

Using an e-Creel Expansion to Estimate Chinook Salmon Harvest

Validation of Method to Estimate Harvest in Basins Lacking e-Creels

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Riverside Hotel

Boise, Idaho



e - Creel Harvest Estimates

Paradigm Shift: Applying Capture-Recapture Techniques to Electronic Licensing System Data to Estimate Chinook Salmon Harvest

Currently being utilized by CCRMP for PST management

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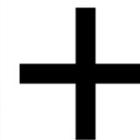
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Intro to e-Creel



- ELS database contains electronically tagged fish or validation of harvest
- In-person Interviews simplest form
 - Establish harvest & electronic to tag (electronic / other) ratio.
 - Collect biological data or release information
 - Demographic or regulation impact data gathered if desired.
- Intercept as many successful anglers as possible (Interview Fish-no effort)
- Chapman Version Lincoln-Petersen Mark Recapture Equation, new assumptions.
 - Marked (Captured) population is ELS, Recapture is creel interview



N_i = the estimated harvest of fall Chinook salmon in fishery i
 M = Total reported harvest to the ELS database corresponding to the period of the fishery.
 C = Total number of biologically sampled (observed) fish from in person e-Creel interviews.
 R = Total number of biologically sampled (observed) fish that were electronically tagged

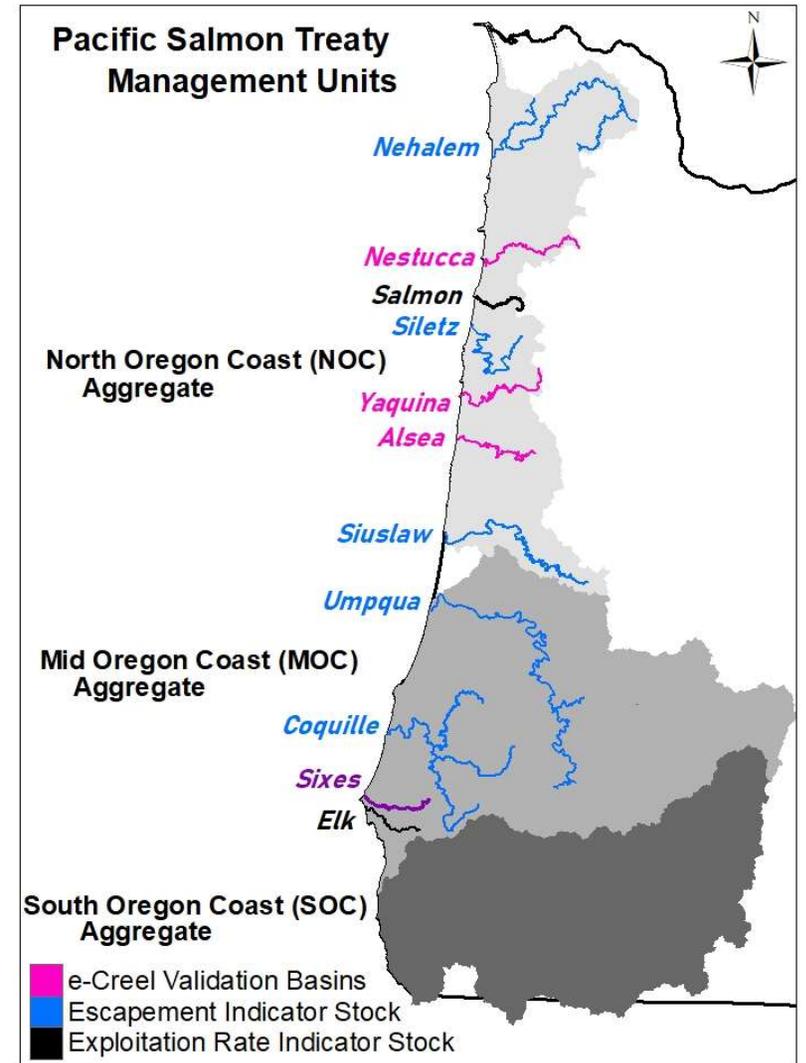
$$\hat{N}_i = \frac{(M+1)(C+1)}{(R+1)} - 1$$

$$v(\hat{H}_i) = \frac{(m_i + 1)(c_i + 1)(m_i - r_i)(c_i - r_i)}{(r_i + 1)^2(r_i + 2)}$$

