

Draft Black Bear Science & Framework Update

Analytical Approach

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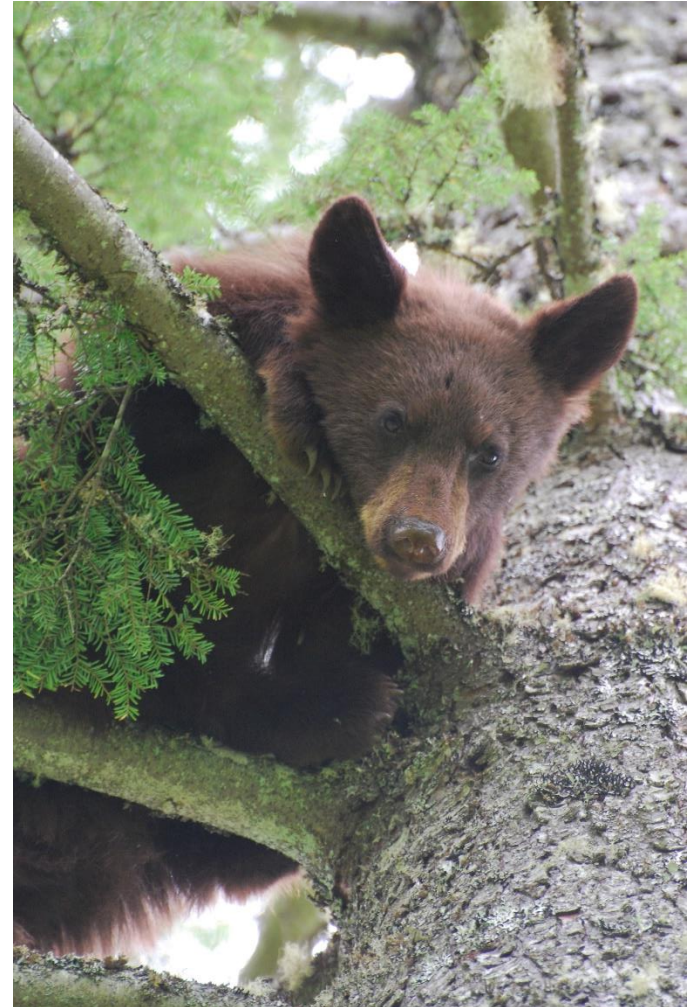
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Outline

- Overview of WDFW black bear research
- Current framework for WA
- Review of other frameworks
- Data sources
- Proposed framework for WA
 - Population model
 - Black bear density
 - Black bear habitat
- Next steps (from draft to final)

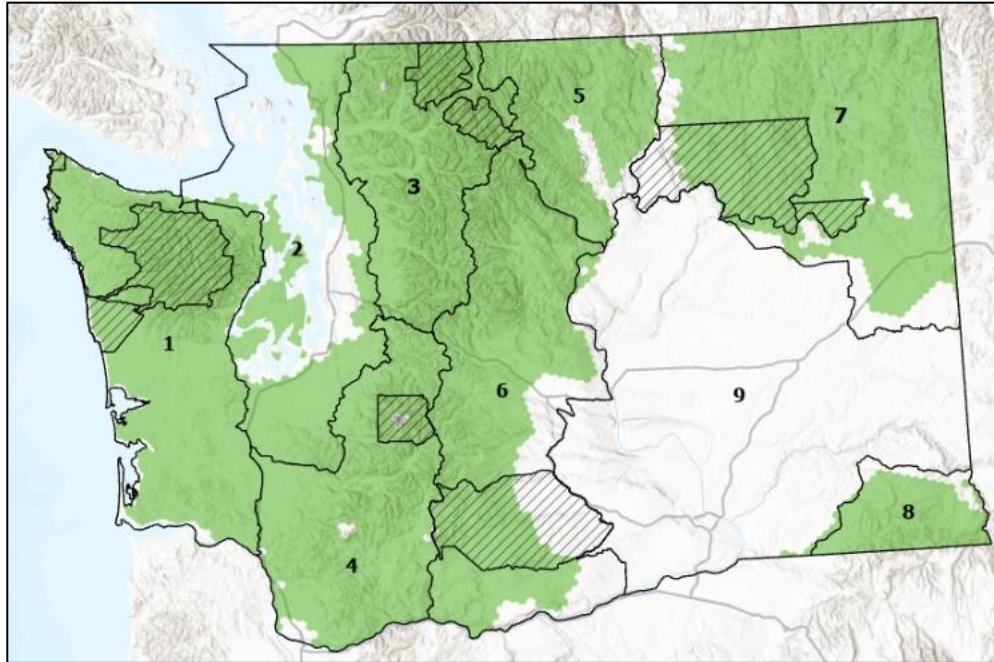


Past Black Bear Research by WDFW

- 1963-1969 (Poelker & Hartwell)
- 1994-1999 (Koehler et al., Collins et al.)
- 1996-1997 (Rice et al. 2001)
- 2006-2011 (Beausoleil et al. 2016)



