
2012 ANNUAL REPORT
US Geological Survey Biological Resources Division
Utah Cooperative Fish and Wildlife Research Unit
Quinney College of Natural Resources
Utah State University, Logan UT 84322-5290



(Left) Bryce Roholt and Konrad Hafen pull gill nets full of Utah chub out of Scofield Reservoir. The reservoir is experiencing a population explosion of Utah chub, with Bear Lake cutthroat trout and tiger trout being stocked as potential biological control agents. (Right). Lisa Winters and Michael Yarnell process Bear Lake cutthroat trout, rainbow trout, tiger trout, and Utah chub caught in gill nets at Scofield Reservoir.

Presented at the:
2013 Coordinating Meeting
QCNR Utah State University
Logan, UT
3 April 2013



COOPERATORS:
USGS Cooperative Research Units Program
Utah Division of Wildlife Resources
QCNR Utah State University
Wildlife Management Institute
U.S. Fish & Wildlife Service

Mission Statement
Utah Cooperative Fish and Wildlife Research Unit
2012

The major limiting influences upon 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 through 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 Design and Analysis of Ecological Research (WILD 6500, emphasizes the research process), Graduate Fish Ecology (WATS 6230), and Fish Diversity and Conservation. Unit personnel have also developed and provide 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 at QCNR to a wide range of agency cooperators as well.

Cooperating faculty in the Quinney College of Natural Resources (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.

PERSONNEL
COOPERATORS – COORDINATING COMMITTEE

UNITED STATES GEOLOGICAL SURVEY

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UTAH STATE UNIVERSITY

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UTAH COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT

LEADERS

Phaedra E. Budy
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Thomas C. Edwards, Jr.
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STAFF

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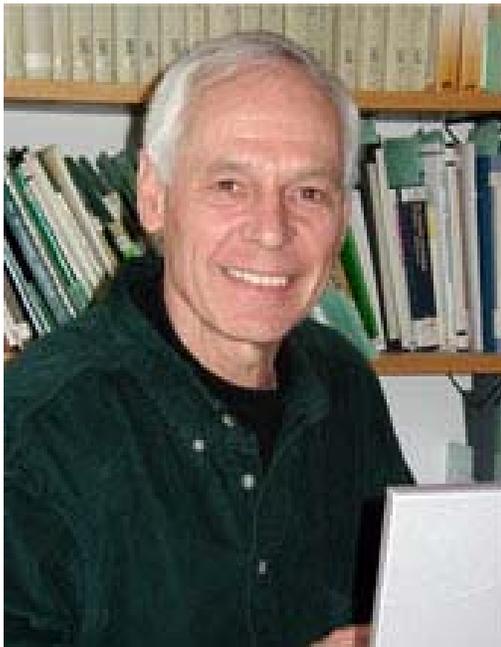
Coop Scientists & Staff



Phaedra Budy
Aquatic Research Ecologist
Unit Leader



Thomas Edwards
Landscape Research Ecologist
Assistant Unit Leader



John Bissonette
Landscape Research Ecologist
Emeritus Unit Leader



Shauna Leavitt
Business Assistant

UDWR University Liaison



Frank Howe
UDWR Research Liaison
USU Adjunct Associate
Professor of
Wildland Resources

Post Doc Fellows & Grad Students



Tracy Bowerman
Fisheries Biology
Ph.D. Candidate



Adam Brewerton
Avian Ecology
Master's Candidate



Kimberly Dibble
Research Biologist
Post Doctoral Fellow

Post Doc Fellows & Grad Students



Jacob Gibson
Landscape Ecology
Master's Candidate



Nick Heredia
Aquatic Ecology
Master's Candidate



Stephen Klobucar
Aquatic Ecology
Master's Candidate



Brian Laub
Aquatic Scientist
Post Doctoral Fellow

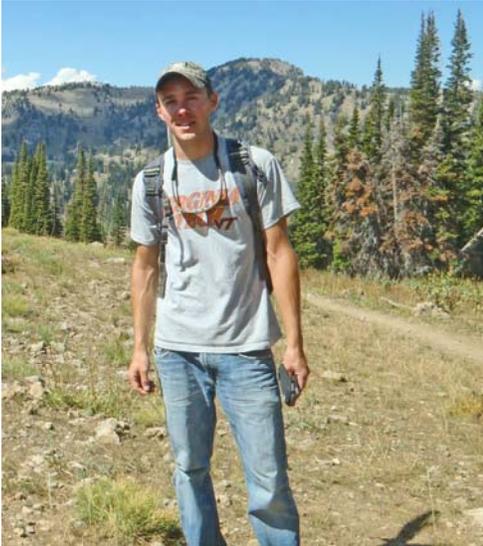


Peter MacKinnon
Aquatic Ecology
Post Graduate Researcher



Christy Meredith
Aquatic Ecology
Ph.D. Candidate

Post Doc Fellows & Grad Students



Harrison Mohn
Fisheries Biology
Master's Candidate



Courtney Newlon
Aquatic Ecology
Master's Candidate



Daniel Olson
Wildlife Biology
Ph.D. Candidate



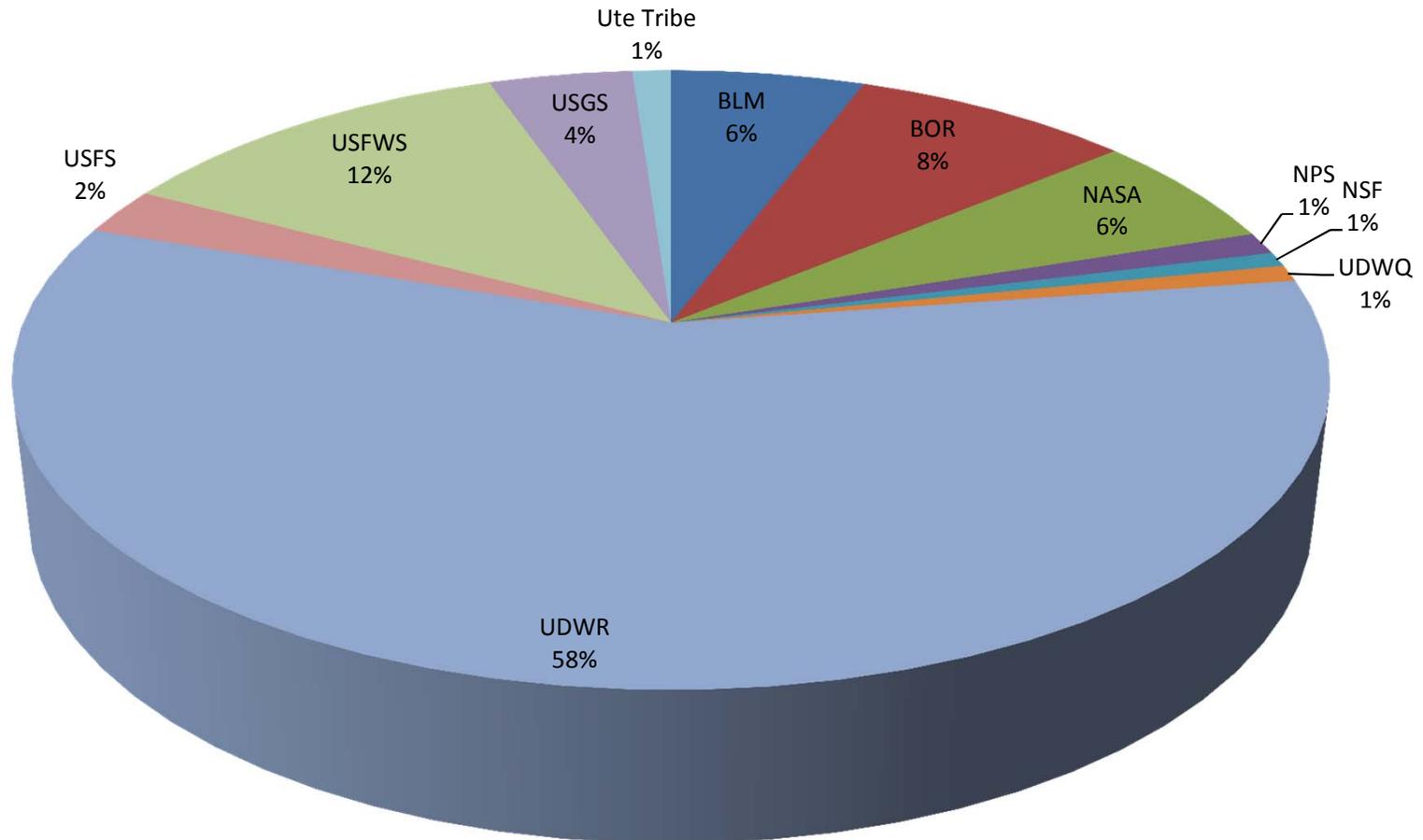
Carl Saunders
Aquatic Ecology
Post Doctoral Fellow



Lisa Winters
Watershed Science
Master's Candidate

Financial Summaries for 2012

2012 Research Contracts & Grants Funding Summary by Source

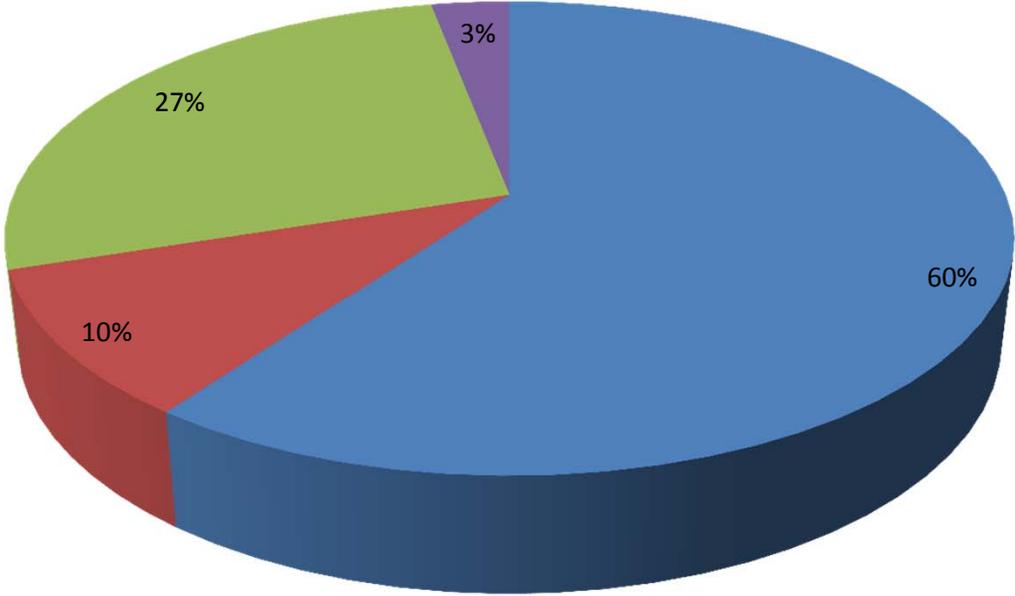


**UTAH COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT
FUNDING SUMMARY BY SOURCE
FISCAL YEAR 2012**

	<i>Agency Contributions</i>	
1. Cooperator Base Funds:		
a. U. S. Geological Survey - Cooperative Research Units		
Federal Salaries & Benefits	477,267	
Operating	10,350	
Subtotal		487,617
b. Utah Division of Wildlife Resources Base		
Base Account	46,000	
10% Direct Administrative Costs paid on UDWR Projects	120,697	
Subtotal		166,697
c. Utah State University Contribution		
Staff Support Salary & Benefits	40,197	
Space	32,031	
Indirect Costs Waived on 2012 Projects	708,207	
Subtotal		780,435
2. Indirect Costs Paid on Non-UDWR 2012 Projects		104,470
3. Total 2012 Research Funding Invoiced (Includes IDC Paid + 10% UDWR-DAC)		2,112,810
**IDC and 10% UDWR-DAC (shaded) are listed individually and also included in #3. This figure prevents double entries.		(225,167)
4. TOTAL 2012 Funding Received		3,426,862
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UDWR 10% Administrative Fees January 2013 Allocation

■ Salaries ■ Wages ■ Benefits ■ Office Supplies/Misc.



