PRELIMINARY Progress Report
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Title: Factors Affecting Native Cutthroat Trout Population Dynamics, Abundance, and Distribution in the Logan and Bear River Drainages: Comparing the Effects of Varying Degrees of Anthropogenic Impact

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The Logan and Bear rivers in northern Utah and southern Idaho support a population of endemic Bonneville cutthroat trout, a species that is imperiled to varying degrees by habitat degradation, hybridization, disease, and competition with non-native fishes. While the Logan River experiences some anthropogenic impacts, this system is considered relatively pristine and provides a refuge and popular fishery for cutthroat trout. In contrast, much of the Bear River is highly degraded, and fish are exposed to highly variable and frequently low flows, poor water quality, and even complete de-watering due to river management for water development; farming and grazing practices have also resulted in substantial erosion and sedimentation. The contrast between these two systems provides and ideal situation for evaluating and understanding the complex and synergistic effects of biotic and abiotic factors, anthropogenic impact, and species interactions on the distribution, abundance, and health of Bonneville cutthroat trout in the Great Basin. The overall objective of this project is to monitor and evaluate the distribution, abundance, and health of native and exotic fishes in the Bear and Logan rivers and to understand the effect that varying degrees of anthropogenic impacts on stream ecosystems has in determining fish health and population dynamics.

During the summer of 2004, 7 sites were samples as part of the Water Initiative funded efforts, and in parallel with other collaborative and on-going efforts. The sites were chosen along an elevational gradient to capture the range of natural variability and anthropogenic impacts (Table 1). The Logan River sites overall represent the more natural riverine condition, whereas the Bear River sites were chosen to represent a more degraded system. The Spawn Creek site is the location of a passive stream restoration and fencing project to begin in 2005; data were collected as part of BEFORE data collection during the summer of 2004 (Spawn Creek sampling and diagnostics were completed based on pro bono efforts of many collaborators and diagnostics paid for by Cache Anglers through a small grant ($1K) from the Bonneville Chapter of the American Fisheries Society).

Table 1. Index sites and elevations.

Site Full Name	Site Short Code	Elevation
Logan River 2nd-3rd Dam	LR Low	1501
Logan River Twin Bridges	LR Mid	1706
Logan River Franklin Basin	LR Up	2046
Spawn Creek Restoration Site (BEFORE)	SC RestB	1844
Bear River Below Cutler Dam	BR Low	1309
Bear River Above Cutler Dam	BR Mid	1334
Bear River near Evanston	BR Up	2580

Table 2. Response variables sampled at each site, the approach or measurement technique used, some indication of sample domain or size, and the status of that data.

Parameter	Sampling Approach	Reach length and/or *n*	Status
Native fish/ km	Depletion electroshocking	100-200 meter reach per site	Done- Reported
Exotic fish/ km	Depletion and/or P/A electroshocking	100-200 meter reach per site	Done- Reported
% prevalence whirling disease (*Mc*)	PCR native fish head samples	20-30 fish per site	Some Done Some at lab (Pisces Molecular) awaiting analysis
Invertebrates (richness and HBI indices)	Kick net	1 sample per site (min 500 bugs)	Done- Reported
Periphyton	Chl. *a* mg/ m^3 from rocks	15 per site	Done but not analyzed/summarized
Nutrients (TN and TP)	Grab sample	1 per site	At lab Awaiting analysis
Discharge CFS	L,w,d transects with velocity measures	1 per site, ~ monthly Jun-August	Done but not analyzed/summarized
Temperature Max, Diel and Daily	TempLoggers	Continuous measurement May-Fall	Done- one measure Reported
Sediment % Fines	Wolman Pebble Count	1 per site	Done- Reported
Misc. Abiotic Vars: pH etc.	Meters	1 per site	Done- Reported
Isotopic Signatures of = Fish (native and exotic)	Delta 15 N and delta 13 C	5 of each species per site	At lab (UC Davis) Awaiting analysis Some Prelim Surrogate Data in graohs

Data collected during the 2004 field season are summarized in the attached progress report and in selected publications; these data are currently in various states ranging from: 1) in the process of current laboratory analysis, 2) in queues at other Universities for diagnostics, 3) summarized and graphed (Table 2*)* and 4) *In review*. Due to the preliminary state of some data, a comprehensive evaluation cannot yet be completed. Thus here we discuss variables independently and some preliminary, apparent relationships. To date, combined data indicate that as of 2004, cutthroat trout are declining at ~70% of the sites where a long-term trend can be statistically evaluated and have been extirpated from both lower elevation Bear sites (Budy et al. 2004). Further, all areas of the Logan River (but one) now test positive for whirling disease with

prevalence increasing at an increasing rate each year. Disease prevalence is a function of dominant fish species, temperature and discharge (De la Hoz Franco and Budy 2004). Cutthroat and brown trout (exotic) experience asymmetric competition where cutthroat trout are negatively affected by the presence of brown trout but not the reverse (McHugh and Budy, *In review*); the outcome of these interactions appears to be a function of, in part, the longitudinal arrangement of physical factors from headwaters to lower elevation sites.

