

Black Bear Ecology

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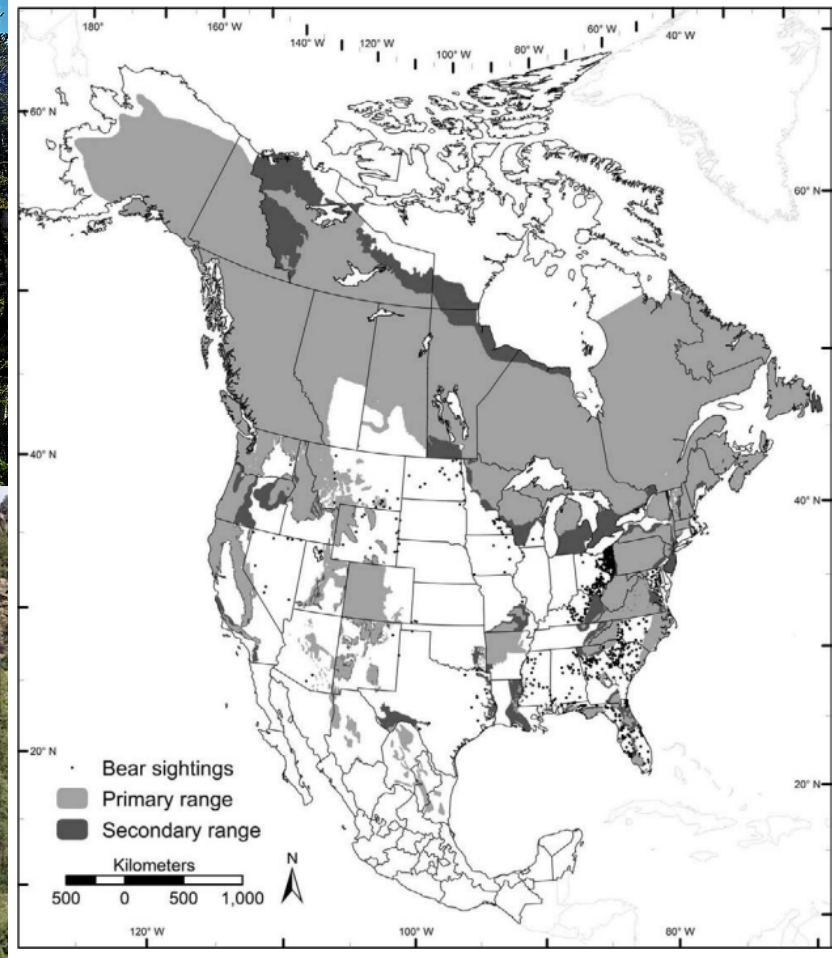


Black Bear Distribution & Habitat

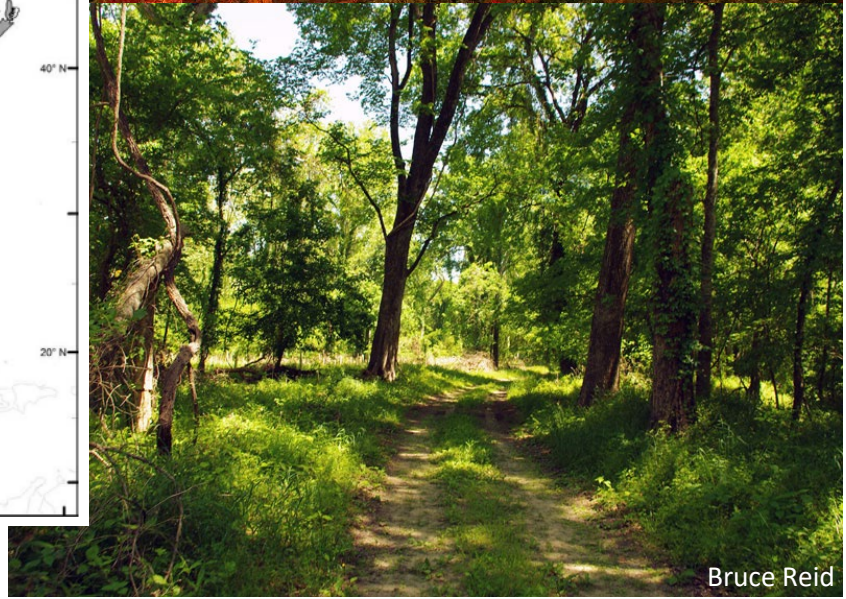
- Describe bear distributions and movement patterns.
- Is all habitat the same or are there degrees of good/fair/poor habitat for bear?



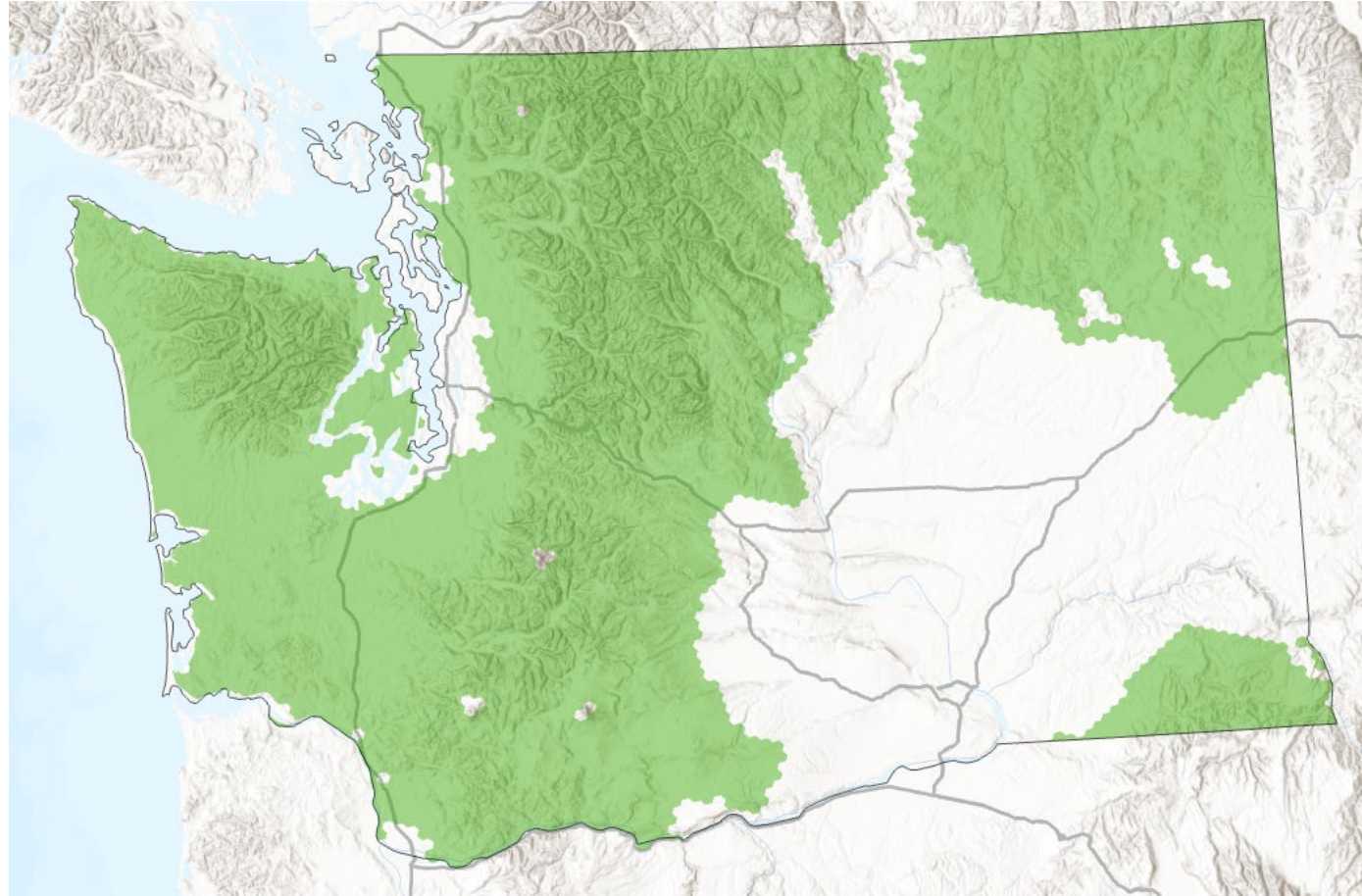
Range-Wide Black Bear Distribution



(Scheick and McCown 2014)