UTAH COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT
UDWR Operating Base
Expenditures

	Calendar Year 2009	Fiscal Year 2010	Calendar Year 2011	Calendar Year 2012
Personnel	\$11,646	\$4,323	\$5,571	\$4,149
Fringe	\$1,903	\$1,332	\$1,402	\$1,450
Travel	\$5,576	\$5,098	\$6,860	\$5,568
Commuting	\$219	\$71	\$0	\$180
Mail	\$679	\$1,284	\$830	\$678
Telecommunications	\$3,930	\$5,513	\$6,013	\$6,502
Supplies	\$9,404	\$9,171	\$4,595	\$6,313
Rentals	\$0	\$0	\$0	\$120
Insurance	\$0	\$250	\$1,750	\$2,175
Equipment	\$36	\$6,081	\$4,900	\$6,588
Vehicles	\$0	\$0	\$0	\$0
Maintenance (all types)	\$3,420	\$4,888	\$3,246	\$4,914
Professional Development	\$3,613	\$936	\$606	\$46
Guests	\$1,501	\$2,291	\$2,568	\$2,906
Tuition	\$1,250	\$0	\$0	\$0
Miscellaneous	\$0	\$0	\$404	\$895
TOTAL	\$43,176	\$41,238	\$38,745	\$42,485

YR09/10/11/12

\$165,643

**UTAH COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT
SUMMARY OF INVOICED RESEARCH FUNDING
FISCAL YEAR 2012**

Utah Division of Wildlife Resources				
	Aquatic Research	320,295		
	Terrestrial Research	1,007,372		
			<u>1,327,667</u>	63%
Federal				
	RWO	343,739		
	Other	426,585		
			<u>770,324</u>	36%
Other Sources				
	Ute Tribe	14,819		
			<u>14,819</u>	1%
			<u>2,112,810</u>	100%
	Grand Total			

ACTIVE RESEARCH: UNIT SCIENTISTS Fiscal Year 2012

Project Duration	Source	Grant Number	Project Title	Principal Investigator	Total Project	FY 2012 Funding
Mar10-Dec13	UDWR	100537	Assessing Vehicle-Related Mortality of Mule Deer in Utah	Bissonette, J	269,610	70,957
Jul12-Jun13	UDWR	130001	Strawberry Reservoir Fish Distribution Study (Blue Ribbon)	Budy, P	3,000	-
Jul07 - July12	USFWS	070722	RWO 56 Bull Trout Viability II	Budy, P	633,421	127,027
May12-Sep13	USFWS	120973	RWO 63 Bull Trout Viability III	Budy, P	71,758	-
Feb12-Dec12	USGS	120601	RWO 62 Occupancy-Based Assessment of Regional Populations Status and Vulnerability for Three Species of Fish in Utah	Budy, P	25,000	16,000
Aug12-Dec14	BLM	121026	RWO 64 Step-Down Demo Analysis of Plants and Animals under the BLM Rapid Ecoregioinal Analysis Process	Budy, P	122,642	-
July11-Jun13	UDWR	111202	Weber River Metapopulation and Source Sink Dynamics of Native Trout	Budy, P	62,828	30,745
July11-Jun13	UDWR	111203	Scofield Reservoir Predator/Prey Interaction	Budy, P	136,929	67,379
Jul12-Jun13	UDWR	121041	Flaming Gorge Burgot: Diet & Distribution, Early Life History (Sports Fisheries)	Budy, P	118,017	-
Jun11-July12	UDWR	110791	Bonneville Cutthroat Trout Restoration in Righthand Fork, Logan River (#1820)	Budy, P	109,154	109,154
Aug10-Sep12	UDWQ	110029	Utah Nonpoint Source Program Evaluation	Budy, P	76,280	52,182
July01-Jun13	UDWR	121106	Logan River Trout Viability - Long Term Monitoring and Evaluation (YR 12 - Blue Ribbon)	Budy, P	581,023	15,279
Apr12-Sep13	UDWR	120649	Three Species Population Monitoring in the White River (UT)	Budy, P	12,446	-
Apr09 - Sept14	BOR	090619	CPCESU: Development of Pit Tag Detection System for Use in Shinumo Creek, Grand	Budy, P	167,661	-
Jan11-Sep15	BOR	110370	CPCESU: Movement & Habitat Studies of Endangered Fishes in the Colorado River Basin	Budy, P	393,755	-
Jul11-Sep13	BOR	110915	CPCESU: Tributary Habitat Use Endangered and Imperiled Fishes in the Price River, UT	Budy, P	166,452	94,726
Sep12-Mar14	NPS-CESU	130041	NPS CP CESU - Channel Narrowing & Sediment...Big Bend Reach of Rio Grande (Schmidt)	Budy, P	102,140	30,000
Apr11-Sep14	USFWS	110834	Pyramid Lake Fishery Evaluation	Budy, P	344,769	118,682
Jun12-Dec14	USFS	121104	Cutthroat Population Conditions within the Logan Watershed	Budy, P	68,902	-
Sep12-Sep17	BLM	130141	BLM CESU - San Rafael Restoration Science	Budy, P	152,000	-
FY12-13	NSF	100618	Artic LTR: Climate Change	Budy, P	67,000	32,000
Jun10-Jun12	Ute Tribe	100253	Ute Indian Tribe - Evaluating Fish Growth	Budy, P	100,951	14,819
May10-Jun13	USGS	100806	RWO 59 Sustainable Communities and Landscape Design	Edwards, T	348,557	8,440
Sep11-Dec13	NASA	111321	RWO 61 Spatial Responses to Climate Across Trophic Levels: Monitoring and Modeling Plants, Prey, and Predators in the Intermountain Western United States	Edwards, T	533,300	192,272
May05-Jun13	UDWR	051817	Monitoring of Wildlife and Vegetation Responses to Manipulation	Edwards, T	880,000	146,667
Oct09-Aug14	FS	100194	Effects of Projected Climate Change on Distribution Patterns of ...Conifers	Edwards, T	150,000	83,887
Jul11-Jun16	BLM	120007	Habitat Modeling of Rare Plant Species on the Colorado Plateau	Edwards, T	228,293	67,290
					5,925,888	1,277,506
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ACTIVE RESEARCH: OTHER PRINCIPAL INVESTIGATORS Fiscal Year 2012

Project Duration	Source	Grant Number	Project Title	Principal Investigator	Total Project	FY 2012 Funding
Jul08-Jun13	UDWR	090110	YR4 - Winter Distribution and Feeding Ecology of Waterfowl on the Great Salt Lake	Conover, M	270,535	79,732
Jul10-Sep13	UDWR	101114	Wildlife Crossing in Utah: Determining What Works and Helping to Create the Best and Most Cost-Effective Structure Designs	Cramer, P	198,100	66,482
Aug12-Jun13	UDWR	130079	UDWR Escalante Fall 2012	Damitz, S	62,000	-
Mar12-Jul12	UDWR	120727	Escalante River Watershed Restoration Project WRI #1632	Damitz, S	31,750	31,750
Mar11-Feb12	UDWR	110851	UDWR Stan Beckstrom	Damitz, S	6,620	6,620
May08-May13	UDWR	080843	Population Dynamics of the Sagebrush Defoliator as Influence by Biotic Interactions, with Implications for Land Management	Evans, E	75,597	18,899
Mar10-Jun12	UDWR	100345	Hamlin Valley Sage-Grouse Population Monitoring	Frey, N	48,428	20,755
Sep09-Jun14	UDWR	100027	Study the Impacts of Artificial Water and Coyotes on Kit Fox in Utah's West Desert	Gese, E	460,017	95,176
Jul08-Jun14	UDWR	090282	Phase III of Cougar Research in Utah (\$85K every May) YR1-4	Gese, E	340,000	85,000
Nov11-Apr12	UDWR	120419	WS-2145 Capturing Aerial Imagery on the San Rafael River, UT Using and Unmanned Aerial Vehicle (UAV)	Jensen, A	12,230	12,230
Nov12-Jun14	UDWR	130304	Assessing Approaches to Manage Phragmites in Utah Wetlands	Kettenring, K	10,000	-
Nov11-Jun12	UDWR	120414	The Economic Impacts and Benefits of Utah's Blue Ribbon Fisheries	Kim, M	27,617	20,712
Jul10-Jun14	UDWR	101213	Improved Monitoring for Management of the Henry Mountains Bison Herd	Koons, D	330,286	106,157
Mar11-Jun13	UDWR	110451	2011-12 Statewide Utah Angler Survey	Krannich, R	58,965	30,361
Nov09-Dec11	UDWR	100126	Strawberry River Restoration: Spawn/Recruit Cutthroat	Luecke, C	107,658	24,844
Jun11-Jun13	UDWR	120069	Sustaining Utah's Sage-Grouse Local Working Group	Messmer, T	128,880	49,295
Jul11-Dec12	UDWR	120097	Demography Vital Rates, Habitat Use and Seasonal Movements of Greater Sage	Messmer, T	130,400	65,200
Jun12-Jun13	UDWR	120967	Demography, ...and Seasonal Movements of Greater Sage-Grouse in Ruby Pipeline	Messmer, T.	109,090	-
Sep10-Jun14	UDWR	110152	Genetic Analysis of Utah Bears	Mock, K	118,878	32,115
Nov10-Jun13	UDWR	101029	Evaluate Habitat Quality of Mexican Spotted Owls' Territories in Utah	Schupp, Gene	125,508	44,664
Oct11-Jun16	UDWR	120335	Evaluating Coyote Predation and Survival of Mule Deer Under Different Predator Management Regimes	Young, J	264,284	45,312
Jun12-Jun13	UDWR	121103	Rehabilitation of Bear Cubs	Young, J	10,000	-
					2,926,843	835,304
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UNIT PRODUCTIVITY CY 2012

Publications

Books and Chapters in Books

- Bissonette, J. A. 2013 The issue of scale in management. Chapter 6, Pages xx-xxx in P. R. Krausman and J. R. Caine, (eds), *Wildlife Management: contemporary principles and practices*. The Johns Hopkins Press, Baltimore, MD, USA.
- Edwards, T. C., Jr., and D. R. Cutler. *In press*. The analysis of ecological data using R. Chapman/CRC Press, Boca Raton, Florida, USA.
- McIntosh, A. R., P. A. McHugh, and P. Budy. 2011. Brown trout (*Salmo trutta*). Invited. Pages 285-296 in R. A. Francis, editor, *A Handbook of Global Freshwater Invasive Species*. Earthscan, London, UK. (<http://www.earthscan.co.uk/>).

Peer-reviewed Publications

- Beard, K. H., C. A. Faulhaber, S. L. Durham, F. P. Howe, and T. C. Edwards Jr. Indirect interactions among rodents and seeds in a shrubsteppe ecosystem. In revision, *Western North American Naturalist*.
- Bissonette, J. A., and S. Rosa. 2012. A mitigation strategy for deer-vehicle collisions in southern Utah: Evaluation of effectiveness. *Wildlife Biology* 18:414-423 [DOI: 10.2981/11-122]
- Bottcher, J.L., T.E. Walsworth, G.P. Thiede, P. Budy, and D. Speas. *In press*. Frequent tributary usage by the endangered fishes of the upper Colorado river basin: observations on the San Rafael River, UT. *North American Journal of Fisheries Management, Management Brief*. *Accepted 20 February, 2013*. *Manuscript ID: UJFM--2011--0212*.
- Bowerman, T. and P. Budy. 2012. Incorporating movement patterns to improve survival estimates for juvenile bull trout *North American Journal of Fisheries Management* 32:1123--1136.
- Brewerton, A., and T.C. Edwards, Jr. Effects of fire restoration treatments on shrubsteppe passerines in the Great Basin. *In revision*, *Rangeland Ecology and Management*.
- Brodie, J., H. Johnson, M. Mitchell, P. Zager, K. Proffitt, M. Hebblewhite, M. Kauffman, B. Johnson, J. Bissonette, C. Bishop, J. Gude, J. Herbert, K. Hersey, M. Hurley, P. M. Lukacs, C. McCorquodale, E. McIntire, J. Nowak, H. Sawyer, D. Smith, and P.J. White. 2013. Relative influence of human harvest, carnivores, and weather on adult female elk survival across western North America. *J. Applied Ecology* 50:295-305.
- Budy, P., G.P. Thiede, A. Dean, D. Olsen, and G. Rowley. 2012. A comparative and experimental evaluation of the performance of diploid and triploid brooks trout. *North American Journal of Fisheries Management* 21:1211--1224.
- Budy, P., G.P. Thiede, J. Lobon-Cervia, G. Gonzales, P. A McHugh, A. McIntosh, L.A. Vollestad, E. Becares and P. Jellyman. *In press*. Limitation and facilitation of one of the world's most invasive fish: an intercontinental comparison. *Ecology*. *Accepted September 5, 2012*. *Manuscript ID: 11-1920*.
- Budy, P., S. Wood[Seidel], and B. Roper. 2012. A study of the spawning ecology and early life history of Bonneville cutthroat trout. *North American Journal of Fisheries Management* 32:436-449.

