



NORTHWEST INDIAN
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Freshwater and Marine Prevalence of *Nanophyetus* infections in Puget Sound.

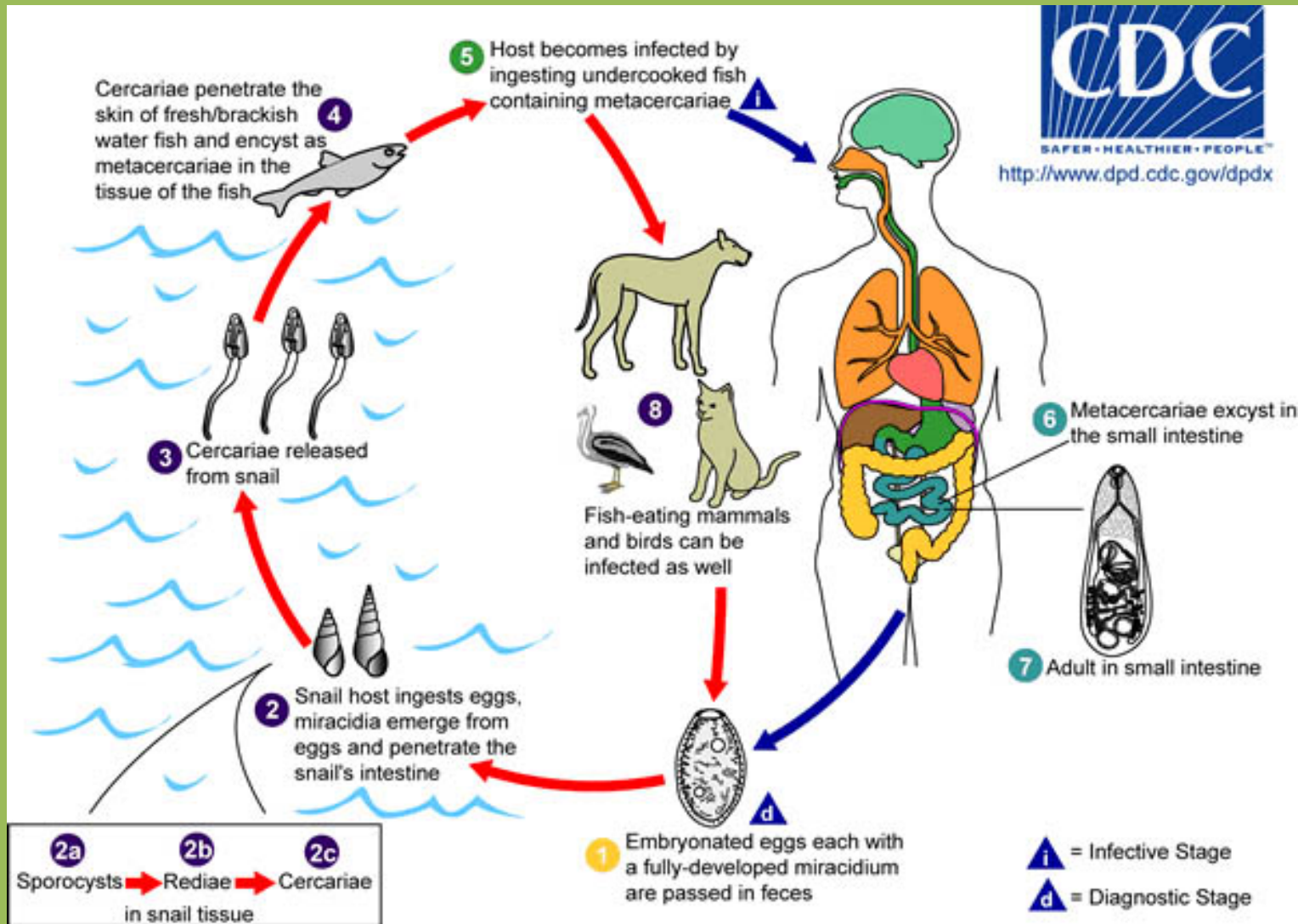
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Nanophyetus salmincola lifecycle