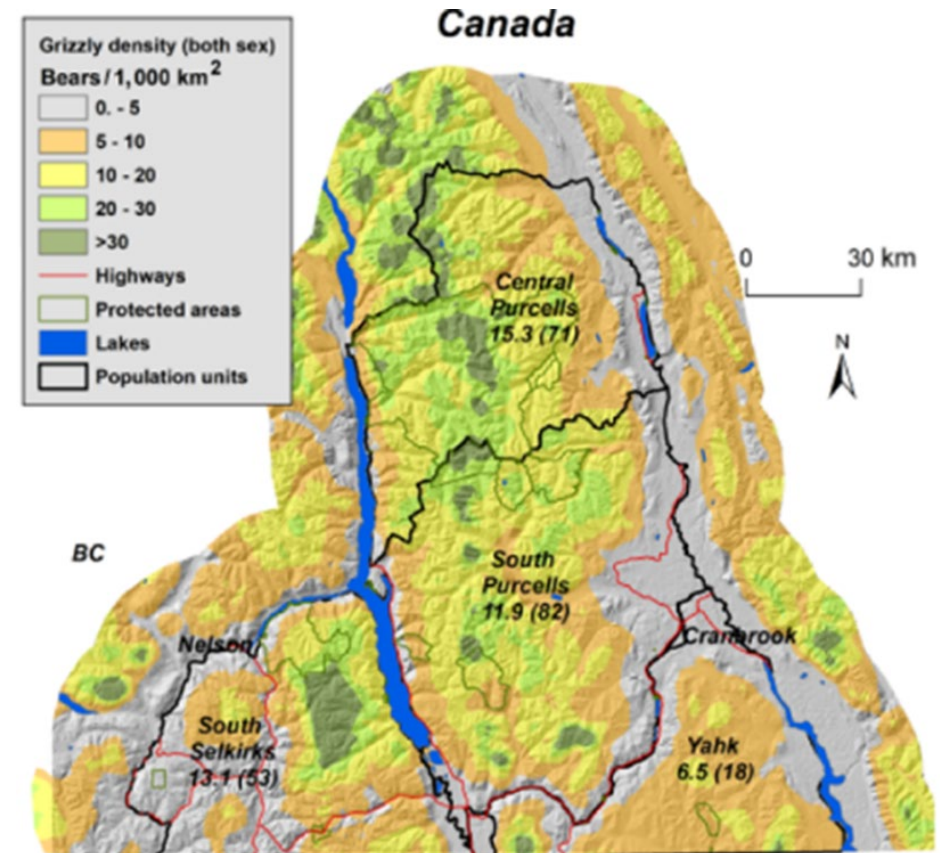
Modelled Black Bear Distribution in Washington



Black Bear Habitat Quality

Black bear density is the result of habitat selection and demographic processes

- Relative effects of bottom-up processes (food availability) and top-down effects (Sultaire et al. 2023, Welfelt et al. 2019, Loosen et al. 2018)
- Washington density monitoring
 - ~8-35 bears/100 km²



Estimated grizzly bear density – Proctor et al. 2023



Ecological Role & Behavior

- What is the role of bear in the ecosystem and the potential impacts to their ecological role from regulation changes?
- The primary ecological relationships and what quantitative information we have on bear.
- Briefly describe the ecological function and/or niche of Washington's black bears.
- Discuss the interrelationship of cougars and bears (and wolves) on the landscape and how this might or might not affect prey populations.
- Is there anything like the cougar social regulatory theory for black bears? What are the competing theories?
- Do black bear populations self-regulate?
- Describe the infanticide theory. Do each of you support this theory?



Diet

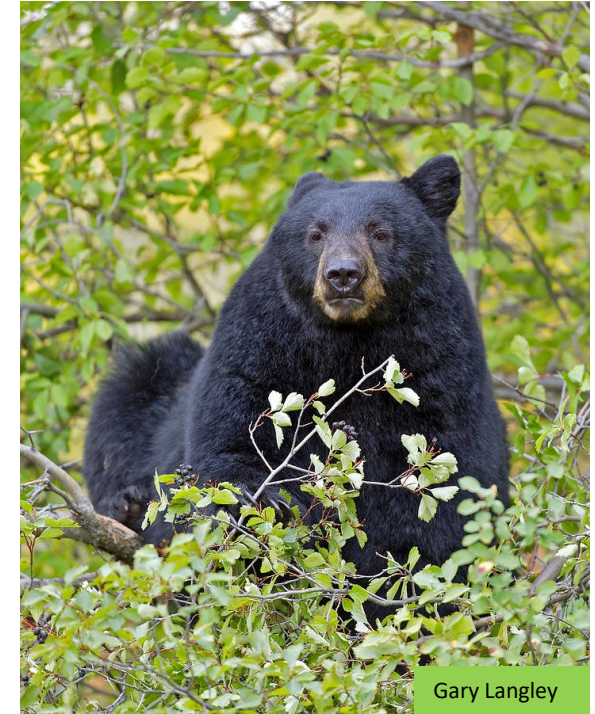
Omnivorous (Bull et al. 2001, Poelker and Hartwell 1973, Partridge et al. 2001)

- Vegetation 65-85%
- Animal matter 15-35%

Varies annually and seasonally depending on availability and by sex-age class (Merkle et al. 2017, Teunissen van Manen et al. 2020)

Human supplied foods can be a significant portion of the diet (Kirby et al. 2016, Welfelt 2018)

- Lead to rapid growth and greater body mass



Ecological Role

Seed dispersal (Enders et al. 2012, Rogers and Applegate 1983, Auger et al. 2002)

Nutrient Recycling/Soil enrichment (Jacoby et al. 1999, Fox et al. 2015)