- Gibson, J., G.G. Moisen, T.S. Frescino, and T. C. Edwards, Jr. Effects of “fuzzing and swapping” forest inventory plot coordinates on species distribution models under projected climate change scenarios: how useful are projection models based on public data. *In revision*, Ecosystems.
- Gross, D.H., J.A. Logan, and T.C. Edwards, Jr. Mountain pine beetle fecundity and offspring size differ among lodgepole pine and whitebark pine hosts. *In revision*, Canadian Journal of Forest Research.
- Jones, K.B., G. Zurlini, F. Kienast, I. Petrosillo, T.C. Edwards, Jr., T.G. Wade, Bai-lian Li, and N. Zaccarelli. 2012. Informing landscape planning and design for sustaining ecosystem services from existing spatial patterns and knowledge. *Landscape Ecology* DOI 10.1007/s10980-012-9794-4
- Larsen, R. T., J. A. Bissonette, J. T. Flinders and J. C. Whiting. 2012. Framework for Understanding the influences of wildlife water developments in the western United States. *California Fish and Game* 98(3):148-163.
- Lobón--Cerviá, J. , P. Budy, and E. Mortensen. 2012. Patterns of natural mortality in stream-living Brown Trout (*Salmo trutta L.*). *Freshwater Biology* 57:575-588.
- McHugh, P., A. McIntosh, S. Howard, and P. Budy. 2012. Niche flexibility and trout--galaxiid co-occurrence in a hydrologically-diverse riverine landscape. *Biological Invasions* doi:10.1007/s10530-012-0237-6.
- Norevll, R, E., T. C. Edwards, Jr., and F. P. Howe. Disturbance as restoration in shrubsteppe: mixed effects on non-target bird species. *In revision*, *Journal of Wildlife Management*.
- Ripplinger, J., J. Franklin, and T.C. Edwards, Jr. Legacies of managed disturbance leave semi-arid plant communities with reduced resilience and altered composition. *In review*, *Landscape Ecology*.
- Sales-Luis, T., J. A. Bissonette, Santos-Reis, M. 2012. Conservation of Mediterranean otters: the influence of map scale resolution. *Biodiversity Conservation*.21:2061-2073. DOI 10.1007/s10531-012-0297-z
- Salant, N.L., J. C. Schmidt, P. Budy, P. R. Wilcock. 2012. Unintended consequences of restoration: Loss of riffles and gravel substrates following weir installation. *Journal of Environmental Management* 109:154-163.
- Walsworth, T.E., P. Budy, and G.P. Thiede. *In press*. Longer food chains and crowded niche space: effects of multiple invaders on imperiled desert fishes. *Ecology of Freshwater Fish*. *Accepted January 19, 2013*.
- Webber, P. A., P. Thompson, and P. Budy. 2012. Status and structure of two populations of bluehead in the Weber River, UT. *Southwest Naturalist* 57:267--276.
- Wilson, T.L., A.P. Rayburn, and T.C. Edwards, Jr. 2012. Spatial ecology of refuge selection by an herbivore under risk of predation. *Ecosphere* 3:art6.
<http://dx.doi.org/10.1890/ES11-00247.1>

Technical Reports

- Budy, P., D. Epstein, T. Bowerman, and G.P. Thiede. 2012. Bull trout population assessment in northeastern Oregon: a template for recovery planning. 2011 Progress Report to US Fish and Wildlife Service. UTCFWRU 2012(2):1-80.

- Budy, P., S. McKay, and G.P. Thiede. 2012. Weber River metapopulation and source-sink dynamics of native and endemic fishes. 2011 Progress Report to Utah Division of Wildlife Resources. Sport Fisheries Research, Grant Number: F-135-R, Section 1. UTCFWRU 2012(4):1-20.
- Budy, P., L. Winters, and G.P. Thiede. 2012. An investigation of the potential roles of interspecific interactions and forage availability on the performance of three predatory fishes. Draft 2011 Progress Report to the Utah Division of Wildlife Resources. UTCFWRU 2012(3):1-42.
- Gresswell, R.E., P. Budy, C. S. Guy, M. J. Hansen, M. L. Jones, P. J. Martinez, C. Suski, J. E. Williams. 2012. Confronting a lake trout invasion of Yellowstone Lake: An interim scientific assessment, June 14–16, 2011. A Report to the Superintendent of Yellowstone National Park. U.S. Geological Survey, Northern Rocky Mountain Science Center, Bozeman, Montana. YCR-2012-04.

Education & Mentoring

Graduate Students and Post-doctoral fellows COMPLETED

- Brewerton, Adam. 2012. Avian response to post wildland fire reseeding treatments in Great Basin shrubsteppe. Major Professor: Edwards. MS Thesis. Ecology. Utah State University.
- Meredith, Christy. 2012. Effects of a changing physical template on the longitudinal distribution of brown trout in a mountain stream: implications for brown trout invasion success. Major Professor: Budy. PhD. Ecology. Utah State University.
- Saunders, W.C. 2010 - 2012. A test of the theory of biotic resistance: novel options for native fish restoration. Mentor: Budy.

Graduate Students and Post-doctoral fellows ACTIVE

- Bowerman, Tracy. *PhD degree in progress- Ecology*. Understanding the effects of land use and natural variation in habitat on early life-history of threatened bull trout. Major Professor: Budy. PhD. Ecology. Utah State University. *To be completed by April 2012.*
- Chaston, Reed. *MNR degree in progress*. Managing fish populations with links to water quality. Major Professor: Budy. MNR. Utah State University. *To be completed by September 2012.*
- Heredia, Nicholas. *MS degree in progress - Ecology*. Evaluating cutthroat trout performance and identifying limiting factors for the native fish community. Major Professor: Budy. MS. Ecology. Utah State University. *To be completed by November 2013.*
- Klobucar, Stephen. *MS degree in progress- Ecology*. An experimental and modeling approach to predator-prey dynamics: identifying limitations of predator performance in high desert impoundments. Major Professor: Budy. MS. Ecology. Utah State University. *To be completed by April 2013.*
- Laub, B. *Post-doctoral Research Fellow*. Identifying restoration potential for an imperiled, desert tributary stream. Mentor: Budy.

- Newlon, Courtney. *MS degree in progress - Aquatic Ecology*. Identifying cues for movement and temporally-dynamic limiting factors in the bull trout movement corridor. Major Professor: Budy. MS. Ecology. Utah State University. *To be completed by January 2014*.
- Olson, Daniel. *Ph.D. Modeling population effects of deer vehicle collisions*, Dan Olson, Ph.D. *To be completed by December 2013*.
- Stoner, David. *Post-doctoral Research Associate*. Spatial Responses to Climate across Trophic Levels: Monitoring and Modeling Plants, Prey, and Predators in the Intermountain Western United States. Funding: NASA. Mentor: Tom Edwards
- Winters, Lisa. *MS degree in progress - Aquatic Ecology*. An investigation of the relative roles of interspecific interactions and forage production on the growth and survival of three trout predators in Scofield Reservoir, UT. Major Professor: Budy. MS. Ecology. Utah State University. *To be completed by September 2013*.

Undergraduate Research Projects ACTIVE

- Hafen, K. 2012. Agonistic behavior between three species of salmonids commonly stocked in Utah reservoirs. Watershed Sciences, USU
- Roholt, B. *In progress*. A morphometric determination of gape limitation of top fish predators in the western US. Mentor: Budy. Watershed Sciences, USU.
- Smith, C.T. *In progress*. Application of otolith aging to determine differences in size structure and growth rates of smallmouth bass in the green and Yampa Rivers in Dinosaur National Monument. Mentor: Budy. Watershed Sciences, USU.
- Weber, D. *In progress*. Determining the contemporary diets of mottled sculpin in the Logan River, Utah. Mentor: Budy. Watershed Sciences, USU.

Courses, Short-courses, and Workshops Taught

- Bissonette, J. A. Landscape Ecology Workshop, 23 January – 2 February 2012 as part of Fulbright, University of Lisbon. 13 Ph.D. students.
- Bissonette, J. A. Drivers of Landscape Change, 6 week class, 9 February – 11 March 2012 as part of Fulbright, University of Lisbon. 9 Ph.D. students.
- Bissonette, J. A. Landscape metrics: understanding larger scale measurement. Lecture/lab class given at U. Lisbon, 27 undergraduate students, 7 March 2012.
- Bissonette, J. A. Understanding the Natural World: Why you cannot believe what you see,hear or read. Invited Public Lecture presented at Instituto Camões, Rua Rodrigues Sampaio, 113, Lisbon at the request of the Portuguese Fulbright Commission as part of the Fulbright Lecture Series. 13 March 2012
- Bissonette, J. A. Visualizing Landscape Pattern: Changing Views, Scale Sensitivity, and Landscape Connectivity. Invited Public Lecture, given at the Open University of Cyprus. Audience: Government, NGOs, Universities, 4 April 2012. 20 agency and NGO
- Bissonette, J. A. Roaded Landscapes: Foundation Concepts and Practical Approaches. Invited Seminar, given at the Open University of Cyprus. Audience: Faculty and Students. 7 April, 2012. 25 students
- Bissonette, J. A. 2012. New Developments in Fragmentation Research: Partitioning habitat loss from habitat configuration. Invited seminar given at U. Lisboa, 11 April 2012, 45 students.

Budy. Fish Diversity and Conservation (WATS 3100 lecture, 3110 laboratory). Utah State University, College of Natural Resources, Watershed Sciences Department, 2012.

Edwards, T.C. baseR for DWR Biologists. Workshop on data organization and manipulations in R often needed to prepare collected field data for analysis. (February 2012, 34 DWR and FWS biologists).

Edwards, T.C., and M. Hooten. WILD 6900, Bayesian Statistics for Ecologists. Team-taught with M. Hooten, COCFWRU. (Mar 2102, 12 MS and PhD graduate students, Utah State University)

Edwards, T.C. WILD 6500, Biometry (Fall 2012, 22 students MS and PhD graduate students, Utah State University).

Edwards, T.C. Integral Projection Models Workshop. IPMs represent the next generation of stage-classified demographic models by offering all of the advantages of discrete matrix models in a more general framework. (August 2012, 9 PhD students, Zurich ETH and Swiss Federal Research Lab WSL)

Edwards, T.C. graphR for Biologists. Workshop on creating presentation-quality graphs in R. (September 2012, 39 USU graduate students and Faculty).

Professional Service

Budy

Reviewer for (most recently): Transactions of the American Fisheries Society, North American Journal of Fisheries Management, Ecology of Freshwater Fish, Conservation Biology, Limnology and Oceanography, Canadian Journal of Fisheries and Aquatic Sciences, Diversity and Distributions, Ecology, Ecological Applications, Nature, Journal of Freshwater Ecology, Journal of Fish Biology, Environmental Management, and BioScience.

Editorial Board: 2011-present, Ecology of Freshwater Fish

Edwards

Edwards, T.C. *Reviewer for:* The Auk, Journal of Wildlife Management, Florida Field Naturalist, The Murrelet, Wilson Bulletin, Journal of Field Ornithology, Condor, Current Ornithology, Conservation Biology, Wildlife Society Bulletin, Ecology, Ecological Monographs, Remote Sensing and Environment, American Naturalist, Ecological Applications, Landscape Ecology, Ecological Modelling, Environmental Management, Biological Conservation, Journal of Vegetation Science, Trends in Ecology and Evolution, Diversity and Distributions, Ecography

Edwards, T.C. Editorial Board: 2010-present, Ecography

Outreach & Extension

Invited Presentation, Pyramid Lake Fisheries staff. 2013. Budy, P., N. Heredia, and G.P. Thiede. Pyramid Lake fishery evaluation: evaluating cutthroat trout performance and identifying limiting factors for the native fish community. Sutcliffe, Nevada. 20 April 2013.

