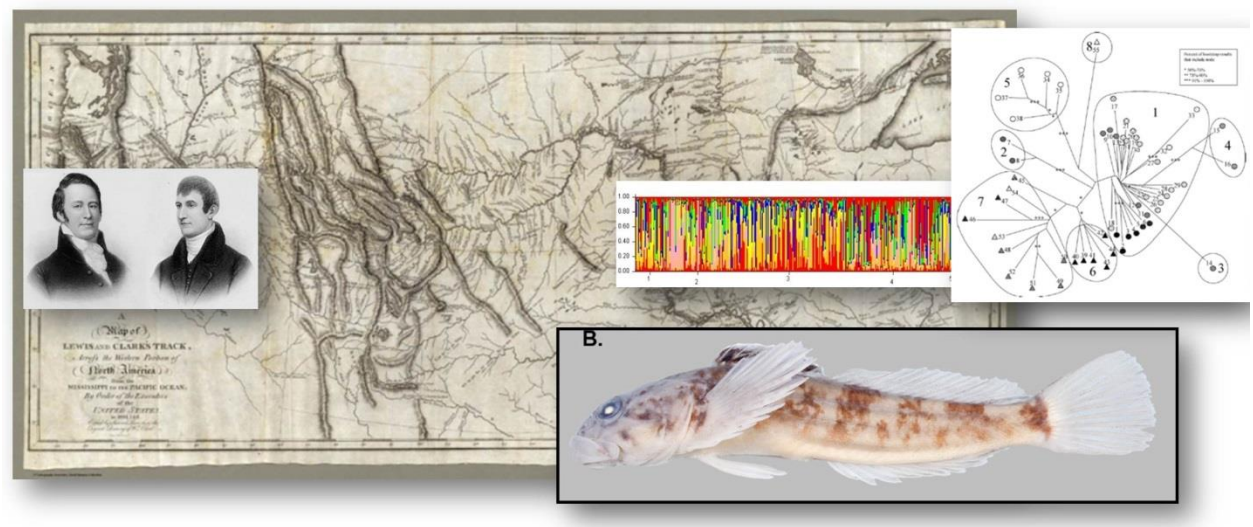
Climate-Aquatics Blog #53: DNA Barcoding & Fish Biodiversity Mapping



Hi Everyone,
Ray Troll once famously asked, "Fish Worship, is it Wrong?" A rhetorical question—no doubt—for this crowd. But as it turns out, there are instances when we may not be worshipping the fish we thought we were. For even in densely sampled regions like the Northern Rockies, it appears we may have been overlooking a few important details as Lemoine and colleagues just brought to our attention with their new species description (graphic 1; study hyperlinked here: http://www.treesearch.fs.fed.us/pubs/45377). It's not that many-o-fish biologist hasn't seen/handled these fish before, it's just that no one bothered to look closely enough look to fully appreciate the Cedar sculpin (*Cottus schitsuumsh*) in all its majesty.

The ability to appreciate & understand that majesty is growing rapidly as costs for genetic analysis continue to decrease and things like DNA barcoding enable industrial scale processing of samples. Combined with the fact that it's so easy to collect the necessary tissue samples from fin clips during electrofishing rodeos (graphic 2; Blog #30), and the door is swinging wide open on a new era of fish biodiversity surveys that will yield unprecedented genetic spatial resolution. In fact, it's exactly that sort of survey which ultimately prompted the realization there might be a new fish species in our midst. The original survey & associated DNA barcoding techniques are described more fully in Young and colleagues (graphic 3; study hyperlinked here: http://www.treesearch.fs.fed.us/pubs/43346), and it's interesting to note the author's contention

that there may be several additional undescribed species yet lurking in tissue samples from the same set of surveys.

It's exciting stuff to think that the next edition of ichthyology books may require some significant additions & revisions, but also a sobering reminder that there's still a lot we don't know about our fishy friends. And better knowing those details, and their spatial distribution across landscapes, is going to be absolutely critical to managing, conserving, and preserving those friends through this transitional century (graphic 4).

