Students demonstrate validity of models that use free, publicly accessible climate data

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A sunrise over Crown Point at Columbia River Gorge. Students of Daniel McGarvey, Ph.D., used widely available climate data to model fish distributions in the waterway. Credit: Virginia Commonwealth University

As concern about the consequences of climate change grows, researchers

are thinking hard about the data and models that drive their understanding of these changes.

Graduate students in Virginia Commonwealth University's Center for Environmental Studies recently contributed to this effort by proving that free, publicly accessible climate data can predict habitat quality within river networks with as much accuracy as data from more complex and expensive sources. Climate data includes variables such as precipitation and air temperature. Scientists place these variables into models created to make predictions regarding environmental changes such as species distributions.

Many of the data sources needed to model climate change effects are available online at no cost to both the scientists and lay users, which alleviates the financial burden associated with many scientific inquiries, said Daniel McGarvey, Ph.D., associate professor in the Center for Environmental Studies in VCU Life Sciences.

"Now that public concern regarding climate change is on the rise, accessibility to information is critical," McGarvey said.

In an article published in the journal *Ecography* this summer, McGarvey and student authors Mitra Menon, Taylor Woods, Spencer Tassone, Jessica Reese, Marie Vergamini and Erik Kellogg developed new models of the distributions of 15 fish species throughout the Columbia River Basin in the Pacific Northwest. The graduate students fulfilled the task as part of McGarvey's conservation biogeography course.

Air temperature and precipitation, readily available from the National Centers for Environmental Information, were shown to predict the availability of fish habitats with roughly the same accuracy as direct measures of water temperature and hydrology, which are less accessible. The students were also able to identify the locations of the best habitats

for each species within the Columbia River Basin.

"We found in our modeling that variables that are somewhat easy to measure were just as good predictors of where the fish would be as variables that require more intensive tools to measure, such as actual streamflow," Woods said.

She added that proving the validity of these variables is especially important to researchers in developing countries.

"In a lot of developing countries, they don't have access to more advanced tools," Woods said. "We have large databases of intensive variables in the U.S., but in other regions of the world that might be biodiversity hotspots, those variables are very hard to obtain. On the other hand, air temperature is very easy to measure."

These predictions on fish distributions can also be illustrated as maps to be utilized by natural resource managers, McGarvey said.

A versatile tool

This work is also particularly important because it addresses a long-standing debate on the use of basic climate data in models of aquatic ecosystems.

Many scientists hesitate to base predictions for aquatic systems on variables that are inherently terrestrial, such as air temperature and precipitation. In recent years, major efforts have been made to downscale or convert basic climate data to more sophisticated measures of water temperature and hydrology. But these downscaled projects can be prohibitively expensive and as McGarvey and his students have shown, they may not be necessary.

"Air temperature is the major determinant of water temperature in most systems but there isn't a perfect one-to-one match. So, there's been a push to build separate models of water temperature, prior to modeling habitat quality for aquatic organisms," McGarvey said. "That's great, but it's not free to do that. The good thing about basic climate data is that it is free and therefore a wonderfully democratic resource."

More information: McGarvey, D. J.et al. On the use of climate covariates in aquatic species distribution models: are we at risk of throwing out the baby with the bath water?. *Ecography*. DOI: 10.1111/ecog.03134

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