

A Research Path to the Control of Dreissenids throughout Entire Water Bodies

Dreissena mussels pose a significant challenge to infrastructures. One key element contributing to this challenge is the lack of a practical method for large-scale control of populations once they become established throughout a water body. As a result, facilities drawing water from such water bodies are subjected to constant reinfestation.

Although concerns exist about environmental impacts of molluscicides, it is the prohibitive total project cost of open-water control programs that currently eliminates them as a mitigation option. Total project cost includes not only the molluscicide and its application throughout the entire water body, but also a myriad of other expenses often required in the overall control program, such as fund raising, administration, regulatory approval, post-treatment mussel mortality monitoring, report writing, etc.

The research project reported herein offers a potential solution to this seemingly intractable problem of prohibitively high control program expense. The key to the low cost of this proposed control approach is that it does not require treatment of the entire water body. In contrast to traditional control programs: 1) only a minuscule portion of the infested water body's volume would be treated ("seeded") with the control agent; and 2) the control agent would subsequently amplify itself and self-spread throughout the water body. There is only one type of control agent capable of doing that – a live one, a biological control agent.

This presentation describes the research conducted in the first year of a multi-year project to find such a control agent. The project is based in Eurasia and specifically designed to find a hypervirulent (i.e., extremely lethal), highly-specific dreissenid parasite that one day (following years of comprehensive environmental safety studies) would be introduced into North American water bodies where it will leave a trail of dead dreissenids in the path of its spread.

SCROLL DOWN TO SEE PRESENTATION SLIDES

A RESEARCH PATH TO THE CONTROL OF DREISSENIDS THROUGHOUT ENTIRE WATER BODIES

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Molloy & Associates, LLC**

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RECLAMATION
Managing Water in the West

What's the Problem?



Can't control dreissenids in
“open waters” (throughout lakes, rivers, etc.)



Exception: Very recent introduction where dreissenids have not yet started to spread

My Background

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.....and have led research programs that resulted in the commercialization of biocontrol agents

My lab has had major commercial successes in R&D for the ...



Biocontrol of black flies with the bacterium *Bacillus thuringiensis israelensis* (BTI) – a leader in this international effort



Biocontrol of dreissenids in pipes with the bacterium *Pseudomonas fluorescens* – patent inventor



Dreissena polymorpha
ZEBRA MUSSEL



Flat

Dreissena rostriformis bugensis
QUAGGA MUSSEL



Convex

BASICALLY THREE MAIN
TYPES OF IMPACTS WITHIN WATER BODIES....

ECOLOGICAL

RECREATIONAL

INDUSTRIAL

So North America obviously has a problem with these invasive mussels....

.... and unfortunately there is currently still no control method capable of drastically reducing dreissenid populations in an **ecologically benign** and **economically affordable** manner throughout an entire water body.

Why?

Treating an entire water body is currently:

- Too expensive

and/or

- Too environmentally degrading

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To be **ENVIRONMENTALLY SAFE** it has to be **VERY HOST SPECIFIC** (the control agent should only kill dreissenid mussels)

To be **economically feasible** the control agent ideally must be applied only once in a small area and be:

- **SELF-PERPETUATING**
- **SELF-SPREADING**

Thus, this control agent must be **LIVE**

It must be a **BIOCONTROL** agent...

.....but what kind of biocontrol agent...???

Natural Enemies of Zebra Mussels: Predators, Parasites, and Ecological Competitors

Daniel P. Molloy,¹ Alexander Y. Karatayev,² Lyubov E. Burlakova,² Dina P. Kurandina,³ and Franck Laruelle¹

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ABSTRACT: This paper reviews the international literature on the natural enemies of *Dreissena* spp. and discusses the biology and ecology of organisms known to be involved in their predation (176 species), parasitism (34 species), and competitive exclusion (10 species). Research on natural enemies, both in Europe and North America, has focused on predators, particularly birds (36 species) and fish (15 and 38 species eating veligers and

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The control agent must be a **PARASITE**

.... because among all types of natural enemies,
parasites are the most host-specific killing agents

.... And not any host-specific parasite will do...

.... It's got to be a **HYPERVIRULENT PARASITE**

This project is an extremely **ambitious** one.

This project is an extremely **challenging** one.

But I am confident there is a parasite already
existing in nature that could be this future
biocontrol agent



Area in past that we have focused on looking for parasites in the same two *Dreissena* spp. as we have in North America:
- *D. polymorpha* (zebra)
- *D. rostriformis* (quagga)

