Chum salmon as a covariate of Resident Killer Whale population growth

(Preliminary Results)

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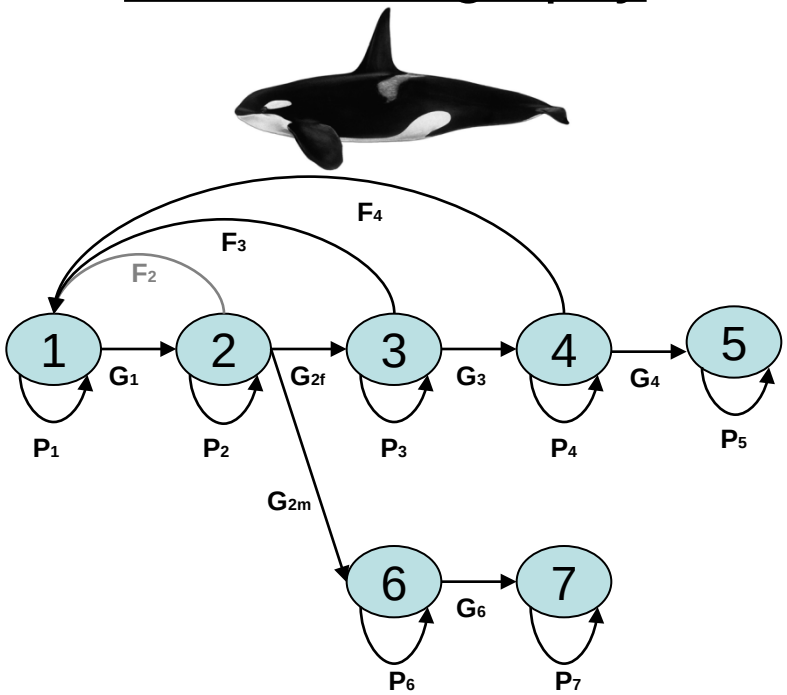
Recap

RKW demography



1: Calves (viable 0.5-year old)

2: Juveniles (ages 2-9; undetermined sex)

3: Female 1

4: Female 2

5: Female 3

6: Male 1

7: Male 2

Regressions

Relationships between RKW vital rates & Chinook abundance (hypothesis-oriented)

Chum

Chum

Perturbation analyses

Influence of interactions on RKW population growth (prospective & retrospective)

Current evidence regarding RKW diet

- Chum salmon increases in RKW's diet in the fall and surpasses Chinook salmon (Ford and Ellis 2006, Ford et al. 2010)

- Chum salmon in NRKW's diet are mainly from Fraser, ECVI, and South BC Coast stocks (Ford and Ellis 2006, Ford et al. 2010)

- Chum salmon fall stock composition in SRKW's not known but assumed to consist mainly of Puget Sound stocks (*Pers. Comm.* B. Hanson)

Data

- BC terminal run (fall)
  - DFO
  - NBC, CBC, SBC

- Washington terminal run (summer, fall, winter)
  - TCCHUM Post-season summary reports
  - Puget Sound, Hood Canal, JdF Strait

RKW-Chum regression models

Summary of significant regressions (p < 0.10)					
Population	**Vital Rate**	**Stock or stock aggregate**	**Lag(s)**	**Adj. R2**	**P-value**
SRKW	Fecundity (Female 2)	Southern BC Fall Chum TR	1	0.102	0.0754
SRKW	Survival (Female 2)	Southern BC Fall Chum TR	0, 1	0.144	0.0811
SRKW	Fecundity (Female 2)	Washington Spring/Summer/Fall Chum TR	0, 1	0.357	0.0047
SRKW	Survival (Female 2)	Washington Spring/Summer/Fall Chum TR	0	0.162	0.0325
SRKW	Fecundity (Female 2)	Washington Fall Chum TR	0, 1	0.338	0.0062
SRKW	Survival (Female 2)	Washington Fall Chum TR	0	0.156	0.0352
SRKW	Survival (Male 2)	Washington Fall Chum TR	1	0.103	0.0741
SRKW	Fecundity (Female 2)	Southern BC and Washington Fall Chum TR	0, 1	0.209	0.0368
SRKW	Fecundity (Female 2)	Southern BC and Washington Chum TR	0, 1	0.219	0.0322
SRKW	Survival (Female 2)	Southern BC and Washington Chum TR	0	0.088	0.0914
NRKW	Fecundity (Female 2)	Northern/Central BCFall Chum TR	1, 2	0.158	0.069
NRKW	Survival (Male 1)	Northern/Central BCFall Chum TR	1	0.157	0.0348
NRKW	Survival (Female 2)	Northern/Central BCFall Chum TR	0, 1	0.275	0.0154

