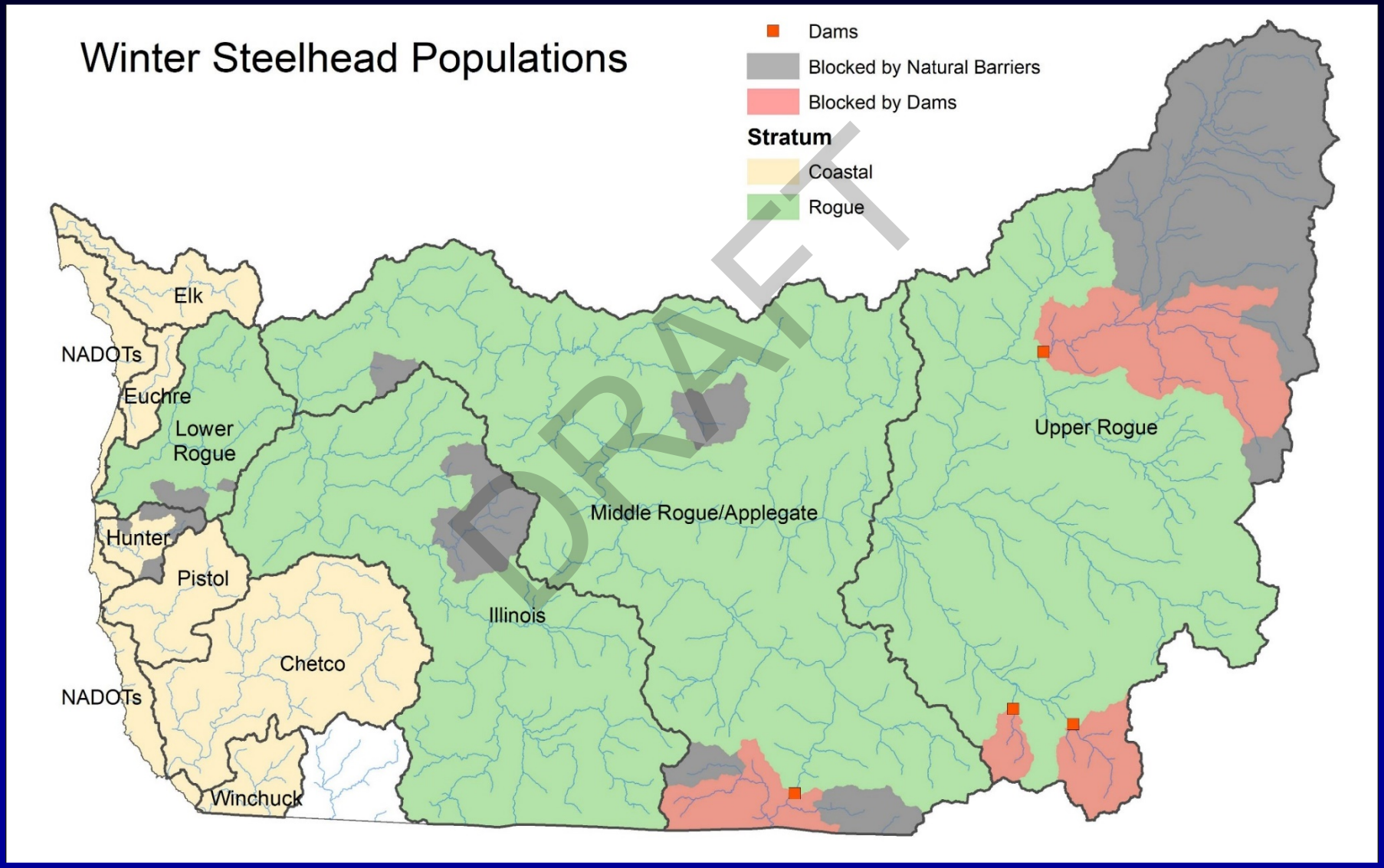
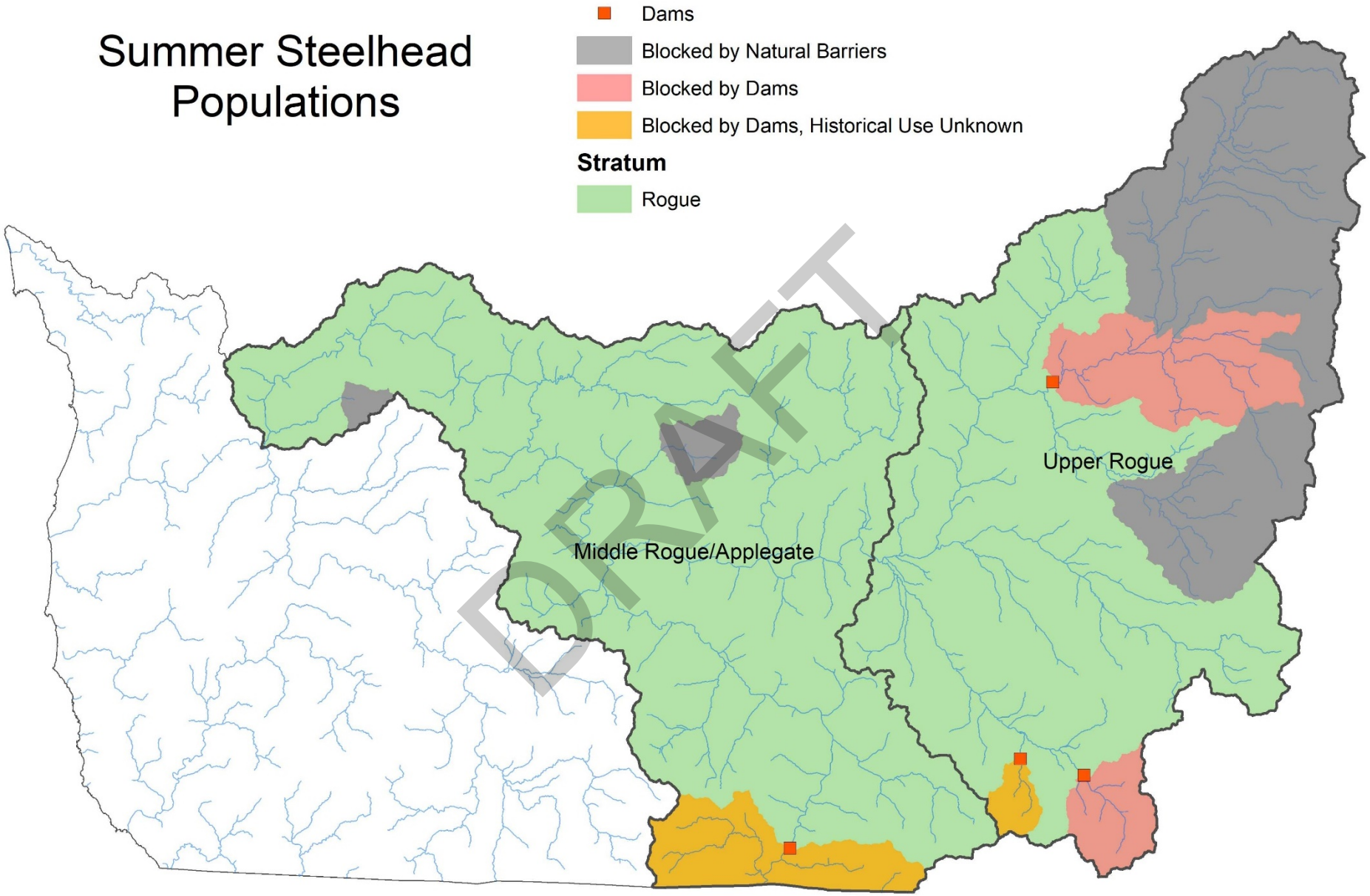
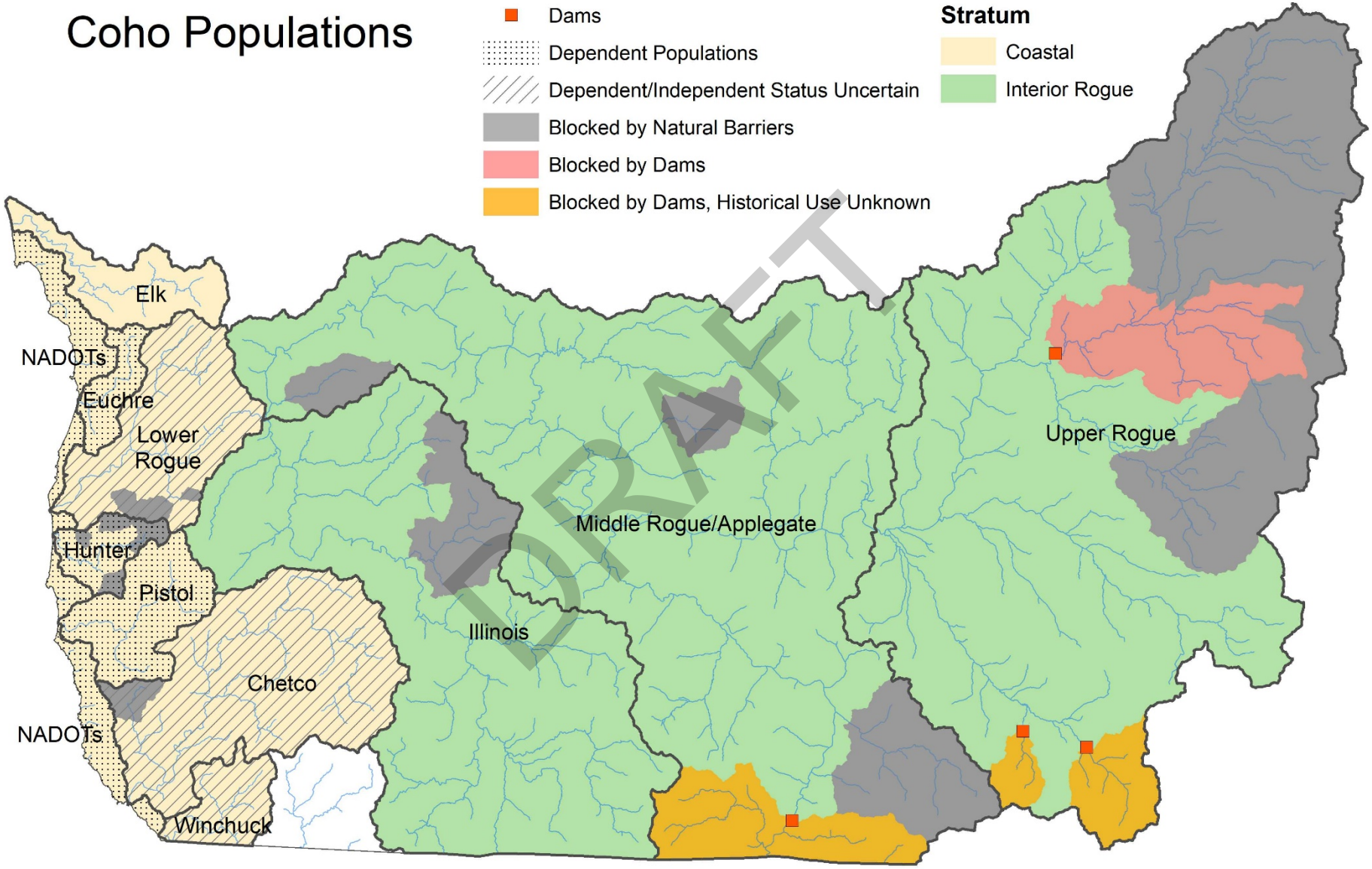
Current Status Assessment

Current Status: Populations



Summer Steelhead Populations




Coho Populations
Dams
Dependent Populations
Dependent/Independent Status Uncertain
Blocked by Natural Barriers
Blocked by Dams
Blocked by Dams, Historical Use Unknown
Stratum
Coastal
Interior Rogue
Elk
NADOTs
Euchre
Lower Rogue
Hunter
Pistol
Chetco
NADOTs
Winchuck
Illinois
Middle Rogue/Applegate
Upper Rogue
DRAFT

Assessment Approach

Assess independent populations

Viable Salmonid Population (VSP) parameters:

Abundance, Productivity, Spatial Structure, and Diversity

Determine viability risk for populations & strata

SMU Status = Viability Risk + Assessment Confidence

Confidence indicators: VSP data completeness, population trend

Status Assessment

Viability Risk is the currency:

- *Viable salmonid population* = an independent population with a negligible risk of extinction due to threats from demographic variation (population fluctuations), local environmental variation, and genetic diversity changes over a 100-yr time frame.