Current BBMUs & Harvest Criteria



Parameter	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



Review Other Agency Frameworks

Formally assessed strengths, weaknesses, and whether WDFW has the data to utilize the method

- Harvest data only (WA, OR): #kills, median ages of M&F, & % female in the harvest
- Capture-recapture (e.g., PA, ME): capture and marking followed by recapture at harvest
- Population reconstruction & IPMs (MN, MT): utilizes ages of hunter-harvested bears & hunter effort – and density estimates for IPM - Requires high compliance of tooth submission
- **Estimated density & harvest rate (NV, CO, NM, WY). Applied via female and/or total harvest targets**



Recent WA Black Bear Research

- 1963-1969 (Poelker & Hartwell)
- 1994-1999 (Koehler et al., Collins et al.)
- 1996-1997 (Rice et al. 2001)
- 2006-2011 (Beausoleil et al. 2016)
- 2013-2023 (WDFW 2023, Welfelt et al. 2019)
- 2019-Current (WDFW 2022)
 - 15 density estimates and counting (including Stillaguamish Tribe contributions); 3 more areas in 2024 are at the DNA lab (n=18)



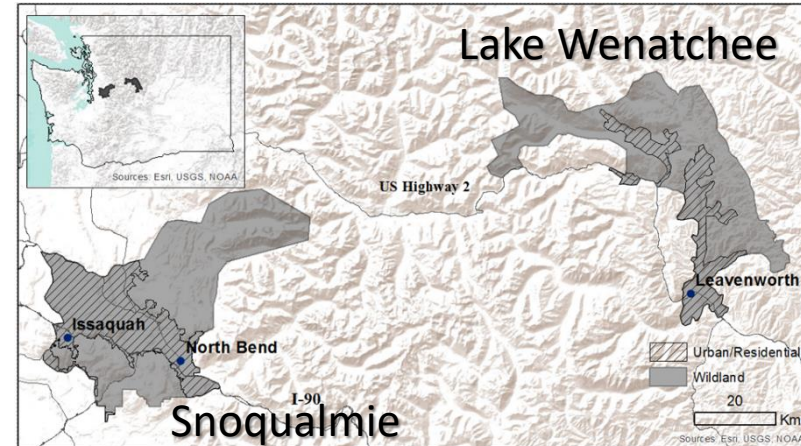
Black Bear Research in WA (2013-2023)

North Cascades Bear Project

Objectives - Study 2 areas (E & W slopes) to capture variability representative in WA

- Density variation and population size
- Home range size
- Growth rate (λ)
- Survival (by sex, all age classes)
- Reproduction rates
- Den selection & chronology
- Diet via stable isotopes

- Establish a long-term & affordable density monitoring program



Washington's Proposed Framework

Objective → stable bear population

- create adaptive management action(s) if objectives are not being met

Female mortalities / habitat \times density \leq intrinsic growth rate

Harvest (+wound loss*)
Timber, Conflict

Female
population size

Natural,
Other (Roadkill, Poaching,...)

