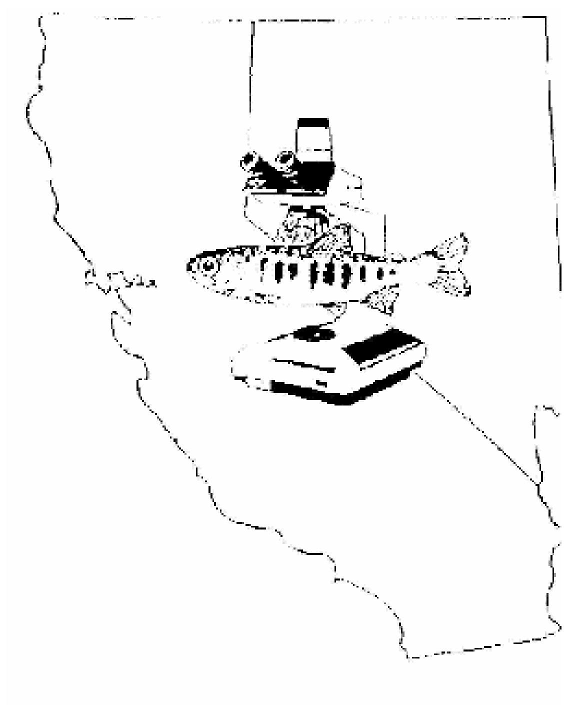
FY2004 Report:

Bio-energetic and histological evaluation of juvenile (0+) sucker fry from Upper Klamath Lake collected in August and September 2004.



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Summary: Upper Klamath Lake juvenile Shortnose and Lost River suckers were collected in August and September 2004. Tissue triglyceride content and muscle RNA: DNA ratios sharply declined from August to late September. No significant health problem was observed in histological samples from these fish. Further research needs to be conducted on the cause(s) for the observed declines of these biochemical indices for energy storage and growth as well as their relationship to over-winter survival.

Background- In support of the United States Geological Survey (**USGS**) juvenile monitoring program and the US Bureau of Reclamation's fish screening efforts at A-canal, the California – Nevada Fish Health Center (**FHC**) conducted a cooperative study examining the growth (RNA : DNA ratio), energy reserves (triglycerides), and histological features of juvenile Lost River and Shortnose suckers. Poor recruitment of juveniles may be related to high winter mortalities. Insufficient energy reserves have been identified as an important factor in winter mortality for other fish inhabiting temperate latitudes (Pangle et al. 2004, Kirjasniemi and Valtonen 1997, Oliver et al. 1979). This work was partially funded by the US Bureau of Reclamation (interagency agreement 04AA204033).

Methods: Juvenile suckers (not identified to species) were collected at the locations and dates listed in Table 1 and Appendix 1, frozen, and later shipped to the FHC for analysis. A sub-sample of the collected fish were preserved in PREFER fixative and later processed for 5µm sections that were stained with hematoxylin and eosin. The weight, fork length, and presence of *Lernaea* was recorded for each frozen fish, condition factor calculated (KF ={ Wt (g) / FL (mm)^3} x 100000), two cross sections of caudal muscle (one for muscle triglyceride and the other for RNA : DNA assay) as well as the entire viscera was then dissected from each fish. Tissue samples were weighed to the nearest 0.01 g, placed into capped tubes, and held at -20°C until assayed. Tissues assayed for triglyceride content were homogenized in distilled water (2x w/v), mixed with absolute isopropanol (10x v/v), centrifuged at 3000xg for 10 min, and the 20x diluted supernatant used in a enzyme assay for triglyceride (Teco Diagnositics, Anaheim California, triglyceride GPO kit).

Caudal muscle was assayed for RNA:DNA ratio by the method of Kaplan, Leamon and Crivello (2001). Briefly, the muscle sample was homogenized and digested in a buffered digest cocktail. Quantity of RNA and DNA in the sample was determined by use of fluorescent dyes and standardized with ribosomal RNA (16S and 23S rRNA from *E. coli*) and lambda DNA standards. RNA:DNA ratios in white muscle are highly correlated with specific growth rate and are useful in detecting growth suppression in fish (Pickering and Pottinger 1995). Histological sections of gill, liver, kidney, and gastrointestinal tract were examined for tissue abnormalities and parasites.

Table 1. Sample collection data.

Collector	**Site**	**Dates**	**Sample types**
USBR	A-canal	05Aug, 26Aug, 23Sep	Frozen fish & histo.
USGS	Northern Upper Klamath Lake	02Aug, 23Aug, 22Sep	Frozen fish & histo.
TNC – J. Crandall	S. Marsh	03 – 11August	Histo.

Results:

Size and condition factor – Fish size increased over the sample period for both collection groups (Fig. 1). Suckers collected from A-canal were significantly larger than those fish from the lake in August (T-test, df 57 – 59, $P \leq 0.009$). This trend was reversed in September (T-test, df 46, $P = 0.003$). The general trend for larger fish at A-canal was also demonstrated by significantly (T-test, df 46 – 59, $P \leq 0.05$) larger condition factors in early August and late September (Fig. 2).

Figure 1. Mean fork length of juvenile suckers collected from A-canal (AC) and Upper Klamath Lake (KL). Letters denote significant differences for a given sample date and bars represent standard error.

