Summary of June sucker mineral analysis
Summer 2004

Two samples, bone (Table 1.) and liver (Table 2.), were acquired from June sucker collected from three locations, Red Butte Reservoir, Camp Creek Reservoir, and the Fisheries Experiment Station (FES) for a total of five treatments. Bone samples consisted of a section of vertebrae and whole ribs. Liver samples were sub-samples from the larger fish, and the entire liver was collected from the smaller fish.

Treatment 1: Red Butte Reservoir. Seven adult fish were sampled from fresh mortalities occurring due to handling stress.
Treatment 2: Camp Creek Reservoir. Five adult/sub-adults fish were sampled during a fish health inspection.
Treatment 3: FES 1. Three fish (<200 mm) were randomly selected from 2002 lot 8.
Fish #1 exhibited scoliosis, lordosis and deformed opercles.
Fish #2 exhibited severe right and mild left opercle shortening.
Fish #3 had mild opercle shortening.
Treatment 4: FES 2. Three fish (<100 mm) selected with deformities from 2003 Lot 22.
Fish #1 exhibited lordosis; the liver was not analyzed due to an insufficient sample size.
Fish #2 exhibited mild opercle shortening and a cranial lesion.
Fish #3 exhibited severe unilateral opercle shortening and did not have caudal or dorsal fins.
Treatment 5: FES 3. Three fish (<100 mm) selected without deformities from 2003 lot 22.

The 2002 and 2003 fish were used because they were both on the more successful feed regime tested to date: brine shrimp and the razorback diet since initial feeding. Red Butte and Camp Creek samples were held on ice in the field. Samples were frozen post collection until all samples were received for processing.

The Utah Division of Wildlife Resources, Fisheries Experiment Station staff collected the bone and liver samples. The Utah Veterinary Diagnostic Laboratory in Logan, Utah performed the ICP-MS Mineral Analysis. The samples were digested in trace mineral grade nitric acid under heat. The digests were then diluted with ultra-pure water to a final nitric acid content of 5%, which provided a matrix match for the analytical standards. The prepared samples were analyzed by ICP-MS and assessed against concentration curves of known standards. Standard curves and quality control samples were analyzed every five samples. Results are reported in parts per million. FES staff analyzed the results in SPSS, using ANOVA with a 95% confidence interval.

One thing to consider with these results is the difference in fish size and age. FES fish were 1 and 2 year olds and <200 mm where as the other sample sites were adult and sub-adult fish (exact age not determined). Another observation is that some of the cultured fish at FES seem to exhibit exothalmia to the on-site fish health biologists, gas level was found to be acceptable and there is no indication of a bacterial infection. This symptom has been shown to be a sign of phosphorus or vitamin A deficiencies in carp by The National Research Council publication in 1977 on the Nutrient Requirements of

Warmwater Fishes. A few elements that stood out while processing the data were Ca, P, Mg & Mn in bone samples and Fe in liver samples.

Table 1. Comparison of individual mineral levels in June sucker bone samples. Matching subscripts depict no significant difference for a given element. Level of significance p=0.05.