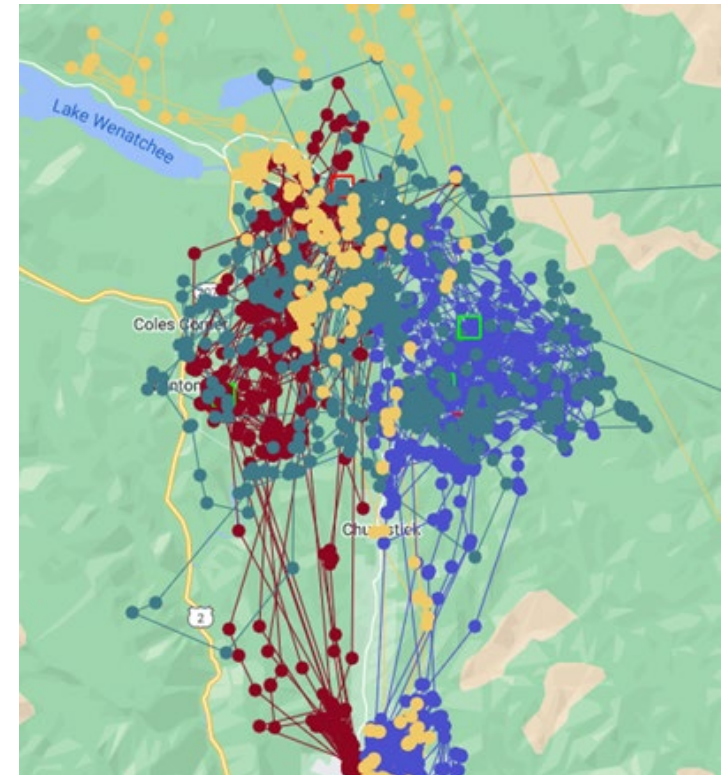
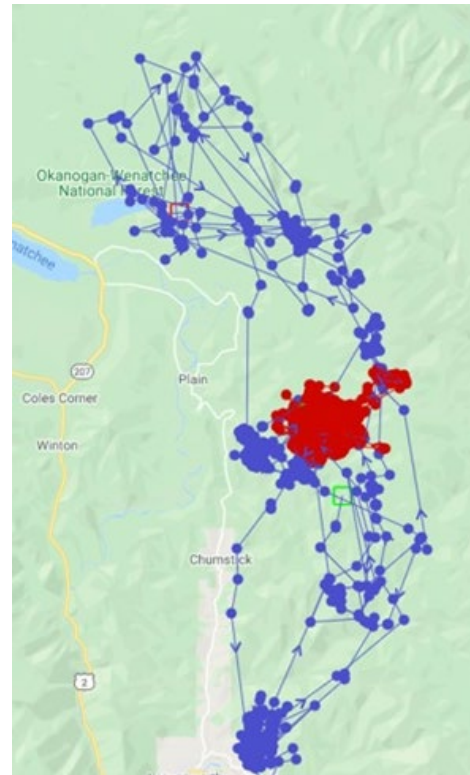
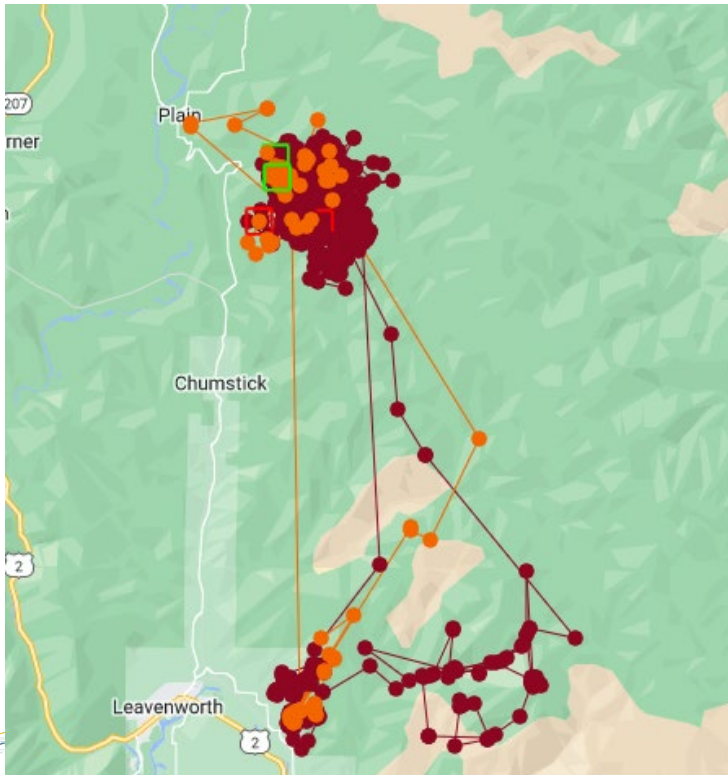
Predation (Zager and Beecham 2006, Yarkovich et al. 2023)



Territoriality and Social Regulation

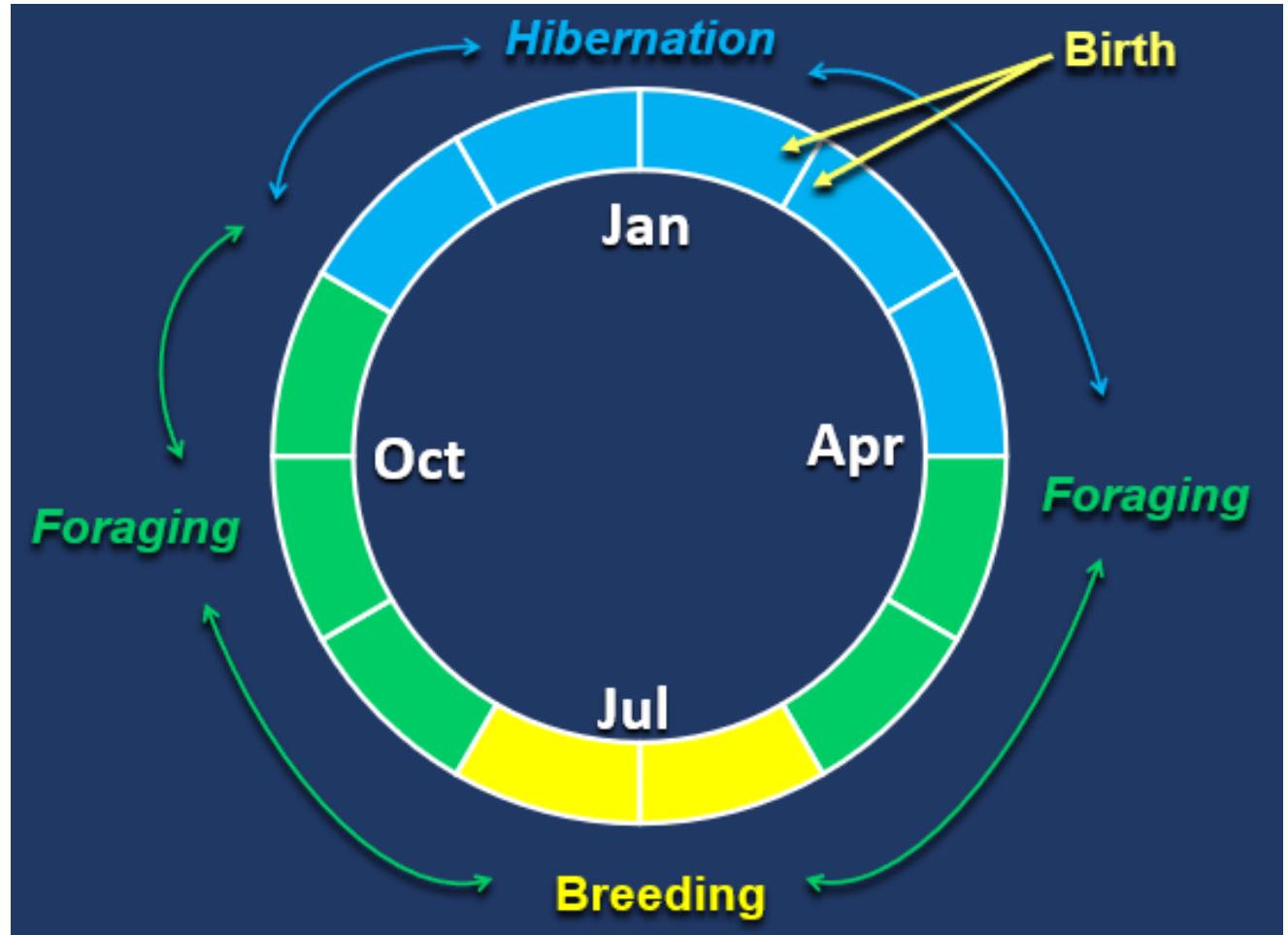
Adult male and female black bears have established home ranges, but do not typically defend "territories"

Female home range size is related to food availability, presence of dependent young, habitat fragmentation (Moyer et al. 2007, Koehler and Pierce 2003, Edwards et al. 2013)



Infanticide

Sexually selected infanticide: The killing of a female's young that the male did not sire to bring the female into early estrous for breeding



Infanticide

Black bears have exhibited infanticide in two studied populations

- Florida (Garrison et al. 2007)
- Arizona (LeCount 1987)

