Watershed Sciences Department

Graduate Student
Fall 2008 Symposium

Friday, November 21, 2008

Eccles Conference Center 205/207

Beginning at 9:00 AM TODAY

Watershed Sciences Department
GRADUATE STUDENT
SYMPOSIUM

College of Natural Resources
Utah State University
November 21, 2008

Welcome to the Semi-Annual Watershed Sciences Graduate Research Pre-Project and PhD Project Symposium.

Today we will have the opportunity to hear from four M.S. and five Ph.D. graduate candidates, as they present the ideas that will form the basis for their research during their tenure in our Department.

The students will not be at the same stage in their research development. Many are still thinking about how best to proceed; others have already determined how they wish to address their questions of interest. The diversity of talks you will hear reflects, in part, the many different approaches each is taking towards answering important water resource, conservation, and ecosystem science issues.

This is their chance to publicly present their ideas and request your feedback on how to improve their research. Remember, your comments and insights are welcome and expected.

Enjoy today's presentations, and please join us for the Turkey Bowl at 3:00 on the Quad and the Thanksgiving dinner at 6:00 at Nick and Phaedra's home - 456 South 100 West in Providence.

Program Schedule

9:00	Welcome – Todd Crowl	
Session 1		
9:10	Brian Creutzburg	Testing trait-based approaches for inferring the factors that structure biotic assemblages: expansion to lotic Chironomidae and application across biogeographic boundaries
9:35	Marshall Baillie	A Pre and Post Monitoring Study on Effectiveness of a Restoration Project on the Upper Strawberry River near Heber, Utah
9:55	Nora Burbank	Predicting the effects of climate change and an invasive species, brown trout (*Salmo trutta*), on the distribution of a native nongame fish, mottled sculpin (*Cottus bairdi*), in Colorado streams
10:15	John Olson	Investigating the effects of geology on stream assemblages: Deriving continuous measurements of the environment from categorical maps
10:40	**Cookie Break!**	
Session 2		
10:50	Simon Bisrat	Predicting the invasion potential of a Puerto Rican frog in Hawaii using MODIS satellite imagery
11:15	David Cole	Morphological variation, genetic structuring, and stable isotopic signatures in the Utah Lake, Utah sucker complex
11:40	Andrew Dean	Triploid brook trout vs. diploid brook trout; and trophic interactions of stocked alpine Uinta Lakes
12:00	Ryan Hill	Stream thermal reference conditions: towards a regional model for assessing the effects of altered climate, riparian cover, and hydrology on stream temperatures and biota
12:25	Jeremy Mears	The distribution, diet and age structure of exotic burbot in the Flaming Gorge Reservoir: Implications for reservoir fisheries
12:45	Lunch (Pizza) in the Conference Center	
3:00	**Turkey Bowl Game on the QUAD**	
6:00	**Thanksgiving Dinner at Nick and Phaedra's home**	

Brian Creutzburg, PhD Student

Title: Testing trait-based approaches for inferring the factors that structure biotic assemblages: expansion to lotic Chironomidae and application across biogeographic boundaries

Advisor: Charles Hawkins

Abstract: Variation in functional trait frequencies across environments is thought to imply the mechanisms that structure aquatic communities. However, most observed functional trait-environment relationships (FTERs) are weak. FTERs might be weak for two main reasons: assemblages are not strongly structured in general, or inaccurate or imprecise characterization of traits obscures real relationships. The latter issue seems especially likely for the Chironomidae, a hyper-diverse family for which currently used traits are coarsely resolved. In the first portion of my presentation, I describe tests regarding whether refining trait states for 99 lotic chironomid genera strengthened FTERs, and determined if FTERs were stronger than relationships based on phylogenetic (taxonomic) classifications (TERs). We used available literature to refine and expand trait states associated with life history, mobility, morphology, and ecology. We then determined the environmental ranges that traits and taxa spanned and examined how single traits, trait groups (aka adaptive syndromes), and taxa varied along environmental gradients. The trait scoring schemes we used did not adequately capture the diversity of adaptive syndromes present among lotic chironomids. Both individual traits and trait groups were less strongly associated with environmental gradients than were taxonomic groups. The observed TERs imply environmental conditions do structure chironomid assemblages, but we apparently have yet to identify those traits most important to chironomid establishment and persistence. In the final portion of my presentation, I outline future research, specifically an evaluation of whether or not FTERs are robust to biogeographic boundaries.

