The Invasive Northern Crayfish:

An Unwelcome Visitor to Alberta's Watersheds

BY VICTORIA VAN MIERLO

Most well-known invasive species come from distant countries, often hitching a ride with humans as we travel about the world. Headlines about the mass die-off of ash trees at the hands of the emerald ash borer or the zebra mussel's terrible impact on the Great Lakes come to mind. The invasiveness of these species is often the result of having no natural predators in their new ecosystem.

In a country as vast as Canada, encompassing so many distinct ecosystems, it's also possible for native species to become invasive without ever leaving their country of origin. This is the case with the northern crayfish (*Faxonius virilis*), which is native to Canada from Saskatchewan to Quebec. The crayfish has now made the jump to Alberta watersheds, where it has become an invasive species capable of negatively affecting river ecosystems.

To understand the distribution of the northern crayfish in Canada, we have to travel back to the end of the last Ice Age, about 12,000 years ago. During this time, the massive melting ice sheets determined the patterns of water flow, and hence the dispersal routes for aquatic species returning to Canada as the ice retreated.[1] As a result of the specific dispersion routes available, Alberta ended up with the lowest number of fish species in western Canada and the only western province with no native crayfish species.

Because of this dispersal process, Saskatchewan's river ecosystems have had millennia to develop stable food webs that included the northern crayfish. Meanwhile, the rivers of Alberta developed stable ecosystems without crayfish. Sometime in the 1990s, anglers transported live northern crayfish from Saskatchewan to Alberta to use as fish bait. The result was an accidental introduction of crayfish into an ecosystem that was not prepared for them.[2]

Following their release into Alberta's watersheds, the northern crayfish population exploded. Today, these small, omnivorous creatures have spread into six Alberta river drainages, including at least 14 tributaries of the North Saskatchewan River basin. Because this crayfish has negatively impacted watersheds in other parts of the world where

Top: A close-up view of a northern crayfish. Note the small yellow bumps on the claws, a key characteristic of this species. SAM STUKEL

Aerial photo of a North Saskatchewan River tributary. These were the kinds of tributaries sampled for northern crayfish throughout the river basin. SAIRAFI BAZAN

The author holding one of the many northern crayfish that were successfully trapped in the Blackmud Creek. A very happy scientist acquiring data for her project! JESSE SHIRTON

it invaded, the Alberta government has declared the crayfish to be an invasive species in the province and manages it as such. To limit further population increases and spread, northern crayfish can be legally captured in any quantity without a fishing license throughout the province. In addition, all captured crayfish must be killed on site, and their use as fishing bait is strictly prohibited.

When the northern crayfish first arrived in Alberta, little was known about what the actual impacts on native Alberta fish might be. This is where my graduate studies at the University of Alberta came in. My aim was to determine if and how the northern crayfish was competing for food with native fish of the North Saskatchewan River basin. I also wanted to identify the tributaries of the basin that were at highest risk for future invasion. I set out in the summer of 2020 to collect fish, crayfish, and relevant environmental data in 43 tributaries of the basin. After three long months of crayfish trapping, electrofishing, and soggy feet from topping my waders on multiple occasions, I had the data I needed to answer my research questions!

Through statistical modeling it became clear that water temperature is the most important water-related factor in determining whether a given tributary will be inhabited by crayfish. Tributaries located in the prairies, with average summer water temperatures over 18°C, were found to be the most suitable for the crayfish, making them the most vulnerable to invasion. This is because all aspects of the crayfish's life cycle are optimized in warm water. In warm water, molting becomes more efficient, allowing individuals to grow faster and reach sexual maturity at a younger age, leading to a larger invasive population. Conversely, western tributaries, in the foothills and alpine regions, may be resistant to crayfish establishment due to their colder average water temperatures, below 15 °C. As water temperature drops, the juvenile mortality rate of the crayfish increases and molting slows or stops completely.

IAN GARDINER

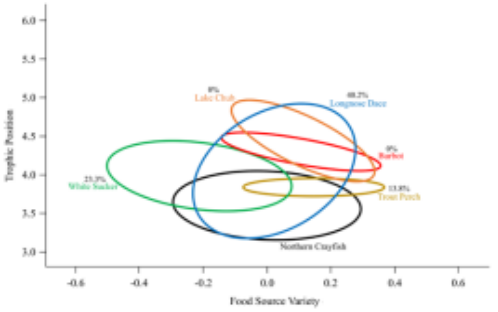

Figure 1. This graph illustrates the level of food competition between the northern crayfish and several native fish species. Each oval represents a species' niche in the local food web. When ovals overlap it means the species are eating the same food sources, and competing for them if the food source is limited. Except for lake chub and burbot, all the fish species studied overlap to some degree with crayfish, suggesting that negative effects could occur from crayfish introduction.

To determine if northern crayfish are competing with our native fish species for food, I used stable isotope analysis, which reveals food web relationships. I found that crayfish, being omnivores, consume many of the same food sources as our native fish. For example, the crayfish's diet included 23% of the white sucker's diet, 40% of the longnose dace's diet, and 14% of the trout-perch's diet (Figure 1). This competition with the crayfish may cause native fish to shift to less-preferred food types, potentially leading to reduced energy intake and reduced reproduction.

My research suggests that the invasion of Alberta waters by the northern crayfish is indeed a cause for concern. In addition, the finding that water temperature is a key determinant of invasiveness should help managers prioritize their efforts. Much more is left to be done — my initial work is just the tip of the iceberg! You can help in the fight against this invasive species too, by reporting any northern crayfish sightings using the EDDMapS App (**eddmaps.org**) and by keeping up to date on recent invasive species research. ■

References:

1. Nelson, J. S. and M. J. Paetz. 1992. The Fishes of Alberta, 2nd ed. University of Alberta Press.
2. Williams, B.W. 2012. A molecular assessment of range expansion of the northern or virile crayfish (Orconectes virilis), crayfish-based community co-structure, and phylogeny of crayfish-affiliated symbionts. PhD Dissertation, University of Alberta.

Victoria Van Mierlo recently completed her MSc at the University of Alberta in Aquatic Conservation Biology. She has a special passion for nature conservation and plans to pursue a PhD with hopes of heading up a research group of her own one day.