Black bears did NOT exhibit infanticide in other studied populations

- Alberta, Canada (Czetwertynski et al. 2007)
- Michigan (Norton et al. 2018)

Density-dependence is more common in un hunted populations or areas with poor habitat quality and/or availability



Population Dynamics & Research

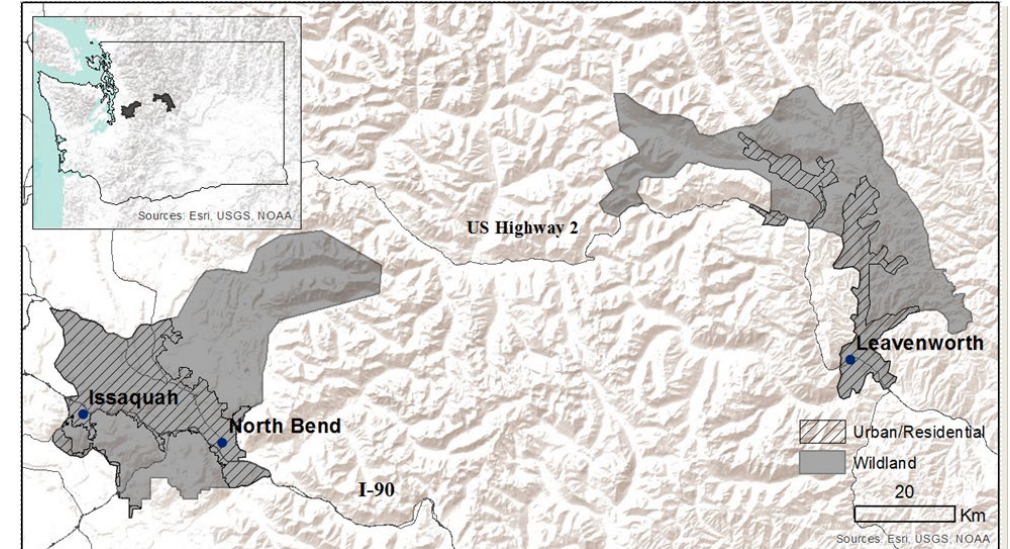
- What are we learning from longitudinal studies on bear? Why are we doing that work?
- Bear abundances and trends.
- Bear vital rates (survival and reproduction by age) and their propensity for emigration or immigration?
- Are black bear populations in Washington experiencing unrestricted or exponential growth that some members of the public have stated is occurring? Why or why not?
- Where are black bears on the mammalian reproductive rate continuum?
- Bear maximum and current growth rates?
- What is the age of first breeding of black bears in Washington? How does this compare with bear populations in other states?
- Bear age and sex structure?
- The full extent of human-related mortality for bear?



Black Bear Longitudinal Study

North Cascades Bear Project (2013-2023)

- Population size & density variations
- Growth rates (λ)
- Survival
- Reproduction rates
- Home range size
- Den selection and chronology
- Diet via stable isotopes
- Establish cost-effective monitoring protocol that can be used statewide using non-invasive mark-recapture



Ongoing Density Estimation & Monitoring

Black Bear Density Monitoring (2019-ongoing)

Document variations in density

Construct a habitat-based density model

Establish a protocol that can be used to monitor population trend



Ongoing Density Estimation & Monitoring

Abundance & Trend

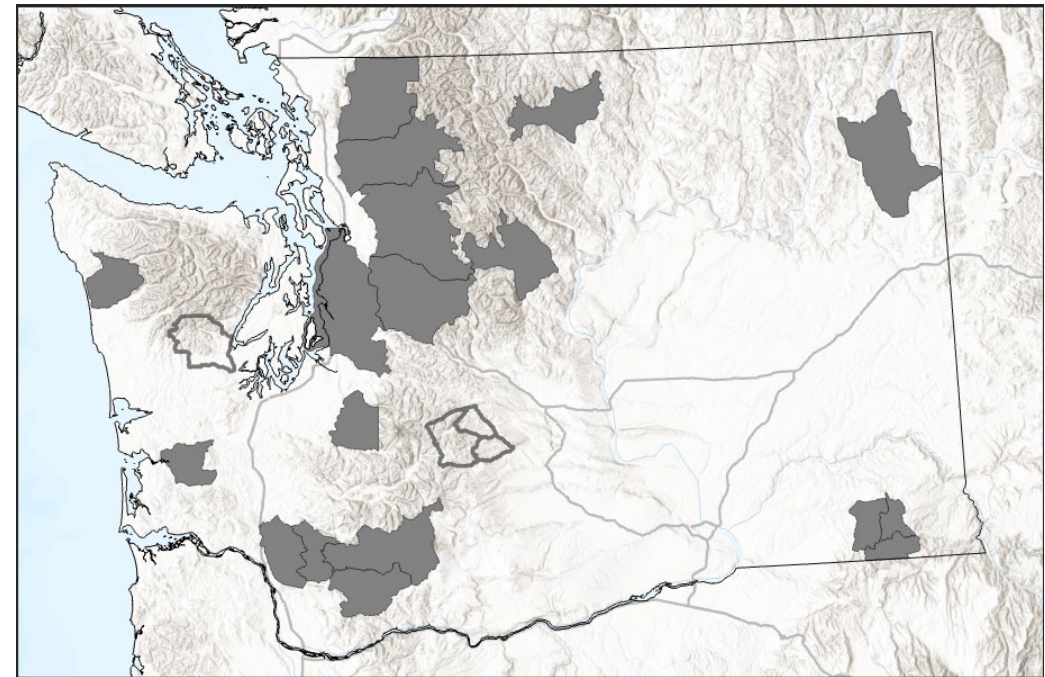
WDFW, tribal co-managers, and other state and agency staff have estimated density in 11 areas throughout the state (2019-2022)

- Lowest densities in Southwest Washington ~ 8 bears/100 km²
- Highest densities in western Olympic Peninsula, Blue Mountains, Northeast Washington ~ 31-35 bears/100 km²

Estimated harvest rates on bears > 1 years old ranged from 6-37% in the GMUs monitored

GMP & harvest framework proposal coming soon

WDFW, Stillaguamish Tribe, Sauk-Suiattle Tribe & other collaborators



Black Bear Survival Rates

WA Survival rates consistent with other hunted populations in Western US and Canada (Beston 2011)

Study Area (years of study)	Sex	n	Survival
Capitol State Forest (2006-2011)	Female	17	0.56
	Male	13	0.59
Okanogan (1994-1998)	Female	11	0.95
	Male	31	0.77
Snoqualmie (1994-1998)	Female	26	0.93
	Male	39	0.69
Olympic (Humptulips) (1997-1999)	Female	10	0.93
	Male	19	0.73

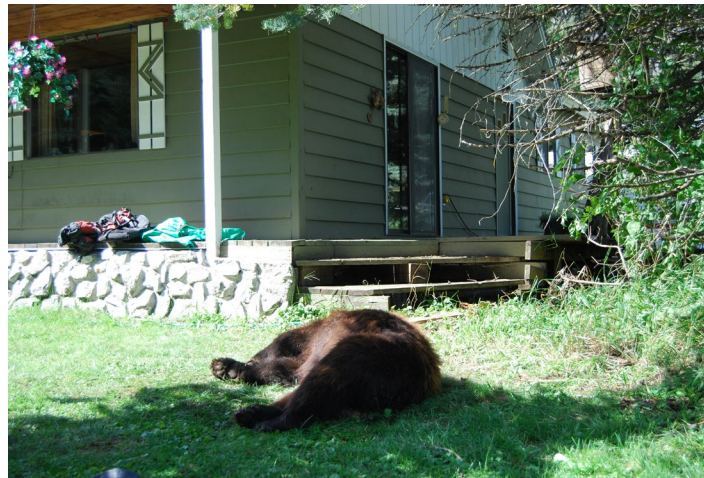
Study Area (2013-2023)	Age Class	Sex	n	Survival
Lake Wenatchee	Adult	Female	54	0.84
		Male	35	0.84
	Subadult	Female	30	0.79
		Male	17	0.74
	Yearling	Both	42	0.64
	Cub	Both	70	0.73
Snoqualmie	Adult	Female	35	0.88
		Male	34	0.79
	Subadult	Female	19	0.61
		Male	36	0.66
	Yearling	Both	30	0.67
	Cub	Both	50	0.82



