Trophic interactions and migration of juvenile salmonids in the California Current System: conclusions from parasitology and genetics

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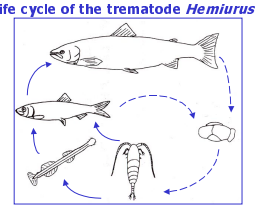
INTRODUCTION

Among our objectives in the U.S. GLOBEC Northeast Pacific Program is the use of parasite community analyses to help characterize trophic interactions, migrations, and salmon population origins. The present analyses focuses on four common parasite species found in juvenile chinook (*Oncorhynchus tshawytscha*) and coho salmon (*O. kisutch*) caught between Newport, Oregon, and Crescent City, California, in June and August of 2000. These parasites use trophic interactions to move through marine food webs and complete their complex life cycles.

Life cycle of the trematode *Hemiurus* sp.



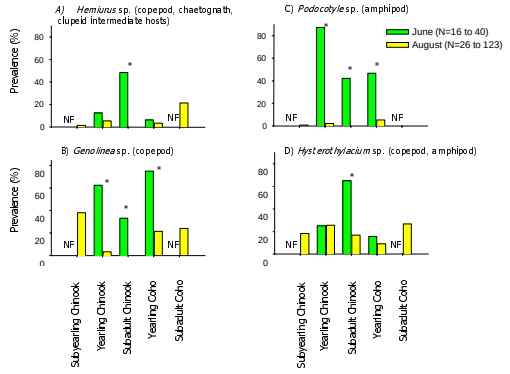
PARASITOLOGY

- Do parasites suggest temporal differences in trophic interactions?
- Do parasites indicate diet differences between salmon species, age classes, and regional habitat use?

METHODS

Juvenile salmon were frozen whole, stomachs and intestine were examined for macroparasites at a later date. Chi-square analyses were used to determine differences in parasite prevalences. Parasite intensities were tested using an ANOVA.

RESULTS



- The prevalences of three trematode species were lower in August than June 2000 in yearling and subadult chinook salmon, and yearling coho salmon.
- The prevalence of the nematode *Hysterothylacium* was lower in August than June of 2000 in subadult chinook salmon.
- Prevalences of the four parasites were similar in yearling coho and yearling chinook
- No subyearling chinook salmon or subadult coho salmon were caught in June of 2000.

Parasite Intensities Compared by Month and Species for GLOBEC 2000 Salmon.

	Month	Parasite Intensity (N)			
		Genolinea sp.	*Hemiurus* sp.	*Podocotyle* sp.	*Hysterothylacium* sp.
Subyearling Chinook	June	NF	NF	NF	NF
	August	2.7±2.9 (47)	1.5±0.7 (2)	1.0±0.0 (1)	1.6±1.1 (22)
Yearling Chinook	June	3.3±2.7 (10)	1.0±0.0 (2)	106.5±100.7 (14)	1.8±1.0 (4)
	August	1.7±0.6 (3)	1.8±1.3 (5)	22.0±1.4 (2)	1.8±1.0 (23)
Subadult Chinook	June	2.5±1.1 (11)	3.9±4.3 (16)	54.6±46.3 (16)	4.8±4.9 (24)
	August	0	0	0	1.0±0.0 (2)
Yearling Coho	June	18.5±31.9 (24)	1.5±0.7 (2)	18.3±21.9 (5)	1.0±0.0 (4)
	August	14.2±20.8 (12)	2.5±0.7 (2)	15.0±17.3 (3)	1.2±0.5 (5)
Subadult Coho	June	NF	NF	NF	NF
	August	0	2.3+2.3 (3)	0	2.0 +1.4 (4)

NF = no fish collected

Although prevalences of theses common parasites were similar between salmon species, intensities of two of the trematodes were significantly different between yearling coho salmon and yearling chinook salmon (noted in red). These data suggest that yearling coho and chinook were eating similar prey, but the quantities of those prey in the diet might have been different.

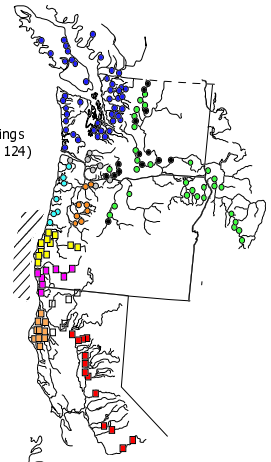
GENETICS

METHODS

The freshwater origins of juvenile chinook and coho salmon were studied using genetic (allozyme) differences among spawning populations in California and the Pacific Northwest by standard methods of genetic mixed stock analysis (Milner et al. 1985). Baselines consisted of 32 gene loci and 116 populations for chinook salmon (Teel et al. 1999) and 58 loci and 49 populations for coho salmon (Weitkamp et al. 1995).

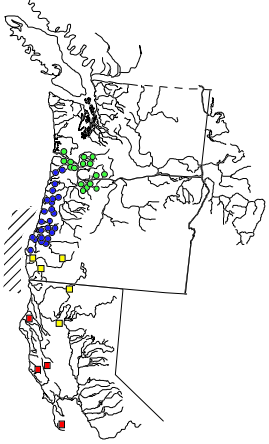
Chinook salmon stock composition

Stock Group	Yearlings June (N=53) %	(SD)	Yearlings August (N=89) %	(SD)	Subyearlings August (N=124) %	(SD)
Columbia and Snake Rivers	6	(11)	5	(4)	3	(3)
North Oregon coast	0	(0)	0	(0)	0	(0)
Mid Oregon coast	60	(14)	0	(0)	4	(0)
South Oregon coast	25	(14)	0	(0)	6	(11)
Klamath and Trinity Rivers	0	(5)	0	(0)	18	(8)
North California coast	0	(0)	1	(4)	7	(7)
Sacramento and San Joaquin Rivers	9	(6)	94	(5)	0	(0)



Coho salmon stock composition estimated from combined June and August samples
(*N* = 104)

Stock Group	%	(SD)
Columbia River	14	(6)
North and mid Oregon coast	48	(8)
Rogue and Klamath Rivers	38	(8)
North California coast	0	(0)



Genetic Results

Genetic data revealed that juvenile salmonids in the study area originate from numerous freshwater sources that support populations characterized by distinct genetic and life-history traits. We detected a strong seasonal shift in the stock composition of juvenile chinook salmon. In early summer chinook salmon were nearly entirely yearlings primarily from coastal rivers which enter the sea in the region immediately north of Cape Blanco, OR. In late summer substantial proportions of both yearlings and subyearlings were present. The late-summer yearling chinook salmon were mostly fish migrating northward from California's Central Valley. Late-summer subyearling chinook salmon were predominately from southern Oregon and northern California coastal streams south of Cape Blanco. Due to sample size constraints, we pooled fish from June and August to estimate the stock composition of coho salmon. Our analyses indicate that juvenile coho salmon were largely from Oregon coastal rivers, but also from Klamath and Columbia river populations. Taken together, the genetic data for chinook and coho salmon show that nearshore juvenile salmonid populations are comprised of heterogeneous mixtures of stocks exhibiting diverse first-summer ocean migration patterns.

GENERAL CONCLUSIONS

Both approaches, parasitology and genetics, substantiate the migration of juvenile chinook salmon during the summer months of 2000. The parasite data also suggests temporal changes in the coho stock composition, however small samples sizes of coho limit confirmation by allozyme analysis.

Literature Cited

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