Until next time, best regards,

Dan

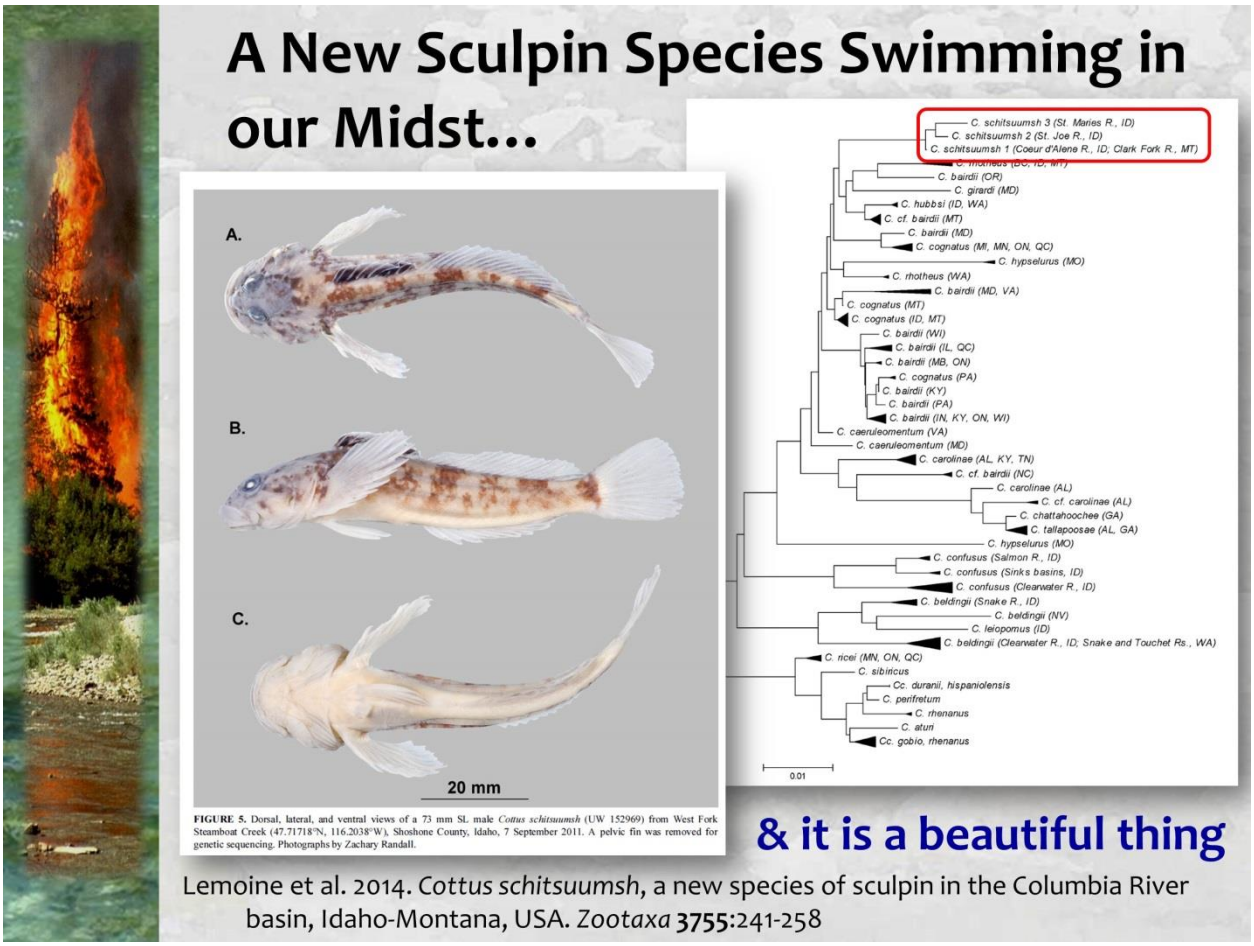
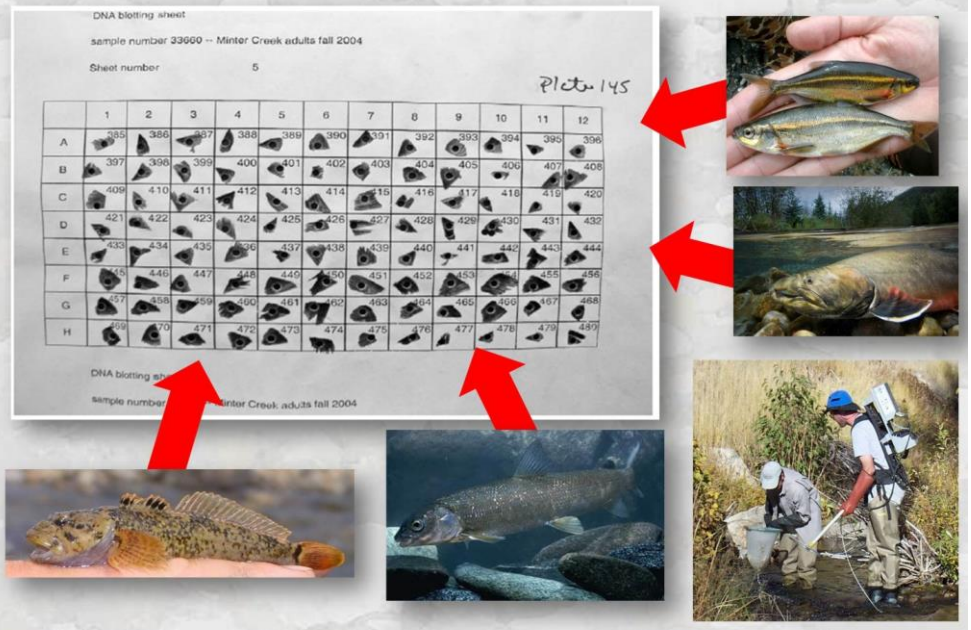


