FY2002 Investigational Report :

Trinity River Fall Chinook Smolt Health Following Passage through the Lower Klamath River, June – August 2002.

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September 2003

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Abstract

Juvenile Chinook salmon (*Oncorhynchus tshawytscha*) were surveyed for selected fish pathogens on a weekly basis from 12 June to 1 August 2002 in the Klamath estuary. An emphasis was placed on collecting health information from adipose fin marked salmon so as to determine the effect of infectious disease on Trinity R. hatchery (TRH) fish. Salmon were also examined in the lower Trinity and Klamath River during June. We observed a higher incidence of disease in salmon from the Klamath River compared to those of the Trinity River. Infection by *Ceratomyxa shasta* was the most significant disease and was detected in 19% of TRH salmon collected in the estuary. *Parvicapsula minibicornis*, a myxosporean parasite infecting the kidney and causing glomerulonephritis, was observed in 23% of estuary samples and 95% of salmon examined from the Klamath River. The intensity of parasite infection and severity of associated tissue damage in tagged hatchery salmon tended to increase with time post-release. We conclude that Trinity River smolts do become infected with *C. shasta* while migrating through the Lower Klamath River with a majority of those infected salmon later dying of Ceratomyxosis.

Introduction

The US Fish and Wildlife Service (USFWS) California-Nevada Fish Health Center has performed fish health evaluations in the Klamath and Trinity Rivers since 1991 in conjunction with tribal, state and federal agencies. Several significant pathogens have been identified which may be contributing to significant mortality among juvenile salmonid emigrants. Pathogens observed to cause disease in the Klamath and Trinity Rivers include *Ceratomyxa shasta* (Klamath only), *Flavobacterium columnare*, Aeromonid bacteria, *Nanophyetus salmonicola*, and the kidney myxosporean *Parvicapsula minibicornis*. Ceratomyxosis has been the most significant disease for juvenile salmon in the Klamath R. basin (Foott et al. 1999, 2003).

The primary objective of this study was to determine the degree of ceratomyxosis experienced by Trinity River Chinook salmon that have migrated through the lower Klamath R. and are rearing in the estuary. Histological evaluation of tissues from tagged salmon was performed to determine both the presence of the parasite infection and severity of disease.

Methods

Juvenile Fall-run Chinook salmon (smolts) were sample at three sites: 1) beach seine collections by California Department of Fish and Game in the Klamath estuary (rkm 0), 2) on 11 June at the Yurok Tribal Fisheries rotary screw trap on the Trinity River below Willow creek (Riverdale Campground, rkm 34), and 3) on 11 June and 25 June at the Klamath R. rotary screw trap jointly operated by the USFWS and Karuk tribe near Big Bar river access (rkm 80). The Klamath Estuary was sampled weekly between 12 June and 1 August 2002. The majority of smolts caught in the estuary were unmarked and the first 10 unmarked fish each week were treated as a random representative sample of the fish in the estuary (Unmarked). Samples from coded-wire-tagged CWT smolts

were individually identified to provide data on stock origin and days at large (post-release) after tag retrieval and reading by CDFG. A 20 fish "grab" sample was taken from the rotary screw traps.

Groups of 5 fish were euthanized in MS222, measured for fork length, and assessed for any clinical signs of disease. If lesions indicative of *Flavobacterium columnare* infection were observed on a particular fish, an imprint of the lesion was made onto a glass microscope slide, fixed in absolute methanol, gram-stained, and examined for the presence of long filamentous Gram-negative rods for a presumptive diagnosis of Columnaris. Diagnosis of bacterial septicemia was performed on smolts with erythema on the skin or at the base of the fins. A sample of kidney tissue was taken aseptically from such symptomatic fish and inoculated onto individually numbered brain heart infusion agar slant tubes. Isolates showing growth within 3 days were screened for bacterial fish pathogens by standard microscopic and biochemical tests (Lasee 1995). The intestinal tract and posterior kidney were rapidly removed from the fish, fixed in Prefer Fixative (Anatech, Battle Creek, MI) for at least 48 hours, processed for 5 μm paraffin sections and stained with hematoxylin and eosin (Humason 1979). All tissues for a given fish were placed on one slide and identified by a unique code number. Each slide was examined at both low (40X) and high magnification (400X) and the intensity of parasitic infection rated as 0 = none, 1 = light or early infection, or 2-3 = severe infection. Any associated tissue lesion was rated in a similar fashion. Specific parasitic infections of interest included *Ceratomyxa shasta, Parvicapsula minibicornis (*myxosporean associated with associated with glomerular inflammation and kidney swelling), and metaceracaria presumptively identified as *Nanophyetus salmonicola.* Unequal sample numbers between incidence of infection and severity of lesion data were a result of either poor specimen condition not allowing for lesion determination or the presence of a given parasite in the vascular system of non-target tissues. A database for each fish sampled allowed for assignment of disease status to specific tagged groups as well as temporal patterns.

Results

Fish Origins -Of the 185 smolts examined in this study, 59 were from the upstream sites including 20 from Riverdale and 39 from Big Bar traps above the confluence of the Trinity. The remaining 126 fish were captured in the Klamath Estuary and included 47 unmarked, 74 Trinity River Hatchery CWT (TRH), and 5 Iron Gate Hatchery CWT (IGH) smolts.

Bacterial infection – One unmarked smolt, captured in the estuary, showed clinical signs of bacterial septicemia (petechial hemorrhaging). Unfortunately the bacteriology sample was contaminated by fungus and no identification was attempted on the isolate. Eight of the 39 smolts examined from Big Bar had gill lesions typical of *F. columnare* infection. Bacteria observed in five of eight gill imprints from these fish were diagnosed as *F. columnare*. Columnaris was also associated with the majority of gill imprints collected from

adult spring-run chinook salmon mortalities in the lower Trinity River during July 2002 (Appendix 1).