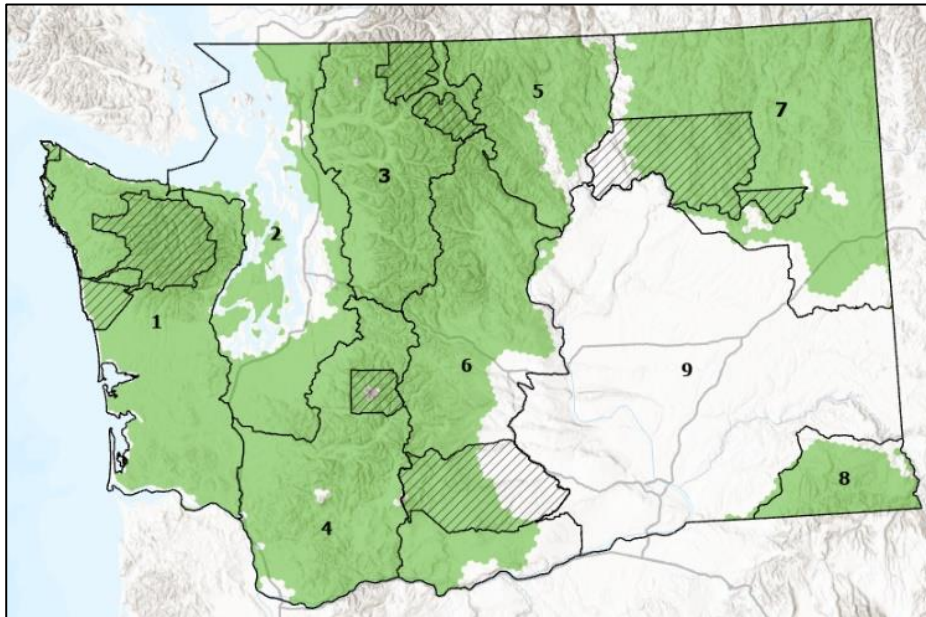


Proposed BBMUs

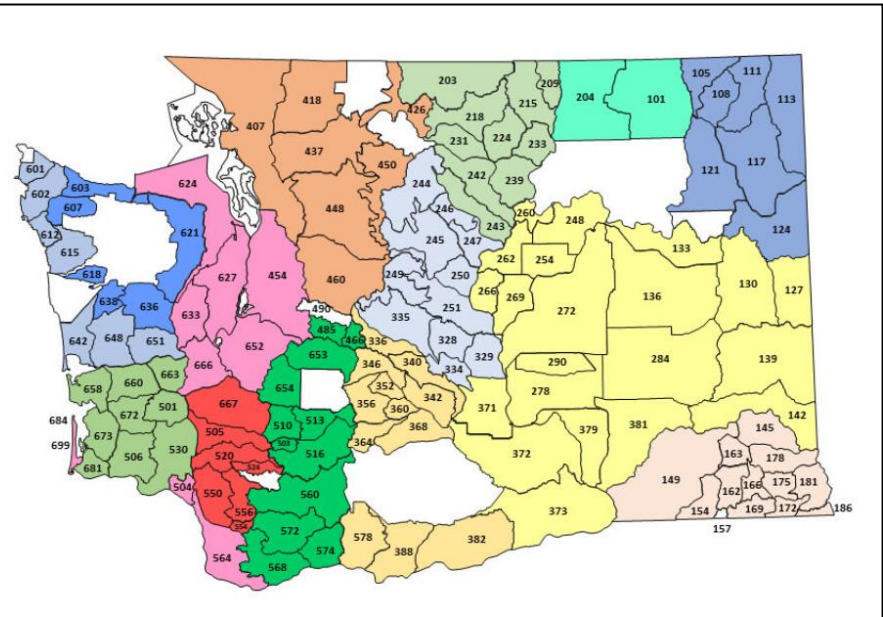
Proposed change from 9 to 14 BBMUs

Management units that are consistent with habitats and black bear populations in addition to administrative & natural boundaries

Current BBMUs



New draft BBMUs



* BBMUs may change based on continued Regional input



Washington's Proposed Framework

Female mortalities/ habitat \times density \leq **intrinsic growth rate**



Assembled Datasets: 10 years across 2 areas in WA

- Monitored survival (sex & age) & reproduction
 - primiparity, litter size, cub survival, birth interval
- West slope (Snoqualmie) – 182 collaring events of 116 bears (47 females)
- East Slope (Lake Wenatchee) – 239 collaring events of 127 bears (75 females)
- Reproduction – info collected from 165 female den visits (21 & 29 individuals)



Model Female Reproductive Years

Over an average (intrinsic) lifetime a female will have:

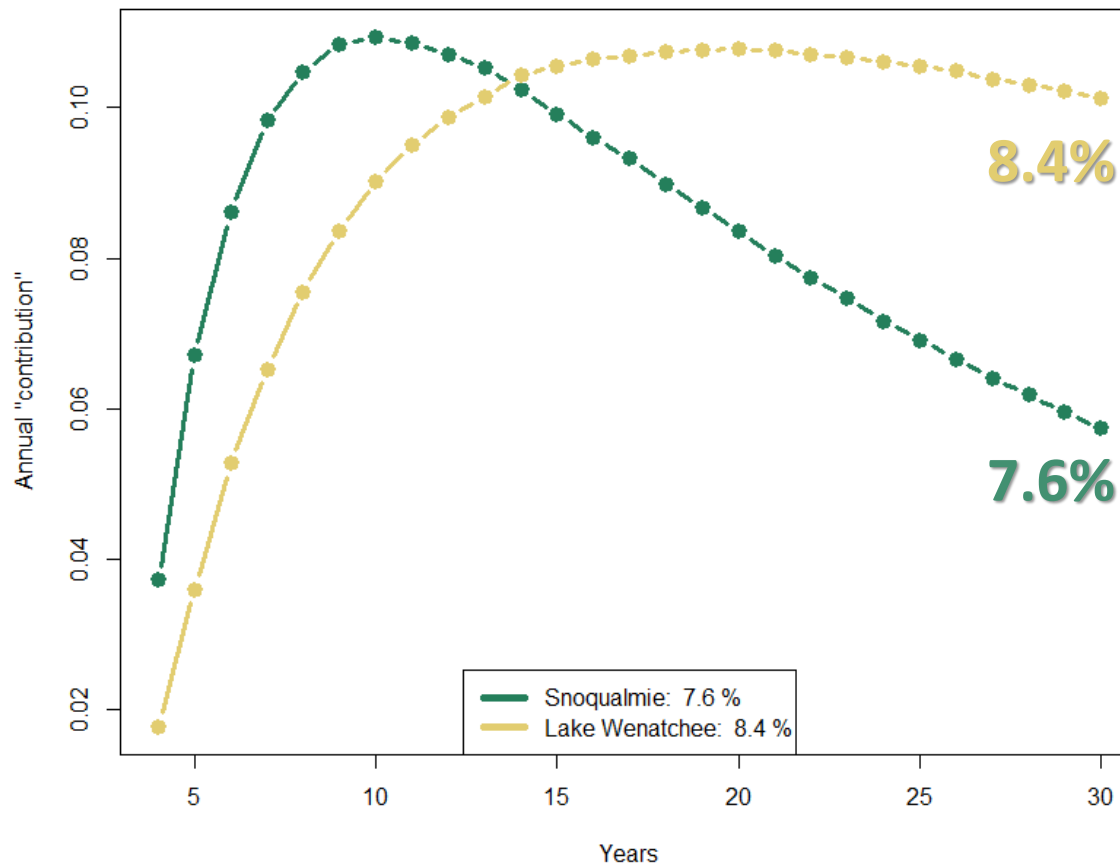
$\hat{S}_c \hat{S}_{1-4}^3 [\widehat{age}(S_a) - \widehat{TFR}] \frac{\hat{n}_f}{2}$	Female replacements	Lwr95%	Upr95%
Snoqualmie	4.08	0.1	8.94
Lake Wenatchee	4.55	0.63	6.8