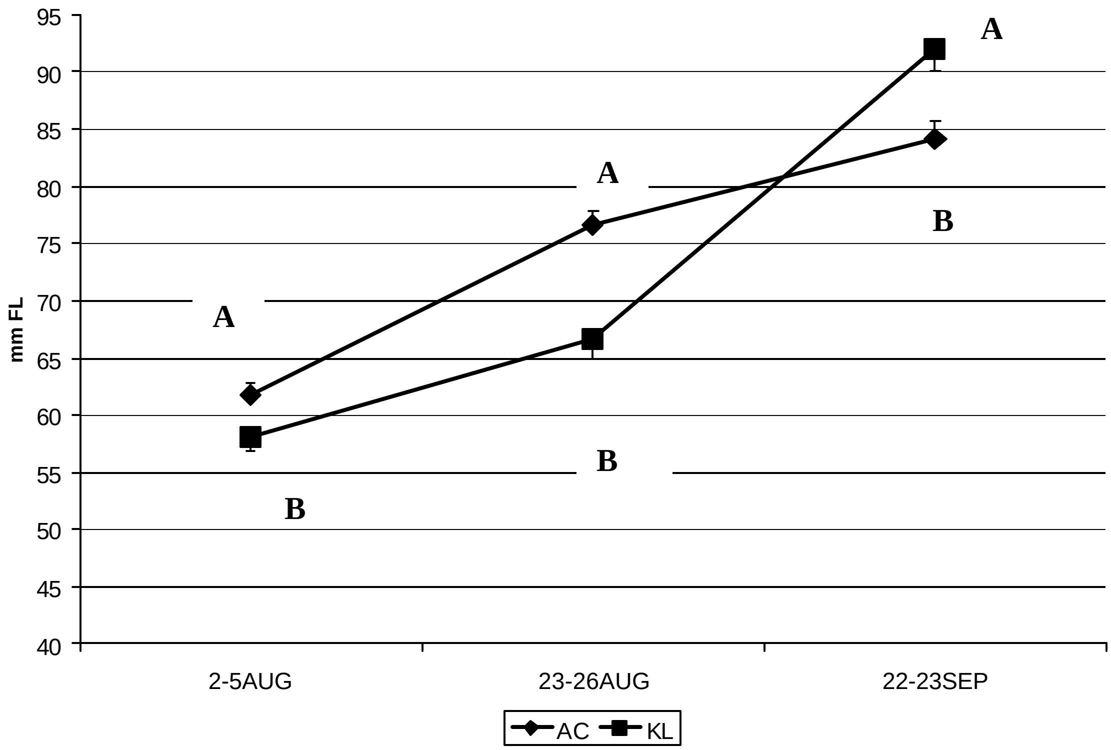
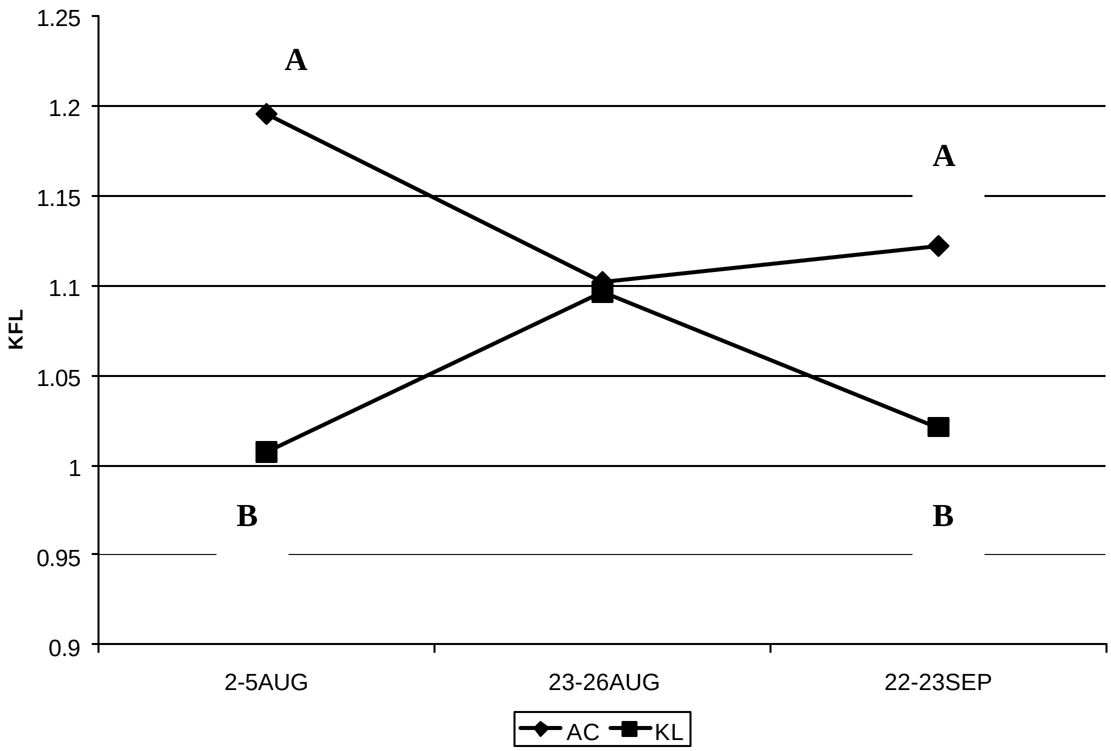


Figure 2. Mean condition factor (KFL) of juvenile suckers collected from A-canal (AC) and Upper Klamath Lake (KL). Letters denote significant differences for a given sample date.



Triglyceride –Viscera triglyceride (TG) content declined from the early August through late September period (Fig. 3). The A-canal fish had significantly (Mann-Whitney Rank sum test, $P<0.001$) lower visceral and caudal muscle TG than lake cohorts for any given sample date (Fig. 3 and 4). Caudal muscle TG content was more variable than viscera but also tended to decline with time. Linear regression of fish size (FL) or condition factor and tissue triglyceride content showed very little correlation between fish size and fat content ($R^2 \leq 0.23$). Muscle tissue contained 4 – 20x less TG per gram than viscera. Some of the September muscle samples were near the calculated sensitivity range for the assay (~1 – 2 mg TG / g tissue). A dilution series of the triglyceride triolein, dissolved in isopropyl, demonstrated a similar sensitivity limit of 1.3 mg TG / g sample.

Figure 3. Mean viscera triglyceride content of juvenile suckers collected from A-canal (AC) and Upper Klamath Lake (KL). Bars indicate standard error. Letters denote significant differences for a given sample date.

