

VALERIE J. MCKENZIE

Assistant Professor
Department of Ecology & Evolutionary Biology
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EDUCATION/ POSITIONS

- Assistant Professor, EBIO, University of Colorado (Fall 2009 - present)
- Staff Scientist, Animal/Disease Ecologist at the National Ecological Observatory Network (NEON) (2008 - 2009)
- Postdoctoral Research Associate: University of Colorado (2006 - 2008)
- Ph.D., Biology: University of California, Santa Barbara (2000 - 2005)
- M.S., Biology: University of Connecticut, Storrs, CT (1998-2000)
- B.S., Biology: University of Connecticut, Storrs, CT (1993-1997)
Graduated in Honors Program

RESEARCH EMPHASIS

My research interests combine the fields of parasitology, disease ecology, and wildlife conservation. I am interested in understanding the ways in which anthropogenic disturbances (e.g., land use, invasive species, aquaculture, wetland management) affect the parasites, pathogens, and symbiotic microbes of wildlife. In the realm of conservation biology, the goal of my research is to identify key factors that lead to shifts in the abundance and distribution of parasites and pathogens in order to offer ecologically informed solutions to mitigate disease threats to vulnerable wildlife. From a theoretical perspective, I am interested in the ways in which the host interacts with microbial symbionts and how those interactions can shape biological functions ranging from disease tolerance to evolution of new traits.

PEER-REVIEWED PUBLICATIONS

* Indicates last author position and research product of the McKenzie lab

Loudon AH, Venkataraman A, VanTreuren W, Woodhams DC, Parfrey LW, **McKenzie VJ**, Knight R, Schmidt T, and R Harris. (Accepted pending revision). Vertebrate hosts as islands: dynamics of selection, immigration, loss, persistence, and function of bacteria on salamander skin. *Frontiers in Microbiology* (IF=3.9).

Woodhams DC, Bletz MC, Kueneman JG, **McKenzie VJ***. (Accepted) Managing amphibian disease with skin microbiota. *Trends in Microbiology* (IF=9.2).

Rebollar EA, Antwis RE, Becker MH, Belden LK, Bletz MC, Brucker RM, Harrison XA, Hughey MC, Kueneman JG, Loudon AH, **McKenzie VJ**, Medina D, Minbiole KPC, Rollins-Smith LA, Walke JB, Weiss S, Woodhams DC, and RN Harris. (Accepted) Using “omics” and integrated multi-omics approaches to guide probiotic selection to mitigate chytridiomycosis and other emerging infectious diseases. *Frontiers in Microbiology* (IF=4).

Vences M, Lyra ML, Kueneman JG, Bletz MC, Archer HM, Canitz J, Handreck S, Randrianiaina RD, Struck U, Bhujji S, Jarek M, Geffers R, **McKenzie VJ**, Tebbe CC, Haddad CFB, Glos J. (Accepted). Gut bacterial communities across tadpole ecomorphs in two diverse tropical anuran faunas. *Naturwissenschaften* (IF=2.1).

Kueneman JG, Woodhams DC, Van Treuren W, Archer HM, Knight R, and **VJ McKenzie*** 2015. Inhibitory bacteria are associated with reduced fungi on early developmental life stages of endangered Colorado boreal toads (*Anaxyrus boreas*). *ISME Journal* (IF=9.3)

Holden WM, Hanlon SM, Woodhams DC, Chappell TM, Wells HL, Glisson SM, **McKenzie VJ**, Knight R, Parris MJ, and L Rollins-Smith. 2015. Skin bacteria provide early protection for newly metamorphosed southern leopard frogs (*Rana sphenoccephala*) against the frog-killing fungus, *Batrachochytrium dendrobatidis*. *Biological Conservation* (IF=3.8), DOI: 10.1016/j.biocon.2015.04.007

Woodhams DC, Alford R, Archer HM, Becker M, Belden L, Bell SC, Bletz M, Davis L, Flechas V, Lauer A, Harris RN, Holden W, Hughey M, Ibañez R, Kueneman JG, Reinert L, Rollins-Smith L, Roman-Rodriguez F, Walke J, Knight R, and **VJ McKenzie***. 2015. Antifungal isolates database of amphibian skin-associated bacteria and function against emerging fungal pathogens: *Ecological Archives* E096-059. *Ecology* (IF=5.2), 96(2), 595-595.

