IN COOPERATION WITH:

U.S. Geological Survey - Utah Division of Wildlife Resources - Utah State University
The Ecology Center - U.S. Fish and Wildlife Service - Wildlife Management Institute

Annual Report 2018

U.S. Geological Survey, Utah Cooperative Fish & Wildlife Research Unit

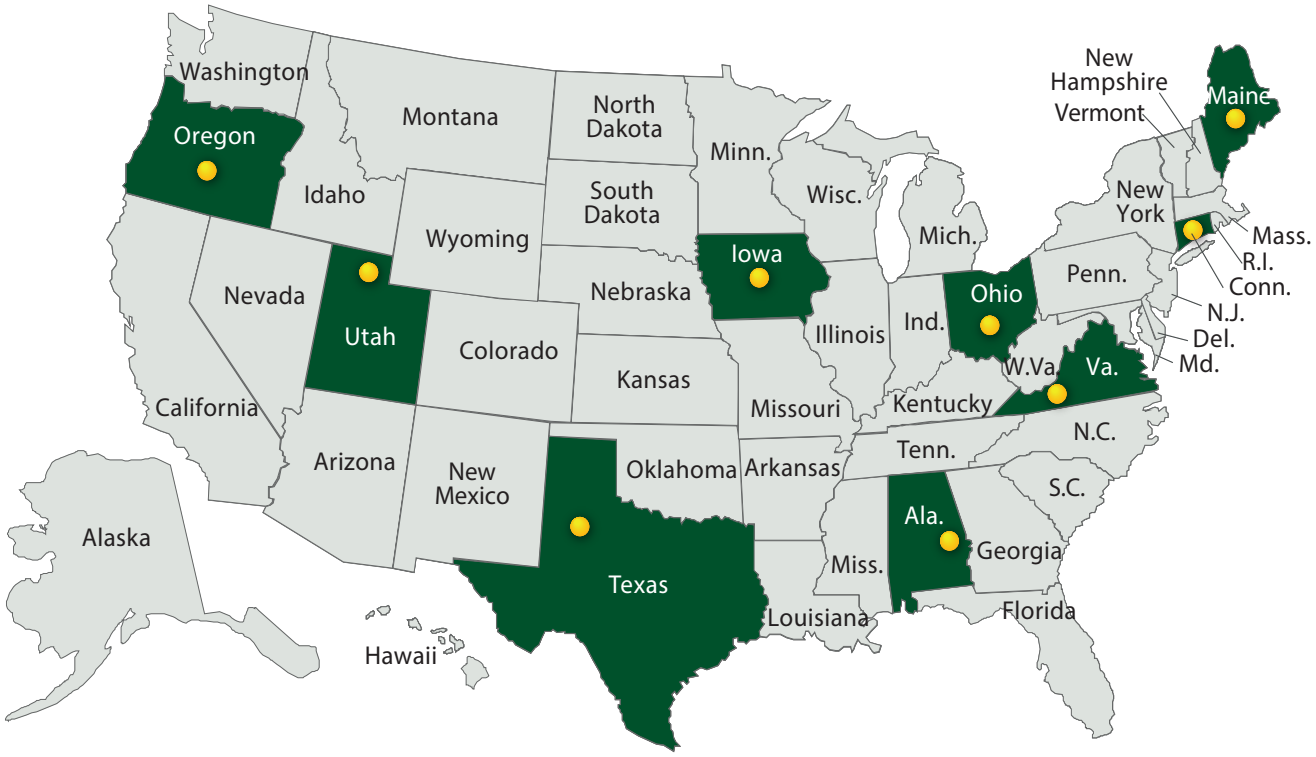
Lorem ipsum

Brief History of U.S. Geological Survey Cooperative Fish & Wildlife Research Units

The Cooperative Fish and Wildlife Research Units date back to 1932 when J.N. "Ding" Darling invested $3,000 to establish the first Unit in Iowa. This investment was in response to reading a report prepared by Aldo Leopold and 14 other prominent conservationists. This influential report boldly stated that, "wildlife demand was stripping supply," and there was a need to educate personnel to solve the wildlife conservation problems and to conduct research for wildlife management.

Three years later the first nine Units were established at land-grant universities. Utah was chosen to be one of the original nine established and was to represent the Intermountain West. Now 84 years later there are 40 Coop Units housed in land-grant universities across the Unit States including Alaska and Hawaii.

Cover Photo by Shauna Leavitt
Bonneville cutthroat trout research
in Right-hand fork, a tributary of Logan River.



1935: First 9 Units

2019: 40 Current Units

Mission Statement
Utah Cooperative Fish and Wildlife Reserach UDWR - Utah

In 2019, the Utah Cooperative Fish and Wildlife Research Unit celebrates its 84th year of educating future wildlife and fisheries managers and conducting fish and wildlife research – all in an effort to preserve the natural resources of the Intermountain West. This is all possible due to the Agreement among its cooperators, Utah Division of Wildlife Resources (UDWR), the U.S. Geological Survey (USGS), and Utah State University (USU). The Wildlife Management Institute and U.S. Fish and Wildlife Service also participate.

The major limiting influences on fish and wildlife resources in the Intermountain West are terrestrial habitat degradation and loss, and watershed and water development issues. Rapid population growth in the state, coupled with societal desires to access the wide range of natural resources available in the state, has exacerbated the pressures on both terrestrial and aquatic resources. These pressures require novel approaches to the study of, and transfer of research results to, those tasked with the responsibility to blend research information on the status and health of the state's terrestrial and aquatic ecosystems with other societal values. The Unit's principal role is to serve as nexus for the collection of this important information. We achieve this though excellence in research, instruction, and interaction with cooperators.

Research expertise of the Unit staff includes landscape ecology, conservation biology, research design and applied statistics, larger scale animal dynamics, geographical information system and habitat restoration methodology, terrestrial and aquatic habitat analysis, population management and assessment, fish population dynamics, and aquatic food web dynamics. Current research activities focus on landscape-level habitat studies, ecological modeling of lake, reservoir, and riverine systems, avian and terrestrial ecology, and the effects of climate change on habitat and biota throughout the Intermountain West. Future research directions of the Unit will continue to involve endangered fish and wildlife species, sustainable game and sport fish management, and landscape-level studies involving modeling for future climate scenarios.

Primary graduate and cross-listed graduate/undergraduate level courses taught by unit personnel include Graduate Fish Ecology (WATS 6230), Research Communication (WATS 4950), and Management and Manipulation of Ecological Data Using R (WILD 4580/6580), plus other R-based courses on request of cooperators. Unit personnel have also developed and provided instruction in continuing education and professional advancement short courses for agency personnel, with a current emphasis on analytical tools used by DWR biologists. The Unit also facilitates instruction in a diverse array of workshops developed by cooperating Faculty in the Quinney College of Natural Resources (QCNR) to a wide range of agency cooperators as well.

Cooperating faculty in QCNR, the Ecology Center, and across the University (USU) are, and will continue to be, integrated into Unit research to apply diverse expertise to all facets of a research problem. The primary goal of the Unit is to provide high quality information necessary to help resolve pressing natural resource problems. The Unit strives to do this by bringing to bear expertise found not only in the Unit staff, but also in the diversity of cooperating faculty found at USU.

Research Highlights

Western Forest Grouse
PI: David Dahlgren

Due to the lack of scientific data, managers do not know the full impact habitat fragmentation, human development, climate change, and improper grazing have on forest grouse.

David Dahlgren, assistant professor in the Quinney College of Natural Resources was discussing this deficit with Jason Robinson, upland game coordinator, for Utah Division of Wildlife Resources. Both recognized the potential benefits of using modern research techniques with forest grouse.

Dahlgren explains, "We wanted to get ahead of the ball." If forest grouse, particularly duskies, are to be considered key species for our mountain ecosystems, we needed scientific information for management.

With the use of tagging they found forest grouse are not being impacted by hunter harvesting. As data continues to be gatherd more question will be answered.

The full stories aired on Utah Public Radio's Wild About Utah.

Bonneville Cutthroat Trout in Right-hand Fork
PI: Phaedra Budy

For over a decade, managers worked in rivers to keep the Bonneville Cutthroat Trout (BCT), off the Endangered Species list.

One such location is the Right-hand fork, a tributary of the Logan River located in mountains of Northern Utah. Prior to 2013, the Right-hand fork was brimming with invasive Brown Trout.

Phaedra Budy, unit leader for the Utah U.S. Geological Survey Cooperative Fish & Wildlife Research Unit, hypothesized the dense population of Brown Trout were overflowing into the main leg of Logan River, increasing the exotic trout population there. She predicted if managers could replace the Brown Trout with a population of Bonneville Cutthroat trout, these native fish would thrive. Once the native trout population were recovered and robust, they too would begin to overflow into the main arm of the river and increase the native trout's population throughout Logan River.

In about 2010, a partnership of UDWR, USFS, Cache Anglers, and USU began taking steps for recovering the BCT trout in the tributary.

The BCT trout are now thriving in the Right-hand fork with multiple age classes and big, fat, catchable native trout.

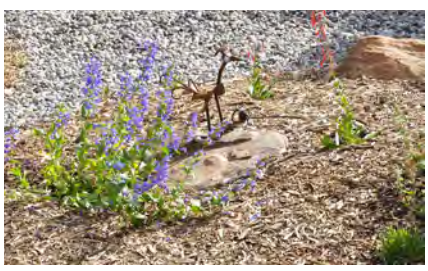
Utah's Native Penstemons
PI: Thomas C. Edwards

Over 100 full species or sub-species of penstemon plants are native to Utah. They thrive in hot conditions and require little water. Some penstemons are quite rare and found in very limited areas

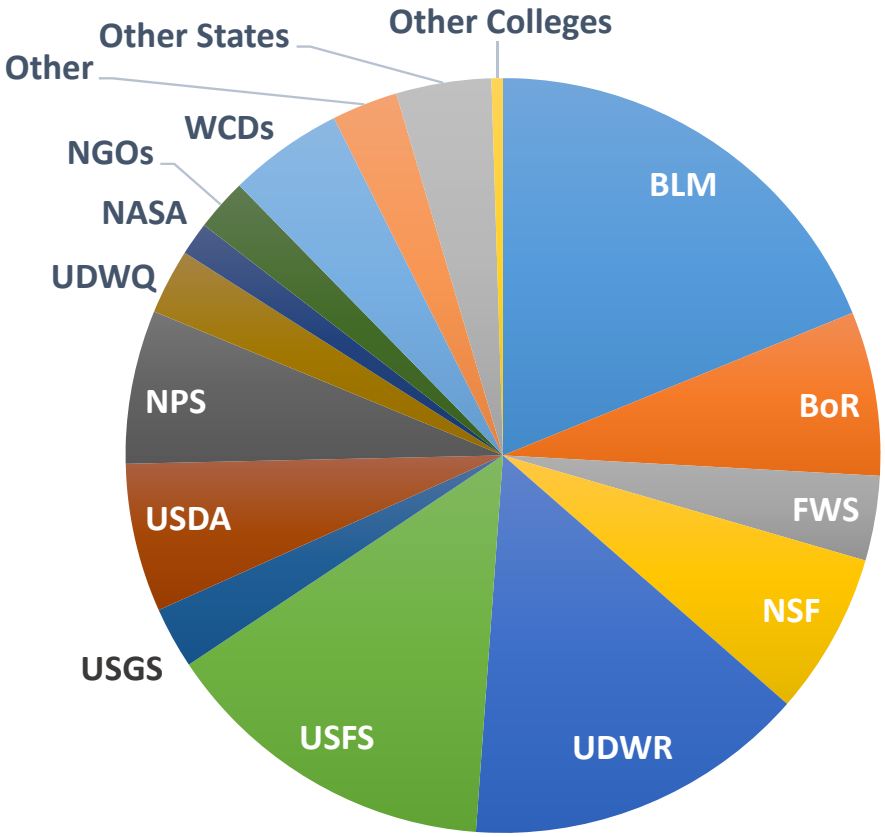
To help preserve these rare flowering plants, Utah's Department of Natural Resources, through the Division of Wildlife Resources, partnered with USU to use modeling as an aid to determine where the rare flowers grow.