- \hat{S}_c GLMMIX(East/West, mother's age, individual effect)
- \hat{S}_{1-4} Weibull AFT(East/West, Natural + Other)
- \hat{S}_a Weibull AFT(East/West, Natural + Other)
- \widehat{TFR} Censored geometric max likelihood(East/West)
- \hat{n}_f 0.5*Multinomial(0-3 , individual effect)



Model female reproductive years

Averaging over the profile of $\hat{S}_c \hat{S}_{1-4}^3 [age(\hat{S}_a) - \widehat{TFR}] \frac{\hat{n}_f}{2}$
provides an estimate of annual intrinsic growth rate



Washington's Proposed Framework

Female mortalities/ habitat x **density** \leq intrinsic growth rate



Estimating Black Bear Density

Capture-Recapture Sampling

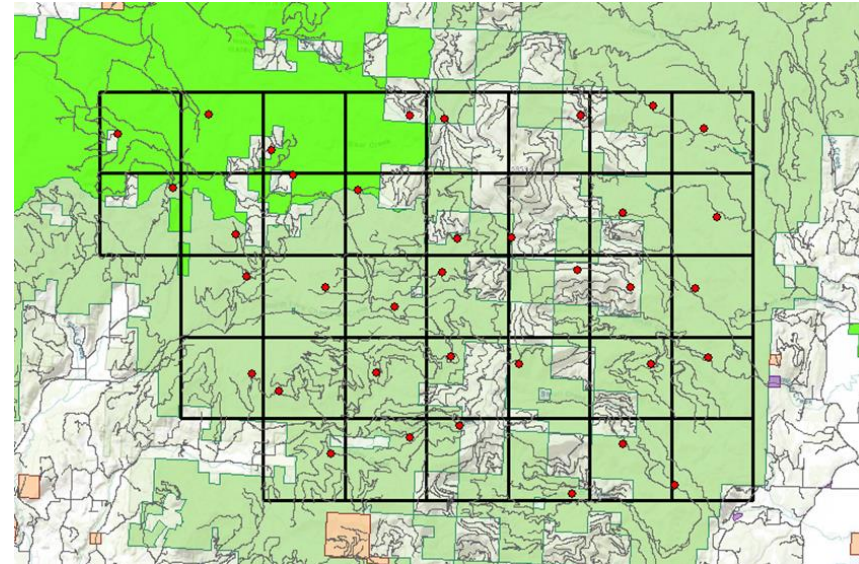


- Collect hair (DNA) samples at non-invasive hair corrals in 4 sampling sessions (late May-late July)
- Send hair to Wildlife Genetics International lab to identify individual bears
- Density analysis – spatially explicit capture-recapture (SECR) model
- Collaborative work in some areas with Stillaguamish Tribe, Sauk-Suiattle Tribe, Lower Elwha Klallam Tribe, and WSDOT

