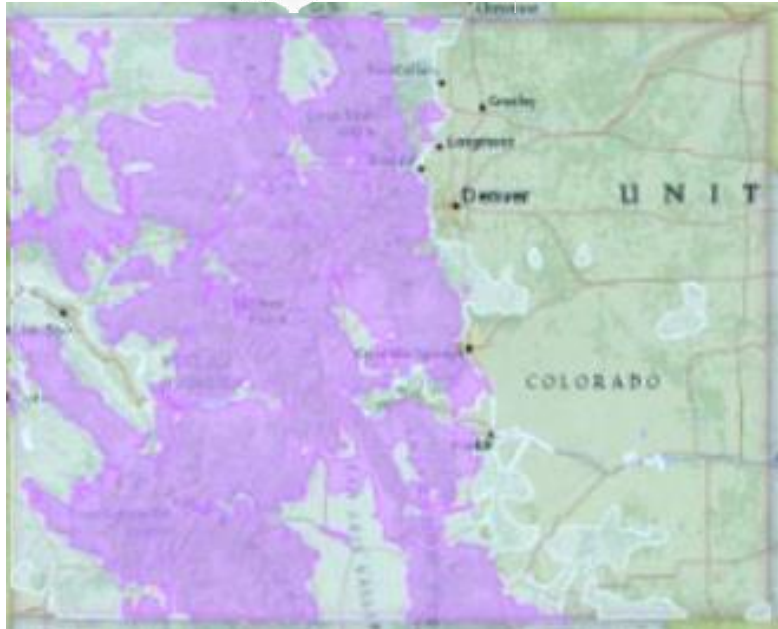
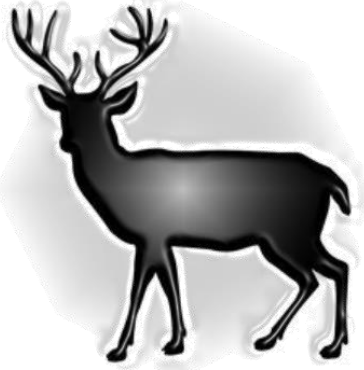


An estimated 3,000 to 7,000 mountain lions inhabit Colorado, perhaps more than any other state





## Elk, mule deer & white-tail deer populations in Colorado, 2022



Elk distribution & habitat in Colorado. With an estimated 280,000 animals, Colorado has the largest elk population in the world.



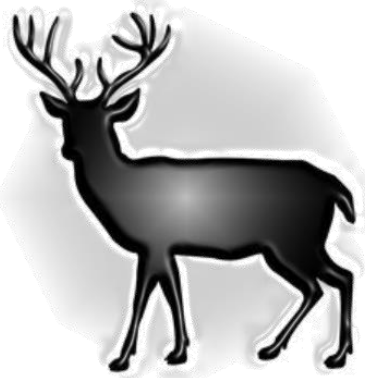
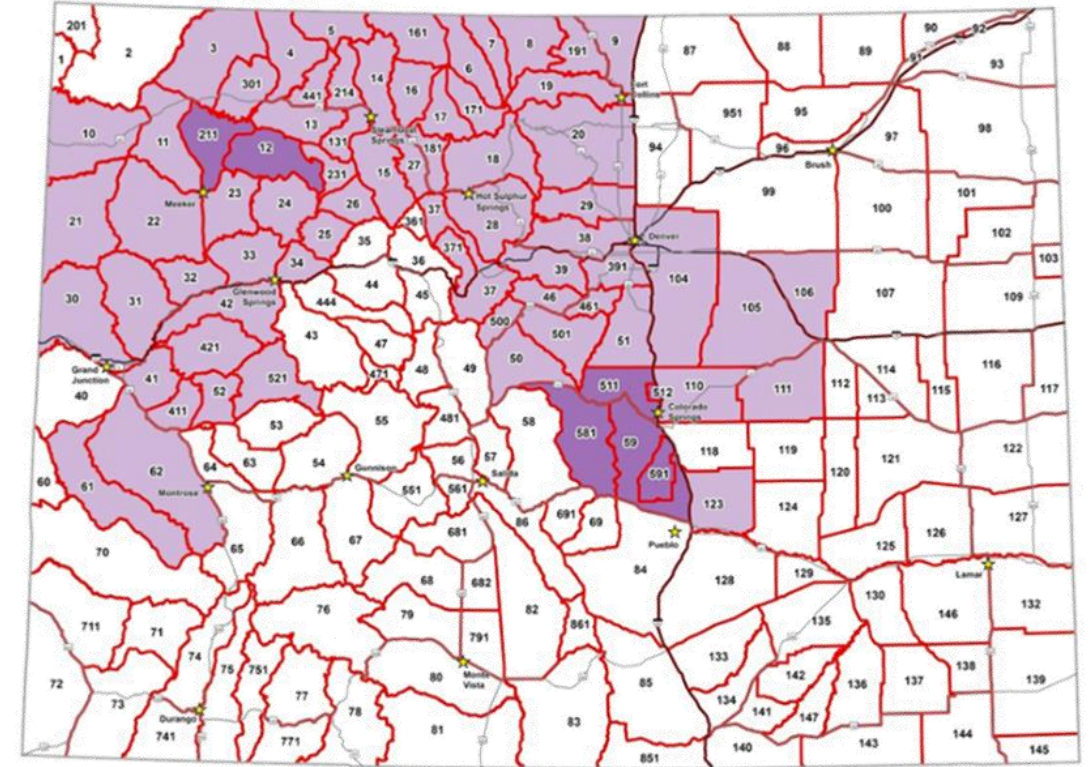
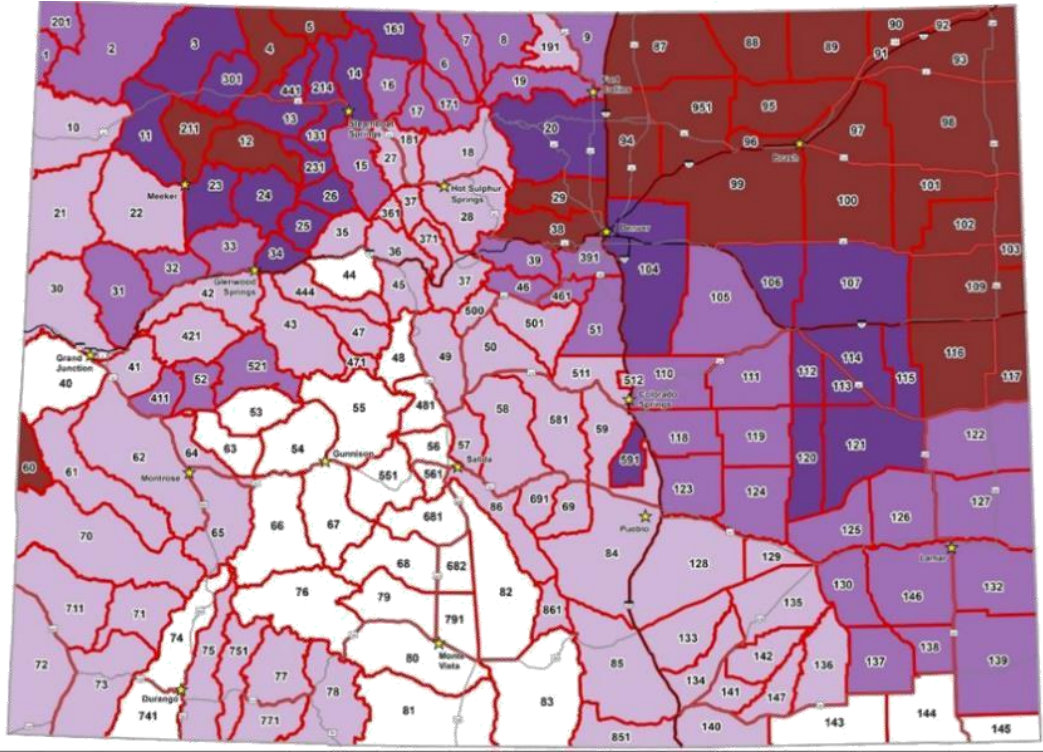
Mule deer distribution & habitat in Colorado. There are an estimated 450,000 mule deer in the state.