Article in *Utah State Today*, University News. 2013. Curbing the Chub: USU Aquatic Ecologist Works to Restore Balance. Lisa Winters, MS student. Logan, Utah. 21 March 2013

Invited External Thesis and Dissertation Examiner

Bissonette

Vetter, Daniela. 2010 (begin) Effects of tropical forest fragmentation on vertebrates, University of Freiburg, Freiburg, Germany

Glatthaar, Libby Bickford. 2010 (begin). The effect of landscape fragmentation on the dispersal behaviour, demographie, population genetics and species diversity of the small mammals of the Black Forest. Faculty of Forest and Environmental Sciences, Wildlife Ecology and Management Department, University of Freiburg.

Popular Articles

Krausman, P.R., and J. A. Bissonette. Connecting TWS to the world: The growth of international outreach. *Wildlife Professional* (fall 2012).

Media Coverage

Budy

Burbot explosion could harm fisheries, *The Herald Journal*, 21 February 2013.

KSL Outdoors: 2013 Burbot Bash, *KSL TV*, 11 February 2013

Burbot Bash: hunt is on in Utah for predatory eel-like fish, *Salt Lake Tribune*, 4 February 2013.

Invasive burbot research conducted in Utah-Wyoming waters, *Utah Public Radio*, 23 November 2012

Research Press Release, published regionally between 27 October – 20 November 2012 online at *UtahFishingInfo.com*, *outdoorhub.com*, *fish101.community.uaf.edu*, *exploreatah.net*, *wildlife.utah.gov*, *the radio network*, ; and in the *Standard Examiner*, *The Green River Star*, *Salmon River Mountain Press*, *Salt Lake Tribune*, *Billings Gazette*, *Casper Star-Tribune*, *Sun Advocate*.

Research

Budy

2012--2015 Arctic LTER: Climate Change and Changing Disturbance Regimes in Arctic Landscapes (PI) - Utah State University, NSF-- OPP, Total Award = 5,640,000. (Ongoing)

- 2012--2014 Development of a science--based restoration plan for the San Rafael River, UT and beyond; can we implement multi--faceted river restoration in an adaptive framework? (PI) - BLM, CESU, 2012--2013 \$110,000. (Ongoing)
- 2012--2013 Understanding the invasion success of a novel predator: burbot life history and trophic interactions in Flaming Gorge Reservoir, WY--UT (PI) - UDWR, \$118,017. (Ongoing)
- 2011--2013 Occupancy based assessment of regional population status and vulnerability for three species of fish (bluehead sucker, flannelmouth sucker, and roundtail chub) in Utah: A template for assessing extinction risk and prioritizing conservation actions. (PI) - USGS/USFWS, Science support partnership & quick response program, RWO, \$25,000.
- 2011--2014 Evaluating cutthroat trout performance and identifying limiting factors for the native fish community of Pyramid Lake (PI) - USFWS, Great Basin Cooperative Ecosystem Unit (CESU), \$344,769. (Ongoing)
- 2011--2013 Predator Prey Interactions in Scofield Reservoir, UT. Phaedra Budy (PI), - UDWR, Sport Fisheries Research, \$136,929. (Ongoing)
- 2011--2013 Weber River Metapopulation Structure and Source Sink Dynamics of Native Trout (PI) - UDWR, Sport Fisheries Research, Total Award to date, \$62,828, \$45,000 in--kind. (Ongoing)
- 2011--2013 Tributary habitat use of endangered and imperiled fishes in the Price River, Utah (PI) - Bureau of Reclamation (BOR), Activities to Avoid Jeopardy Program, \$166,452. (Ongoing)
- 2011--2016 Movement and Habitat Studies of Endangered Fishes in the Colorado River Basin (PI) - Bureau of Reclamation (BOR), Activities to Avoid Jeopardy Program, \$393,755. (Ongoing)
- 2002--2013 Limiting factors affecting trout population dynamics, abundance, and distribution in the Logan River, Utah: population dynamics, disease, and synergistic effects (PI) - Utah Division of Wildlife Resources and U.S. Forest service, \$674,202. (Ongoing)
- 2002—2013 Bull trout population assessment and life--history characteristics in association with habitat quality and land use: template for recovery planning. (PI) - US Fish and Wildlife Service (USFWS), 2013 = 71,757.90, RWO, Total Award \$1,300,445. (Ongoing)

Edwards

- 2009-2012 Avian response to post wildland fire reseeding treatments in Great Basin shrubsteppe (PI) - Utah Division of Wildlife Resources, \$107,100. (Completed)
- 2012-2012 Colorado Plateau Rapid Ecoregional Assessment (Co-PI) - Bureau of Land Management, \$127,300. (Completed)
- 2011-2015 Step-down demonstration analyses of plants and animals under the BLM Rapid Ecoregional Analysis process (PI) - Bureau of Land Management, \$533,300. (New)
- 2011-2015 Spatial responses to climate across trophic levels: monitoring modeling plants, prey, & predators in the Intermountain Western United States (Co-PI) - NASA, \$533,300. (Ongoing)

- 2009-2011 Sustainable communities and landscape designs (PI) - U.S. Geological Survey, \$349,500. (Ongoing)
- 2009-2014 Effects of projected climate change on distribution patterns of Western North America conifers (PI) - USDA Forest Service, Rocky Mountain Research Station, \$125,000. (Ongoing)
- 2010-2014 Assessing the importance of biotic interactions for predicting the impact of climate change on the future distribution of plant assemblages (Co-PI) - Swiss National Science Foundation, \$425,000 CHF. (Ongoing)

Presentations

- Brewerton, A.B., and T.C. Edwards, Jr. 2012. Response of shrubsteppe obligate passerines to post-wildland fire restoration treatments. Offered paper, 2012 Annual Meeting of the Wildlife Society Utah Chapter, March 22, Springdale, Utah.
- Budy, P., M. Conner, N. Salant, and W. MacFarlane. 2012. Update on the occupancy based assessment of regional population status and vulnerability for three species of fish (bluehead sucker, flannelmouth sucker, and roundtail chub) in Utah: A template for assessing extinction risk and prioritizing conservation actions. Utah Chapter, American Fisheries Society, Annual Meeting, March 26-29, Bullfrog, UT.
- Budy, P., G.P. Thiede, D. Beauchamp, and C. Luecke. 2012. Conflicts between native fish conservation and non-native lake trout sport fisheries: historical perspectives of two large, natural oligotrophic lakes, Lake Tahoe and Bear Lake. Invited Symposium Presentation. American Fisheries Society, National Meeting, August 19-23, 2012, Minneapolis, MN.
- Budy, P., C. Luecke, and G.P. Thiede. 2012. Resources allocation among arctic char in closed arctic lakes: implications for population structure and regulation. Poster Presentation. American Fisheries Society, National Meeting, August 19-23, 2012, Minneapolis, MN.
- Budy, P., C. Luecke, and Gary P. Thiede. 2012. Resources allocation among arctic char in closed arctic lakes: implications for population structure and regulation. Poster. American Fisheries Society, National Meeting, August 19-23, 2012, Minneapolis, MN.
- Budy, P., G.P. Thiede, D.A. Beauchamp, and Chris Luecke. 2012. Conflicts between native fish conservation and non-native lake trout sport fisheries: Historical Perspectives of Two Large, Natural Oligotrophic Lakes, Lake Tahoe and Bear Lake. Invited Presentation. American Fisheries Society, National Meeting, August 19-23, 2012, Minneapolis, MN.
- Edwards, T.C., Jr., Gibson, J. R., G. G. Moisen, T.S. Frescino, and N. Zimmermann. 2012. Linking tree-species demographic parameters to species-distribution models: can static maps be made dynamic for forecasting under projected global change? Invited paper, 2012 Riederalp Workshop on Demographic rates: the key to understand and model range dynamics? August 21, Riederalp, Switzerland.
- Edwards, T.C., Jr. 2012. Modelling contraction and expansion zones of piñon pines and junipers in Western North America under projected climate change scenarios. Invited paper, May 27, University of Tromsø, Tromsø.
- Gresswell, R.E., P. Budy, C.S. Guy, M.J. Hansen, M. Jones, P.J. Martinez, C. Suski, and J.E. Williams. 2012. Role of external peer review in supporting invasive species

- suppression efforts. Invited Presentation. American Fisheries Society, National Meeting, August 19-23, 2012, Minneapolis, MN.
- Hafen, K., W.C. Saunders, and P. Budy. 2012. Effects of impoundments on brown trout source-sink dynamics in the Logan River, Utah: Conservation implications for endemic Bonneville cutthroat trout. Poster Presentation. Utah Chapter, American Fisheries Society, Annual Meeting, March 26-29, 2012, Bullfrog, UT.
- Heredia, N., P. Budy, and G.P. Thiede. 2012. Food web interactions in Pyramid Lake, Nevada: identifying factors limiting the performance of Lahontan cutthroat trout. Western Division, American Fisheries Society, Annual Meeting, March 26-29, 2012, Jackson, WY.
- Heredia, N. A., P. Budy, and G. P. Thiede. 2012. Food web interactions in Pyramid Lake, Nevada: factors influencing Lahontan cutthroat trout growth and production. American Fisheries Society, National Meeting, August 19-23, Minneapolis, MN.
- Jackson-Smith, D., A. Armstrong, N. Mesner, Lorien Belton, N. Salant, P. Budy, and D. Stevens. 2012. A comparison of alternative approaches to measuring BMP implementation, maintenance, and effectiveness. National Water Conference, May 20-24, 2012, Portland, OR.
- Klobucar, S., P. Budy, and G.P. Thiede. 2012. Examining the potential of forage enhancement in trophically limited reservoirs: results from a large-scale experiment. American Fisheries Society, National Meetings, August 19-23, 2012, Minneapolis, MN.
- Klobucar, S., P. Budy, and G.P. Thiede. 2012. Can we improve predator performance in trophically limited reservoirs: Results from a large-scale experiment. Utah Chapter, American Fisheries Society, Annual Meeting, March 26-29, 2012, Bullfrog, UT.
- McKay, S., P. Budy, and G.P. Thiede. 2012. Weber River metapopulation and source-sink dynamics of native and endemic fishes. Utah Chapter, American Fisheries Society, Annual Meeting, March 26-29, 2012, Bullfrog, UT.
- Meredith, C., P. Budy, and M. Hooten. 2012. Effects of a changing physical template on the distribution of brown trout in a mountain stream. Utah Chapter, American Fisheries Society, Annual Meeting, March 26-29, 2012, Bullfrog, UT.
- Morán, L.S., B. Poulter, P. Balvanera, F. Kienast, and T.C. Edwards, Jr. Modelling the vulnerability of ecosystem service hotspots in Mexico to climate change. Offered paper, 2012 Meeting of the U.S. Chapter of the International Association for Landscape Ecology, April 9, Newport, Rhode Island.
- Olson, D. D. and J. A. Bissonette. 2012. Impact of roads on mule deer in Utah. Utah Division of Wildlife Resources Annual Habitat Meeting, March 2012, Midway, Utah.
- Olson, D. D. and J. A. Bissonette. 2012. Assessing the impacts of roads on mule deer in Utah. Utah Chapter of the Wildlife Society Annual Meeting, March 2012, Springdale, Utah.
- Olson, D. D. and J. A. Bissonette. 2012. Tracking wildlife-vehicle collisions in Utah with smartphone technology. Utah Chapter of the Wildlife Society Annual Meeting, April 2012, Springdale, Utah.
- Olson, D. D. and J. A. Bissonette. 2012. Impact of roads on mule deer in Utah. Western Association of Fish and Wildlife Agencies Summer Meeting, July 2012, Waikoloa, Hawaii.
- Olson, D. D., C. Garrard, and J. A. Bissonette. 2012. Movement Barrier Tool. ESRI User Conference App Fair, Jul 2012, San Diego, California.