Element	Red Butte	Camp Creek	FES 1	FES 2	FES 3
Ag	0.02_{zy}	0.02_{zy}	0.01_{zy}	0.04_{z}	0.00_{y}
SD	0.01	0.01	0.01	0.06	0.00
Al	1.12_{y}	2.89_{z}	0.54_{y}	1.25_{y}	1.25_{y}
SD	0.55	1.32	0.38	0.47	0.68
As	0.12_{z}	0.10_{zy}	0.04_{zy}	0.06_{zy}	0.01_{y}
SD	0.06	0.05	0.04	0.10	0.01
B	0.13_{y}	1.01_{z}	0.03_{y}	0.07_{y}	0.00_{y}
SD	0.17	0.59	0.06	0.12	0.00
Ba	12.30_{y}	50.32_{z}	1.18_{y}	1.51_{y}	1.02_{y}
SD	3.78	19.61	1.00	0.38	0.33
Be	0.00_{y}	0.00_{y}	0.00_{y}	0.01_{z}	0.01_{z}
SD	0.00	0.00	0.00	0.00	0.01
Ca	$160,931.00_{z}$	$154,158.00_{z}$	$41,377.60_{y}$	$26,682.40_{y}$	$19,641.90_{y}$
SD	8,059.38	9,109.12	44,937.58	3,186.30	8,834.68
Cd	0.01_{y}	0.05_{z}	0.00_{y}	0.00_{y}	0.01_{zy}
SD	0.01	0.01	0.00	0.01	0.01
Co	0.41_{z}	0.39_{z}	0.08_{y}	0.05_{y}	0.04_{y}
SD	0.08	0.03	0.08	0.02	0.02
Cr	0.40_{y}	0.57_{zy}	1.36_{zy}	0.79_{zy}	1.93_{z}
SD	0.18	0.21	1.22	0.39	2.25
Cu	0.72_{z}	0.37_{z}	0.24_{z}	0.62_{z}	0.53_{z}
SD	0.86	0.11	0.12	0.21	0.08
Fe	$1,137.68_{z}$	$1,046.82_{z}$	188.28_{y}	122.78_{y}	124.25_{y}
SD	206.87	75.54	192.16	29.71	73.71
K	$2,137.67_{yx}$	$3,483.37_{z}$	$1,687.78_{x}$	$3,298.92_{z}$	$3,149.65_{zy}$
SD	549.77	891.05	1,168.10	238.48	175.77
Li	0.23_{y}	0.36_{z}	0.07_{x}	0.06_{x}	0.03_{x}
SD	0.02	0.06	0.06	0.02	0.01
Mg	$3,052.89_{z}$	$2,566.96_{y}$	689.58_{x}	577.15_{x}	481.30_{x}
SD	313.08	116.48	686.07	23.34	109.41
Mn	53.19_{z}	75.45_{z}	1.53_{y}	1.67_{y}	1.24_{y}
SD	25.27	26.66	1.66	0.16	0.36
Mo	0.09_{z}	0.08_{z}	0.05_{z}	0.16_{z}	0.00_{z}
SD	0.08	0.06	0.05	0.26	0.00
Na	$3,534.65_{z}$	$3,424.86_{z}$	$1,191.99_{y}$	$1,146.42_{y}$	966.15_{y}
SD	269.29	492.21	1,028.41	154.41	225.31
Ni	0.35_{z}	0.32_{z}	0.07_{y}	0.25_{zy}	0.07_{y}
SD	0.09	0.06	0.06	0.28	0.03
P	$85,582.40_{z}$	$80,825.20_{z}$	$32,712.50_{y}$	$15,699.10_{x}$	$12,202.50_{x}$
SD	4,848.93	3,665.74	14,057.57	1,055.20	4,462.68

Pb	0.28_{zy}	0.69_{z}	0.02_{y}	0.04_{y}	0.04_{y}
SD	0.28	0.58	0.01	0.03	0.02
Sb	0.02_{z}	0.02_{z}	0.01_{z}	0.03_{z}	0.00_{z}
SD	0.02	0.02	0.01	0.04	0.00
Se	1.32_{z}	0.79_{y}	0.20_{x}	0.27_{x}	0.28_{x}
SD	0.46	0.20	0.13	0.07	0.00
Si	18.68_{y}	37.53_{z}	13.22_{y}	15.97_{y}	19.06_{y}
SD	5.00	3.06	8.32	3.44	1.73
Sn	0.01_{z}	0.13_{z}	0.00_{z}	0.00_{z}	0.00_{z}
SD	0.02	0.27	0.00	0.01	0.01
Sr	394.16_{z}	271.49_{y}	69.55_{x}	40.15_{x}	30.81_{x}
SD	122.40	74.15	75.13	3.48	12.26
Ti	0.00_{y}	0.01_{zy}	0.00_{zy}	0.01_{zy}	0.01_{z}
SD	0.00	0.00	0.01	0.01	0.00
V	0.63_{z}	0.56_{z}	0.05_{y}	0.02_{y}	0.08_{y}
SD	0.27	0.21	0.03	0.02	0.06
Zn	68.20_{z}	64.99_{z}	23.84_{y}	44.21_{zy}	29.91_{y}
SD	22.29	22.05	11.11	4.83	5.07

Table 2. Comparison of individual mineral levels in June sucker liver samples. Matching subscripts depict no significant difference for a given element. Level of significance p=0.05.