The first intermediate host is a snail

Juga plicifera

Juga silicula



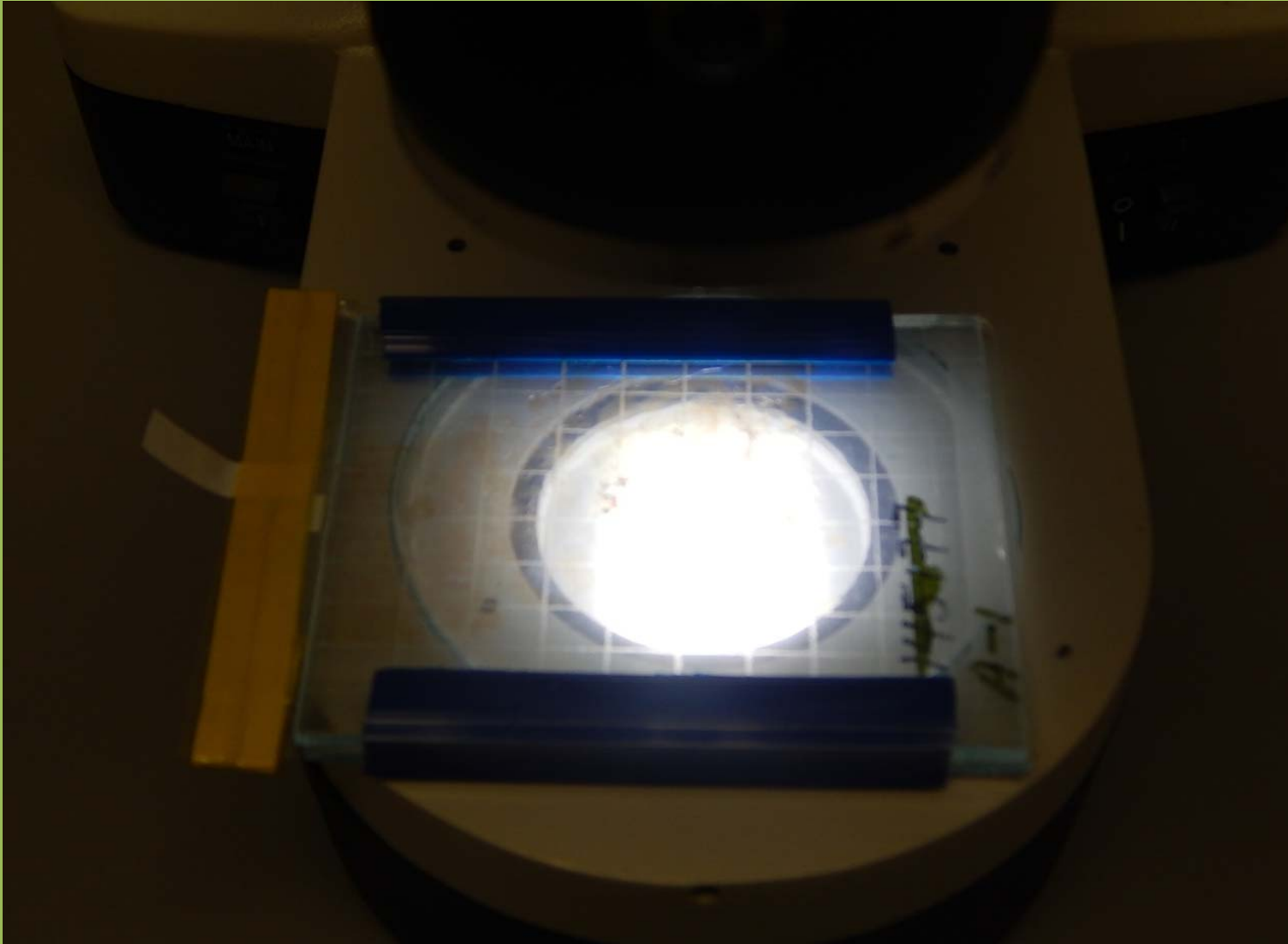
(*Juga* formerly known as *Oxytrema*)

Salmon Poisoning Disease of dogs is caused by the bacterium *Neorickettsia helminthoeca* carried by *Nanophyetus salmincola*





Remove posterior kidney and count numbers of metacercaria.






Kidney samples were placed in a sample bag, compressed between two glass plates and examined at 15X.

Study Questions:




1. Is there a correlation between the lower return of steelhead to South Sound Rivers and the presence and intensity of *N. salmincola* infection?
2. Does the intensity of infection as outmigration proceeds suggest a causal effect between *N. salmincola* and poor marine survival?