- Olson, D. D. and J. A. Bissonette. 2012. Using smartphones to track wildlife-vehicle collisions in the information age. ESRI User Conference, July 2012, San Diego, California.
- Olson, D. D. and J. A. Bissonette. 2012. The Utah wildlife-vehicle collision reporter. Utah Department of Transportation Annual Conference, October 2012, Salt Lake City, Utah.
- Olson, D. D. and J. A. Bissonette. 2012. Habitat fragmentation: When do roads become barriers to deer movements? The Wildlife Society Annual Conference, November 2012, Portland, Oregon.
- Saunders, W.C., and P. Budy. 2012. Experimental Evidence for Biotic Resistance by Bonneville Cutthroat Trout to Brown Trout Invasion. March 20, 2012, Logan, UT. Cache Anglers Chapter of Trout Unlimited.
- Thiede, G.P., P. Budy, C. Meredith, and W.C. Saunders. 2012. Exotic brown trout impacts: the case of a novel predator. Utah Chapter, American Fisheries Society, Annual Meeting, March 26–29, 2012, Bullfrog, UT.
- W.C. Saunders, and P. Budy. 2012. Biotic resistance by native Bonneville cutthroat trout to the establishment of exotic brown trout is influenced by population density. Utah Chapter, American Fisheries Society, Annual Meeting, March 26-29, 2012, Bull Frog, UT.
- Winters, L. P. Budy, and G.P. Thiede. 2012. Investigating food web interactions and exploring the potential for biological control of three top predatory fishes in a high elevation, western reservoir. Poster Presentation. Utah Chapter, American Fisheries Society, Annual Meeting, March 26-29, 2012, Bullfrog, UT.
- Winters, L., P. Budy, and G.P. Thiede. 2012. Quantifying the potential for biological control of an explosive prey base by predatory fishes in a novel food web of a high elevation, western reservoir. American Fisheries Society, National Meeting, August 19-23, 2012, Minneapolis, MN.

Awards and other Honors

- Bissonette, J. A. Senior Fulbright Scholar, University of Lisbon, 15 January-15 April 2012
- Bissonette, J. A. Senior Fulbright Scholar, Fulbright Inter-Country Program Cyprus, 1-8 April 2012
- Budy, P.E. Recipient, National Cooperative Research Units Recognition Star Award, US Department of Interior, 2012.
- Edwards, T.C. Recipient, National Cooperative Research Units Recognition Star Award, US Department of Interior, 2012.

DEVELOPMENT OF A SCIENCE BASED RESTORATION AND MANAGEMENT PLAN FOR THE SAN RAFAEL RIVER, UT: INTEGRATING DATA ON FISH DISTRIBUTIONS AND HABITAT NEEDS WITH HISTORICAL ANALYSES OF CHANNEL CHANGE

Dates:

2012-2013

Abstract:

Like many rivers in the southwestern US, the San Rafael River in southeast Utah has been impacted by hydrologic alterations, habitat fragmentation, and non-native fish and vegetation establishment. In low-water years, the lower San Rafael River often becomes dewatered due to irrigation withdrawals. In addition, spring snowmelt floods have declined in magnitude and duration due to water capture in the upper portion of the basin. However, summer monsoon floods still occur regularly and transport large quantities of sediment into the lower river. This sediment is no longer exported from the river channel due to the loss of spring snowmelt floods. As a result, the channel has narrowed and deepened, the floodplain has aggraded, and backwaters and other off-channel habitats have filled with sediment. Saltcedar (*Tamarix* sp.) has colonized the river banks in high densities and exacerbated floodplain aggradation and channel narrowing by stabilizing bank and floodplain sediments. The combination of reduced spring snowmelt flows and saltcedar colonization has led to a narrowing and simplification of the river channel. Non-native fish species have also colonized the San Rafael River below Hatt Ranch dam (pictured below), which is a complete barrier to upstream fish movement. Despite these threats, three native species of conservation concern are found in the San Rafael River, the bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), and roundtail chub (*Gila robusta*). However, these species occur in low abundances in the San Rafael River and thus restoration has the potential to help ensure the persistence of these native fish.



We are combining hydrological and geomorphic analyses of channel change with data on current fish distributions and habitat needs to guide restoration efforts on the lower San Rafael River. We are applying an experimental approach to the restoration design, so that we can understand the cumulative impacts of different restoration projects over a large scale. We envision that the outcomes of the San Rafael River restoration project will help inform restoration efforts throughout the southwestern US.



Funding:

Primary: Bureau of Land Management
Bureau of Reclamation & U.S. Geological Survey – UCFWRU (in-kind)

Investigators:

Phaedra Budy, Principle Investigator, USGS – UCFWRU, USU- Dept. of Watershed Sciences
Brian Laub, Postdoctoral Fellow, USU- Dept. of Watershed Sciences
Justin Jimenez, Fisheries/Riparian Program Lead, BLM Utah State Office
David Dean, Researcher, USU- Dept. of Watershed Sciences

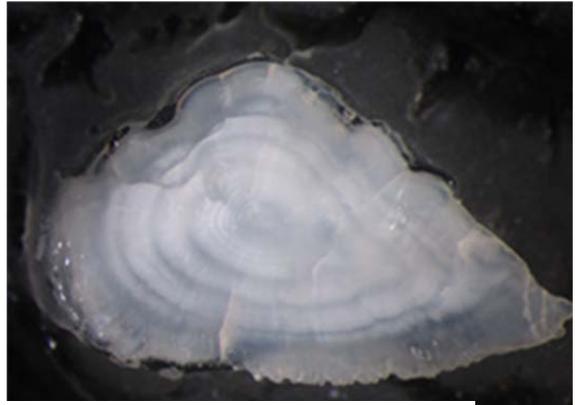
BULL TROUT MOVEMENT DYNAMICS IN A LARGE, HUMAN INFLUENCED RIVER AND THE IMPLICATIONS TO RESOURCE MANAGEMENT

Dates:

2012-2014

Abstract:

Movement is an essential part of a species' life-history strategy and has wide ranging consequences for reproduction, survival and population stability. Bull trout are sensitive to riverscape alterations given their complex and diverse life histories. Resource managers need to understand the interactions between a species and its environment to inform recovery actions for Threatened and Endangered Species. The goal of this project is to understand how human disturbances affect the full life expression of bull trout life-history. The main objectives are to characterize the migratory movement patterns of the Walla Walla River bull trout metapopulation using a long term mark-recapture dataset and otolith microchemistry. The results from this objective will be combined with environmental variable data to better understand how the environment influences bull trout movement patterns. Combining the bull trout habitat use, survival, genetics and movement data that has been collected for the last 10 years with new findings will allow us to inform bull trout recovery efforts in the Walla Walla River Basin and throughout their range.



Funding:

U.S. Fish and Wildlife Service (USFWS)
U.S. Geological Survey – UCFWRU (*in-kind*)

Investigators:

Phaedra Budy, Principle Investigator, U.S. Geological Survey – UCFWRU, USU- Department of Watershed Sciences
Howard A. Schaller, Project Leader, USFWS - Columbia River Fisheries Program Office
Courtney Newlon, Graduate Research Assistant, USFWS, USU – Department of Watershed Sciences {expected graduation, 2014}.

Selected Publications:

Homel, K. and P. Budy. 2008. Temporal and spatial variability in the migration patterns of juvenile and subadult bull trout (*Salvelinus confluentus*) in Northeast Oregon. Transactions of the American Fisheries Society 137: 869-880.

Bowerman, T. and P. Budy. 2012. Incorporating movement patterns to improve survival estimates for juvenile bull trout. North American Journal of Fisheries Management 32(6):1123-1136.

HYDROACOUSTIC AND TRAWLING ASSESSMENTS OF FISH DENSITY AND ABUNDANCE IN WESTERN LAKES AND RESERVOIRS

Dates:

2011-2013

Abstract:

During 2011 and 2012, we conducted hydroacoustic and trawling surveys in several western lakes and reservoirs to estimate density and abundance of forage fishes (e.g., chub) and sport fishes (e.g., trout). We conducted acoustic surveys in two Ute Tribe reservoirs in Utah, Scofield Reservoir and Strawberry Reservoir in Utah, and Pyramid Lake, Nevada. In Strawberry Reservoir, Estimates of forage fish abundance, the prey base, will allow managers to determine the capacity of inland water bodies to support the current or an enhanced sport fishery. Further, estimates of the sport-fish population will allow managers to determine if current fish stocks are adequate, or if enhancement through increased stocking or angler harvest can be management options.

Funding and collaborators:

Utah Division of Wildlife Resources
US Fish and Wildlife Service
Ute Tribe Fish and Wildlife Department
US Geological Survey – UCFWRU (in-kind)

Investigators:

Phaedra Budy, Principle Investigator, USGS – UCFWRU, USU – Watershed Sciences
Gary P. Thiede, Fisheries Biologist, USU – Watershed Sciences
Carl W. Saunders, Post doctoral fellow, USU – Watershed Sciences

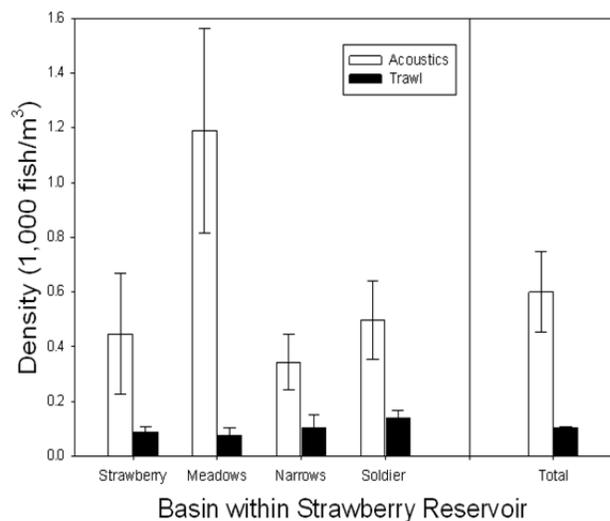
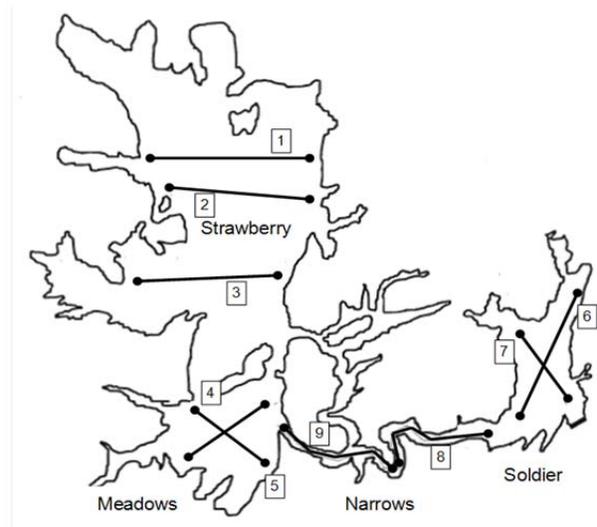


Figure 1. Density estimates (± 1 standard error) determined from hydroacoustic surveys (white bars) and from trawling surveys for fish (all species combined) in four basins of Strawberry Reservoir, Utah, July 2011.

INVESTIGATING PREDATOR PREY INTERACTIONS IN SCOFIELD RESERVOIR, UT.

Dates:

2011-2014

Abstract:

Aquatic food webs are controlled by complex spatial and temporal interactions within and among trophic levels. The strength of interactions within the community may determine processes that regulate populations in the food web. The spread of introduced species into the dynamic artificial species assemblages of reservoirs can additionally create challenges for fisheries managers to accurately predict how these species may interact. The unintentional introduction of Utah chub at Scofield Reservoir has prompted managers to stock three top predators (rainbow trout, Bonneville cutthroat trout, and tiger trout) as potential biological control species, but their ability is unknown. A comprehensive survey of the fish community and limnology of Scofield Reservoir has investigated these interactions between predator and prey. Results suggest a substantial portion of chub outgrow the gape limit of trout predators (20%) and are not susceptible to predation. Furthermore, stable isotope and diet analyses demonstrate considerable trophic niche overlap, suggesting the potential for competition is high. There is a significant decline of rainbow trout catch (CPUE) in recent years, potentially due to competition for shared food resources or preferred littoral feeding space. However, we used bioenergetics modeling to quantify predatory control of forage and have found considerable consumption of chub at all age classes of cutthroat and tiger trout. The results of this study will assist managers in establishing a more biologically efficient stocking program to optimize sport fish growth and survival, control chub, and enhance and maintain angler satisfaction.