Peterson, A. C. and **V.J. McKenzie***. 2014. Investigating differences across host species and scales to explain the distribution of the amphibian pathogen *Batrachochytrium dendrobatidis*. *PLoS ONE*, 9(9), e107441.

Woodhams, D. C., Brandt, H., Baumgartner, S., Kielgast, J., Küpfer, E., Tobler, U., Davis, L.R., Schmidt, B.R., Bel, C., Hodel, S., Knight, R., and **V.J. McKenzie***. 2014. Interacting symbionts and immunity in the amphibian skin mucosome predict disease risk and probiotic effectiveness. *PLoS ONE*, 9(4), e96375

Loudon, A.H., Woodhams, D.C., Parfrey, L.W., Archer, H.M., Knight, R., **McKenzie, V.J.**, and R.N. Harris. (2014). Microbial community dynamics and effect of environmental microbial reservoirs on red-backed salamanders (*Plethodon cinereus*). *ISME Journal*, 8(4), 830-840.

Kueneman, J.G., Parfrey L.W., Woodhams, D.C., Archer, H.M., Knight, R., and **V.J. McKenzie*** (2014). The amphibian skin-associated microbiome across species, space and life history stages. *Molecular Ecology*, 23(6), 1238-1250. (Invited for special issue entitled, "Nature's Microbiome".)

Peterson, A.C., Richgels, K.L.D., Johnson, P.T.J., and **V.J. McKenzie***. 2013. Investigating the dispersal routes used by an invasive amphibian, *Lithobates catesbeianus*, in human-dominated landscapes. *Biological Invasions*. doi 10.1007/s10530-013-0442-y

McKenzie, V.J., Hall, W.E., and R.P. Guralnick. 2013. New Zealand mudsnails in Boulder Creek, Colorado: environmental factors associated with fecundity of a parthenogenic invader. *Canadian Journal of Zoology* 91: 30-36.

McMahon, T.A., Brannelly, L.A., Chatfield, M.W.H., Johnson P.T.J., Joseph, M.B., **McKenzie, V.J.**, Richards-Zawacki, C.L., and J.R. Rohr. 2012. The chytrid fungus, *Batrachochytrium dendrobatidis*, has non-amphibian hosts and releases chemicals that cause pathology in the absence of infection. *PNAS*. doi: 10.1073/pnas.1200592110

Hufft Kao, R., Gibson, C.M., Gallery, R.E., Meier, C.L., Barnett, D.T., Docherty, K.M., Blevins, K.K., Travers, P.D., Azuaje, E., Springer, Y.P., Thibault, K.M., **McKenzie, V.J.**, Keller, M., Alves, L.F., Hinckley, E.S., Parnell, J., and D. Schimel. 2012 NEON Terrestrial field observations: designing continental-scale, standardized sampling. *Ecosphere* 3(12) article 115.

McKenzie, V.J. and A.C. Peterson. 2012. Pathogen pollution and the emergence of a deadly amphibian pathogen. *Molecular Ecology* 21: 5151-5154.

Johnson, P.T.J., Hoverman[†], J.T., **McKenzie, V.J.**, Blaustein, A.R., and K.L.D. Richgels[†]. 2012. Urbanization and wetland communities: applying metacommunity theory to understand the local and landscape effects. *Journal of Applied Ecology*. doi: 10.1111/1365-2664.12022

Saviola, A.J., **McKenzie, V.J.**, and D. Chizar. 2012. Predatory behavior responses to chemical and visual stimuli in five species of colubrid snakes. *Acta Herpetologica* 7(1): 91-103.

McKenzie, V.J., Bowers, R.M., Fierer, N., Knight, R., and C.L. Lauber. 2011. Co-habiting amphibian species harbor unique skin bacterial communities in wild populations. *ISME Journal*. doi:10.1038/ismej.2011.129.