White-tail deer distribution & habitat in Colorado. There are an estimated 125,000 white-tail deer in the state.



# CWD infection prevalence for hunter harvested deer & elk in Colorado, 2017-2021



Detected CWD in  
harvested adult  
deer bucks

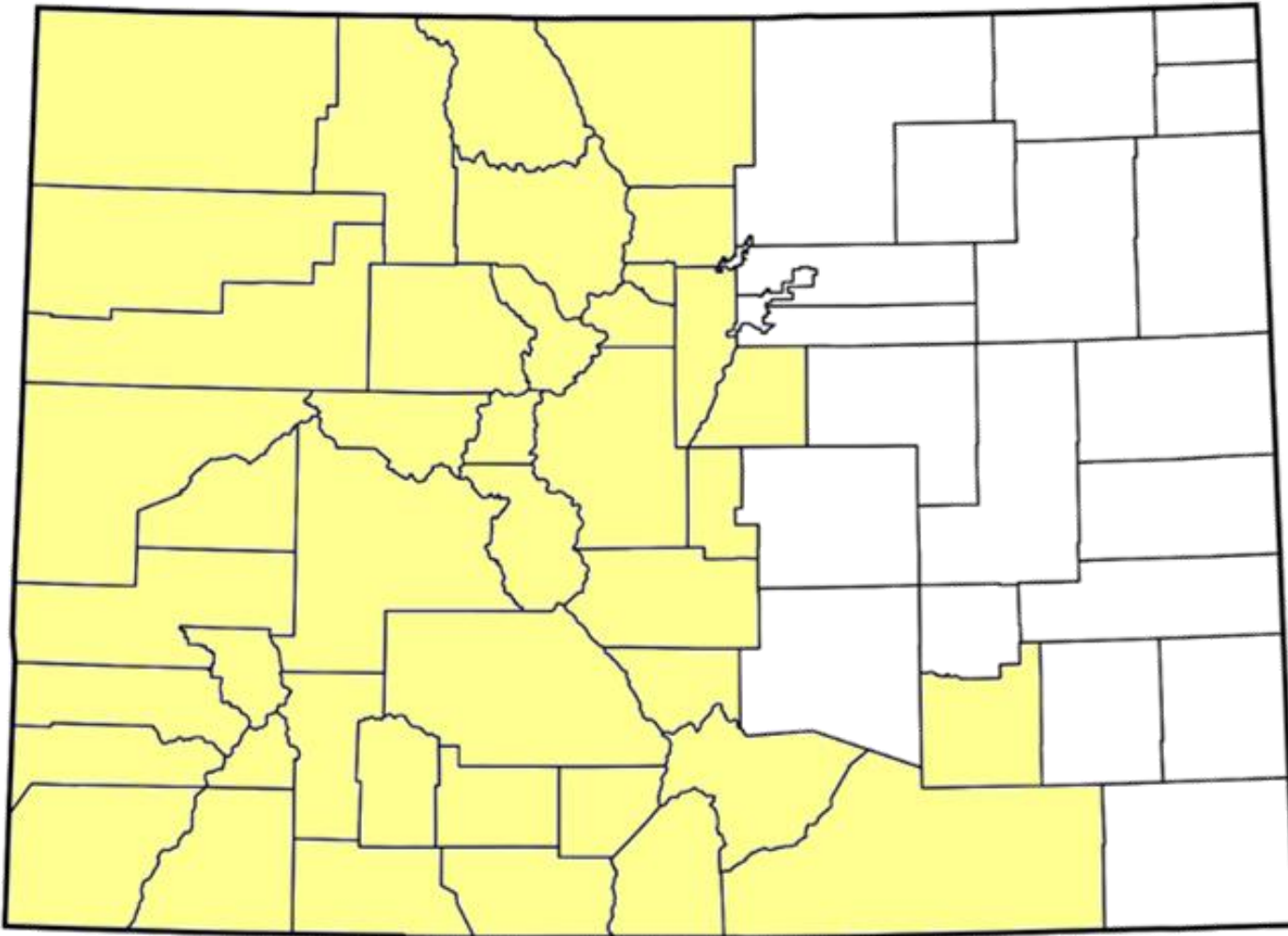
-  Not detected
-  Detected under 5%
-  Detected 5-10%
-  Detected >10%
-  Detected >20%

Detected CWD in  
harvested adult &  
yearling elk





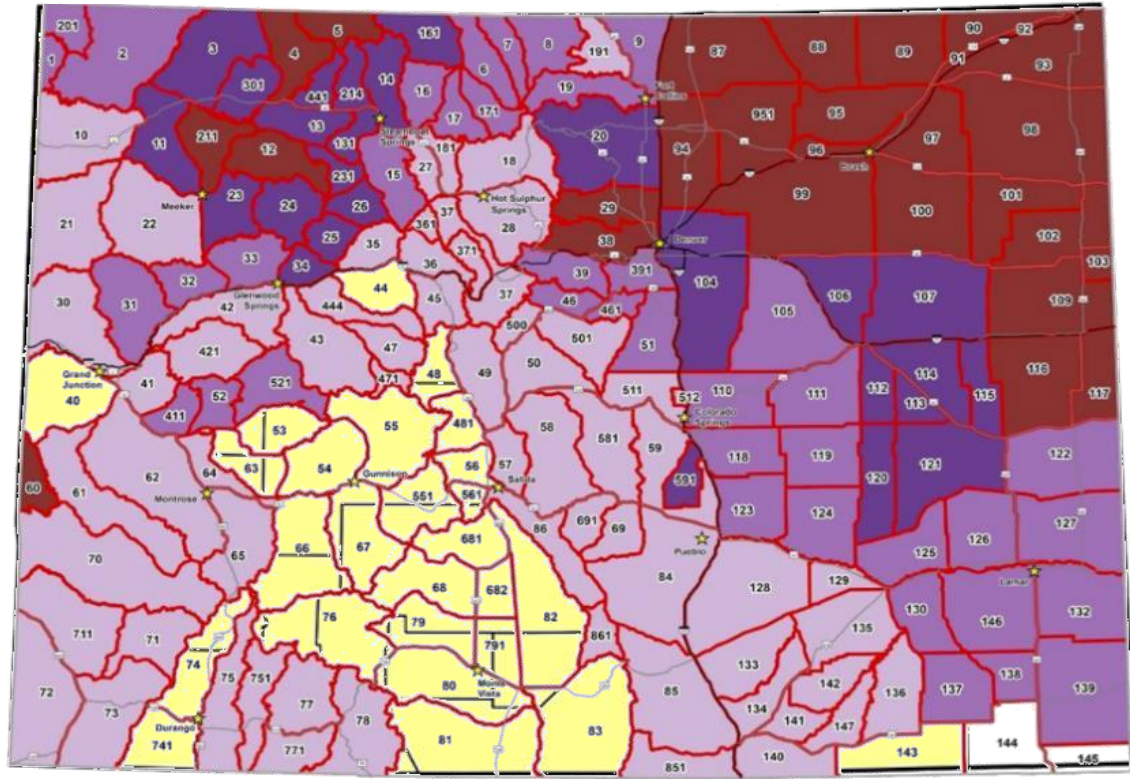
## Approximate range of mountain lions in Colorado counties



