United States Department of Agriculture
Forest Service

Rocky Mountain Research Station

Air, Water, and Aquatic Environments Program

Providing scientific knowledge and technology to sustain our nation's forests, rangelands, and grasslands

Science BRIEFING

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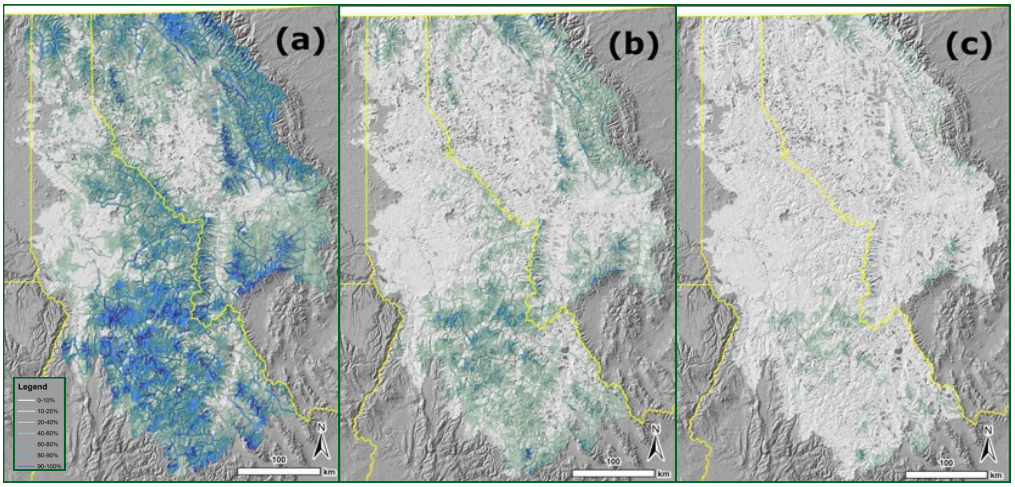
SPECIES DISTRIBUTION UNCERTAINTY

BACKGROUND

Concern over implications of climate change for biodiversity has led to the use of bioclimatic models to forecast range shifts of species under future climate-change scenarios. Forecast of species distributions under future climates are inherently uncertain, but there have been few attempts to understand and describe this uncertainty.



Mean projected occurrence probability (habitat suitability) for bull trout under recent conditions (a), 2040s climate projections (b) and 2080s climate projections (c).

RESEARCH

Research Activity: RMRS researchers helped to develop an approach that produces site-specific occurrence probabilities across a species range, while accounting for uncertainty within models (parameter uncertainty and residual error), among competing models (model uncertainty), and in future climate conditions (climate uncertainty). They illustrated the method by forecasting suitable habitat for bull trout (*Salvelinus confluentus*), a climate-sensitive fish species of conservation interest in the Interior Columbia River Basin, under recent and projected 2040s and 2080s climate conditions. The 95% interval of total suitable habitat under recent conditions was estimated at 30,144-42,500 km, with the highest-probability stream segments located at high elevations; this was predicted to decline to 496-7,946 km by the 2080s. Projections for the 2080s showed that the great majority of stream segments would be unsuitable with high certainty, regardless of the climate dataset or bull trout model used. The largest contributor to uncertainty in total suitable habitat was climate uncertainty, followed by parameter uncertainty and model uncertainty. This approach makes it possible to calculate a full distribution of possible outcomes for a species, and permits ready graphical display of site-specific uncertainty and total habitat.

KEY FINDINGS

- Accurate forecasts of climate change impacts on extinction risks are critical for conservation management responses.
- Uncertainty in species distributions should be taken into consideration in conservation planning and reserve design.
- For bull trout, there are many areas where the amount of suitable habitat is projected to be near zero, with >95% certainty, even by the 2040s. Apparently the species is already living at the edge of its niche space in this geographic region, suggesting that these areas are likely to be poor conservation investments.
- Areas where the amount of suitable habitat is highly uncertain in coming decades may be important locations to monitor, and potential candidates for restoration activities that could offset climate warming effects.

MORE INFORMATION

- fs.usda.gov/treesearch/pubs/44180

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