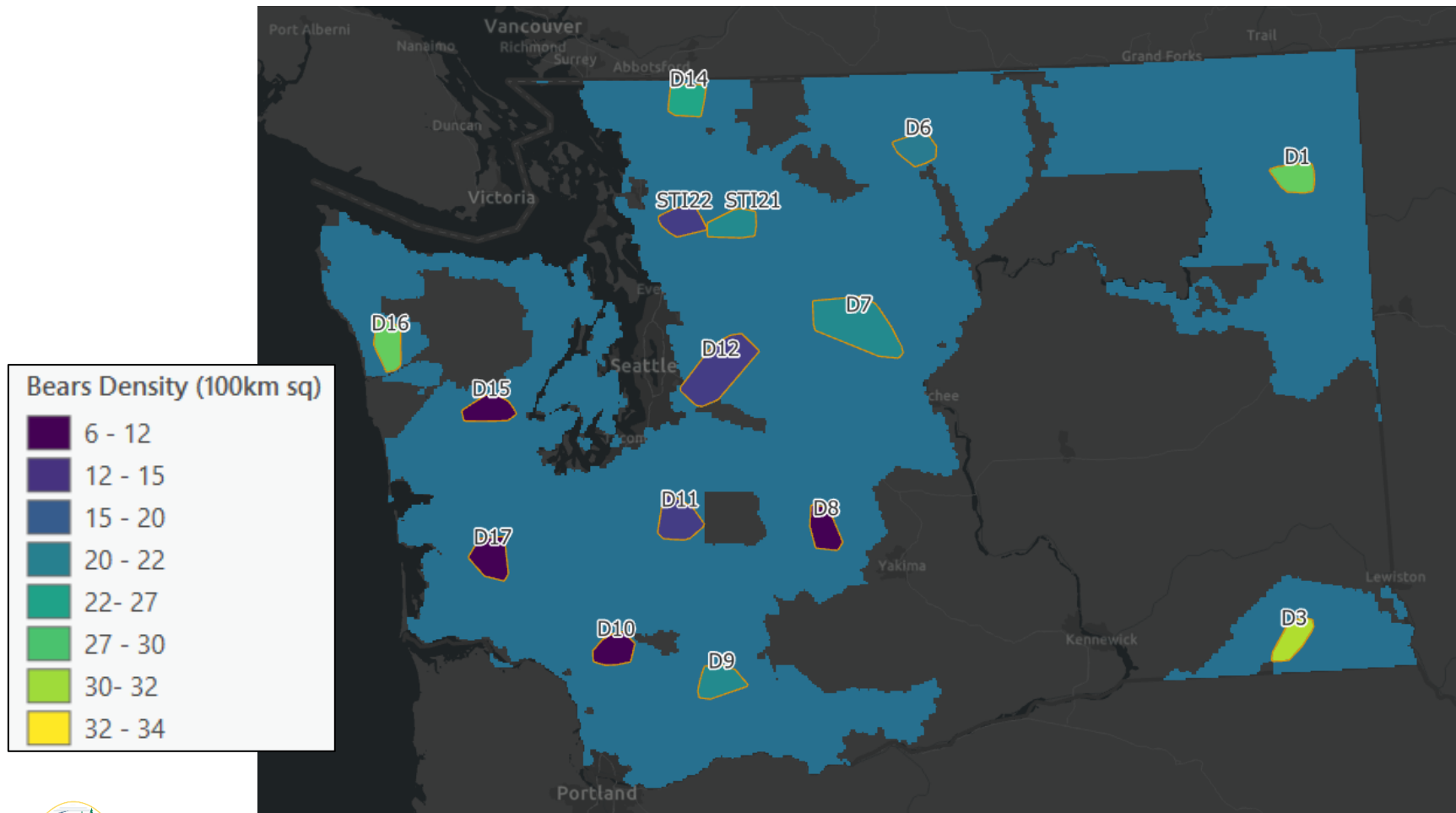


Statewide Monitoring

- Used sampling design that would allow rigorous independent density estimates
- 36 cells within each study area - each cell being 3km x 3km (9km²)
- 2013-2016 & 2019-2023 sampling area GMUs shown in dark gray (n=15)
- Estimates adjusted to reflect bears ≥ 1 year-of-age