By using survey data from the Utah Heritage Program, which tells where the rare plants have been found, the data is entered into the model and fined tuned so it can more accurately tell the researchers other locations where the rare plants may be.

Tom Edwards, assistant unit leader with the U.S. Geological Survey, said, once we have the models and understand where the rare plants are, it allows management agencies to work with their stakeholders (who include tribal nations, energy groups and ranchers) to decrease the impacts they have on these rare plants.



FY2018 QCNR Reserach Funding
Total: $6M



BLM- Bureau of Land Management
BoR - Bureau of Reclamation
FWS - U.S. Fish and Wildlife Service
NSF - National Science Foundation
UDWR - Utah Division of Wildlife Resources
USFS - U.S. Forest Service
USGS - U.S. Geological Survey

USDA - U.S. Department of Agriculture
NPS - National Park Service
UDWQ - Utah Division of Water Quality
NASA - Aeronautics & Space Admin.
NGOs - Non-Government Organizations
WCDs - Water Conservancy Districts

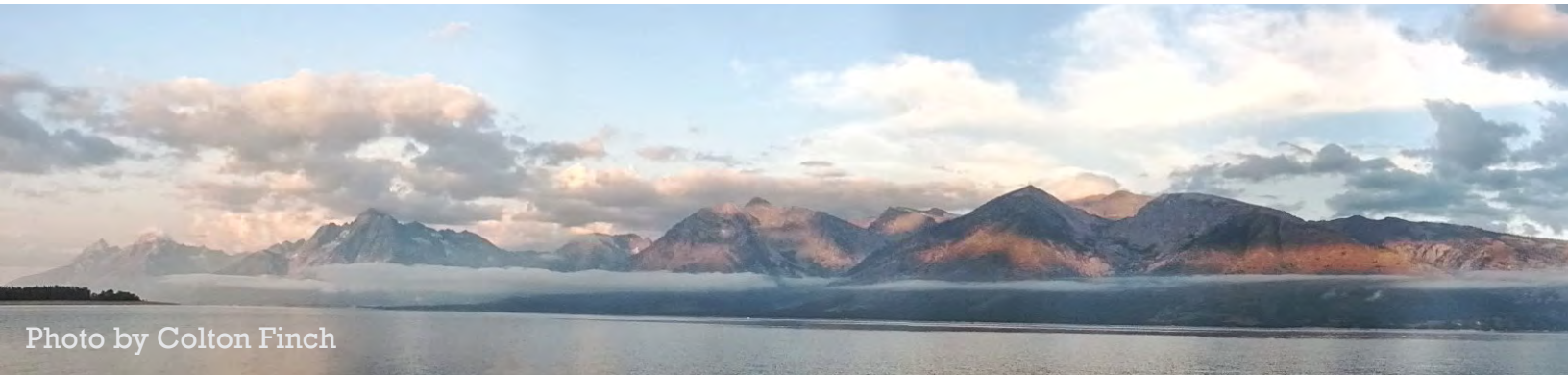
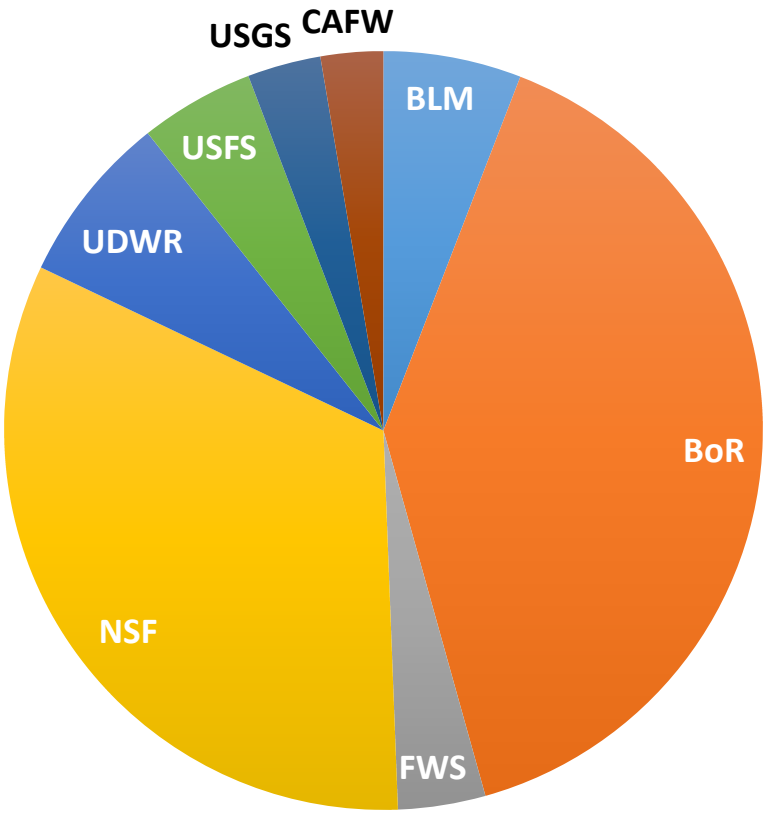


Photo by Colton Finch

FY2018 Utah Coop Unit Research Funding
Total: $1.4M



BLM - Bureau of Land Management
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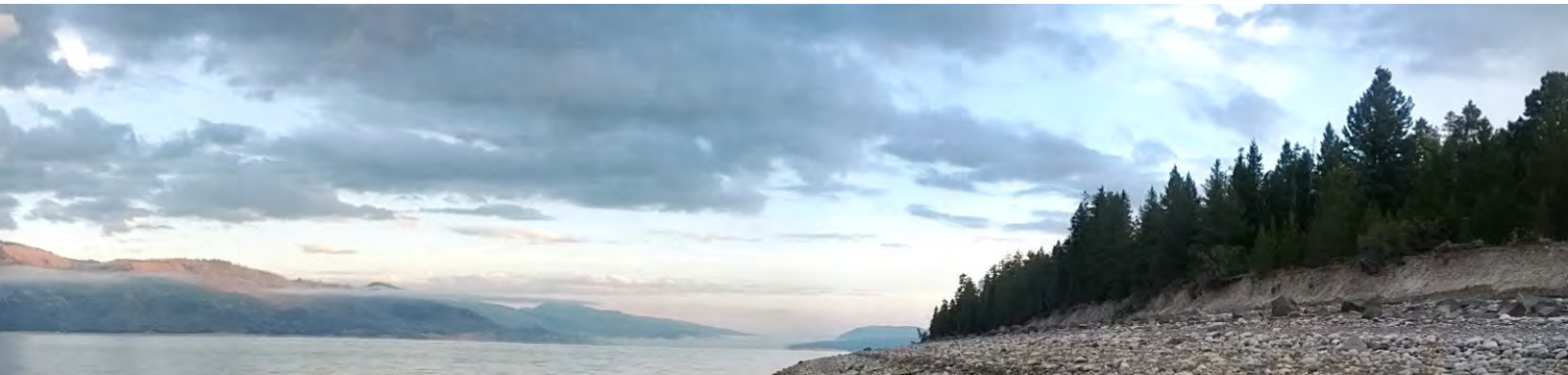
FWS - U.S. Fish and Wildlife Service
NSF - National Science Foundation
UDWR - Utah Division of Wildlife Resources
USFS - U.S. Forest Service
USGS - U.S. Geological Survey
CAFW - CA Department of Fish & Wildlife



USU Alumni Working for UDWR

Name	Job Title	USU College	Major	Degree
J.D. Abbott	**Sergeant**	NR	Fisheries & Aquatics	BS
Jodie Anderson	**Volunteer Services Coordinator**	NR	Interdisciplinary Studies	BS
Paul Vincent Badame	**Assistant Chief of Aquatics**	NR	Fisheries & Wildlife	BS
Shawn Bagley	**Conservation Officer**	NR	Wildlife Management	BS
Melinda Bennion	**Native Aquatic Biologist II**	NR	Natural Resources	MNR
Heather Hill Bernales	**Biometrician**	NR	Wildlife Biology	MS
David L. Beveridge	**Lieutenant**	NR	Fisheries & Wildlife	BS
Gary John Bezzant	**Habitat Program Manager**	NR	Human Dimensions	MS
Garn J. Birchell	**Asst Aquatics Program Manager**	NR	Fisheries & Wildlife	MS
Calvin M. Black	**Asst Aquatics Program Manager**	NR	Fisheries & Wildlife	BS
Natalie Boren	**Fisheries Biologist**	NR	Natural Resources	MNR
Rhett Boswell	**Wildlife Habitat Biologist**	NR	Natural Resources	MNR
Quent Bradwisch	**Mantua Hatchery Manager**	NR	Fish & Wildlife Mngt	BS
Nic Braithwaite	**Blue Ribbon Fisheries Biologist**	NR	Fisheries Biology	MS
Adam Brewerton	**Wildlife Conservation Biologist**	NR	Ecology	MS
Matthew G. Briggs	**Lieutenant, Law Enforcement**	NR	Fisheries & Wildlife	BS
Wyatt Bubak	**Training Lieutenant, Enforcement**	NR	Natural Resources	MNR
Kevin Bunnell	**SRO Regional Supervisor**	NR	Wildlife Ecology	PhD
Michael F. Canning	**Wildlife Recreation Programs**	NR	Aquatic Ecology	MS
Torrey Christophersen	**Law Enforcement Manager**	NR	Fisheries & Wildlife	BS
Bryan Christensen	**Volunteer Services Coordinator**	NR	Wildlife Administration	MNR
Devin Christensen	**Sergeant**	NR	Environmental Studies	BS
James Christensen	**Assistant Wildlife Manager**	NR	Natural Resources	MNR
Byran Clyde	**Sergeant**	NR	Wildlife Science	BS
Avery Cook	**Upland Game Project Leader**	NR	Wildlife Ecology	MS
Gary L. Cook	**Wildlife Recreation Prgm Coord**	NR	Fisheries & Wildlife	BS
Jason Cox	**Range Trend Project Leader**	NR	Natural Resources	MNR
Chad Cranney	**Asst. Wildlife/Wetland Manager**	NR	Aquatic Ecology	MS
Darren L. Debloois	**Game Mammals Coordinator**	NR	Wildlife Management	MS
Travis Dees	**Wildlife Biologist II**	NR	Interdisciplinary Sciences	BS
Justin S. Dolling	**NRO Regional Supervisor**	NR	Fisheries & Wildlife	BS
Cody Edwards	**Native Aquatics Species Biologist**	NR	Fisheries & Aquatics	BS
Eric Edgley	**GIS Manager**	NR	GIS/Remote Sensing	MS
Ja Eggett	**Asst Hunter Education Coordinator**	AGR	Landscape Architecture	BS
Robert Fitts	**Biologist**	AGR	Plant Science	MS
Wayne Gustaveson	**Fisheries Manager, Lake Powell**	NR	Fisheries Biology	MS
Kevin Gunnell	**Assistant Habitat Section Chief**	NR	Range Science	MS
Michael Hadley	**Regional Aquatics Biologist**	NR	Fisheries and Wildife	BS
Troy T. Hammond	**Conservation Officer**	NR	Fisheries & Wildlife	BS
Makeda Trujillo Hanson	**Habitat Program Manager**	NR	Wildlife Science	BS
Richard Dale Hepworth	**Aquatics Program Manager**	NR	Fisheries & Wildlife	BS
Brian Hines	**Aquatic Biologist II**	NR	Fisheries Biology	MS
Gary Howes	**Assistant FES Hatchery Manager**	NR	Natural Resources	MNR
Bradley Hunt	**Hardware Ranch Manager**	NR	Wildlife Science	BS
Bruce C. Johnson Jr.	**Lieutenant**	NR	Fisheries & Wildlife	BS
Jason D. Jones	**Wetland Manager**	NR	Natural Resources	MNR
Kody Jones	**Conservation Officer**	NR	Wildlife Science	BS
Daniel Keller	**Native Aquatics Biologist**	NR	Natural Resources	MNR
Kyle Kettle	**Predator Management Specialist**	Science	General Studies	Assoc
Kip L. King	**Conservation Officer**	NR	Wildlife Management	BS
Shane Kitchen	**Conservation Officer**	NR	Wildlife Science	BS

