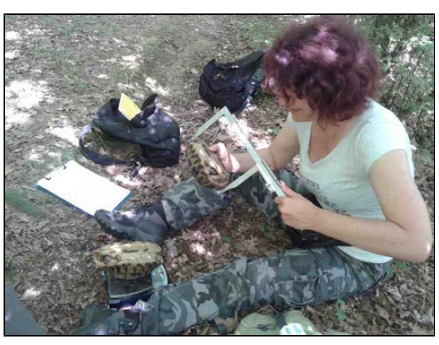
25.07.2017

Invited Speakers

Priv.-Doz. Mag. Dr. Elisabeth HARING is the head of the Central Research Laboratories at the Natural History Museum Vienna (NHMW) comprising the Laboratory of Molecular Systematics as well as the Electron Microscopy Facilities. Elisabeth Haring studied biology and genetics at the University of Vienna and has been working since 1998 as a researcher at the NHMW. Besides her scientific work at the NHMW she has been engaged as a lector at the University of Vienna (Faculty of Science) since 1998. She performed numerous research projects on phylogeny, phylogeography and population genetics of various groups of organisms. She is Editor-in-Chief of Journal of *Zoological Systematics and Evolutionary Research.*

Prof. Igor S. Zonn is Doctor of Geographical Sciences, Member of the Russian Academy of Natural Sciences, General Director of the Engineering Research and Production Center for Reclamation, Water Economy and Ecology "Soyuzvodprojekt" (Moscow), member of the editorial board of the international journal "Problems of Desert Development" (Turkmenistan) and " Arid Ecosystems", creator and Editor-in-Chief (since 1996) of the journal "Vestnik Kaspiya" (the Caspian Sea Bulletin). He is an author of more than 450 scientific articles and 50 monographs, including the encyclopaedias of the Black, Caspian, Aral, Japan, Okhotsk, Bering, Barents, White, Kara, Laptev, East Siberian, Chukchi, Baltic, Adriatic (first and second editions) seas, the Arctic Ocean and the Danube River, published in 2004-2017 in the publishing houses "International Relations" (Russia) and "Springer" (Germany).



Prof dr Ljiljana Tomović is a Full Professor at the Faculty of Biology University of Belgrade. She performed numerous research projects on ecology and conservation biology of reptiles in Serbia and the Balkans. She is the Chief Editor of *Red Book* of *Fauna of Serbia I & II – Amphibians* & *Reptiles*.

Prof. dr. Daniel Molloy is a Research Scientist and Adjunct Professor at the State University of New York Great Lakes Center at Buffalo and an internationally recognized expert in the biology, ecology, and control of dreissenid mussels. He has over 25 years of experience working with these mussels both as a research scientist and consultant in North America and Eurasia. Marked by a passion for environmental protection, his research has centered on parasites and the prospects for their use as biocontrol agents of aquatic pest invertebrates, such as dreissenid mussels. He is currently leading a research project examining the parasites of dreissenid mussels in Eurasia (his photo on this page was taken during recent fieldwork on Šasko Lake, Montenegro), and he will discuss this project in detail in his presentation.

Page down to see Abstract and the Presentation slides

An International Collaborative Project Documenting the Parasites of *Dreissena* spp. Mussels throughout Eurasia

Daniel P. Molloy

State University of New York Great Lakes Center at Buffalo State College, USA

North American freshwater ecosystems have been ravaged by high densities of two invasive bivalve species from Eurasia, *Dreissena rostriformis bugensis* and *Dreissena polymorpha*. In addition, the fouling of infrastructures by these bivalves has had an economic impact in the billions of dollars. Unfortunately, there is currently no environmentally safe and economically feasible method of controlling them throughout infested waterbodies. In an attempt to develop such a control agent, a project is now underway examining parasites in Eurasian *Dreissena* populations. Several new parasites have already been discovered and will be evaluated for their virulence and host specificity. It is timely that this ecology conference is being held in Montenegro since a very high priority of this project is to sample the parasites from *Dreissena* spp. endemic to the Balkans (e.g., *D. blanci*, *D. carinata*) and nearby 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 *Dreissena* spp., and thus infection may prove highly virulent to them. This project is an ambitious and challenging one and the collaborators participating in it will be highlighted in this presentation as their diverse expertise brings valuable contributions to it.