Invertebrate data indicate greater enrichment (habitat degradation and pollution) at low elevation sites on both the Bear and the Logan rivers, and the relative density of native fishes as compared to exotic fishes also declines with decreasing elevation Figures 1 and 2), likely in response to elevated temperatures, turbidity, and sedimentation. However, preliminary (in progress) isotopic data for fish indicates little difference in trophic position across sites. Nutrient, primary productivity, discharge, disease, and isotope data for selected sites have been collected but are not yet available (Table 2) Future analyses will include 1) validation of relationship reported in De la Hoz Franco and Budy 2004, 2) predictions of habitat-based juvenile trout survival potential (McHugh, P., P. Budy, and H. Schaller 2004), 3) general descriptive and multivariate analyses of index sites, and 4) predictions of extinction risk for native fishes across index sites and under different future scenarios of natural and anthropogenic change based on the range of data measured here.

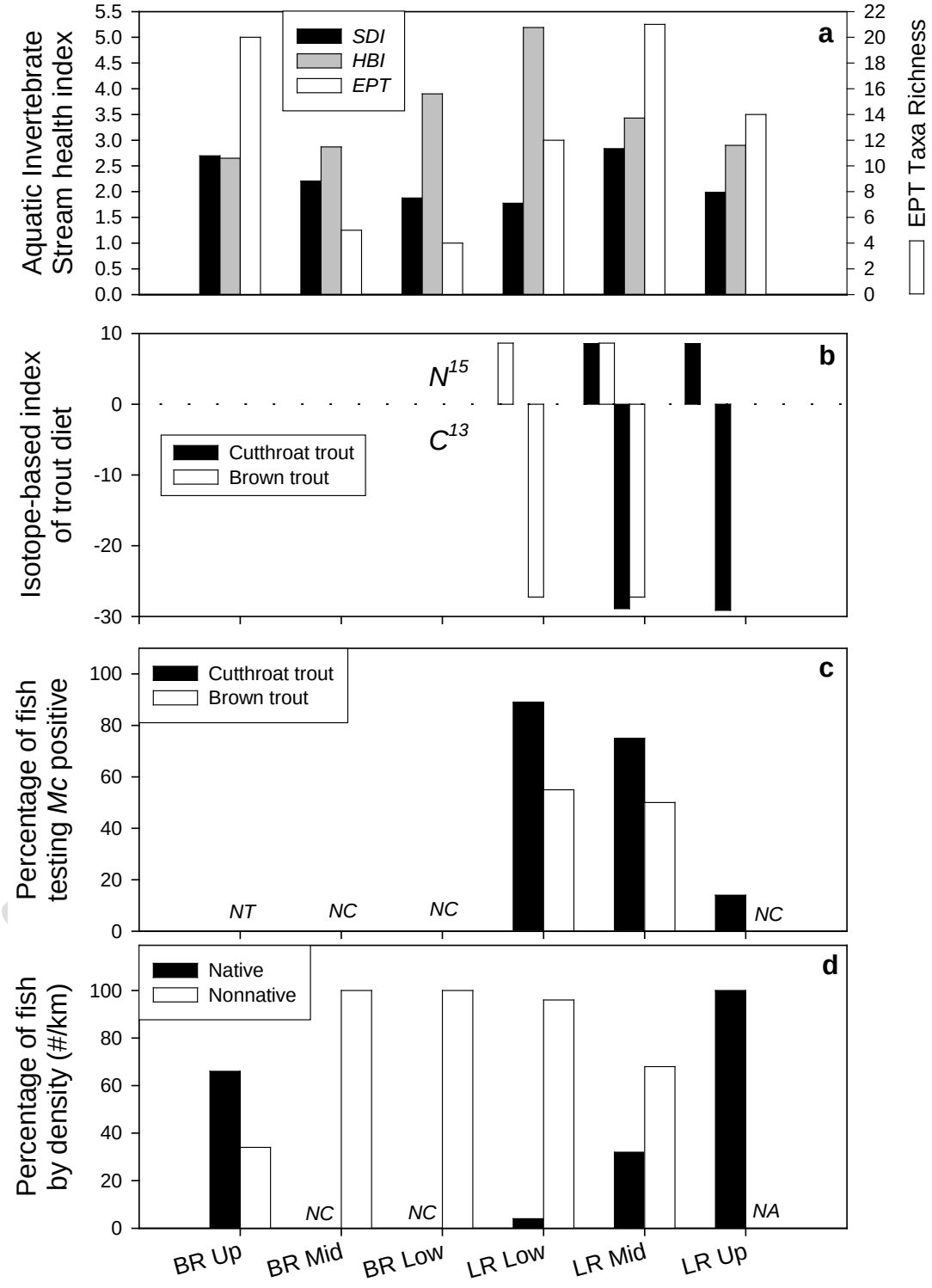

Figure 1. Biotic variables associated with sample sites along a longitudinal gradient on the Bear River (BR) and Logan River (LR), summer 2004; Up to Low indicates downstream flow. (**a**) Various aquatic invertebrate indices used to evaluate stream health condition: Shannon Diversity Index (SDI), Hilsenhoff Biotic Index (HBI), and EPT (Ephemeroptera, Plecoptera, Trichoptera

Taxa Richness Index). Roughly, high SDI, low HBI, and high EPT indicate a healthy stream. (**b**) Isotope-based index of trout diets relates feeding relation patterns in trout: higher N^{15}-value suggests higher degree of piscivory and more-negative C^{13}-value suggests greater reliance on terrestrial diet inputs. (**c**) Percentage of trout testing positive for *Myxobolus cerebralis*, the causative agent of whirling disease. *NT* = not tested, *NC* = none captured. (**d**) Percentage of fish by density at given sample sites. *Native* includes cutthroat trout on the Logan River and cutthroat trout, mountain whitefish, longnose dace, and mountain suckers on the Bear River. *Nonnative* includes brown trout and brook trout. *NA* = estimate not available.