Human-Caused Mortality

North Cascades black bear research project (2013-2023)

- Western Cascades mortalities (n = 44 mortalities) - 52% hunter harvest, 19% conflict removals, 9% poached, 7% wounding loss, 7% road mortality, 7% natural causes
- Eastern Cascades mortalities (n = 48 mortalities) - 64% hunter harvest, 15% natural causes, 8% wounding loss, 7% conflict removals, 4% road mortality, 2% poached



Black Bear Reproduction

Black bears are one of the lowest reproducing terrestrial mammals in North America due to their relatively late maturity, low litter sizes, and extended period of dependency

Reproduction has a strong link to body size and condition of adult females (Robbins et al. 2012, Noyce and Garshelis 1994, Samson and Hout 1995, Wightman et al. 2022)



Black Bear Reproduction in WA

Average age at first reproduction 5 (range 3-9)

Average litter size 2 cubs (range 1-3)

- Smaller for first litters (4-5 year olds) in Eastern Cascades

Interbirth interval 2 years (range 1-4)

Maternity rate

- Western Cascades
 - 0.53 female cubs/adult female/year
- Eastern Cascades
 - 4-5 year olds 0.31 female cubs/adult female/year
 - 6+ year olds 0.46 female cubs/adult female/year



Black Bear Growth Rates

A maximum growth rate can be as high as ~20% in un hunted recovering or reintroduced populations over short periods of time (Brongo et al. 2005, Murphy et al. 2015, Clark et al. 2005)

In Washington we are estimating current growth rates for 2 populations in the Cascade mountains, but analysis of this data is not complete and will be a part of the GMP

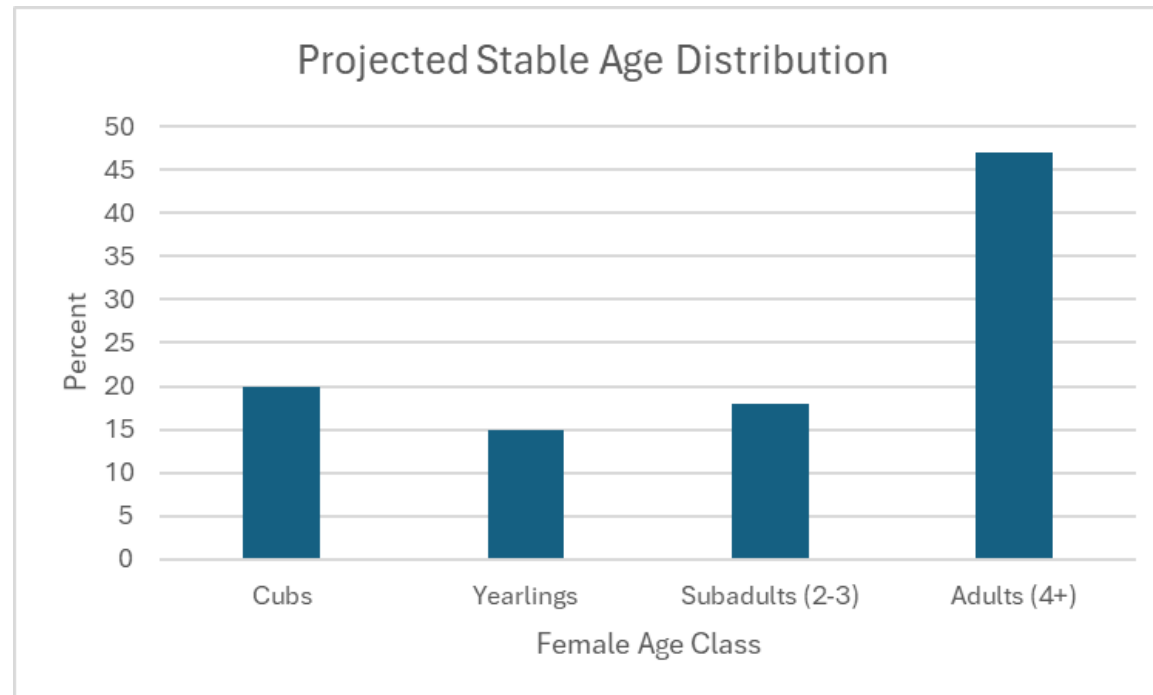
Preliminary analysis of data suggest current growth rates are stable (1.0) and up to 8-10% excluding hunting mortality (subject to change)



Sex and Age Structure

Sex ratio of the population from the density monitoring projects show that sexes ranged from 45-75% female and 25-55% male depending on area.

Preliminary data from modelled Leslie matrix in the 2 long-term study areas on both slopes of the North Cascades (female component)



Black Bear Emigration/Immigration

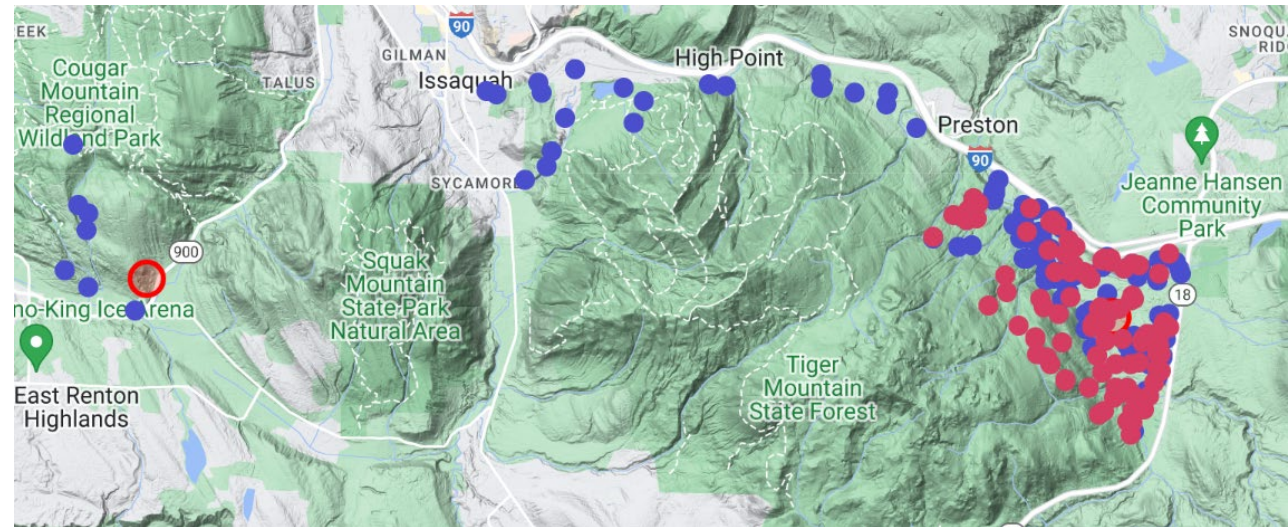
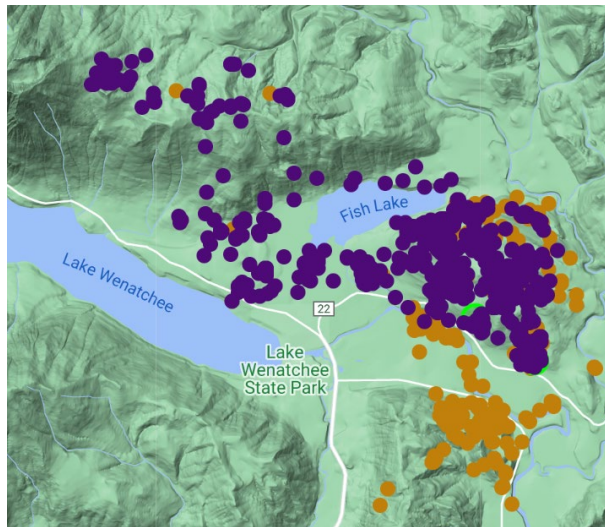
Black bear dispersal is male biased