Conditionally non-biased when $(M+C \gtrsim N)$

Pacific Salmon Treaty Study Area

- Indicator Stocks
 - Exploitation + Sixes River
 - Escapement (in blue)
- Annual, core PST e-Creels conducted in indicator stocks except Coquille
- Escapement stocks used to derive expansion factor
- Calibration investigation in pink
- Applicable to all species where harvest is recorded



2024 e-Creel Calibrated Index Estimates, Prediction, & Variance

Sales Ratio ~ 0.506	Alsea	Nehalem	Nestucca	Salmon Hatchery	Siletz	Siuslaw	Umpqua	Yaquina	Elk Hatchery	Sixes	Average
e-Creel Estimate	2,662	2,575	2,206	1,870	4,744	1,838	2,063	553	348	211	
CV e-Creel Estimate	4.6%	4.3%	4.8%	6.2%	3.4%	2.9%	4.4%	8.6%	5.5%	9.3%	
ELS Index Count	1,728	1,241	1,420	717	2,193	1,150	1,039	269	143	91	
e-Tag Ratio	0.648	0.4820	0.642	0.382	0.4623	0.6254	0.5036	0.482	0.411	0.425	0.518
Expansion Estimate	3,336	2,397	2,744	1,386	4,238	2,222	2,007	519	277	175	
Expansion Variance	101959		68853	17571				2468	702	280	
CV Expansion Est	9.6%		9.6%	9.6%				9.6%	9.6%	9.6%	9.6%
ELS Ratio Expansion	3,415	2,453	2,806	1,417	4,334	2,273	2,053	532	283	180	
CV Ratio Estimate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Basin	Alsea	Nestucca	Salmon	Yaquina	Elk	Sixes
Abs diff A_t	406	537	484	34	71	36
MAPE	0.254	0.244	0.259	0.061	0.203	0.171
		Nehalem				MAPE
		Siletz				
		Siuslaw				
Avg e-Ratio	C.V.	Umpqua				
0.518	9.6%					19.9%

$$M = \frac{1}{n} \sum_{t=1}^n \left| \frac{A_t - F_t}{A_t} \right|$$

$$v(\hat{H}_i) = \frac{(m_i + 1)(c_i + 1)(m_i - r_i)(c_i - r_i)}{(r_i + 1)^2(r_i + 2)}$$

Predicted Harvest

$$\hat{H} = C / (\pi)$$

Variance of Predicted Harvest

$$v\hat{H}_t = C_t^2 v(\pi)$$

$$v(\pi) = \sum_{i=1}^k \frac{(\hat{\pi}_i - \hat{\pi})}{k-1} + \sum_{i=1}^k v(\hat{\pi}_i)$$