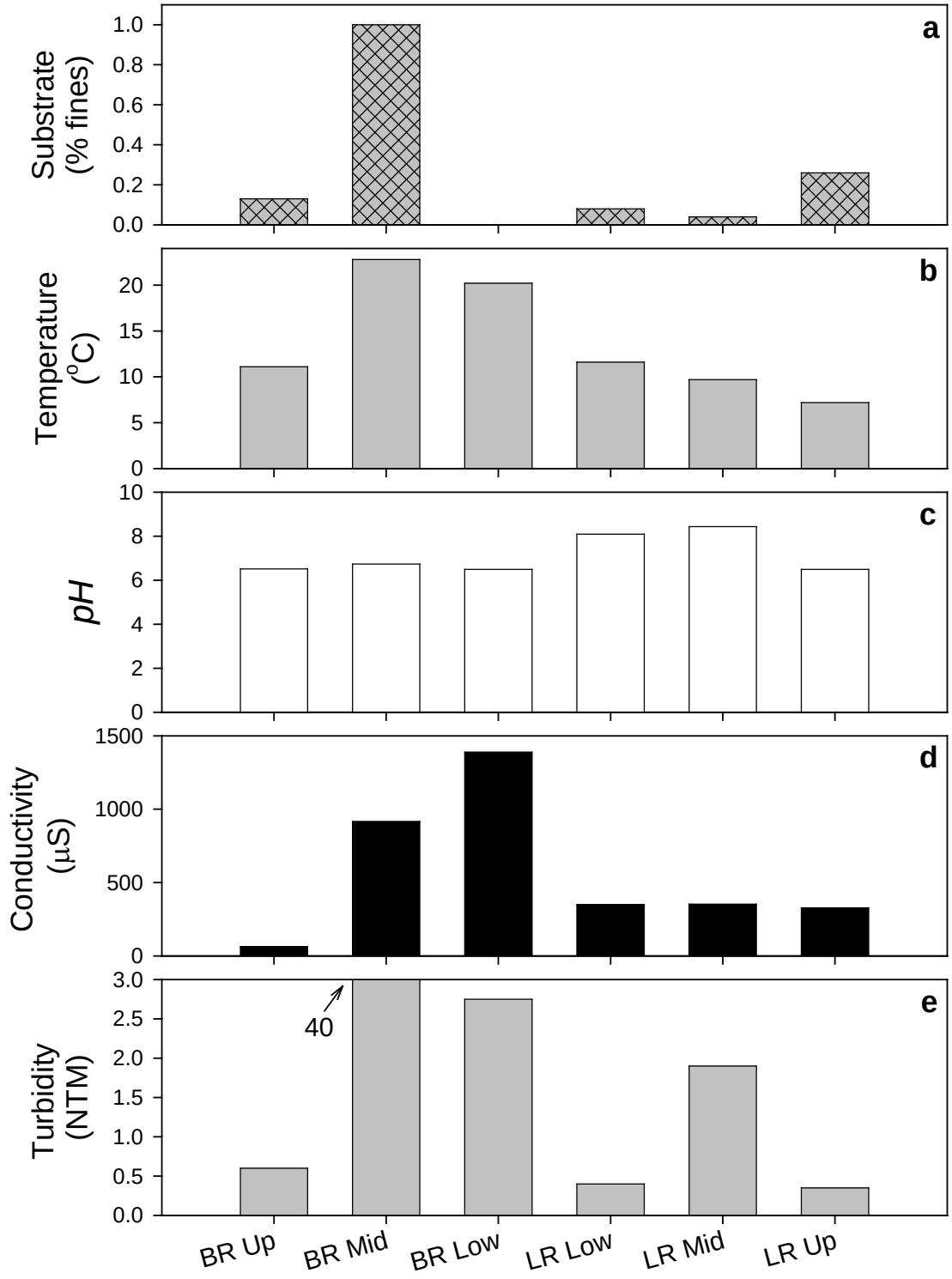

Figure 2. Physical variables measured at sample sites on the Bear River (BR) and Logan River (LR), summer 2004. Up to Low indicates downstream flow. (**a**) Substrate measured as percent fine sediments (< 10-mm diameter rock particles) on the stream bottom. (**b**) Temperature of water measured at the time fish were sampled. (**c**) The pH of water determines the solubility and

biological availability (amount that can be utilized by aquatic life) of chemical constituents such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals (lead, copper, cadmium, etc.). Ammonia has a high pH value. (**d**) Conductivity measures the amount of total dissolved salts or dissolved ions in the water. (**e**) Turbidity is a measure of suspended particles in the water.

Project Publications:

De la Hoz Franco, E.A., and P. Budy. 2004. Linking environmental heterogeneity to the distribution and prevalence of *Myxobolus cerebralis*: a comparison across sites in a northern, Utah. Transactions of the American Fisheries Society 133: 11761189.

De la Hoz Franco, E.A., and P. Budy. *In Press*. Effects of biotic and abiotic factors on the distribution of trout and salmon along a longitudinal stream gradient. Environmental Biology of Fishes, *Accepted July 18, 2004*.

McHugh, P., and P. Budy. *In review*. A comparison of visual measurement-based techniques for quantifying cobble embeddedness and fine sediment levels in salmonid-bearing streams. North American Journal of Fisheries Management. Submitted December 11, 2004.

Project Technical Reports:

Budy, P., P. McHugh , and G. P. Thiede. 2004. Logan River study: factors affecting trout population dynamics, abundance, and distribution in the Logan River, Utah. Project XIII, Annual Report to Utah Division of Wildlife Resources. 63 pp.