Element	Red Butte	Camp Creek	FES 1	FES 2	FES 3
Ag	0.037_{y}	0.376_{z}	0.077_{zy}	0.070_{zy}	0.090_{zy}
SD	0.026	0.374	0.031	0.099	0.017
Al	1.155_{y}	1.978_{y}	2.400_{zy}	7.390_{zy}	32.083_{z}
SD	1.106	1.830	2.073	1.923	47.155
As	0.174_{zy}	0.160_{zy}	0.223_{z}	0.230_{zy}	0.000_{y}
SD	0.108	0.039	0.194	0.283	0.000
B	0.057_{y}	0.135_{y}	1.913_{zy}	0.300_{y}	4.357_{z}
SD	0.061	0.126	2.570	0.424	4.666
Ba	0.174_{z}	0.128_{zy}	0.017_{y}	0.120_{zy}	0.103_{zy}
SD	0.116	0.122	0.012	0.057	0.091
Be	0.001_{y}	0.002_{z}	0.000_{y}	0.000_{y}	0.000_{y}
SD	0.001	0.001	0.000	0.000	0.000
Ca	151.372_{z}	71.466_{z}	56.953_{z}	157.235_{z}	88.637_{z}
SD	103.813	21.933	13.477	130.426	48.532
Cd	0.104_{y}	0.420_{z}	0.020_{y}	0.055_{y}	0.057_{y}
SD	0.088	0.353	0.000	0.007	0.025
Co	0.056_{y}	0.113_{z}	0.013_{x}	0.025_{yx}	0.033_{yx}
SD	0.026	0.028	0.006	0.007	0.023
Cr	0.221_{zy}	0.327_{z}	0.197_{zy}	0.085_{y}	0.013_{x}
SD	0.116	0.042	0.131	0.120	0.023
Cu	39.101_{z}	50.598_{z}	20.357_{z}	30.020_{z}	25.900_{z}
SD	28.870	42.042	2.778	37.222	7.836
Fe	711.008_{zy}	960.644_{z}	47.763_{y}	42.135_{zy}	17.320_{y}

SD	615.758	721.513	10.911	1.563	14.878
K	1,561.640$_{y}$	2,826.600$_{z}$	2,840.100$_{z}$	3,048.540$_{z}$	2,668.540$_{z}$
SD	692.115	198.192	41.809	340.373	389.528
Li	0.010$_{y}$	0.012$_{y}$	0.040$_{zy}$	0.055$_{zy}$	0.090$_{z}$
SD	0.004	0.008	0.027	0.007	0.090
Mg	167.871$_{z}$	184.613$_{z}$	154.213$_{z}$	255.655$_{z}$	166.823$_{z}$
SD	92.436	18.339	1.984	118.957	18.560
Mn	1.798$_{z}$	1.928$_{z}$	1.220$_{z}$	1.520$_{z}$	1.217$_{z}$
SD	0.920	0.743	0.089	0.269	0.310
Mo	0.263$_{y}$	0.328$_{zy}$	0.637$_{zy}$	0.050$_{y}$	0.967$_{z}$
SD	0.133	0.153	0.601	0.042	0.960
Na	866.435$_{z}$	1,016.600$_{z}$	855.160$_{z}$	1,119.740$_{z}$	827.553$_{z}$
SD	463.984	138.030	49.292	162.055	97.570
Ni	0.032$_{x}$	0.059$_{zyx}$	0.043$_{yx}$	0.160$_{z}$	0.143$_{zy}$
SD	0.014	0.012	0.023	0.156	0.112
P	3,199.420$_{z}$	3,863.070$_{z}$	2,376.160$_{z}$	2,831.130$_{z}$	2,458.570$_{z}$
SD	1,732.592	342.985	85.721	244.221	296.070
Pb	0.029$_{y}$	0.111$_{zy}$	0.140$_{zy}$	0.100$_{zy}$	0.350$_{z}$
SD	0.027	0.077	0.199	0.057	0.511
Sb	0.014$_{y}$	0.029$_{y}$	0.053$_{zy}$	0.000$_{y}$	0.173$_{z}$
SD	0.009	0.007	0.084	0.000	0.205
Se	2.392$_{z}$	1.624$_{zy}$	0.620$_{y}$	0.395$_{y}$	0.423$_{y}$
SD	1.209	0.334	0.252	0.177	0.174
Si	35.992$_{z}$	59.630$_{z}$	32.017$_{z}$	36.110$_{z}$	49.853$_{z}$
SD	20.818	20.162	2.931	5.8548	30.980
Sn	0.004$_{y}$	0.007$_{y}$	0.013$_{zy}$	0.010$_{zy}$	0.070$_{z}$
SD	0.002	0.014	0.006	0.014	0.104
Sr	0.502$_{z}$	0.160$_{z}$	0.143$_{z}$	0.520$_{z}$	0.217$_{z}$
SD	0.379	0.117	0.046	0.509	0.133
Ti	0.004$_{y}$	0.005$_{y}$	0.013$_{zy}$	0.020$_{z}$	0.020$_{z}$
SD	0.002	0.002	0.006	0.000	0.017
V	0.127$_{zy}$	0.252$_{z}$	0.017$_{y}$	0.030$_{zy}$	0.000$_{y}$
SD	0.087	0.216	0.015	0.042	0.000
Zn	59.822$_{z}$	62.493$_{z}$	25.343$_{z}$	34.085$_{z}$	33.343$_{z}$
SD	38.416	21.799	1.162	9.185	7.971

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