$$v(\hat{\pi}_i) = (\hat{H}_i) C_i^{-2}$$

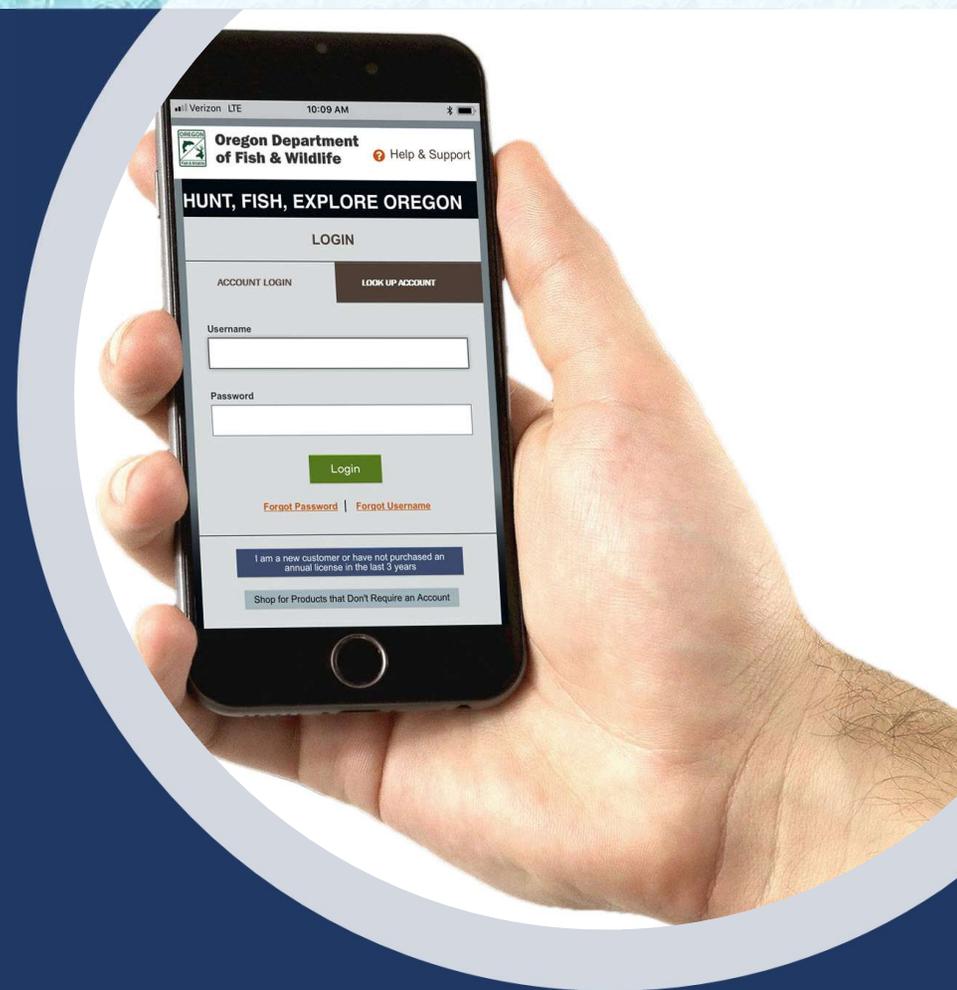
Non-Compliance Error

Issues:

- Printing multiple /reusing paper tags
- Purposely using incorrect location
- Not immediately tagging fish (Fail to Validate)

Non-Compliance Rate:

- Oregon State Police Nehalem Sting Operation
 - 222 anglers, 21 Validation Citations
 - 9.5% Average Non-Compliance Rate
- Siletz e-Creel Interviews
 - 3.7% Non-Compliance Rate Chinook Salmon
 - 7.8% Non-Compliance Rate Coho Salmon



Assessing Management Risk with Electronic Data



- e-Creel Estimates (Gold Standard) - Low Risk
 - Real Time (manage harvest by knowing harvest)
 - Reduced cost-fewer and more efficient interviews
 - Little bias or error
 - Confidence in precision metric (Chapman)
 - Assess management impacts
- Traditional Creel - High Risk
 - Effort Bias
 - High Cost
 - Inefficient-cannot be widely used
 - High Safety Risk
- Ratio Estimator -Moderate Risk
 - Low cost-no creel personnel necessary
 - Safe
 - Spatial & Temporal Bias likely
 - Unknown Precision
- Calibrated e-Creel - Low Risk
 - Reduced cost per population
 - Relatively Low Safety Risk
 - Measured Precision
 - Low Socioeconomic & Conservation Risk

Thank you:

- Creel surveyors and other CCRMP staff
 - ODFW colleagues
 - US Pacific Salmon Commission Chinook Technical Committee
- Thank you for listening!



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Questions?

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