ANNA E. STEEL

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Department of Wildlife, Fish, and Conservation Biology
University of California, Davis

EDUCATION

2015 (Degree awarded) **Ph.D.** in Ecology, University of California, Davis
Dissertation: "Movements of juvenile Chinook salmon in the Sacramento watershed, California"
Committee: Drs. A. Peter Klimley (Chair), J. Louise Conrad (CA Dept Water Resources), Peter B. Moyle

2001-2005 **B.A.** in Biology, Magna cum laude with honors, Whitman College
Undergraduate Thesis: "Pollination activity in a milkweed (*Asclepias*) hybrid zone"
Whitman Advisors: Drs. Charles Drabek, Joel Carlin (currently with Gustavus Adolphus College)
Research PI: Dr. Mark Fishbein (currently at Oklahoma State University, Stillwater, OK)

PROFESSIONAL HISTORY

2017 – present **Postdoctoral Research,** Dept of Environmental Science and Policy, UC Davis
Managed research on behavioral of juvenile sturgeon with sources of mortality (biotic and abotic) at water diversion structures. Expanded to assess movement trade-offs between foraging opportunities and predation risk, and the role of nutritional stress in mediating this tradeoff.
PI: Nann Fangue (UC Davis, Dept. of Fish, Wildlife, and Conservation Biology)

2015 - 2016 **Postdoctoral Research,** Dept of Environmental Science and Policy, UC Davis
Conducted analyses of survival rates and movement patterns of juvenile salmon in the Sacramento River, CA to parameterize an individual-based fish behavioral model (ELAM; Goodwin et al 2006), as well as address role of individual variation in movement. Results will be used to enhance and guide management planning processes for floodplain activation and water operations.
PI: David Smith (US Army Engineer Research and Development Center)
UC Davis Host: Andy Sih (UC Davis, Dept of Environmental Science and Policy)

2014 - 2015 **Research Assistant,** Center for Watershed Sciences, UC Davis
Designed and managed research on invertebrate community response to flow disturbance to aid in designing environmental flow regimes in managed rivers.
PI: Sarah Yarnell (UC Davis, Center for Watershed Sciences)

2011 **Visiting Research Assistant**, Universidad Catolica de Chile, Santiago, Chile
Analyzed catch data of benthic marine resources to develop models of population trends, and address the effect of new legal protections on populations outside of managed areas.
PI: Miriam Fernandez (Estación Costera de Investigaciónes Marinas)

2008 - 2014 **Doctoral Research,** Biotelemetry Laboratory, UC Davis
Examined the movement ecology and survival of largemouth bass and juvenile Chinook salmon, with emphasis on the influence of altered habitats, using fine-scale telemetry.
PI: A. Peter Klimley (UC Davis, Dept. of Fish, Wildlife, and Conservation Biology)

2007 - 2008 **Research Intern,** Point Blue (formerly Point Reyes Bird Observatory)

Conducted various surveys of avian populations, including mist-netting, nest searching, territory mapping, and area searches. Worked at both restoration and long-term monitoring sites.

PI: A. Peter Klimley (UC Davis, Dept. of Fish, Wildlife, and Conservation Biology)
Supervisors: Alicia Young, Renée Cormier

2004 **REU Research Student,** Mississippi State University

Observed insect pollinator activity on two species of *Asclepias* (Milkweed) occurring in a hybridization zone to evaluate potential vectors of hybridization. Also collected and extracted DNA samples to assess extend of hybridization and introgression.

PI: Mark Fishbein

TEACHING EXPERIENCE

Primary Instructor

2013 winter "Basics in R" (ECL 298) - Dept. Env. Science and Policy, UC Davis

Created and delivered course content to provide an introduction to data manipulation and analysis in the R statistical software program. Students included graduate students, post-doctoral scholars, and faculty members. Course structure followed a 'flipped-classroom' design to provide students with in-class opportunities to work through problem sets with the aid of myself, their peers, and teaching assistants.

2013 spring "Conservation Biology" (WFC 154) - Dept. Wildlife, Fish, and Cons. Biol., UC Davis

As co-instructor of this mandatory undergraduate course, I used principles of backwards-design (*sensu* Scientific Teaching by Handelsman et al.) to modify a large lecture-based course of approximately 120 students. The goal was to incorporate greater student engagement during class periods. We utilized strategies such as "think-pair-share" to encourage critical thinking, and small low-consequence assessments to facilitate student self-evaluation. Learning objectives were made explicit to aid students in processing and integrating key information.