Ceratomyxa shasta – Of 172 intestine samples examined by histology, 43 (25%) were infected with *C. shasta* trophozoites and the majority of these samples were rated as severe infections. In the estuary, *C. shasta* trophozoites were observed in three of five (60%) IGH smolts, 13 of 68 (19%) TRH smolts, and 12 of 47 (26%) unmarked smolts (Fig. 1). Fifteen of 38 (39%) salmon collected in early June at Big Bar trap were infected while *C. shasta* trophozoites were absent in the 14 intestinal section of salmon collected in the Trinity River. The incidence of *C. shasta* infection and severity of associated lesions in TRH smolts captured in the Estuary appeared to increase with time following release from the hatchery (Table 1). *Ceratomyxa shasta* was also detected in 2 of 11 intestinal samples collected from adult spring-run Chinook salmon mortalities in the lower Trinity River during July 2002 (Appendix 1).

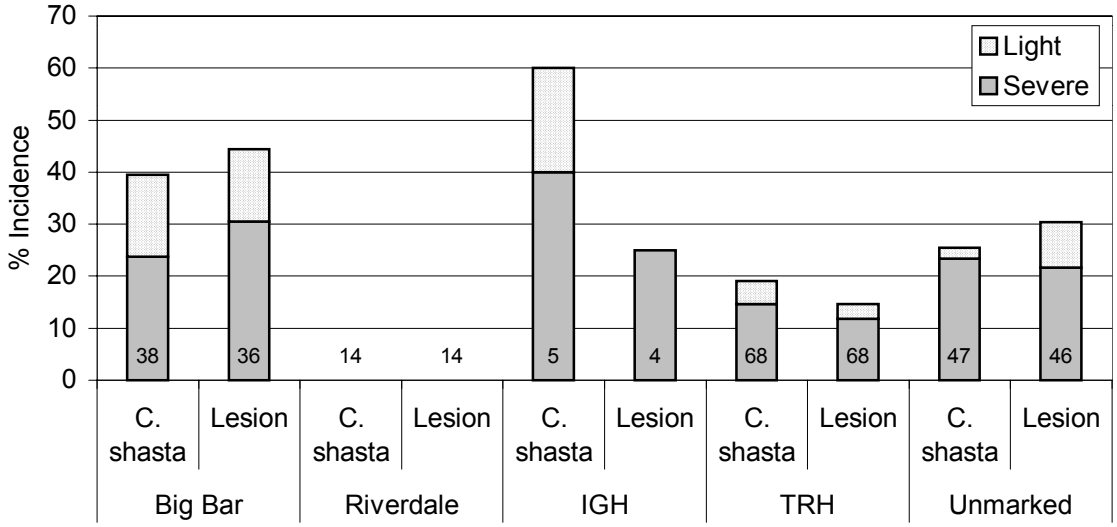

Figure 1. Incidence of *Ceratomyxa shasta* and associated intestinal lesion observed in Klamath and Trinity River Chinook Salmon smolts. Fish were captured near Big Bar on the Klamath River, Riverdale on the Trinity River, and in the Klamath Estuary. Marked and CWT implanted fish captured in the estuary were identified as originating from Iron Gate Hatchery on the Klamath (IGH) or Trinity River Hatchery (TRH). A random sample of unmarked fish from the estuary was also surveyed. Data is presented as severity of infection or lesion and number of samples.

Table 1. Days since hatchery release and incidences of *Ceratomyxa shasta* infection, typical *C. shasta* intestinal lesion (Int. Lesion), *Parvicapsula minibicornis* infections, associated glomerulonephritis (Kd. Lesion), and *Nanophyetus salmonicola* infection for Trinity River Hatchery Chinook Salmon smolts captured in the Klamath River Estuary during the summer of 2002.

Days	*C. shasta*	Int. Lesion	*P. minibicornis*	Kd. Lesion	*N. salmonicola*
19	0/23 (0%)	0/23 (0%)	0/19 (0%)	0/19 (0%)	10/19 (53%)
24-25	1/21 (5%)	1/21 (5%)	1/21 (5%)	1/21 (5%)	18/21 (86%)
33	4/9 (44%)	3/9 (33%)	2/9 (22%)	1/9 (11%)	8/9 (89%)
42	2/10 (20%)	2/10 (20%)	4/10 (40%)	1/10 (10%)	6/10 (60%)
55	4/5 (80%)	4/5 (80%)	2/5 (40%)	0/5 (0%)	5/5 (100%)

Parvicapsula minibicornis (Kidney Myxosporean) – Of 174 kidney samples examined by histology, 79 (45%) were infected by the pre-sporogonic stage of this myxosporean parasite and the majority of these samples were rated as severe infections. The parasite was identified by Polymerase Chain Reaction assay on replicate kidney samples from histology-positive smolts. Dr. Simon Jones, at the Pacific Biological Station in Nanaimo British Columbia, generously performed this work. We had previously been unable to identify the myxosporean due to the lack of identifying spores. The parasite was observed within the glomeruli and renal tubule lumens of kidney sections from five of five (100%) IGH, 9 of 64 (14%) TRH, and 18 of 47 (60%) unmarked smolts collected in the estuary (Fig. 2). Thirty-seven of 39 Big Bar samples (95%) contained the parasite however it was not detected in any of the 19 sections from Trinity smolts collected at Riverdale. As with ceratomyxosis, the incidence of infection and severity of disease (glomerulonephritis) in TRH smolts captured in the Estuary appeared to increase with time following release from the hatchery (Table 1).