- VSP metrics scored from 1 to 5 (*Very Low to Very High Risk*)

*Risk Score = (2/3*A&P + 1/6*SS + 1/6*D) or A&P*

Data Sources

- Juvenile snorkel surveys
  - Steelhead
  - Coho salmon
  - Cutthroat Trout
- Huntley Park estimates
  - Coho salmon
  - Late-run summer steelhead
  - Half-Pounder steelhead

- Winter steelhead counts at Gold Ray Dam
- Elk River coho spawning surveys

Current Status Assessment Metrics and Analysis

			Viable Salmonid Population (VSP) Parameter Assessment									Viability Risk		Indicators of Confidence in Viability Results				STATUS
			Abundance & Productivity			Spatial Structure				Diversity				Trend Risk Scores				
SMU	Stratum	Population	100-year Extinction Risk	Juvenile Rearing Density	*Score*	% Historic Distribution Score	Probability of Occurrence	Spatial Structure Trend	*Score*	Life History Loss Score	*Diversity Score*	**Population Scores**	**Stratum Risk Category**	Adult Abundance	Half-Pounder Abundance	Juvenile Abundance	VSP Data Completeness	
WINTER STEELHEAD	Coastal	Elk	-	1	*1.0*	1	1	-	*1.0*	1	*1.0*	**1.0**	**Very Low**	-	-	5	Low	**Strong-Guarded**
		Euchre			*1.0*	1	1		*1.0*	1	*1.0*	**1.0**						
		Hunter			*1.0*	1	1		*1.0*	1	*1.0*	**1.0**						
		Pistol			*1.0*	1	1		*1.0*	1	*1.0*	**1.0**						
		Chetco			*1.0*	1	1		*1.0*	1	*1.0*	**1.0**						
		Winchuck			*1.0*	1	1		*1.0*	1	*1.0*	**1.0**						
	Rogue	Lower Rogue	-	2	*2.0*	1	1	1	*1.0*	1	*1.0*	**2.0**	**Low**	-	1	5	Medium	
		Illinois			*2.0*	1	2		*1.3*	1	*1.0*	**2.0**						
		Middle Rogue/Applegate			*2.0*	1	2		*1.3*	1	*1.0*	**2.0**						
		Upper Rogue	2		*2.0*	2	2		*1.7*	2	*1.5*	**2.0**		2				
SUMMER STEELHEAD	Rogue	Middle Rogue/Applegate	-	-	-	1	-	-	*1.0*	2	*1.5*	**1.3**	**Low**	4	1	-	Very Low	**Sensitive**
		Upper Rogue			-	2			*2.0*	2	*1.5*	**1.8**						
COHO SALMON	Coastal	Elk	-	4	*4.0*	1	5	-	*3.0*	2	*2.0*	**4.0**	**High**	1	-	-	Low	**Sensitive-Critical**
	Interior Rogue	Illinois	3	3	*3.0*	1	4	1	*2.0*	2	*2.0*	**3.0**	**Moderate**	3	-	5	Low	
		Middle Rogue/Applegate			*3.0*	1	4		*2.0*	2	*2.0*	**3.0**						
		Upper Rogue			*3.0*	2	4		*2.3*	2	*2.0*	**3.0**						
CUTTHROAT TROUT	Coastal	Elk	-	1	*1.0*	1	2	-	*1.5*	2	*2.0*	**1.3**	**Very Low**	-	-	1	Low	**Strong-Guarded**
		Euchre			*1.0*	1	2		*1.5*	2	*2.0*	**1.3**						
		Hunter			*1.0*	1	2		*1.5*	2	*2.0*	**1.3**						
		Pistol			*1.0*	1	2		*1.5*	2	*2.0*	**1.3**						
		Chetco			*1.0*	1	2		*1.5*	2	*2.0*	**1.3**						
		Winchuck			*1.0*	1	1		*1.0*	2	*2.0*	**1.2**						
	Rogue	Lower Rogue	-	1	*1.0*	1	2	1	*1.3*	2	*2.0*	**1.2**	**Very Low**	-	-	1	Low	
		Illinois			*1.0*	1	2		*1.3*	2	*2.0*	**1.2**						
		Middle Rogue/Applegate			*1.0*	1	2		*1.3*	2	*2.0*	**1.2**						
		Upper Rogue			*1.0*	1	2		*1.3*	2	*2.0*	**1.2**						

Abundance & Productivity

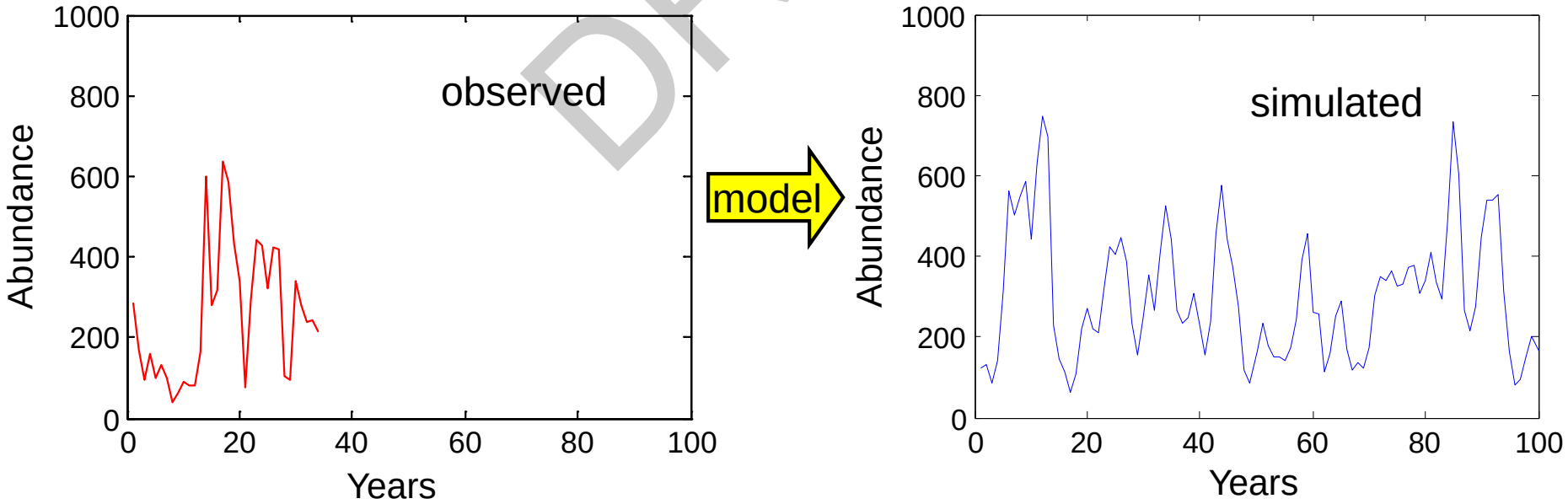
Matt Falcy, Ph.D.
Fish Conservation Biologist
Oregon Department of Fish and Wildlife

Population Viability Analysis (PVA)

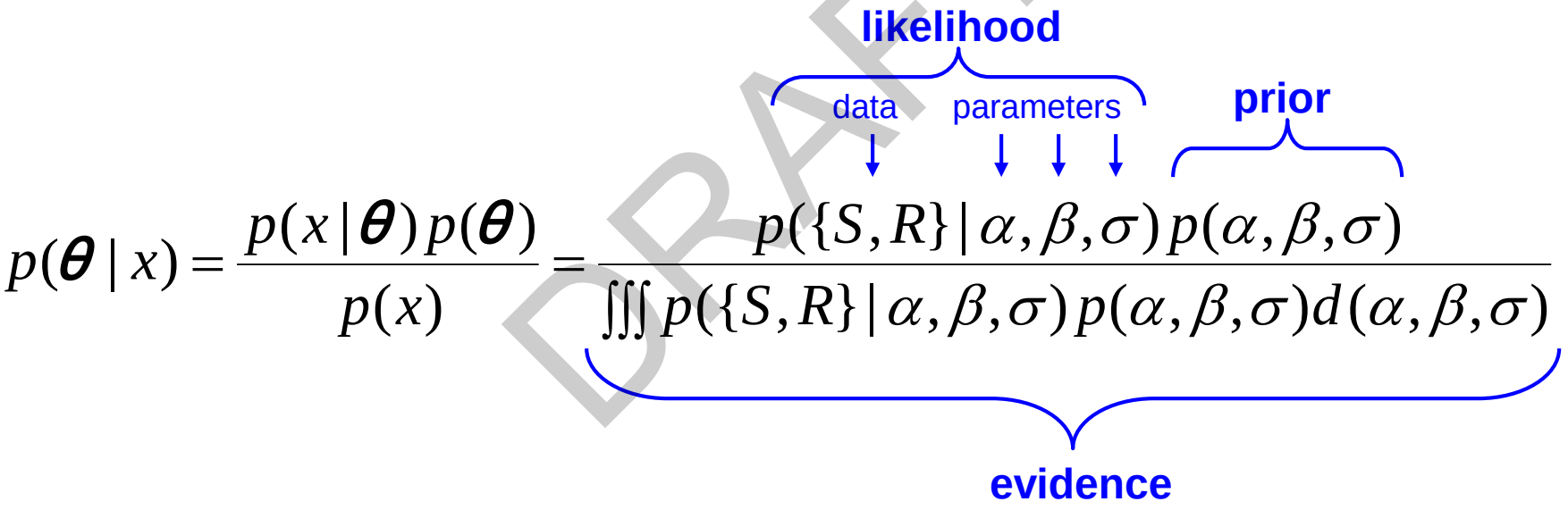
1. PVA is a computerized simulation model that incorporates abundance and productivity.

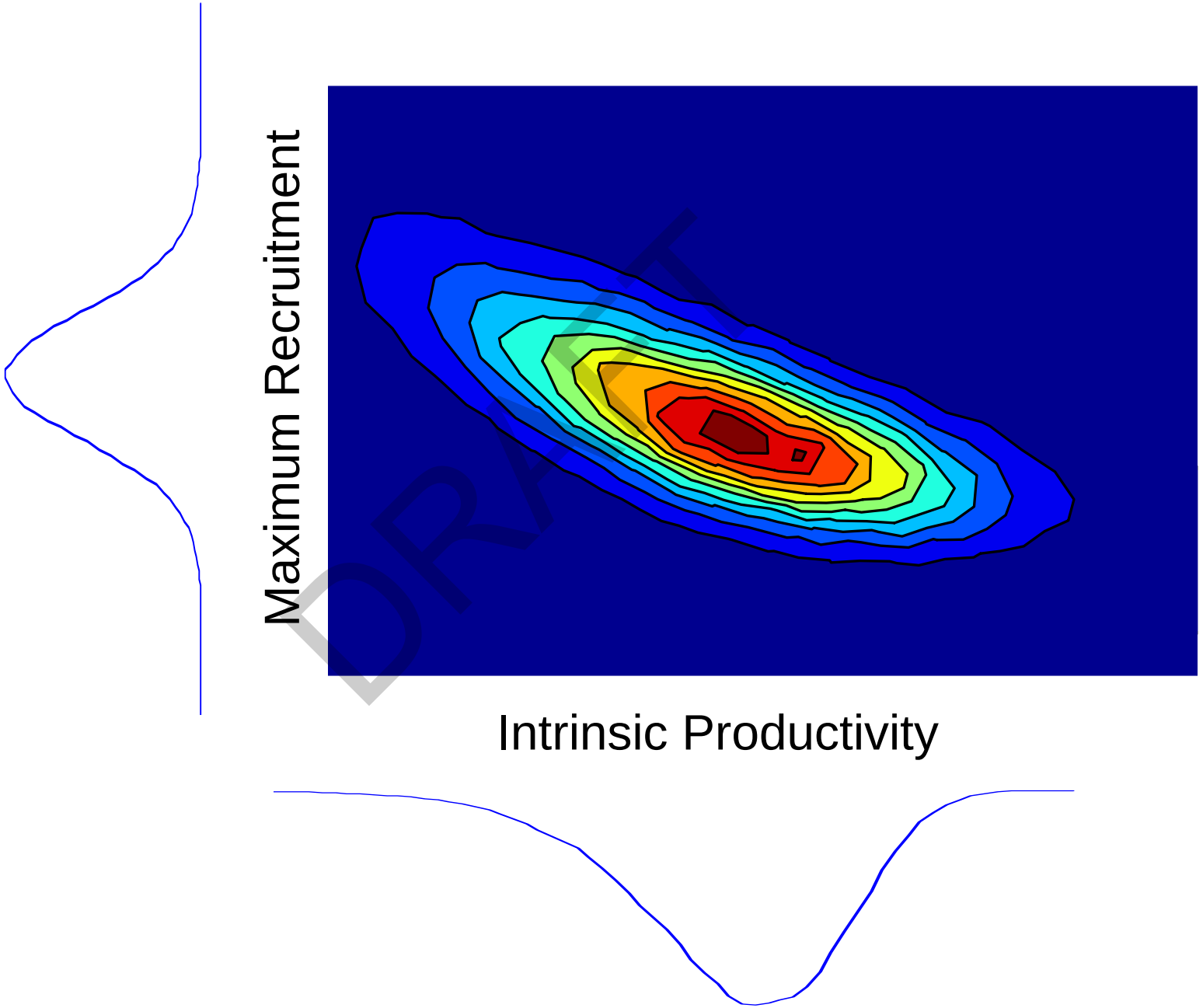
2. The output of the PVA model is an estimate of the probability of extinction over 100 years.