Funding:

Utah Division of Wildlife Resources
US Geological Survey – Utah Cooperative Fish and Wildlife Unit (in-kind)

Investigators:

Phaedra Budy, Principal Investigator, US Geological Survey–UCFWRU, USU Dept. of Watershed Sciences
Gary P. Thiede, Fishery Biologist, USU Dept. of Watershed Sciences
Lisa Winters, Graduate Research Assistant (M.S.), USU Dept. of Watershed Sciences (expected graduation, Autumn 2013)

EXAMINING THE SEASONAL MOVEMENTS BY BURBOT (*Lota Lota*) IN FLAMING GORGE RESERVOIR, UT AND THE ONGOING EFFECTS OF THIS EXOTIC SPECIES ON THE FOOD WEB

Dates:

2012-2013

Abstract:

Flaming Gorge Reservoir supports trophy sport fisheries in Utah and Wyoming and provides habitat for imperiled, native fishes. However, the recent illegal introduction of burbot (*Lota lota*) to the Green River threatens to impact fish assemblages throughout the drainage, and particularly in Flaming Gorge Reservoir where the population has rapidly expanded.

This research examines the extent of seasonal movements by burbot in Flaming Gorge Reservoir and the ongoing effects of this exotic species on the food web. Burbot catch varied spatially with the greatest catch rates occurring in the Inflow region and lowest catch rates in the Canyon region. However, extensive up-reservoir movements by mature burbot suggest that habitats in the Open Hills region (central reservoir) are likely important foraging habitats and seasonally support high densities of burbot.

Our dietary analyses indicated that crayfish dominated burbot diets (80% mean occurrence), but diet breadth was wide and we observed considerable consumption of fish (45% mean occurrence) by burbot. When exhibiting piscivory, burbot most commonly consumed forage fishes (e.g., sucker and chub), but we also observed sport fish consumption (e.g., rainbow trout, smallmouth bass) and cannibalism by burbot. We most often observed piscivory in larger burbot, but burbot as small as 310 mm consumed fish prey.

We used acoustic telemetry to measure seasonal movements of burbot associated with winter spawning and identify sources of recruitment within Flaming Gorge Reservoir. Many burbot moved up-reservoir during fall to spawn, and some these migrations were of great distances (up to 65 km) and rapid speeds (up to 6.5 km/day). Investigating the success of identified spawning locations will occur in late spring 2013 via sampling of larval burbot and highest larval densities are anticipated in the Inflow region of the reservoir. Preliminary analysis of movement data suggests the presence of both resident and adfluvial life-history expressions in burbot in Flaming Gorge Reservoir.

Funding and Collaborators:

Utah Division of Wildlife Resources, US Geological Survey – UCFWRU (in-kind), Wyoming Game and Fish Department (in-kind), Addictive Fishing (in-kind)

Investigators:

W. Carl Saunders, USU – Watershed Sciences
Stephen Klobucar, USU – Watershed Sciences
Phaedra Budy, USGS – UTCFWRU, USU – Watershed Sciences

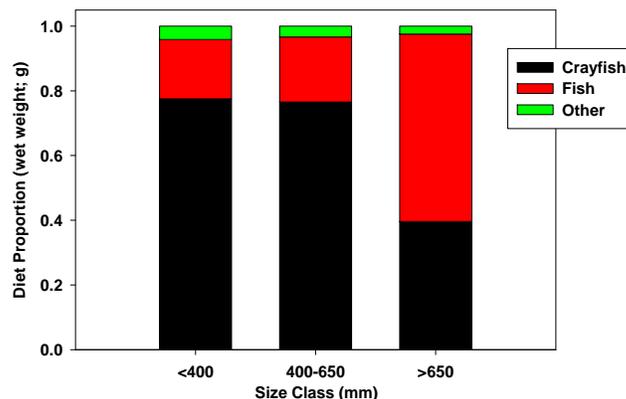


Figure 1: Diet proportions (wet weight; g), by size class (mm), for burbot in Flaming Gorge Reservoir sampled October 2012-February 2013.



Figure 2: Large burbot are highly piscivorous and may have strong impacts on prey resources in Flaming Gorge Reservoir.

INNOVATIVE USES OF PIT-TAG TECHNOLOGY: EXAMPLES FROM THE COLORADO RIVER BASIN AND BEYOND

Dates:

2010-2013

Abstract:

Radio Frequency Identification or RFID was introduced into the realm of fisheries science in the Pacific Northwest in the mid-1980's with the introduction of the Passive Integrated Transponder (PIT) tag. PIT tags were first used to evaluate survival of anadromous salmonids through the hydroelectric projects in the Columbia and Snake rivers. Innovations such as multiplexing antenna readers, smaller high-performance tags, and larger more robust antennas have resulted in the widespread application of PIT-tag technology as a fisheries data collection tool. PIT-tag detection antennas have traditionally been used in the form of fixed antenna arrays detecting PIT-tagged fish as they move through specific areas of a river covered by the antennas. As the use of PIT-tag technology becomes more geographically widespread, the need for alternative detection techniques and methods has become apparent. The Colorado River Basin presents some unique challenges in fish detection whether using more traditional sampling techniques (e.g., electrofishing, seining, trammel netting, hoop netting) or when using PIT-tag technology. In this basin we are dealing with long-lived fishes that do not predictably migrate annually to the exact same spawning grounds and have very diverse habitat use over their life span. Innovative new styles and types of fish detection antennas have been developed and tested, driven by the needs and ideas of biologists working in the field. These new methods allow biologists to detect fish "actively" instead of "passively" waiting for the fish to move past a fixed point. These innovative methods open up the possibilities to expand the use of PIT-tag data from traditional mark-recapture studies to habitat use studies. We present a number of these projects where smaller, temporary, mobile, and floating antennas have been successfully used to detect PIT-tagged fish where traditional sampling methods have been less effective.



Funding and collaborators:

US Bureau of Reclamation
Utah Division of Wildlife Resources
US Forest Service
US Geological Survey – UCFWRU (in-kind)

Investigators:

Phaedra Budy, Principle Investigator, USGS – UCFWRU, USU – Watershed Sciences
Peter Mackinnon, Research Associate, USU – Watershed Sciences
Gary P. Thiede, Fisheries Biologist, USU – Watershed Sciences

EVALUATING CUTTHROAT TROUT PERFORMANCE AND IDENTIFYING LIMITING FACTORS FOR THE NATIVE FISH COMMUNITY OF PYRAMID LAKE, NV

Dates:

2011-2014

Abstract:

Understanding aquatic food webs is important for both conservation and economic purposes. In Pyramid Lake, NV, the threatened Lahontan cutthroat trout (*Onchorhynchus clarki henshawi*, LCT) is the centerpiece of a world-class fishery. Maintained through stocking, LCT are no longer able to reach their natal spawning grounds due to damming and water diversions on the Truckee River. While past research on Pyramid Lake has focused primarily on water quality issues, the main focus of this study is to quantify the interactive and ecological effects of the aquatic food web and to identify potential limiting factors of LCT growth and survival. In addition to LCT, the fish community of Pyramid Lake is made up of two suckers, cui-ui (*Chasmistes cujus*) and Tahoe (*Catostomus tahoensis*), tui chub (*Gila bicolor*), the main forage item of LCT, and the exotic Sacramento perch (*Archoplites interuptus*). The three primary objectives of the study are to 1) identify factors limiting LCT growth and survival,

2) determine if exotic Sacramento perch are negatively impacting LCT through either exploitative or interference competition, and 3) quantify major pathways of energy through the food web. To this point, LCT appear to face little opposition in terms of biotic-restrictions to growth. While diet and isotope data suggest strong resource overlap between LCT and Sacramento perch, both spatial distribution and the relatively low abundance of Sacramento perch suggest that this exotic species likely has little impact on the growth and survival of LCT. Additionally, tui chub consumption by LCT remains relatively consistent across seasons, and annual consumption of tui chub appears to be well below annual tui chub production. These findings suggest that an increase in stocking will produce more LCT, without being detrimental to LCT growth rates, and subsequently increase the number of catchable trout for this already world-class fishery.



Funding:

US Fish and Wildlife Service, Reno, NV.
USGS – Utah Cooperative Fish and Wildlife Unit (*in-kind*)

Investigators:

Phaedra Budy, Principle Investigator, USGS – UCFWRU, USU- Dept. of Watershed Sciences
Robert Al-Chokhachy, Research Fisheries Biologist, USGS
Gary P. Thiede, Fishery Biologist, USU- Dept. of Watershed Sciences
Nick Heredia, Graduate Research Assistant (M.S.) USU- Dept. of Watershed Sciences
{expected graduation, Fall 2013}

WEBER RIVER METAPOPULATION STRUCTURE AND SOURCE-SINK DYNAMICS OF NATIVE FISHES

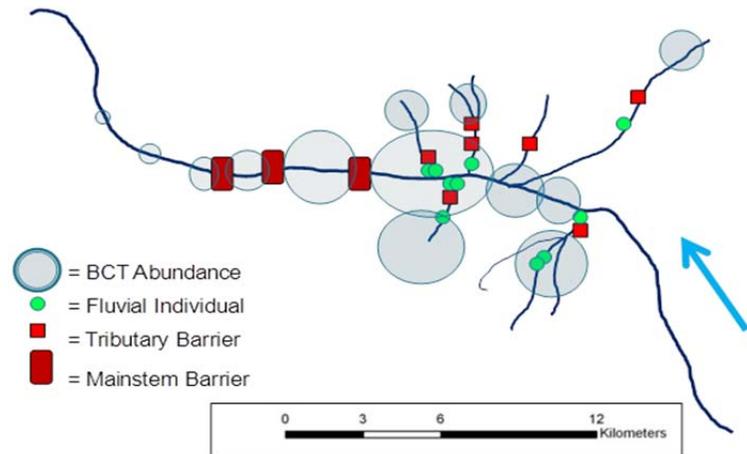
Dates:

2011-2013

Abstract:

The Weber River, Utah, is home to two sensitive fish species, Bonneville cutthroat trout (*Oncorhynchus clarkii utah*) and bluehead sucker (*Catostomus discobolus*). Puzzling strongholds of these species remain, despite potential impacts from habitat fragmentation, water management, and the presence of invasive species. Although populations of Bonneville cutthroat trout and bluehead sucker in the Weber River are especially important for management and conservation purposes, little is known about their specific life histories and potential limiting factors.

We will determine if source-sink metapopulation dynamic exists between tributary and the mainstem populations of cutthroat trout using a combination of mark-recapture movement analysis, strontium signatures in hard tissue structures, and genetic relatedness. We will identify the locations and attributes of barriers to upstream movement in the tributaries and mainstem, and evaluate priority areas for barrier removal. Finally, we will evaluate the population size and structure of Bonneville cutthroat trout in the mainstem Weber River and tributaries, and the bluehead sucker population size and structure in the mainstem. The primary goal of this research is to identify limiting factors to these populations to allow managers to prioritize conservation actions.