USU Alumni Working for UDWR

Name	Job Title	USU College	Major	Degree
Jim Lamb	**Wildlife Biologist**	NR	Fisheries and Wildife	BS
Charles Lawrence	**Conservation Officer**	NR	Forestry	MS
David R. Lee	**CUP Project Leader**	NR	Fish & Management	BS
Marnie Lee	**Wildlife Recreation Prgm Coord**	NR	Recreation Resource Mngt	BS
Dale F. Liechty	**Wildlife Biologist**	NR	Fisheries & Wildlife	BS
Raymond Lee Loken	**Sergeant, Law Enforcement Section**	NR	Fisheries & Wildlife	BS
John Allen Lytle	**Conservation Officer**	NR	Fisheries & Wildlife	BS
Dax L. Mangus	**Upland Game Program Coordinator**	NR	Wildlife Biology	MS
Roy Marchant	**Wildlife Biologist**	NR	Fisheries & Wildlife	BS
Tory D. Mathis	**Habitat Restoration Biologist**	Science	Biology	BS
Randall McBride	**Private Lands Biologist NRO**	NR	Wildlife Biology	MS
Roger Mellenthin	**Fish Culture Coordinator**	NR	Fisheries & Wildlife	BS
Douglas Messerly	**Supervisor Law Enforcement**	NR	Wildlife Management	BS
Eric Miller	**Conservation Officer**	NR	Wildlife Sciences	BS
Dustin Lee Mitchell	**Wildlife Biologist II**	NR	Wildlife Management	MS
Jonathan K. Moser	**Conservation Officer**	Science	Biology-Ecol/Biodiversity	BA
Benjamin K. Nadolski	**Legislative Liaison, Policy Analyst**	NR	Fisheries Biology	MS
Nicole Nielson	**Habitat Restoration Biologist**	NR	Natural Resources	MNR
Russell Norvell	**Avian Conservation Programs**	NR	Wildlife Ecology	PhD
Casey Olsen	**Landowner Assistance Biologist**	NR	Wildlife Biology	BS
Daniel Olson	**Wildlife Migration Coordinator**	NR	Wildlife Biology	PhD
Weston P. Pearce	**Strawberry Fishery Biologist**	NR	Fisheries & Aquatics	BS
Tana Pickett	**Wildlife Biologist**	NR	Fisheries & Wildlife	BS
Jason D. Robinson	**Tooele District Wildlife Biologist**	NR	Wildlife Biology	MS
Clint Sampson	**Wildlife Biologist**	NR	Wildlife Biology	BS
Craig J. Schaugaard	**Assistant Chief of Aquatics**	NR	Aquatic Ecology	MS
Thomas Six	**Conservation Officer**	NR	Wildlife & Ecol Mgmt	BS
Michael T. Slater	**Regional Sportfish Project Leader**	NR	Fisheries & Wildlife Mgmt	MS
Sean Spencer	**Conservation Officer - Sergeant**	NR	Natural Resources	MNR
Blair Stringham	**Migratory Game Bird Programs**	NR	Wildlife Biology	MS
James Thomas	**Conservation Officer**	NR	Environmental Studies	BS
Brock Thornley	**Conservation Officer**	NR	Wildlife Science	BS
Rachael Tucett	**Wildlife Recreation Specialist**	NR	Wildlife Science	BS
Phil Tuttle	**Conservation Outreach Manager**	NR	Fisheries	MNR
Amy Vande Voort	**Wildlife Biologist II**	NR	Wildlife Biology	MS
Erin Vandyke	**Asst Hatchery Manager, Whiterocks**	NR	Fisheries & Aquatics	BS
Xaela Walden	**Wildlife Biologist I**	NR	Wildlife Science	MS
Guy W. Wallace	**Wildlife Program Manager**	NR	Wildlife Science	BS
Alan Ward	**Strawberry Project Leader**	NR	Fisheries & Wildlife	MS
Mike Wardle	**Private Lands/Public Wildlife Coordinator**	NR	Natural Resources	MNR
Arlo Wing	**Assistant Wetland Manager**	NR	Wildlife Biology	MNR
Brian Wing	**Assistant Hatchery Supervisor**	NR	Wildlife Biology & Mgmt	MS
Randy H. Wood	**Wildlife Program Manager**	NR	Fisheries & Wildlife	BS
Jessica Wootton	**Invasive Species Specialist**	NR	Wildlife Management	BS

S.J. & JESSIE E. QUINNEY
COLLEGE of
NATURAL RESOURCES
UtahStateUniversity

SUMMARY:

Natural Resources	**95%**
Science	**3%**
Agriculture	**2%**

Scientists, Staff & Graduate Students

Photo by Colton Finch

Phaedra Budy
Aquatic Research Ecologist
Unit Leader

Thomas Edwards
Landscape Research Ecologist
Assistant Unit Leader

John Bissonette
Landscape Research Ecologist
Emeritus

Shauna Leavitt
Administrative Assistant
and Outreach Specialist

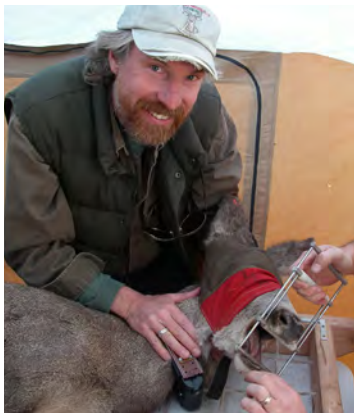
Frank Howe
UDWR Research Liaison
USU Adjunct Faculty

Gary Thiede
Research Associate
Watershed Sciences

Mary Conner
Reserach Associate Professor
Wildland Resources

Robert Fitts
Research Associate
UT Natural Heritage Program

Peter MacKinnon
Research Associate
Watershed Sciences



David Stoner
Research Associate
Wildland Resources

Tim Walsworth
Aquatic Ecology
Post Doc Researcher

Nick Barrett
Aquatic Ecology
Ph.D. Candidate

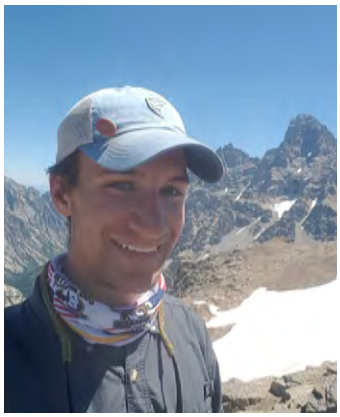
Niall Clancy
Aquatic Ecology
Master's Candidate

Emma Doden
Mammalian Ecology and
Riparian Restoration
Master's Candidate

Brian Healy
Aquatic Ecology
Ph.D. Candidate

Graduate Students
continued

Kent Hersey
Wildlife Biology
Ph.D. Candidate



Jack McLaren
Aquatic Ecology
Ph.D. Candidate

Ben Stout
Aquatic Ecology
Ph.D. Candidate

Zach Ahrens
Aquatic Ecology
Master's Candidate

Where are they now?
Graduates from the past 11 years

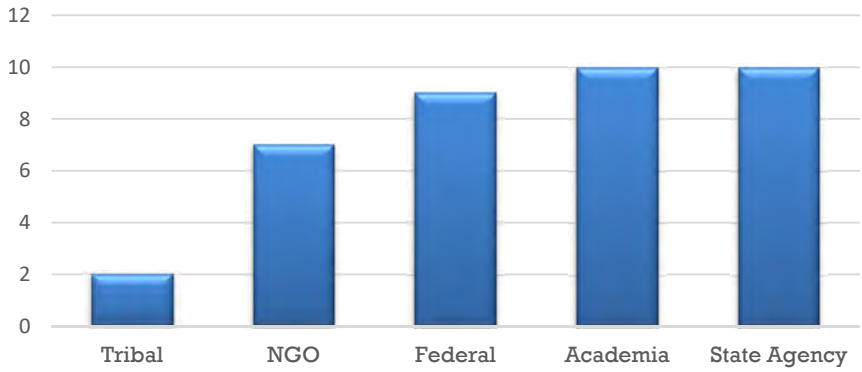


Photo by Kent Hersey

Productivity

Publications

BISSONETTE

IN PRESS

Bissonette, J. A. 2019. Additional Thoughts on Rigor in Wildlife Science: Unappreciated Impediments. Journal of Wildlife Management. Accepted 14 March 2019.

BUDY

PUBLISHED

Laub, B.G., G.P. Thiede, W.W. MacFarlane, and P. **Budy**. 2018. Evaluating the conservation Upotential of tributaries for native fish in the Upper Colorado River Basin. Fisheries, Feature Article 43:194-206. DOI: 10.1002/fsh.10054. *USGS IP: 081178.*

Dornelas, M and P. **Budy** (#25) and 182 others. 2018. BioTIME: a database of biodiversity time series for the Anthropocene. Global Ecology and Biogeography. Global 2018; 00:1–26. https://doi.org/10.1111/geb.12729. *USGS FSP: IP-088450 (under USGS co-author Rybicki).*

LaPlanche, C. A. Elger, F, Santoul, G.P. Thiede, and P. **Budy**. 2018. Forecasting the eradication success of an exotic fish from an alpine stream. Biological Conservation 223:34-46. doi.org/10.1016/j.biocon.2018.04.024. *USGS FSP: IP-XX.*

Heredia, N. and P. **Budy**. 2018. Trophic ecology of Lahontan Cutthroat Trout *Oncorhynchus Clarkii Henshawi*: historical predator-prey interaction supports native apex predator in unique desert lake. Transactions of the American Fisheries Society. *147:842–854, DOI: 10.1002/tafs.1006. USGS FSP: IP-066465.*

Klobucar, S.L., J.W. Gaeta, and P. **Budy**. 2018. A changing menu in a changing climate: using experimental and long-term data to predict invertebrate prey biomass and availability in arctic lakes. Freshwater Biology 2018:1-13. DOI: 10.1111/fwb.13162. *USGS FSP: IP-087907.*

Meredith, C. P. **Budy**, and J Schmidt. 2018. Investigating scour depths in relation to patterns of spawning brown trout and the changing physical template of a mountain river. River Research and Applications 2018:1-11. DOI: 10.1002/rra.3321. *USGS FS: IP-01031.*

Budy, P., K.B. Rogers, Y. Kanno, B. Penaluna, N.H. Hitt. G.P Thiede, J. Dunham, C. Mellison, and W.L. Somer., and J. DeRitto. *In press for 2019.* Distribution and Status of Trout and Char in North America. *Invited* Chapter 8 in: Diversity and Status of Trout and Char of the World. Editors: J.L. Kershner, J. E. Williams, R. E. Gresswell. American Fisheries Society. Symposium Book. *USGS FSP: IP-088494.*

Hansen, M., P. **Budy** , C. Guy, and T. McMahon. *In press for 2019.* Trout as Native and Invasive Species: a Management Paradox. *Invited* Chapter 19 in: Diversity and Status of Trout and Char of the World. Editors: J.L. Kershner, J. E. Williams, R. E. Gresswell. American Fisheries Society. Symposium Book. *USGS FSP: IP-095921.*

IN REVIEW/REVISION

Stout, B., M. Conner, **P. Budy**, P. MacKinnon, and M. McKinstry. *In review.* Keeping it classy: Differentiating between live fish and ghost tags detected with a mobile PIT tag interrogation system using an innovative analytical approach. *April 2019. Submitted to* Canadian Journal of Fisheries and Aquatic Sciences.