On 25 June, a 24 hr saltwater challenge was conducted with 30 Chinook smolts collected in the lower estuary that same day. The 27 ppt challenge (Instant Ocean salt) was performed in a 100L container held in the estuary (19 - 20°C) and aerated with compressed air. Of the 16 survivors, three smolts were infected with the kidney myxosporean without a dual infection by *C. shasta*. There was no significant difference in plasma osmolarity or total protein between the infected fish and the 11 healthy (no *C.shasta* or *Parvicapsula* infection detected by histology) survivors.

Nanophyetus salmonicola – Of 175 kidney samples examined 79 (45%) were infected with a trematode metacercaria presumptively identified as *N. salmonicola*. In estuary samples, metacercaria were observed in none of 5 (0%) IGH, 47 of 64 (73%) TRH, and 19 of 47 (40%) unmarked smolts. It was detected in 3 of 39 (8%) of Big Bar and 10 of 20 (50%) Riverdale trap samples. There was no extensive lesion or tissue damage associated with this parasite.

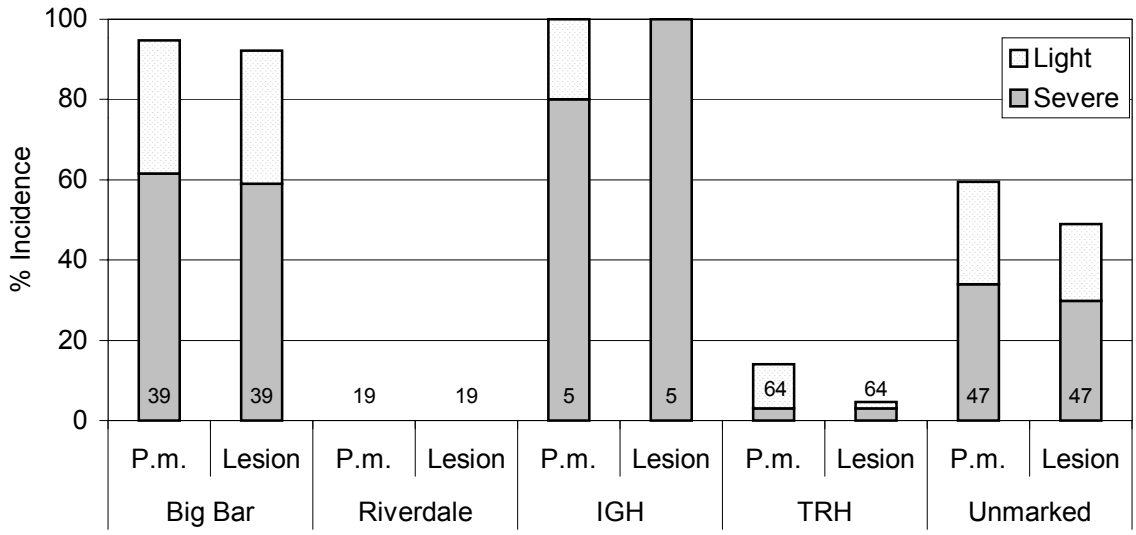

Figure 2. Incidence of *Parvicapsula minibicornis* (*P.m.*) and associated glomerulonephritis (lesion) observed in kidney tissue of Klamath and Trinity River Chinook Salmon smolts. Fish were captured near Big Bar on the Klamath River, Riverdale on the Trinity River, and in the Klamath Estuary. Marked and CWT implanted fish captured in the estuary were identified as originating from Iron Gate Hatchery on the Klamath (IGH) or Trinity River Hatchery (TRH). A random sample of unmarked fish from the estuary was also surveyed. Data is presented as severity of infection or lesion and number of samples.

Discussion

As in previous years, ceratomyxosis was the most significant health problem observed in out-migrant Chinook salmon collected in the Klamath River and estuary (Foott et al. 1999, Foott et al. 2002, Williamson & Foott 1998). Regardless of reduced water temperatures found in the estuary (< 20°C), this disease has been shown to be lethal in a majority of fish with detectable infections (Foott et al. 2003). As the majority of samples were rated as severe infections, it is likely that mortality will be similar to the incidence of *C. shasta* infection for a particular site. The higher incidence of ceratomyxosis observed in out-migrant fish captured at the Big Bar trap (39%) compared to the combined estuary collection (25%) is consistent with past studies and suggests that many infected smolts do not reach the estuary (Foott et al. 1999, Appendix 2). This trend would likely affect Klamath R. out-migrants significantly more than Trinity R. smolts given their longer exposure period. The absence of *C. shasta* infection in smolts captured in the Trinity River was consistent with previous Fish Health Center studies as well as those by Hendrickson et al. (1989). As Trinity River smolts migrated through the Lower Klamath River, they became infected with *C. shasta,* and the incidence of infection appears to increase with the time it takes to travel to the Estuary.