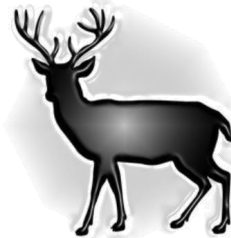
- There are 3,000 to 7,000 mountain lions in Colorado, perhaps more than in any other state
- About 500 mountain lions are killed each year by trophy hunters in Colorado

## Mountain lions in south-central & south-western CO could provide “predator cleansing” eco-services

- Predator buffer to keep these areas CWD-free in elk and mule deer or at least slow CWD geo-spread
- Mountain lion disease control benefits even though CWD is prevalent in elk & esp deer in much of CO

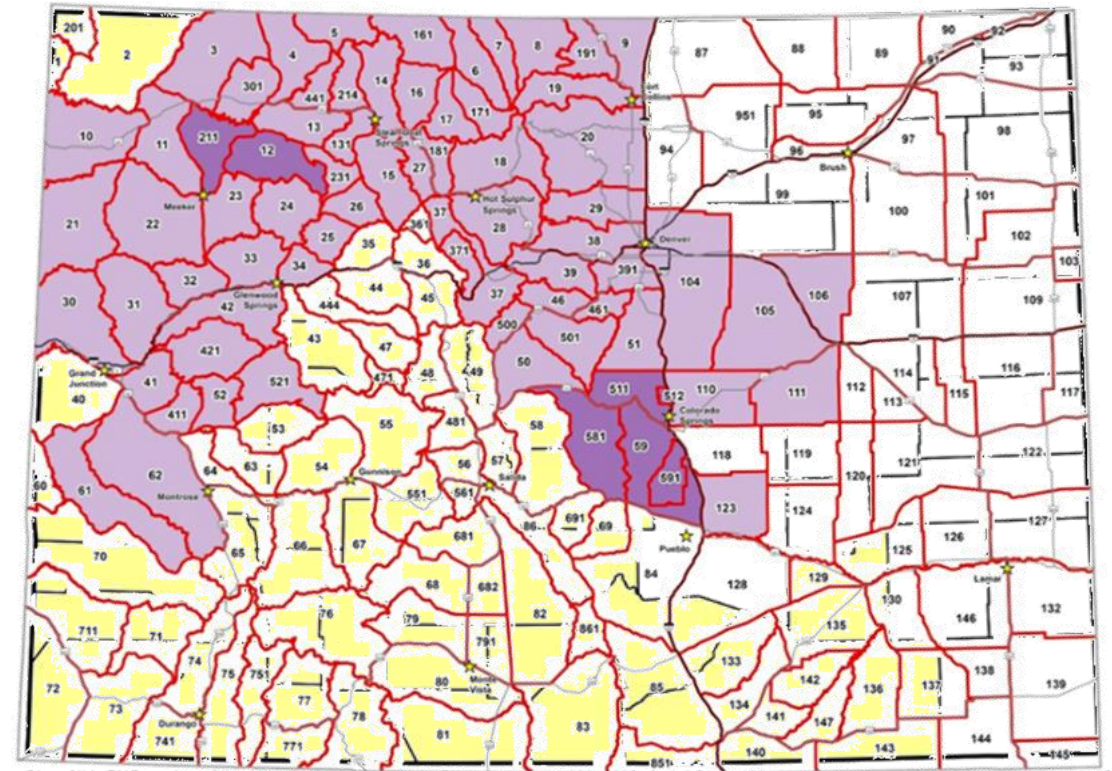


Areas in Yellow represent mountain lion habitats overlapping with mule deer range that are currently test-negative for deer CWD



CWD prevalence 2017-2021

□ Not detected    □ Detected under 5%    □ Detected 5-10%    □ Detected >10%    □ Detected >20%







Areas in Yellow represent mountain lion habitats overlapping with elk range that are currently test-negative for elk CWD





## Estimated apex predator & prey numbers in Colorado, 2021-2022

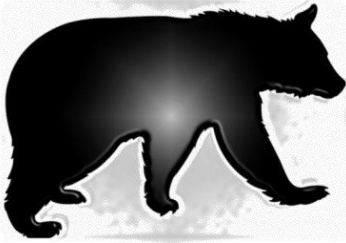




- Mountain lions kills about 156,000 deer per year in Colorado, far more than any other predator
- Many adult cervids killed by mountain lions were likely CWD-infected depending on where they were killed

<i>Prey species</i>		<i>Annual no. killed by human activities:</i>				<i>Annual no. killed by apex predators:</i>				
<i>Cervid</i>	<i>Population</i>	<i>No. of licensed hunters</i>	<i>Hunter or trapper kills</i>	<i>Vehicle collisions</i>	<i>Poached *</i>	<i>35K black bears</i>	<i>3K adult mountain lions</i>	<i>60K coyotes</i>	<i>12K bob-cats</i>	<i>150 lynx</i>
Elk 	280,000	250,000 (15% hunter success)	36,709 (13.1% of population harvested)	630	1,200	50-100 yr (0.002 elk per bear / yr)	200-300 (0.05 elk per lion per yr)	0	0	0
Mule deer 	400,000 to 500,000 (avg 450,000)	84,000 (19% hunter success)	25,000 (5.6% of population harvested)	1,265	1,000	500 to 1000 per yr (most fawns)	156,000 (1 deer per week per adult lion)	50-100 (1.5 calves per yr)	5-10	36 (?)
White tail deer 	100,000 to 150,000 (avg 125,000)	100,000 (30% hunter success)	30,000 (20% of population harvested)	2,885	800	100 to 200 per yr (most fawns)	400 (0.1 deer per lion per yr)	100-200 (0.03 deer per coyote)	10-20	36 (?)
Moose 	3,000	589 (4% hunter success)	16 bulls; 7 cows (0.8% of population harvested)	123	13	0 (?)	10-20 per yr	0 (?)	0	0

\* Likely a large underestimate

## Estimated apex predator & prey numbers in Colorado, 2021-2022

- Killing of these five apex predators, by humans, especially cougars, is likely counter-productive in the fight against CWD
- Cougars are only CO apex predator that primarily kills adult deer most likely to be CWD-infected.