Results – Density Estimate for Each Study Area

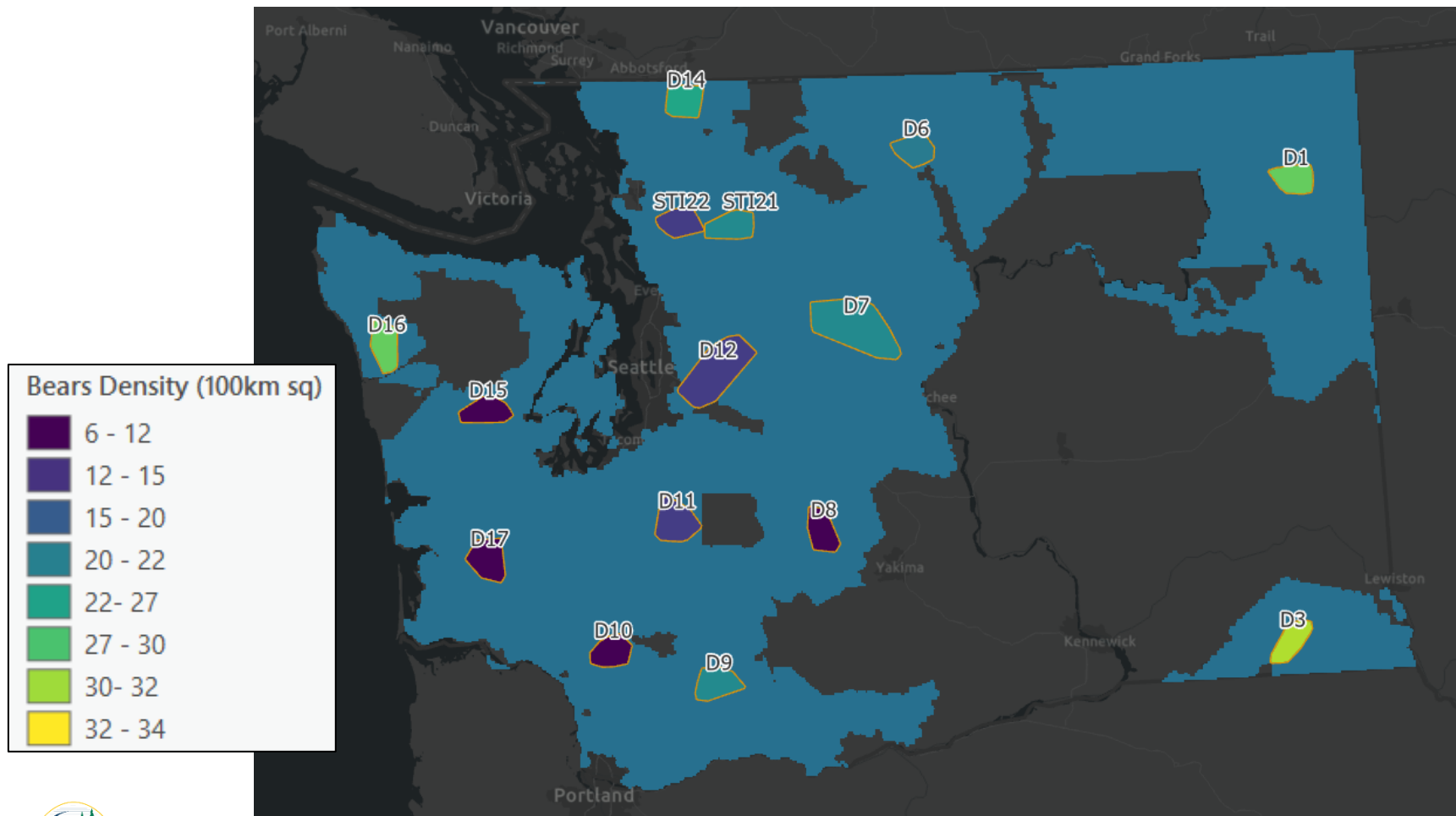


Washington's Proposed Framework

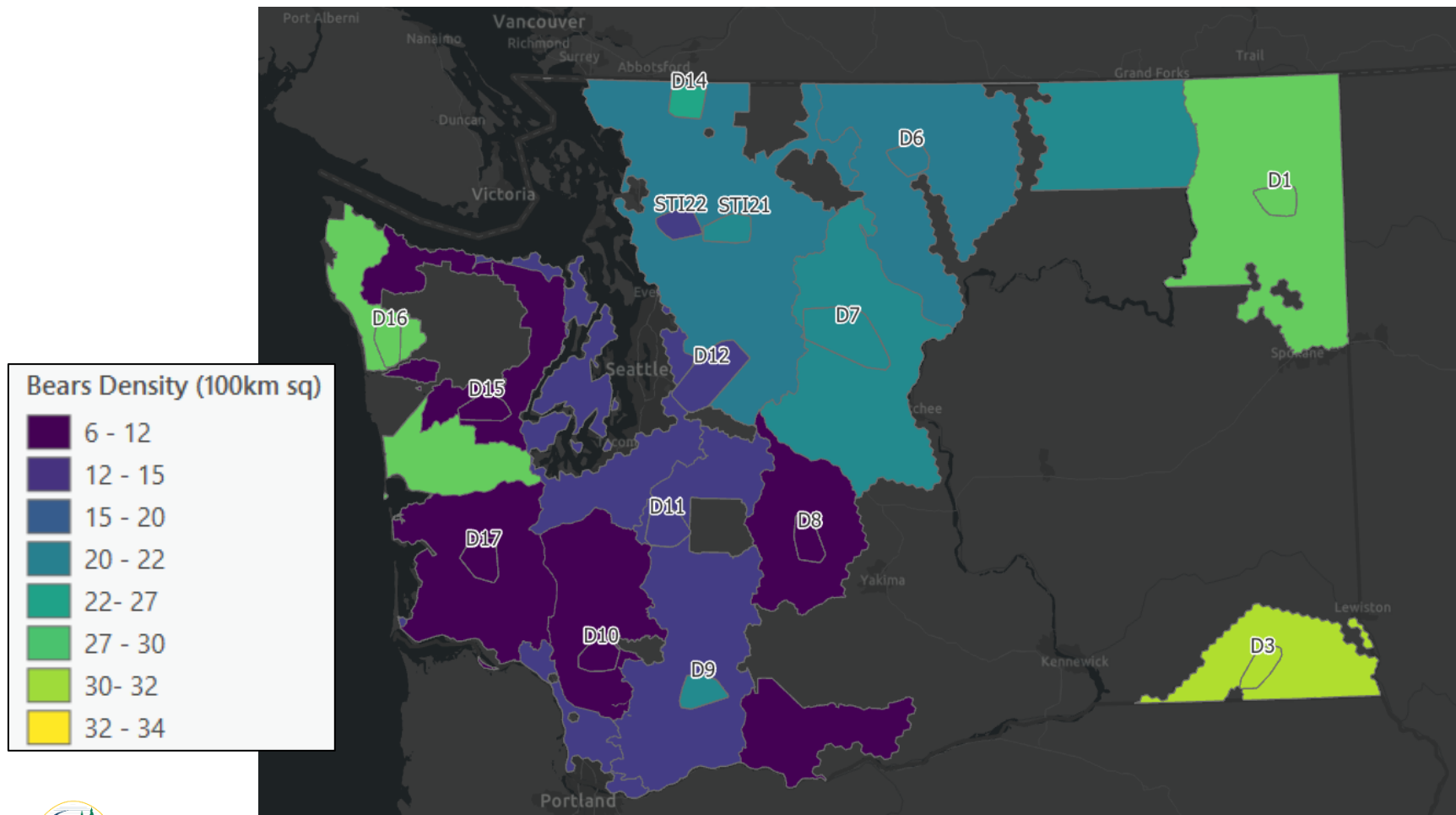
Female mortalities/**habitat** x density < intrinsic growth rate