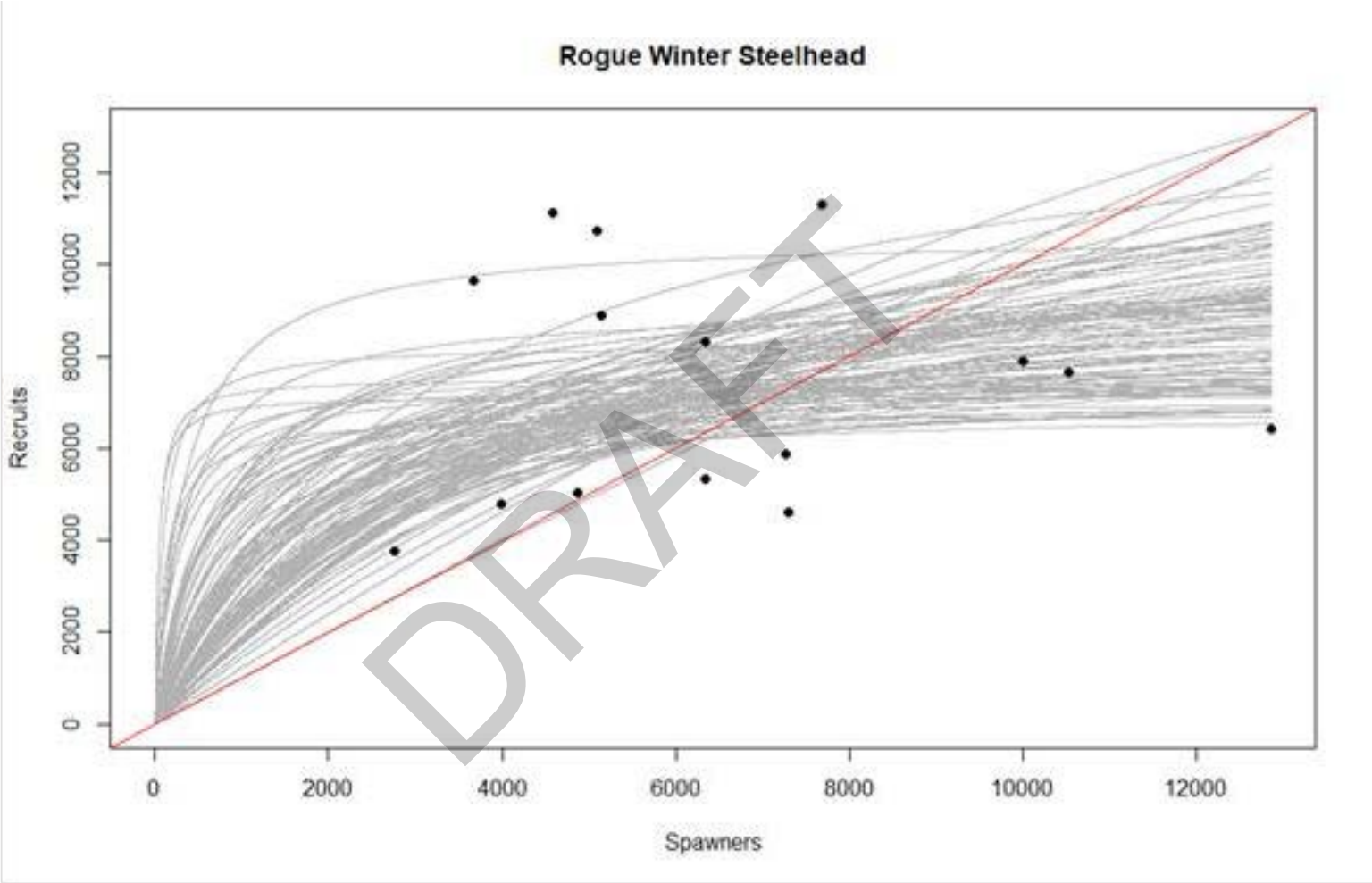
3. The PVA model projects the consequences of recent environmental conditions (the model intentionally ignores future environmental change).



Bayes' theorem of conditional probability can improve PVA

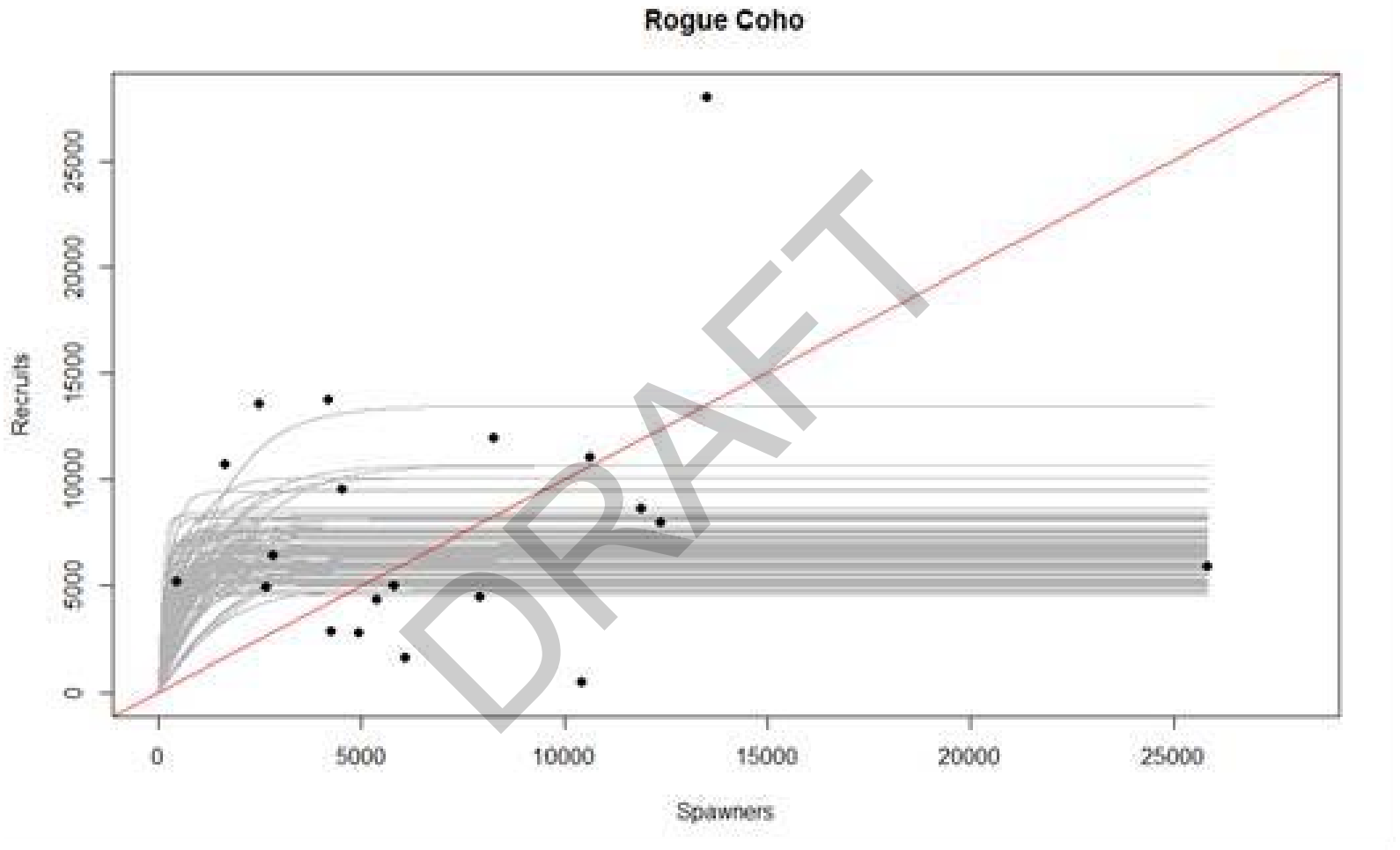






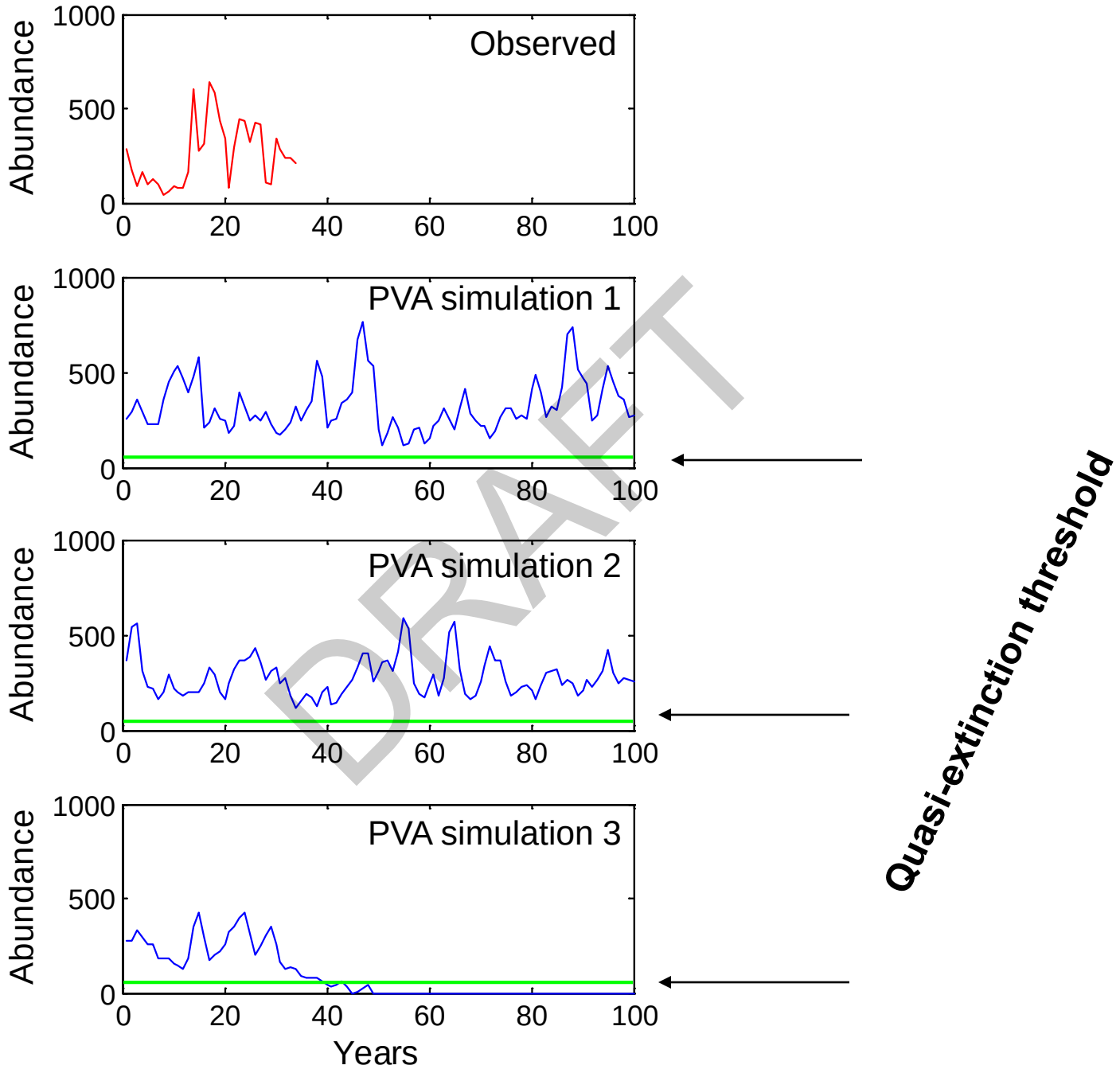
Beverton-Holt Model with the Jeffreys prior

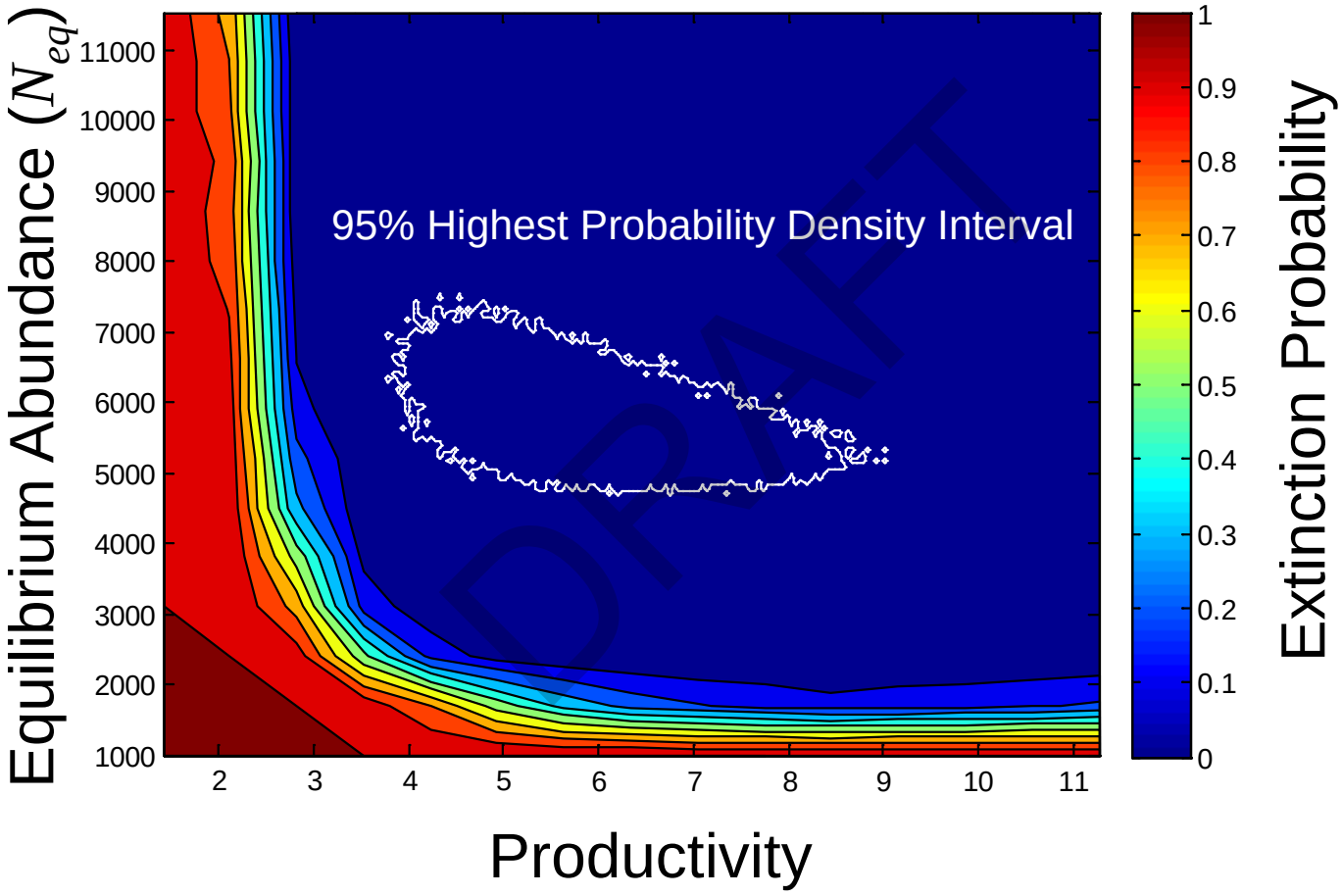
Mean Smsy = 2,581 (95% CI = 1,453 - 4,213)