We have previously observed a high incidence of *P. minibicornis* infection (54 – 84%) in the kidneys of Klamath R. basin smolts similar to that seen in this

study (Appendix 2). We did not detect this parasite in the Trinity River samples in 2002; however, it has been noted in past Trinity R. surveys (Foott et al. 2002, Williamson & Foott 1998). The Klamath R. appears to be primary source of infection and Steelhead are resistant to infection (Foott et al. 2003). *Parvicapsula minibicornis* has been previously described in sockeye salmon adults returning to the Frazer and Columbia river systems (St-Hiliare et al. 2002, Jones et al. 2003). The glomerulonephritis associated with the parasite results in markedly swollen kidneys and anemia. This clinical presentation resembles Bacterial Kidney Disease, however, infection by *Renibacterium salmoninarum* is relatively rare in Klamath R. basin fish (Foott 1996, Williamson & Foott 1998). The effect of this parasite on Klamath R. basin salmon smolts is not understood however kidney damage is likely to impair hemopoiesis (blood cell formation), osmoregulation, and blood filtration efficiency. Our June 25 saltwater challenge attempted to examine the osmoregulatory effect of *P. minibicornis* infection but was inconclusive due to the small sample size (3 infected fish) and overall low challenge survival (53%) that was probably influenced by high water temperatures. As with ceratomyxosis, the incidence of infection and severity of disease (glomerulonephritis) in TRH smolts captured in the Estuary appeared to increase with time following release from the hatchery. Disease from both *C. shasta* and *P. minibicornis* was more prevalent in smolts collected from the Big bar trap in comparison to the Riverdale site. This consistent observation suggests that disease mortality is more significant to chinoook smolts in the Klamath than the Trinity River

Nanophyetus salmonicola infection of the kidney appeared higher in Trinity River smolts captured at Riverdale; however there was no lesion or other clinical signs of disease associated with these infections. The parasite is observed in both gill and kidney with the incidence of infection in estuary salmon kidney ranging from 23 – 70 % (Appendix 2). It is likely *N. salmonicola* was not a significant health problem for smolts in 2002.

This study demonstrated that Trinity R. smolts are affected by ceratomyxosis upon entering the Klamath R. and that multiple parasitic infections are common. As ceratomyxosis is largely fatal, this disease could have claimed more than 10% of the Trinity R. fish passing through the estuary in 2002.

Acknowledgements

We wish to thank the CDFG Klamath Estuary monitoring crew for sampling assistance and CWT reading; the USFWS Arcata FWO Klamath and Trinity crews for help sampling and monitoring; the Yurok Tribe crew for help sampling the Riverdale trap; the Karuk Tribe crew for help sampling the Big Bar trap; and everyone at the CA-NV Fish Health Center for help in the lab in particular Rick Harmon and Ron Stone for processing endless histology samples. Partial funding of the project was obtained from the Trinity R. Restoration Program (11230 – 1332- 1TRN, $20,526)

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Appendix 1. Trinity River Adult Spring Chinook Mortality, 2002

Below is a summary of lab results from Trinity River Adult Spring Run Chinook Salmon sampled to diagnose mortality occurring during July 2002. Mortality was presumed to be caused by Columnaris or Ceratomyxosis. Presumptive diagnosis of Columnaris was performed by Gram stain of gill imprints and finding of long filamentious Gram negative rods typical of *Flavobacterium columnare*. Presumptive diagnosis of Ceratomyxosis was performed by Leishman-Giemsa stain of vent smear samples and observation of *Ceratomyxa shasta* trophozoite stage (spore stage had not yet formed).

Results:

Agency Sampling: Hoopa TF

Date	Reach	Tissue	ID	Results	Notes
7/11	Big Rock to Rolland's	Vent	1	Neg	Sparse sample, few cells observed
7/12	Roland's to Klamath	Gill	1	*Fc*	
7/19	Hawkin's Bar to Big Rock	Vent	1	Neg	Cells lysed
"	"	Gill	2	*Fc*	
"	"	Vent	3	Neg	
"	"	Gill	4	*Fc*	
"	"	Gill	5	*Fc*	
7/22	Rolands to Klamath	Gill	1	*Fc*	
"	"	Vent	1	Neg	
"	"	Gill	2	*Fc*	
"	'	Vent	2	Neg	

Agency Sampling: Yurok TF

Date	**Reach**	**Tissue**	**ID**	**Results**	**Notes**
7/12	Hawkin's Bar to Sayler	Gill	1	Neg	Zoo of all kinds of bacteria
"	"	Vent	1	*Cs*	Possibly heavy. I have little experience with this sample type

Agency Sampling: Lower Trinity Ranger District

Date	Reach	Tissue	ID	Results	Notes
7/12	South Fork to Big Rock	Vent	1	Neg	
"	"	Gill	2	Neg	Zoo of various bacteria
"	"	Vent	2	*Cs*	
"	"	Gill	A	Neg	Zoo of various bacteria
"	"	Vent	B	Neg	Cells lysed
"	"	Gill	C	*Fc*	
"	"	Vent	C	Neg	

Agency Sampling: CDFG

Date	Reach	Tissue	ID	Results	Notes
7/15	Steel Bridge to DC Campground	Gill	1	*Fc*	
"	"	Vent	1	Neg	Sparse sample, few cells

A group of unlabeled samples possibly from USFWS-Arcata was not processed.

Conclusions:

Fc: 8/11

Cs: 2/11

Both *Ceratomyxa shasta* and *Flavobacterium Columnare* were detected in these fish and may have contributed to pre-spawning mortality. Eight of 11 gill imprints showed signs of infection with *Fc* and the last 3 may have been infected but were overgrown with various bacteria. *Cs* was detected in two of 11 samples. The vent swab was expected to only detect heavily infected fish. This was a trial of the swab method and it appears to have worked. Several of the samples were very bloody, which made the sample difficult to read. The presence of the parasite may have been missed in these bloody samples. Two of the samples contained mostly (95%+) lysed cells which may be avoided by fixing the sample sooner. The *C. shasta* trophozoite would also have lysed and been lost in these samples. This sample method would be more useful in the future if care was taken to avoid blood in the sample and fixation was preformed immediately after sampling.