Presentation Evaluation

Please rank from 1 – 5 (5 excellent)

Abstract information content	_____	Relevance of abstract to presentation	_____
Clarity of questions/hypotheses	_____	Clarity of research design	_____
Soundness of overall design	_____	Quantitative approach	_____
Quality of slides (fonts, etc)	_____	Quality of overall presentation	_____

Comments to strengthen research:

Comments to strengthen presentation:

Marshall Baillie, MS Student

Title: A Pre and Post Monitoring Study on Effectiveness of a Restoration Project on the Upper Strawberry River near Heber, Utah

Advisor: Jack Schmidt

Abstract: Habitat degradation, hydrologic alterations, channelization and agricultural practices are some of the leading causes for habitat loss and species declines. In an effort to restore aquatic environments to a more ecologically functional state, restoration efforts have increased exponentially over the last decade and evolved into a multibillion dollar industry. Specific to the Intermountain West, physical habitat restoration is at the forefront of these efforts, making it one of the most common river restoration actions. A primary example of this in the Intermountain West is the Strawberry River above the Strawberry Reservoir which is thought to be impaired for habitat degradation; therefore a justification has been made to restore several reaches on the mainstem reach. Specifically, accelerated lateral river migration is thought to have increased width to depth ratios and increased fine sediment loading to the stream, both of which reduce the quality and quantity of habitat for Bear lake cutthroat, rainbow trout and kokanee salmon. A restoration plan to fortify the outsides of meander bends, deepen pools, reduce width to depth ratios and reintroduce willows began in the July of 2008. My research will quantify lateral channel migration using decadal historic aerial photographs as well as a survey grade GPS and establish the amount of channel migration. Hydrology of the system through Bureau of Reclamation records and existing pressure transducers will establish a stage-discharge relationship for use calculating stream competence. Lastly, a post-project monitoring regimen will be established for the remaining phases of the restoration to assess restoration effectiveness.

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Comments to strengthen research:

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Nora Burbank, MS Student

Title: Predicting the effects of climate change and an invasive species, brown trout (*Salmo trutta*), on the distribution of a native nongame fish, mottled sculpin (*Cottus bairdi*), in Colorado streams

Advisor: Charles Hawkins

Abstract: Freshwater ecosystems and their fauna are among the most endangered in the world. In North America, an estimated 39% of all freshwater fish are now considered imperiled. Five major causes of this decline are overexploitation, water pollution, flow modification, destruction or degradation of habitat, and invasion by exotic species. Specifically, alteration of habitat due to climate change and invasion by exotic species has had considerable negative effects on the native fish fauna of North America. These two threats have been studied extensively separately, but few studies have looked at the combined effects of climate change and invasive species. My research will investigate the individual and combined effects of climate change and an invasive species, brown trout (*Salmo trutta*), on a native nongame fish species, mottled sculpin (*Cottus bairdi*). I will use Random Forest modeling to predict both current and future distributions of brown trout and mottled sculpin in Colorado streams based on stream thermal, hydrologic, and channel morphology habitat variables. I will use simulated changes in both mean annual air temperature and mean annual precipitation to estimate spatially explicit changes in stream temperature and hydrologic conditions, which will then be used to predict changes in the probabilities of occurrence of both species at all stream sites (30 x 30 m pixels) in Colorado. This research should provide new insight into the individual and interactive effects of two major threats, climate change and invasive species, on native species.