Logistic Hockey Stick Model

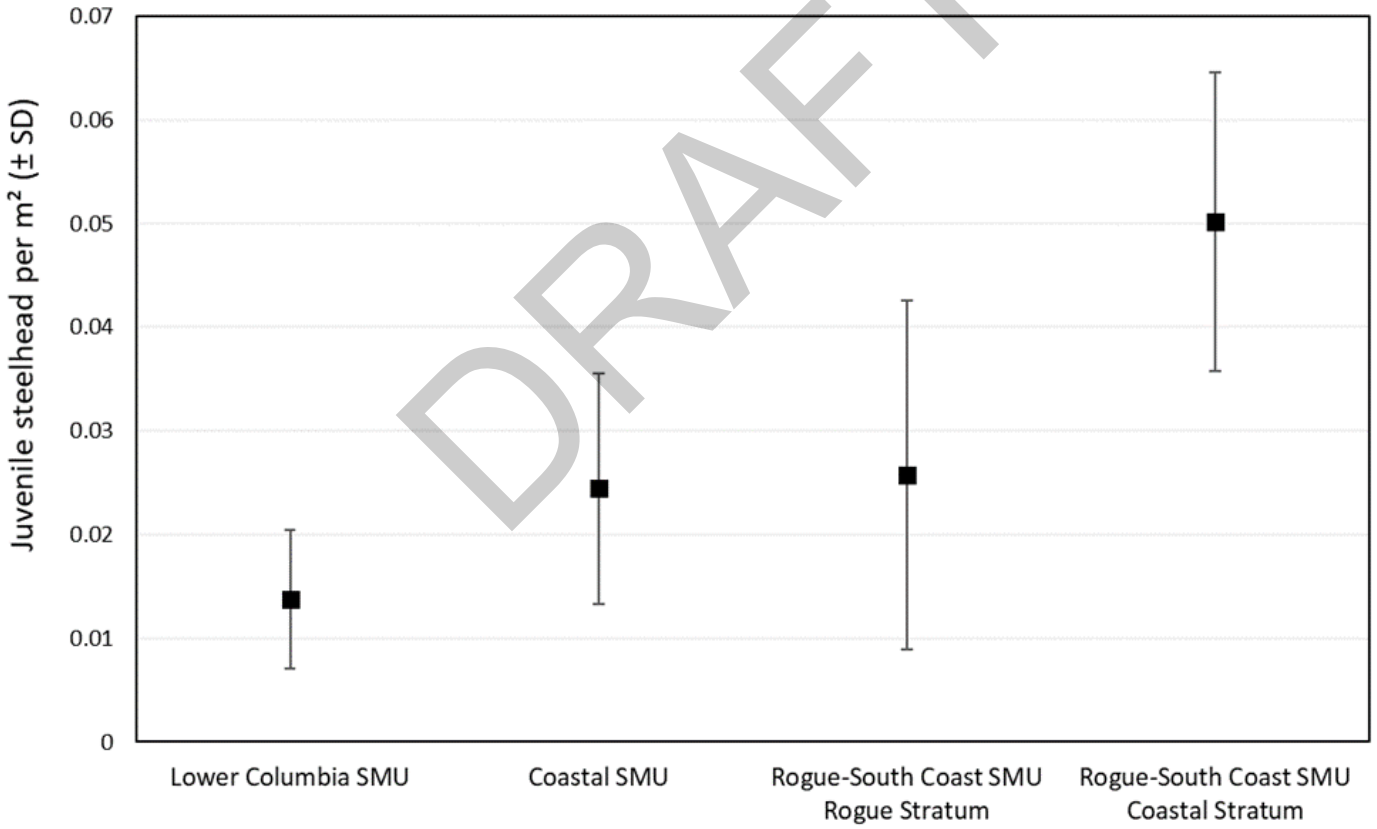
Mean Smsy = 1,322 (95% CI = 273 – 2,607)

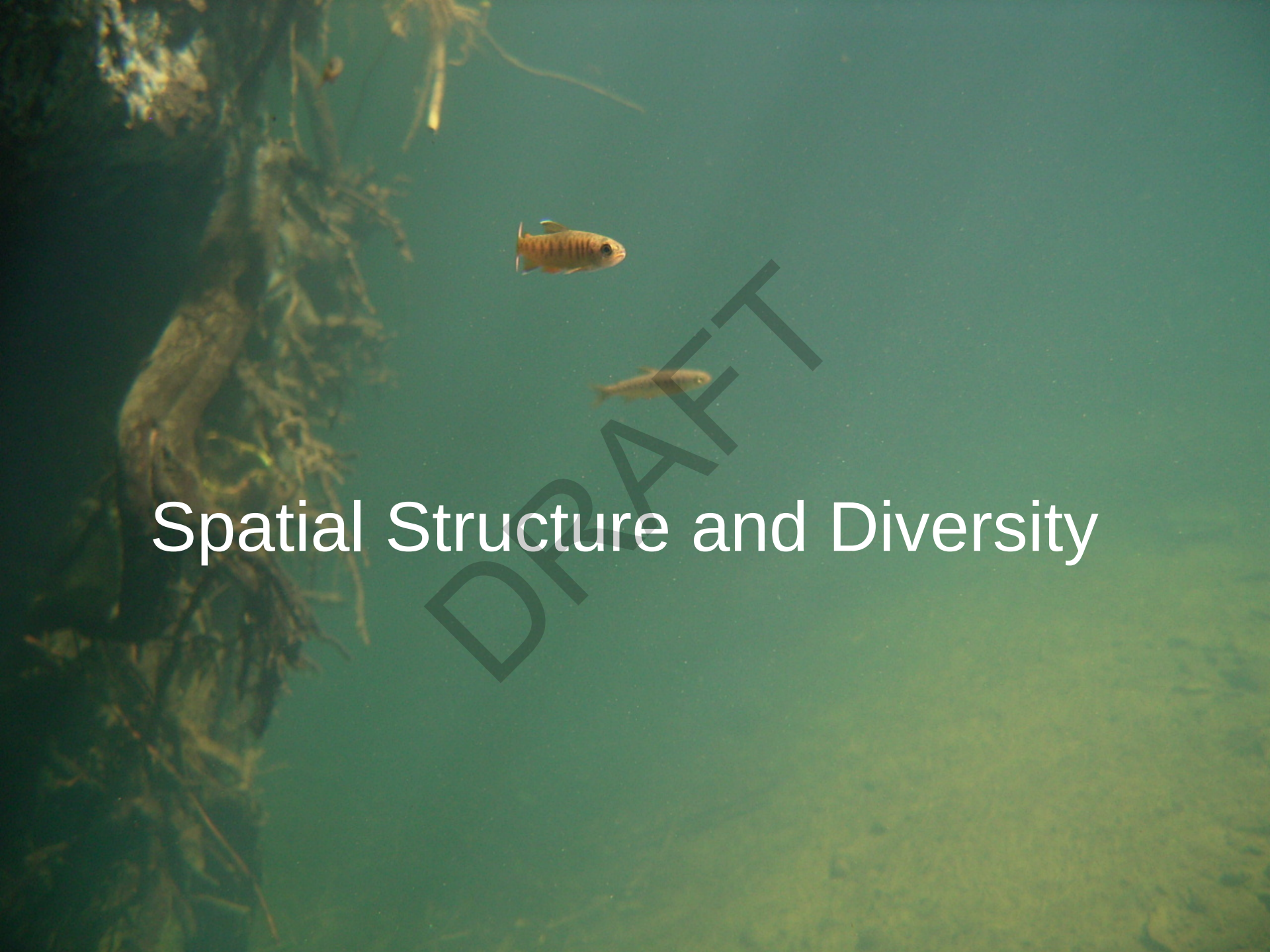

Observed
PVA simulation 1
PVA simulation 2
PVA simulation 3
Abundance
Years
0
500
1000
0
20
40
60
80
100
Quasi-extinction threshold


Equilibrium Abundance (N_{eq})
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
2
3
4
5
6
7
8
9
10
11
Productivity
95% Highest Probability Density Interval
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Extinction Probability

Juvenile Abundance Data

- For many populations/strata, juvenile data best available indicator
- Consistent methods allow rearing density to be compared with Coastal and Lower Columbia SMUs, where viability status has been assessed





Spatial Structure and Diversity

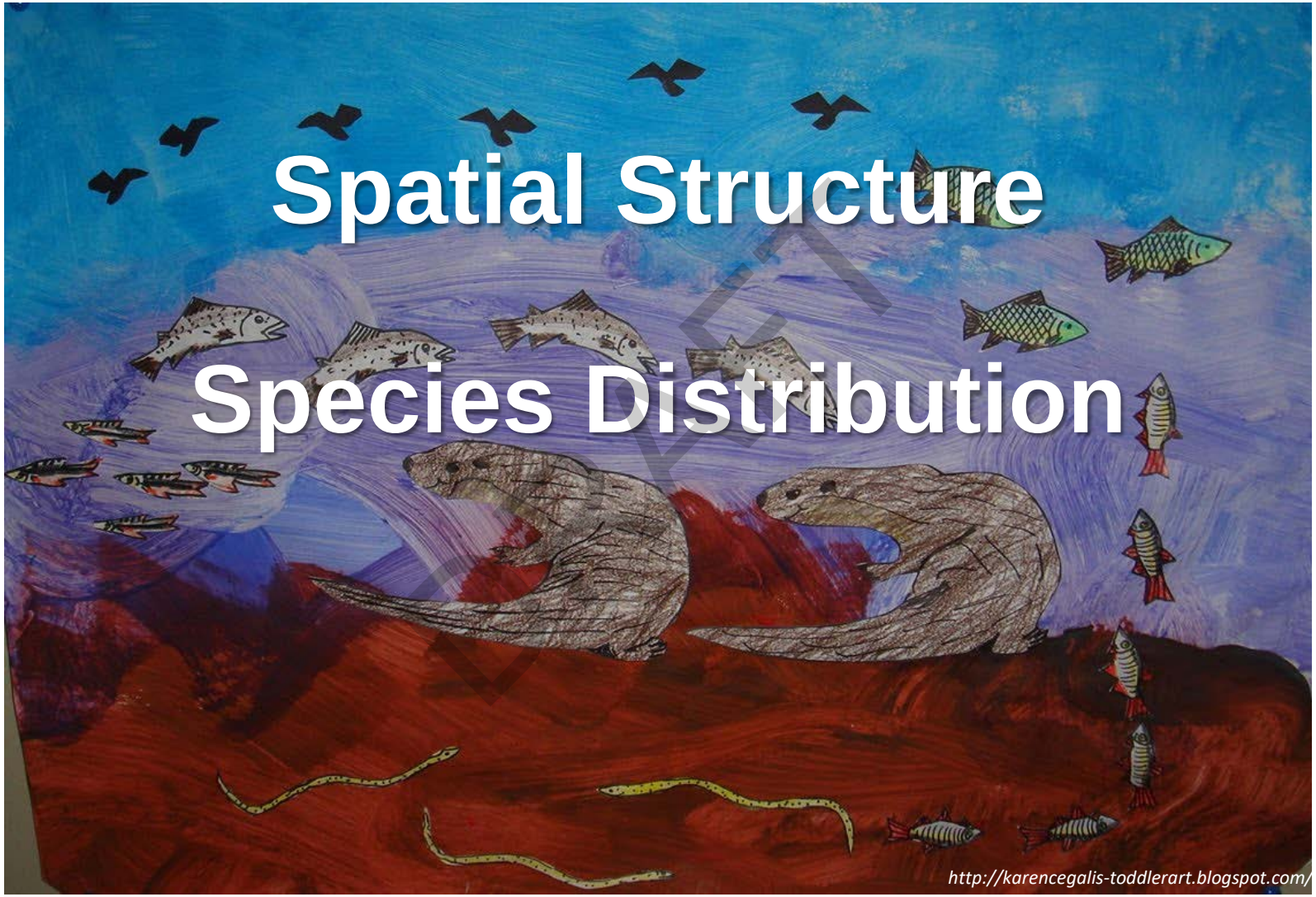
Metrics

Spatial Structure:

1. Loss of historical habitat
2. **Probability of Occurrence (Species Distribution Models)**
3. Spatial Structure Trend (Rogue Stratum only)

Diversity

1. Loss of life-history diversity
   (e.g. Run timing, juvenile strategies, age structure)


Spatial Structure
Species Distribution
http://karencegalis-toddlerart.blogspot.com/