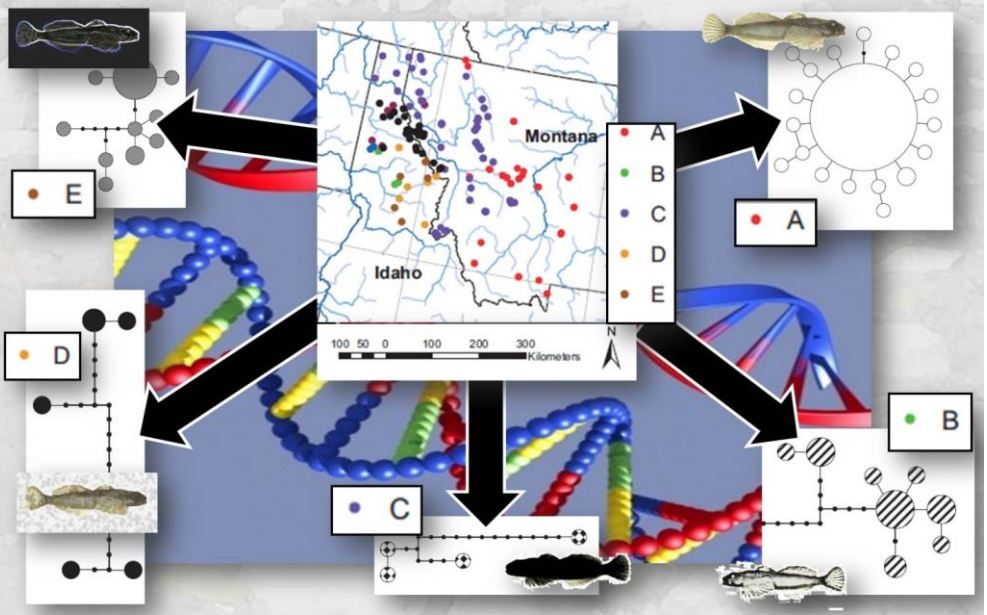
FIGURE 5. Dorsal, lateral, and ventral views of a 73 mm SL male *Cottus schitsuumsh* (UW 152969) from West Fork Steamboat Creek (47.7171°N, 116.2038°W), Shoshone County, Idaho, 7 September 2011. A pelvic fin was removed for genetic sequencing. Photographs by Zachary Randall.