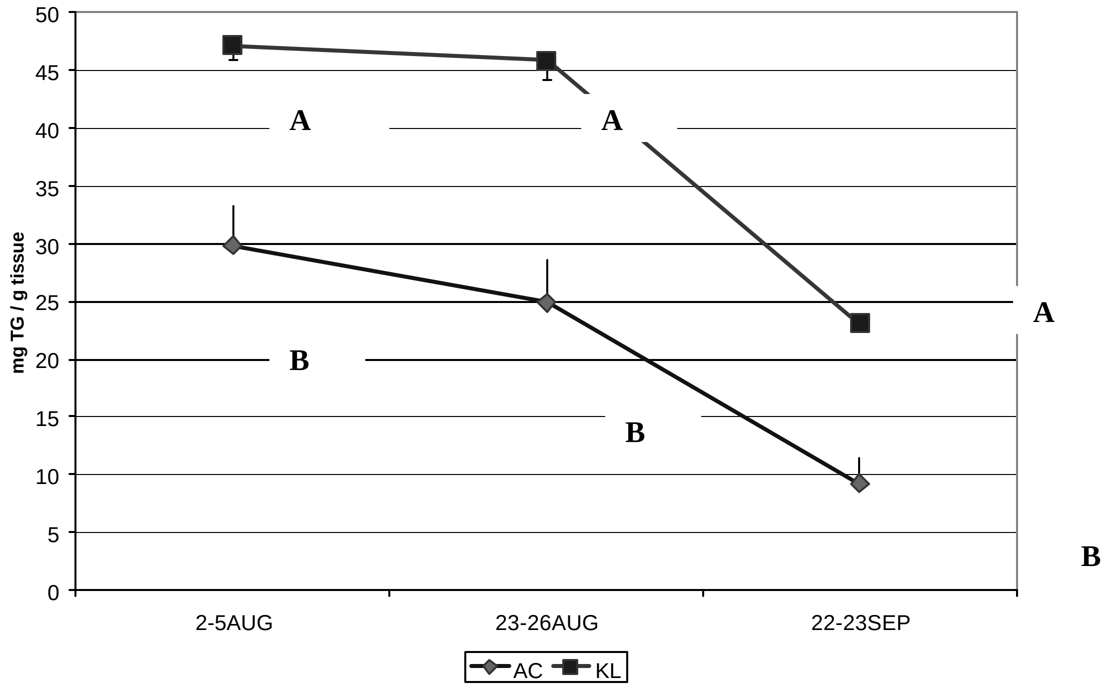
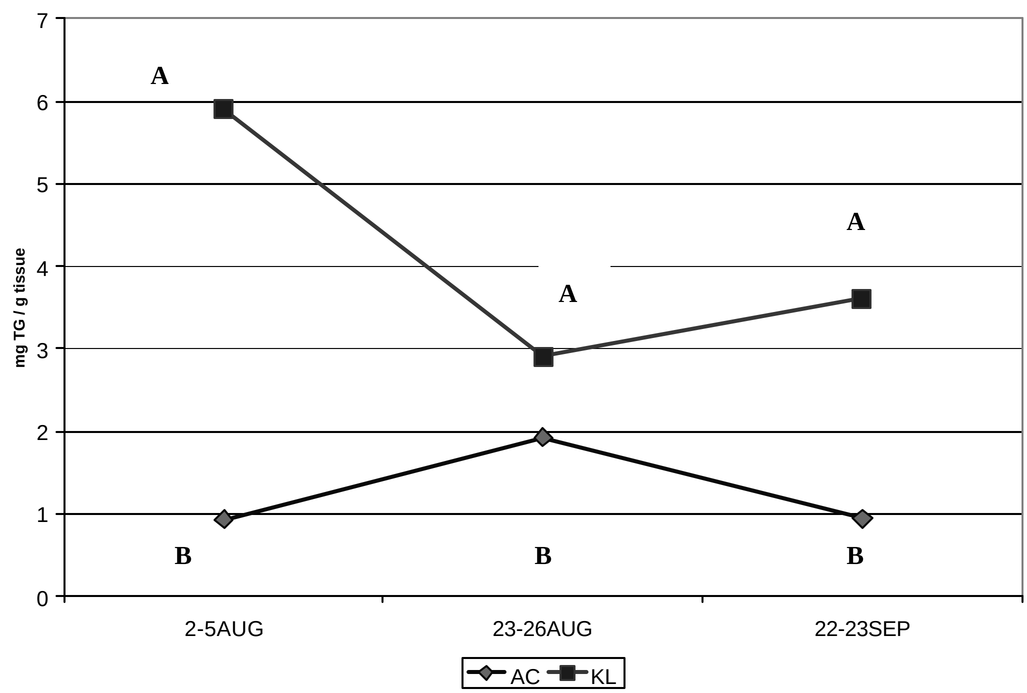


Figure 4. Mean caudal muscle triglyceride content of juvenile suckers collected from A-canal (AC) and Upper Klamath Lake (KL). Letters denote significant differences for a given sample date.



RNA: DNA ratio – The growth indicator RNA: DNA ratio (R/D) showed a similar pattern of decline as triglyceride over time (Fig 5). There were significant differences (ANOVA P<0.001) between A-canal and lake fish for both August sample dates. Due to a processing error, the 23Sep A-canal group was excluded from the data set. When sample protein content was used as the denominator, statistical difference (ANOVA, P< 0.001, Dunn's Multiple comparison procedure) between A-canal and lake fish was only detected in late August sample (Fig. 6).

Figure 5. Mean caudal muscle RNA:DNA ratio of juvenile suckers collected from A-canal (AC) and Upper Klamath Lake (KL). Bars indicate standard error. Letters denote significant differences for a given sample date.