Appendix II. Pathogen data for juvenile chinook salmon collected in the Klamath Estuary during the spring and summer of 1997, 1998 and 2001. Incidence of infection reported as no. positive / no. examined (%) for infection by *Ceratomyxa shasta* in histological sections of intestine, *Renibacterium salmoninarum* (RS) by ELISA (optical density > 0.3) or direct fluorescent antibody technique (dfat), metacercaria (Metac., presumptive *Nanophyetus salmincola*) in kidney squash preparations (KSQH) or histological sections of gill or kidney (Kd), and a myxosporean within sections of kidney (presumptive *Parvicapsula minibicornis*).

Year/ Group	*Cshasta*	RS OD>0.3	RS dfat	Metac. KSQH	Metac. GILLhist	Metac. Kdhist	Kidney Myxosp.
1997 x	11 / 212 (5)	0 / 50 (0)	4 / 215 (2)	90 / 172 (52)	2 / 8 (25)	8 / 85 (9)	61 / 90 (68)
1998 y	1 / 19 (5)	ND	ND	35 / 50 (70)	14 / 23 (61)	12 / 25 (48)	15 / 28 (54)
2001 z	12 / 42 (29)	ND	0 / 30 (0)	7 / 30 (23)	18 / 24 (75)	5 / 43 (12)	36 / 43 (84)

X In preparation: Health and physiology of natural and hatchery out-migrant Chinook smolts in the Klamath R. basin (June – July 1997)

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Appendix III. Data by individual Fish

Date	Location	Fish #	FL	Gill Pale	Gill Lesion	Swollen Abdomen	Hemor Skin/Fins	Head Tag#	Origin	DAL	Cs lesion (0-3)	Kd lesion (0-3)	Cshasta (0-3)	Kd myxo (0-3)	Metac (0-1)	Gill Imprint	Bacte
6/11/02	Big Bar	1	83	1	0	0	0		#N/A	#N/A	3	2	3	0	0		
6/11/02	Big Bar	2	98	1	0	0	0		#N/A	#N/A	2	1	2	1	0		
6/11/02	Big Bar	3	83	1	0	0	0		#N/A	#N/A	0	1	1	1	0		
6/11/02	Big Bar	4	93	1	0	0	0		#N/A	#N/A	3	1	0	1	0		
6/11/02	Big Bar	5	98	1	0	0	0		#N/A	#N/A	3	1	0	1	1		
6/11/02	Big Bar	6	84	1	0	0	0		#N/A	#N/A	0	3	0	3	0		
6/11/02	Big Bar	7	100	1	0	0	0		#N/A	#N/A	NR	3	NR	3	0		
6/11/02	Big Bar	8	89	1	1	0	0		#N/A	#N/A	3	0	0	1	0	Fc	
6/11/02	Big Bar	9	90	2	1	0	0		#N/A	#N/A	3	1	0	1	0	zoo	
6/11/02	Big Bar	10	80	0	0	0	0		#N/A	#N/A	3	1	0	1	1		
6/11/02	Big Bar	11	83	1	0	0	0		#N/A	#N/A	0	3	0	3	0		
6/11/02	Big Bar	12	81	0	0	0	0		#N/A	#N/A	0	3	0	3	0		
6/11/02	Big Bar	13	86	1	1	0	0		#N/A	#N/A	0	3	1	3	0	no infection	
6/11/02	Big Bar	14	86	1	0	0	0		#N/A	#N/A	2	3	2	3	0		
6/11/02	Big Bar	15	94	1	0	0	0		#N/A	#N/A	2	3	0	1	0		
6/11/02	Big Bar	16	95	1	0	0	0		#N/A	#N/A	2	3	1	1	0		
6/11/02	Big Bar	17	91	1	0	0	0		#N/A	#N/A	NR	1	3	2	0		
6/11/02	Big Bar	18	94	0	0	0	0		#N/A	#N/A	NR	2	3	1	0		
6/11/02	Big Bar	19	94	0	0	0	0		#N/A	#N/A	1	2	0	1	0		
6/11/02	Big Bar	20	96	0	0	0	0		#N/A	#N/A	1	1	1	2	0		
6/11/02	Riverdale	1	107	0	0	0	0		#N/A	#N/A	NR	0	NR	0	0		
6/11/02	Riverdale	2	77	0	0	0	0		#N/A	#N/A	NR	0	NR	0	0		
6/11/02	Riverdale	3	93	0	0	0	0		#N/A	#N/A	NR	NR	NR	NR	0		
6/11/02	Riverdale	4	80	0	0	0	0		#N/A	#N/A	NR	0	NR	0	0		
6/11/02	Riverdale	5	106	0	0	0	0		#N/A	#N/A	0	0	0	0	1		
6/11/02	Riverdale	6	114	0	0	0	0		#N/A	#N/A	0	0	0	0	0		
6/11/02	Riverdale	7	114	0	0	0	0		#N/A	#N/A	0	0	0	0	1		
6/11/02	Riverdale	8	112	0	0	0	0		#N/A	#N/A	0	0	0	0	1		
6/11/02	Riverdale	9	83	0	0	0	0		#N/A	#N/A	NR	0	NR	0	1		
6/11/02	Riverdale	10	107	0	0	0	0		#N/A	#N/A	0	0	0	0	1		
6/11/02	Riverdale	11	112	0	0	0	0		#N/A	#N/A	0	0	0	0	0		
6/11/02	Riverdale	12	76	0	0	0	0		#N/A	#N/A	0	0	0	0	0		
6/11/02	Riverdale	13	87	0	0	0	0		#N/A	#N/A	0	0	0	0	1		
6/11/02	Riverdale	14	93	0	0	0	0		#N/A	#N/A	0	0	0	0	0		
6/11/02	Riverdale	15	77	0	0	0	0		#N/A	#N/A	0	0	0	0	1		
6/11/02	Riverdale	16	103	0	0	0	0		#N/A	#N/A	0	0	0	0	1		
6/11/02	Riverdale	17	95	0	0	0	0		#N/A	#N/A	0	0	0	0	1		
6/11/02	Riverdale	18	82	0	0	0	0		#N/A	#N/A	0	0	0	0	0		
6/11/02	Riverdale	19	105	0	0	0	0		#N/A	#N/A	NR	0	NR	0	1		
6/11/02	Riverdale	20	85	0	0	0	0		#N/A	#N/A	0	0	0	0	0		
6/12/02	Estuary	1	94	1	0	0	0	3327	IGH	33	NR	3	3	2	0		
6/12/02	Estuary	2	97	0	0	0	0		#N/A	#N/A	0	0	0	0	0		
6/12/02	Estuary	3	76	0	0	0	0		#N/A	#N/A	2	0	0	0	1		
6/12/02	Estuary	4	102	0	0	0	0		#N/A	#N/A	1	3	0	2	0		
6/12/02	Estuary	5	94	0	0	0	0		#N/A	#N/A	NR	3	3	2	0		
6/17/02	Estuary	1	82	2	0	0	0		#N/A	#N/A	0	1	0	1	0		
6/17/02	Estuary	2	97	1	0	0	0		#N/A	#N/A	0	3	0	2	0		
6/17/02	Estuary	3	94	1	0	0	0		#N/A	#N/A	3	3	3	3	0		
6/17/02	Estuary	4	96	1	0	0	0		#N/A	#N/A	2	3	2	3	0		
6/17/02	Estuary	5	86	0	0	0	0		#N/A	#N/A	0	3	0	3	0		
6/17/02	Estuary	6	77	0	0	0	0		#N/A	#N/A	3	2	2	2	1		
6/25/02	Big Bar	1	90	2	1	0	0		#N/A	#N/A	0	2	0	3	0	Fc	