Extrapolate study area densities? To bear habitat

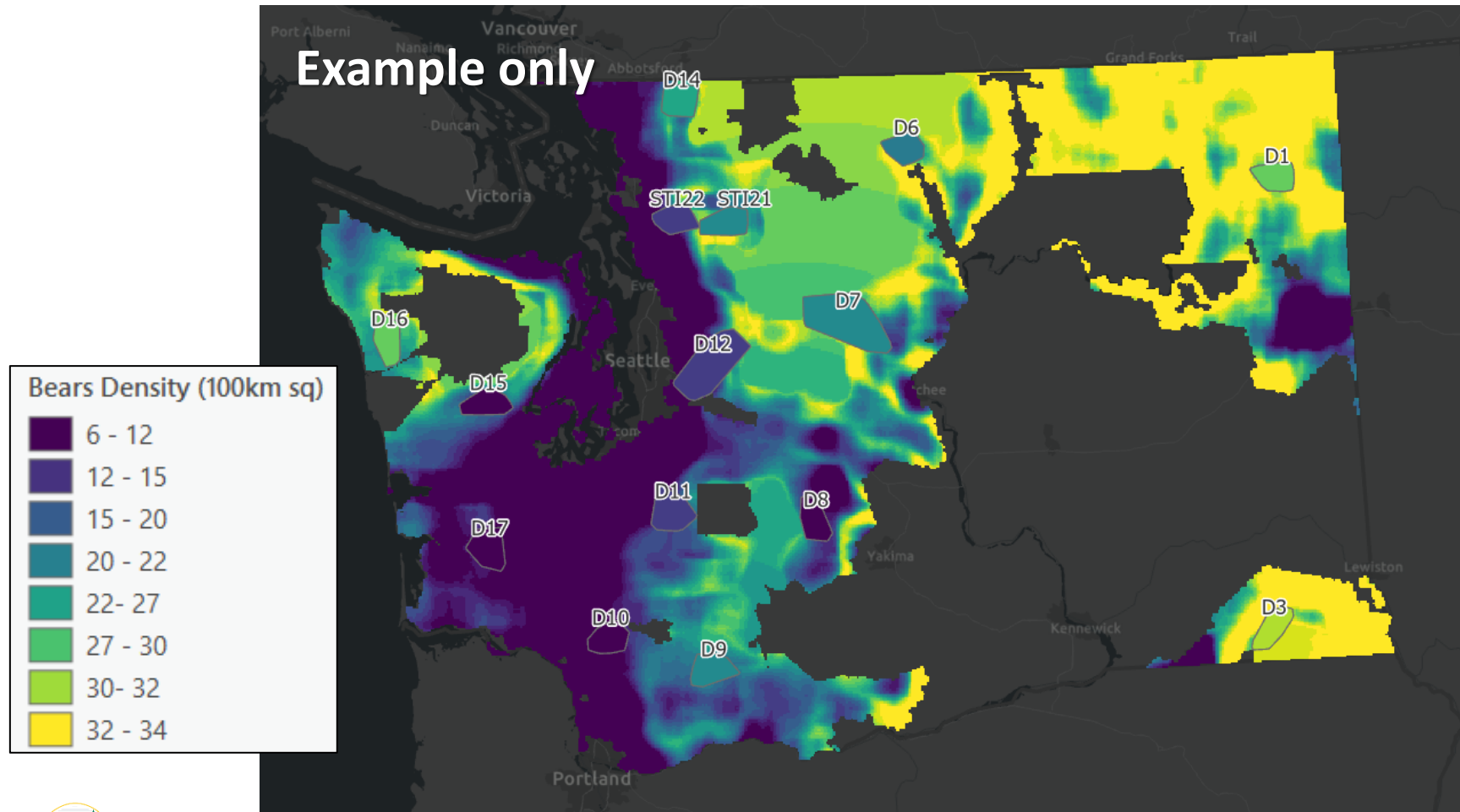


Extrapolate study area densities? To BBMU's



Extrapolate study area densities?