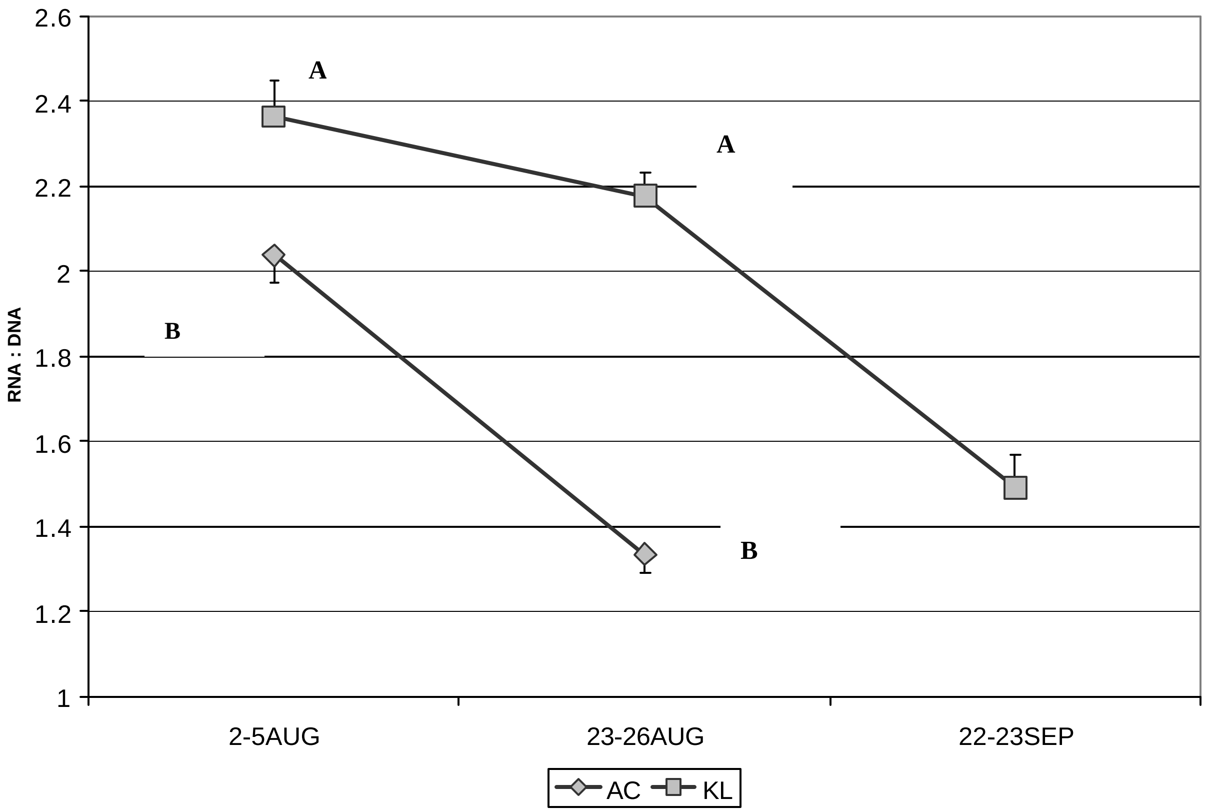
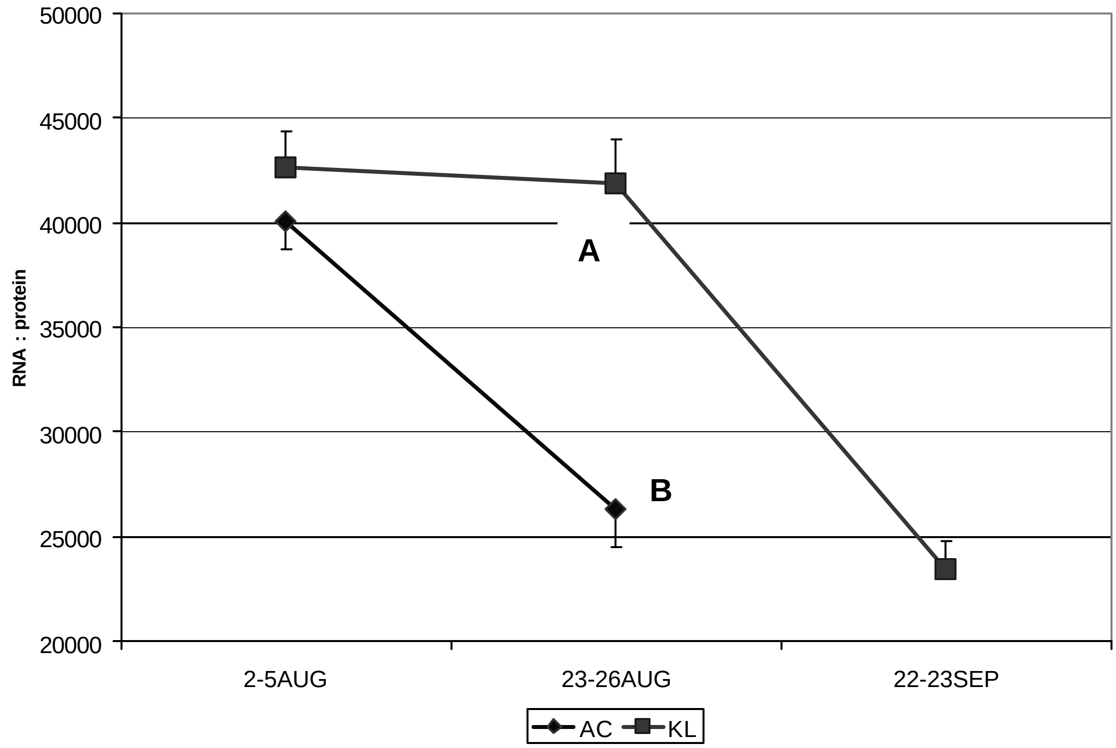


Figure 6. Mean caudal muscle RNA: protein ratio of juvenile suckers collected from A-canal (AC) and Upper Klamath Lake (KL). Bars indicate standard error. Letters indicate statistically difference between specific sample period groups.



Parasite and histological examination- The copepod ecto-parasite, *Lernaea sp.,* was only observed in specimens collected from the A-canal. Single copepods were seen on the dorsal aspect of 3% (1 / 30) of the 05Aug, 63% (19 / 30) of the 26 Aug, and 37% (11 / 30) of the 26Sep collection groups. Hemorrhage in the dermis was associated with some these attached parasites. A few suckers had "blackspot" in their muscle wall from metacercaria infection (Fig. 8). The most common parasite observation was gill infection by the cilate *Trichodina* sp. in 55% of all histological sections (Fig. 7). This infection occurred in all sample groups and rarely resulted in gill hyperplasia (10%) despite high numbers of *Tricodina* seen in several gill sections. One fish from the lake also had gill infection by *Epistylus* sp (Table 2). An unidentified myxosporean(s) was observed in cysts within the kidney and lower intestine but was not associated with any tissue abnormality. Several cysts contained spores resembling Myxobolus sp.. Inflammation of the visceral adipose tissue was observed in 15 % of the fish. This condition can occur due to rapid lipolysis under high water temperature.

Table 2. Histological results recorded as number of sections positive / total sections. The incidence of specific lesions (hyperplasia = HP, Visceral adipose inflammation = V-fat Inflam) or parasites (Trichodina = Trc, Epistylus = Epi, myxosporean = myx) is given for all samples.

