Marine survival and interspecific interactions of coho salmon in SE Alaska

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Abstract

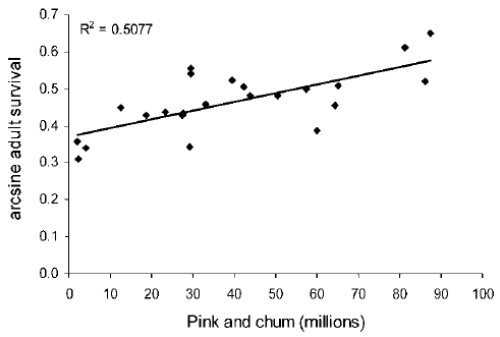
We examined physical and biotic factors potentially affecting marine survival of coho salmon in Auke Creek, Alaska, where a weir has produced a long time series of smolt and adult abundance. Marine survival was positively related to nearby releases of hatchery-produced pink and chum salmon. Strong correlation of jack and adult coho returns suggested survival was determined in the first summer at sea. Early marine growth was positively related to both the jack return rate and the survival of both male and female coho.

When we expanded this study to 14 coho stocks situated throughout SE Alaska, abundance of hatchery produced chum and wild pink salmon was often correlated with coho survival, but the effect was sometimes positive and sometimes negative. Models that best explained coho marine survival varied from place to place, both in the factors included and the direction of their effect. Only the North Pacific Index had a consistent (positive) effect. However, despite the disparity in explanatory models, productivities of the 14 coho salmon stocks were highly correlated.

Auke Creek coho survival patterns

- Jack returns and survival to adulthood correlated
  - suggests survival determined in first ocean summer
- Survival related to release of hatchery pink and chum salmon
  - hatchery fish are coho prey?
  - hatchery fish buffer coho from predators?

Auke Creek Adult Survival vs. DIPAC release numbers



Confirmatory study on other SE AK coho

Compared survival of other coho stocks to local abundance of pink and chum (hatchery and wild)

Compared to other potential environmental influences

Also compared to each other

TABLE 4.—Summary of correlation coefficients among the coho salmon marine survival time series and the covariates (DIS = April discharge; SST = summer sea-surface temperature; NP = North Pacific index; PDO = Pacific decadal oscillation; WP = wild pink salmon fry abundance index; HPC = hatchery pink salmon and chum salmon fry abundance index; na = no data available).

Stock	DIS	SST	NP	PDO	WP	HPC
Auke Creek	−0.25	−0.04	0.13	−0.39	0.25	0.68
Bear Cove	0.16	−0.41	0.20	−0.07	−0.24	−0.56
Berners River	−0.46	−0.06	0.48	−0.18	−0.06	0.00
Deer Lake	−0.46	0.26	0.24	−0.08	−0.61	−0.31
Earl West Cove	−0.60	0.08	0.21	−0.35	0.10	−0.05
Ford Arm Lake	−0.21	0.08	0.21	−0.21	−0.02	na
Gastineau Channel	−0.15	−0.41	0.32	−0.35	−0.16	0.09
Herring Cove	−0.23	−0.33	0.48	−0.14	0.05	na
Hugh Smith Lake	−0.31	−0.15	0.53	−0.52	−0.29	na
Kasnyku Bay	−0.08	−0.32	0.12	−0.26	−0.34	−0.47
Neets Bay	−0.32	−0.29	0.39	−0.51	−0.30	−0.25
Nakat Inlet	−0.11	−0.06	0.34	−0.52	−0.36	−0.24
Shamrock Bay	0.15	0.25	0.27	0.38	−0.38	na
Taku River	−0.05	0.00	0.29	−0.18	−0.11	0.62

■ $P < 0.05$.
▨ $P < 0.10$.

Result: each stock has different set of factors influencing survival

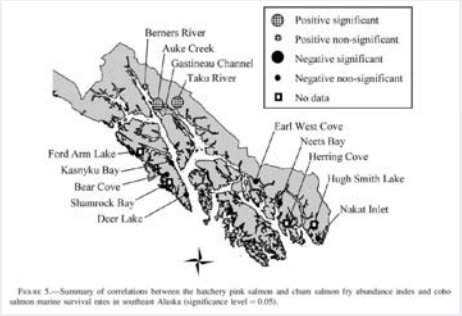


FIGURE 5.—Summary of correlations between the hatchery pink salmon and chum salmon fry abundance index and coho salmon marine survival rates in southeast Alaska (significance level = 0.05).

Result: Hatchery releases have varying relationships with different coho stocks

=> sometimes relationship is negative, not positive

TABLE 3.—Summary of pairwise correlations among the 14 coho salmon stocks' marine survival rates. Stock codes are defined in Table 1.

	AC												
HC	0.25	HC											
HR	0.65	0.36	BR										
DL	0.36	0.08	0.68	DL									
EWC	0.63	0.42	0.81	0.84	EWC								
FAL	0.45	0.43	0.27	−0.14	0.08	FAL							
GC	0.67	0.61	0.78	0.65	0.78	0.20	GC						
HC	0.39	0.19	0.59	0.65	0.59	0.07	0.80	HC					
HSL	0.54	0.36	0.74	0.72	0.74	0.04	0.70	0.51	HSL				
KB	0.67	0.53	0.69	0.69	0.93	0.21	0.78	0.47	0.78	KB			
NB	0.41	0.49	0.60	0.51	0.75	0.26	0.77	0.56	0.63	0.75	NB		
NI	0.37	0.42	0.45	0.65	0.69	0.03	0.55	0.50	0.67	0.59	0.63	NI	
SB	0.05	0.60	0.54	0.69	0.63	−0.17	0.34	0.06	0.53	0.47	−0.18	0.47	SB
TR	0.71	0.48	0.86	0.72	0.84	0.32	0.75	0.44	0.74	0.84	0.48	0.51	0.74

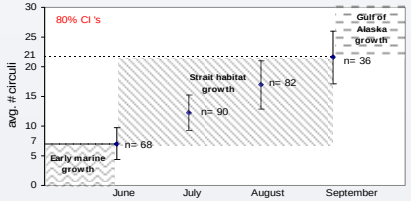
■ $P < 0.05$.
▨ $P < 0.10$.

Result: Despite divergent set of relationships, most coho stocks show similar trends in survival

Marine growth and marine survival

From fish collected at sea by the SECM, the first marine circuli were assigned to specific habitats:

Average Number of Circuli vs. Recovery Month (Unmarked Juveniles)



Growth (as inferred from the width of scale zones) in these habitats was compared to marine survival "survival" = returns per smolt. For jacks, this is not survival per se

Correlations between zonal growth and survival

	Female EM growth	Strait growth	GOA growth	Male EM growth	Strait growth	GOA growth	Jack EM growth	Strait growth	GOA growth
adult survival	0.04	0.23	-0.17	**0.40**	**0.43**	-0.20	0.32	0.09	-0.02
jack survival	0.06	0.01	-0.36	**0.48**	0.27	-0.14	-0.08	0.39	0.39

Results:

Male and female growth was strongly correlated, but jacks had a different growth pattern

Early marine and strait growth in males predicted marine survival, but female growth didn't

Jack production was related to smolt length, marine growth, and local (Auke Bay) SST

References

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