PAGE DOWN TO SEE PRESENTATION SLIDES

An International Collaborative Project Documenting the Parasites of *Dreissena* spp. Mussels throughout Eurasia

Daniel P. Molloy, Ph.D.
(www.danielpmolloy.com)
Great Lakes Center – University of the State of New York

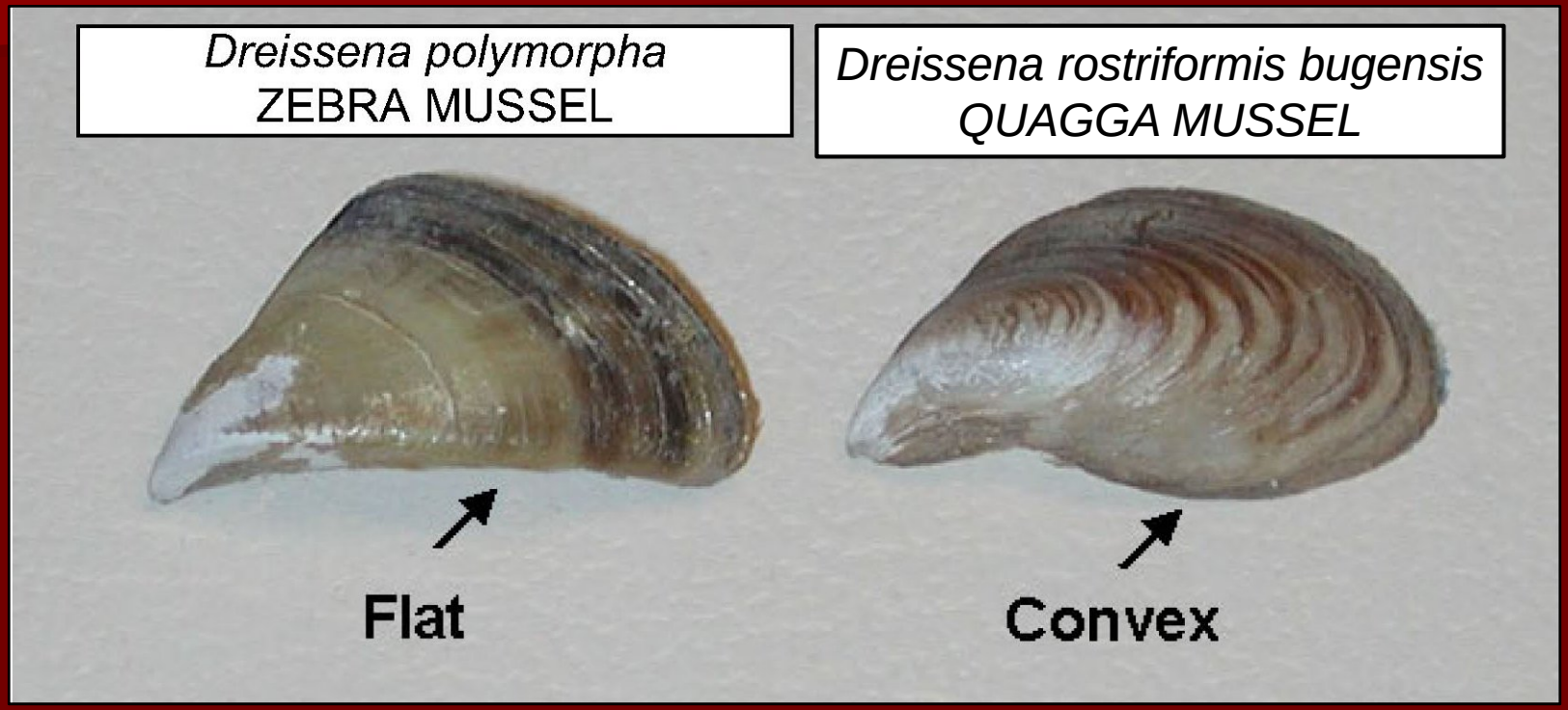
October 4, 2017
7th International Symposium of Ecologists - ISEM7

My Background

- Biologist
- Aquatic
- Freshwater
- Invertebrates
- Diseases
- Parasites and pathogens
  - Fundamental Research: Life cycle, ecology, taxonomy, phylogeny
  - Applied Research: Potential use for biocontrol of pest species