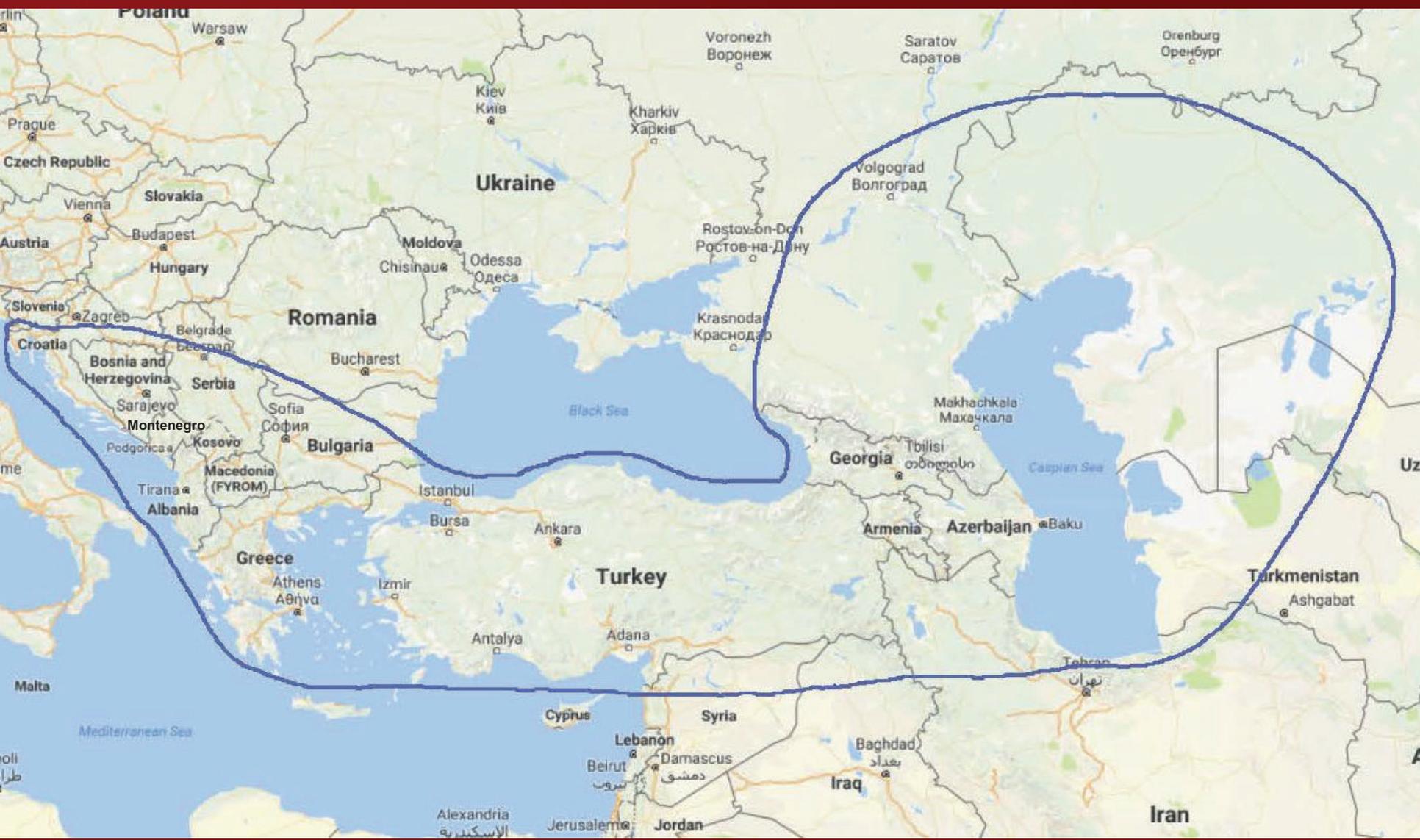
... and we have found a variety of parasites in zebra and quagga populations... but none with evidence of hyper-virulence

Area we have switched to... focusing on possible “**novel**” parasites from other dreissenid species



What is a novel parasite?

What is a naïve host?



A very high priority of this project is to sample the parasites from “cousin” *Dreissena* spp. endemic to:

- the Balkans (e.g., *D. blanci*, *D. carinata*)
- Turkey (e.g., *D. caputlacus*, *D. anatolica*)

These latter samples will be particularly valuable because North American dreissenid populations have not likely encountered the parasites from these latter four Eurasian “cousin” *Dreissena* spp.

Note: Even though these parasites may not be very harmful to their natural host species, i.e. the “cousin” *Dreissena* species

.... these “novel” parasites may prove highly virulent to “naïve” zebra and quagga mussels.



Lake Ohrid



Skadar Lake

There's only one dreissenid species in these lakes: *D. carinata*





Collecting mussels in
the field





Dissecting mussels in the lab

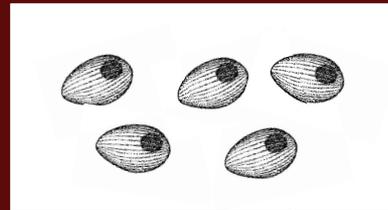


Next logical research step is to try to infect zebra and quagga mussels with parasites that have co-evolved with *D. carinata*

Could some relatively harmless parasite from *D. carinata* be hypervirulent to “naïve” zebra/quagga mussels and kill them?



D. carinata



International Team of Collaborating Scientists



FINLAND
Jouni Taskinen



MONTENEGRO
Mihailo Jovičević



MACEDONIA
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ALBANIA
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ITALY
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USA
Jacque Keele



TURKEY
Zeki Yildirim



USA
Yale Passamaneck



FRANCE
Laure Giamberini



USA
Sherri Pucherelli

TAKE HOME MESSAGE

Will there ever be lake-wide biocontrol of dreissenids in North American waterbodies?

Don't give up on the use of parasites for that purpose.

To achieve this goal, I believe the solution may well involve exposing our North American dreissenid populations to a parasite they have never ever encountered before...

...quite possibly a parasite from a distant Eurasian dreissenid cousin

Thanks for your attention !