Species Distribution Models Methods

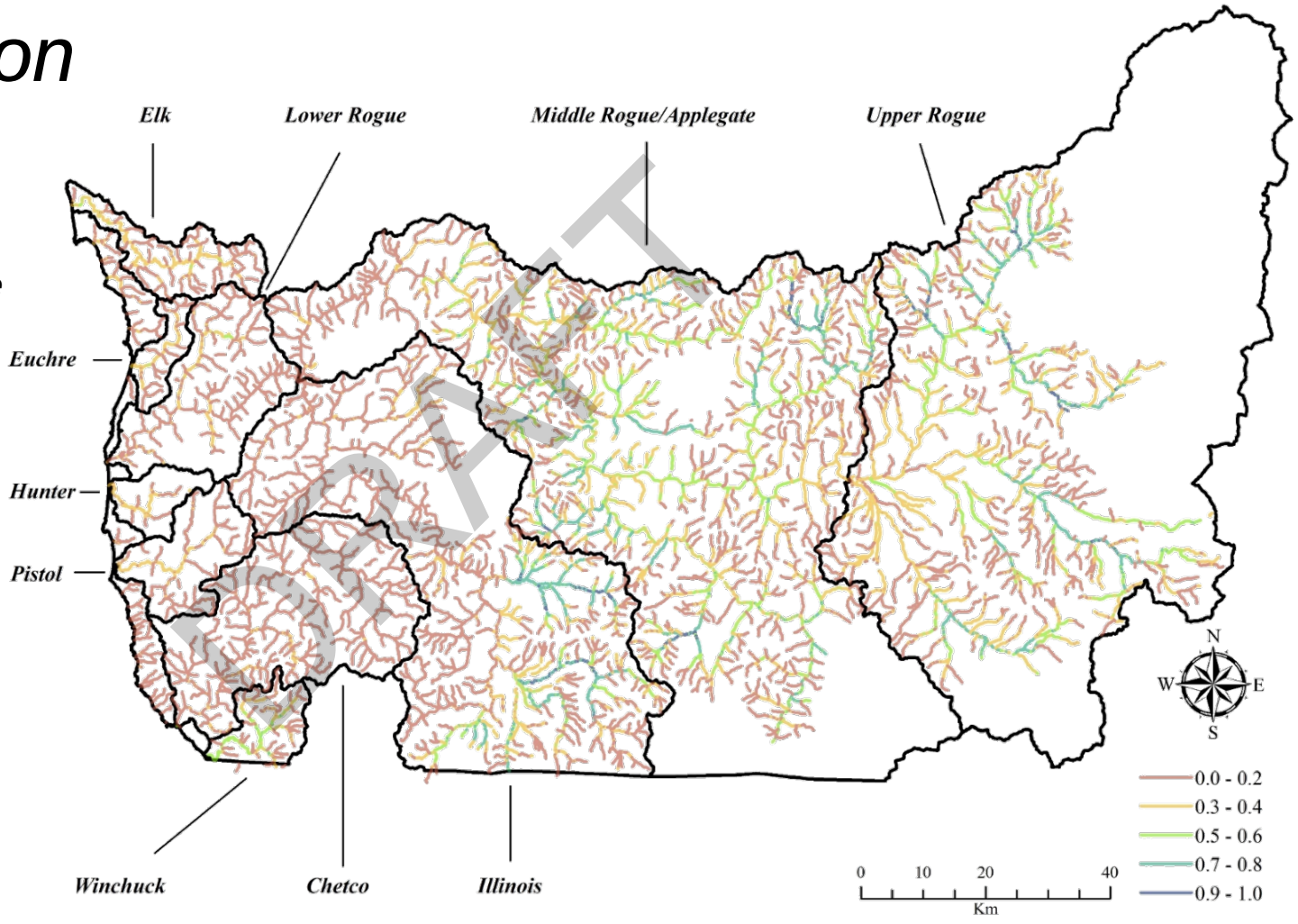
- Predict probability of occupancy to unsampled locations
- Use occurrence and landscape/climatic data
- Juvenile distributions
- Ensemble modeling
- Model performance metrics

Coho Salmon

1,079 observations

- *Hydrologic landscape*
- *Stream order*
- *Streamflow permanence*
- *Historical stream flow*
- *August temperature*
- *Gradient*

AUC 0.936

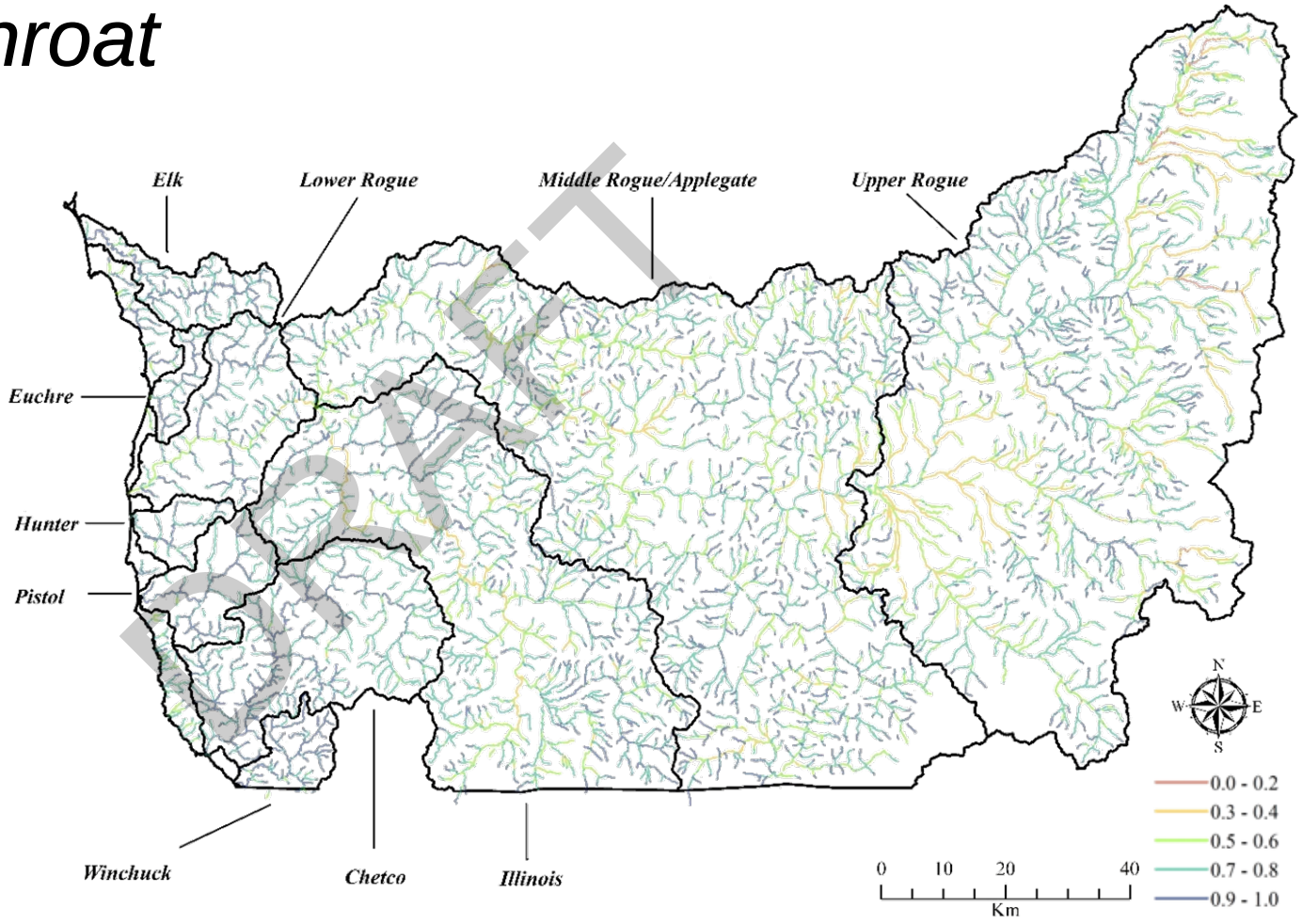


Coastal Cutthroat

3,313 observations

- *Historical stream flow*
- *Hydrologic landscape*
- *Streamflow permanence*
- *August temperature*
- *Stream order*
- *Solar shading*
- *Drainage area*

AUC 0.909

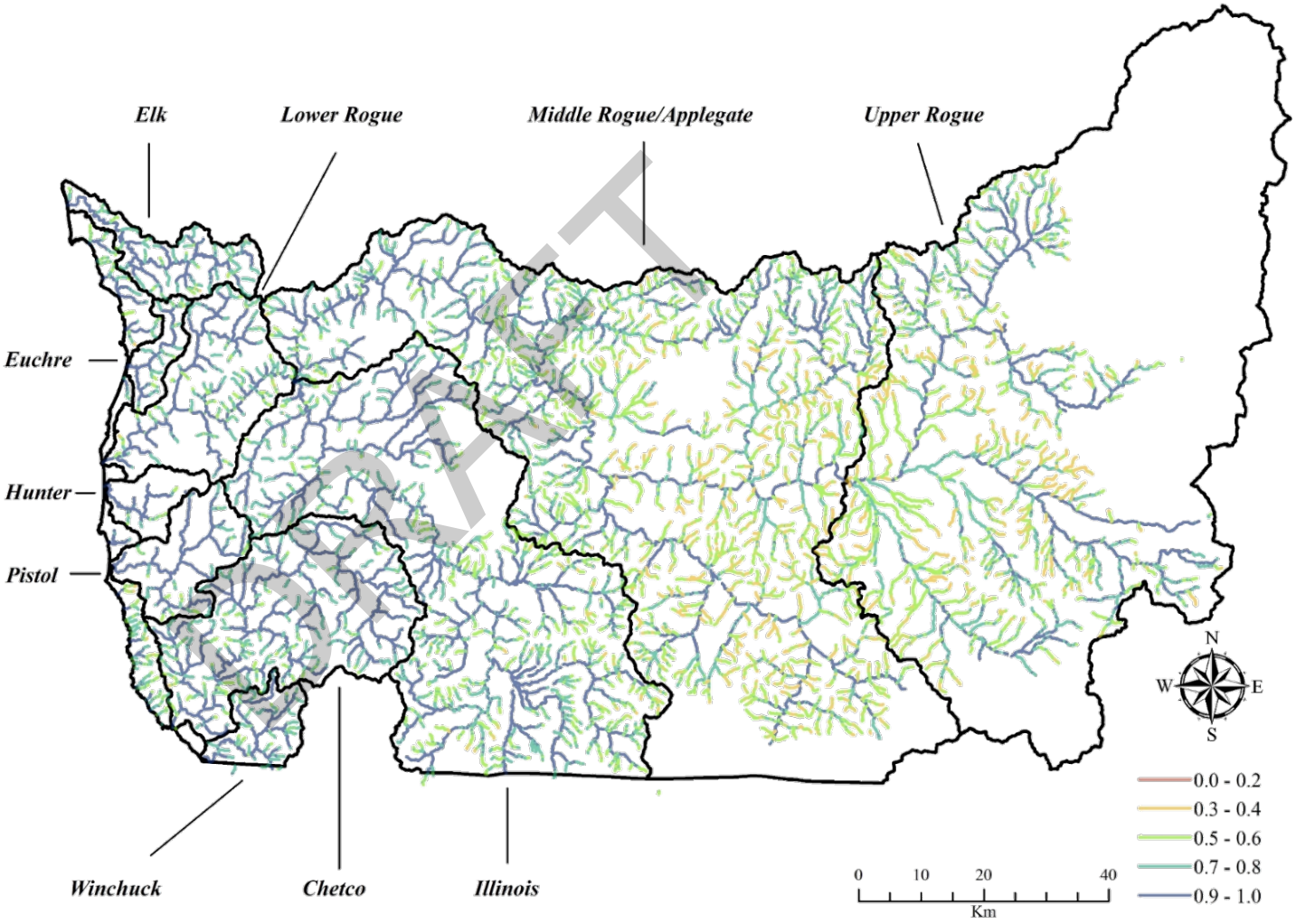


Steelhead

1,723 observations

- *Historical stream flow*
- *Hydrologic landscape*
- *Floodplain width*
- *Drainage area*
- *August temperature*
- *Gradient*
- *Streamflow permanence*