<i>Predator species</i>		<i>No. killed by human activity</i>				
<i>Predators</i>	<i>Colorado population</i>	<i>licensed hunters</i>	<i>hunters or trappers</i>	<i>vehicle collisions</i>	<i>poached<sup>1</sup></i>	<i>USDA Wildlife Services<sup>2</sup></i>
	Black bears 30,000-40,000 (avg 35,000)	17,000 (12% hunter success)	2,000 (6% of population harvested)	60	25	64
	Mountain lions 3,000 to 5,000 (avg 4,000)	5,000 (10% hunter success)	486 (11% of population harvested)	30	10	12
	Coyotes 60,000	12,000 (86% hunter success)	10,300 (17% of population harvested)	200	50	1,581
	Bobcat 12,000	7,000 (28% hunter success)	1,978 (16% of population harvested)	10	10	2
	Lynx 150-200	0 (illegal)	0	5	2	0

<sup>1</sup> Likely large underestimate

<sup>2</sup> Nuisance or dangerous animals



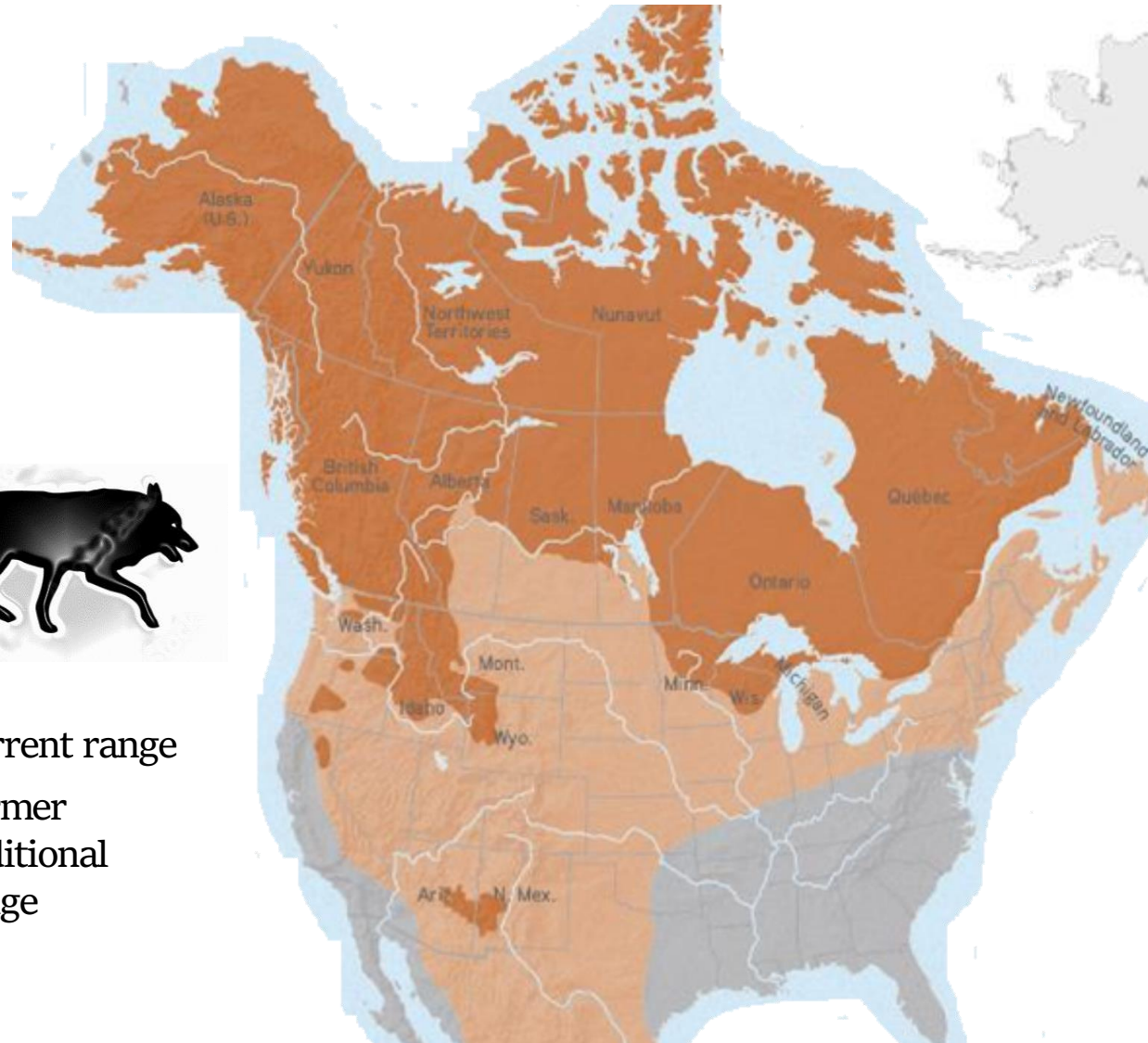
## Chronic Wasting Disease & predator cleansing hypothesis outside of Colorado

- Slides 18 to 26
- Wolves & Wisconsin emphasis

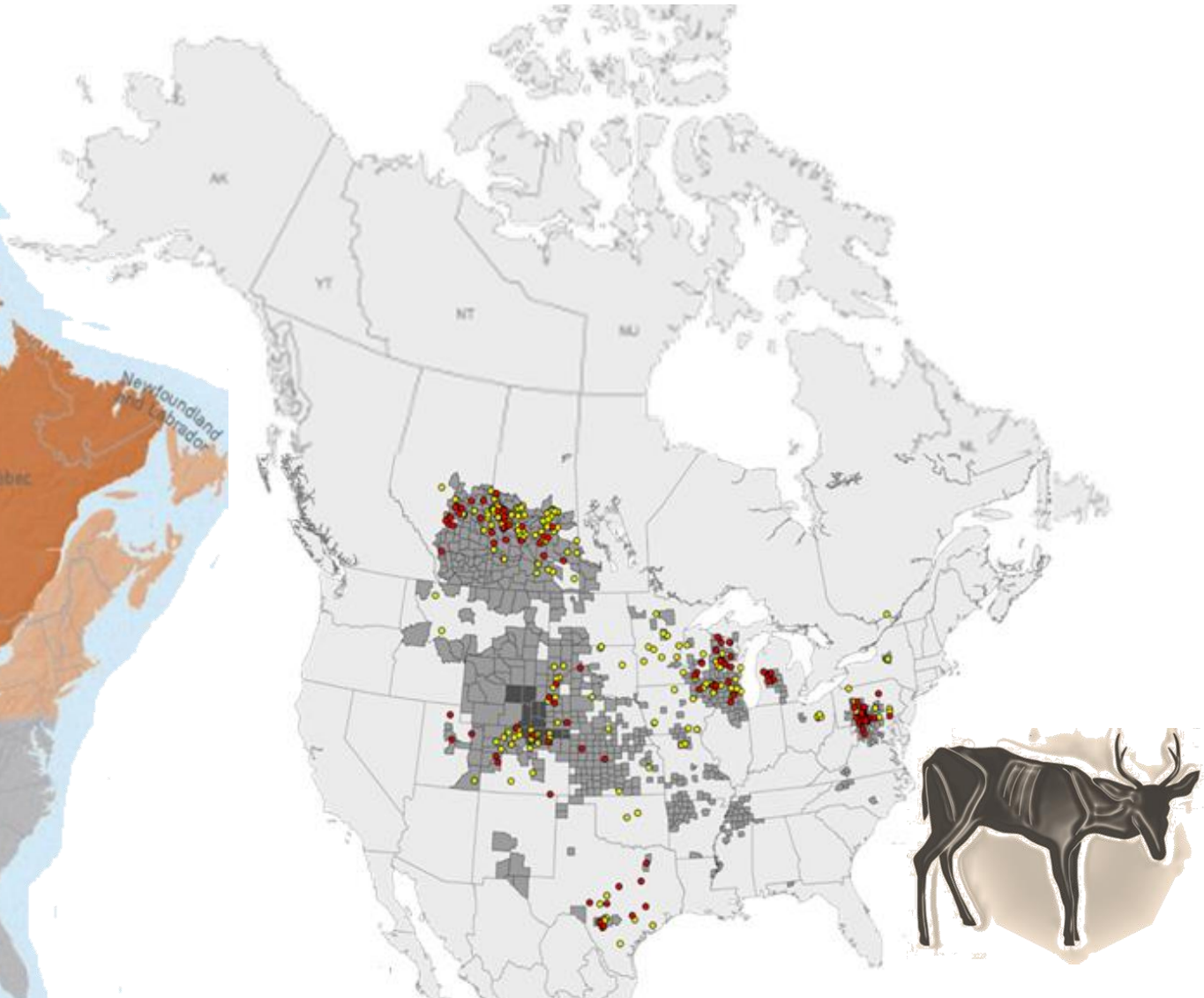
## Negative spatial correlation between gray wolf range & CWD occurrence in North America