Dreissena polymorpha
ZEBRA MUSSEL

Dreissena rostriformis bugensis
QUAGGA MUSSEL




1988
CANADA
Washington
Oregon
California
Nevada
Idaho
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Wyoming
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South Dakota
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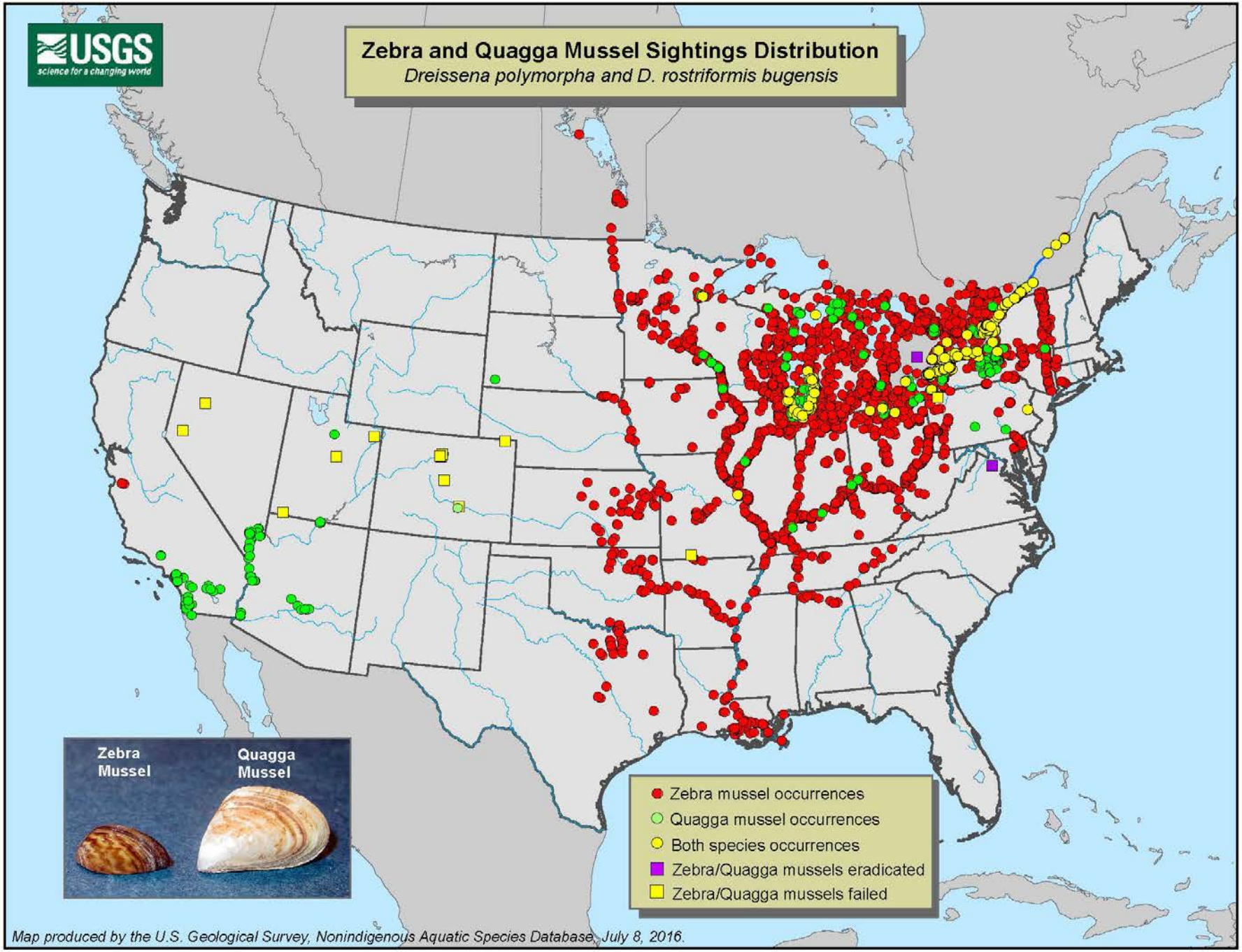
Louisiana
Wisconsin
Illinois
Michigan
Indiana
Ohio
Kentucky
Tennessee
Mississippi
Alabama
Georgia
Florida
South Carolina
North Carolina
Virginia
West Virginia
Pennsylvania
New York
Maine
Vermont
New Hampshire
Massachusetts
Connecticut
New Jersey
Delaware
MEXICO
Zebra / Quagga Mussel Location
Source: U.S. Geological Survey, Nonindigenous Aquatic Species Database, April 2011


USGS
science for a changing world
Zebra and Quagga Mussel Sightings Distribution
Dreissena polymorpha and D. rostriformis bugensis
Zebra Mussel
Quagga Mussel
Zebra mussel occurrences
Quagga mussel occurrences
Both species occurrences
Zebra/Quagga mussels eradicated
Zebra/Quagga mussels failed
Map produced by the U.S. Geological Survey, Nonindigenous Aquatic Species Database, July 8, 2016.