Maloney, B., J, Gaeta, and P. **Budy**. *In revision.* Recruitment bottlenecks and habitat requirements for an imperiled desert fish. *Submitted to:* North American Journal of Fisheries Management, 16 March, 2018. UJFM-2018-0042.

Photo by Tom Edwards

Saunders, W.C., and P. **Budy.** *In revision.* Can high densities of native Bonneville cutthroat trout minmize negative impacts of exotic brown trout establishment through bioti resistane? Tranactions of the American Fisheries Society. *USGS FSP: IP-049187.*

Mohn, H.E., P. **Budy**, B. Roper, and J. Walton. *In revision.* Aligning conservation goals and management objectives for on of the largest remaining populations of Bonneville Cutthroat Trout (*Oncorhynchus clarkii utah*). North American Journal of Fish Management.

Murphy, B., T. Walsworth, P. Belmont, M.M. Conner, and P. **Budy**. *In review*. Dynamic Habitat Disturbance and Ecological Response (DyHDER)-PVA: modeling fish population dynamics in response to landscape disturbance. *April 2019. Submitted to* Ecological Applications.

EDWARDS

PUBLISHED

Ironside, K. E,. D. J. Mattson, T. Arundel1, Tad Theimer, B. Holton, M. Peters, T. C. **Edwards**, Jr., and J. Hansen. 2018. Geomorphometry in landscape ecology: Issues of scale, physiography, and application. Environment and Ecology Research 6(5): 397-412. DOI: 10.13189/eer.2018.060501

Goeking, S. A, Izlar, D. K., and T. C. **Edwards**, Jr. 2018. A landscape-level assessment of whitebark pine regeneration in the Rocky Mountains, USA. Forest Science doi: 10.1093/forsci/fxy029

Stoner, D. C., J. O. Sexton, D. M. Choatec, J. Nagolb, H. H. Bernalesd, S. A. Simsa, K. E. Ironsidee, K. M. Longshoref, and T. C. **Edwards**, Jr. 2018. Climatically driven changes in primary production propagate through trophic levels. Global Change Biology. DOI: 10.1111/gcb.14364


Photo provided by USFWS

IN PRESS

Sofaer, Helen R., C. S. Jarnevich, I. S. Pearse, R. Lyons Smyth, S. Auer, G. L. Cook, T. C. **Edwards**, Jr., G. F. Guala, T. G. Howard, J. T. Morisette, and H. Hamilton. *In press*. The development and delivery of species distribution models to inform decision-making. BioScience.

Presentations

BUDY

Stout, J.B., P. **Budy**, M. Conner, P. MacKinnon, and M. McKinstry. 2018. Can we improve upon vital rate estimation and reduce handling stress of endangered fishes using passive floating PIT tag detectors and post hoc statistical classification of live versus dead tags? 43rd Annual Meeting of the Western Division of the American Fisheries Society. Anchorage, AK. May 23, 2018.

Stout, J.B., P. **Budy**, M. Conner, P. MacKinnon, and M. McKinstry. 2018. You can do it! Determining fish status from mobile PIT antenna detections. Annual Meeting of Utah American Fisheries Society. Ogden, UT. March 14, 2018.

Nichols, K., P. **Budy**, W. Carl Saunders, G.P. Thiede. 2018. Evaluating diet overlap between cutthroat trout and brown trout in instream, experimental enclosures under differing densities: can native trout resist the impacts of nonnative trout when they occur at higher densities? Poster presentation: Annual Meeting of the Utah Chapter of the American Fisheries Society, Ogden, Utah, 13 – 15 March 2018.

West, R. G.P. Thiede, and P. **Budy**. 2018. Spatial variation of sculpin (Cottus spp.) diets along the longitudinal gradient in the Logan River, Utah. Poster presentation: Annual Meeting of the Utah Chapter of the American Fisheries Society, Ogden, Utah, 13 – 15 March 2018.

Hafen, T. N. Barrett, P. **Budy**, and G.P Thiede. 2018. Ecological effects of lake characteristics and arctic char presence on cohabiting native fish assemblages, demographics, and trophic niche. Oral presentation: Annual Meeting of the Utah Chapter of the American Fisheries Society, Ogden, Utah, 13 – 15 March 2018.

Arnold, T. C. Penne, P. **Budy**, and G.P. Thiede. 2018. Determining age and size of fecund walleye (Sander vitreus) in Willard Bay, Utah using non-lethal dorsal spine. Analysis.

Oral presentation: Annual Meeting of the Utah Chapter of the American Fisheries Society, Ogden, Utah, 13 – 15 March 2018.

Barrett, N. and P. **Budy**. 2018. Warming up the waters in arctic lakes: Implications from individuals to ecosystems. Oral presentation. Annual Meeting of the Western Division of the American Fisheries Society, May 22-25, 2018, Anchorage, AK, USA.

Budy, P. , A. Giblin, G. Kling, D. White, and C. Luecke. 2018. Understanding the indirect effects of climate change on pristine arctic lakes and char; delayed, multi-trophic level response to a long-term, low-level fertilization experiment. Oral presentation. Annual Meeting of the Western Division of the American Fisheries Society, May 22-25, 2018, Anchorage, AK, USA.

Barrett, N., and **Budy**, P. 2019. A warmer north: How will climatic warming affect the biota & physical regime of arctic lakes? *Invited Department Seminar*: Weber State University, Ogden, Utah, 13 February 2019.

Ahrens, Z., P. **Budy**, G. Thiede and D. Weedop. 2019. Unintended fragmentation: fish community impacts and conservation implications of the Piute Farms Waterfall, San Juan River, UT. Oral presentation: Annual Meeting of the Utah Chapter of the American Fisheries Society, Provo, Utah, 12 – 14 March 2018.

West, R. N. Barrett, G.P. Thiede, and P. **Budy**. 2019. Feeding ecology and diet overlap of coexisting lake trout and arctic grayling in two open and connected arctic lakes. Poster presentation: Annual Meeting of the Utah Chapter of the American Fisheries Society, Provo, Utah, 12 – 14 March 2018.

Kilmer J., N. Barrett, G.P. Thiede, and P. **Budy**. 2019. Estimating the abundance of slimy sculpin in an arctic lake using catch data and mark-recapture methods. Poster presentation: Annual Meeting of the Utah Chapter of the American Fisheries Society, Provo, Utah, 12 – 14 March 2018.

Walsworth, T.E., **Budy**, P., Wheaton, J., Macfarlane, W.W., Shahverdian, S., Thiede, G.P., Keller, D., Goodell, J., and Jimenez, J. 2019. Harnessing process-based restoration to improve in-stream and riparian habitat in the Price River, Utah. Oral presentation: Utah Chapter American Fisheries Society Annual Meeting, Provo, Utah, March 12-14, 2019.

Stout, J.B., Conner, M.M., Yackulic, C., **Budy**, P., Mackinnon, P., and M. Mckinstry. 2019. Gone, but not forgotten: Bias and error, the legacy of ghost tags in aquatic systems.


Photo by Shauna Leavitt

Oral presentation: Annual Meeting of the Utah Chapter of the American Fisheries Society, Provo, Utah, 12-14 March 2018.

Barrett, N., **Budy**, P. 2019. A slimy situation: Effects of temperature and food avilability on slimy sculpin (*Cottus cognatus*). Oral presentation: Annual Meeting of the Utah Chapter of the American Fisheries Society, Provo, Utah, 12-14 March 2019.

EDWARDS

Edwards, T.C., Jr. Assessing decision risk in species range maps and distribution models for use in conservation and management. Invited paper (workshop), Association of Fish & Wildlife Agencies 108th Annual Meeting, Tampa, FL, 9 September 2018.

Stoner, D., and T.C. **Edwards**. Predation-forage trade-offs in anthropogenic landscapes: behavioral response of an obligate carnivore to human activities. Invited paper, 4th North American Congress for Conservation Biology, Toronto, ON, Canada, 25 July 2018.

Edwards, T.C., Jr., and R.D. Fitts. Rare plant community composition and distribution modelling: assessing landscape-scale risk from non-renewable energy development. Presented paper, US-IALE 2018 Annual Meeting, Chicago, IL, April 11, 2018.

D. Stoner, D., D. Dahlgren, J. Sexton, M. Kohl, R. Larson, N. Frey, T. **Edwards**, and T. Messmer. Using satellite-derived estimates of plant phenology to map sage grouse nesting dates across a climatological gradient. Utah Chapter of The Wildlife Society. Vernal, UT, March 22, 2018.

Edwards, T.C., Jr. Using plant community composition as a means of assessing biodiversity risk to climate change. Presented paper, Inter'l Biogeographical Society Mtg, Climate Change Biogeography, Evora, Portugal, March, 2018.

Popular Media

LEAVITT (COOP EXTENSION AND OUTREACH)

RADIO:

April 2, 2019. Utah Public Radio. *Wild About Utah,* "Yellowstone Elk's response to Wolves." https://wildaboututah.org/yellowstone-elks-response-to-wolves/

April 20, 2019. Utah Public Radio. *Wild About Utah, "* Invasive Phragmites." (Rebroadcast March 2019, Originally aired April 2018). https://www.upr.org/post/invasive-phragmites-wild-about-utah

February 2019. Utah Public Radio. *Wild About Utah,*"Finding Wolves in Yellowstone."

January 4, 2019. Utah Public Radio. *Wild About Utah,* "Winter Bird Feeding." https://www.upr.org/post/winter-bird-feeding-wild-about-utah-0

December 7, 2018. Utah Public Radio. *Wild About Utah, "* Enjoying Utah's Backcountry with Snowmobile." https://www.upr.org/post/enjoying-utah-s-backcountry-snowmobiles-wild-about-utah

November 9, 2018. Utah Public Radio. *Wild About Utah,* Western Forest Grouse." https://www.upr.org/post/western-forest-grouse-wild-about-utah

October 1, 2018. Utah Public Radio. *Wild About Utah,* "Aspen Seedlings on the Brian Head Fire Footprint." *https://wildaboututah.org/aspen-seedlings-on-the-brian-head-fire-footprint/*

Septebmer 7, 2018. Utah Public Radio. *Wild About Utah,* "Proposed Beaver Holding Facility in Millville, Utah." https://www.upr.org/post/proposed-beaver-holding-facility-millville-utah-wild-about-utah

August 9, 2018. Utah Public Radio. *Wild About Utah,* "Piute Farms Waterfall on the Lower San Juan Rive – A Triubutary of Lake Powell." https://www.upr.org/post/piute-farms-waterfall-lower-san-juan-tributary-lake-powell-wild-about-utah

July 6, 2018. Utah Public Radio. *Wild About Utah,* "Decreasing Habitat Risks of Utah's Southern Sage-Grouse." https://www.upr.org/post/decreasing-habitat-risks-utah-s-southern-sage-grouse-wild-about-utah

June 8, 2018. Utah Public Radio. *Wild About Utah,* "Monitoring Utah Moose and Their Calves." https://www.upr.org/post/monitoring-utah-moose-and-their-calves-wild-about-utah

April 20, 2018. Utah Public Radio. *Wild About Utah,* "Invasive Phragmites." https://www.upr.org/post/invasive-phragmites-wild-about-utah

March 12, 2018. Utah Public Radio. *Wild About Utah,* "Bonneville Cutthroat Trout in the Right-hand Fork." https://wildaboututah.org/recovery-of-native-bonneville-cutthroat-trout-in-right-hand-fork/

January 26, 2018. Utah Public Radio. *Wild About Utah,* "South Canyon Sage-Grouse." https://www.upr.org/post/south-canyon-sage-grouse-wild-about-utah

INTERNET

March 2019. Coop Catch-up Newsletter, Issue 78, U.S. Geological Survey Coop Fish & Wildlife Research Unit Program. (Editor)

October 2018. Coop Catch-up Newsletter, Issue 77, U.S. Geological Survey Coop Fish & Wildlife Research Units Program (Editor)

May 2018, Coop Catch-up Newsletter, Issue 76, U.S. Geological Survey Coop Fish & Wildlife Research Unit Program. (Editor)

January 2018, Coop Catch-up Newsletter, Issue 75, U.S. Geological Survey Coop Fish & Wildlife Research Unit Program. (Editor)

PRINT:

Recovery of Native Bonneville Cutthroat Trout - *Wildlife Management Institute's Outdoor News Bulletin* (March 2018) https://wildaboututah.org/recovery-of-native-bonneville-cutthroat-trout-in-right-hand-fork/

Wild About Utah Highlights - QCNR Fall 2017 Newsletter

Research Grants (Active)

BUDY

2018 -2020. Understanding the dynamics of beaver reintroduction. Principal Investigators: Phaedra Budy, Julie Young. Bureau of Land Management. Total Award to date $45,000.

