Mathematician develops model to control spread of aquatic invasive species

21 November 2019

Credit: University of Tennessee

Adjusting the water flow rate in a river can prevent invasive species from moving upstream and expanding their range. An applied mathematician at UT has developed a partial differential equation model to find the desired flow rate to reduce invasive populations.

The model is detailed in a new paper by Suzanne Lenhart, Chancellor's Professor and James R. Cox Professor of Mathematics, published in *Mathematics*.

"Invasives pose a serious threat to native habitats and species, especially in aquatic environments," said Lenhart. "Using optimal control techniques in a model with realistic hydrology features, we illustrated how to adjust the flow rate in a river to keep an invasive species from moving upstream."

Mathematical models like the PDE model in this study, which represents an invasive population in a river, can give insight into new management strategies. Current strategies to prevent upstream expansion of invasive species include electric fences or nets in the river, but these are not the only management actions that can be taken.

River flow affects species survival success in habitats. Lower flow rates increase the chance of a species persisting, and higher flow rates inhibit success by limiting the species's range and chance of survival. This study investigates how water discharge rates, controlled by water release mechanisms like dams, can force the invasive populations downstream while minimizing the cost of management.

"With our model, we show how far the invasive population moves upstream with no control, constant control, and optimal control of water discharge," said Lenhart. "As expected, the populations with no control are able to move further upstream, and we can manipulate the control levels to find the desired flow rate."

"In the future, we hope to apply these results with new data to a particular invasive species like Asian carp," said Lenhart.

More information: Rebecca Pettit et al, Optimal Control of a PDE Model of an Invasive Species in a River, *Mathematics* (2019). DOI: 10.3390/math7100975

Provided by University of Tennessee at Knoxville