- Areas with a high wolf population tend to have a low CWD prevalence & vice versa

*Range of Gray Wolf in North America*



*Range of CWD in North America cervids*





# Co-distribution of CWD in free-ranging cervids & gray wolves in lower 48 United States

- With the exception of southwestern MT, CWD prevalence is 0 or very low (<<1%) in most U.S. counties w/ wolves

15 CWD cases in central Idaho in 2021-2022

Northern Rocky Mountain (n~2700) & Pacific Northwest (n~400) Gray Wolves

Eight CWD-POS deer in northern Minnesota from 2010-2023

Western Great Lakes Gray Wolf (n~3700)

One CWD-POS deer in UP MI 2018



Counties w/ CWD-positive wild cervids 2000-2023. Prevalence usually at <5%

Counties w/ CWD-positive wild adult male deer prevalence at 20% or greater in 2022 (“CWD hot spots”)



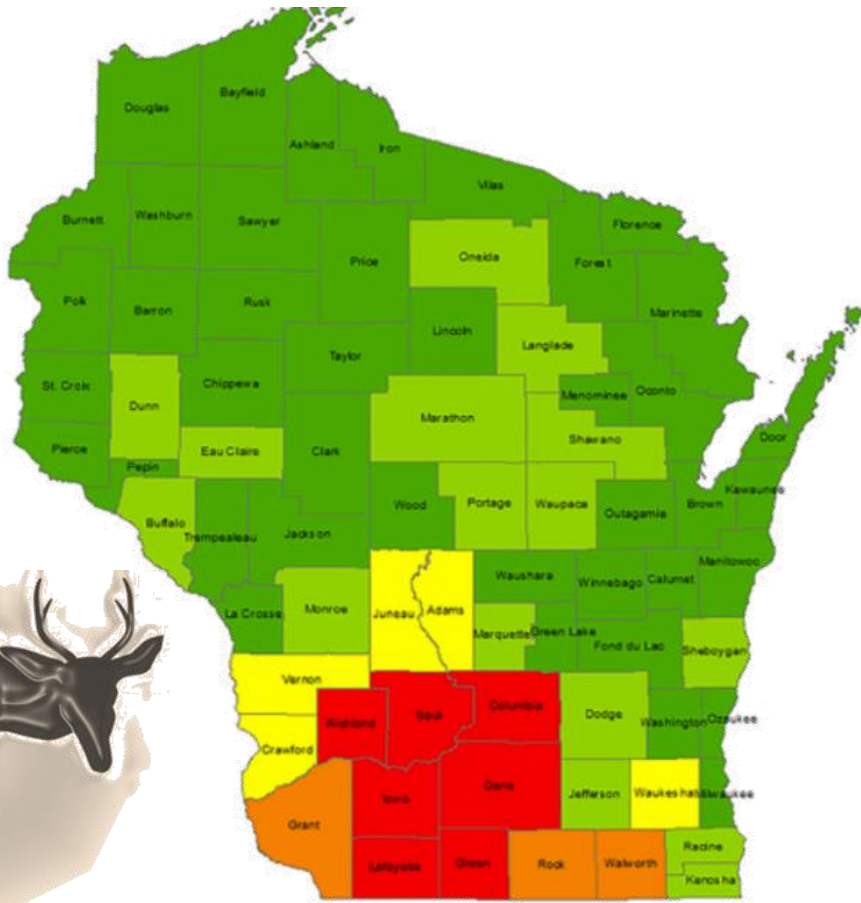
Current range of free ranging wolf populations in lower 48 United States

One CWD-POS deer in Grand Teton NP in 2022

Mexican Gray Wolf (n~240)

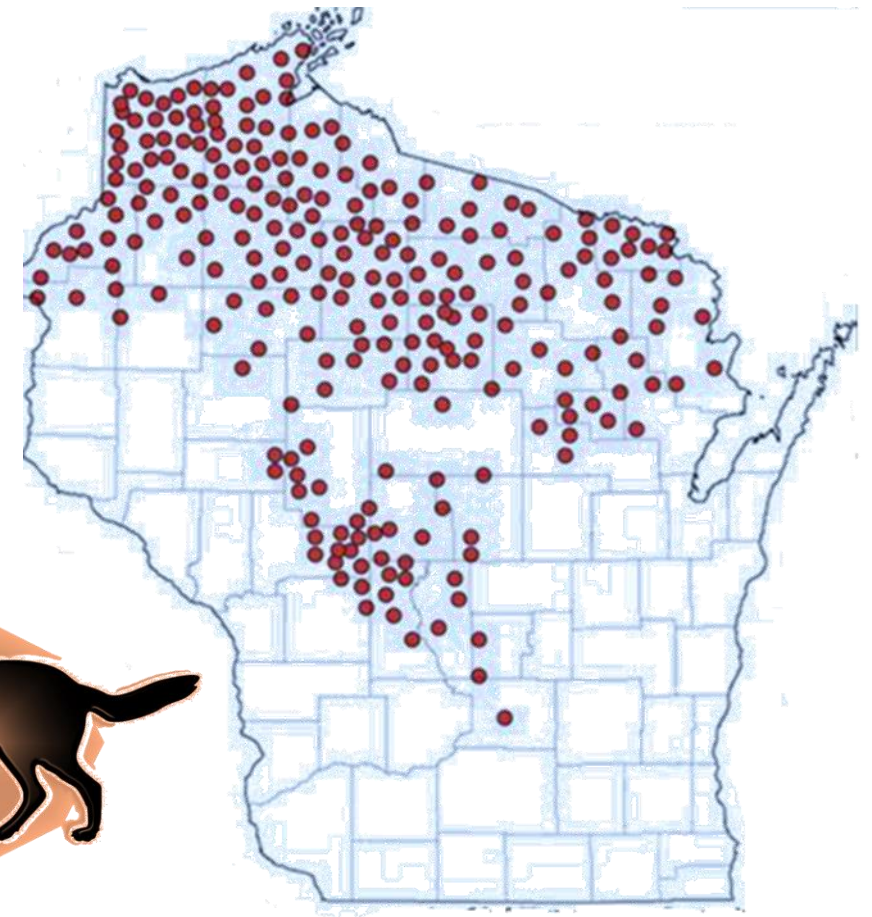
# Predator cleansing? Negative spatial correlation between wolves & CWD prevalence in Wisconsin

Wisconsin has about 1.6 million white-tail deer



Based on CWD testing of hunter-killed deer in 2022, disease rates are near or above 20% in seven Wisconsin counties (red), 10% to 19.4% in three counties (orange), 5% to 9.9% in five counties (yellow), less than 5% in 16 counties (light-green) and “not found” in 41 counties (dark green).