Johnson, P.T.J., **McKenzie, V.J.**, Peterson, A.C., Kerby, J.L., Brown, J., Blaustein, A.R., and Jackson, T. 2011. Regional decline of an iconic amphibian species: understanding multi-scale patterns of leopard frog declines in Colorado. *Conservation Biology*. DOI: 10.1111/j.1523-1739.2010.01645

- McKenzie, V.J.** and N. Goulet. 2010. Bird community composition linked to human West Nile virus cases along the Colorado Front Range. *EcoHealth*. doi:10.1007/s10393-010-0360-8.
- Johnson, P.T.J., Townsend, A.R., Cleveland, C.C., Glibert, P., Howarth, R.W., **McKenzie, V.J.**, Rejmankova, E., and M. Ward. 2010. Linking nutrient enrichment and disease emergence. *Ecological Applications* 20(1): 16-29.
- Johnson, P.T.J. and V.J. McKenzie. 2008. Effects of environmental change on helminth infections in amphibians: exploring the emergence of *Ribeiroia* and *Echinostoma* infections in North America. In *The Biology of Echinostomes*, eds. B. Fried and R. Toledo. Springer Science.
- McKenzie, V.J.** and H.A. Starks. 2008. Blood parasites of two Costa Rican amphibians with comments on detection and microfilaria density associated with adult filarial worm intensity. *Journal of Parasitology* 94 (4): 824-829.
- McKenzie, V.J.** and A.R. Townsend. 2007. Parasitic and infectious disease responses to a changing nitrogen cycle. *EcoHealth* 4: 384-396.
- McKenzie, V.J.** 2007. Human land use and patterns of parasitism in tropical amphibian hosts. *Biological Conservation* 137 (1): 102-116.
- Torchin, M.E., Lafferty, K.D., Dobson, A.P., McKenzie, V.J. and A.K. Kuris. 2003. Introduced species and their missing parasites. *Nature* 421: 628-630.
- McKenzie, V.J.** and J.N. Cairn. 1998. Three new genera of tapeworms from the longnose sawshark, *Pristiophorus cirratus*, with description of their modes of attachment to the spiral intestine. *Journal of Parasitology* 84 (2): 409-421.

NON PEER-REVIEWED PUBLICATIONS

- McKenzie, V.J. and A.C. Peterson[†]. Submitted. Amphibian conservation in Colorado: understanding the links between land use change, invasive species, and infectious disease. US Golf Association: *Turfgrass and Environmental Research Online (TERO)*.
- McKenzie, V.J. and M.E. Torchin. 2010. Introduction of Armand Kuris, recipient of the 2010 Clark P. Read mentor award. *Journal of Parasitology* 96(6): 1041-1043.
- Dosch[†], K.L., Johnson, P.T.J., and V.J. McKenzie. 2009. Northern Leopard Frog (*Lithobates pipiens*) sampling protocol. Prepared for the Colorado Division of Wildlife. 40pp.

FUNDING AND AWARDS

* Indicates grants awarded since the date of hire at CU (n=7)

- ***Templeton Foundation: \$977,501**, 2013-2016
Project title: Convergent evolution of the vertebrate microbiome.
PI: Valerie McKenzie (collaborator: Rob Knight)
- ***Keck Foundation: \$1M**, 2013-2016.
Project title: The Earth Microbiome Project.
PI: Rob Knight, coPIs (alphabetical): Aaron Clauset, Robin Dowell, Noah Fierer, Jack Gilbert, Ryan Gill, Janet Jansson, Manuel Lladser, Valerie McKenzie
- ***Bat Conservation International: \$2,800**, 2013-2014
Project title: To the bat cave: unraveling environmental influences on bat symbionts.
PI: Valerie McKenzie, Collaborator: Christine Avena (graduate student)
- ***NSF - Population and Community Ecology Section: \$400,000**, 2012-2014.
Project title: Symbiotic microbial communities on amphibian skin and their role in disease resistance. PI: Valerie McKenzie, coPI: Rob Knight.
- ***Boulder County Open Space: \$6,238**, 2011-2012.
Project title: Distribution of an invasive species and an amphibian pathogen in the Front Range of Colorado. PI: Valerie McKenzie. Collaborator: Anna Peterson (graduate student).
- ***CU Innovative Grant Program, Faculty Seed Grant: \$48,942**, 2010-2011.
Project title: Symbiotic microbial communities on amphibian skin and their role in disease resistance. PI: Valerie McKenzie.
- ***National Fish and Wildlife Foundation: \$60,000**, 2009-2012.