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John Olson, PhD Student

Title: Investigating the effects of geology on stream assemblages: Deriving continuous measurements of the environment from categorical maps

Advisor: Charles Hawkins

Abstract: Although ecologists have long acknowledged the effect of underling geology on stream conditions and chemistry, the categorical nature of geologic maps has limited their usefulness in determining how this effect occurs. In the past, I have demonstrated a technique for estimating average CaO concentrations of rocks within a catchment and have used these estimates for modeling stream alkalinity and conductivity. We have now developed maps of CaO concentration and rock hardness for 11 states, with each state showing similar results. Taking advantage of advances in geochemistry data management and geologic mapping, I modified this approach to be both more repeatable and faster. I will also show how we have expanded this approach to include other aspects of geology such as hydraulic conductivity and rock nutrient content.

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Simon Bisrat, PhD Student

Title: Predicting the invasion potential of a Puerto Rican frog in Hawaii using MODIS satellite imagery

Advisor: Michael White

Abstract: The Puerto Rican coqui frog (*Eleutherodactylus coqui,* hereafter coqui), which was introduced into Hawaii accidentally via commercial nurseries, is an aggressive invasive species in Hawaii. The coqui threatens Hawaii's unique ecological communities because it predates upon endemic invertebrates, which comprise the large majority of Hawaii's endemic fauna. Coqui frogs also affect real estate valuations because of their loud mating calls. Despite this widespread problem, the potential coqui range in Hawaii is currently unknown, making control and management efforts difficult. We fitted linear discriminant analysis (LDA), logistic regression (LR) via generalized linear models (GLMs), generalized additive models (GAMs), classification trees (CTs), random forests (RF), and support vector machine (SVM) to model the species distribution and map their invasion potential. We used five MODIS satellite imagery-derived biophysical variables as explanatory variables: leaf area index (LAI), fraction of photosynthetically active radiation absorbed by vegetation (FPAR), enhanced vegetation index (EVI), normalized difference vegetation index (NDVI), and land surface temperature (LST) from three MODIS products: MOD11 (LST), MOD13 (LAI and FPAR), and MOD15 (Vegetation Index) (collection 4). We used 2000-2005 MODIS data from Aqua and Terra satellites to generate monthly climatologies for each biophysical variable. We collected presence/absence data from Puerto Rico and Hawaii using a 1 km grid overlaid over the entire islands of Puerto Rico and the Island of Hawaii by sampling every other pixel of the grid intersecting with the road network. We then used the dataset from Puerto Rico to train the six models while the Hawaii dataset was used as a test set. All six models predicted the invasion potential of coqui frogs in Hawaii with a moderate success with mean Kappa value of 0.30, mean area under the curve of receiver operating characteristics (AUC) of 0.75 and mean classification accuracy (CA) of 0.68. RF and SVM outperformed the other classifiers with Kappa value of 0.4, AUC value of 0.78 and CA of 0.71 for RF and Kappa value of 0.38, AUC value of 0.73 and CA value of 0.72 for SVM. These results suggest there is a moderate climate matching between the native and the introduced habitats of coqui frogs. Further, the results suggest coqui frogs in their introduced habitat are showing moderate niche conservation.

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David Cole, PhD Student

Title: Morphological variation, genetic structuring, and stable isotopic signatures in the Utah Lake, Utah sucker complex

Advisor: Todd Crowl

Abstract: Population decline in the federally endangered June sucker, *Chasmistes liorus*, a lakesucker unique to Utah Lake, Utah, has been attributed in part to hybridization with the more widespread Utah sucker, *Catostomus ardens*. Meristic and morphological ambiguities, presumably the result of hybridization, create a continuum of intermediate forms between *Chasmistes* and *Catostomus* extremes and prevent definitive identification to species. Here we describe and evaluate the morphological and genetic variation in suckers in Utah Lake by comparing a morphological analysis with amplified fragment length polymorphism (AFLP) and microsatellite analyses; additionally, we use stable isotopes (^{13}C and ^{15}N) to compare sucker diet along the morphological gradient. Suckers were differentiated using mouth characters associated with different presumed feeding strategies: planktivory (June sucker) and benthivory (Utah sucker). Although we found no genetic evidence for a deep divergence between June and Utah morphs, slight, but significant, population structuring accompanied the substantial morphological variation. Bayesian model-based genetic clustering detected two sucker populations in Utah Lake, though these clusters were only weakly concordant with morphological groupings or between marker systems. Stable isotopic signatures were congruent with the presumed feeding strategies. The suckers in Utah Lake present an interesting dilemma regarding conservation: should one conserve (breed and stock) a subset of the morphotypic variation in the Utah Lake sucker complex, focusing on the endangered June sucker morphotype, or should one conserve both June sucker and Utah sucker morphotypes in this complex, possibly maximizing evolutionary potential?