AUC 0.943



			Viable Salmonid Population (VSP) Parameter Assessment									Viability Risk		Indicators of Confidence in Viability Results				STATUS
			Abundance & Productivity			Spatial Structure				Diversity				Trend Risk Scores				
SMU	Stratum	Population	100-year Extinction Risk	Juvenile Rearing Density	*Score*	% Historic Distribution Score	Probability of Occurrence	Spatial Structure Trend	*Score*	Life History Loss Score	*Diversity Score*	**Population Scores**	**Stratum Risk Category**	Adult Abundance	Half-Pounder Abundance	Juvenile Abundance	VSP Data Completeness	
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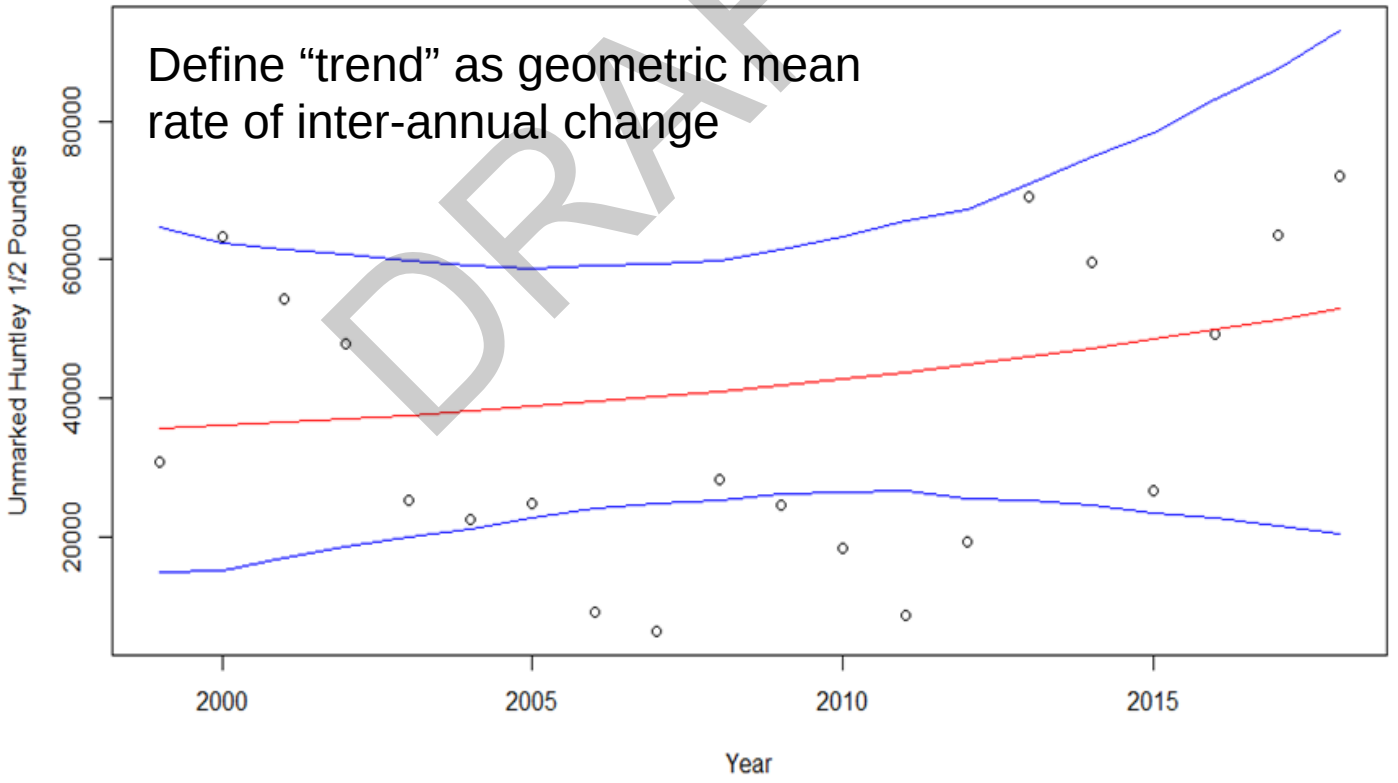
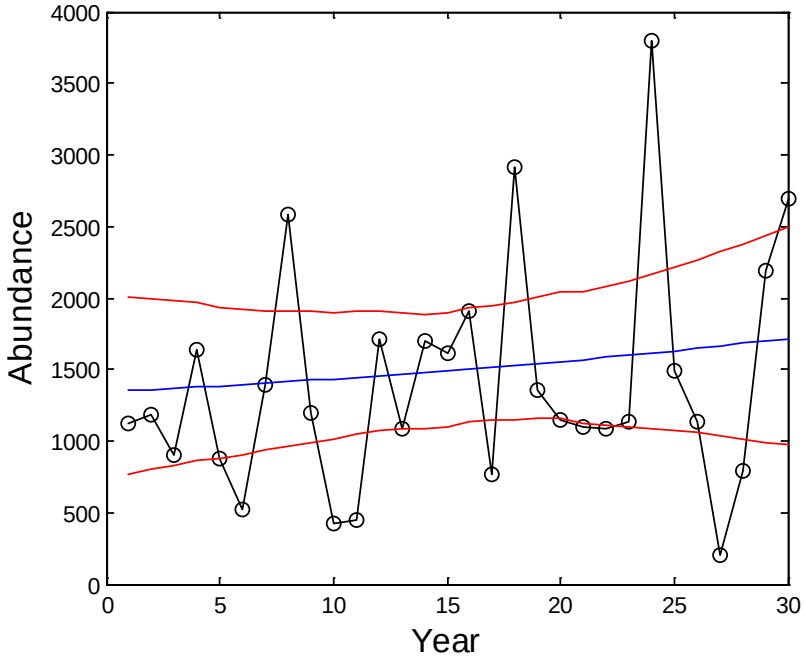
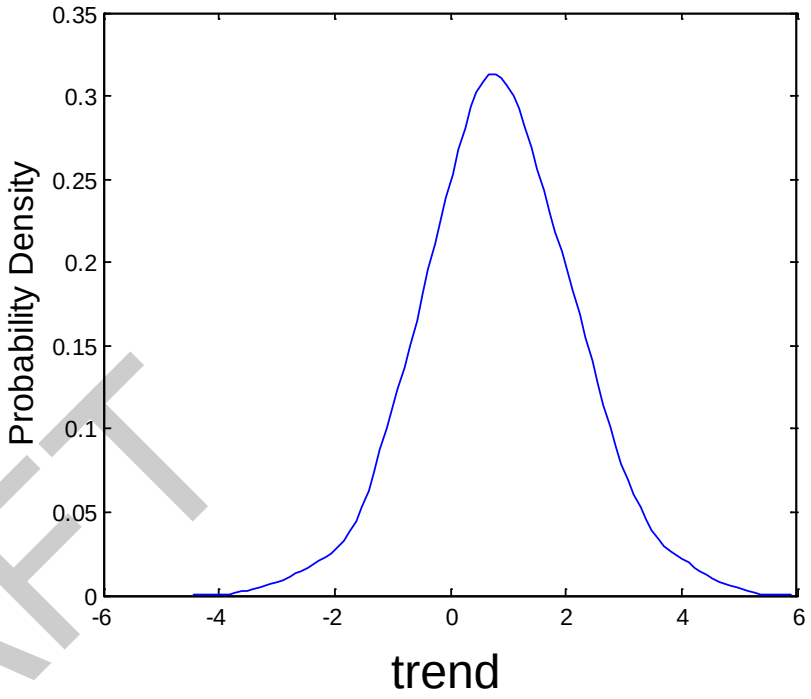
		Euchre			*1.0*	1	1		*1.0*	1	*1.0*	**1.0**						
		Hunter			*1.0*	1	1		*1.0*	1	*1.0*	**1.0**						
		Pistol			*1.0*	1	1		*1.0*	1	*1.0*	**1.0**						
		Chetco			*1.0*	1	1		*1.0*	1	*1.0*	**1.0**						
		Winchuck			*1.0*	1	1		*1.0*	1	*1.0*	**1.0**						
	Rogue	Lower Rogue	-	2	*2.0*	1	1	1	*1.0*	1	*1.0*	**2.0**	**Low**	-	1	5	Medium	
		Illinois			*2.0*	1	2		*1.3*	1	*1.0*	**2.0**						
		Middle Rogue/Applegate			*2.0*	1	2		*1.3*	1	*1.0*	**2.0**						
		Upper Rogue	2		*2.0*	2	2		*1.7*	2	*1.5*	**2.0**		2				
SUMMER STEELHEAD	Rogue	Middle Rogue/Applegate	-	-	-	1	-	-	*1.0*	2	*1.5*	**1.3**	**Low**	4	1	-	Very Low	**Sensitive**
		Upper Rogue			-	2			*2.0*	2	*1.5*	**1.8**						
COHO SALMON	Coastal	Elk	-	4	*4.0*	1	5	-	*3.0*	2	*2.0*	**4.0**	**High**	1	-	-	Low	**Sensitive-Critical**
	Interior Rogue	Illinois	3	3	*3.0*	1	4	1	*2.0*	2	*2.0*	**3.0**	**Moderate**	3	-	5	Low	
		Middle Rogue/Applegate			*3.0*	1	4		*2.0*	2	*2.0*	**3.0**						
		Upper Rogue			*3.0*	2	4		*2.3*	2	*2.0*	**3.0**						
CUTTHROAT TROUT	Coastal	Elk	-	1	*1.0*	1	2	-	*1.5*	2	*2.0*	**1.3**	**Very Low**	-	-	1	Low	**Strong-Guarded**
		Euchre			*1.0*	1	2		*1.5*	2	*2.0*	**1.3**						
		Hunter			*1.0*	1	2		*1.5*	2	*2.0*	**1.3**						
		Pistol			*1.0*	1	2		*1.5*	2	*2.0*	**1.3**						
		Chetco			*1.0*	1	2		*1.5*	2	*2.0*	**1.3**						
		Winchuck			*1.0*	1	1		*1.0*	2	*2.0*	**1.2**						
	Rogue	Lower Rogue	-	1	*1.0*	1	2	1	*1.3*	2	*2.0*	**1.2**	**Very Low**	-	-	1	Low	
		Illinois			*1.0*	1	2		*1.3*	2	*2.0*	**1.2**						
		Middle Rogue/Applegate			*1.0*	1	2		*1.3*	2	*2.0*	**1.2**						
		Upper Rogue			*1.0*	1	2		*1.3*	2	*2.0*	**1.2**						