Only freshwater mussels now in North American with byssal threads enabling them to attach on to ANY hard surface


S. van Mechelen

BASICALLY THREE MAIN
TYPES OF IMPACTS WITHIN WATER BODIES….

ECOLOGICAL

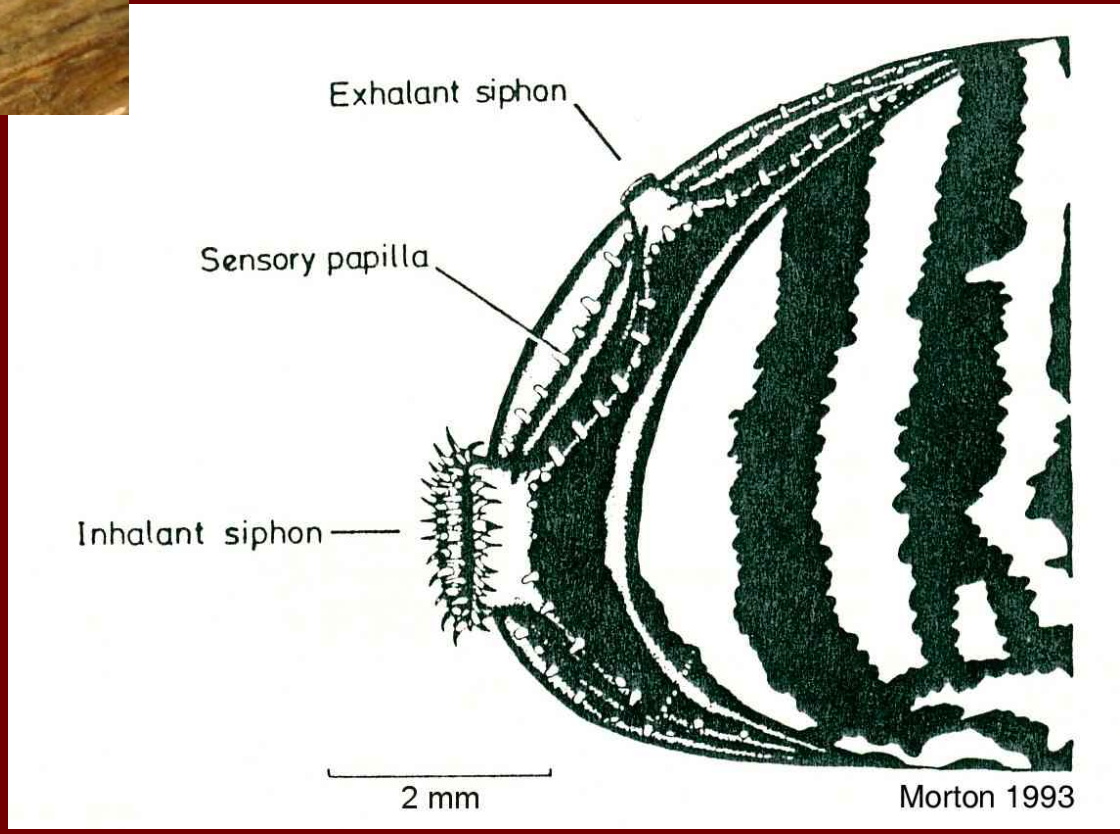
RECREATIONAL

INDUSTRIAL

Ecological Impacts

Mussels can filter 1 liter/day

Millions of mussels in water body filtering



Ecological effects of filtration by *Dreissena* spp.

- Decrease in phytoplankton
- Decrease in zooplankton
- Increase in water transparency
- Increase in macrophytes
- Alteration of fish community
- Alteration of benthic community

Example of infested unionid clams

Example of infested unionid clams

Recreational Impacts

Industrial Impacts

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 throughout an entire water body.