2018 – 2020. Watershed restoration initiative lower price river and intream habitat. Principal Investigator: Phaedra Budy. Utah Divisions of Wildlife Resources. Total Award: $132,080.

2019 -2024. Adaptive management and monitoring of Pyramid lake, Nevada. Principal Investigator: Phaedra Budy. US Fish & Wildlife Services. Total Award: $55,000 per year.

2019-2021. Logan River Brown Trout Expansion. Principal Investigator: Phaedra Budy. Utah Divsion of Wildlife Resources. In kind. Master's of Natural Resources (Clint Brunson).

2018-2020. Hydrological & ecol assessment of Henry's Fork River. Principal Investigators: Soren Brothers, Phaedra Budy, and Sarah Null. Henry's Fork Foundation. Total Award: $75,000/year.

2018-2023. Towards a more advanced analytical understanding of the relationship between hydrology and endangered Rio Grande Silvery Minnow persistence and recovery. & 2) Evaluation of Rio Grande Silvery Minnow life history, movement dynamics, and habitat use in the Middle Rio Grande. Prinicipal Investigator: Phaedra Budy. Bureau of Reclamation (DOI). Total Award: $200,000/year.

2016- 2021. Collaborative research: an exploration of the direct and indirect effects of climatic warming on arctic lake ecosystems. Principal Investigators: Budy, P., A. Giblin, B. Crump, S. Null, J. Jin. National Science Foundation: Office of Polar Programs. Total Award: $999,335.

2015- 2018. Assessing the state of river science, water resources management, and water resources planning tools for the Rio Grande / Rio Bravo. Principal Investigators: P. Budy and J. Schmidt. U.S. Geological Survey, Total Award $131,725.

2017-2021. Arctic LTER: Climate change and changing disturbance regimes in arctic landscapes: LAKES.


Photo by Zach Ahrens

Principal Investigator: P. Budy. National Science Foundation (NSF), UDWR, Total Award $192,000.

2015- present. Adaptive management with and installation and development of methods and analyses for PIT-tag technology and data. Principal Investigators: Phaedra Budy and Mary Conner. Bureau of Reclamation (DOI). Total Award $2,352,222.

2017-present. Adaptive and experimental desert river restoration. Principal Investigators: Phaera Budy and Joe Wheaton. Bureau of Land Management & UDWR Watershed Restoration Initative. Total Combined Award: $350,000.

2011-2018. Evaluating cutthroat trout performance and identifying limiting factors for the native fish community of Pyramid Lake and development of an Adaptive Fishery management Plan. Principal Investigator: Phaedra Budy. U.S. Fish & Wildlife Service, Great Basin Cooperative Ecosystem Unit (CESU II). Total Award $394,769.

2016-present. Understanding the role of increasing water quality and groundwater inputs on ecosystem structure, function, and health in Big Bend National Park and Rio Grande Wild and Scenic River. Principal Investigators: Phaedra Budy, J. Brahney, Utah State University. Total Award *to date*: $56,202.

2002-present. Limiting factors affecting trout population dynamics, abundance, and distribution in the Logan River, Utah: population dynamics, disease, and synergistic effects. Principal Investigator: Phaedra Budy. Utah Division of Wildlife Resources, UDWR, Total Award to date: $734,454.

EDWARDS

2017-2020 Developing distribution models for select wildlife species in Utah. Principal Investigator: Thomas C. Edwards Jr. Utah Division of Wildlife Resources, $39,500; U.S. Forest Service, Total Award: $17,500.

2016-2021 Habitat modelling of rare plant species in the Intermountain West. Principal Investigator: Thomas C. Edwards Jr. Bureau of Land Management, Total Award: $98,300

2016-2019 Unifying mathematical and statistical approaches for modeling animal movement and resource selection. Co-Principal Investigator: Thomas C. Edwards Jr. National Science Foundation, Total Award: $180,000

Graduate Students Directed

BUDY

COMPLETED

Klobucar, Stephen. 2018. The abiotic and biotic controls of arctic lake food webs: A multifaceted approach to quantifying trophic structure and function. PhD Dissertation. Ecology. Utah State University.

Blythe, Demi. 2018. Assessing the ecological implications of the altered flow and sediment regimes of the Rio Grande along the West Texas-Mexico border. MS Thesis. Ecology. Utah State University.

Newlon, Courtney. 2018. Identifying cues for movement and temporally-dynamic limiting factors in the bull trout movement corridor. MS Thesis. Ecology. Utah State University.

IN PROGRESS

Barett, Nick. *In progress.* From individuals to ecosystems: Evaluating the effects of warming on arctic lakes. PhD Dissertation. Ecology. Utah State University. *Slated date of completion: 2021.*

Clancy, Naill. *In progress.* Stream food web response to benthic algae blooms in the kootenai river basin. MS Thesis. *Slated date of completion*: Fall 2019. Co-Advised with Dr. J. Brahney.


Photo by Eric Thacker

Stout, Benjamin. *In progress.* Improving our ability to estimate vital rates of endangered fishes on the San Juan River using novel applications of PIT tag technology. MS Thesis. Ecology. Utah State University. *Transferring to a PhD in 2019, adding MRG RGSM movement ecology component.*

Ahrens, Zachery. *In progress.* Ecological effects and fishery conservation implications of a quasi-natural fish barrier on the Lower San Juan River, Utah. MS Thesis. *Slated date of completion:* Fall 2020.

Healy, Brian. *In progress.* Efficacy of conservation strategies for imperiled desert fishes of the Colorado River basin. PhD Dissertation. Ecology. Utah State University. *Slated date of completion: 2022.*

McLaren, Jack. *In progress.* Managing development: evaluating the effect of nutrient enrichment on the Henry's Fork River, Idaho. PhD Dissertation. Ecology. Utah State University. *Slated date of completion: 2022.* Co-Advised with Dr. S. Brothers.

GRADUATE COMMITTEE ADVISEMENT (OTHERS) – CURRENT

Balcom, Thomas. MS Watershed Sciences, 2016-present
Lyster, Samuel. MS Watershed Sciences, 2015-present
Keaton, Jenna. MS Watershed Sciences, 2016-present
Wolf, Marshall. PhD Watershed Sciences, 2018-present
Morrisett, Christina. PhD Watershed Sciences 2018-present
Eddings, James, M.S. Watershed Sciences, 2015-present

MNR GRADUATE COMMITTEE ADVISEMENT – CURRENT

Edwards, Cody. UDWR, Fisheries
Black, Calvin. UDWR, Fisheries
Brunson, Clint. UDWR, Fisheries (*Major Advisor)
Elsen, Seth. Hood Canal Salmon Enhancement Group
Fiorelli, Michael. UDWR, Fisheries

EDWARDS

IN PROGRESS

Kent Hersey. *In progress.* Adaptive modelling of seasonal mule deer movement patterns (tentative topic). Ph.D. Dissertation. Wildlife Biology. Utah State University. *Slated date of completion:* Fall 2021

Ian McGahan. *In progress.* Using point-pattern processes to model animal movement across landscapes of varying resistance. Ph.D. Dissertation. Utah State University. *Slated date of completion:* 2020

One new MS student is being sought for new DWR/FS-funded work on species distribution modelling.

MNR GRADUATE COMMITTEE ADVISEMENT – CURRENT

Coy, Kari. Bio-West, Modelling spread of phragmites using remote sensing techniques.
Washkovia, Lindsey. Nature Conservancy, Rare plant distribution

Post Doctoral Fellows and Research Associates Directed

BUDY

Tim Walworth. 2018–present. Co-advised with Dr. J. Gaeta. Budy portion: Towards a more advanced analytical understanding of the relationship between hydrology and endangered Rio Grande Silvery minnow persistence and recovery & adaptive and experimental restoration of desert tributaries of the Green River.

EDWARDS

Robert Fitts, 1st IALE 2012-2019; 2nd IALE 2018-2020. Rare plants monitoring, State of Utah

Undergraduate Research Projects Advised

BUDY

Hafen, T. 2018. Ecological effects of lake characteristics and arctic char presence on cohabiting native fish assemblage structure and fish size, diet, and growth. Oral presentation at the Utah Chapter of the American Fisheries Society meeting, March 2018. Ogden, UT.

Arnold, T. 2018. Using non-lethal fin ray analysis to determine growth rates of spawning and non-spawning walleye (*Sander vitreus*) in Willard Bay Utah. Oral presentation at the Utah Chapter of the American Fisheries Society meeting, March 2018. Ogden, UT.

Shamo, T. 2018. Examining relationships between barometric pressure and lunar cycle on angler catch rates in the Logan River, Utah. Oral presentation at the Utah Chapter of the American Fisheries Society meeting, March 2018. Ogden, UT.

West, R. 2018. Potential drivers of diet and spatial variation of sculpin in the Logan River, Utah. Poster presentation at the Utah Chapter of the American Fisheries Society meeting, March 2018. Ogden, UT.

Nichols, K. 2018. Evaluating diet overlap between cutthroat trout and brown trout held in experimental enclosures under differing densities: can native trout at higher densities resist nonnative trout impacts. Poster presentation at the Utah Chapter of the American Fisheries Society meeting, March 2018. Ogden, UT.


Photo by Colton Finch


Photo by Shauna Leavitt

Professional & Academic Service

BISSONETTE

PROFESSIONAL SERVICE: REVIEWS

Book Chapters: John Hopkins University Press

Protocol Systematic:
Dror Denneboom and Assaf Shwartz: The effects of structural and spatial attributes of wildlife crossingson their use by wildlife populations: A systematic review and meta-analysis protocol. Technion (Israel), faculty of Architecture and Town Planning, Human & Biodiversity Research Group

Manuscripts: PloS One, Biological Conservation, Movement Ecology, Human Dimensions of Wildlife, Journal of Wildlife Management (2)

PhD Dissertation: Lilian Maria de Souza Almeida. Understanding industry's expectations of engineering communication skills. Department of Engineering, USU which may aid in the management of Utah's Natural Resources.

BUDY

PROFESSIONAL SERVICE

Editor, 2017 – present, Ecology of Freshwater Fish.

National Science Foundation, Research Experience for Undergraduates (REU). 2014-2019. Associated with an NSF project, Actic LTER.
USU, Quinney College of Natural Resources representative. Chemical Hygiene Committee. 2017-present.

USU, Honors Application Review Committee, 2015, 2018, 2019.

EDWARDS

PROFESSIONAL SERVICE

Nation-wide program in application of species distribuion models to management and conservation. In CY201 Tom Edwards implemented a national program in the application of species distribution models (SDM) to conservation and management issues of pressing concern.

General-Secretary
International Association for Landscape Ecology

Councilor at Large
US Regional Association of the International Association for Landscape Ecology


Niall Clancy

Education, Workshops & Training

BUDY

WATS 4950, Spring 2019 (NEW*). Research Communication. In this 'class', students will learn how to: 1) develop a research project, 2) write a defensible proposal, 3) draft an abstract for a professional presentation, 4) apply for (and most receive) funding to attend a professional meeting, 5) analyze their data, 6) graph their data, 7) complete a professional poster or oral presentation, and 8) present their presentation at a professional meeting.