2013 summer "Data manipulation and analysis in R" - Wildlife Conservation Society, San Pedro, Belize

Designed a one week workshop for conservation practitioners working with marine ecosystems in the Gulf of Mexico. The goal was to provide attendees with basic knowledge of the R statistical software to enable them to collaborate more effectively and leverage existing datasets to guide conservation actions.

CAMEOS Teaching Fellow

2012-13 CAMEOS program for inquiry based learning - NSF GK-12 program

Grant awarded to Dr. Susan Williams at Bodega Marine Labs, UC Davis

Partner teacher: Teri O'Donnell, Honors Biology, Maria Carrillo High School, Santa Rosa, CA

This NSF program placed graduate students into K-12 classrooms to partner with experienced teachers. I was placed with two 9-10th grade biology courses, and designed an inquiry-based curriculum to teach science as a process. I guided small groups of students as they designed, executed, and analyzed their own research during the course of the academic year. All students presented their findings at a professional symposium.

Guest Lectures

2015 – present "Biology and Conservation of Fishes" (WFC 120) -
Dept. Wildlife, Fish, and Cons. Biol., UC Davis
2015 "Natural History of California" (field course) -
Sierra Institute, UC Davis Extension Center
2015 "Introduction to Biology: Biodiversity, Evolution, and Ecology" -
American River Community College, Sacramento, CA

Public Outreach Lectures

2018 "Chinook Salmon: Return to Putah Creek" CreekSpeak Series; Davis, CA.

2015 "Movement ecology in a changing world" Point Blue Palomarin Field Station, Bolinas, CA.

2014 "Floods, food, and fish" California Fly Fishers Unlimited, Sacramento, CA.

2012 "Movement patterns of largemouth bass" Diablo Valley Fly Fishermen, Walnut Creek, CA.

2010 "Fine-scale movement of largemouth bass in vegetation beds and open water" Marin Rod and Gun Club, San Rafael, CA.

Teaching Assistant

2015 winter Naturalist and guide, "Ecogeomorphology of the Grand Canyon" (ECL 290) -
Dept of Env. Science and Policy, UC Davis
2014 spring Field techniques instructor & field course assistant, "Ecogeomorphology" (WFC 102) -
Dept of Env. Science and Policy, UC Davis
2012 winter Discussion leader, "Ecological Principles and Applications" (ECL 200b) -
Dept of Env. Science and Policy, UC Davis
2010 spring Computer laboratory instructor, "Population Dynamics and Estimation" (WFC 122) -
Dept of Wildlife, Fish, and Cons. Biol., UC Davis
2004-2005 Laboratory assistant, "The Biological World" (BIOL 122) - Biology Dept., Whitman College

Outdoor Education

2007 Outdoor School Instructor – Mendocino Woodlands, Fort Bragg, CA

2006 - 2007 Naturalist and guide for whale-watching tours – San Juan Safaris, San Juan Island, WA

PEER REVIEWED PUBLICATIONS

Steel, A.E., J.J. Anderson, B. Mulvey, D. Smith. *In review*. Applying the mean free-path length model to juvenile Chinook salmom migrating in the Saramento River, California. Environmental Biology of Fishes.

McInturf, A.G.*, **A.E. Steel**, M. Buckhorn, P. Sandstrom, C.J. Slager, N.A. Fangue, A.P. Klimley, D. Caillaud. *In review*. Examining behavioral response to current in broadnose sevengill sharks (*Notorynchus cepedianus*) using a hydrodynamic model. Journal of the Royal Society, Interface. **indicates a closely mentored student*

Steel, A.E., M.J. Hansen, D. Cocherell, N.A. Fangue. *In review*. Behavioral responses of juvenile white sturgeon (*Acipenser transmontanus*) to manipulation of nutritional state and predation risk. Environmental Biology of Fishes.

Baird, S.E.*, D. Cocherell, **A.E. Steel,** J.J. Cech, N.A. Fangue. 2018. California Native Chinook Salmon, *Oncorhynchus tshawytscha*, and Invasive Brook Trout, *Salvelinus fontinalis*, Prefer Similar Water Temperatures. Journal of Fish Biology. **indicates a closely mentored student*

Johnston, M.E., **A.E. Steel**, M. Espe, T. Sommer, A.P. Klimley, P. Sandstrom, D. Smith. 2018. Survival of juvenile Chinook salmon in the Yolo Bypass and the lower Sacramento River, California. San Francisco Estuary and Watershed Science, 16(2). https://escholarship.org/uc/item/8bq7t7rr