[https://www.antigojournal.com/sports/outdoors/wisconsin-finds-cwd-in-record-31-counties-curing-2022-deer-hunts/article\\_7aa4e232-b126-11ed-89e1-871a9coaoc6d.html](https://www.antigojournal.com/sports/outdoors/wisconsin-finds-cwd-in-record-31-counties-curing-2022-deer-hunts/article_7aa4e232-b126-11ed-89e1-871a9coaoc6d.html)



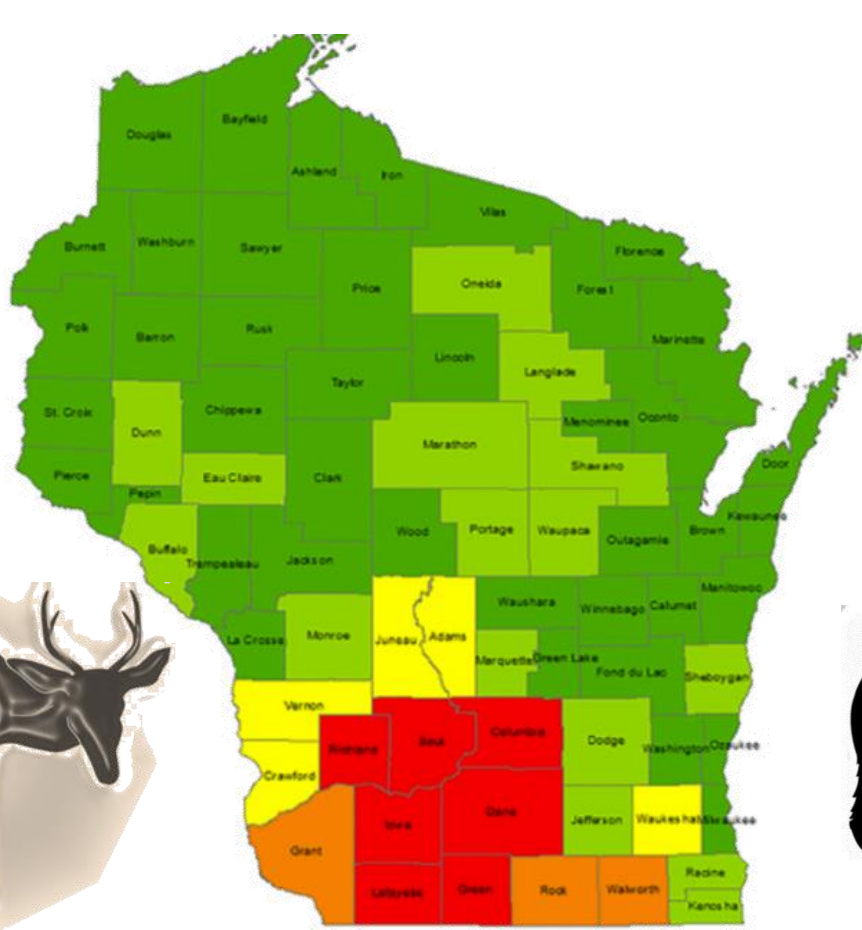
Known Wisconsin gray wolf packs detected in 2020, estimated 292 packs, average pack size 3.8 wolves (~1034 wolves). Wolf trophy hunting was, until recently, permitted in WI.

[https://www.reddit.com/r/wisconsin/comments/psla17/wisconsin\\_wolf\\_pack\\_map/](https://www.reddit.com/r/wisconsin/comments/psla17/wisconsin_wolf_pack_map/)

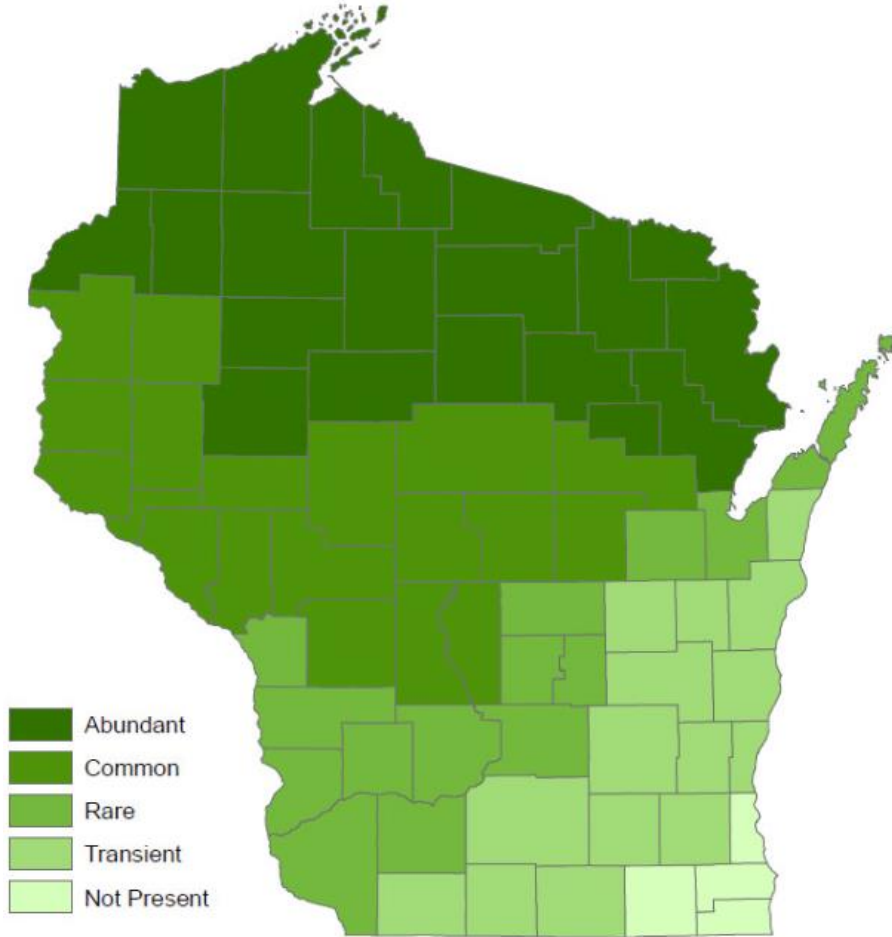
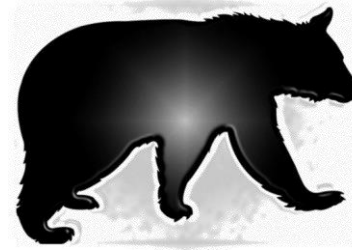


# Predator cleansing? Negative spatial correlation between black bears & CWD prevalence in Wisconsin

Wisconsin has about 1.6 million white-tail deer



Wolves prey mostly on adult deer. Black bears prey mostly on fawns. Thus, wolves are likely much more important to control CWD than bears.