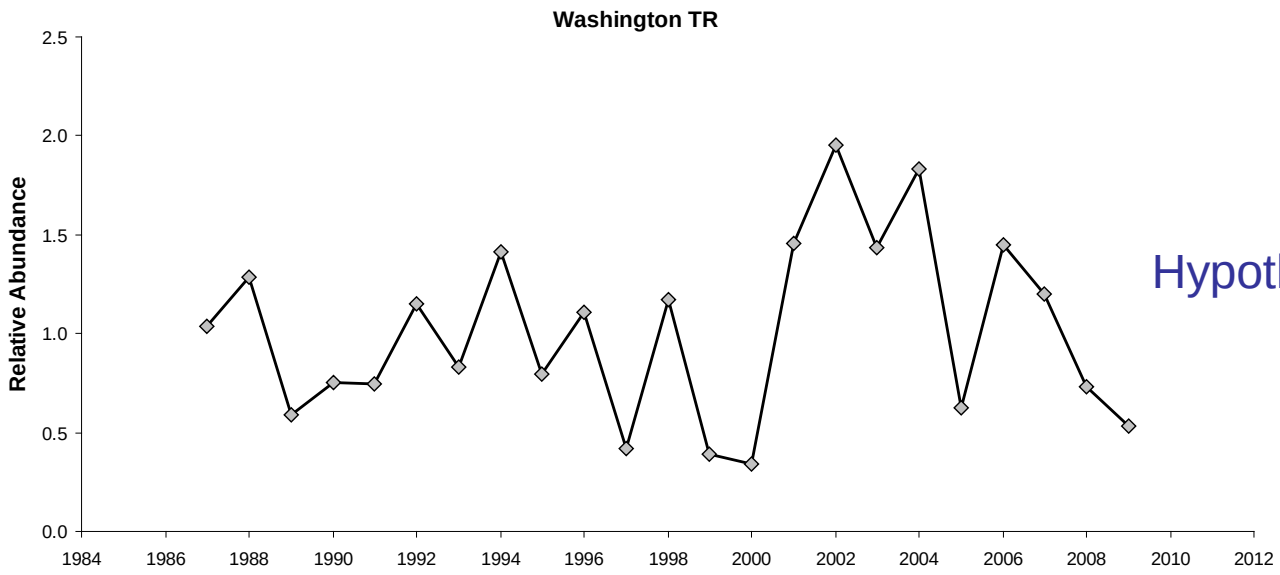
What are the RKW-Chinook regression models relevant for Female 2?

Population	Vital Rate	Stock or stock aggregate	Lag(s)	Adj. R2	P-value	Hypothesis
SRKW	Fecundity (Female 2)	FE + PS Terminal Run	2	0.132	0.0452	1a
SRKW	Fecundity (Female 2)	NA	NA	NA	NA	2a
SRKW	Survival (Female 2)	NA	NA	NA	NA	1a
SRKW	Survival (Female 2)	Coastwide Ocean Abundance	0	0.357	0.0012	2a
NRKW	Fecundity (Female 2)	Northern BC Terminal Run	0,1	0.160	0.0617	1b
NRKW	Fecundity (Female 2)	WCVI Ocean Abundance	0, 1, 2	0.274	0.0207	2b
NRKW	Survival (Female 2)	Georgia Strait Terminal Run	0	0.114	0.0589	1b
NRKW	Survival (Female 2)	Fraser Early Terminal Run	1	0.086	0.0885	2b