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Andrew Dean, MS Student - Ecology

Title: Triploid brook trout vs. diploid brook trout and, trophic interactions of stocked alpine Uinta Lakes

Advisor: Phaedra Budy

Abstract: Studies involving the comparison of triploid and diploid fish are abundant yet variable. Most research has been conducted in a controlled laboratory setting, but little research has looked into performance and recruitment in a natural setting. I propose to evaluate the performance and recruitment of triploid and diploid brook trout of the high mountain Uinta Mountain fishery. Stocking non-native fishes into high mountain lakes is a widely practiced activity in many states fishery programs. Stocked fishes into high mountain lakes can create problems in the stability of food webs. Therefore, in addition to comparing triploid and diploid brook trout in alpine lakes of the Uintas, I am also pursuing to characterize and identify factors influencing food web dynamics and trophic cascades in Uinta alpine lakes. Trophic cascades in stocked lakes will be compared to natural food webs of fishless lakes to assess food web responses to and recoveries of lakes remaining in the stocking program and lakes post fish disappearance.

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Ryan Hill, PhD Student

Title: Stream thermal reference conditions: towards a regional model for assessing the effects of altered climate, riparian cover, and hydrology on stream temperatures and biota

Advisor: Charles Hawkins

Abstract: The abundance and distribution of most stream organisms are strongly influenced by water temperature. For bioassessments, the effects of 'natural' stream temperatures on the distribution of biota are usually predicted with surrogate variables (e.g., elevation, latitude). However, direct estimates of stream reference condition temperatures that are both accurate and precise across a large diversity of stream types and regions would be preferable. In addition, it is important to understand the potential responses of stream temperatures, and hence stream biota, to anthropogenic effects, such as climate change and riparian cover alteration. To address this goal, I am developing stream temperature models for the western United States. I used daily temperature data at 455 reference-quality USGS streams gauges in the western USA to develop stream temperature predictive models for mean annual, mean winter and mean summer time temperatures. Simple empirical models based on easily obtained measures of long-term air temperature and precipitation, catchment size and shape, and watershed soils account for large percentages of the variation in mean annual, winter and summer stream temperatures (R^2 = 0.87, 0.75 and 0.73, respectively). These thermal estimates have proven effective for modeling invertebrate and fish distributions in several regions in the West, and are often the most important predictors. I am now incorporating reach-level estimates of canopy shading, solar radiation, and discharge to better characterize the physical processes known to influence local variation in stream temperatures. These models should allow us to more precisely predict both spatial variability in local stream temperatures and the thermal responses to climatic, landscape, and hydrologic alterations. In doing so, we should be able to better explain current distribution patterns of stream biota and their likely responses to thermal alterations.

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Jeremy Mears, MS Student

Title: The distribution, diet and age structure of exotic Burbot in the Flaming Gorge Reservoir: Implications for reservoir fisheries

Advisor: Chris Luecke

Abstract: The purpose of this study is to look at the potential effects of recently introduced burbot (Lota lota) in the Flaming Gorge Reservoir. The major objectives are to assess the relative abundance, age structure, and feeding habits of burbot in the reservoir and how these factors fluctuate seasonally. Additionally behavioral experiments looking at prey selection will be carried out consisting of the dominant food items. Sampling will occur throughout the reservoir and be divided among the three major areas of Flaming Gorge (canyon, open-hills, and inflow). Most sampling will be done using trammel nets, cod traps, and angling. Additionally sampling will allow for information on life history including identification of spawning aggregations, larval emergence, age of first reproduction and habitat selection. This information on the distribution, feeding habits and life history of burbot will useful in the management of the fisheries of Flaming Gorge Reservoir.

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