By study area location & covariates



Generalized Additive Models

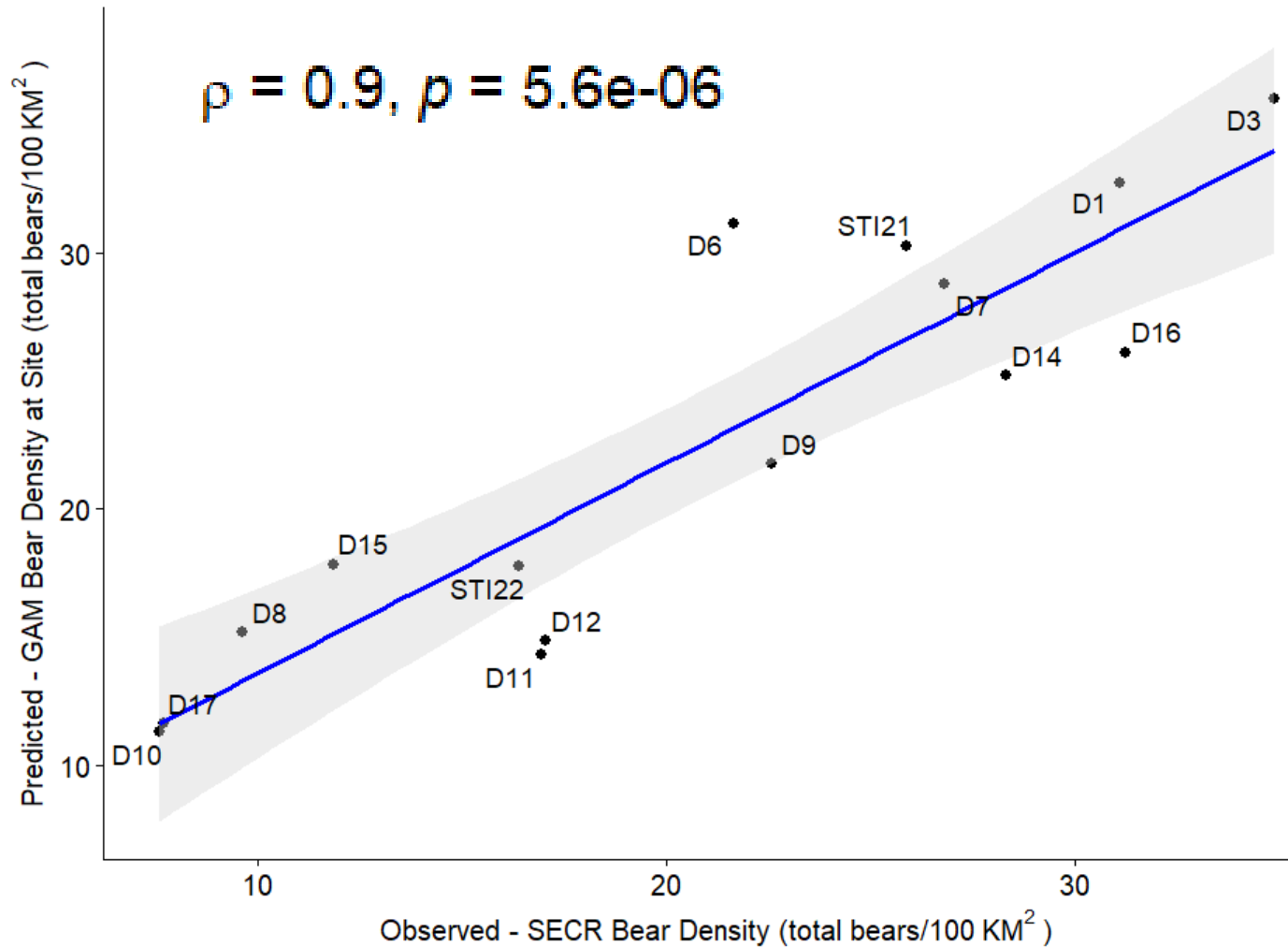
("non-linear" regression)

- Extrapolate adult female density / **Extrapolate bear density * proportion adult females**
- Predictors:
 - **Easting, Northing**, Elevation, Ruggedness
 - **Forest cover**, %Evergreen, %Deciduous mixed, %shrub, Riparian, USFS_CanopyCover, Forest height, NDVI, NPP
 - **Road density, Human footprint**, "Resistance", Primary roads, Secondary roads, %Agriculture, %Developed
 - ...
- Interactions, Degrees of nonlinearity, Distributions (**Poisson**), Overdispersion (*statistical*), etc.



Model Fit

By study area location & covariates



Washington's Proposed Framework

Female mortalities / habitat \times density \leq intrinsic growth rate



Document mortalities

WDFW mechanism

Monitor female black bear mortality

- General season harvest estimates – analysis of hunter reports
- Timber damage removals – mandatory permit reporting, USDA WS
- Human-bear conflict removals – WDFW staff reports
- Wounding loss – multiply estimated rate (10% from empirical data) by hunter harvest

$$\frac{\text{WDFW managed Female Mortality Rate}}{\text{Intrinsic Growth Rate}} \leq 8\%$$
$$\frac{\text{harvest} * 1.1 + \text{timber} + \text{conflict}}{\text{female density} * \text{habitat}} \leq 8\%$$



Next Steps

1. Complete covariate female density model
2. Calculate total female take for each BBMU at 8% (i.e., $\text{harvest} * 1.1 + \text{timber} + \text{conflict}$)
3. Review by external scientists
4. Continue monitoring



Questions?