RKW-Chinook/Chum regression models

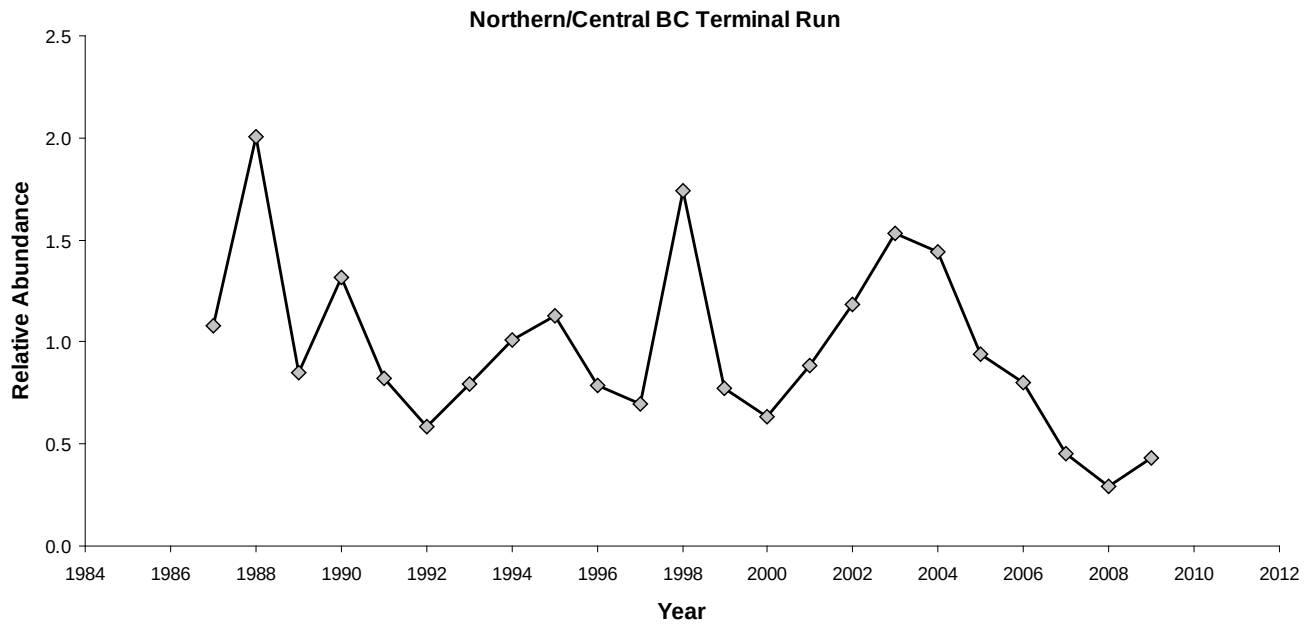
Best Models (AIC Criterion)						
Population	**Vital Rate**	**Stock or stock aggregate**	**Lag(s)**	**Adj. R2**	**P-value**	**Hypothesis**
SRKW	Fecundity (Female 2)	Washington **Chum** TR and Fraser Early+ Puget Sound **Chinook** TR	Chum:1; Chinook:0,2	0.383	0.0066	1a
SRKW	Fecundity (Female 2)	NA	NA	NA	NA	2a
SRKW	Survival (Female 2)	NA	NA	NA	NA	1a
SRKW	Survival (Female 2)	Washington Fall **Chum** and Coastwide **Chinook** Ocean Abundance *(Best model excluded Washington Fall Chum)*	Chinook: 0	0.351	0.0017	2a
NRKW	Fecundity (Female 2)	Northern/Central BC **Chum** TR and Northern BC **Chinook** TR	Chum:1,2; Chinook:0	0.273	0.0285	1b
NRKW	Fecundity (Female 2)	Northern/Central BC **Chum** TR and WCVI **Chinook** Ocean Abundance	Chum:0; Chinook:0,1,2	0.313	0.0278	2b
NRKW	Survival (Female 2)	Northern/Central BC **Chum** TR and Georgia Strait **Chinook** TR	Chum:0; Chinook:1	0.502	0.0004	1b
NRKW	Survival (Female 2)	Northern/Central BC **Chum** TR and Fraser Early **Chinook** TR	Chum:0; Chinook:1	0.460	0.0008	2b