Graduate Fish Ecology (WS 6230/7230). Utah State University, Department of Watershed Sciences. 2002, 2004, and 2006, 2017, 2019.

EDWARDS

baseR, Utah State University, WILD 4580 / 6580 Spring / Fall 2018

baseR, US Fish and Wildlife Service, National Conservation Training Center, Fall 2018
This course provides instruction on the underpinnings of the R computing and statistical environment, as well as how to manage and manipulate data in the R environment. Starting Fall 2018 the course was ported to NCTC and is now available under DOI Talent.

Unit Sponsorship & Hosting

UTAFS Sponsorship: The Utah Cooperative Fish & Wildlife Unit provided a $500 sponsorship to the Utah Chapter of the American Fisheries Society (UTAFS) to help Utah Chapter host successful Annual Meeting. This contribution all helped the Chapter sustain growth and financial viability into the future.

Watershed Scienes Seminar: The Utah Cooperative Fish & Wildlife Unit hosted the Watershed Sciences Department Seminar "Life history diversity and behavioral flexibility as strategies to promote population resiliency," Dr. Annika Walters from the Wyoming Cooperative Fish & Wildlife Research Unit was the guest speaker. February 13, 2019.

UDWR-USU Sciene Seminar Series: The Utah Cooperative Fish & Wildlife Unit hosts an annual seminar series (held monthly during the Fall and Springs semesters). These seminars share ideas with UDWR about regional research.


Photo by Shauna Leavitt


Photo by Tom Edwards

Aquatic Research Projects

Understanding how arctic lakes will respond to a warming climate

The goal of this project is to better understand how increased temperatures will affect arctic lakes. I plan to evaluate these effects across multiple scales of biological organization, from individuals to ecosystems. At the individual scale, I am conducting experiments interested in assessing the independent and interactive effects of food availability and temperature on the performance of an important mid-level consumer in arctic lakes, slimy sculpin (*Cottus Cognatus*). To complement and expand on the results of these experiments, I am also performing bioenergetics simulations to predict the effects of changing temperatures and resource availability on arctic fishes. At the ecosystem scale, I am investigating how warming may affect lake metabolism through changes in the rates and balance of gross primary production and ecosystem respiration. Future work will aim at developing community-level bioenergetics simulations and ecosystem models to further assess the impacts of warming on arctic lake food webs. Ultimately, this research provide us with valuable knowledge and predictive power that will allow for effective management and conservation of freshwater resources within the Arctic under a changing climate.

FUNDING
National Science Foundation
Utah State University Department of Watershed Sciences
Utah State University Ecology Center
U.S. Geological Survey UCFWRU (in-kind)

INVESTIGATORS
Nick Barrett, Ph.D. Candidate

FACULTY SUPPORT
Phaedra Budy, USGS, UTCFWRU, USU-Watershed Sciences, Ecology Center

PROJECT PERIOD
2017 - 2021

FIGURE CAPTION
Graduate student Nick Barrett holding an arctic char (*Salvelinus alpinus*) caught in a study lake during an ice-fishing sampling period on the North Slope of the Brooks Range, AK

Improving our ability to estimate vital rates of endangered fishes on the San Juan River using novel applications of PIT tag technology

Accurate estimates of vital rates are essential for tracking and understanding the successful recovery of endangered species such as the razorback sucker and the Colorado pikeminnow. Mobile Passive Integrated Transponder (PIT) tag antenna systems (e.g., on a floating raft) have recently been developed to increase resight rates; however, mobile systems present new challenges. Tags, not fish, are detected thus increasing the chance that shed tags or dead fish with tags are being detected. Thus, classification of tags as live or dead is essential. Our goal for this study was to examine the bias in survival rate estimation when classification is not possible and test a false positive model's ability to deal with non-classified PIT tag detections. We used simulation data to examine the differences between a biased CJS mark-recapture model (using unclassified tags) and a false positive model (accounted for possibility of detecting dead tags). Despite a very low coefficient of variation, the relative bias of the biased CJS model was extremely high. The false positive model had low relative bias, but higher coefficients of variation. With this method, we can incorporate all sources of data to improve vital rate estimation, which could help identify influential management actions, and potentially improve our ability to conserve and recover endangered and threatened fish.

FUNDING
U.S. Bureau of Reclamation
U.S. Geological Survey UCFWRU (in-kind)

INVESTIGATOR
Ben Stout, M.S. Candidate

FACULTY SUPPORT
Phaedra Budy, USGS, UTCFWRU, USU Watershed Sciences, Ecology Center
Mary Conner, USU, Wildland Resources, Ecology Center

PROJECT PERIOD
2015 - 2019

FIGURE CAPTION
Ben Stout setting up raft based mobile PIT tag detection system on the San Juan River, UT.

Efficacy of conservation strategies for imperiled desert fishes of the Colorado River basin across multiple scales

Novel habitats of the Colorado River in the post-dam era favor invasive fishes that evolved in stable and predictable environments, leading to imperilment of many native fishes. Endangered fish recovery actions have been underway, yet responses have been equivocal; environmental variability has sometimes confounded the interpretation of outcomes. Assessments of responses in demographic rates, while accounting for environmental variation, can improve understanding of native fish ecology, while informing managers of the efficacy of conservation actions. Objectives of our research include 1) quantifying the effects of invasive fish suppression and environmental variability on the demographic rates of native and invasive fishes; 2) understanding factors contributing to the establishment of self-sustaining humpback chub (*Gila cypha*) populations; 3) developing a population model for invasive brown trout *(Salmo trutta*) to evaluate management scenarios meant to minimize effects of predation and competition and augment native fish populations; and 4) investigating range-wide survival of razorback sucker (*Xyrauchen texanus*). By understanding drivers of vital rates of imperiled native fishes, from individual tributary to basin-wide scales, we will provide valuable insights into population ecology, and assist fisheries managers in designing effective conservation strategies.

FUNDING
U.S. Bureau of Reclamation; U.S. National Park Service, Grand Canyon National Park; USU's Center for Colorado River Studies, Dept of Watershed Sciences; Grand Canyon Conservancy; U. S. Geological Survey UCFWRU (in kind); NPS's Albright-Wirth Grant Program.

INVESTIGATORS
Brian Healy, Ph.D. candidate

FACULTY SUPPORT
Phaedra Budy, USGS UTCFWRU, USU Watershed Sciences, Ecology Center

PROJECT PERIOD
2018 - 2021

FIGURE CAPTION
Ph.D. student Brian Healy holding an invasive brown trout removed from Bright Angel Creek, a tributary to the Colorado River in Grand Canyon.

Adaptive management plan for Lahontan cutthroat trout in Pyramid Lake, Nevada

Pyramid Lake, Nevada is one of the last remaining strongholds for lacustrine Lahontan cutthroat trout (LCT); almost all other large lake populations have undergone population declines or extirpation as a result of habitat degradation, over-harvest, and water diversions, all compounded by the stocking of non-native species. In 2015, we completed a comprehensive research project driven by critical uncertainties surrounding the performance of the fishery and stocked LCT across space and time, the role of exotic Sacramento perch the potential for native forage fish recovery, and the link between fish performance and lake productivity and carrying capacity. The main goals for the management of Pyramid Lake are to maintain a healthy fishery of LCT, manage for a wild population of LCT, ultimately to meet conservations goals, and lastly, to detect any significant changes in the ecosystem. Managers sought recommendations and guidance on: level of creel, mark-recapture effectiveness, tagging rate, and annual sampling by collaborators (Utah State University, Pyramid Lake Fisheries (the Tribe), and the US Fish and Wildlife Service). We provided recommendations meant to be adaptive, such that they should be modified if monitoring data indicates a state change.

FUNDING
U.S. Fish and Wildlife Service, Lahontan National Fish Hatchery Complex
U.S. Geological Survey, UCFWRU (in kind)

INVESTIGATORS
Gary Thiede, Research Associate
Nick Heredia, Ph.D. Candidate
Bryan Maloney, Master's completed
Brian Laub, Researcher

FACULTY SUPPORT
Phaedra Budy, USGS, UTCFWRU, USU Watershed Sciences, Ecology Center
Jereme Gaeta, USU Watershed Sciences

PROJECT PERIOD
2012 - present

FIGURE CAPTION
Gary Thiede collecting larval tui chub with a larval-fish tow net in Pyramid Lake, Nevada

Stream food web response to the benthic algae *didymosphenia geminata* in an inland temperate rainforest

The response of species to environmental change is studied for its import to both conservation science and ecological theory. In the Kootenai River basin of Montana, nuisance blooms of *Didymosphenia geminata* (Didymo) alter the benthic habitat of stream-dwelling macroinvertebrates leading to concerns about food availability to vulnerable Redband Trout (*Oncorhynchus mykiss gairdneri*) populations. The goal of this study was to determine if Didymo blooms influence the production of secondary consumers and examine underlying trophic mechanisms. Two study streams with similar physical habitats were selected, one with Didymo blooms and one without. Trout were captured bi-monthly, weighed, measured, and lavaged for diet contents. We constructed energy-flow food webs using mark-recapture population estimates, measured trout growth, and diet samples in both streams. During the summer of 2018, Redband Trout production was more than three times higher in the stream with Didymo compared to the reference. Food web analysis revealed that this stark contrast is likely attributable to differing sources and magnitudes of macroinvertebrate energy flow to trout.

FUNDING
Utah State University, Dept. of Watershed Sciences & Ecology Center
British Columbia Ministry of the Environment, BC Parks
U.S. Geological Survey UCFWRU (in-kind)
Montana Fish, Wildlife & Parks (in-kind)

INVESTIGATORS
Niall Clancy, M.S. Candidate

FACULTY SUPPORT
Phaedra Budy, USGS UTCFWRU, USU Watershed Sciences, Ecology Center
Janice Brahney, USU Watershed Sciences

PROJECT PERIOD
2018- 2019

FIGURE CAPTION
Graduate student Niall Clancy and technician Jon McFarland electroshocking a Montana stream.

Comparing Comparing resident and translocated beaver ecology at stream restoration sites

Translocation of nuisance American beavers (*Castor canadensis*) serves as both a method to mitigate human-wildlife conflict and a riparian restoration technique. Beavers are a keystone species and ecosystem engineer; they are especially important to arid western ecosystems. However, success of beaver translocation is variable and lacks documented outcomes. The goal of this study is to determine if translocated beavers serve as ecological equivalents to naturally occurring beavers, to improve strategies for beaver-assisted stream restoration. I will compare the vital rates, space use, and behavior of resident and translocated beavers. Nuisance beavers will be translocated to the San Rafael and Price Rivers in Eastern Utah this summer as part of a larger project aimed at stream and imperiled fish restoration. All captured beavers (nuisance and resident) will be PIT-tagged and a subset will be fitted with GPS or VHF tail-mounted transmitters and monitored post-release. Understanding the potential differences in ecology could affect the success of a restoration project. This project will fill knowledge gaps in research assessing the efficacy of beaver-assisted restoration and help to understand the complexities of wildlife translocation.

FUNDING
U.S. Bureau of Land Management
Utah Division of Wildlife Resources
USDA-National Wildlife Research Center (NWRC)
U.S. Geological Survey UTCFWRU (in-kind)
U.S. Bureau of Reclamation
The Wildlife Society – Utah State Chapter

INVESTIGATORS
Emma Doden, M.S. Candidate

FACULTY SUPPORT
Julie Young, USDA-NWRC, USU Wildland Resources, Ecology Center
Phaedra Budy, USGS UTCFWRU, USU Watershed Sciences, Ecology Center

PROJECT PERIOD
2019 - 2021

FIGURE CAPTION
Graduate student Emma helping a restoration project in Idaho build a beaver dam analog at a potential beaver translocation release site.