	A- canal		TNC	North Lake USGS			
	05Aug	26Aug	3-11Aug	02Aug	21-27Sep	23Aug	Incidence of infection / lesion
Gill Lesion Parasite	 NA NA	 2 / 5 hp 3 / 5 Trc	 0 / 4 2 / 4	 NA NA	 2 / 6 hp 6 / 6 Trc 1 / 6 Epi	 0 / 5 2 / 5 Trc	 2 / 20 (10%) hp 11 / 20 (55%) Trc 1 / 20 (5%) Epi
Liver Lesion Parasite	 0 / 4 0 / 4	 0 / 3 0 / 3	 0 / 4 0 / 4	 0 / 5 0 / 5	 0 / 4 0 / 4	 0 / 5 0 / 5	 0 / 25 0 / 25
Kidney Lesion Parasite	 0 / 4 0 / 4	 0 / 4 0 / 4	 0 / 4 0 / 4	 0 / 4 2 / 4 myx	 0 / 3 0 / 3	 0 / 5 0 / 5	 0 / 16 2 / 16 (13%) myx
Intestine Lesion Parasite	 0 / 4 2 / 4 myx	 0 / 4 0 / 4	 0 / 5 0 / 5	 0 / 5 1 / 5 myx	 0 / 4 0 / 4	 0 / 5 0 / 5	 0 / 27 3 / 27 (11%) myx
V-Fat Inflam.	1 / 4	1 / 4	0 / 5	1/ 5	0 / 4	1 / 5	4 / 27 (15%)

Figure 7. *Trichodina* sp. on gill (600x mag.).

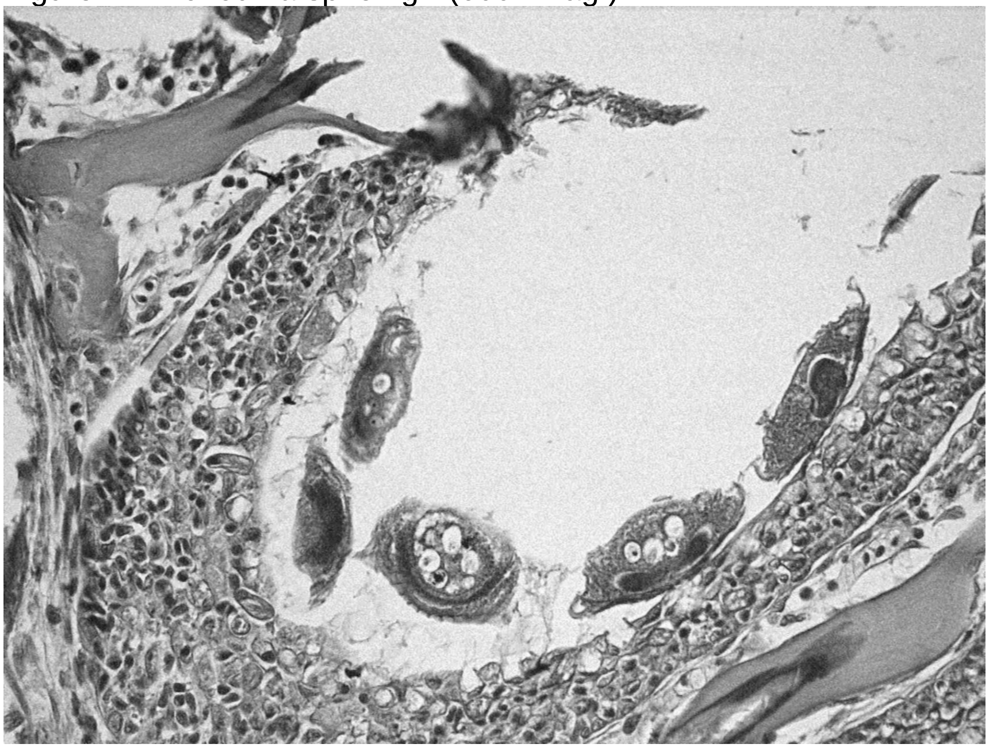
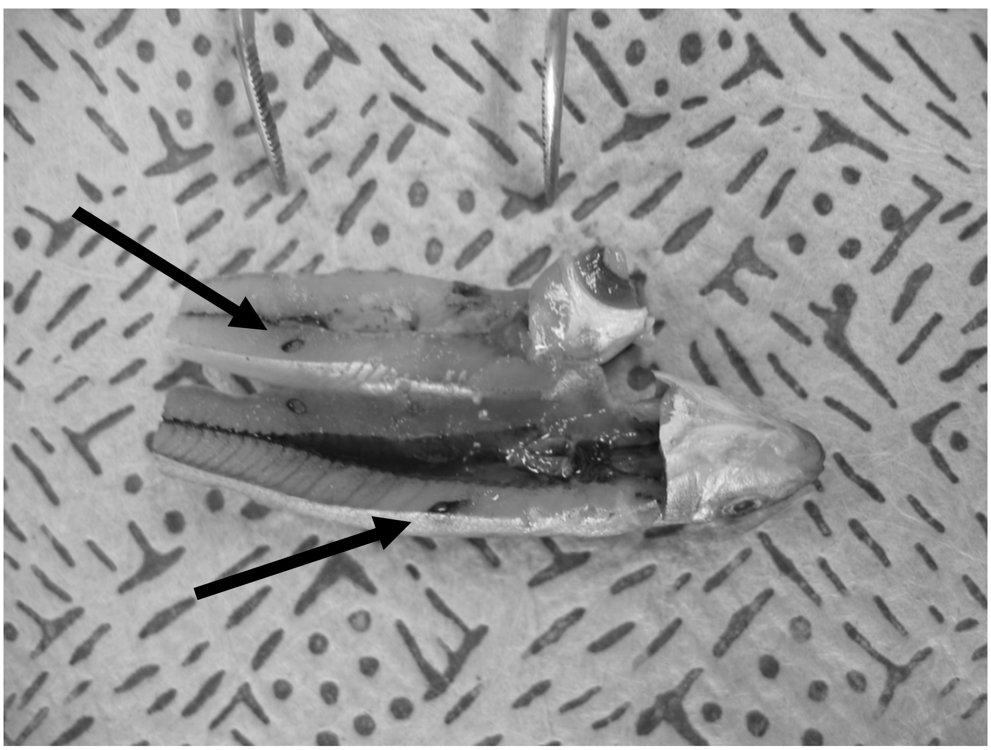


Figure 8. Metacercaria (black spot) in muscle.