Date	Location	Fish #	FL	Gill Pale	Gill Lesion	Swollen Abdomen	Hemor Skin/Fins	Head Tag#	Origin	DAL	Cs lesion (0-3)	Kd lesion (0-3)	Cshasta (0-3)	Kd myxo (0-3)	Metac (0-1)	Gill Imprint	Bacte
6/25/02	Big Bar	2	90	1	1	0	0		#N/A	#N/A	0	2	0	2	0	Fc	
6/25/02	Big Bar	3	88	0	0	0	0		#N/A	#N/A	1	2	2	2	0		
6/25/02	Big Bar	4	90	1	0	0	0		#N/A	#N/A	3	0	3	2	0		
6/25/02	Big Bar	5	83	0	0	0	0		#N/A	#N/A	0	1	0	3	0		
6/25/02	Big Bar	6	77	0	0	0	0		#N/A	#N/A	0	2	0	2	0		
6/25/02	Big Bar	7	68	1	0	0	0		#N/A	#N/A	0	0	1	1	0		
6/25/02	Big Bar	9	72	2	1	0	0		#N/A	#N/A	0	2	0	3	0	Fc	
6/25/02	Big Bar	10	80	2	0	0	0		#N/A	#N/A	0	3	0	2	0		
6/25/02	Big Bar	11	84	0	0	0	0		#N/A	#N/A	0	3	0	3	0		
6/25/02	Big Bar	12	96	1	0	0	0		#N/A	#N/A	1	2	2	3	0		
6/25/02	Big Bar	13	95	0	0	0	0		#N/A	#N/A	0	2	0	3	1		
6/25/02	Big Bar	14	80	0	0	0	0		#N/A	#N/A	0	2	0	3	0		
6/25/02	Big Bar	15	87	0	0	0	0		#N/A	#N/A	0	3	0	3	0		
6/25/02	Big Bar	16	95	0	1	0	0		#N/A	#N/A	0	1	0	0	0	Fc	
6/25/02	Big Bar	17	92	1	0	0	0		#N/A	#N/A	0	3	1	1	0		
6/25/02	Big Bar	18	90	0	0	0	0		#N/A	#N/A	0	1	0	2	0		
6/25/02	Big Bar	19	85	0	1	0	0		#N/A	#N/A	0	1	0	3	0	Fc	
6/25/02	Big Bar	20	50	0	0	0	0		#N/A	#N/A	1	1	2	3	0		
6/26/02	Estuary	1	86	0	0	0	0		#N/A	#N/A	3	1	3	2	0		
6/26/02	Estuary	2	96					3345	TRH	19	NR	0	NR	0	0		
6/26/02	Estuary	3	88					3346	TRH	19	0	0	0	0	1		
6/26/02	Estuary	4	89					3347	TRH	19	0	0	0	0	1		
6/26/02	Estuary	5	88					3348	TRH	19	0	0	0	0	0		
6/26/02	Estuary	6	90					3349	TRH	19	NR	NR	NR	NR	NR		
6/26/02	Estuary	7	90					3350	TRH	19	NR	NR	NR	NR	NR		
6/26/02	Estuary	8	84					3351	TRH	19	0	NR	0	NR	NR		
6/26/02	Estuary	9	92					3352	TRH	19	0	NR	0	NR	NR		
6/26/02	Estuary	10	98					3353	TRH	19	0	NR	0	NR	NR		
6/26/02	Estuary	11	88					3354	TRH	19	0	NR	0	NR	NR		
6/26/02	Estuary	12	93					3355	TRH	19	0	NR	0	NR	NR		
6/26/02	Estuary	13	91					3356	TRH	19	NR	0	NR	0	0		
6/26/02	Estuary	14	98					3357	TRH	19	0	0	0	0	1		
6/26/02	Estuary	15	89					3358	TRH	19	0	0	0	0	0		
6/26/02	Estuary	16	110					3359	TRH	19	0	0	0	0	0		
6/26/02	Estuary	17	95					3360	TRH	19	0	0	0	0	0		
6/26/02	Estuary	18	90					3361	TRH	19	0	0	0	0	1		
6/26/02	Estuary	19	92					3362	TRH	19	0	0	0	0	1		
6/26/02	Estuary	20	86					3363	TRH	19	0	NR	0	NR	NR		
6/26/02	Estuary	21	88					3364	TRH	19	0	0	0	0	0		
6/26/02	Estuary	22	94					3365	TRH	19	#N/A	#N/A	#N/A	#N/A	#N/A		
6/26/02	Estuary	23	100					3366	TRH	19	#N/A	#N/A	#N/A	#N/A	#N/A		
6/26/02	Estuary	24	89					3367	TRH	19	0	0	0	0	1		
6/26/02	Estuary	25	90					3368	TRH	19	0	0	0	0	0		
6/26/02	Estuary	26						3369	TRH	19	0	0	0	0	0		
6/26/02	Estuary	27						3370	TRH	19	0	0	0	0	1		
6/26/02	Estuary	28						3371	TRH	19	0	0	0	0	1		
6/26/02	Estuary	29						3372	TRH	19	0	0	0	0	1		
6/26/02	Estuary	30						3373	TRH	19	0	0	0	0	1		
6/26/02	Estuary	31		mort	mort	mort	mort		#N/A	#N/A	3	0	3	0	0		
6/26/02	Estuary	32		mort	mort	mort	mort		#N/A	#N/A	1	0	2	0	0		
7/1/02	Estuary	1	88	0	0	0	0	3375	TRH	24	0	0	2	0	1		
7/1/02	Estuary	2	90	0	0	0	0	3376	TRH	24	0	0	0	0	1		

