Climate-Aquatics Blog #42: BREAKING ALERT! New study confirms broad-scale fish distribution shifts associated with climate change

Read all about it!!!!!!

Hi Everyone,
It had to happen sooner or later and now it has. A new study (attached) published in *Ecography* by Lise Comte and Gael Grenouillet, entitled "Do stream fish track climate change? Assessing distribution shifts in recent decades" provides strong empirical evidence for broad-scale distribution shifts in dozens of stream fish species across France. The study used a BIG DATA approach (Blog #'s 39 and 40) wherein 3,500+ sites were sampled to determine species distributions in an early period (1980's) and a more recent period (2000's). Distribution models were developed from data for each period separately, then comparisons made between periods for the locations of upstream and downstream distributional boundaries (Graphic 1). Of the 32 species assessed, 25 showed evidence of upstream distribution shifts (Graphic 2) as per the general predictions from the bioclimatic models (Blog #33). The shifts were not monotonic in nature although some types of shifts were much more common than others (Graphic 3). The average rate of distribution shift at range center (0.6 km/decade) also lagged the average climate velocity in streams across France (14.2 km/decade; Blog #36), which means that species are often moving more slowly than their thermal niches (Graphic 4). Even in streams without barriers to impede dispersal, therefore, some species and populations could well be overcome by shifting isotherms in future decades and lose the climate race.

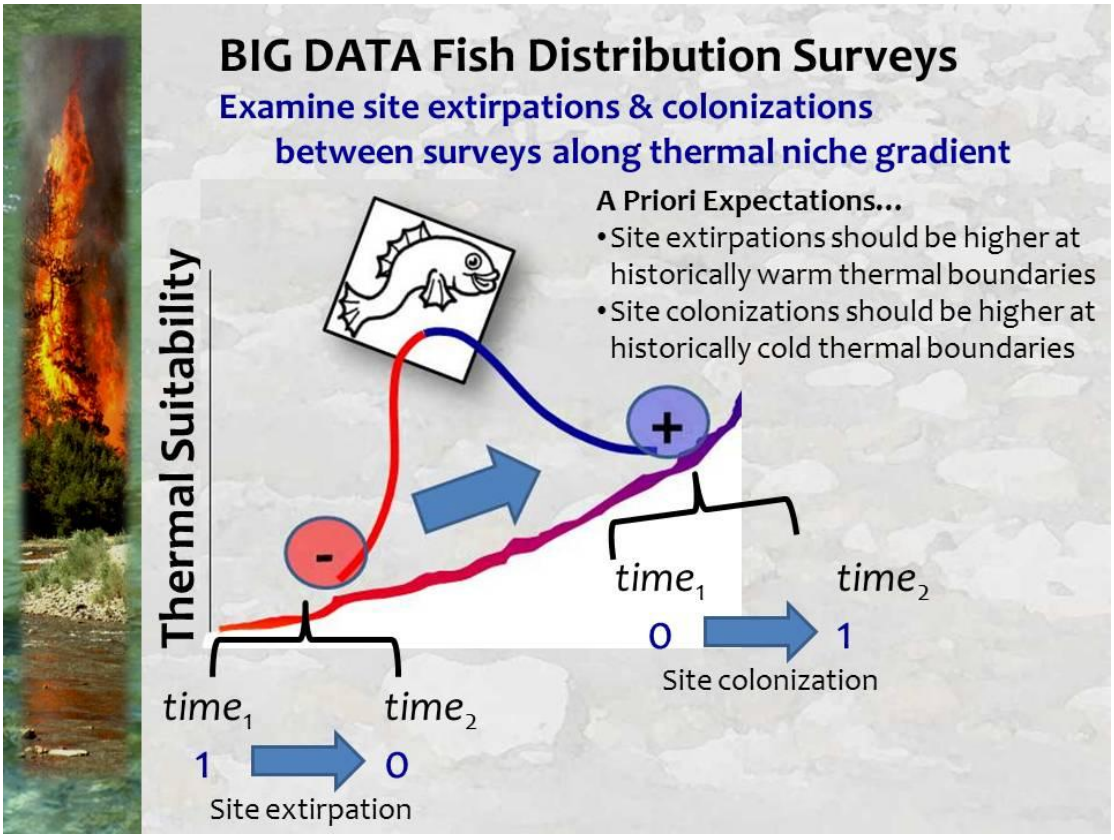
Comte & Grenouillet's study is a watershed event because it provides biological evidence in support of the basic predictions made by some 20+ fish bioclimatic models in previous decades (Blog #33). The fact that most fish species are behaving like their terrestrial brethren and shifting to higher elevations & cooler areas as the climate warms appears now to be largely corroborated. Climate change is real & is having real effects on something as fundamental as the distribution of species across river networks and regional/national river drainages. There's nuance and detail, of