Fin Tissue Samples Easily & Inexpensively Preserved on Chromatography Paper

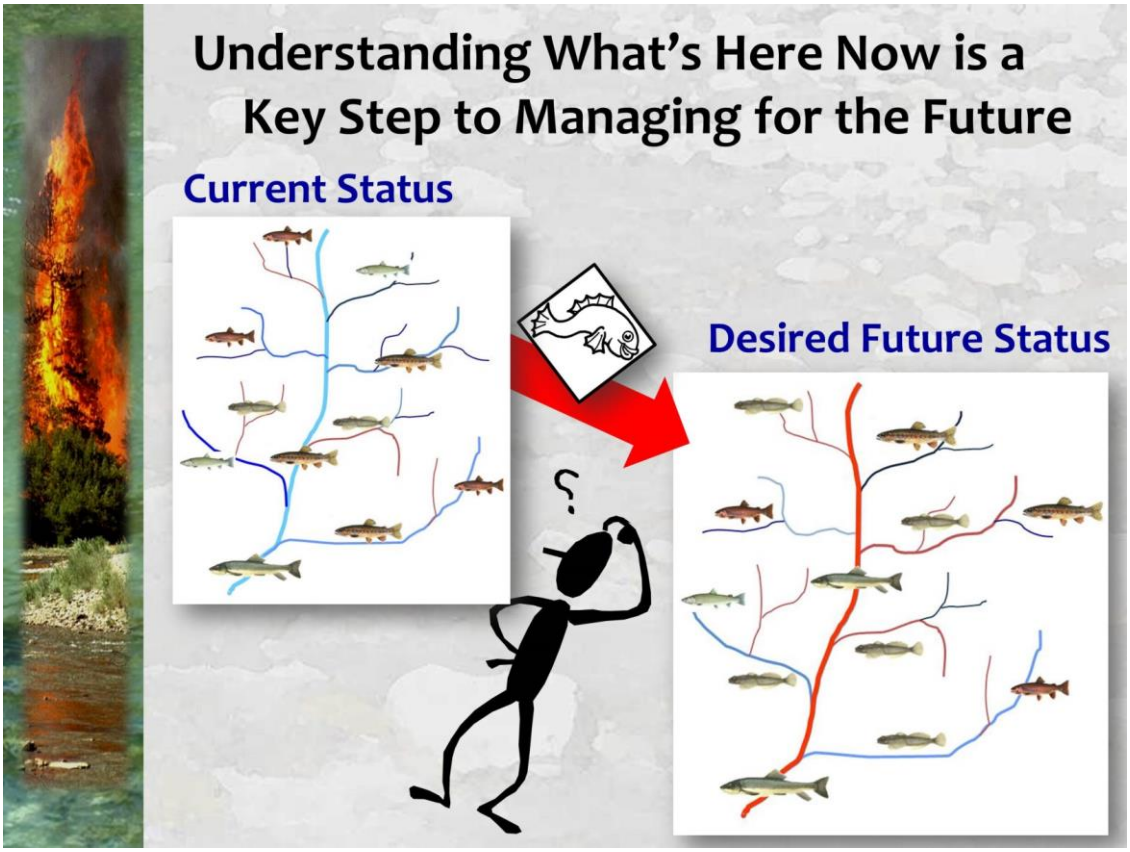


LaHood et al. 2008. A rapid, ethanol-free fish tissue collection method for molecular genetic analysis. *Trans. American Fisheries Society* **137**:1104-1107.

DNA Barcoding = Industrial Scale Genetic Analysis Yields Unprecedented Spatial Resolution



Young et al. 2013. DNA barcoding at riverscape scales: assessing biodiversity among fishes of the genus *Cottus* in northern Rocky Mountain streams. *Molecular Ecology* doi: 10.1111/1755-0998.12091


Understanding What's Here Now is a
Key Step to Managing for the Future
Current Status
Desired Future Status


Not Just Mothers Should Love
These Pretty Faces Anymore
1 cm

Welcome to the Climate-Aquatics Blog. For those new to the blog, previous posts with embedded graphics can be seen by clicking on the hyperlinks at the bottom or by navigating to the blog archive webpage on our Forest Service site at: (http://www.fs.fed.us/rm/boise/AWAE/projects/stream_temp/stream_temperature_climate_aquatics_blog.html). To discuss these topics with other interested parties, a Google discussion group has also been established and instructions for joining the group are also on the webpage. The intent of the Climate-Aquatics Blog and associated discussion group is to provide a means for the 6,551 (& growing) field biologists, hydrologists, anglers, students, managers, and researchers currently on this mailing list across North America, Europe, and Asia to more broadly and rapidly discuss topical issues associated with aquatic ecosystems and climate change.

Messages periodically posted to the blog will highlight new peer-reviewed research and science tools that may be useful in addressing this global phenomenon. Admittedly, many of the ideas for postings have their roots in studies I and my colleagues have been a part of in the Rocky Mountain region, but attempts will be made to present topics & tools in ways that highlight their broader, global relevance. Moreover, I acknowledge that the studies, tools, and techniques highlighted in these missives are by no means the only, or perhaps even the best, science products in existence on particular topics, so the hope is that this discussion group engages others doing, or interested in, similar work and that healthy debates & information exchanges will occur to facilitate the rapid dissemination of knowledge among those concerned about climate change and its effects on aquatic ecosystems.

If you know others interested in climate change and aquatic ecosystems, please forward this message to them. If you do not want to be contacted again in the future, please reply to that effect and you will be de-blogged.