Oncorhynchus clarkii utah

Funding and collaborators:

Utah Division of Wildlife Resources
Trout Unlimited
US Geological Survey – UCFWRU (in-kind)

Investigators:

Phaedra Budy, Principle Investigator, USGS – UCFWRU, USU – Watershed Sciences
Gary P. Thiede, Fisheries Biologist, USU – Watershed Sciences

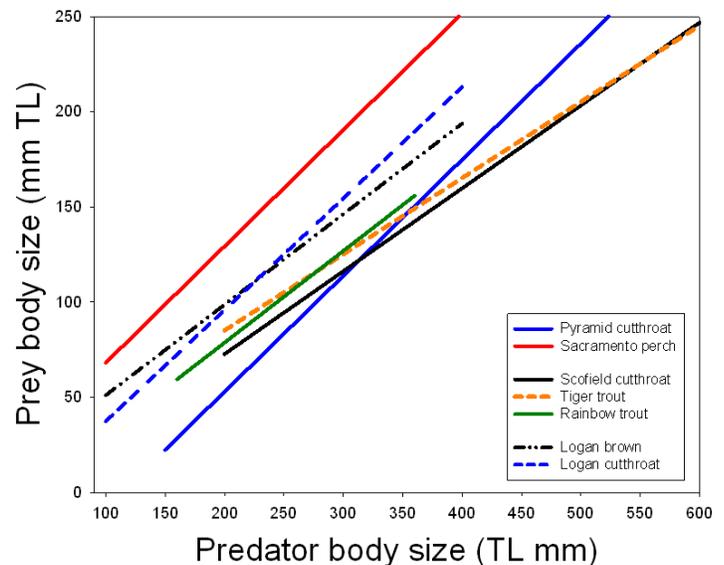
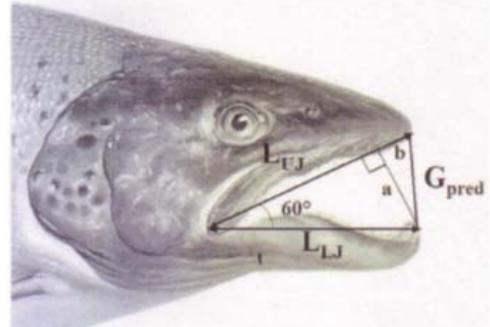
A MORPHOMETRIC DETERMINATION OF GAPE LIMIT FOR SEVEN FISH PREDATORS IN THREE WESTERN USA WATERS

Dates:

2012-2013

Abstract:

For piscivorous fishes, components of body morphology such as gape size affect the size of prey species that can be eaten, and can determine the ability of predators to effectively utilize and control the prey base. We examined gape sizes of seven piscivorous fishes in three western water bodies: six salmonids and one centrarchid. We measured predator and prey morphometrics in the field and later analyzed fish diets to determine prey sizes consumed. In Pyramid Lake, Nevada, endemic Lahontan cutthroat trout (LCT) became piscivorous as small as 250 mm; however, most LCT switched to piscivory at 380 mm and consumed prey well within their vertical and horizontal gape size. Conversely, exotic Sacramento perch became piscivorous at 120 mm and consumed native Tui chub greater than their vertical gape size, but within their horizontal gape (i.e., mouth width) size. In Scofield Reservoir, Utah, stocked Bear lake cutthroat trout became piscivorous at 320 mm TL, consuming Utah chub near and well above their horizontal and vertical gape size. Similarly, stocked tiger trout switch to piscivory at 340 mm TL and also consumed fish very close to or just exceeding their horizontal and vertical gape sizes, demonstrating that these two stocked predators may be effective chub control agents. In contrast, stocked rainbow trout fed on prey less than their gape size and exhibited very limited piscivory. In the Logan River, Utah, naturalized brown trout become piscivorous at 250 mm, feeding on prey far below both their vertical and horizontal gape size. These gape limit data provide an excellent indicator of the size range of prey being consumed by predatory fish, and thus provide a better understanding of the effectiveness of different piscivores to control aquatic systems from the top and as biological controls agents.



Funding and collaborators:

Utah Division of Wildlife Resources
US Fish and Wildlife Service
US Geological Survey – UCFWRU (in-kind)

Investigators:

Phaedra Budy, Principle Investigator, USGS – UCFWRU, USU – Watershed Sciences
Bryce Roholt, Undergraduate Researcher, USU – Watershed Sciences
Gary P. Thiede, Fisheries Biologist, USU – Watershed Sciences

UNDERSTANDING HOW LAKE POPULATIONS OF ARCTIC CHAR ARE STRUCTURED AND FUNCTION WITH SPECIAL CONSIDERATION OF THE ROLE OF CLIMATE CHANGE

Dates:

2011-2013

Abstract:

Size dimorphism in lake fish populations, both causes and consequences, has been area of considerable focus. However, uncertainty remains whether this population structure is dynamic or stabilizing and to the role of exogenous factors (e.g., ice-free days) that may affect growth rates and size structure. Here, we quantified and explored patterns among empirical vital rates, population structure, abundance and trend, built a population model to understand how char populations are structured and function, bioenergetically modeled the effects of climate and climate change on growth, and then combined these components to predict the effects of climate change on population structure in two Arctic char lakes. Despite differences in underlying geology, population and lake size, the density of adult char was similar between lakes (0.002 - 0.003 / m²). Both populations cycle between small (< 300 mm) and large (> 300 mm) char. Annual survival rates were relatively high (age-3 and older; 40 - 96%); growth rates were also relatively high (~0.1 g/day) and comparable conspecifics at lower latitudes. Climate change scenarios mimicked the pattern of warming and cooling observed in nature and resulted in temperature closer to optimal for char growth and for a longer duration. An increase in predicted consumption rates (28 - 34%) under climate change scenarios led to much greater growth rates (23 - 34%). The population model captured the cycle in population structure but with greater amplitude in cycles. Collectively, these results indicate that char extremely sensitive to small changes in time of ice-off. We hypothesize that in the Arctic, years of significantly longer growing season, which are predicted to occur more often under climate change, produce elevated growth rates of small char and thus act in a manner to a "resource pulse". As modeled here, these warmer years of longer growing season result in a shift in vital rates that may then allow a sub-set of small char to "break through" into the large char morph or cohort, thus setting the cycle in population structure.

Funding and collaborators:

National Science Foundation – LTER
US Geological Survey – UCFWRU (in-kind)

Investigators:

Phaedra Budy, Principle Investigator, USGS – UCFWRU, USU – Watershed Sciences
Chris Luecke, Professor, USU – Quinney College of Natural Resources
Stephen Klobucar, student, USU – Watershed Sciences
Gary P. Thiede, Fisheries Biologist, USU – Watershed Sciences

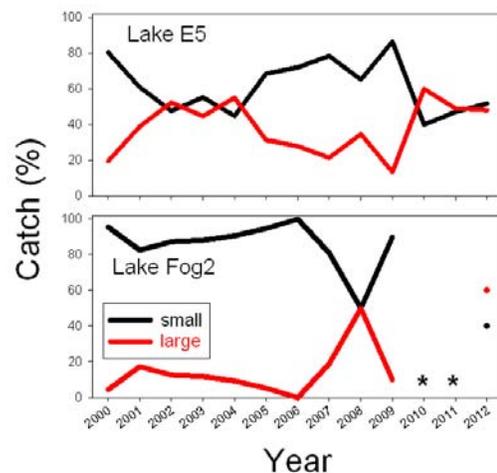


Figure 1. Percentage of catch (both angling and gill net) of small (<300 mm TL solid black line, circle) and large (≥ 300 mm TL dashed line, open circle) arctic char in lakes E5 and Fog2, 2000 to 2012. Asterisks indicate no char were caught in Lake Fog2 in 2010 and 2011.

LOGAN RIVER TROUT VIABILITY AND LONG-TERM MONITORING: FACTORS AFFECTING TROUT POPULATION DYNAMICS, ABUNDANCE, AND DISTRIBUTION IN THE LOGAN RIVER, UT

Dates:

2001-2012 (on-going)

Abstract:

Most subspecies of cutthroat trout *Oncorhynchus clarkii* are imperiled or extinct due to the combined effects of habitat degradation and interactions with exotic species. To quantify abundance and vital rates and evaluate trends, we selected a large population of Bonneville cutthroat trout *O. c. utah* from the Logan River of northern Utah, a river characterized by high-quality and connected habitat. Over a 12-year period, we completed a comprehensive population assessment, including depletion-based abundance estimates and a mark-recapture study (several thousand tagged fish) of site fidelity, growth, and survival. Abundance of Bonneville cutthroat trout (> 100 mm TL) varied greatly by sample site, ranging from 38 fish/km at the Third Dam site (the lowermost end of their distribution in the river) up to 822 fish/km at Franklin Basin. Population trend (λ) of cutthroat trout estimated for the entire Logan River population based on pooled site abundance estimates was 0.89 (0.77 – 1.02), indicating an apparent overall decline; however, site-specific population trends are highly variable. Clinical signs of whirling disease were observed in less than 1% of fish handled ($n > 14,000$ fish), while prevalence of *Myxobolus cerebralis* in cutthroat trout was 50 – 100%. The distribution of cutthroat trout and brown trout show a distinct species-zonation pattern (Figure 1). Our results provide important conservation and recovery benchmarks for identifying range-wide limiting factors of Bonneville cutthroat trout. We continue to recommend a precautionary approach to the management of this endemic and important population.

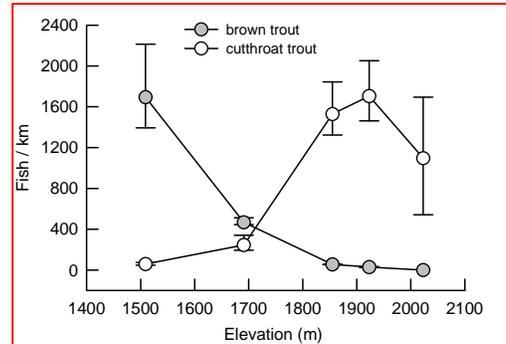


Figure 1. The brown trout and cutthroat trout species-zonation pattern of the Logan River, Utah. Estimates of average trout abundance (\pm range) based on three-pass electrofishing surveys at five long-term index sites.



Funding:

Utah Division of Wildlife Resources, US Geological Survey–UCFWRU (*in-kind*), Numerous partners!

Investigators:

Phaedra Budy, Principle Investigator, USGS-UTCFWRU, USU-Dept. of Watershed Sciences
Gary P. Thiede, Fisheries Biologist, USU-WATS
Harrison Mohn, MS student, USU-WATS
W. Carl Saunders, Post-doctoral Fellow, USU-WATS

Selected Publications:

Budy, P., G.P. Thiede, P. McHugh, E.S. Hansen, and J. Wood. 2008. Exploring the relative influence of biotic interactions and environmental conditions on the abundance and distribution of exotic brown trout (*Salmo trutta*) in a high mountain stream. *Ecology of Freshwater Fish* 17:554-566.
Budy, P., G.P. Thiede, J. Lobón-Cerviá, G.G. Fernandez, P. McHugh, A. McIntosh, L.A. Vøllestad, E. Becares, and P. Jellyman. 2013. Limitation and facilitation of one of the world's most invasive fish: an intercontinental comparison. *Ecology* 94(2)

QUANTIFYING BONNEVILLE CUTTHROAT TROUT MOVEMENT WITHIN THE LOGAN RIVER WATERSHED: INVESTIGATING THE POTENTIAL FOR A METAPOPULATION APPROACH TO CONSERVATION

Dates:

2009-2013 (on-going)

Abstract:

Few studies have been able to draw a correlation between fish movement and the spatially-structured population model commonly known as a metapopulation. The Logan River is a prime area to test metapopulation concepts by evaluating the population structure of Bonneville cutthroat trout (*Oncorhynchus clarki utah*) within the watershed, in part due to the extensive high quality habitat (64 rkm) in which they occupy. The goals of this research are to, (1) better understand spawning and movement of Bonneville cutthroat trout at the watershed scale, (2) understand large-scale movement during “non-spawning” times of the year, and (3) determine the level of site fidelity to spawning areas. To evaluate this, initial tagging with Passive Integrative Transponders (PIT) tags was completed during the summers of 2009-2012 within seven, 100-200 meter reaches of the Logan River using standard electrofishing, three-pass depletion techniques. Resight date and location data from cutthroat trout are currently being detected via stationary antennas, as well as mobile antennas used in strategic sections regularly. Using date and location observations from PIT tag readings, we will infer whether the Logan River is (1) a large panmictic population, (2) many small independent populations, or (3) a population that fits a hybrid model of the two. The findings of this research will provide fisheries managers with more detailed information on how cutthroat trout utilize the Logan River as a whole so that management decisions better protect Bonneville cutthroat trout populations during crucial times of the year and in critical areas.



Oncorhynchus clarki



Funding and Collaboration:

USDA Forest Service
Utah Division of Wildlife Resources
US Geological Survey (in-kind)
Numerous partners!

