

FY 2002 Investigational Report:
Health Assessment of VAMP Release Groups – 2002



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Summary

All 6 release groups were in good health and at a similar state of smolt development when sampled at the hatchery and 24-hours post-release. No biologically significant differences were observed in pathogen infections, gill Na⁺/K⁺-ATPase activities, or blood chemistry values. Early infections of *Tetracapsula bryosalmonae* were common, with clinical signs of Proliferative Kidney Disease (PKD) in only 1% of fish examined. Short-term survival of all groups was not likely to be impacted by their health. Health problems resulting from PKD (e.g. anemia) could have arisen several weeks post-release.

Methods

The California-Nevada Fish Health Center examined 6 release groups of Merced River Hatchery Fall-run Chinook Salmon used in the Vernalis Adaptive Management Plan 2002 smolt survival studies. Groups were released at: Durham Ferry on April 18 (DF1) and April 25 (DF2), Mossdale on April 19 (MD1) and April 26 (MD2), and Jersey Point on April 23 (JP1) and April 30 (JP2). Each group was sampled twice, first at the Merced River Hatchery (hatchery) and again from live cars at the release sites approximately 24 hours after release (live car). At the hatchery, 144 total fish were examined for virus, systemic bacteria, gill ATPase activity, blood hematocrit value, plasma total protein concentration, plasma chloride concentration, external and internal signs of disease, and other abnormalities. From live cars, a total of 216 fish were assessed for gill ATPase activity, plasma total protein concentration, plasma chloride concentration, internal and external abnormalities, and *Tetracapsula bryosalmonae* prevalence of infection. Each group consisted of 2 CWT tag codes that were assessed as A and B subgroups. Data from the subgroups were compared and pooled where no significant difference was detected ($P < 0.05$, t-test or rank sum test).

Results and Discussion

No bacterial or viral pathogens were detected. Prevalence of infection for the kidney parasite *Tetracapsula bryosalmonae* (*Tb*), the myxosporean causing Proliferative Kidney Disease (PKD), ranged from 29 to 70% (Figure 1). Overall, 93 of 201 (46%) of the fish examined were infected with *Tb*. Except for 2 specimens (1%), the *Tb* infection was in the early stage of PKD (Clifton-Hadley et. al. 1987). This stage was characterized by the initial invasion of the kidney blood sinuses by the parasite and only minor inflammatory changes. The disease may have continued to progress even after the fish enter salt water (Hedrick and Aronstien 1987) and health problems resulting from PKD (e.g. anemia) could arise several weeks post-release. No evidence of anemia was seen in the blood hematocrit values from any of the hatchery sample groups. While the prevalence of infection varied between release groups there was no apparent pattern of disease progression over the 12-day period of releases. The variation is likely due to the moderate sensitivity of the screening method (histology) for detecting low-level infections. Histology was chosen because it allows for both observation of the parasite and the kidney lesions typical of clinical PKD.

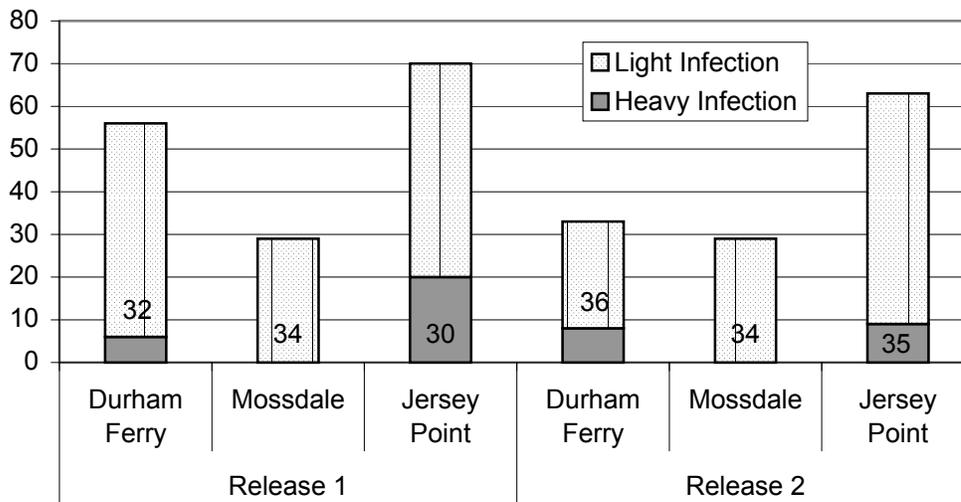


Figure 1. *Tetracapsula bryosalmonae* infection status of VAMP 2002 release groups sampled from live cars at release sites (Durham Ferry, Mossdale, or Jersey Point) 24-hours post-release from April 19 to May 1. Data presented as percent of fish with heavy infections (multiple parasites per microscope field & >10 in section) + percent with light infections (<10 parasites in section or sparse distribution) and number of samples.

Gill Na^+/K^+ -ATPase activity levels were similar among and between hatchery and live car groups. There was no significant change in the 1-6 days between hatchery and 24-hour post-release samples. Mean activities ranged from 9.2 to 11.5 (mmol ADP/mg protein/hr) in the sample groups at the hatchery and 9.8 to 11.0 (mmol ADP/mg protein/hr) 24-hours post-release. All sample groups demonstrated elevated gill ATPase activity consistent with salmon in an advanced stage of smoltification.