Date	Location	Fish #	FL	Gill Pale	Gill Lesion	Swollen Abdomen	Hemor Skin/Fins	Head Tag#	Origin	DAL	Cs lesion (0-3)	Kd lesion (0-3)	Cshasta (0-3)	Kd myxo (0-3)	Metac (0-1)	Gill Imprint	Bacte	
7/1/02	Estuary	3	85	0	0	0	0	3377	TRH	24	0	0	0	0	1			
7/1/02	Estuary	4	82	0	0	0	0	3378	TRH	24	0	0	0	0	1			
7/1/02	Estuary	5	86	0	0	0	0	3379	TRH	24	0	0	0	0	1			
7/1/02	Estuary	6	88	1	0	0	0	3380	IGH	26	0	3	0	1	0			
7/1/02	Estuary	7	75	0	0	0	0	3381	TRH	24	0	0	0	0	1			
7/1/02	Estuary	8	86	0	0	0	0	3382	TRH	24	0	0	0	0	1			
7/1/02	Estuary	9	86	0	0	0	0	3383	TRH	24	0	0	0	0	0			
7/1/02	Estuary	10	84	0	0	0	0	3384	TRH	24	0	0	0	0	1			
7/1/02	Estuary	11	89	0	0	0	0		#N/A	#N/A	0	0	0	0	1			
7/1/02	Estuary	12	83	0	0	0	0	3385	TRH	24	0	0	0	0	1			
7/1/02	Estuary	13	86	0	0	0	0		#N/A	#N/A	3	1	3	2	1			
7/1/02	Estuary	14	95	0	0	0	0	3386	TRH	24	0	0	0	0	1			
7/1/02	Estuary	15	85	0	0	0	0	3387	TRH	24	0	0	0	0	1			
7/1/02	Estuary	16	82	0	0	0	0	3388	TRH	24	0	0	0	0	1			
7/1/02	Estuary	17	88	1	0	0	0	3389	TRH	24	1	1	1	1	1			
7/1/02	Estuary	18	80	0	0	0	0	3390	TRH	24	0	0	0	0	1			
7/1/02	Estuary	19	95	0	0	0	0	3391	TRH	24	0	0	0	0	0			
7/1/02	Estuary	20	88	0	0	0	0	3398	TRH	25	0	0	0	0	1			
7/1/02	Estuary	21	89	0	0	0	0	3392	TRH	24	0	0	0	0	1			
7/1/02	Estuary	22	85	0	0	0	0	3393	TRH	24	0	0	0	0	1			
7/1/02	Estuary	23	85	1	0	0	0	3394	TRH	24	0	0	1	0	0			
7/1/02	Estuary	24	93	0	0	0	0	3395	TRH	24	0	0	0	0	1			
7/10/02	Estuary	1	93	0	0	0	0	3401	TRH	33	0	0	0	0	1			
7/10/02	Estuary	2	80	0	0	0	0		#N/A	#N/A	0	0	0	0	0			
7/10/02	Estuary	3	92	0	0	0	0		#N/A	#N/A	0	2	0	1	0			
7/10/02	Estuary	4	85	0	0	0	0		#N/A	#N/A	0	0	0	0	1			
7/10/02	Estuary	5	78	0	0	0	0		#N/A	#N/A	1	0	1	0	0			
7/10/02	Estuary	6	96	0	0	0	0		#N/A	#N/A	1	0	0	0	0			
7/10/02	Estuary	7	85	0	0	0	0		#N/A	#N/A	0	1	0	1	0			
7/10/02	Estuary	8	88	0	0	0	0		#N/A	#N/A	2	1	2	1	0			
7/10/02	Estuary	9	95	0	0	0	0		#N/A	#N/A	0	3	0	2	1			
7/10/02	Estuary	10	82	0	0	0	0		#N/A	#N/A	0	0	0	0	0			
7/10/02	Estuary	11	80	1	0	0	0	3402	TRH	33	1	0	2	1	1			
7/10/02	Estuary	12	89	0	0	0	0	3403	TRH	33	0	0	0	0	1			
7/10/02	Estuary	13	82	0	0	0	0	3404	TRH	33	0	0	1	0	1			
7/10/02	Estuary	14	97	0	0	0	0	3405	IGH	35	0	3	0	2	0			
7/10/02	Estuary	15	77	2	0	0	1		#N/A	#N/A	0	0	0	0	0		Fungus	
7/10/02	Estuary	16	83	0	0	0	0	3406	IGH	35	3	3	3	2	0			
7/10/02	Estuary	17	87	0	0	0	0	3407	TRH	33	3	2	3	2	1			
7/10/02	Estuary	18	85	0	0	0	0	3408	TRH	33	0	0	0	0	1			
7/10/02	Estuary	19	98	0	0	0	0	3409	TRH	33	0	0	0	0	0			
7/10/02	Estuary	20	87	0	0	0	0	3410	TRH	33	3	0	3	0	1			
7/10/02	Estuary	21	110	0	0	0	0	3411	IGH	35	0	3	1	2	0			
7/10/02	Estuary	22	93	0	0	0	0	3412	TRH	33	0	0	0	0	1			
7/19/02	Estuary	1	88	0	0	0	0		#N/A	#N/A	0	0	0	1	1			
7/19/02	Estuary	2	79	0	0	0	0		#N/A	#N/A	0	1	0	1	1			
7/19/02	Estuary	3	81	0	0	0	0		#N/A	#N/A	0	0	0	0	1			
7/19/02	Estuary	4	77	0	0	0	0		#N/A	#N/A	3	0	3	1	0			
7/19/02	Estuary	5	80	0	0	0	0		#N/A	#N/A	0	1	0	1	0			
7/19/02	Estuary	6	91	1	0	0	0		#N/A	#N/A	0	0	0	0	0			
7/19/02	Estuary	7	87	0	0	0	0		#N/A	#N/A	0	0	0	0	0			
7/19/02	Estuary	8	84	0	0	0	0		#N/A	#N/A	0	0	0	0	1			