- Inbreeding avoidance

Females home range 0-7 km from their natal range in New Mexico, males dispersed 22-62 km at 18-36 months old (Costello et al. 2010)

Males dispersed ~ 13 km in Virginia (Lee and Vaughan 2003)

North Cascades project, all females established home ranges that overlapped their natal range, and males dispersed ~ 20 km between 18-36 months, most commonly ~ 2.5 years old



Management Framework and Modeling

- Do we utilize non-harvest mortality in our bear modeling?
- How confident are we of the density and habitat information used for bear modeling?
- We utilize harvest data of bear and ungulates in our various management approaches. Critics suggest that the harvest data isn't always reported or is reported inaccurately. Has the department reviewed harvest reporting for statistical veracity? Is there a basis for that criticism, or is it not a large factor?
- How well we can monitor bear to detect population change?
- In the vein that "All models are wrong, but some are useful," can the panel briefly describe our current bear management model? What are the its shortcomings and strengths? What will it take to develop or refine the model? Is it regional or statewide? What are the timeframes, costs, and competing priorities for it?
- How useful is the Black Bear Management Unit designation/areas? Does new science suggest these to be useful, outdated or need adjustments?
- In terms of the recent regulation change for bears, how many bears were harvested during the new portion of the fall season (i.e., where the season start date was extended), and how many bears were harvested under the second bear tag in eastern Washington?
- How well do bear populations tolerate the current level of take?
- Are we confident the population can handle the current level [of harvest] without a roll-back to past harvest levels?

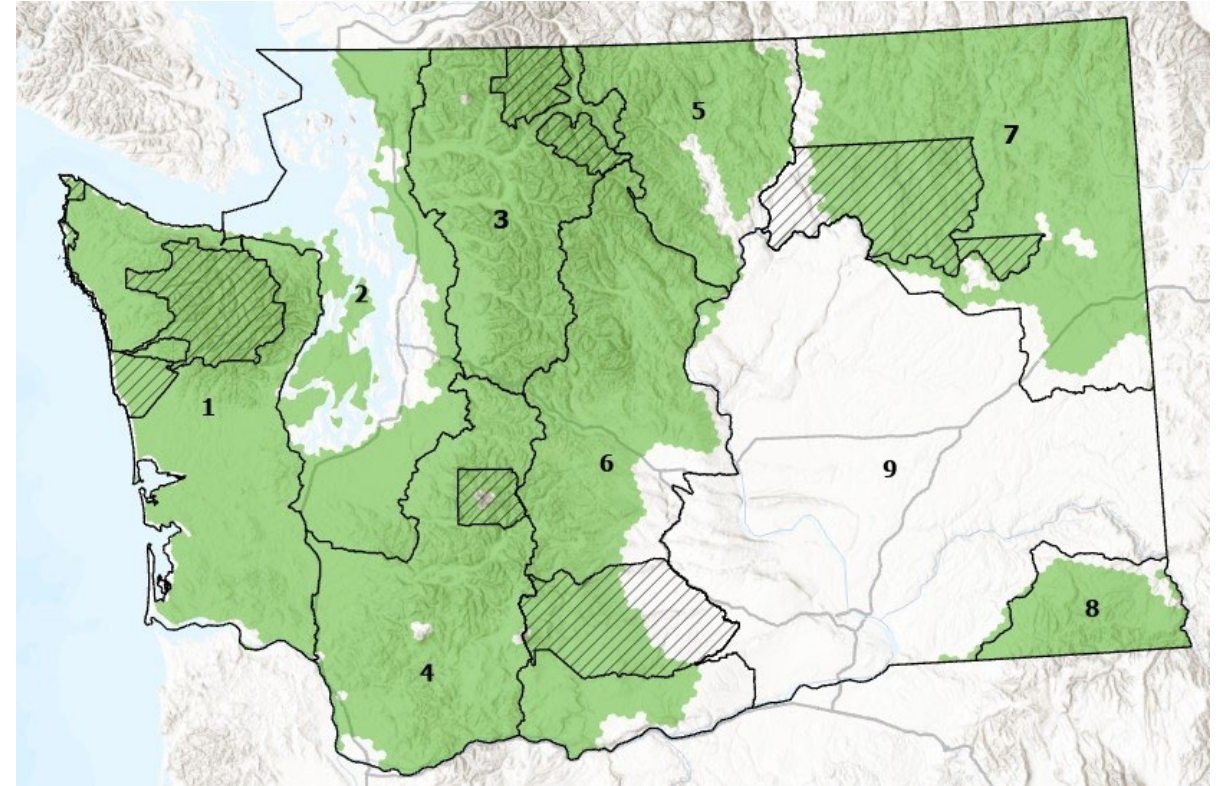


Management Framework and Modeling

Black bear management units (BBMUs) are used to delineate harvest data analysis for management recommendations

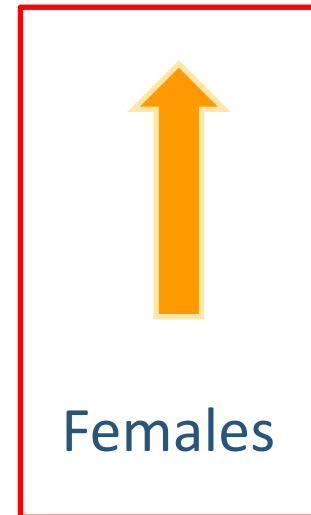
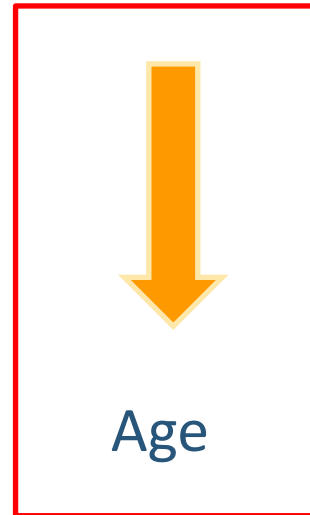
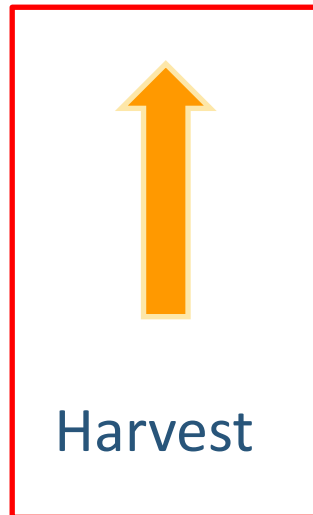
Current BBMUs are loosely based on Washington ecoregions

GMP process will review BBMUs to determine appropriate scale and configuration



Current Management Framework and Modeling

Parameter	Harvest		
	Liberalize	Acceptable	Restrict
% Female in the harvest	< 35%	35-39%	> 39%
Median age of harvested females	>6 years	5-6 years	< 5 years
Median ages of harvested males	>4 years	2-4 years	<2 years



Current Management Framework and Modeling

Age and sex metrics have been used by many agencies for decades to infer population status and trend, based on age and sex data of heavily and lightly hunted bear populations (Beecham and Rohlman 1994)