Discussion: Energy reserve (TG) and recent growth (RNA : DNA) had both temporal and spatial patterns of change. Despite similar or larger size, suckers collected from the A-canal bypass tended to have lower TG content and lower R/D ratios than their cohorts collected at the same time from the lake. It is possible that A- canal represents an energy intensive environment (low food and / or stressful conditions) or that capture methods may influence these parameters. The general decline in recent growth (R/D) and tissue TG in the autumn may indicate reduced feeding due to water temperature decline or food abundance. One area of further investigation is to determine if the abundance of food items utilized by 80 – 120 mm juveniles is reduced in the fall. Competition for similar food resources with Fathead minnows may also play a role in the September declines.

The low TG content of some muscle samples makes this sample type unsuitable for monitoring. We plan to assay whole bodies in any future work. In an attempt to use archived fish samples for TG assay, we tested several 2004 carcasses held in ethanol and found their TG values 2 – 10x lower than frozen samples. It is likely that the breakdown of triglyceride in the archived samples was a factor.

The parasitic infections observed in the juveniles was similar to those seen in Upper Klamath lake blue chub sampled in 1998 and did not appear to be significant health problems (Foott and Harmon 1999).

We cannot predict the over-winter survival effects of the late September TG values observed in this study and propose a winter starvation experiment to help elucidate this critical relationship.

Reference:

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Appendix 1 Individual fish data.

FISH	DATE	WT	FL	kfl	TG MSCL mgTG/g MSCL	TG VISC. mgTG/g VISC	RNA/DNA	RNA/TP	STD. L
A- canal	09/23/04	6.0	85	0.9770	1.08341	15.73922	1.3443	17796.68	
	09/23/04	8.4	94	1.0113	1.56119	10.66775	1.4531	24062.85	
A- canal		5.5	85	0.8956	0.70516	5.98031	1.3825	23768.68	
A- canal		6.9	92	0.8861	1.18295	11.58010	1.3817	17670.63	
A- canal		11.8	104	1.0490	0.96396	15.40778	5.7191	18233.94	
A- canal		6.4	85	1.0421	1.00378	9.58573	1.0699	13695.30	
A- canal		7.4	85	1.2050	0.96396	5.80835	1.4716	19385.93	
A- canal		2.8	58	1.4351	0.66535	7.86799	2.0095	20380.30	
A- canal		4.9	80	0.9570	0.74498	4.41513	1.7922	30298.99	
A- canal		7.0	90	0.9602	0.74498	5.90678	1.6221	21900.94	
A- canal		7.2	83	1.2592	0.68525	6.30382	1.5098	31406.95	
A- canal		5.9	82	1.0701	0.78479	9.97025	1.4143	23150.24	
A- canal		5.8	78	1.2222	1.20285	10.11309	2.1488	37626.33	
A- canal		5.1	80	0.9961	0.92415	14.33469	1.0730	16245.16	
A- canal		6.4	90	0.8779	1.48156	15.42652	1.6889	24903.78	
A- canal		8.4	90	1.1523	0.96396	5.27402	1.7870	30598.52	
A- canal		4.8	76	1.0935	1.40193	6.50949	1.7584	22912.52	
A- canal		7.7	82	1.3965	1.00378	7.32976	1.2013	17981.28	
A- canal		8.9	90	1.2209	0.68525	7.35373	1.7106	30258.28	
A- canal		9.5	95	1.1080	0.58572	7.71021	1.6971	28333.17	
A- canal		6.7	88	0.9832	0.72507	5.99299	1.7520	23212.93	
A- canal		6.8	85	1.1073	0.78479	6.26248	1.3268	16422.86	
A- canal		6.6	86	1.0376	0.94405	11.93151	1.8287	26135.82	
A- canal		6.9	84	1.1642	1.40193	16.54589	1.6444	22156.81	
A- canal		5.1	73	1.3110	1.10332	8.69277	1.4875	20993.81	
A- canal		6.3	86	0.9905	1.10332	4.96089	1.7043	16991.63	
A- canal		7.9	90	1.0837	0.74498	13.27354	2.0195	24058.30	
A- canal		7.9	82	1.4328	0.26719	7.12188	2.0082	20961.85	
		5.5	74	1.3573	0.52599	6.35257	1.7116	28403.58	
		4.7	70	1.3703	1.18295	13.67734	4.8902	24849.04	
WRE04	08/02/04	1.9	60	0.8796	3.07418	34.11145	2.0387	32764.88	54
WRE05	08/02/04	1.8	57	0.9720	3.89039	20.12299	2.9897	63617.86	64
5290408016		1.5	53	1.0075	4.32836	45.68198	2.5404	53098.87	47
WRE040801G		1.2	52	0.8534	2.37741	32.96188	2.2506	19404.01	59
WRE040801E		2.3	61	1.0133	3.65150	43.05431	3.1061	51334.29	65
WRE040801BR2	08/02/04	1.3	51	0.9800	3.25335	41.59125	2.5156	23252.05	59
WRE040801BR2	08/02/04	2.9	64	1.1063	3.25335	30.65103	2.3327	39825.92	66
361-0408022	08/03/04	2.6	61	1.1455	2.09870	27.85290	1.9720	38270.91	70
361-0408022	08/03/04	0.8	40	1.2500	9.78307	34.90452	2.4073	42872.76	70
391-04080114	08/02/04	3.3	64	1.2589	3.73113	28.39449	2.4477	34745.71	58
WRE040801BR1	08/02/04	1.8	49	1.5300	6.36399	49.95951	2.5188	54586.51	59
WRE040801F	08/02/04	2.1	59	1.0225	3.26614	61.37652	3.3565	41925.31	65
WRE040801	08/02/04	2.4	64	0.9155	4.47378	55.62753	2.2189	35639.85	71
WRE040801	08/02/04	2.0	65	0.7283	4.21125	88.90688	2.5248	42197.24	66
WRE040801D	08/02/04	0.8	51	0.6031	18.07279	36.27530	1.8069	47010.79	55
495-0408017	08/02/04	1.5	56	0.8541	1.32343	20.08097	2.1854	40416.88	61
495-0408017	08/02/04	1.9	52	1.3513	4.36877	35.70850	2.5474	38793.60	58
495-0408017	08/02/04	2.9	66	1.0087	5.73392	56.43725	2.4272	49895.81	71