Assessment Confidence

- VSP Data Completeness
- Population Trend

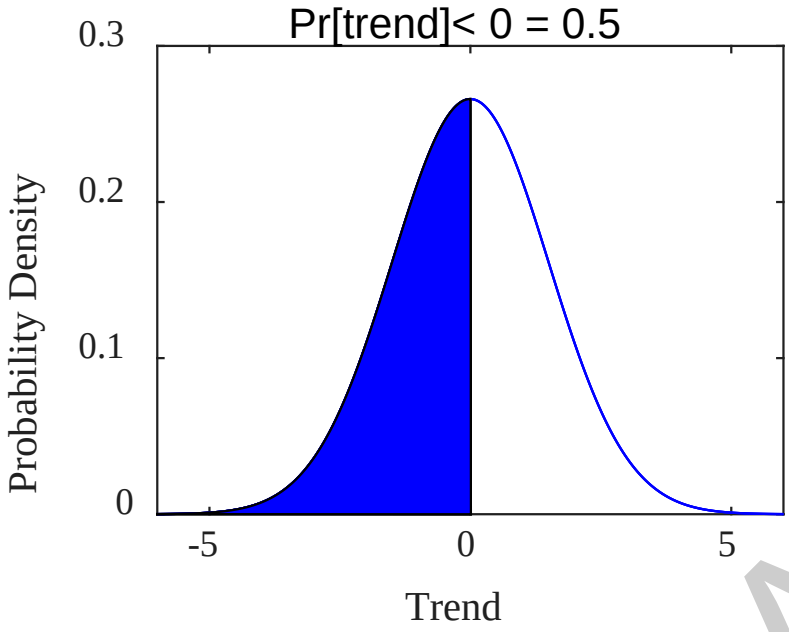


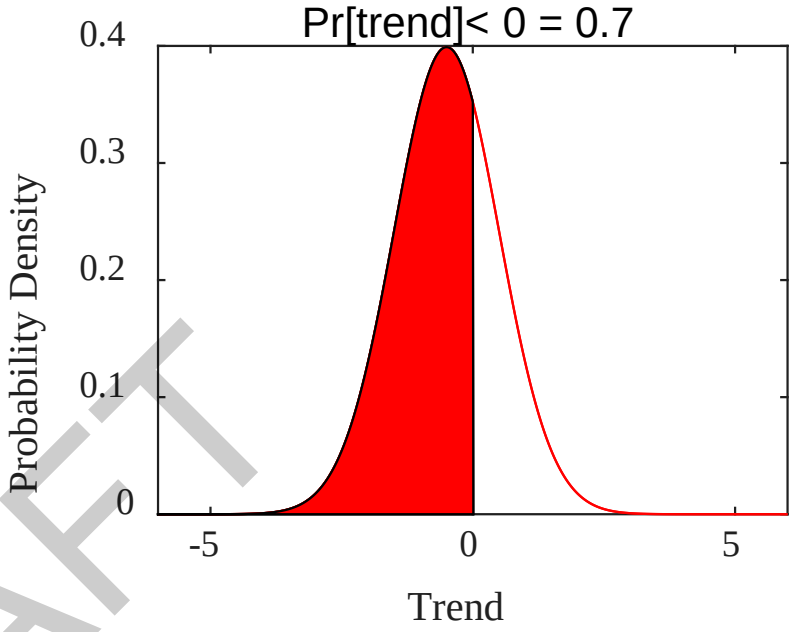


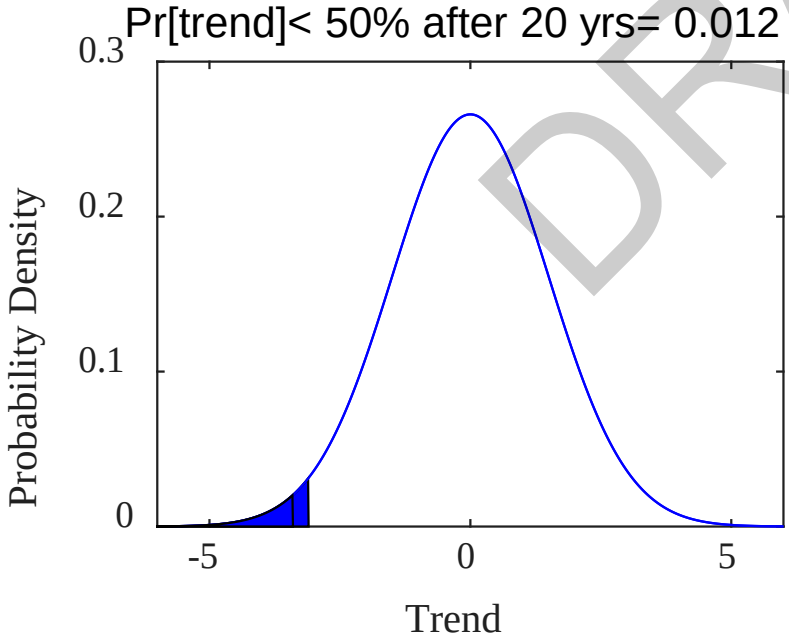


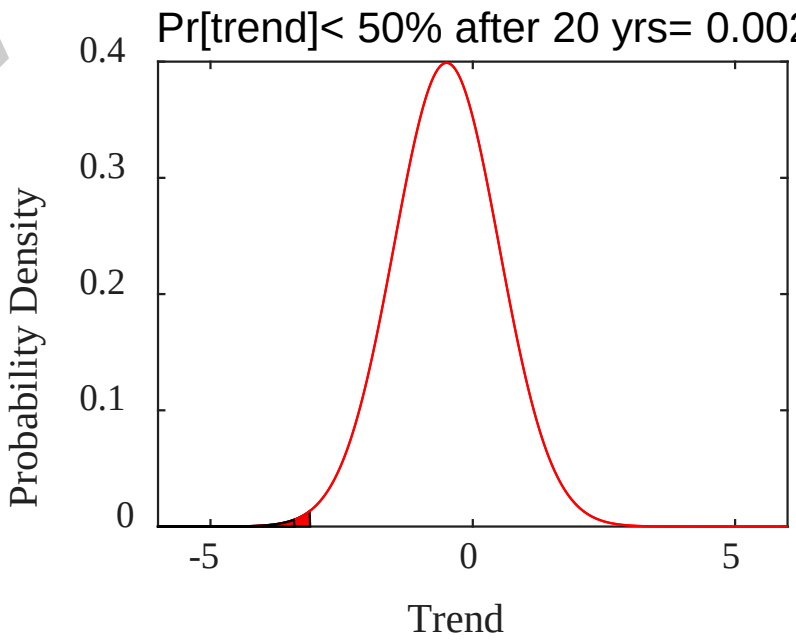
$$\Pr[\text{decline}] < x^{crit}$$

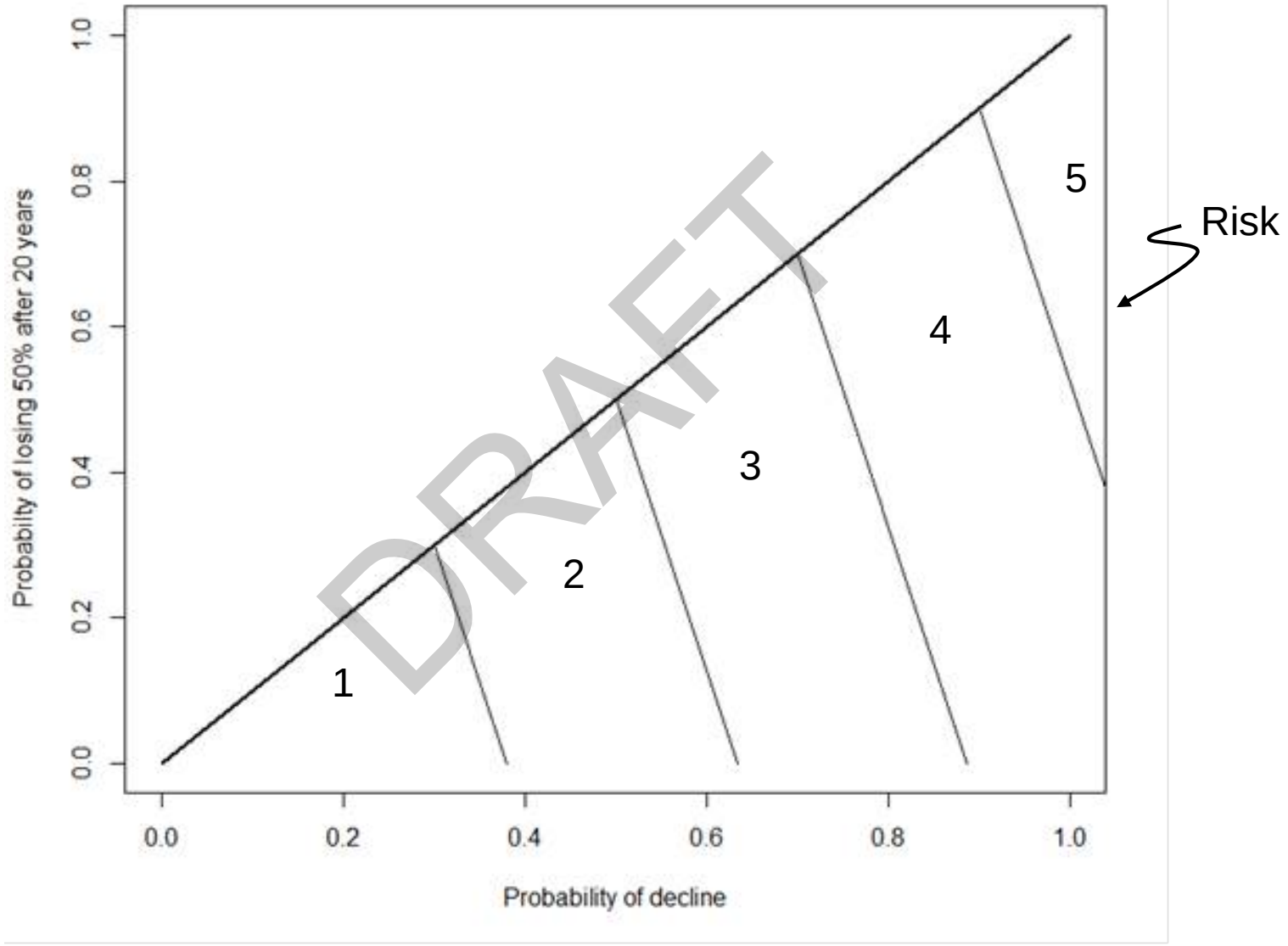
$$\int_{-\infty}^{x^{crit}} \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} dx$$

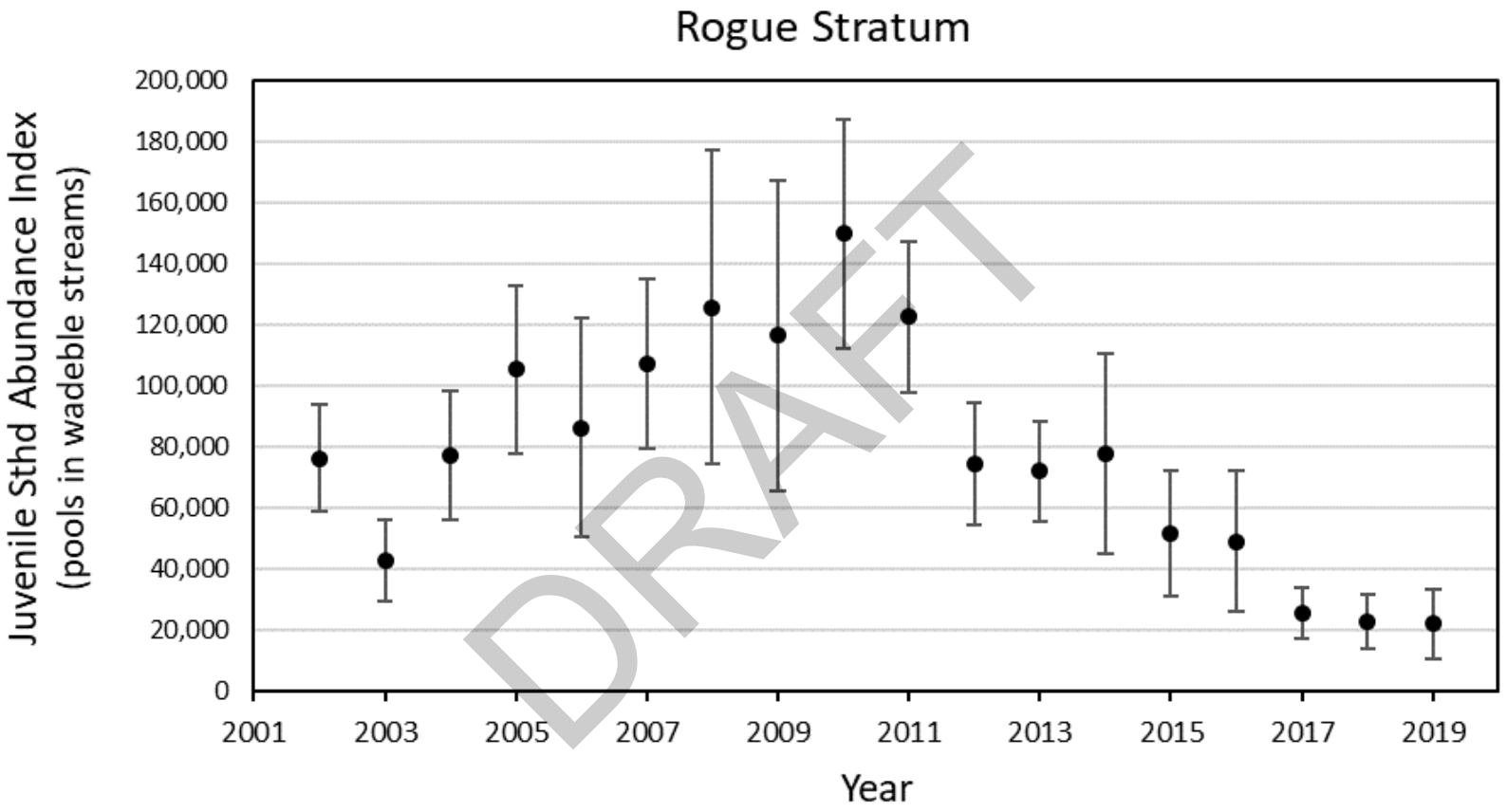

Pr[trend]< 0 = 0.5
Probability Density
0.3
0.2
0.1
0
-5
0
5
Trend


Pr[trend]< 0 = 0.7
Probability Density
0.4
0.3
0.2
0.1
0
-5
0
5
Trend

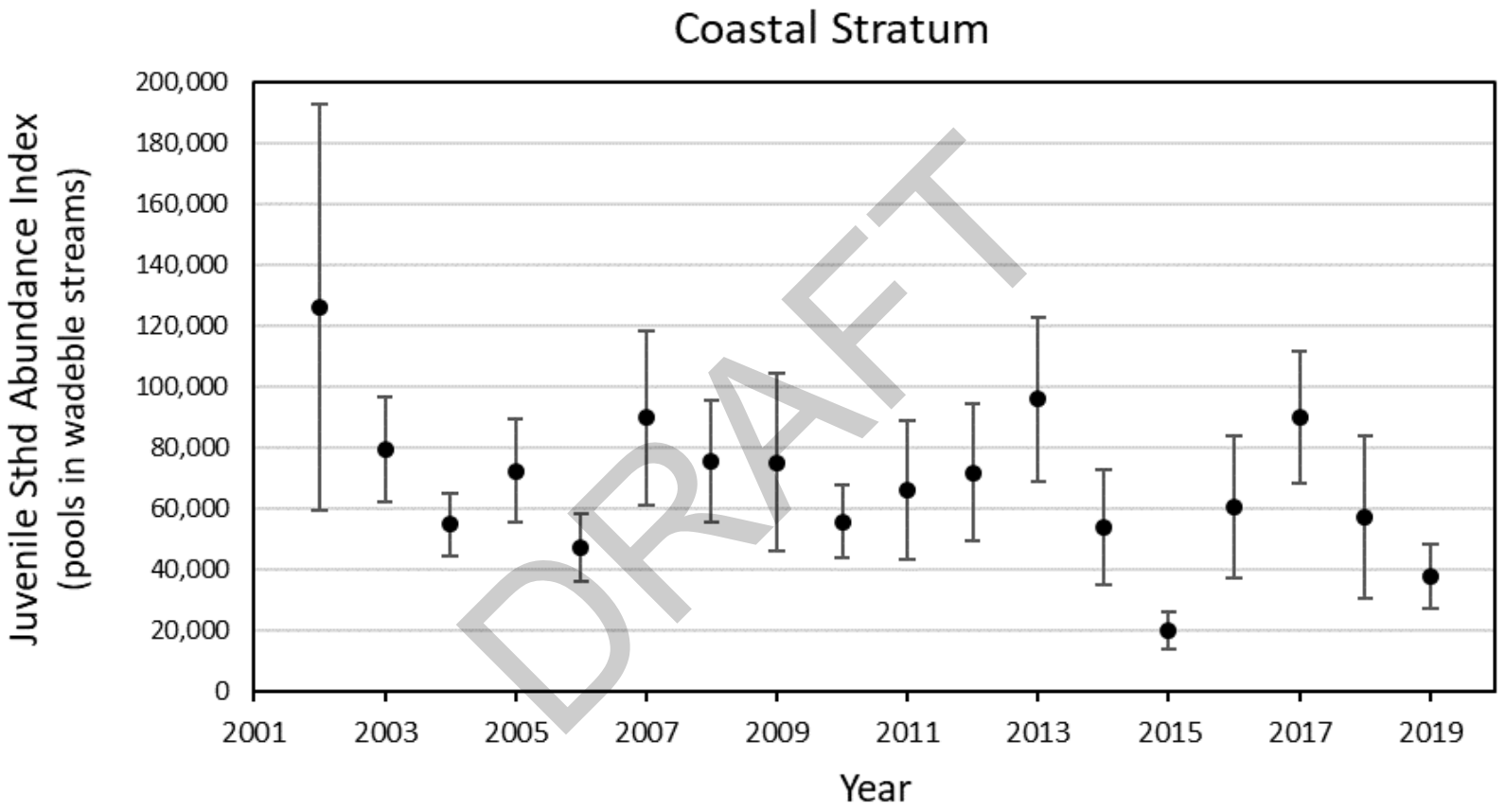

Pr[trend]< 50% after 20 yrs= 0.012
Probability Density
0.3
0.2
0.1
0
-5
0
5
Trend


Pr[trend]< 50% after 20 yrs= 0.002
Probability Density
0.4
0.3
0.2
0.1
0
-5
0
5
Trend