- Project title: Restoring Colorado wetlands to benefit native amphibians.
PI: Valerie McKenzie, coPI: Pieter Johnson.
- **NSF - Ecology section, \$372,911**, 2008-2011.
Project title: Linking land use change, host diversity, and amphibian malformations.
PI: Pieter Johnson, coPIs: Valerie McKenzie and Alan Townsend.
 - **Colorado Division of Wildlife: \$43,592**, 2008-2009.
Project title: Effects of land use, invasions and disease on Colorado's Northern leopard frog (*Rana pipiens*). PI: Pieter Johnson, coPI: Valerie McKenzie.
 - **World Wildlife Fund**: Kathryn Fuller Postdoctoral Fellowship 2008, runner-up finalist.
 - **Best poster award** at the meeting of UC TSR&TP (Toxic Substances Research & Teaching Program), April, 2005.
 - **UC TSR&TP** (University of California Toxic Substances Research & Teaching Program) **Graduate Student Fellowship: \$25,000**, 2004-2005
Project title: The effects of nutrient pollution on parasite abundance in freshwater ecosystems.
 - **Worster Mentor Fellowship at UCSB: \$2,500**, 2003
Project: mentor an undergraduate intern for a summer field research experience collecting protozoan parasites of amphibians in Costa Rica,.
 - **Mellon Organization for Tropical Studies/ Smithsonian Tropical Research Institute: \$2,300**, 2002. Project: PhD research on parasites of tropical amphibians in Costa Rica.
 - **EPA STAR Doctoral Fellowship: \$80,000**, 2000-2003
Support for 3 years of doctorate research on parasites of tropical amphibians.
 - **Best Student Paper Presentation Award**: Metazoan parasites of Guatemalan reptiles and amphibians. Student paper competition, 75th Annual Meeting of the American Society of Parasitologists, August, 2000, San Juan, Puerto Rico.

TEACHING AT CU

- **Conservation Biology** (EBIO/ENVS 3040), a 4 unit large undergraduate course.
- **Parasitology** (EBIO 3630), a 4 unit upper division undergraduate course with a laboratory.
- **Parasites and Pathogens** (EBIO 6120), 1-2 units, graduate seminar.
- **Conservation Medicine** (EBIO 4800/5800), a 3 unit critical thinking course.
- 2009-present: CU. Guest lecturer in **Entomology** (Bowers/Nufio), **Disease Ecology** (Johnson), **Community Ecology** (Davies)

MENTORSHIP AT CU

2013 – Summer: Mentor for SMART student, Franklin Roman from University of Puerto Rico
2012 – present: Advisor for postdoctoral research associate: Dr. Doug Woodhams.
2012-2013: Mentor for Fairview Highschool student, Natalie Griffin, winner of the Boulder Valley Science Fair for her project conducted in the McKenzie lab.
2011 – Summer: Mentor for SMART student, Alexis Brown from Baltimore Maryland
2010 – present: Advisor for four graduate students in EBIO Dept.: Anna Peterson (Masters student), Lisette Arellano, Christine Avena and Jordan Kueneman (PhD students).
2009 – 2014: Advisor for four Undergraduate Honors students, Nicolas Goulet, Robert Adams*, Julia Moy*, Alexandra Fresch* (*indicates highest Summa honors awarded)

SERVICE

- EBIO Budget Committee (Fall 2014 - present)

MCKENZIE CV

- EBIO Learning Goals Committee (Spring 2015 - present)
- EBIO Graduate Committee (3 terms - Fall 2010 – Spring 2013)
- EBIO Curriculum Committee (2009-2014)
- EBIO Merit Evaluation Committee (2013)
- CU Innovative Seed Grant Panelist (2011)
- NSF Integrative Organismal Systems Panelist (2012)
- NSF Division of Environmental Biology Panelist (2014)
- Reviewer for Journals and Grant Programs

OUTREACH

- Chytrid Hack Design Session, promoted by Conservation X Labs at the Smithsonian Conservation Biology Institute (October 2014)
- Parasite Family Day at the CU Natural History Museum (January 2013)
- Organizing member of the Americas Latinos Festival (2013 and 2014)
- Member of Colorado Partners in Amphibian and Reptile Conservation (2009-present)