Steel, A.E., M. Thomas, A.P. Klimley. 2018. Reach specific use of spawning habitat by adult green sturgeon (*Acipenser meditostris*) under different operation schedules at Red Bluff Diversion Dam. Journal of Applied Ichthyology 1-8. doi: 10.1111/jai.13602

Steel, A.E., R.A. Peek, R.A. Lusardi, S.M. Yarnell. 2017. Associating metrics of hydrologic variability with benthic macroinvertebrate communities in regulated and unregulated snowmelt-dominated rivers. Freshwater Biology 1-15. doi: 10.1111/fwb.12994

Steel, A.E., B. Lemasson, D.L. Smith, J.A. Israel. 2017. Two-dimensional movement patterns of juvenile winter-run and late-fall run Chinook salmon at the Fremont Weir, Sacramento River, CA. US Army Corps of Engineers, Engineering Research and Development Center, Environmental Labs. Vicksburg, MS.

Steel, Z.L., **A.E. Steel**, J. Williams, J. Viers, P. Marquet, O. Barbosa. 2016. Patterns of bird diversity and habitat use in mixed vineyard-matoral landscapes of Central Chile. Ecological Indicators 73, 345-357.

Singer, G.P., **A.E. Steel**, D.L. Smith, B. Mulvey. 2015. Two-dimensional (2-D) Acoustic Fish Tracking at River Mile 85, Sacramento River, California – Water Year 2012. US Army Corps of Engineers, Engineering Research and Development Center, Environmental Labs. Vicksburg, MS.

Steel, A.E., J. Coates, A. Hearn, A.P. Klimley. 2014. Performance of an ultrasonic telemetry positioning system under varied environmental conditions. Animal Biotelemetry 2:15.

Steel, A.E., P. Sandstrom, P. Brandes, A.P. Klimley. 2013. Migration route selection of juvenile Chinook salmon at the Delta Cross Channel, and the role of water velocity and individual movement patterns. Environmental Biology of Fishes 96(2-3) 215-244.

Stoepler, T.M., A. Edge, **A.E. Steel**, R.L. O'Quinn, M. Fishbein. 2012. Variation in pollination effectiveness in a milkweed (*Asclepias*, Apocynaceae) hybrid zone. American Journal of Botany 99(3) 1:11.

PROFESSIONAL PRESENTATIONS

Steel A.E. D.E. Cocherell, J. Poletto, N.A. Fangue. "Screening water diversions to protect California sturgeons." National Sturgeon Workshop, Gloucester, MA. Oral Presentation. May 2018

Steel A.E., T. Nguyen, D.E. Cocherell, K. Carr, M.L. Kavvas, N.A. Fangue. "Juvenile behavior at a model louver, considering effects of size and environmental condition." Interagency Ecological Program, Annual Workshop, Folsom, CA. Oral Presentation. March, 2018.

Steel A.E., T. Nguyen, D.E. Cocherell, K. Carr, M.L. Kavvas, N.A. Fangue. "Testing hypotheses for low capture rates of juvenile green sturgeon at fish protection facilities: louver efficiency under various conditions" California-Nevada Chapter of the American Fisheries Society, San Luis Obispo, CA. Oral Presentation. February 2018

Steel A.E., S.M. Yarnell, R.A. Peek, R.A. Lusardi. "Natural and anthropogenic variability in spring snowmelt recession flows and association with benthic macroinvertebrate communities." Society for Freshwater Science, Sacramento, CA. Poster. May 2016.

Steel A.E., J.J. Anderson, D. Smith, B. Mulvey. "Evaluating survival and behavior of juvenile salmon using the mean free-path length model." Western Division of the American Fisheries Society, Reno, NV. Oral Presentation. March 2016.

Steel A.E. "Exploring null models of animal movement." University of California Davis, Postdoctoral Symposium, Davis, CA. Poster. May 2015.

Steel A.E., D. Smith, B Mulvey. "Mean free-path length model applied to Sacramento Valley Chinook salmon." American Fisheries Society, Quebec City, CAN. Oral Presentation. August 2014.

Awarded Best Student Oral Presentation:* **Steel A.E., A.P. Klimley. "Movement Patterns of the largemouth bass in a littoral habitat of the Sacramento-San Joaquin Delta." Bay-Delta Science Conference, Sacramento, CA. Oral Presentation. October 2012.

Steel, A.E., J. Coates, A. Hearn, A.P. Klimley. "Comparison of ultrasonic positioning systems under various environmental challenges." American Fisheries Society, St. Paul, MN. Oral Presentation. August 2012.

