

Molecular and Genetic Ecology at WERC

Updated:
June 2011

Contact:
Amy Vandergast
Lizabeth Bowen

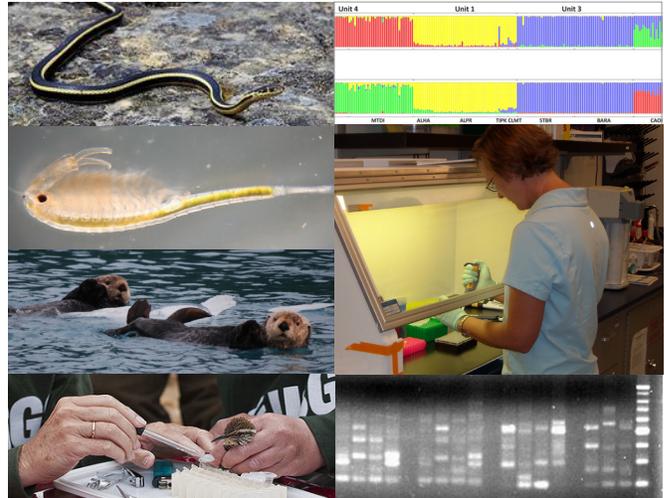
Email:
avandergast@usgs.gov
lbowen@usgs.gov

Phone:
619-225-6445
530-752-9720

U.S. Geological Survey | Western Ecological Research Center | 3020 State University Dr. East, Suite 3006, Sacramento, CA 95819

Genetic and molecular analyses have become powerful and essential tools for conservation biology and environmental monitoring. Researchers at the **USGS Western Ecological Research Center (WERC)** are advancing research in two fields of science with critical applications for federal, state and local conservation and land use issues.

As a U.S. Geological Survey science center, WERC research efforts are part of the greater USGS mission to provide sound scientific information to federal, state, local and international agencies. We invite collaborations with resource managers, academia and area partners to develop new analytical methods and survey efforts — collaborations that enhance our understanding of our changing landscapes and ecosystems.



Landscape Genetics

- Led by Amy Vandergast and Robert Fisher at the WERC San Diego Field Station.
- Research focuses on identifying unique wildlife populations and gene-flow corridors over a landscape, through genetic and genomic analyses.
- Findings can help determine impacts of land use change and habitat fragmentation; assess the success of habitat corridors and other conservation instruments; estimate population size; or delineate endangered populations.
- Molecular markers include microsatellites, Single Nucleotide Polymorphisms (SNPs) and DNA sequences.
- Equipment includes 454 Genome Sequencer GS Junior system, and partnerships with San Diego State University Microchemical Core Facility.
- Computer models developed include the Genetic Landscapes GIS Toolbox, using ArcGIS to visualize population genetic structure across geographic space.
- Field station hosts tissue archive of over 400 species from Australia, New Zealand, South Africa, South/Central/North America with focus on California, in addition to development of a centralized, GIS-tagged "multi-taxa database" to standardize cross-agency records.

Gene Transcription

- Led by Keith Miles and Lizabeth Bowen at the WERC Davis Field Station.
- Research focuses on identifying markers expressed by activated genes as responses to specific stressors — providing the ability to assess an individual animal's exposure to disease, contaminants and parasites through simple blood samples.
- Gene transcription analysis greatly enhances environmental monitoring capabilities, providing timely evidence of wildlife exposure to stressors.
- Methods are adapted from human medicine and utilize markers in RNA chains transcribed in the cell during protein formation.
- Application development began with wild sea otters, based on laboratory mink models. Markers tentatively identified to-date include those expressed as a result of petroleum exposure, tumor growth, and serotonin production, and will be used in coastal health studies.
- Researchers currently investigating exposure markers in Mojave desert tortoises, and opportunity exists for identifying suites of gene transcription markers in other wildlife species.