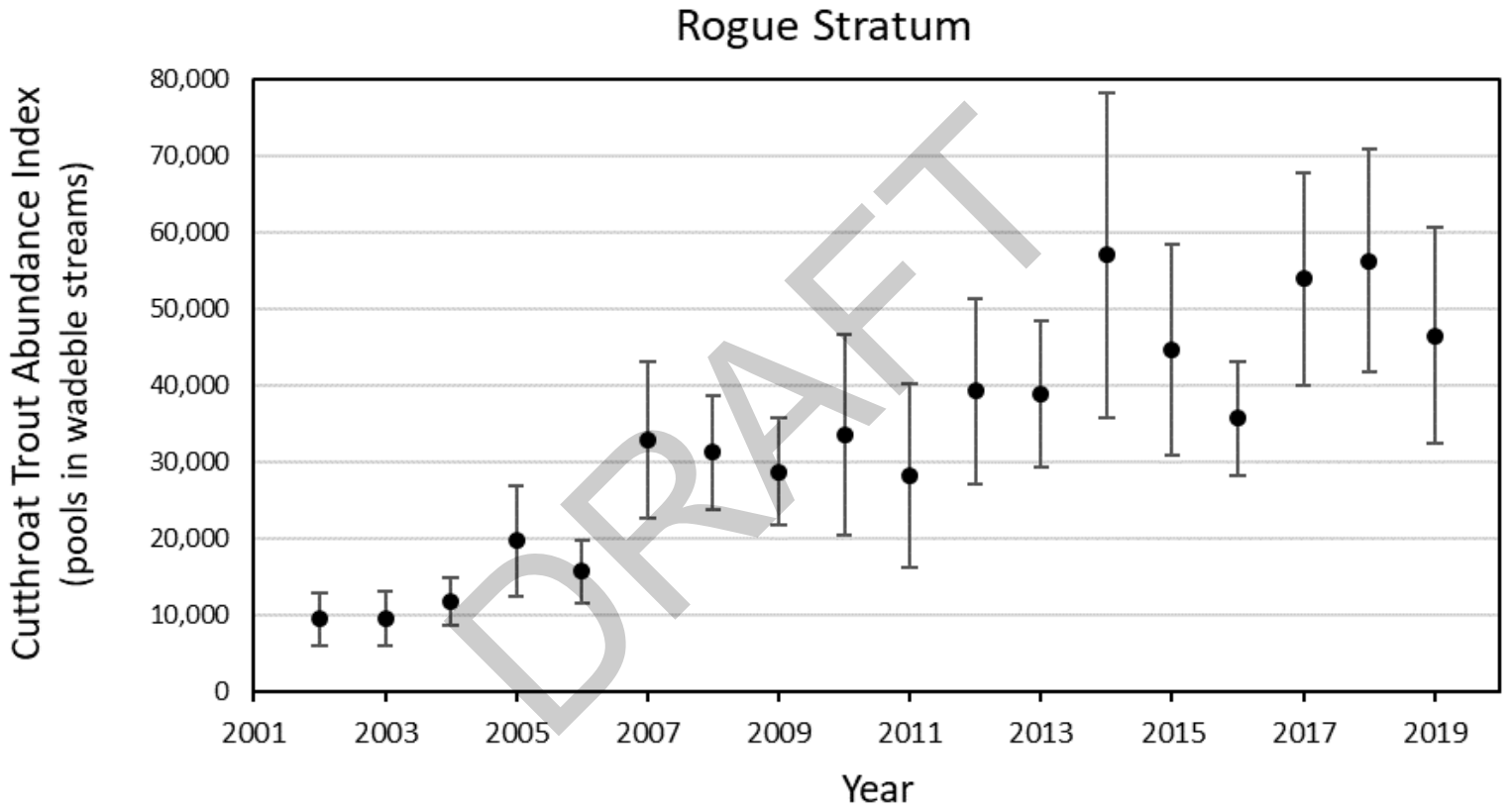

Probability of losing 50% after 20 years
0.0
0.2
0.4
0.6
0.8
1.0
Probability of decline
0.0
0.2
0.4
0.6
0.8
1.0
1
2
3
4
5
Risk
DRAFT


Rogue Stratum
Juvenile Sthd Abundance Index
(pools in wadeble streams)
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019
Year
DRAFT

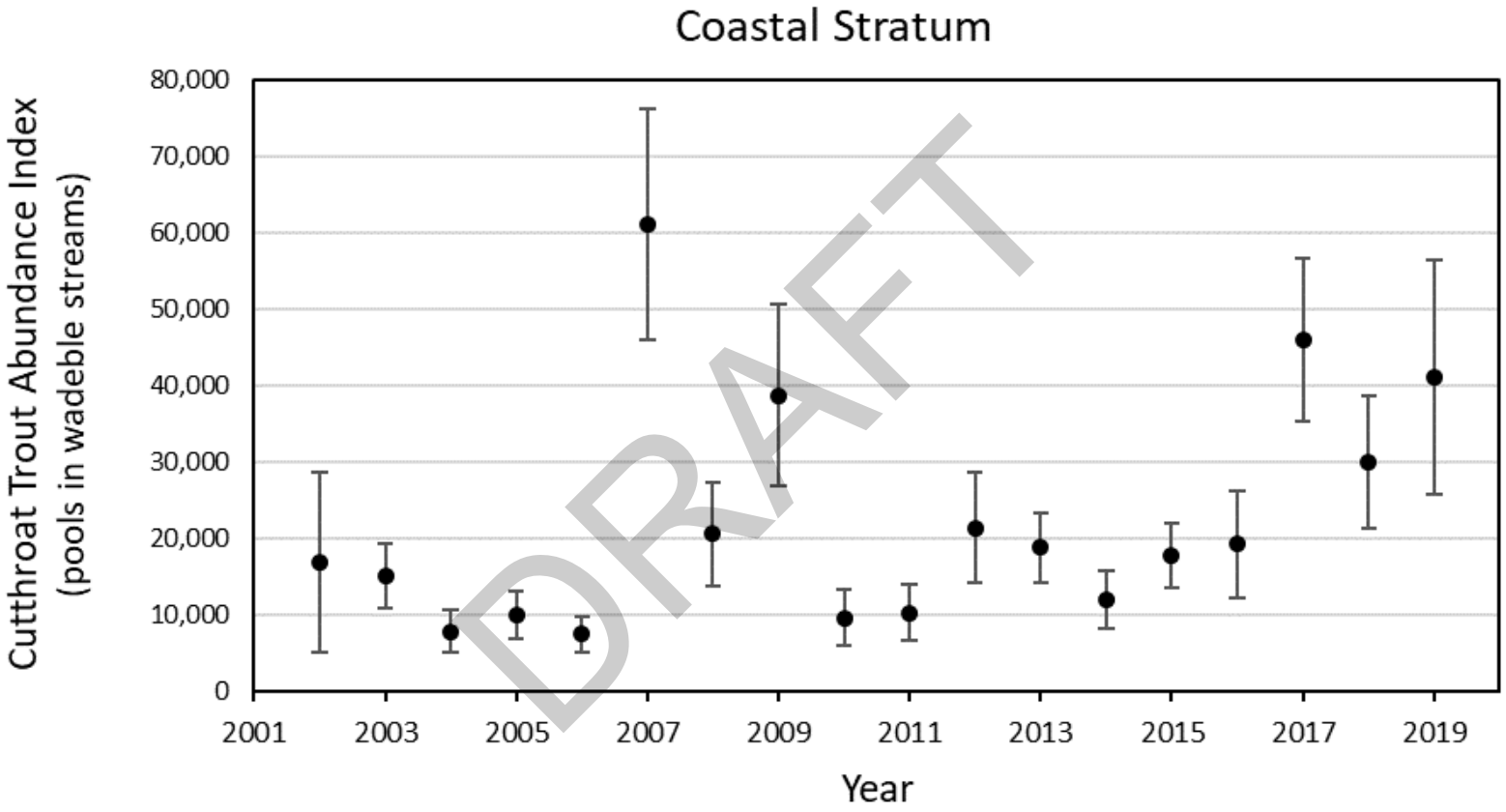
Risk Score = 5


Coastal Stratum
Juvenile Sthd Abundance Index
(pools in wadeble streams)
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019
Year
DRAFT

Risk Score = 5


Rogue Stratum
Cutthroat Trout Abundance Index
(pools in wadeble streams)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019
Year
DRAFT

Risk Score = 1


Coastal Stratum
Cutthroat Trout Abundance Index
(pools in wadeble streams)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019
Year
DRAFT

Risk Score = 1

			Viable Salmonid Population (VSP) Parameter Assessment									Viability Risk		Indicators of Confidence in Viability Results				STATUS
			Abundance & Productivity			Spatial Structure				Diversity				Trend Risk Scores				
SMU	Stratum	Population	100-year Extinction Risk	Juvenile Rearing Density	*Score*	% Historic Distribution Score	Probability of Occurrence	Spatial Structure Trend	*Score*	Life History Loss Score	*Diversity Score*	**Population Scores**	**Stratum Risk Category**	Adult Abundance	Half-Pounder Abundance	Juvenile Abundance	VSP Data Completeness	
WINTER STEELHEAD	Coastal	Elk	-	1	*1.0*	1	1	-	*1.0*	1	*1.0*	**1.0**	**Very Low**	-	-	5	Low	**Strong-Guarded**
		Euchre			*1.0*	1	1		*1.0*	1	*1.0*	**1.0**						
		Hunter			*1.0*	1	1		*1.0*	1	*1.0*	**1.0**						
		Pistol			*1.0*	1	1		*1.0*	1	*1.0*	**1.0**						
		Chetco			*1.0*	1	1		*1.0*	1	*1.0*	**1.0**						
		Winchuck			*1.0*	1	1		*1.0*	1	*1.0*	**1.0**						
	Rogue	Lower Rogue	-	2	*2.0*	1	1	1	*1.0*	1	*1.0*	**2.0**	**Low**	-	1	5	Medium	
		Illinois			*2.0*	1	2		*1.3*	1	*1.0*	**2.0**						
		Middle Rogue/Applegate			*2.0*	1	2		*1.3*	1	*1.0*	**2.0**						
		Upper Rogue	2		*2.0*	2	2		*1.7*	2	*1.5*	**2.0**		2				
SUMMER STEELHEAD	Rogue	Middle Rogue/Applegate	-	-	-	1	-	-	*1.0*	2	*1.5*	**1.3**	**Low**	4	1	-	Very Low	**Sensitive**
		Upper Rogue			-	2			*2.0*	2	*1.5*	**1.8**						
COHO SALMON	Coastal	Elk	-	4	*4.0*	1	5	-	*3.0*	2	*2.0*	**4.0**	**High**	1	-	-	Low	**Sensitive-Critical**
	Interior Rogue	Illinois	3	3	*3.0*	1	4	1	*2.0*	2	*2.0*	**3.0**	**Moderate**	3	-	5	Low	
		Middle Rogue/Applegate			*3.0*	1	4		*2.0*	2	*2.0*	**3.0**						
		Upper Rogue			*3.0*	2	4		*2.3*	2	*2.0*	**3.0**						
CUTTHROAT TROUT	Coastal	Elk	-	1	*1.0*	1	2	-	*1.5*	2	*2.0*	**1.3**	**Very Low**	-	-	1	Low	**Strong-Guarded**
		Euchre			*1.0*	1	2		*1.5*	2	*2.0*	**1.3**						
		Hunter			*1.0*	1	2		*1.5*	2	*2.0*	**1.3**						
		Pistol			*1.0*	1	2		*1.5*	2	*2.0*	**1.3**						
		Chetco			*1.0*	1	2		*1.5*	2	*2.0*	**1.3**						
		Winchuck			*1.0*	1	1		*1.0*	2	*2.0*	**1.2**						
	Rogue	Lower Rogue	-	1	*1.0*	1	2	1	*1.3*	2	*2.0*	**1.2**	**Very Low**	-	-	1	Low	
		Illinois			*1.0*	1	2		*1.3*	2	*2.0*	**1.2**						
		Middle Rogue/Applegate			*1.0*	1	2		*1.3*	2	*2.0*	**1.2**						
		Upper Rogue			*1.0*	1	2		*1.3*	2	*2.0*	**1.2**						

SMU Results

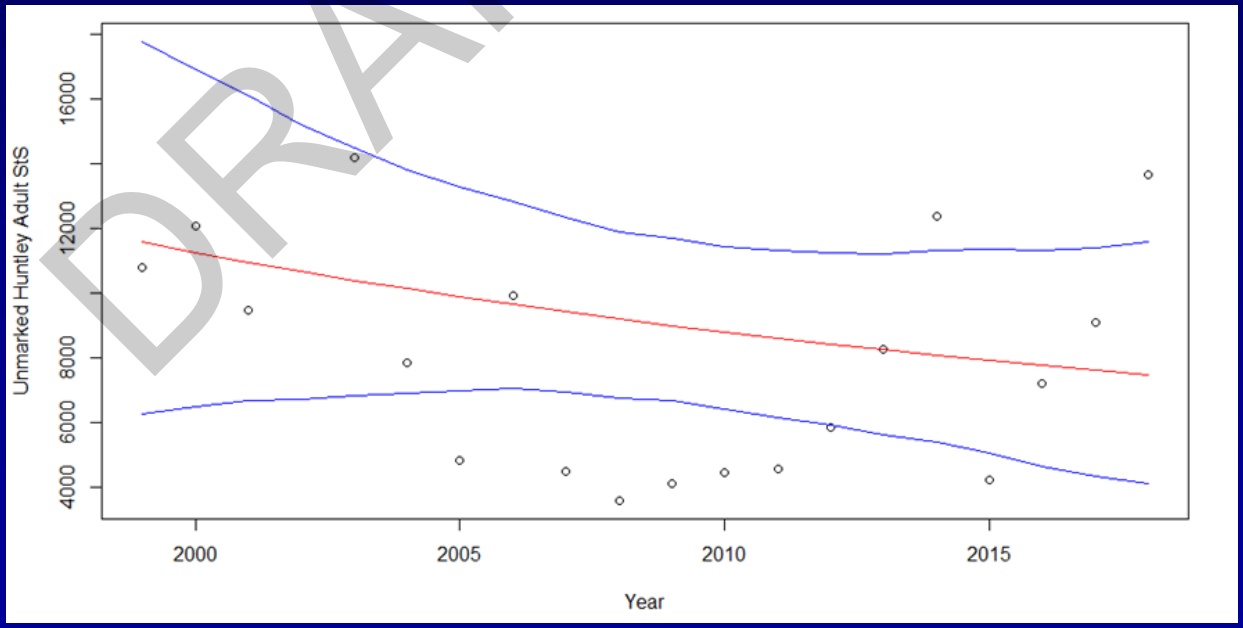
Winter Steelhead: Strong-Guarded

- PVA for Upper Rogue population: 100-yr persistence > 98%
- Juvenile steelhead density comparable or higher than Coastal SMU
- SDM indicates broad distribution and generally high probability of occurrence
- Low Viability Risk, but incomplete VSP data and juvenile abundance trends lowered assessment confidence

Summer Steelhead: Sensitive

- Very limited VSP data available
- Risk scores based on SS/D
- Naturally limited range also considered in SMU status

Late-run adult trend indicated risk, but returns have increased in recent years



Coho Salmon: Sensitive-Critical

- PVA for Rogue Aggregate: 100-yr persistence < 95% (Moderate Risk)
- Juvenile coho density low compared to Coastal SMU
- SDM indicates patchy distribution with low probability of occurrence in most streams
- High Viability Risk for Elk population, but low risk score for adult population trend

Cutthroat Trout: Strong-Guarded

- Cutthroat trout density comparable or higher than neighboring SMUs
- SDM indicates moderate to high probability of occurrence throughout SMU
- Stable or positive abundance trends in both strata