495-0408017	08/02/04	2.1	60	0.9722	5.99645	68.17814	2.8168	47514.18	65
WRE040802		2.2	62	0.9231	1.74348	79.75709	2.2471	37573.80	
495-0408017	08/02/04	3.0	68	0.9541	12.24464	79.02834	2.3985	56902.85	75
39104080114	08/02/04	2.3	62	0.9651	3.79120	74.81781	2.5310	55154.40	55
4950408017	08/02/04	1.9	56	1.0819	17.54773	59.35223	2.0611	46970.13	61
39104080114	08/02/04	1.7	57	0.9180	5.62891	46.80162	2.4104	48427.83	48
WRE040801BR2	08/02/04	1.8	57	0.9720	5.94394	54.33198	2.6831	49829.75	61
	08/23/04	2.0	60	0.9259	2.21603	53.68421	2.7707	54165.13	54
WRE040801BR01	08/02/04	1.2	50	0.9600	5.73392	36.03239	2.1343	33831.42	
MPT040823D	08/24/04	2.2	58	1.1276	8.14919	74.65587	2.3308	54158.32	50
MPT040823B	08/24/04		76	0.0000	1.32343	52.38866	1.9516	40655.04	70
WRE040801BR3	08/02/04	2.6	61	1.1455	3.79120	33.27935	2.2671	46141.56	73
SITE 599	08/23/04	4.6	72	1.2324	3.47617	45.26316	2.0391	41864.26	68
MDT040823BR2		1.7	55	1.0218	6.41649	55.70850	2.4384	66295.33	61
WRE040802	08/02/04	1.7	62	0.7133	3.68619	26.80162	1.7539	30900.84	
SITE 599	08/23/04	1.4	53	0.9404	0.48334	13.19838	2.3086	32334.39	45
SITE 614	08/23/04	4.2	70	1.2245	1.58596	72.38866	2.1270	45853.40	66
MPT040825B	08/24/04	2.2	61	0.9692	1.21842	63.88664	1.9396	40916.21	55
SITE 599	08/23/04	2.1	57	1.1340	5.68141	72.46964	2.3783	51869.22	53
MPT040823B	08/24/04	4.5	78	0.9483	1.69097	64.61538	2.2366	45528.30	71
SITE 599	08/23/04	3.1	69	0.9437	5.68141	24.12955	2.0124	51942.34	60
MPT040823BR2	08/23/04	4.6	78	0.9693	2.26853	1.13360	#DIV/0!	0.00	71
MDT040823BR2		3.5	70	1.0204	2.53106	70.04049	1.8830	47111.41	76
MPT040823B	08/24/04	1.7	58	0.8713	0.64085	51.57895	2.4795	50778.11	52
SITE 614	08/23/04	4.6	75	1.0904	6.52151	46.80162	2.5044	46449.12	68
MDT040823BR2		3.1	63	1.2398	3.47617	37.32794	2.0350	38390.62	75
WRE040810D	08/02/04	1.8	60	0.8333	5.15635	71.49798	1.8553	33151.20	66
MDT040823E	08/23/04	4.2	75	0.9956	0.74587	68.01619	1.7923	17637.93	80
WRE040802BR1	08/02/04	1.8	52	1.2802	19.85798	43.88664	3.1391	41741.09	55
SITE 565	08/23/04	3.5	68	1.1131	1.63846	57.16599	2.5037	34647.00	73
SITE 599	08/23/04	3.4	65	1.2381	2.53106	71.74089	1.7544	30982.09	64
SITE 599	08/23/04	3.1	63	1.2398	3.89621	69.14980	2.2137	44435.52	58
SITE 565	08/23/04	4.3	70	1.2536	1.50147	31.12540	2.2485	38135.10	68
SITE 599	08/24/04	6.0	58	3.0752	2.05889	37.47053	1.9891	41293.33	78
SITE 599	08/23/04	3.1	75	0.7348	2.43713	28.68167	1.8831	46728.91	61
SITE 614	08/24/04	5.2	63	2.0796	3.07418	31.93998	2.1554	43357.18	77
A-canal	08/05/04	2.8	60	1.2963	1.38202	35.92712	2.4550	47291.02	
A-canal	08/05/04	3.1	75	0.7348	3.57187	26.58092	2.8368	58429.92	
A-canal	08/05/04	2.7	52	1.9202	1.60101	29.49625	2.5152	51603.98	
A-canal	08/05/04	4.2	68	1.3357	1.62092	31.46838	#DIV/0!	39015.02	
A-canal	08/05/04	3.8	65	1.3837	0.98387	38.71383	2.4453	42732.27	
A-canal	08/05/04	3.0	63	1.1998	1.08341	28.72454	2.4742	56049.59	
A-canal	08/05/04	2.6	62	1.0909	0.14775	27.60986	2.0582	48616.94	
A-canal	08/05/04	2.8	83	0.4897	0.92415	34.81243	2.0188	39749.65	
A-canal	08/05/04	2.3	66	0.8000	0.94405	38.45659	1.5506	34829.68	
A-canal	08/05/04	3.3	80	0.6445	0.28710	36.14148	1.6880	34958.08	
A-canal	08/05/04	4.5	64	1.7166	1.60101	37.47053	2.2565	48340.09	
A-canal	08/05/04	3.4	63	1.3597	0.86442	32.58307	2.2508	41261.02	
A-canal	08/05/04	2.4	63	0.9598	1.12322	23.40836	1.8501	33231.74	
A-canal	08/05/04	1.9	70	0.5539	0.26719	15.30547	1.9555	35144.49	
A-canal	08/05/04	1.6	73	0.4113	0.46627	30.99678	1.8014	43504.84	
A-canal	08/05/04	2.5	62	1.0490	0.02830	15.60557	1.3354	23950.56	

