Heat and acid could squeeze trout out of southern Appalachian streams

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A newly published research study that combines effects of warming temperatures from climate change with stream acidity projects average losses of around 10 percent of stream habitat for coldwater aquatic species for seven national forests in the southern Appalachians - and up to a 20 percent loss of habitat in the Pisgah and Nantahala National Forests in western North Carolina.

Published in the online journal *PLOS ONE*, the results represent the first regional assessment in the U.S. of aquatic habitat suitability tied to the combined effects of stream temperature and acidity. Authors of the article include researchers from E&S Environmental Chemistry, Inc., the U.S. Forest Service, and Oregon State University.

Previous research has shown that stream-dwelling species in the southern Appalachian region are particularly vulnerable to climate change and that many coldwater species are already shifting their ranges in response to warming temperatures. Headwater streams, which provide the coldest available habitat in many areas, are often assumed to be the ultimate refuges for coldwater species, but many of these species are also acid-sensitive - and many headwaters of the southern Appalachian region are already too acid to support them.

The researchers focused on streams draining seven national forests in the southern Appalachian region, first mapping out how much of the area's current habitat is suitable for acid- and heat-sensitive aquatic species such as the native brook trout.

"We then used models to forecast future habitat loss in the national forests from expected temperature increases in the region," says Andrew Dolloff, research fishery biologist for the Forest Service Southern Research Station and a co-author of the study. "Our goal was to help watershed managers identify and assess specific stream reaches that are potentially vulnerable to stress from warming, acidification, or both."

Of the seven national forests studied, the Pisgah and Nantahala in North Carolina contained the most coldwater habitat - and are predicted to have the greatest losses in suitable habitat for acid-sensitive coldwater species. In these forests the combined effect of acidification in headwater streams and stream warming will restrict acid-sensitive coldwater species such as brook trout to a narrowing band of mid-level stream reaches, increasing the likelihood that these species will disappear locally and possibly regionally.

Though they seem discouraging, results from the study will help Forest Service managers classify watersheds in response to human-produced stressors and develop regional climate adaptation plans. Forest managers and aquatic biologists can use the study's data on specific streams for restoration planning and to assess the need for intervention (liming, riparian afforestation, native fish reintroduction) in stream reaches that are potentially vulnerable to warming, acidification, or both.

More information: *PLOS ONE*, www.srs.fs.usda.gov/pubs/48955

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