Assessing the impact of nutrient enrichment in the henry's fork headwaters

Western U.S. rivers are experiencing changes in nutrient flux from urban development and changes to migratory fish populations, which could influence productivity of ecologically, economically, and culturally important trout populations. The Henry's Fork of the Snake River in east Idaho is experiencing rapid development, requiring new avenues of wastewater disposal and changes in the management of stocked migratory salmon, which may result in changing nutrient flux. We seek to understand how the ecology of the Henry's Fork will respond to anthropogenically-driven nutrient flux change, including 1) understanding the effect of nutrients on primary productivity and whole-stream metabolism 2) linking changes in primary productivity to changes in stream ecosystem structure and food webs, focusing on trout growth and habitat, and 3) developing a nutrient budget for the Henry's Fork under various climate and development scenarios. Our results will assist local resource managers in mitigating human development for the benefit of the Henry's Fork ecosystem and the trout that call it home, and will advance the field of stream and fish ecology by examining how nutrients can affect stream ecosystems.

FUNDING
Henry's Fork Foundation www.henrysfork.org
U.S. Geological Survey UCFWRU (in-kind)
Idaho Department of Fish and Game (in-kind)
Idaho Department of Environmental Quality (in-kind)

INVESTIGATORS
John S. McLaren, Ph.D. candidate

FACULTY SUPPORT
Phaedra Budy, USGS UTCFWRU, USU Watershed Sciences, Ecology Center
Soren Brothers, USU Watershed Sciences

PROJECT PERIOD
2018 - 2022

FIGURE CAPTION
The Henry's Fork Headwaters 50 yards downstream of Big Springs near Island Park, Idaho, looking downstream.

Remarkably rapid recovery of native cutthroat trout following removal of dominant non-native brown trout: evidence of resilience and conservation potential

While the importance of reducing the impacts of non-native species is increasingly recognized in conservation, the plausibility of such actions is highly dependent upon the stage of invasion and the size of the ecosystem being restored. Here, we present the results of a multi-year, invasive brown trout removal and native cutthroat trout recovery in a small tributary in the Intermountain West, USA. In the tributary, we monitored trout populations for 9 years prior to the onset of eradication efforts, which included two years of mechanical removal followed by two years of rotenone treatment. Cutthroat trout populations were then seeded with low numbers of both eggs and juvenile trout. We estimated population growth rates and carrying capacities for both populations from long-term depletion estimate data, assuming logistic growth. Following brown trout eradication with subsequent chemical treatments and initial seeding efforts, cutthroat trout populations have demonstrated exponential growth. Within five years of stocking, cutthroat trout populations have approached the estimated carrying capacity previously demonstrated by brown trout. Population projections suggest that cutthroat trout are between 70 and 80% of their estimated carrying capacity and are likely to be at 90% of their carrying capacity in approximately 10 years. These results demonstrate native trout species have substantial resilience and can rapidly recover following the removal of invasive species in otherwise minimally altered habitats.

FUNDING
U.S. Forest Service; Utah Division of Wildlife Resources
Trout Unlimited; U.S. Geological Survey, UCFWRU (in kind)

INVESTIGATORS
Timothy Walsworth, Post-doctoral Research Associate
Gary Thiede, Research Associate
W. Carl Saunders, Adjunct Assistant Professor

FACULTY SUPPORT
Phaedra Budy, USGS, UTCFWRU, USU Watershed Sciences, Ecology Center

PROJECT PERIOD
2001 - present

FIGURE CAPTION
Native Bonneville cutthroat trout in a restored tributary stream, Right Hand Fork of the Logan River, Utah

Harnessing process-based restoration to improve in-stream and riparian habitat in the Price River, Utah

Many restoration projects rely on engineering solutions to the local symptoms of larger scale drivers of degradation, ignoring the underlying natural processes which create and maintain the habitats they seek to restore. Additionally, pre-and especially post-restoration monitoring efforts are frequently insufficient to determine whether and across what time-frames restoration actions were successful. The effectiveness of treating the symptoms of degradation is particularly dubious in desert river systems, which are extremely dynamic naturally and have experienced dramatic alterations to their hydrological regime. We have recently begun implementation of a process-based restoration project in the Price River, UT, which has experienced extensive habitat and hydrologic degradation in the past century, yet still supports remnant populations of several native fish species of conservation concern. Our project aims to (1) maintain and restore stream longitudinal connectivity, (2) provide sufficient habitat to ensure persistence of native fish and vegetation, (3) recover and sustain natural habitat forming processes, (4) provide sufficient flow to prevent dewatering and recover natural channel movement, and (5) conduct sufficient monitoring of restoration impacts to quantitatively assess restoration effectiveness. Ultimately, we aim to scale up these restoration efforts to provide not only real, lasting benefits to the native in-stream and riparian biota, but also to provide useful information for restoration practitioners working in other systems, information which will only be available with appropriate monitoring and treatment comparisons.

FUNDING
U.S. Bureau of Land Management; Utah Division of Wildlife;
U.S. Geological Survey UTCFWRU (in-kind)

INVESTIGATORS
Timothy Walsworth, Post-doctoral Research Associate; Willam Macfarlane, Research Associate; Scott Shahverdian, Researcher
Emma Doden, M.S. Candidate; Julie Young, Associate Professor

FACULTY SUPPORT
Phaedra Budy, USGS UTCFWRU, USU Watershed Sciences, Ecology Center; Joseph Wheaton, USU Watershed Sciences

PROJECT PERIOD
June 2018 - Present

FIGURE CAPTION
Graduate student Ben Stout and research scientist Gary Thiede tag native flannelmouth sucker in the Price River during a pre-restoration monitoring survey.

Exploring relationships between hydrologic conditions and endangered Rio Grande silvery minnow population dynamics

Arid-land rivers have been highly altered over the past century, as human land and water development has redistributed the timing and magnitude of the natural hydrograph. Hydrologic alterations such as dams, diversions and levees have altered desert rivers from the conditions to which the native fish species have adapted, resulting in widespread species declines, extirpations, and listings under the Endangered Species Act. In this project, we are investigating the impact of different annual hydrologic conditions on the productivity and survival of the Rio Grande silvery minnow, an endemic fish of the Rio Grande. The Middle Rio Grande is a highly developed watershed, with large water withdrawals and diversions for agricultural and municipal purposes. As such, the spring flooding conditions to which the silvery minnow is evolutionarily adapted do not occur in all years, and summer water withdrawals often lead many sections of the river channel to dry completely. These changes have led to dramatic range reductions and declines in abundance of the endangered Rio Grande silvery minnow. Our objectives are to use quantitative modeling approaches to explore the relationships between different components of the annual hydrograph and Rio Grande silvery minnow populations. Ultimately, these analyses could inform an adaptive management approach by being used to explore the expected silvery minnow population responses to alternative water management strategies in the Middle Rio Grande.

FUNDING
U.S. Bureau of Reclamation
U.S. Geological Survey UTCFWRU (in-kind)

INVESTIGATORS
Timothy Walsworth, Post-doctoral Research Associate

FACULTY SUPPORT
Phaedra Budy, USGS UTCFWRU, USU Watershed Sciences, Ecology Center

PROJECT PERIOD
June 2018 - Present

FIGURE CAPTION
Extensive summertime drying of the Middle Rio Grande in summer 2018.

Ecological effects and fishery conservation implications of a quasi-natural fish barrier on the Lower San Juan River, Utah

Impacts of stream fragmentation and non-native species introductions shape the structure and function of freshwater ecosystems and contribute to the decline of stream fish biodiversity. On the San Juan River, Utah, a novel waterfall poses a likely barrier to upstream movement, both for ESA-listed migratory fish Colorado Pikeminnow and Razorback Sucker and potentially invasive predatory sportfish from a downstream impoundment (Lake Powell). Given the likely permanence of this novel feature and its potential to influence imperiled species, our goal is to weigh its relative costs (impeding native fish migration) versus benefits (spatially limiting detrimental species interactions) to native fish conservation. In 2018 we collected fish, their diets and stable isotope samples along a river continuum spanning the waterfall to test whether metrics of fish community composition, structure and species interactions differ between reaches above and below the feature. In the coming year, we will integrate these data into a population viability model for Razorback Sucker with simulated barrier management scenarios (e.g., full or selective fish passage). Predicting positive or negative effects of this barrier on native fish populations will inform management decisions regarding the waterfall (i.e., should fish passage be considered, and if so, what type?) as well as other future endangered fish recovery efforts.

FUNDING
U.S. Bureau of Reclamation
Utah Division of Wildlife Resources

INVESTIGATORS
Zach Ahrens, M.S. Candidate and UDWR Biologist

FACULTY SUPPORT
Phaedra Budy, USGS, UTCFWRU, USU-Watershed Sciences, Ecology Center

PROJECT PERIOD
2018 - 2019

FIGURE CAPTION
Zach Ahrens and field technicians holding native fishes captured below the waterfall on the San Juan River, UT.

Terrestrial Research Projects

Photo by Tom Edwards

Habitat modeling of rare plant species in the intermountain west

This project increases knowledge on rare plants in the Intermountain West by continuing to (i) Implement sampling, data organization, and modelling protocols developed previously, with an expansion outside of the extent of the Colorado Plateau; (ii) Expand modelling efforts to now include abundance estimates, and species-specific occupancy estimates, where data density is sufficient; and (iii) Begin development of a more encompassing data structure amenable to BLM REA Data Portal. The Utah Natural Heritage Program will continue to provide detailed GPS based locations of sensitive species, along with abundance measures of individual plants at sample locations. This information will update older reports of the species using hand drawn maps of plant clusters and rough estimates of numbers of individuals. The information gathered at negative (i.e., true absence) points will be used to better define the habitat of the sensitive species, and help in future surveys for rare plants. Collection of these data is part of a longer-term strategy to survey these species and obtain sufficient data for spatial modelling efforts.

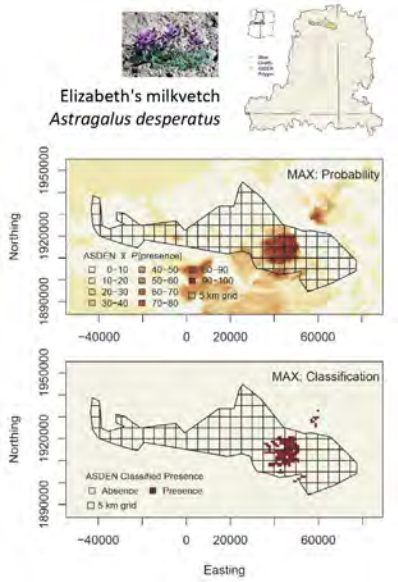
FUNDING:
Bureau of Land Management

INVESTIGATORS
Robert Fitts, Research Associate
Mindy Wheeler, Research Associate
Benjamin Gibbons, Undergraduate Researcher
Kristian Valles, Undergraduate Researcher

FACULTY:
Thomas Edwards, USGS UTCFWRU, USU Wildland Resources

PROJECT PERIOD:
2012–2018

FIGURE CAPTION: Spatially explicit prediction model for Elizabeth's milkvetch..



Utah threatened and endangered plant inventory: modelling rare plant species distributions in the context of multiple-use land management

Utah is the home of approximately 340 endemic plant taxa. Many of these are considered species of concern at both State and Federal levels, with the U.S. Fish and Wildlife Service having responsibility for reviewing the species of concern for possible listing under the Endangered Species Act. Of special interest are identifying, mapping, and modelling known and possible locations of the species on public lands. The botany element of the Utah Natural Heritage Program, now housed in the Quinney College of Natural Resources, Utah State University, will survey for plants considered for review by the Fish and Wildlife Service, along with other species where little information is available. Species distribution models will be built for each species and analyzed in the context of ongoing management issues on public lands, especially energy development.