Investigators:

Phaedra Budy, Principal Investigator, US Geological Survey–UCFWRU, USU Dept. of Watershed Sciences
-Brett Roper, Principal Investigator, USDA Forest Service, USU Dept. of Watershed Sciences
-Gary P. Thiede, Fishery Biologist, USU Dept. of Watershed Sciences
-Harrison Mohn, Graduate Research Assistant (M.S.), USU Dept. of Watershed Sciences (expected graduation, spring 2014)

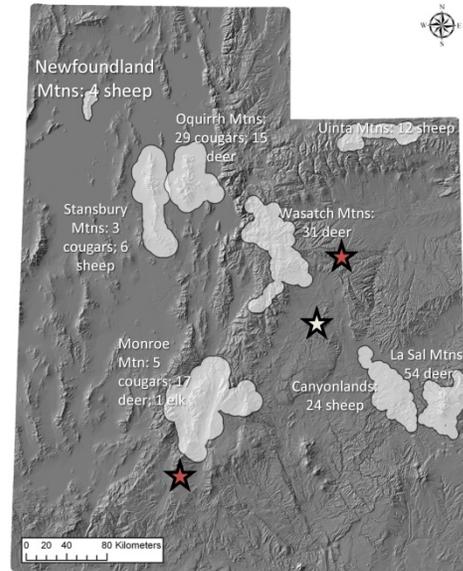
SPATIAL RESPONSES TO CLIMATE ACROSS TROPHIC LEVELS: MONITORING AND MODELING PLANTS, PREY, AND PREDATORS IN THE INTERMOUNTAIN WESTERN UNITED STATES

Dates:

2011-2015 (Ongoing)

Abstract:

We will investigate the impact of climate on trophic linkages between primary productivity, herbivores, and top predators across landscapes in the Intermountain western United States. We will deploy GPS collars on 30 mule deer and use the data collected to model spatial patterns of ungulate density on a 16-day interval based on remotely sensed vegetation phenology. The resulting dynamic ungulate habitat models will be used to extrapolate predictions of prey density across the study area, which we will then use as the main predictor for modeling cougar movement using a decade of records collected from 70 intensely monitored individuals across the region. Resulting occupancy surfaces will be modified by spatially-explicit estimates of survival from known fates of >200 cougars to derive analogs of density. With the cost and occupancy surfaces from this analysis, we will then analyze the habitat and movement of cougars as a network to assess the sustainability of the regional cougar metapopulation.



Eight Utah sites from which ungulate and cougar data were collected, 2002-current. Stars indicate sites where elk (red) and bighorn sheep (white) are currently collared (data will be available spring, 2014).

Funding:

National Aeronautics and Space Administration

Investigators:

Joe Sexton, University of Maryland (PI)

David Mattson, U.S. Geological Survey and Northern Arizona University (Co-PI)

Thomas C. Edwards, U.S. Geological Survey UTCFWRU and Utah State University (Co-PI)

David Stoner, Post-doctoral Research Associate, Utah State University

Reports:

None; new research start

Publications:

None; new research start

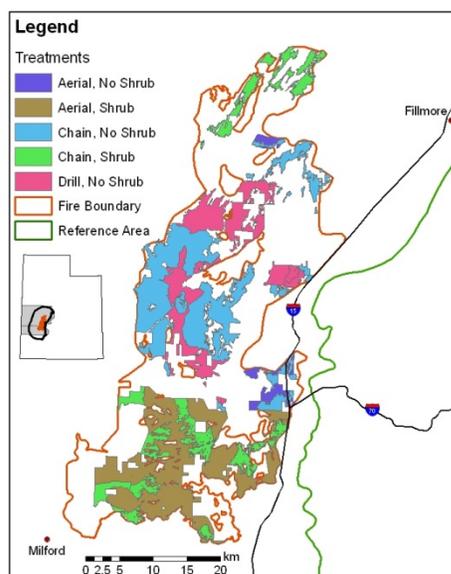
AVIAN RESPONSE TO POST WILDLAND FIRE RESEEDING TREATMENTS IN THE GREAT BASIN SHRUBSTEPPE

Dates:

2009-2012 (Completed)

Abstract:

The Milford Flat Fire was the largest wildfire recorded in Utah; considered catastrophic, concern exists that it would lead to a state change. To mitigate this state change, vegetation reseeding treatments were applied immediately post-fire. These treatments were two seed mix types, with or without a shrub component, and three mechanical applications, drill seeding, aerial seeding followed by chaining, and aerial seeding only. We are surveying the avian community in the different treatment types and in untreated areas within the fire. As there is no pre-fire data, we are sampling nearby areas of similar pre-fire habitat as reference. We are also collecting vegetation cover and structure data as covariates. These covariates will be used to identify any treatment effects.



Spatial locations of seeding treatments applied post-fire, Milford Flats, Utah

Funding:

Utah Division of Wildlife Resources

Investigators:

Thomas C. Edwards, U.S. Geological Survey UTCFWRU and Utah State University (PI)
Adam Brewerton, Graduate Research Assistant (MS Ecology)

Reports:

Brewerton, A. 2011. Avian response to post wildland fire reseeding treatments in Great Basin shrubsteppe. Unpublished M.S. Thesis, Utah State University, Logan, Utah.

Publications:

Brewerton, A., and T.C. Edwards, Jr. Effects of Fire Restoration Treatments on Shrubsteppe Passerines in the Great Basin. In review, *Rangeland Ecology and Management*

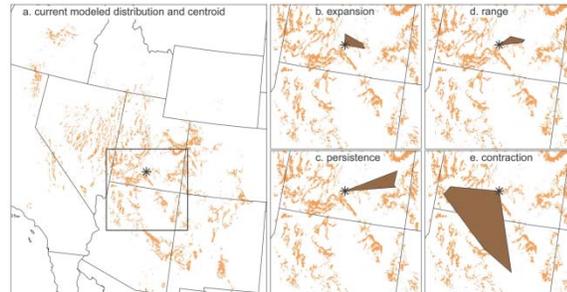
MODELLING CLIMATE CHANGE EFFECTS ON NORTH AMERICAN DRY MID-LATITUDE CONIFERS

Dates:

2009-2014 (Ongoing)

Abstract:

We are evaluating projected climate change effects on ~30 conifer species occupying the mid-dry latitudes of Western North America. The project involves three interrelated components. First, widely used climate projections (e.g., NCAR PM1) will be downscaled to 1km resolution for Western North America. Ensemble classifiers will next be used to model species distributions as functions of the downscaled climate variables to establish the relationships to current climate conditions. These models will then be linked with projected climate shifts and the potential shifts in species distributions evaluated. The third component focuses on defining the leading and trailing edges of the species distributions given projected climate changes.



Modeled expansion, persistence, and contraction of piñon juniper woodlands as a result of projected climate change over the next 80 years.

Funding:

USDA Forest Service, Rocky Mountain Research Station, FIA Program

Investigators:

Thomas C. Edwards, U.S. Geological Survey UTCFWRU and Utah State University (PI)
Gretchen G. Moisen, USDA Forest Service Rocky Mountain Research Station
Niklaus Zimmermann, Swiss Federal Research Lab WSL
Jacob Gibson, Graduate Research Assistant (MS Ecology 2011)

Reports:

None

Publications:

Gibson, J.R., G. G. Moisen, T.S. Frescino, N.K. Zimmermann, and T. C. Edwards, Jr. Effects of location "fuzz-swap" on species distribution models under projected climate change scenarios: how useful are projection models based on public data? In review, *Ecosystems*.

Gibson, J.R., G. G. Moisen, T.S. Frescino, N.K. Zimmermann, and T. C. Edwards, Jr. Individualistic responses of piñon and juniper distributions to projected climate change. In review, *Diversity and Distributions*.

HABITAT MODELLING OF RARE PLANT SPECIES ON THE COLORADO PLATEAU: SUPPORT OF BLM'S ECOREGIONAL ASSESSMENT

Dates:

2012-2016 (New)

Abstract:

Utah is home to 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 BLM lands. We will construct species distribution models for 6 rare plant species under consideration for listing by the FWS, and evaluate model capabilities to predict likely locations of the species. Research goal is to provide information to cooperators for use in the listing process.



Penstemon grahamii.
Picture from TNC.

Funding:

Bureau of Land Management

Investigators:

Thomas C. Edwards, U.S. Geological Survey UTCFWRU and Utah State University (PI)
Robert Fitts, Research II, Utah State University (Co-PI)

Reports:

None: new research start

Publications:

None; new research start

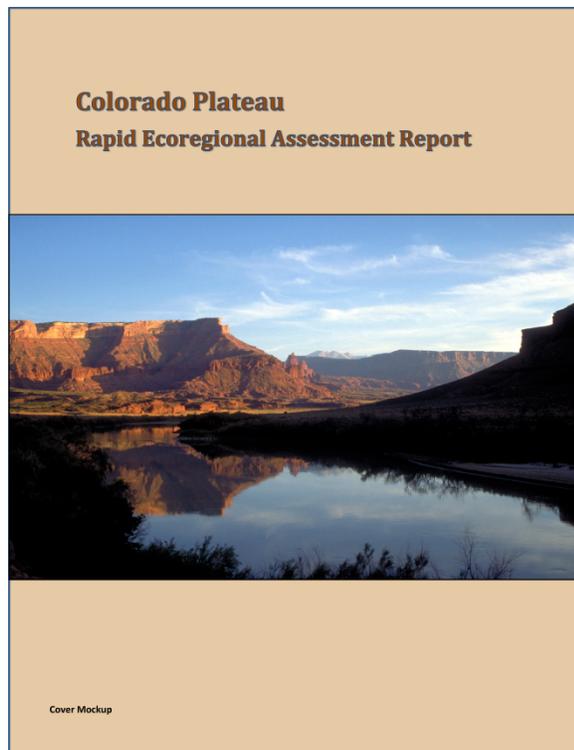
COLORADO PLATEAU BLM RAPID ECOREGIONAL ASSESSMENT

Dates:

2010-2012 Completed

Abstract:

Rapid Ecological Assessments (REAs) are a product of the Bureau of Land Management's evolution toward a landscape approach to land and resource management. Using the landscape approach, the BLM hopes to integrate available scientific data and information from BLM field offices, other federal and state agencies, and public stakeholders to develop shared responses and collaborative management efforts across administrative boundaries. Another objective of the REAs is to assess the current status of selected ecological resources (conservation elements) at the ecoregional scale and to investigate how this status may change in the future across several time horizons. REA results are expected to identify areas with high ecological integrity and high biological and ecological value—conservation areas, biological hotspots, and wildlife corridors—to provide a better understanding of key ecosystem processes and the potential impacts of future changes. REAs are timely in supporting planning, management, and mitigation strategies for impacts anticipated from various climate change scenarios as well as rapidly developing issues related to renewable energy development, the spread of invasive species, and changing fire regimes.



Funding:

Bureau of Land Management

Investigators:

Kate Kitchell, U.S. Geological Survey, Southwest Biological Science Center (Co-PI)
Thomas C. Edwards, U.S. Geological Survey UTCFWRU and Utah State University (Co-PI)
Other USGS Interdisciplinary Team Members

Reports:

Final REA Report submitted

Publications:

None expected

SUSTAINABLE COMMUNITIES AND LANDSCAPE DESIGNS

Dates:

2010-2015 (Ongoing)

Abstract:

Environmental sustainability is important to the well-being of people and communities. Land cover and land use are known to affect the quality of a wide range of ecosystem processes and services. The distribution and pattern of land-use activities within a landscape or watershed can dramatically affect the quality of ecosystem services and well-being of societies. However, few studies have documented how community and city designs might affect the sustainability of ecosystem services. Most applications of ecosystem services in community and city planning have either been entirely conceptual, or are very early on in the process. However, rapid environmental change (e.g., climate change) requires a more immediate understanding of the ability of landscape designs to support and sustain a range of ecosystem. This project will develop a set of landscape metrics and models to capture differences in landscape designs and will compare those indicator and model results to conditions of ecological attributes and ecosystem services. An outcome of the project will be new methodologies to evaluate sustainability of ecosystem services.

Funding:

U.S. Geological Survey

Investigators:

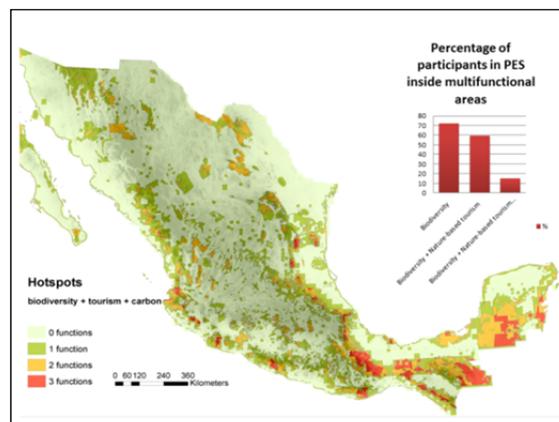
Thomas C. Edwards, U.S. Geological Survey UTCFWRU and Utah State University (PI)
Bruce Jones, U.S. Geological Survey (Co-PI)
Felix Kienast, Swiss Federal Research Lab WSL (Co-PI)
Lorena Segura Morán, Universidad Nacional Autónoma de México, Mexico

Reports:

None; research ongoing

Publications:

None; research ongoing



Large-scale depiction of the capacity of Mexico lands to deliver specific ecosystem services. Three functions evaluated here include gross biodiversity, nature tourism, and carbon sequestration.