Budy, P., P. McHugh , G. P. Thiede, and E. VanDyke. *Preliminary Progress Report, October 22, 2004.* Logan River study: factors affecting trout population dynamics, abundance, and distribution in the Logan River, Utah. Project XIII, *for* Utah Division of Wildlife Resources. 77 pp.

Additional research funding applied for based on recent Logan River Watershed results:

EXOTIC BROWN TROUT REMOVAL AND BONNEVILLE CUTTHROAT TROUT RECOVERY IN ROCK CREEK, UTAH. *Project Proposal Submitted to*: National Fish and Wildlife Foundation, Bring Back The Natives Program*,* Prepared By: Peter McHugh, Research Assistant, Phaedra Budy, Assistant Professor, Gary Thiede, Fisheries Biologist, USGS / Utah Cooperative Fish and Wildlife Research Unit, Utah State University. 5 January 2005.

Project Presentations 2004:

Budy, P., G.P. Thiede, and P. McHugh. 2004. Modeling the synergistic effects of physical factors, disease, and species interactions on the survival and status of endemic cutthroat trout. Ecological Society of America, National, Portland, OR. August 4, 2004.

McHugh, P., and P. Budy. 2004. Evaluating the potential for competition between introduced brown trout and native Bonneville cutthroat trout in the Logan River, Utah. Western Chapter of American Fisheries Society, Salt Lake City, UT. March 4, 2004.

McHugh, P., and P. Budy. 2004. An experimental evaluation of altitudinal species-zonation patterns in montane streams: do abiotic or biotic factors determine the distribution of native and nonnative trout in Utah, USA, rivers? Utah State University – Water Initiative: Spring 2004 Runoff Conference, Logan, UT. Poster. March 26, 2004.

*McHugh, P., and P. Budy. 2004. An experimental evaluation of altitudinal species-zonation patterns in montane streams: do abiotic or biotic factors determine the distribution of native and nonnative trout in Utah, USA, rivers? VI International Congress on the Biology of Fish. Manaus, Brazil. 2 August 2004. *Award: Best Oral Presentation in the Fish Communities and Fisheries Symposium at the VI International Congress on the Biology of Fish*.