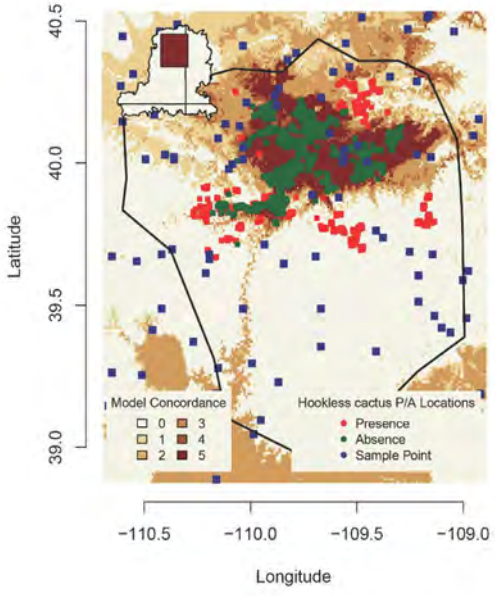
FUNDING:
Bureau of Land Management
Utah Department of Natural Resources

INVESTIGATORS
Robert Fitts, Research Associate
Mindy Wheeler, Research Associate
Benjamin Gibbons, Undergraduate Technician
Kristian Valles, Undergraduate Technician

FACULTY SUPPORT
Thomas Edwards, USGS UTCFWRU, USU Wildland Resources

PROJECT PERIOD
2012 – 2018

FIGURE CAPTION: Predicted distribution of the hookless cactus (darker brown, higher presence likelihood) in relation to known presence (green) and absence (red). Blue are random field sample test locations.



Linking mule deer survival to nutritional condition and habitat use in Utah

Understanding and managing mechanisms that affect population dynamics compose perhaps the most fundamental aspects of wildlife management. To better understand the underlying factors influencing mule deer populations in Utah, in 2014 the Utah Division of Wildlife Resources (UDWR) began monitoring mule deer survival using GPS collars and collecting data on nutritional condition, habitat use, and cause-specific mortality on seven management units across the state. These data will be analyzed to 1) determine the relationship between December and March body condition and overwinter survival of adult female mule deer across the climatic gradient in Utah, 2) examine the relationship between cause-specific mortality and December body condition, and 3) assess how mule deer use of habitat treatment areas influences overwinter body condition decline and survival. Preliminary results suggest a strong influence of December nutritional condition on survival with animals entering winter in lesser condition having a higher probability of dying due to malnutrition or coyote predation. Data also suggest weather events such as drought and severs winters negatively impact nutritional condition, but nutritional condition can be improved by increasing habitat quality.

FUNDING
Utah Division of Wildlife Resources
Mule Deer Foundation
Safari Club International
Sportsmen for Fish and Wildlife
Utah Archery Association
U. S. Geological Survey, UTCFWRU (in-kind)

INVESTIGATORS
Kent Hersey, UDWR and PhD Candidate

FACULTY SUPPORT
Thomas Edwards, USGS, UTCFWRU, USU WILD

PROJECT PERIOD
2017–2021

FIGURE CAPTION
Graduate Student Kent Hersey releases a GPS-collared mule deer on the Wasatch Management Unit, UT.

learnR: data management, manipulation, and analysis of ecological data using R

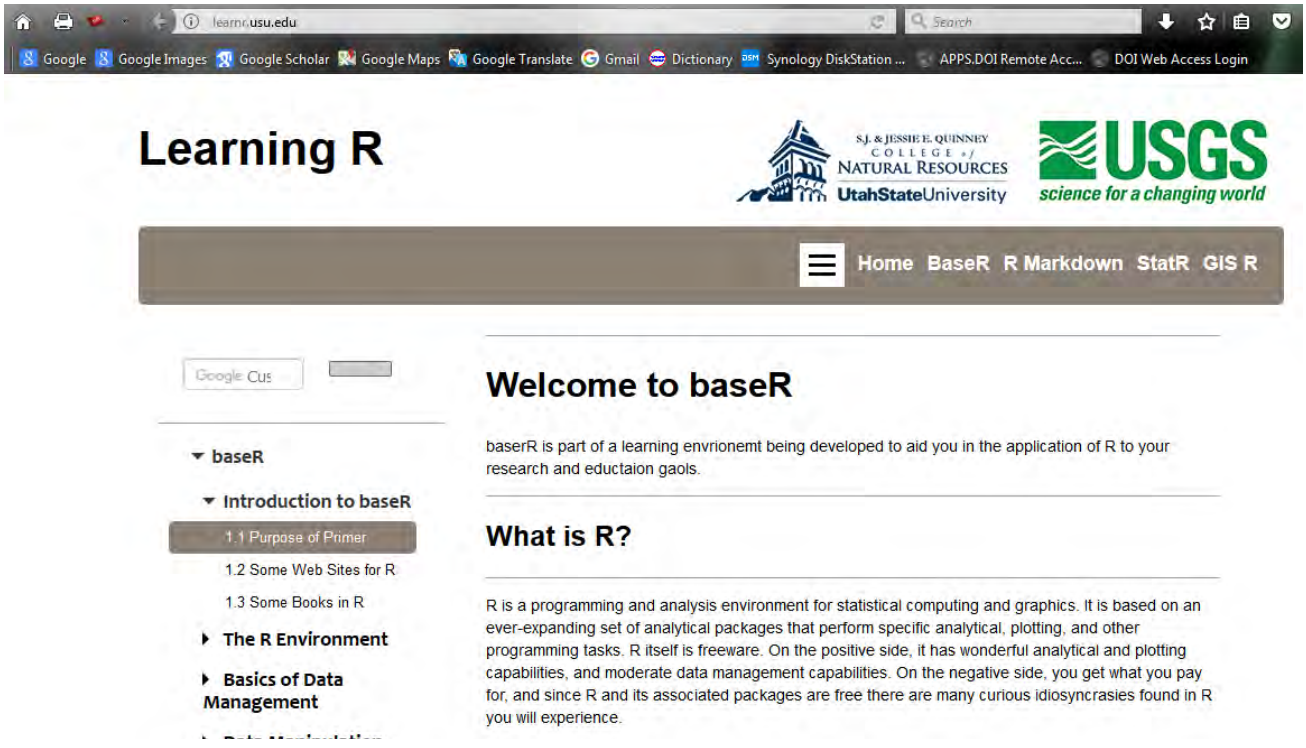
The nature of analytical tools employed by University, Federal, State, Tribal and NGO researchers and scientists for analyzing ecological data has changed dramatically from commercial packages (e.g., SAS, SYSTAT) to an open source ("freeware") environment. Central to this new approach towards analysis of ecological data is R. As a self-described statistical computing package, R rests on a core set of analytical base "packages" augmented by an extensive library of contributed analytical packages. While end-users can learn R by themselves through trial and error, experience indicates some level of base training is required to jump-start end-users. Much of this training can occur in traditional classroom settings, but the nature of R makes it amenable to distance delivery methods. This proposal will generate a set of courses in R amenable for online delivery, including through DOI Learn.

FUNDING
U.S. Geological Survey, Office of Employee Development

FACULTY SUPPORT
Thomas Edwards, USGS UTCFWRU, USU Wildland Resources

PROJECT PERIOD
2016 – 2018

FIGURE CAPTION
FIGURE LEGEND: Web interface to learnR.



Sponsored Events

04/03/2019

USGS, Utah Cooperative Fish and Wildlife Research Unit
Attn: Phaedra Budy
5290 Old Main Hill
Utah State University
Logan, UT 84322-5290

Dear Phaedra,

On behalf of the Utah Chapter of the American Fisheries Society (UTAFS), please accept our sincere appreciation for your generous sponsorship. Not only did your sponsorship help our Chapter host another successful Annual Meeting on March 12th-14th, 2019 in Provo, but your financial contribution will also help us sustain growth and financial viability into the future.

Your continued support helps us maintain our mission of promoting conservation and responsible utilization of aquatic resources throughout the state of Utah. It also helps further our goals to improve the conservation and sustainability of fishery resources and aquatic ecosystems by advancing the science and promoting the development of fisheries professionals.

As we continue to grow as a chapter, please know that partnerships with our sponsors are vital to our success. You are truly appreciated. Thanks again.

Sincerely,

Benjamin R. Brown

Benjamin Brown
Past President
Utah Chapter of the American Fisheries Society
801 536 4363; utafspp@gmail.com

UDWR-USU Science Seminar Luncheon Series

Fall 2018 - Spring 2019

Kezia Manlove, Assistant Professor
Department of Wildland Resources, USU

Date: Tuesday, October 9th, 2018
Time: 12:00—1:00 p.m. (Light lunch will be served)
Place: DNR Room 2000, DWR SLC Main Offices

Bighorn Sheep Pneumonia: Understanding and Managing a Disease Threat in the Wild

Bighorn sheep have suffered major declines throughout their range over the last 150 years. The foremost cause of these declines, infectious pneumonia, remains an insidious problem for sportsmen, conservationists, and management agencies alike. Dr. Manlove will review current knowledge about bighorn sheep pneumonia, emphasizing work she and her collaborators have conducted across five states, discuss current questions of high priority, and consider potential pathways forward toward managing this disease in the wild.

Clark Rushing, Assistant Professor
Department of Wildland Resources, USU

Date: Tuesday, December 4, 2018
Time: 12:00—1:00 p.m. (Light lunch will be served)
Place: DNR Room 2000, DWR SLC Main Offices

Estimating the effects of habitat loss and climate change on migratory birds across their annual cycle

Every year, billions of birds migrate between their temperate breeding grounds and tropical wintering grounds in one of the most extraordinary phenomena in the animal kingdom. Although migratory birds are exquisitely adapted to a life on the move, completing these daunting journeys requires high-quality habitat at each stage of their annual cycle, including breeding, migration/stopover, and wintering. Migratory birds therefore live life on the edge - climate or habitat disruptions at any stage of their annual cycle can have devastating effects on population viability. In this talk, I will discuss my research to quantify and predict the impacts of habitat loss and climate change occurring across the annual cycle on the population dynamics of migratory birds.

Tal Avgar, Assistant Professor
Department of Wildland Resources, USU

Date: Thursday, January 17, 2019
Time: 12:00—1:00 p.m. (Light lunch will be served)
Place: DNR Room 2000, DWR SLC Main Offices

Using Movement-Ecology Research to Advance Wildlife Management and Conservation

This seminar will introduce Dr. Tal Avgar's research program and how it may contribute to advancing wildlife management and conservation in Utah. To illustrate, Tal will focus on his recent work on integrated Step-Selection Analysis and its application to the study of the impacts of anthropogenic linear features on various wildlife species. He'll discuss knowledge gaps and inferential weaknesses in the field of wildlife movement ecology, and how might those be bridged.

Tom Edwards, Professor
Department of Wildland Resources, USU

Date: Thursday, February 14, 2019
Time: 12:00—1:00 p.m. (Light lunch will be served)
Place: DNR Room 2000, DWR SLC Main Offices

Assessing Decision-Risk in Species Range Maps and Distribution Models for Use in Conservation Management

All spatially-based (landscape-scale) management relies to some extent on knowledge of species distributions. At the level of the Endangered Species Act, distributions are clearly integral to ESA-related Federal Register documentation. Defensible distributions are equally integral to state-based Wildlife Action Plans, as well as being important to land management agencies such as the DWR, BLM, NPS, and USFS. This seminar will address questions you may have about this topic.

Sarah Klain, Assistant Professor
Dept. of Environment & Society, USU

Date: Thursday, April 18, 2019
Time: 12:00—1:00 p.m. (Light lunch will be served)
Place: DNR Room 2000, DWR SLC Main Offices

Catalyzing Ecologically Regenerative Renewable Energy

How can transitioning to clean energy, which is among humanity's most urgent challenges, be done in ways that address climate change and support biodiversity? Mitigating climate change requires scaling up wind and solar farms. These farms can negatively impact wildlife, and they have larger footprints per unit of energy generated than most conventional ways of producing electricity. Land-based wind has grown rapidly while solar photovoltaic (PV) farms are on the brink of large-scale deployment. Instead of minimizing ecological harm, how can the wind and solar industries be ecologically beneficial? This talk will identify how conservation social science can contribute to solutions involving renewable energy infrastructure and wildlife.

Contributed by Zach Ahrens

Thank you for your ongoing support for research and education.

Notes