Steel A.E., A.P. Klimley. "Use of a telemetry positioning system to track largemouth bass (*Micropterus salmoides*) in a littoral habitat." American Fisheries Society, St. Paul, MN. Poster. August 2012.

Steel, A.E., M. Fernández, F. Vidal, A. Parma, N. Barahona, J. Guerra. "Efecto de la implementación de areas de manejo sobre la abundancia de *Fisurella* spp. en areas de libre acceso." (translation: "Effect of the implementation of management areas on the abundance of *Fisurella* spp. in open-access areas") Chilean Society of Conservation Biology, Puerto Varas, Chile. Poster. November 2011.

Steel A.E., A.P. Klimley. "Fine-scale movement of largemouth bass and potential for open-water predation." Interagency Ecological Program Workshop, Sacramento, CA. Oral Presentation, May 2010.

Steel, A.E., P. Sandstrom, P. Brandes, A.P. Klimley. "A Fork in the Road: Using a VPS Array to determine the tracks of salmon smolts at the sunction between mainstem Sacramento River and the Delta Cross Channel." Salmonid Telemetry Symposium, Bodega Bay, CA. Oral Presentation. May 2010.

Steel, A.E.. "Two paths diverged in the Sacramento Delta; fine-scale data on the migratory path decisions of salmonid smolts." American Fisheries Society, California-Nevada Chapter, Santa Rosa, CA. Poster. April 2008.

Stephenson (now Steel)**, A.E.** "Pollination activity in a milkweed (*Asclepias*) hybrid zone." Whitman Undergraduate Conference, Walla Walla, WA. Oral Presentation. April 2005.

Stephenson (now Steel)**, A.E**. "The Role of Pollinators in an *Asclepias* Hybrid Zone in Shenandoah National Park, VA." Murdock Undergraduate Conference, Portland, OR. Poster. November 2004.

PROFESSIONAL DEVELOPMENT

2013-2014	Professors For The Future, UC Davis - tri-weekly meetings with professional development speakers - enrollment in course on scientific ethics
2013-2014	CAMEOS, Bodega Marine Lab, UC Davis - instruction on pedagogy, based on Scientific Teaching by Handelsman et al. - instruction on scientific ethics
2012	"Exploring Student Diversity" Certification, Graduate Teaching Community, UC Davis
2012	"ArcGIS for fisheries biologists" Continuing Education Courses, Am. Fisheries Society

GRANTS

2016	Young Professional Travel Award, Western Division Am. Fish Soc ($482)
2014	Bob Bitner, California Fly Fishers Unlimited, merit scholarship ($2,600)
2012	Bob Wisecarver Diablo Valley Fly Fishermen, merit scholarship ($2,500)
2010	Marin Rod and Gun Club, merit scholarship ($1,500)
2008-2012	UC Davis, Graduate Group in Ecology, grants ($32,560)
2001-2005	Whitman College, merit scholarships ($44,000)

AWARDS and HONORS

2012 – 2013	NSF GK-12 Fellow, Bodega Marine Lab, UC Davis
2012 – 2013	Fellow in the 'Professors for the Future' program, UC Davis

Oct 2012	Best Student Oral Presentation – 7th Biennial Bay-Delta Science Conference
inducted 2005	Phi Beta Kappa, Walla Walla Chapter
inducted 2005	Order of Waiilatpu, Whitman College
May 2005	Cynthia Lechner Award for Outstanding Biology Senior, Whitman College

PROFESSIONAL SERVICE

2014 - 2016	Co-chair Education & Outreach Committee, Soc. for Conservation Biology, Davis chapter
2012 - 2013	Officer for Soc. for Conservation Biology, Davis chapter
2009 - 2010	Chair Ecology Graduate Student Association
2010	Planning committee member, UCD Ecology Symposium
2009 - 2010	Co-Chair Ecology Graduate Student Association
Manuscript Reviews:	Environmental Biology of Fishes
	Canadian Journal of Fisheries and Aquatic Sciences

PUBLIC OUTREACH

2014 - 2016	Mentor with SLEWS program (Student & Landowner Education and Watershed Stewardship)
	More information at https://landbasedlearning.org/slews
2014	Guest Scientist with "Women Outdoors with Science", rafting Lower Salmon River
	Girls summer science camp (6th – 9th grade) by McCall Outdoor Science School, ID

REFERENCES

Nann A. Fangue, Ph.D.
Postdoctoral Advisor
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Peter Klimley, Ph.D.
Ph.D. Advisor
Adjunct Professor, Retired from University of California, Davis
Current: Biotelemetry Consultant, 2870 Eastman Ln, Petaluma, CA 94952
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