Plasma total protein concentrations of some individual fish were slightly elevated. No protein values were outside of normal ranges for juvenile chinook. Elevated plasma protein values would not necessarily indicate reduced survival for the affected fish. An difference was detected between the subgroups of the hatchery DF2 sample ($P=0.047$, t-test). This was likely a short-term change due to a “stress event” such as feeding or sampling for CWT quality control. The same stress event also caused elevated total protein values in the hatchery MD2 group compared to unstressed hatchery groups ($P<0.001$, ANOVA). One subgroup of the live car JP1 fish had depressed total protein values ($P=0.006$, t-test) due to excessive handling during sampling, so that subgroup was dropped from the data set. The 75% quartile of all hatchery protein samples was designated as the cutoff for “elevated” values. The observed incidence of “elevated” values appears to indicate that the release site may have had an effect on plasma total protein concentration (Figure 2). Possible reasons for this site effect include variations in time since last feeding (mild starvation), differences in transport, or site water quality.

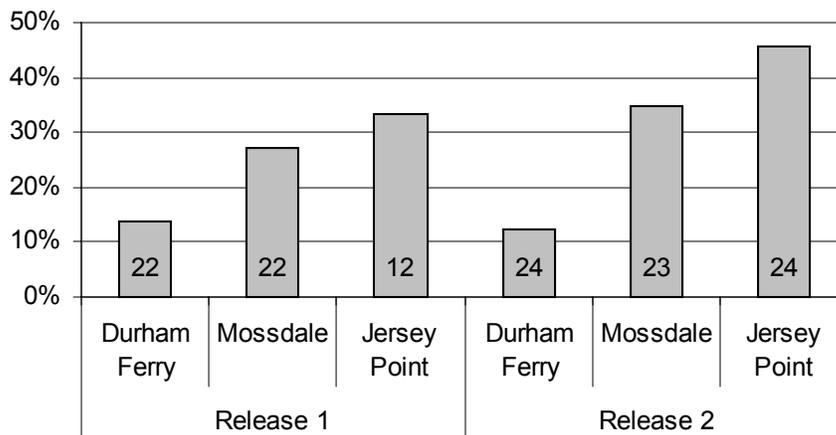


Figure 2. Percent of fish in each VAMP 2002 release group with “high” total protein values sampled from live cars at release sites (Durham Ferry, Mossdale, or Jersey Point) 24-hours post-release from April 19 to May 1. “High” total protein values were designated as those values greater than the 75% quartile of all fish sampled at Merced River Hatchery on April 18, 2002. Data presented as percent of fish with “high” values and total fish sampled.

Plasma chloride values further supported the “stress event” observed in the hatchery total protein values. Decreased chloride values were observed in one DF2 subgroup, the MD2 group and the JP2 group ($P < 0.001$, ANOVA). These stressed fish were dropped from the hatchery baseline data set. There was no significant difference among any of the live car sample groups ($P = 0.254$, ANOVA on ranks). All live car groups had depressed plasma chloride values relative to baseline hatchery values ($P < 0.001$, t-test) indicating they were under stress probably due to sampling. Hatchery fish were dip netted directly from the raceway and quickly euthanized, while capture from the live car took longer. Even with this added stress of sampling, plasma chloride values of live car groups remained within the normal range for juvenile salmonids.

References

Hedrick, R.P. and D. Aronstien. 1987. Effects of saltwater on the disease progress of proliferative kidney disease (PKD) in Chinook salmon. Bulletin of the European Association of Fish Pathologists. 7(4): 93-96.

Clifton-Hadley, R.S., D. Bucke and R.H. Richards. 1987. A study of the sequential clinical and pathological changes during proliferative kidney disease in rainbow trout, *Salmo gairdneri* Richardson. Journal of Fish Diseases. 10(5): 335-352.

Appendix 1. Fish health data for 2002 VAMP release groups. Data is given as mean \pm SE (n). Fish were sampled at the Merced River Hatchery (hatchery) and from live cars 24-hrs post release (live cars) at Durham Ferry (DF1 and DF2), Mossdale (MD1 and MD2) and Jersey Point (JP1 and JP2). Subgroups (A and B) represent different CWT codes within each sample group and were combined where there was no statistical difference ($P < 0.05$, t-test).

	Sample Date	Sample Group	<i>Tetracapsula bryosalmonae</i> (%Prevalence)	Gill ATPase (mmol ADP/mg protein/hr)	Plasma Total Protein (g/dL)	Plasma Chloride (mEq)
Hatchery	April 18	DF1	Not Done	10.4 \pm 0.7 (16)	3.2 \pm 0.1 (23)	133 \pm 1 (22)
		MD1	Not Done	11.5 \pm 0.7 (16)	3.2 \pm 0.1 (24)	133 \pm 1 (24)
		JP1	Not Done	9.2 \pm 0.7 (16)	3.1 \pm 0.1 (24)	127 \pm 1 (24)
		DF2	Not Done	Not Done	A: 3.0 \pm 0.1 (12) B: 3.2 \pm 0.1 (12)	A: 135 \pm 2 (12) B: 123 \pm 1 (12)
		MD2	Not Done	Not Done	3.4 \pm 0.1 (24)	122 \pm 1 (24)
		JP2	Not Done	Not Done	3.1 \pm 0.1 (24)	125 \pm 1 (24)
		Live car	April 19	DF1	56	9.8 \pm 0.8 (16)
April 20	MD1		29	10.8 \pm 1.0 (15)	3.1 \pm 0.1 (22)	120 \pm 2 (22)
April 24	JP1		70	10.3 \pm 0.7 (16)	A: 3.3 \pm 0.1 (12) B: 3.1 \pm 0.0 (11)	123 \pm 1 (23)
April 26	DF2		33	10.3 \pm 1.1 (16)	3.2 \pm 0.1 (24)	121 \pm 1 (24)
April 27	MD2		29	11.0 \pm 0.5 (16)	3.3 \pm 0.1 (23)	120 \pm 1 (23)
May 1	JP2		63	Not Done	3.4 \pm 0.1 (24)	121 \pm 1 (24)