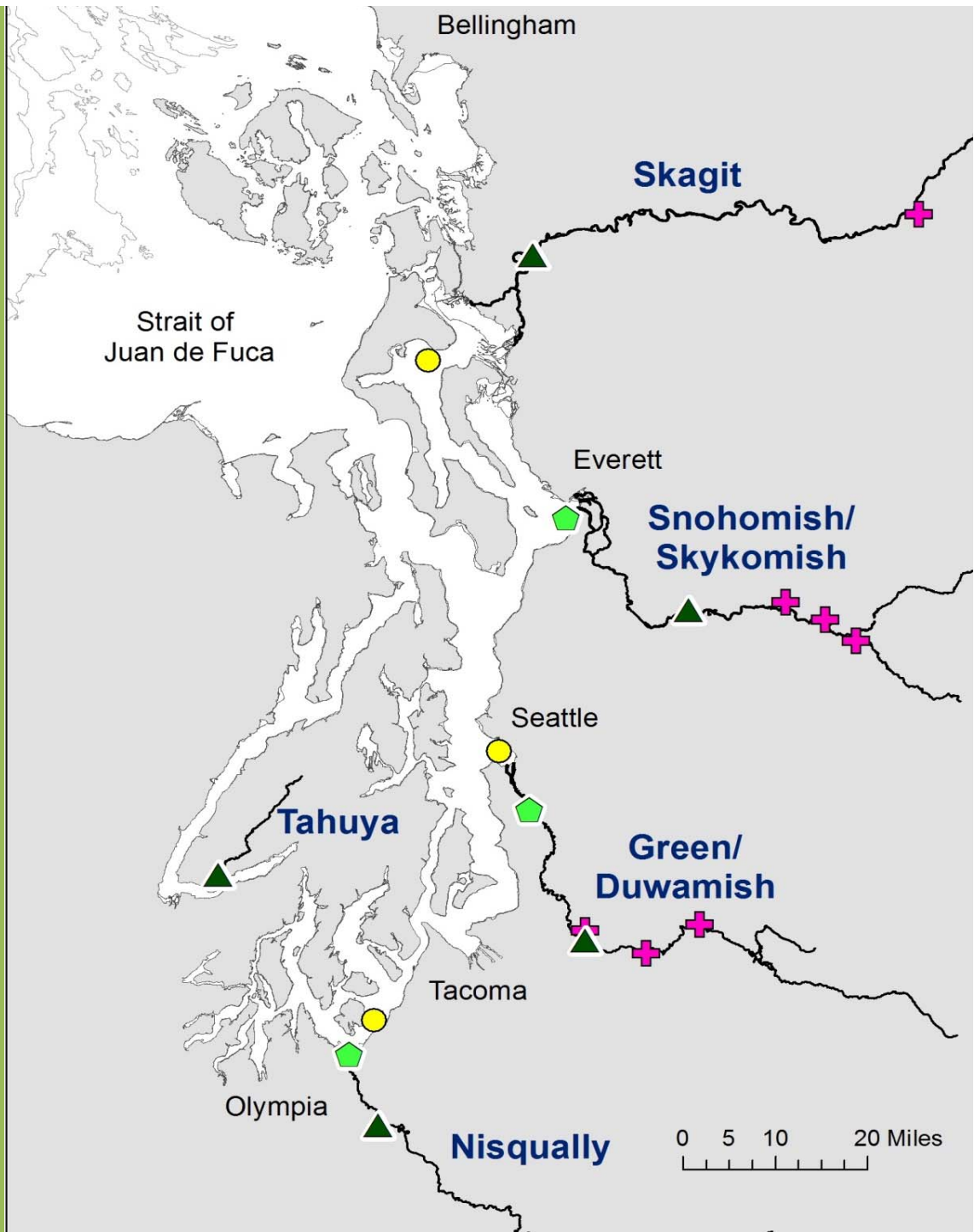
Sampling Design

5 Puget Sound watersheds

-  Hatcheries
-  Traps
-  Lower River / Estuary

3 Offshore Areas

-  Whidbey Basin
-  Green / Duwamish
-  Nisqually



% Prevalence of *Nanophyetus salmincola*, other parasites and organ pathology in steelhead smolts from four Puget Sound river basins in 2014. (n)= sample size