Chum abundance trends concerning RKW

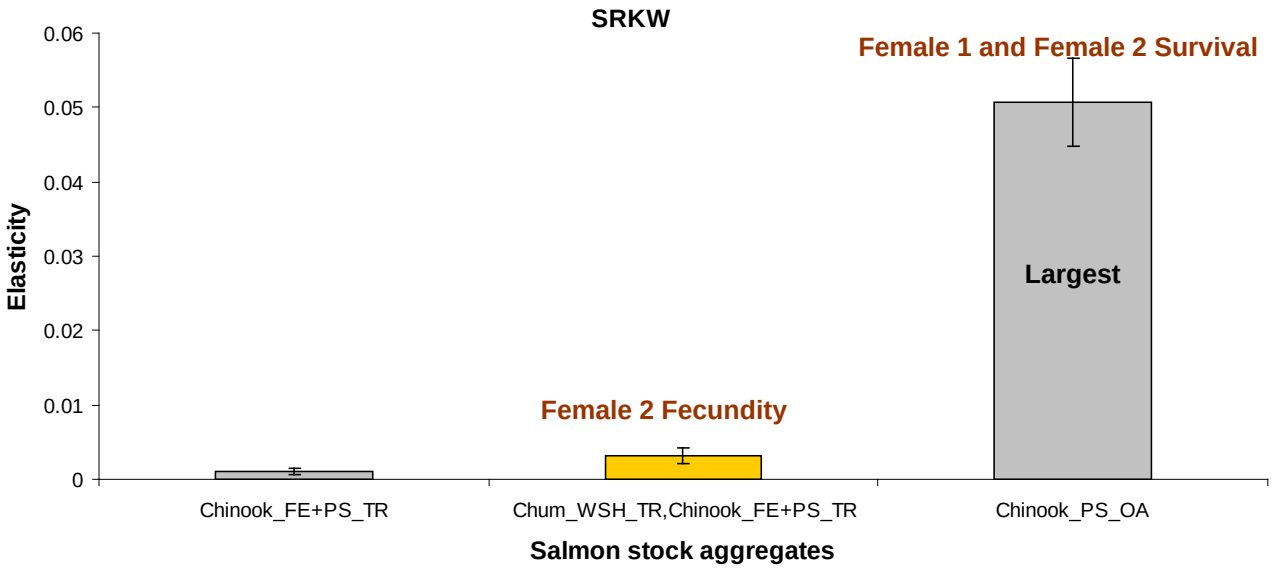


Hypothesis 1a

Hypotheses 1b, 2b

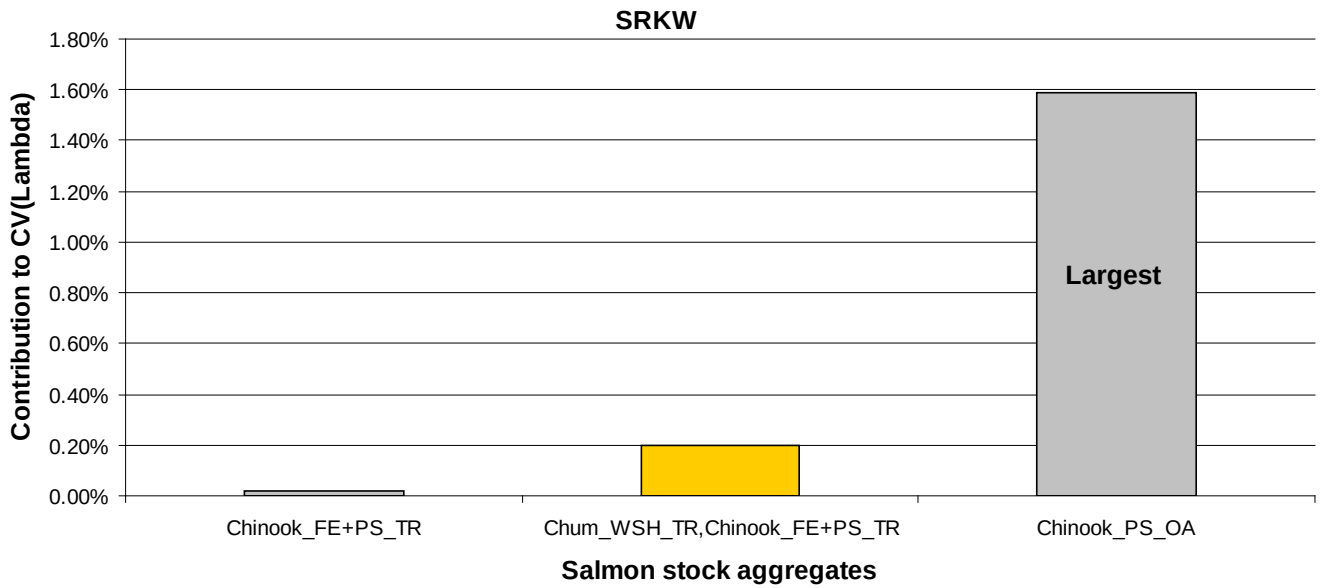


Elasticities and contributions to CV(λ) of interactions between SRKW vital rates and Chinook/Chum salmon abundance