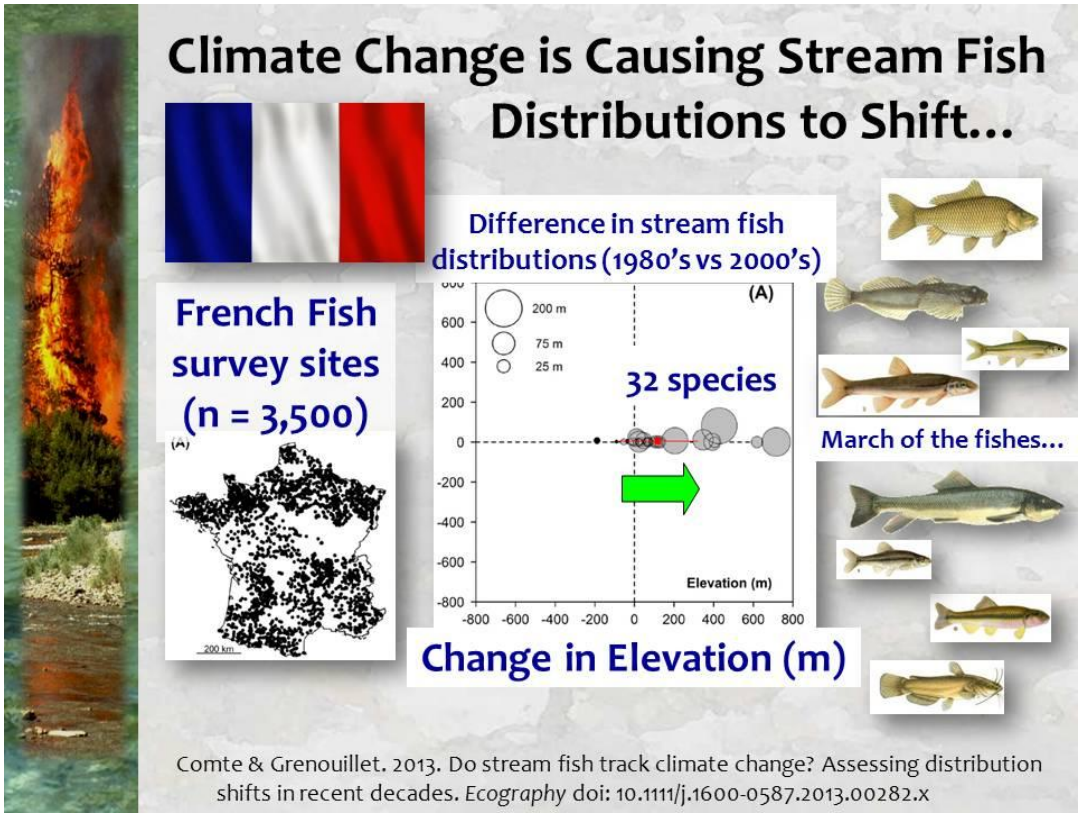
course, which have yet to be resolved, & we need scientists to replicate these results in other parts of the world, but this study should stimulate those efforts and add impetus to our actions as we grapple with the phenomenon of climate change and its effect on aquatic ecosystems.

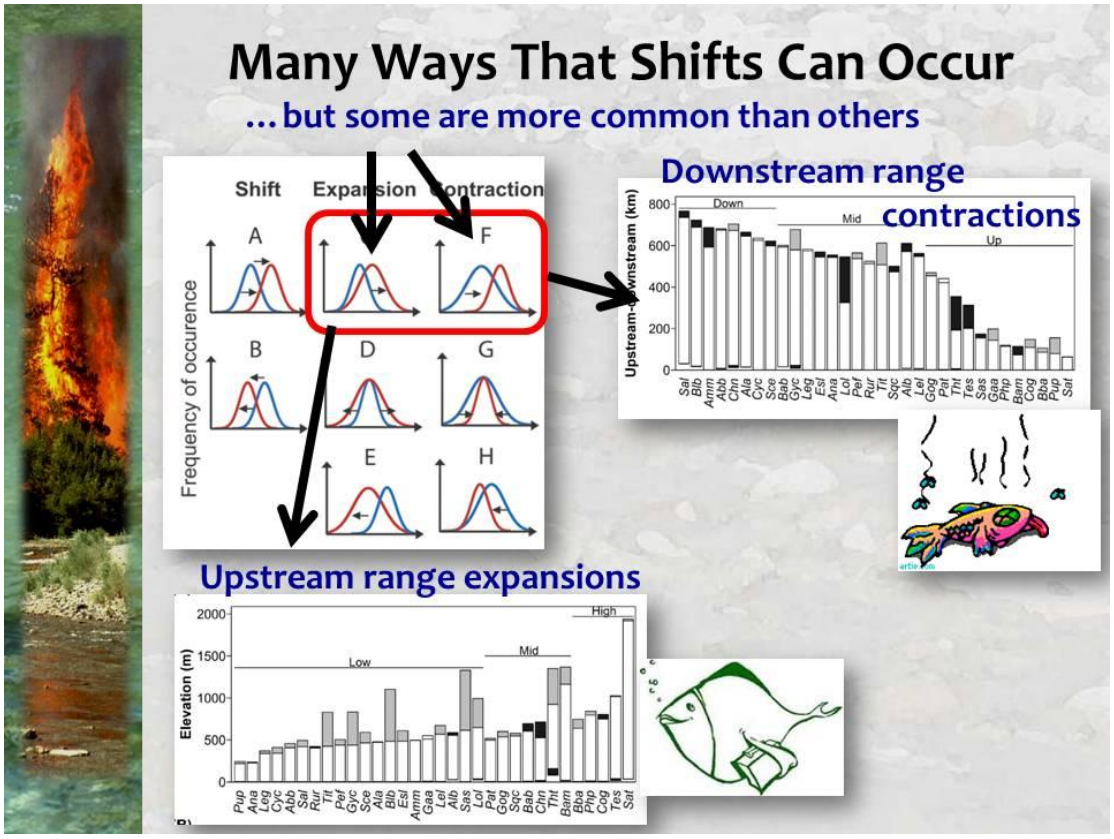
So congratulations to Lise & Gael for being the global fish-X prize winners (Graphic 5). As per earlier contest disclaimers, recall that there is no monetary remuneration accompanying this silly prize, just the eternal esteem of, and recognition by, the global fish community for providing an answer to one of the day's most pressing questions. You are now two famously fishy people. To further spread your fame, I'd direct interested readers to some of Lise & Gael's previous research on this topic that helped lay the foundation for this signature achievement (http://gael.grenouillet.free.fr/grenouillet_publications.html).