Site	N. salmincola	Kidney Myxosporean	Sanguinicola	Gill Pathology	Heart Pathology
Skagit R.	5 (21)	40 (5)	0 (5)	0 (5)	0 (5)
Whidbey Offshore	7 (42)	36 (31)	3 (31)	0 (31)	3 (31)
Snohomish R.	0 (7)	20 (5)	0 (5)	0 (5)	0 (5)
Green R.	73 (112)	12 (89)	0 (89)	28 (89)	45 (89)
South-Central Offshore	94 (15)	36 (14)	14 (14)	7 (14)	29 (14)
Nisqually R.	99 (69)	47 (59)	34 (59)	42 (59)	69 (59)

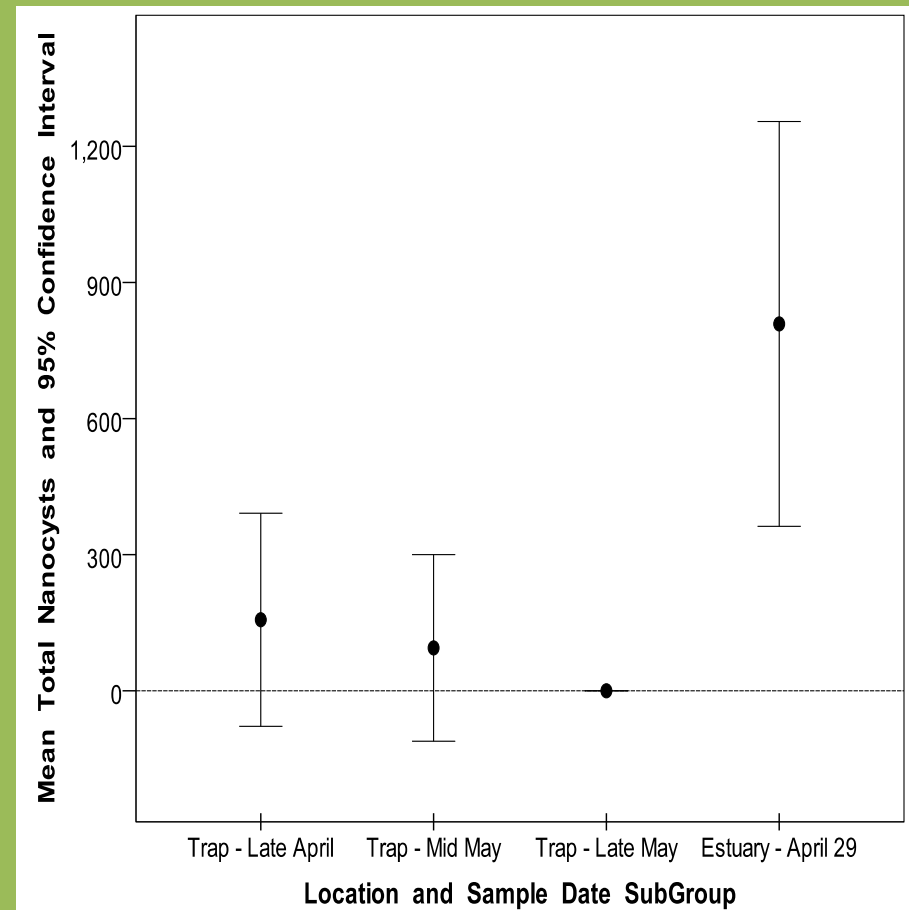
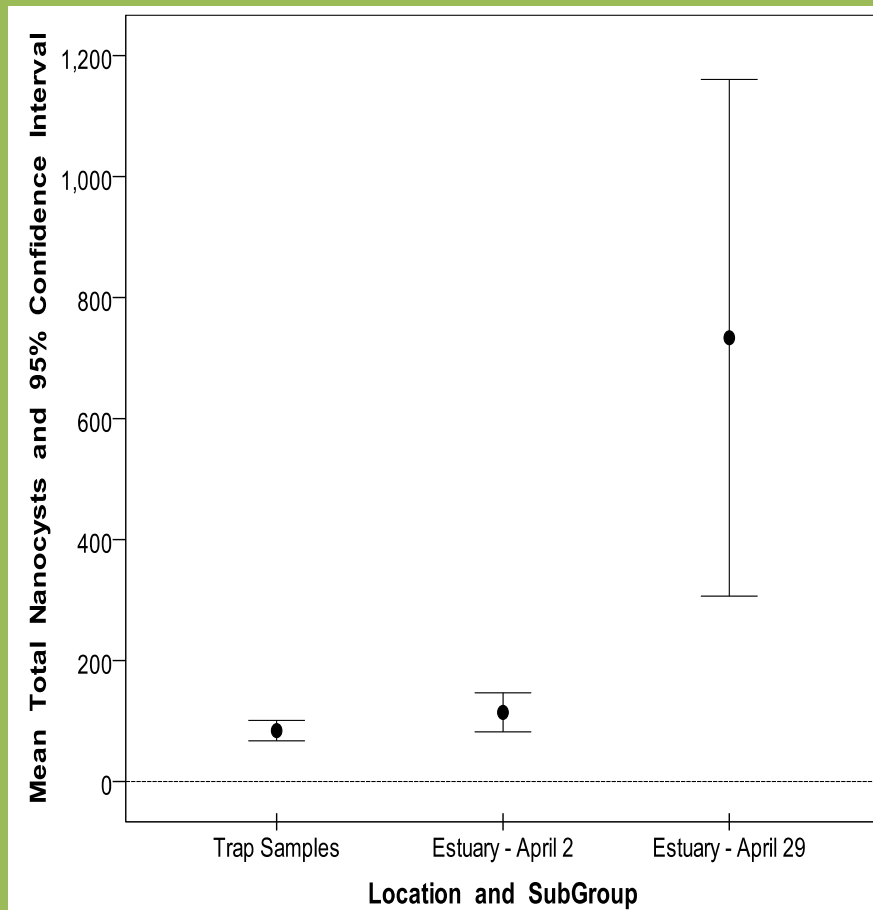
Wild steelhead cyst burden changes with downstream movement