A-canal	08/05/04	3.7	62	1.5525	1.54129	38.75670	1.8732	36069.35	
A-canal	08/05/04	3.5	63	1.3997	0.60562	33.05466	1.9700	30785.99	
A-canal	08/05/04	1.6	60	0.7407	0.18756	16.67738	2.1920	32986.30	
SITE 599	08/23/04	1.5	70	0.4373	4.12929	34.98392	-0.4240	7918.17	
SITE 599	08/23/04	4.6	67	1.5294	1.04359	30.91104	2.0001	38220.69	
MPT040823BR2	08/23/04	1.1	60	0.5093	0.48618	6.04502	2.1205	34108.25	44
SITE 614	08/23/04	4.5	65	1.6386	2.57649	38.37085	2.5548	56280.73	65
0408230R2		2.4	55	1.4425	3.55196	33.82637	2.0325	40567.70	67
A-canal	08/05/04	2.5	50	2.0000	1.04359	36.22722	2.3386	42820.06	
A-canal	08/05/04	2.7	55	1.6228	0.94405	21.00750	2.1164	45478.22	
A-canal	08/05/04	3.0	68	0.9541	0.58572	24.18006	1.6632	36185.61	
A-canal	08/05/04	2.3	66	0.8000	0.12784	10.07503	2.0101	40081.86	
A-canal	08/05/04	3.2	53	2.1494	0.66535	34.34084	1.9313	42639.81	
A-canal	08/05/04	2.8	50	2.2400	1.12322	34.29796	2.4547	45584.46	
A-canal	08/05/04	2.9	77	0.6352	0.12784	26.53805	1.6608	40089.00	
A-canal	08/05/04	4.1	50	3.2800	1.00378	34.98392	1.3281	27474.73	
A-canal	08/05/04	2.2	73	0.5655	0.36673	29.11040	1.9109	37741.32	
A-canal	08/05/04	2.0	60	0.9259	0.50608	35.15541	1.8438	31783.09	
A-canal	08/05/04	3.0	58	1.5376	1.56119	35.36977	2.0078	37935.70	
A-canal	08/05/04	2.1	59	1.0225	1.52138	32.11147	2.3118	36436.44	
040921C	09/22/04	7.2	92	0.9246	3.11399	14.50413	1.1877	19934.15	85
HPK040921BR2	09/22/04	7.8	92	1.0017	3.01446	9.54545	1.2962	17471.67	82
HPK040921BR1	09/22/04	5.3	81	0.9973	3.39270	30.08264	1.2612	23540.38	75
HPK040621BR1	09/22/04	5.4	80	1.0547	3.39270	23.18182	1.5898	23737.42	74
40928		9.6	100	0.9600	2.81538	29.00826	1.4675	14969.16	92
KHJVN		12.1	104	1.0757	2.83529	26.23967	0.9273	16717.01	93
610040927		5.8	80	1.1328	3.93021	34.79339	1.5180	25823.41	73
HPK040921B	09/22/04	6.5	87	0.9871	3.83067	34.38017	1.3524	22262.14	97
A- canal	08/26/04	5.4	80	1.0547	2.13852	32.89256	1.0337	18631.08	
A- canal	08/26/04	3.6	75	0.8533	1.34221	14.46281	1.1973	24634.74	
A- canal	08/26/04	4.9	77	1.0733	3.91030	29.42149	1.2664	26867.10	
A- canal	08/26/04	5.3	82	0.9612	2.15842	31.61157	1.0020	19960.00	
A- canal	08/26/04	3.7	71	1.0338	1.36212	22.06612	1.1715	25586.62	
A- canal	08/26/04	6.9	86	1.0848	2.73575	31.36364	1.3723	18939.15	
A- canal	08/26/04	4.4	72	1.1788	1.54129	18.14050	1.3622	27326.80	
A- canal	08/26/04	4.5	77	0.9857	2.27787	27.35537	1.5568	21666.58	
A- canal	08/26/04	2.6	66	0.9044	1.68064	4.95868	1.4021	23723.12	
A- canal	08/26/04	2.0	60	0.9259	1.40193	3.51240	1.5820	31891.98	
A- canal	08/26/04	5.6	81	1.0537	2.19824	27.19008	1.0955	22779.52	
A- canal	08/26/04	8.2	90	1.1248	3.05427	29.83471	0.9423	20552.60	
040921K	09/22/04	12.5	104	1.1112	5.08486	26.15702	#DIV/0!	#DIV/0!	
40928		7.0	90	0.9602	2.21815	9.42149	1.2353	20012.97	
HPK040929		6.7	81	1.2607	3.17372	29.46281	1.5000	27773.30	
SITE 599	08/23/04	4.6	72	1.2324	3.98993	36.15702	1.7915	31697.83	
HPK04092113	09/22/04	10.5	104	0.9334	4.88578	30.28926	2.2459	29239.04	
040921BR1		9.0	97	0.9861	4.86587	14.00826	1.6678	24651.42	
040921BR1	09/22/04	5.7	85	0.9281	4.00984	27.52066	1.7849	27719.49	
HPK A	09/22/04	7.9	95	0.9214	2.85519	5.99174	1.2503	24976.71	
40928		12.5	106	1.0495	3.75104	15.82645	1.5885	22044.98	
HPK040929C		7.3	89	1.0355	2.95473	28.76033	1.5985	21271.30	
HPK040929C		8.0	91	1.0616	4.40799	26.61157	1.8789	37325.26	
A-canal	08/26/04	7.3	84	1.2316	1.95935	29.54545	2.9745	55492.76	

A-canal	08/26/04	5.8	76	1.3213	1.48156	30.08264	1.5373	24990.35	
A-canal	08/26/04	4.4	68	1.3993	1.66073	30.49587	1.3856	27609.47	
A-canal	08/26/04	6.5	75	1.5407	2.55658	28.88430	1.2242	18990.53	
A-canal	08/26/04	6.0	80	1.1719	1.58110	29.13223	1.0789	20839.13	
A-canal	08/26/04	4.2	78	0.8850	1.36212	16.03306	1.3709	23899.02	
A-canal	08/26/04	4.4	76	1.0023	1.68064	29.00826	1.6507	24049.45	
A-canal	08/26/04	5.3	76	1.2074	1.99916	29.25620	1.4174	25583.19	
A-canal	08/26/04	4.7	75	1.1141	2.09870	20.45455	2.6911	48970.90	
A-canal	08/26/04	4.5	77	0.9857	1.74036	30.148	1.4551	28441.49	
A-canal	08/26/04	5.3	80	1.0352	2.21815	32.047	1.6411	23918.79	
A-canal	08/26/04	4.6	75	1.0904	1.66073	30.979	1.1787	19993.71	
A-canal	08/26/04	4.1	77	0.8981	1.91953		1.1609	23173.95	
A-canal	08/26/04	3.0	67	0.9975	0.86442	5.697	1.2660	23097.75	
A-canal	08/26/04	5.0	72	1.3396	1.08341	29.318	1.2233	16960.63	
A-canal	08/26/04	5.1	72	1.3664	2.39732	30.781	1.4802	26460.59	
A-canal	08/26/04	7.9	90	1.0837	1.46165	29.397	3.2858	54946.50	
A-canal	08/26/04	6.8	84	1.1473	2.11861	20.653	1.9378	20176.98	