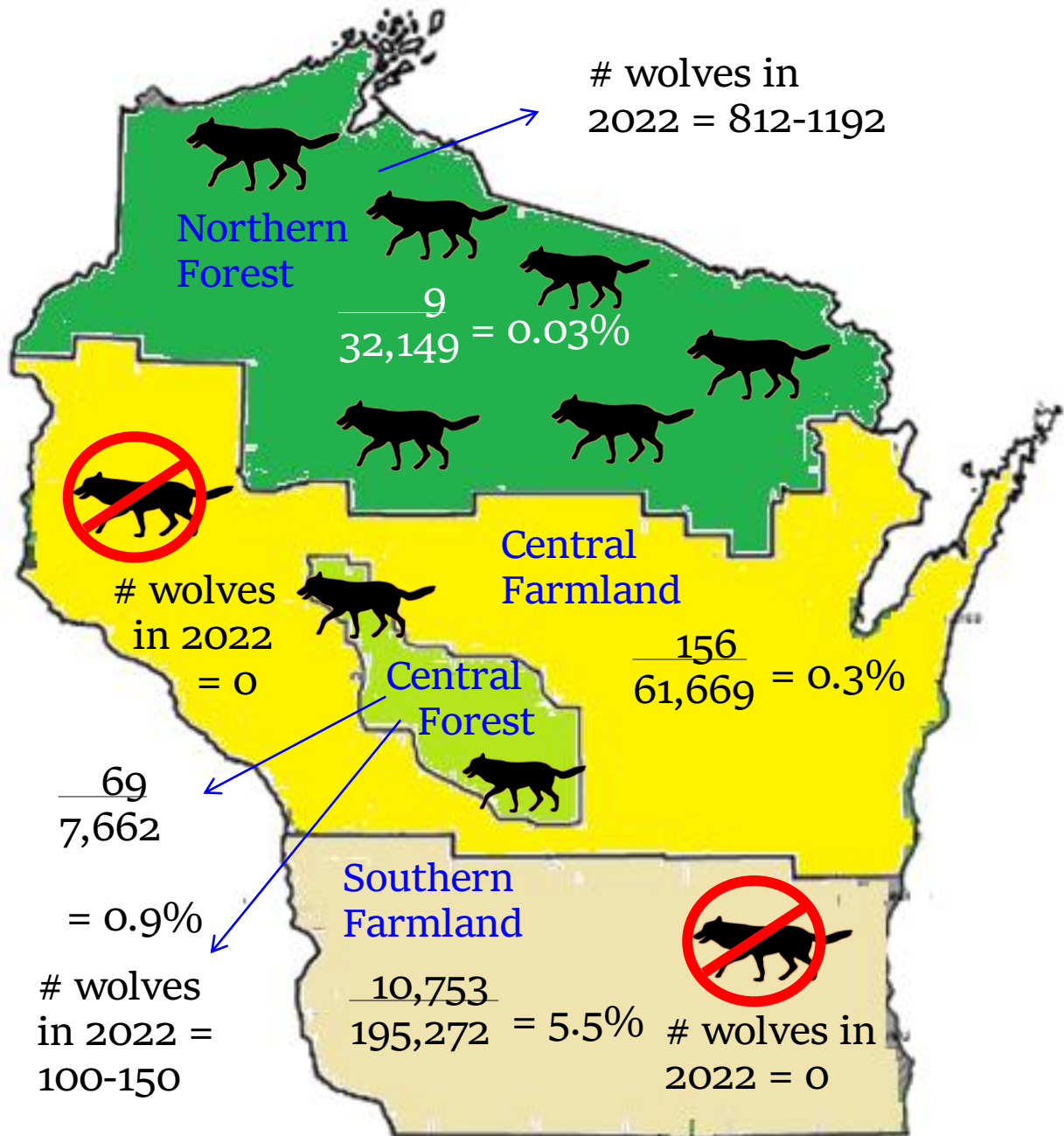
CWD prevalence - Based on CWD testing of hunter-killed deer in 2022, disease rates are near or above 20% in seven Wisconsin counties (red), 10% to 19.4% in three counties (orange), 5% to 9.9% in five counties (yellow), less than 5% in 16 counties (light-green) and “not found” in 41 counties (dark green).

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## Wisconsin black bear density

<https://wiscontext.org/bears-wolves-and-people-search-balance>

- There are an estimated 24,000 black bears in Wisconsin



Cumulative prevalence of CWD in wild Wisconsin deer from 1999 to May 2023 by Deer Management Zone

- 97.8% of CWD cases occurred in Southern Farmland Zone where wolves are absent
- Only 0.71% of CWD cases occurred in Northern Forest and Central Forest Zones where wolves are common

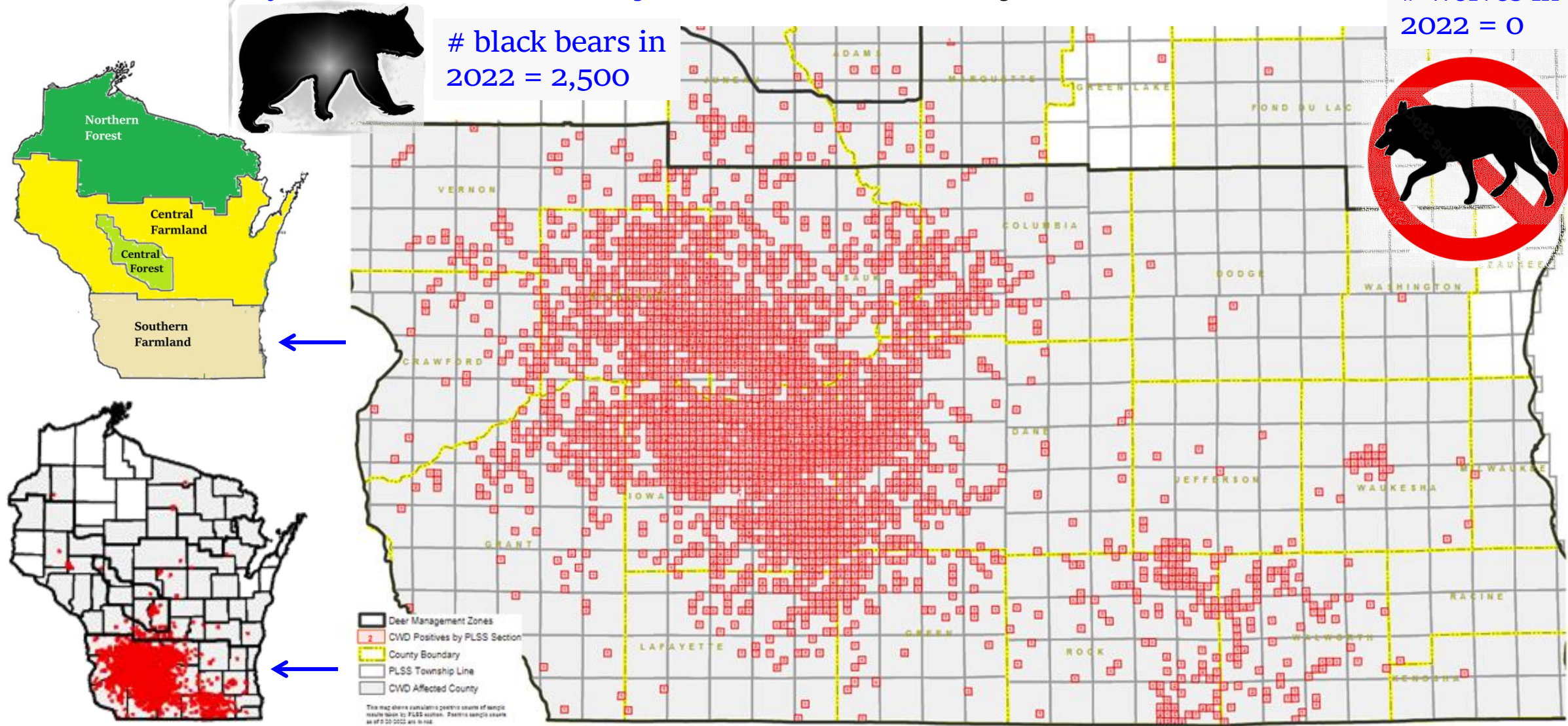
Overall CWD cumulative prevalence  
 =  $\frac{10,987}{296,752} = 3.70\%$