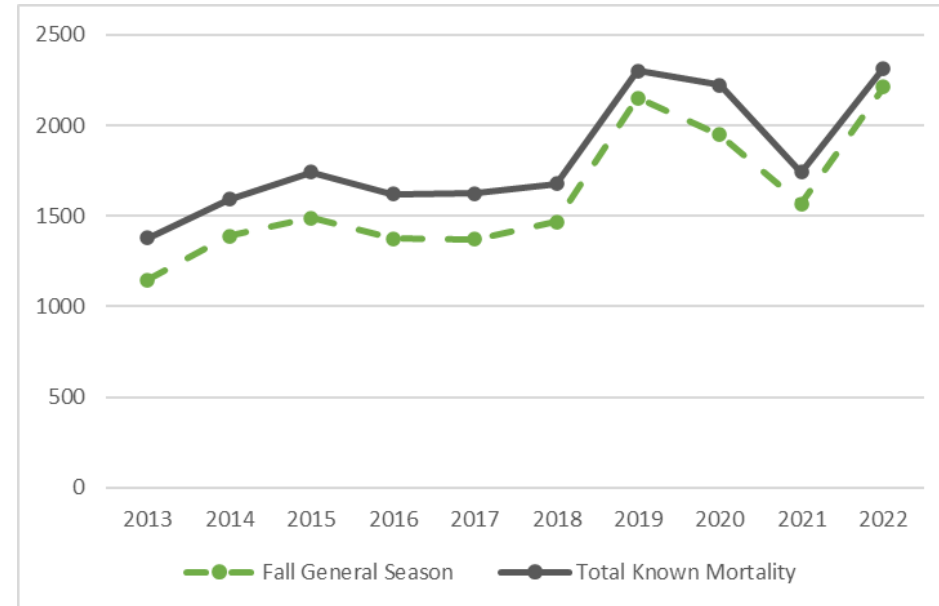
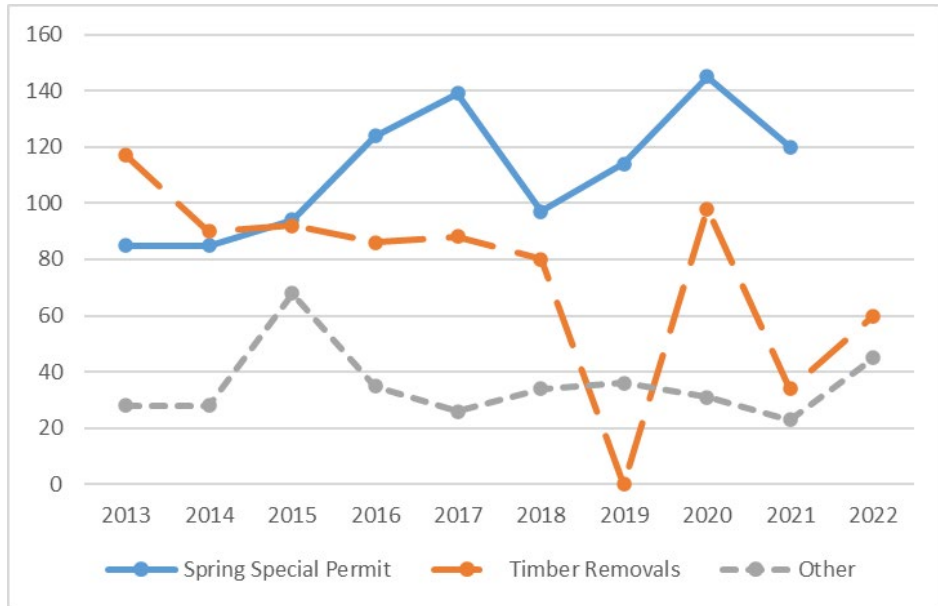
- Data readily available
- Simple analysis
- Low cost

Reasons to look forward

- Age and sex of bears in harvest not always a useful tool by itself to identify population trend or impact of harvest management (Beston and Mace 2012, Garshelis and Hristienko, 2006, Harris and Metzgar 1987, McLellan et al. 2017, Noyce and Garshelis 1997)
- Low tooth submission rates in WA (~25%)
- Timeframe to make inference not clearly lined out (annual, 3-year, 5-year, etc.)
- Long-term research and monitoring results can be utilized
- Better methods to monitor population size and trend are becoming available



Statewide Human-Caused Black Bear Mortality



The enforcement program reported 159 incident reports related to hunting black bear for 2018-2022



Reliability of Hunter Effort and Harvest Data

- Mandatory end of year hunter reporting rates vary and trend
- Since 2001, considerable resources into follow-up surveys and analyses
 - Tooth submission (age data) is not assessed for reporting bias
- Account for "response bias" in hunter effort and harvest statistics

Black Bear LY 2022 hunter reports

Tags	Reported	Hunted	Harvested
71,412	37,848	10,612	1,372
	53%	28%	13%
Follow up:	2,356	594	50
		25%	8%