Sample Location	N	% Prevalence	Mean Parasite load of Infected Fish
Green Trap	30	13.3	698
Green River/Estuary	30	86.7	933
Green Offshore	6	100.0	209
Nisqually Trap	40	97.5	1798
Nisqually River/Estuary	30	100.0	2544
Nisqually Offshore	4	75.0	1448

Does parasite burden increase with time and downstream movement? Green River

Hatchery release

Wild fish



Nanophyetus Exposure Levels Resulting in 50% Mortality

Fish Species	Cercaria exposure level
Kokanee	58
Westslope cutthroat	74
Atlantic salmon	110
Coho salmon	200
Rainbow trout ¹	295
Coastal Cutthroat ²	430

¹Klama Hatchery, OR

²Cedar Creek Hatchery, OR

Baldwin et al. 1967. J. Parasitol. 53: 556-564

Recent (up to 96 hrs) *N. salmincola* infections reduce swimming ability

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EFFECT OF THE "SALMON POISONING" TREMATODE, *NANOPHYETUS SALMINCOLA*, ON THE SWIMMING ABILITY OF JUVENILE SALMONID FISHES*

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ABSTRACT: Coho salmon, *Oncorhynchus kisutch*, and steelhead trout, *Salmo gairdneri*, 57 to 60 mm in total length, were exposed either once for 1 hr to 1,500 cercariae of *Nanophyetus salmincola*, or daily for 1 hr to 100 of these parasites for 15 days. The effect of the parasites on the swimming ability of fish exposed only once was determined immediately after exposure, or after 6, 12, 24, or 96 hr, or after 15 days; fish exposed daily were tested immediately after the last exposure. Groups of control and infected fish were tested together in a swimming tube. In some tests, the water velocity in the tube was increased gradually at 10-min intervals, and the velocity at which each fish became fatigued was recorded. In other tests, the water velocity was suddenly increased to a high, constant level, and the duration of swimming of each fish at that velocity was recorded. In both types of tests, there was a marked effect of the parasite on the swimming ability of fish exposed once and tested 0 to 96 hr later and on those exposed repeatedly and tested after their last exposure. The mean swimming speeds or times of groups of steelhead trout were reduced by 10 to 58%, as compared with those of controls, and corresponding per cent reduction values for coho salmon ranged from 4 to 95%. This impairment of the swimming ability of infected fish is attributed to tissue injury caused by migrating parasites. The swimming ability of fish that were exposed once and tested 15 days later, when the parasites were encysted, was little affected. However, it is likely that the effect would have been greater had the infections been heavier.

Study Questions.