<https://apps.dnr.wi.gov/cwd/summary/zone>



# Cumulative wild deer CWD positive locations: Southern Farmland Zone

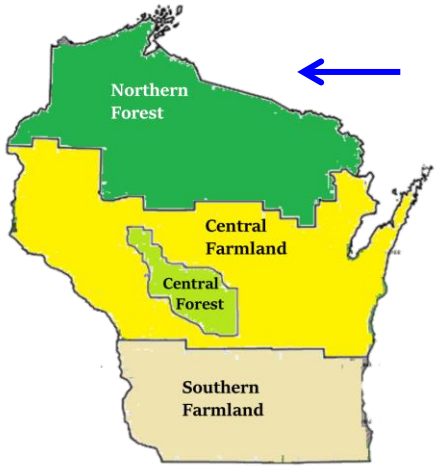
- 10,753 wild deer positive for CWD out of 195,244 samples from 1999-2023 in southern Wisconsin = 5.5% prevalence
- Some scientists predict the *eventual extinction* of wild deer in southwestern Wisconsin due to CWD
- *Wolves absent from southern WI since early 1900s (more than a century)*



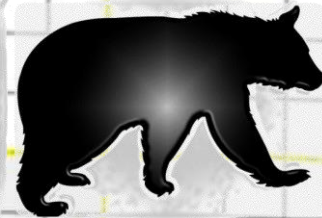


## Cumulative wild deer CWD positive locations: Northern Forest Zone

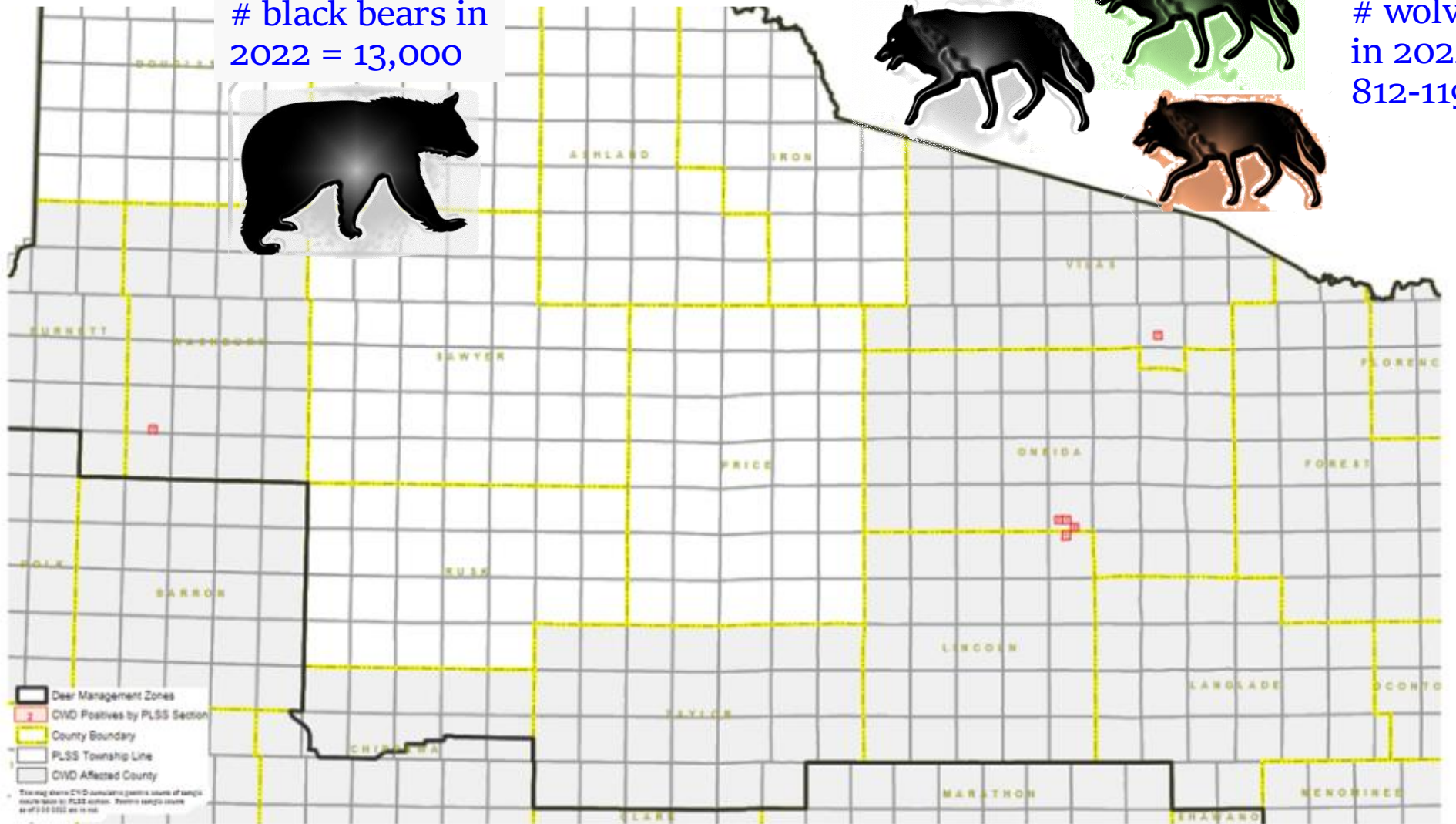
- Nine wild deer positive for CWD from 1999-2023 out of 32,149 specimens in northern WI = 0.028% prevalence
- CWD prevalence *196 times higher* in southern WI w/out wolves than in northern WI where wolves are common
- Wolves & black bears abundant



# black bears in 2022 = 13,000



# wolves in 2022 = 812-1192





# Wisconsin 2009

## DEER MORTALITY IN WISCONSIN'S NORTHERN AND CENTRAL FORESTS



Source: Wisconsin Department of Natural Resources

\* the range estimate is based on 5-15% of the 2009 winter standing deer herd for a moderate winter.

## Wisconsin 2022

Deer Mgmt Zone	Est. deer popul <sup>n</sup> 2022	Hunter killed deer, 2022	Prop <sup>n</sup> deer popul <sup>n</sup> hunter killed	No. licenses sold	Hunter success (no. killed /no. license)	Est CWD cumulative prevalence	No. black bears	No. wolves	No. coyotes	No. deer vehicle collisions	No. bob-cats	Winter deer mortality
Southern Farmland	500,000	42,000	8.4%	96,415	43.6%	5.5%	2,500	0 since 2014	45,000	4,600	300-500	10-20%
Central Farmland	500,000	68,000	13.6%	154,940	43.9%	0.9%	3,500	0 since 2014	33,000	5,910	500-700	5-10%
Central Forest	250,000	35,252	14.1%	101,560	34.7%	0.3%	5,000	100-150	25,000	8,088	800-1100	15-20%
Northern Forest	300,000	58,744	19.6%	131,755	44.6%	0.03%	13,000	812 to 1,193	50,000	10,399	1400-1700	10-20%
Totals	1,550,000	203,996	13.2%	495,590	41.2%	3.7%	24,000	912-1343	153,000	28,997	3000-4000	10-20%