Relative influence on potential population growth

Influence on the variation of observed population growth



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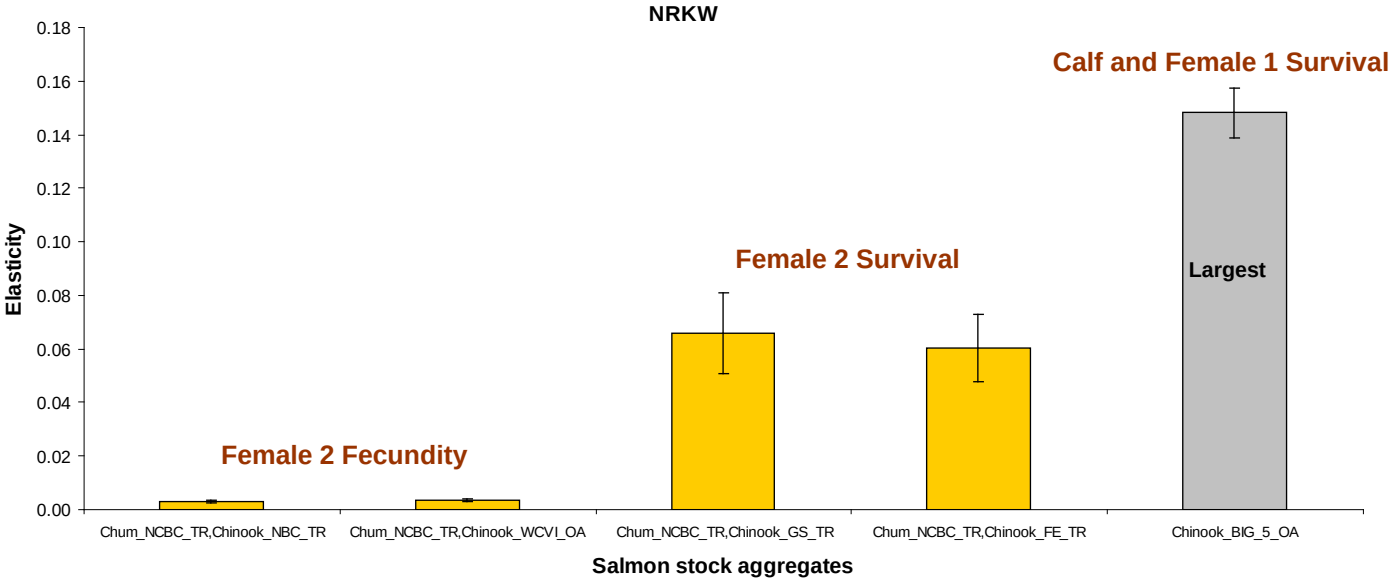