INVITED PRESENTATIONS

- McKenzie, V.J. (2015) "Ecology of the amphibian skin microbiome," Invited Plenary Speaker at the **Colorado Partners in Amphibian and Reptile Conservation** annual meeting, Greeley, Colorado.
- McKenzie, V.J. (2014) "The ecology of emerging wildlife disease from the global scale to the microbial scale," Invited Colloquium Speaker at **University of Auckland**, Auckland, New Zealand.
- McKenzie, V.J. (2013) "Wildlife disease, from the landscape scale to the microbial scale," Invited colloquium speaker at **University of Costa Rica**, San Jose, Cost Rica.
- McKenzie, V.J. (2013) "Wildlife disease, from the landscape scale to the microbial scale," Invited colloquium speaker at **University of New Mexico**.
- McKenzie, V.J. (2012) "Landscape-scale dynamics of amphibian parasites across human-altered ecosystems," Invited colloquium speaker at **Tulane University**.
- McKenzie, V.J. (2012) "From tapeworms to microbes, versatility is key to a career in parasitology," Invited oral presentation. **American Society of Parasitologists**, Richmond, Virginia.
- McKenzie, V.J. (2011) "Parasitic and infectious disease responses to changing global nutrient cycles," Invited speaker at **University of Colorado's** Hydrologic Sciences Symposium.
- McKenzie, V.J. (2011) "Landscape-scale dynamics of amphibian parasites across human-altered ecosystems," Invited colloquium speaker at **University of Northern Colorado** Biology Department.
- McKenzie, V.J. (2007) "Parasitic and infectious disease responses to changing global nutrient cycles." Invited speaker at the Environmental Science Dept. colloquium series, March 2, 2007, **University of Colorado**.
- McKenzie, V.J. (2005) "A modeling approach to explore the relationship between aquatic eutrophication and parasitic disease." Invited speaker at the **University of California** Toxic Substances Research and Teaching Program Annual Meeting, Sacramento, California.

CONTRIBUTED PRESENTATIONS

- McKenzie, V.J. (2014) "Amphibian skin microbial community responses to *Batrachochytrium dendrobatidis*: a time series experimental approach," oral presentation in Organized Oral Session. Ecological Society of America (ESA), Sacramento, CA.
- McKenzie, V.J. (2013) "Non-amphibian hosts for chytrid", oral presentation at the Boreal Toad Recovery Team Meeting, Fort Collins, CO.
- McKenzie, V.J. (2012) "Your health and your microbes: symbiotic microbial communities and their role in host pathogen tolerance," oral presentation. EcoHealth Conference, Kunming, China.
- McKenzie, V.J. (2012) "Co-habiting amphibian species harbor unique skin bacterial communities in wild populations," oral presentation. American Society of Parasitologists, Richmond, Virginia.
- McKenzie, V.J. (2012) "Landscape scale dynamics of amphibian disease across human-altered ecosystems," oral presentation. World Herpetological Congress, Vancouver, British Columbia, Canada.
- McKenzie, V.J. (2011) "Co-habiting amphibian species harbor unique skin bacterial communities in wild populations," oral presentation. Ecological Society of America meeting, Austin Texas.
- McKenzie, V.J. (2010) "Human land use and patterns of parasitism in amphibian hosts," oral presentation. American Society of Parasitologists Annual Meeting, Colorado Springs, Colorado.
- McKenzie, V.J. and M.E. Torchin (2010) "Introduction of Armand Kuris, 2010 recipient of the Clark P. read Mentor Award," oral presentation. American Society of Parasitologists Annual Meeting, Colorado Springs, Colorado.
- McKenzie, V.J. (2009) "The U.S. National Ecological Observatory Network (NEON): A new large facility initiative," poster presentation. Ecological Society of America Annual Meeting, Albuquerque, New Mexico.
- McKenzie, V.J. (2008) "The U.S. National Ecological Observatory Network (NEON): A new large facility initiative," poster presentation. EcoHealth meeting, Merída, Mexico.
- McKenzie, V.J. (2007) "Human land use and patterns of parasitism in amphibian hosts." Ecological Society of America meeting, San Jose, California.
- McKenzie, V.J. (2006) "Tropical land use and amphibian parasites." EcoHealth meeting, Madison, Wisconsin.
- Townsend, A.R., V.J. McKenzie, R. Howarth, and L. Martinelli. (2006) "Brown clouds, green water, and red herrings: Human health effects of an altered nitrogen cycle." Ecological Society of America Annual Meeting, Memphis, Tennessee.
- McKenzie, V.J. (2006) "Distribution and abundance of amphibian parasites: anthropogenic effects associated with land use in Costa Rica." University of Colorado, EBIO Brown bag lunch seminar series, February 8, 2006.
- McKenzie, V.J. (2004) "The influence of habitat type on the parasite communities of three species of frogs from Costa Rica." Ecological Society of America Annual Meeting, Portland, Oregon.
- McKenzie, V.J. (2003) "Endoparasite communities of three species of frogs from Costa Rica." American Society of Parasitologists Annual Meeting, Halifax, Nova Scotia.
- McKenzie, V.J. and J.N. Caira (2000) "Metazoan parasites of Guatemalan reptiles and amphibians." American Society of Parasitologists Annual Meeting, San Juan, Puerto Rico.
- McKenzie, V.J. (1998) "Phyllobothriid cestodes of sharks from the Gulf of California." American Society of Parasitologists Annual Meeting, Kona, Hawaii.
- McKenzie, V.J. (1996) "Three new genera of tapeworms from the longnose sawshark, *Pristiophorus cirratus*." American Society of Parasitologists Annual Meeting, Tuscon, Arizona.