1. Is there a correlation between the lower return of steelhead to South Sound Rivers and the presence and intensity of *N. salmincola* infection? The high prevalence and intensity of infection in the Green and especially the Nisqually does correlate with the low rate of return.

2. Does the intensity of infection as outmigration proceeds suggest a causal effect between *N. salmincola* and poor marine survival? The prevalence and intensity of infection increases as fish move into the lower Green River, suggesting that newly acquired *N. salmincola* could be adversely affecting marine survival.

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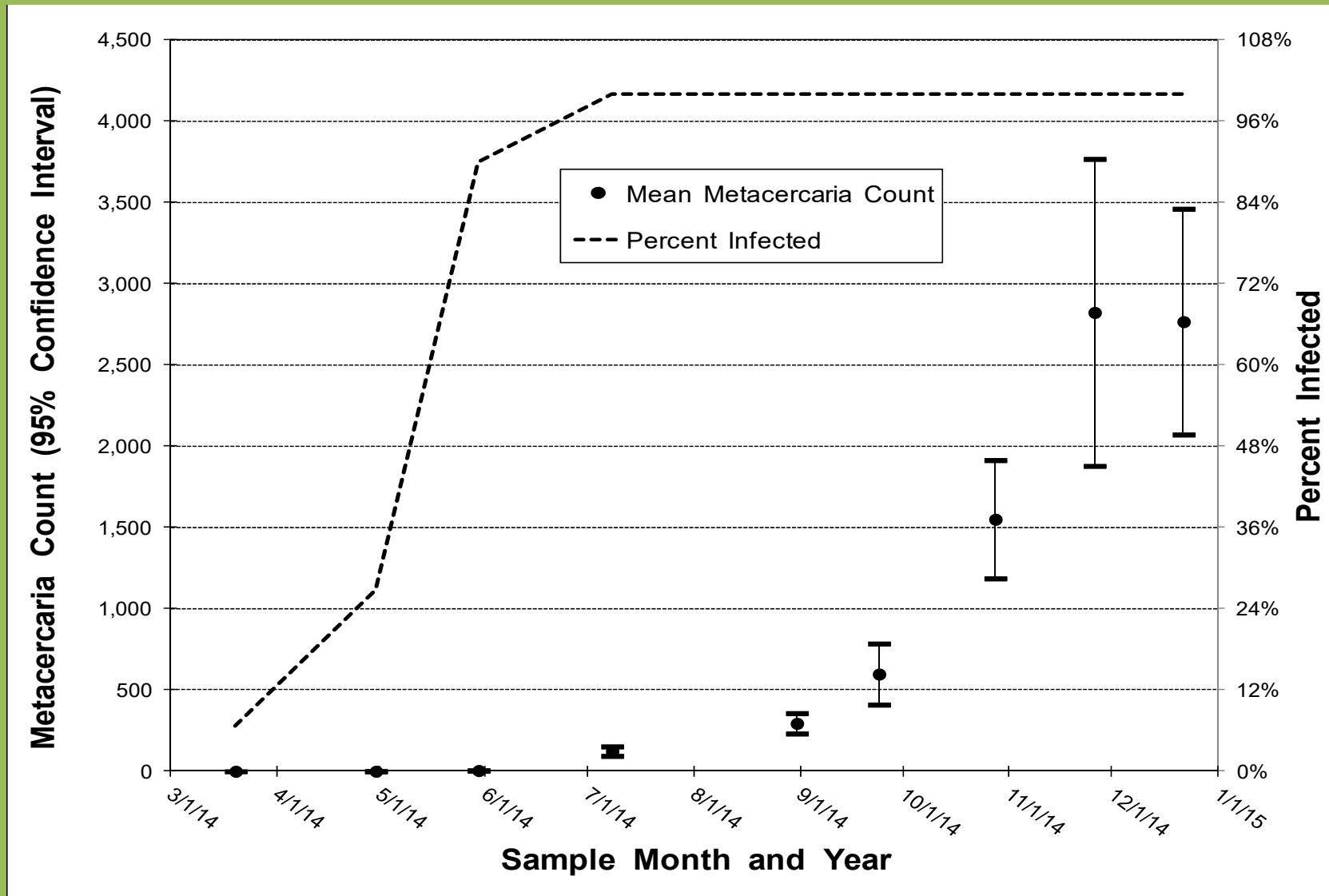
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Hatchery steelhead reared on Soos Creek water were sampled monthly March-December 2014 to determine infection timing.