Date	Location	Fish #	FL	Gill Pale	Gill Lesion	Swollen Abdomen	Hemor Skin/Fins	Head Tag#	Origin	DAL	Cs lesion (0-3)	Kd lesion (0-3)	Cshasta (0-3)	Kd myxo (0-3)	Metac (0-1)	Gill Imprint	Bacte	
7/19/02	Estuary	9	70	0	0	0	0	3413	TRH	42	3	2	3	1	1			
7/19/02	Estuary	10	85	0	0	0	0		#N/A	#N/A	0	3	0	1	0			
7/19/02	Estuary	11	87	0	0	0	0	3414	TRH	42	0	0	0	0	1			
7/19/02	Estuary	12	84	0	0	0	0		#N/A	#N/A	0	0	0	0	1			
7/19/02	Estuary	13	88	0	0	0	0	3415	TRH	42	2	0	2	0	0			
7/19/02	Estuary	14	87	0	0	0	0	3416	TRH	42	0	0	0	2	1			
7/19/02	Estuary	15	112	0	0	0	0	3417	TRH	42	0	0	0	0	0			
7/19/02	Estuary	16	85	0	0	0	0	3418	TRH	42	0	0	0	0	1			
7/19/02	Estuary	17	83	0	0	0	0		#N/A	#N/A	0	3	0	3	0			
7/19/02	Estuary	18	91	1	0	0	0	3419	TRH	42	0	0	0	0	0			
7/19/02	Estuary	19	87	0	0	0	0	3420	TRH	42	0	0	0	1	1			
7/19/02	Estuary	20	91	1	0	0	0	3421	TRH	42	0	0	0	0	0			
7/19/02	Estuary	21	90	2	0	0	0	3422	TRH	42	0	0	0	1	1			
8/1/02	Estuary	1	82	0	0	0	0		#N/A	#N/A	3	2	2	2	0			
8/1/02	Estuary	2	86	1	0	0	0		#N/A	#N/A	0	2	0	2	1			
8/1/02	Estuary	3	91	0	0	0	0		#N/A	#N/A	0	0	0	0	1			
8/1/02	Estuary	4	82	1	0	0	0		#N/A	#N/A	0	0	0	2	1			
8/1/02	Estuary	5	85	1	0	0	0	3427	TRH	55	3	0	2	0	1			
8/1/02	Estuary	6	88	0	0	0	0		#N/A	#N/A	0	3	0	2	0			
8/1/02	Estuary	7	89	0	0	0	0		#N/A	#N/A	0	0	0	2	1			
8/1/02	Estuary	8	86	0	0	0	0		#N/A	#N/A	0	0	0	1	1			
8/1/02	Estuary	9	97	0	0	0	0		#N/A	#N/A	0	1	0	1	1			
8/1/02	Estuary	10	81	2	0	0	0		#N/A	#N/A	0	0	0	0	1			
8/1/02	Estuary	11	86	0	0	0	0		#N/A	#N/A	0	1	0	1	1			
8/1/02	Estuary	12	85	1	0	0	0	3428	TRH	55	0	0	0	0	1			
8/1/02	Estuary	13	76	0	0	1	1		#N/A	#N/A	0	0	0	0	0			
8/1/02	Estuary	14	94	2	0	1	0	3429	TRH	55	3	0	3	1	1			
8/1/02	Estuary	15	83	1	0	0	0	3430	TRH	55	3	0	3	0	1			
8/1/02	Estuary	16	84	2	0	0	0	3431	TRH	55	3	0	3	1	1			