RESEARCH AND FIELD EXPERIENCE PRIOR TO FACULTY HIRE

2008-2009 **NEON staff scientist:** As an animal and infectious disease ecologist at the National Ecological Observatory Network, based in Boulder Colorado, I developed the plans and scientific design for the observatory at 60 sites across the US. Specifically, I developed technical protocols, and budgets for small mammals, birds, beetles, mosquitoes, West Nile Virus, dengue virus, Lyme disease, and hantavirus.

- 2007-2008 **Post-doctoral research:** CU. Field studies on the links between land use, invasive species, and amphibian disease risk in the CO front range, in collaboration with Dr. Pieter Johnson (EBIO). Received a CO research collecting permit, an approved IACUC protocol, and permission to work in Boulder Open Space and public lands in several counties.
- 2006-2007 **Post-doctoral research:** CU. Field studies on invasive New Zealand mudsnails in Boulder, CO. I am examining temporal patterns of density and fecundity in collaboration with Dr. Rob Guralnick (EBIO).
- 2006-2007 **Post-doctoral research:** CU. Analysis of the relationships between anthropogenic nutrient pollution and infectious disease in collaboration with Dr. Alan Townsend (EBIO/INSTAAR).
- 2000-2005 **Doctoral Research:** UCSB. Amphibian parasites in Costa Rica, examining the role of anthropogenic land-use in parasite community structure.
- 2002-2003 **NCEAS Working Group:** Collaborative research on the parasite communities of animals in their native vs. non-native range. Work resulted in a *Nature* publication.
- 1998-2000 **Master's Research:** U. of CT. NSF funded survey of the reptiles and amphibians of Guatemala, collaborating with herpetologists from the University of Texas at Arlington. Examined 150 species of reptiles and amphibians for metazoan parasites throughout Guatemala.
- 1997-1999 **Visiting scientist:** Gulf Coast Research Laboratory, MS. Parasitology training in the laboratory of Dr. Robin Overstreet.
- 1996-1997 **Field biologist:** NOAA Apex Predator Investigation, NMFS. Shark tagging/parasite research cruises in the western Atlantic Ocean.
- 1995-1996 **Field biologist:** Undergraduate, U. of CT NSF Survey of the Metazoan Parasites of Elasmobranchs of the Gulf of California, with P.I. Janine Caira of the U. of CT. Assisted in the collection of parasites from sharks, skates, and rays in Baja, México.
- 1994-1996 **Undergraduate research:** U. of CT Discovered and formally described three new genera of tapeworms from shark hosts. Acquired training in light microscopy, histological sectioning, and scanning electron microscopy.