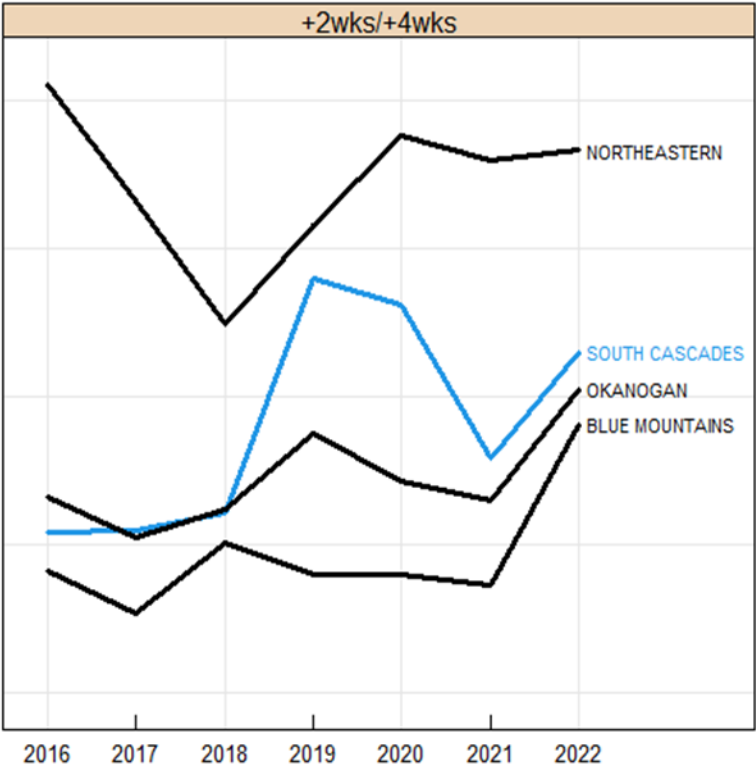
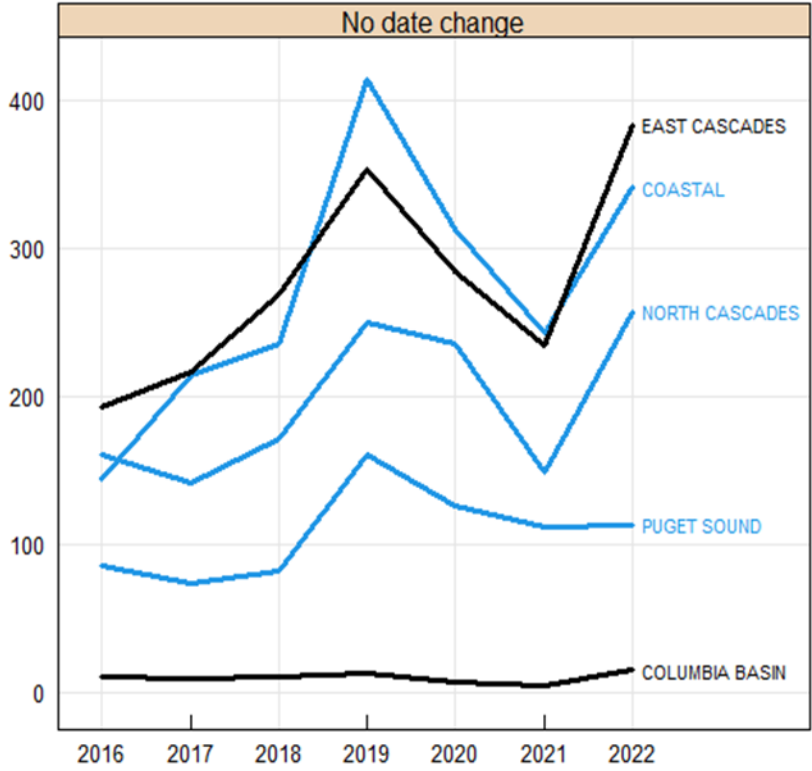
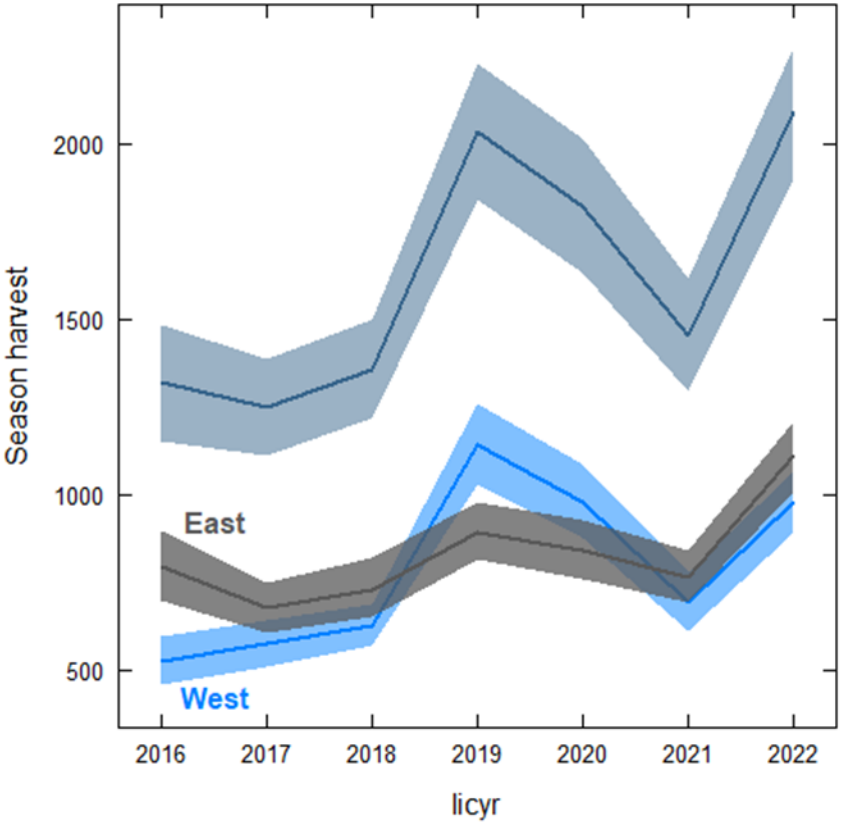
Reliability of Hunter Effort and Harvest Data

- Follow up survey with a stratified random sample of non reporting hunters.
- Estimates derived from analysis of the survey relative to reports received
- Results of statistical models designed to ensure the best estimate for a need
 - Should not expect an exact match between products.

Black Bear LY 2022 hunter reports				Youth			
Tags	Reported	Hunted	Harvested	Tags	Reported	Hunted	Harvested
71,412	37,848	10,612	1,372	5,001	2,488	493	72
	53%	28%	13%	7%	50%	20%	15%
Follow up:	2,356	594	50		172	37	5
		25%	8%			22%	14%



Estimated Trend in Hunter Harvest Through the 2019 Rule Change



Comparison of 3-yr average Harvest Before and After the 2019 Rule Change

	Statewide		BBMU 1-3, 6, 9 (no date extension)		BBMU 4,5,7,8 (season extended)		2 nd bear East
	Increase From 2016-2018	During extended opportunity	Increase From 2016-2018	During extended opportunity	Increase From 2016-2018	During extended opportunity	Estimate (all 2 nd harvest <5% total)
2019	55%	11%	77%	<1%	33%	25%	28
2020-2022 3yr avg.	37%	16%	40%	<1%	33%	33%	37



Risks and Threats

- What are the risks to bear population status?
- Bear vulnerability to climate change and human growth and development?
- How does climate change affect the bear population?
- How do natural events like wildfire affect habitat over time for bear?
- Are bear subject to known disease concerns?



Human Growth and Development

Effects of human development show mixed results

- Lower density (Humm et al. 2017, Welfelt et al. 2019)
- Higher density (Fusaro et al. 2017)
- Lower survival (Beckmann and Lackey 2008, Hostetler et al. 2009)
- Increased fecundity (Beckmann and Lackey 2008, Gould et al. 2021)
- Reduced habitat effectiveness and selection (Gaines et al. 2005, Hiller et al. 2015)
- Habitat loss, fragmentation, and reduced gene flow (Dixon et al. 2007)
- Altered activity patterns (Beckmann and Berger 2003)



Climate Change

Potential for less snow, increasing temperatures, longer growing seasons (Raymond et al. 2014)

- Shorter denning periods (Johnson et al. 2018, Fowler et al. 2019, Gámez-Brunswick and Rojas-Soto 2019)
- Improved spring forage (Honda and Kozakai 2020)
- Increased habitat quality in some habitats and higher elevations (Roberts et al. 2014, Ransom et al. 2023)

Potential for increasing magnitude and frequency of drought (Stocker et al. 2013) and reduced food availability at lower elevations (Roberts et al. 2014)

- Increased human-bear conflict and human-caused mortality (Laufenberg et al. 2018)

Black bears flexible diet, foraging tactics, and ability to migrate provides resiliency that many other species do not possess (Bonin et al. 2020)



Wildfires

Wildfire expected to increase due to direct and indirect effects (forest pathogens, cheat grass) of temperature and precipitation changes (Raymond et al. 2014, Halofsky et al. 2020)

- Some direct mortality
- Temporary loss/decrease in habitat quality (Cunningham et al. 2003)
- Regrowth creating early seral habitats can be beneficial for bears and many other species (Souliere et al 2020). Timeline of habitat improvement is highly variable depending on burn intensity, climate, forest composition, etc. (Lewis et al. 2022)



Disease

- WDFW/WSU identified cases of encephalitis in bears in 2022 & 2023, with unknown origin.
 - Other jurisdictions have documented encephalitis from protozoal *Sarcosystisi*, and canine distemper virus over the past decade (Greenfield et al. 2022, Cottrell et al. 2013, Stephenson et al. 2015)
- Highly pathogenic avian influenza (HPAI) found in grizzly bears in Montana (Montana FWP 2023) and black bears in Quebec (Jakobek et al. 2023)
- Mange has become increasingly common in the Northeast US (Rojas-Sereno et al. 2022, Peltier et al. 2018, Niedringhaus et al. 2019a), and documented west in Michigan and New Mexico.
 - Impacts of mange vary, but can lead to death from emaciation or secondary infections and transmission comes from direct or indirect contact (Niedringhaus et al. 2019b).
 - Proactive measures—reduce gathering of bears in common areas such as can occur with human-provided foods in residential areas and supplemental/diversionary feeding on commercial timber lands.



A young black bear displaying neurological abnormalities, including a prominent head tilt, undergoes a CT scan at UC Davis in 2019. The bear became something of a social media sensation for approaching people at the Northstar ski resort before being treated by CDFW and placed with a wildlife facility in San Diego, where the bear has required ongoing veterinary care. *CDFW photo by Kirsten Macintyre.*



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Bryan Murphie, D15

Erin Wampole, D8

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Tribe



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