WERC Principle Investigators in Genetics

San Diego Field Station - Landscape Genetics

<http://www.werc.usgs.gov/sandiego>

Amy Vandergast, avandergast@usgs.gov
Robert N. Fisher, rfisher@usgs.gov

Davis Field Station - Gene Transcription

<http://www.werc.usgs.gov/davis>

A. Keith Miles, keith_miles@usgs.gov
Lizabeth Bowen, lbowen@usgs.gov

WERC Genetics Research Projects

Potential Impact of Renewable Energy Development on

Desert Wildlife: Construction of electricity transmission corridors and renewable energy facilities in the CA/NV deserts are likely to impact wildlife movement and genetic integrity. WERC researchers will use niche modeling and landscape genetic analyses **to map suitable habitat, movement and gene flow corridors** for as many as 30 species of concern throughout the Mojave Desert. For more information, contact Ken Nussear at knussear@usgs.gov

Rare and Endangered Species Population Surveys: To assist species management plans of the **U.S. Fish and Wildlife Service** and other agencies, WERC conducts comprehensive genetic surveys to map patterns of population genetics and delineate units for conservation. Species include Riverside fairy shrimp, three-spined stickleback, Santa Ana sucker, California red-legged frog, blunt-nosed leopard lizard, Alameda whipsnake, narrow-headed garter snake, Tucson shovel-nosed snake, western pond turtle, southwestern willow flycatcher. Amy Vandergast at avandergast@usgs.gov

Evolutionary Hotspots for Conservation Planning: WERC established an evolutionary framework for Southern California with which to evaluate land conservation plans. Researchers gathered 21 mitochondrial DNA datasets from different species, helping to pinpoint geographic regions where genetic divergence is particularly high and whether these hotspots fall within currently protected lands. Visit <http://www.werc.usgs.gov/Project.aspx?ProjectID=167>

Impacts of Urbanization on Southern California Wildlife:

WERC researchers are assessing how roadways and urban development are fragmenting wildlife populations and community structure. Target species span multiple taxa and ranges of mobility, including bobcats and songbird, reptile and insect species. Visit <http://www.werc.usgs.gov/Project.aspx?ProjectID=168>

Post-Wildfire Impacts on Population Connectivity: Climate change and human impacts are altering fire regimes in the Pacific Southwest, which could permanently fragment landscapes or cause habitat type conversion. WERC is exploring landscape genetics analysis as a way to assess post-fire impacts on wildlife populations. Initial efforts include coastal cactus wren and California gnatcatcher. Contact Amy Vandergast at avandergast@usgs.gov

FOR ADDITIONAL INFORMATION:

WERC CENTER DIRECTOR

Steven E. Schwarzbach, steven_schwarzbach@usgs.gov

WERC RESOURCE MANAGERS PORTAL

Search for genetics keywords in our Products Database, or learn more about WERC researchers and stations. Online at:

<http://www.werc.usgs.gov/OutreachForResourceManagers.aspx>

WERC EVENTS LISTING

Interact directly with WERC scientists at upcoming workshops and conferences. Browse the calendar online:

<http://www.werc.usgs.gov/Events.aspx>

Genetic Landscapes GIS Toolbox: Originally developed for an ecoregional assessment of genetic divergence patterns of Southern California wildlife, the program contains four tools to **map and summarize multiple genetic landscapes** as average and variance surfaces in ArcGIS. Together, these tools automate a series of calculations and data manipulations to create genetic landscape surfaces directly from tables containing genetic distance or diversity data and sample location coordinates. To download, visit <http://www.werc.usgs.gov/ProductDetails.aspx?ID=4017>

Pacific Nearshore Ecosystem Health: Under the USGS Pacific Nearshore Project co-led by WERC researchers, researchers are using sea otters as an indicator species to compare coastal health from CA to AK. Gene transcription analysis will be applied to sea otter blood and tissue samples **to assess exposure to stressors, contaminants and parasites**. Combined with watershed modeling, food web productivity and other environmental data, this multi-agency project will study linkages between natural/human inputs and coastal health. For more, visit: <http://on.doi.gov/nearshore>

Southern Sea Otter Conservation: California sea otters are federally listed as threatened. To assess their exposure to stressors and to determine causes of poor population recovery, WERC is comparing sea otter health at Big Sur and Monterey through gene transcription analysis. Contact Tim Tinker at ttinker@usgs.gov

Desert Tortoise Conservation: Transcription markers correlating to environmental stress are now being explored in Mojave desert tortoises, also a threatened species. Contact Ken Nussear at knussear@usgs.gov and Todd Esque at todd_esque@usgs.gov

WERC Genetics Research Partners

- USGS Alaska Science Center • USGS National Wildlife Health Center • Bureau of Land Management • National Park Service
- U.S. Fish and Wildlife Service • Department of Fisheries and Oceans, Canada • CA Department of Parks and Recreation
- CA Department of Fish and Game • San Diego Monitoring and Management Program • AZ Department of Game and Fish
- University of California-Davis • San Diego State University • California Academy of Sciences • Monterey Bay Aquarium