Next time out, we'll resume our regularly scheduled programming with part 2 of the "mechanisms" blog module.

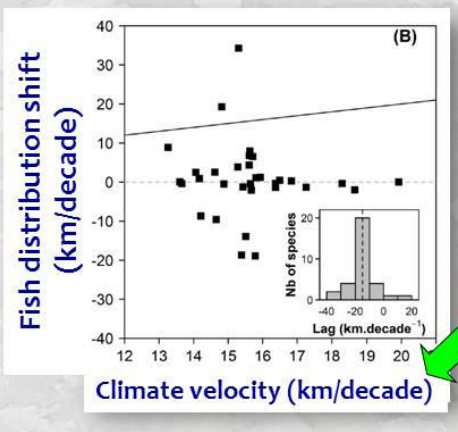
Until then, best regards,
Dan

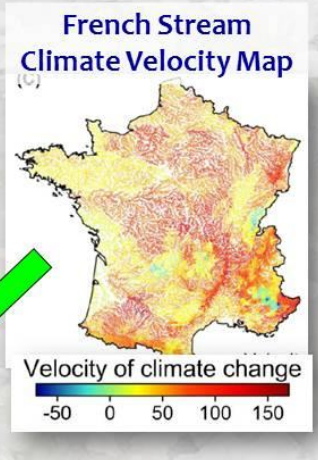



Climate Change is Causing Stream Fish Distributions to Shift…
French Fish survey sites (n = 3,500)
Difference in stream fish distributions (1980's vs 2000's)
200 m
75 m
25 m
(A)
32 species
Elevation (m)
Change in Elevation (m)
March of the fishes…
Comte & Grenouillet. 2013. Do stream fish track climate change? Assessing distribution shifts in recent decades. Ecography doi: 10.1111/j.1600-0587.2013.00282.x


Many Ways That Shifts Can Occur
… but some are more common than others
Shift
Expansion
Contraction
Frequency of occurence
Downstream range contractions
Upstream-downstream (km)
Down
Mid
Up
Upstream range expansions
Elevation (m)
Low
Mid
High

Distributions are Shifting Slower Than Isotherms are Moving





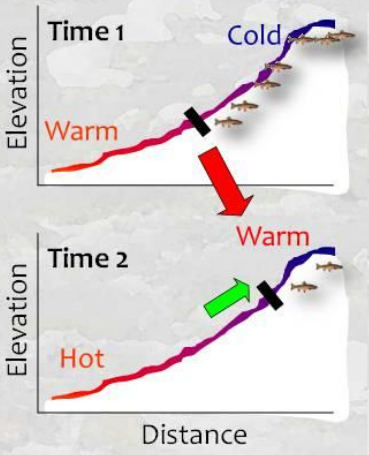
Fish distribution centers are shifting at 0.6 km/decade, but…

isotherms across French streams are shifting at 14.2 km/decade, so…

… climate velocity is faster than the swimming fish (so to speak)

We have Our Winners!

& two famously fishy people…



How far?

How fast?

Grenouillet Publication Webpage:
http://gael.grenouillet.free.fr/grenouillet_publications.html

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 5,167 (& 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 of 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

Future topics…
Climate-Aquatics Management Module