Previous Blogs…

Climate-Aquatics Overviews
Blog #1: Climate-aquatics workshop science presentations available online
Blog #2: A new climate-aquatics synthesis report

Climate-Aquatics Thermal Module
Blog #3: Underwater epoxy technique for full-year stream temperature monitoring
Blog #4: A GoogleMap tool for interagency coordination of regional stream temperature monitoring
Blog #5: Massive air & stream sensor networks for ecologically relevant climate downscaling
Blog #6: Thoughts on monitoring air temperatures in complex, forested terrain
Blog #7: Downscaling of climate change effects on river network temperatures using inter-agency temperature databases with new spatial statistical stream network models
Blog #8: Thoughts on monitoring designs for temperature sensor networks across river and stream basins
Blog #9: Assessing climate sensitivity of aquatic habitats by direct measurement of stream & air temperatures
Blog #10: Long-term monitoring shows climate change effects on river & stream temperatures

Blog #11: Long-term monitoring shows climate change effects on lake temperatures
Blog #12: Climate trends & climate cycles & weather weirdness
Blog #13: Tools for visualizing local historical climate trends
Blog #14: Leveraging short-term stream temperature records to describe long-term trends
Blog #15: Wildfire & riparian vegetation change as the wildcards in climate warming of streams
Blog #23: New studies describe historic & future rates of warming in Northwest US streams
Blog #24: NoRRTN: An inexpensive regional river temperature monitoring network
Blog #25: NorWeST: A massive regional stream temperature database
Blog #26: Mapping thermal heterogeneity & climate in riverine environments
Blog #40: Crowd-sourcing a BIG DATA regional stream temperature model

Climate-Aquatics Hydrology Module
Blog #16: Shrinking snowpacks across the western US associated with climate change
Blog #17: Advances in stream flow runoff and changing flood risks across the western US
Blog #18: Climate change & observed trends toward lower summer flows in the northwest US
Blog #19: Groundwater mediation of stream flow responses to climate change
Blog #20: GIS tools for mapping flow responses of western U.S. streams to climate change
Blog #21: More discharge data to address more hydroclimate questions
Blog #22: Climate change effects on sediment delivery to stream channels

Climate-Aquatics Cool Stuff Module
Blog #27: Part 1, Spatial statistical models for stream networks: context & conceptual foundations
Blog #28: Part 2, Spatial statistical models for stream networks: applications and inference
Blog #29: Part 3, Spatial statistical models for stream networks: freeware tools for model implementation

Climate-Aquatics Biology Module
Blog #30: Recording and mapping Earth's stream biodiversity from genetic samples of critters
Blog #31: Global trends in species shifts caused by climate change
Blog #32: Empirical evidence of fish phenology shifts related to climate change
Blog #33: Part 1, Fish distribution shifts from climate change: Predicted patterns
Blog #34: Part 2, Fish distribution shifts from climate change: Empirical evidence for range contractions
Blog #35: Part 3, Fish distribution shifts from climate change: Empirical evidence for range expansions
Blog #36: The "velocity" of climate change in rivers & streams
Blog #37: Part 1, Monitoring to detect climate effects on fish distributions: Sampling design and length of time
Blog #38: Part 2, Monitoring to detect climate effects on fish distributions: Resurveys of historical stream transects
Blog #39: Part 3, Monitoring to detect climate effects on fish distributions: BIG DATA regional resurveys
Blog #41: Part 1, Mechanisms of change in fish populations: Patterns in common trend monitoring data

Blog #42: BREAKING ALERT! New study confirms broad-scale fish distribution shifts associated with climate change
Blog #43: Part 2, Mechanisms of change in fish populations: Floods and streambed scour during incubation & emergence
Blog #44: Part 3, Mechanisms of change in fish populations: Lower summer flows & drought effects on growth & survival
Blog #45: Part 4, Mechanisms of change in fish populations: Temperature effects on growth & survival
Blog #46: Part 5, Mechanisms of change in fish populations: Exceedance of thermal thresholds
Blog #47: Part 6, Mechanisms of change in fish populations: Interacting effects of flow and temperature
Blog #48: Part 7, Mechanisms of change in fish populations: Changing food resources
Blog #49: Part 8, Mechanisms of change in fish populations: Non-native species invasions
Blog #50: Part 9, Mechanisms of change in fish populations: Evolutionary responses
Blog #51: Part 10, Mechanisms of change in fish populations: Extinction
Blog #52: Review & Key Knowable Unknowns

Future topics…
Climate-Aquatics Management Module

Climate-Aquatics End Game