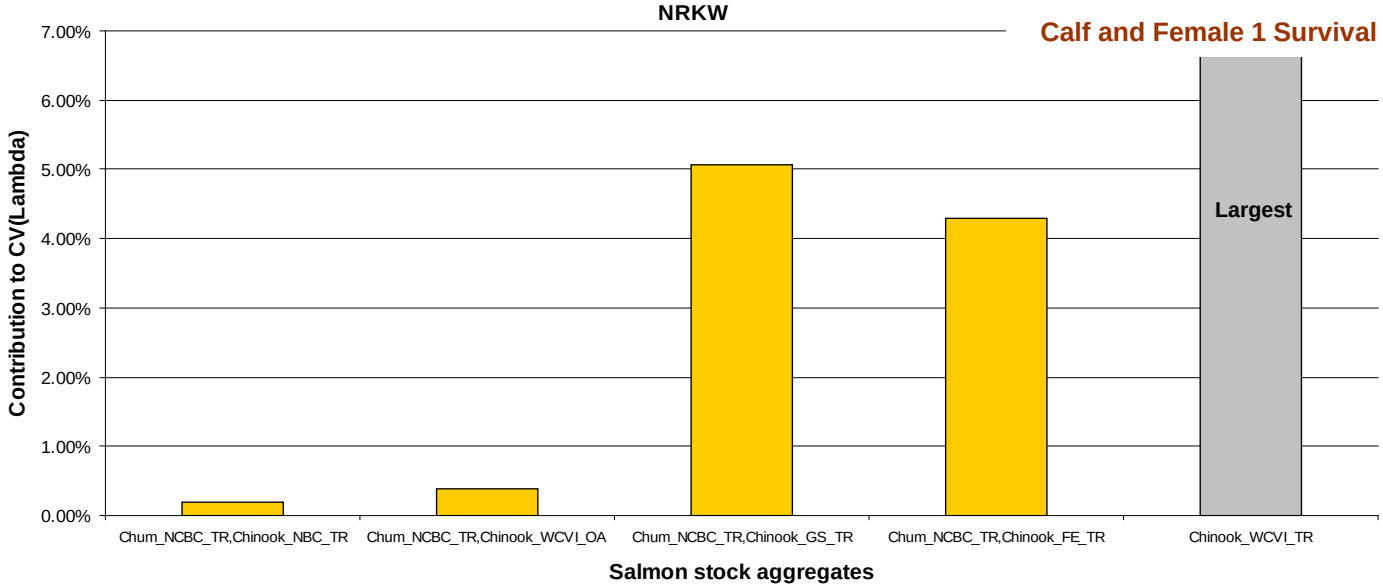

RKW-Chinook/Chum salmon interactions

- Significant RKW-Chinook/Chum interactions detected only for old reproductive females
- Washington Chum TR more important than Southern BC TR for SRKW whereas NCBC TR more important for NRKW
- Inclusion of Washington Chum TR improves substantially the regression with Female-2 fecundity under hypothesis **1a** but influence on SRKW population viability remains very low
- Inclusion of NCBC Chum TR improves substantially the regressions with Female-2 fecundity and survival but there are Chinook models with greater influence on NRKW population viability