Why?

….because successfully treating an entire water body is currently either:

- Too expensive

or

- Too environmentally degrading

To be ECONOMICALLY FEASIBLE controlling the mussels must be **VERY INEXPENSIVE (~ one thousand fold less expensive)**

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…???

Reviews in Fisheries Science, 5(1): 27-97 (1997)

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 Laruelle[1]

[1]Biological Survey, New York State Museum, The State Education Department, Cultural Education Center, Albany, NY 12230, [2]Lakes Research Laboratory, Belarusian State University, F. Skoryna Ave. 4, Minsk, 220050 Belarus; [3]Institute of Hydrobiology, Ukrainian Academy of Sciences, 12 Prospect Geroyev Stalingrada, Kiev-210 254655 Ukraine

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

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

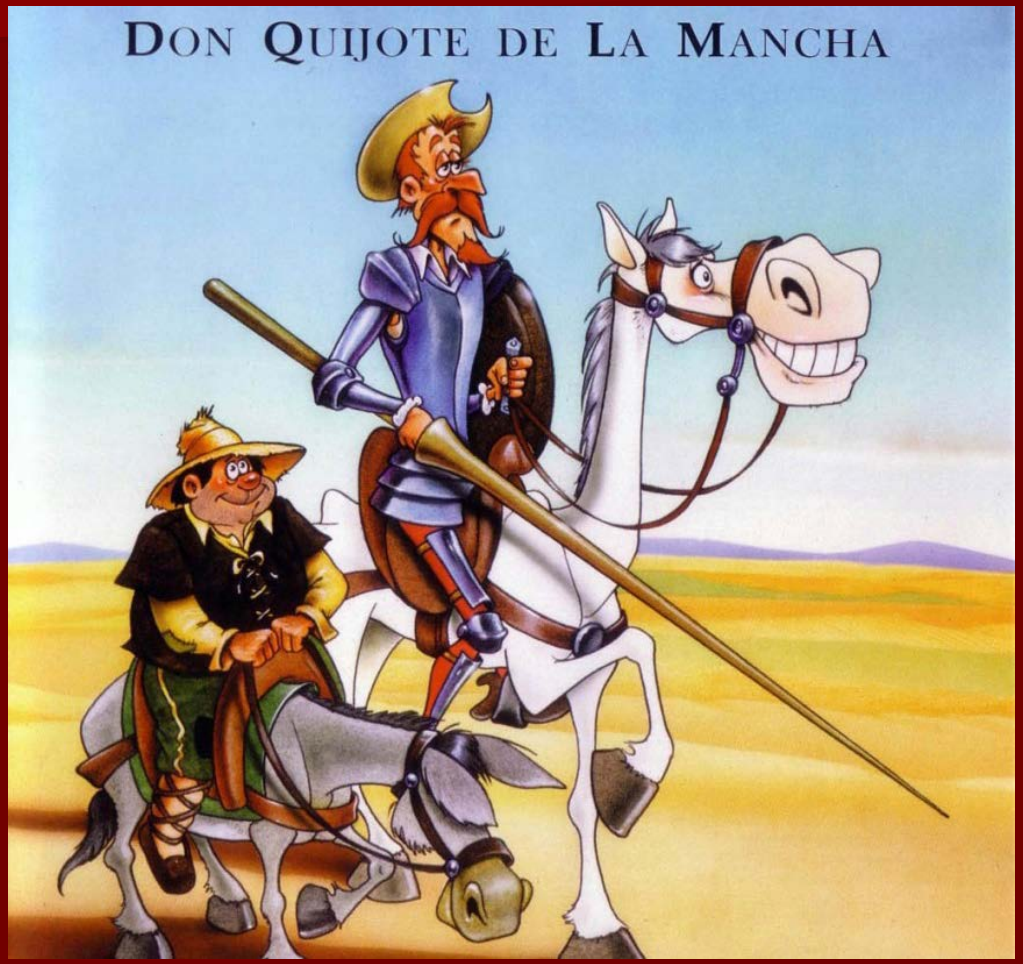
But I and my international team just have to find it.

It’s out there.

I wouldn’t be surprised if … as you are listening

to me speak, you’re thinking ….

…. this researcher Dan Molloy is probably a biocontrol idealistic dreamer -- a scientific version of Don Quijote, Man of La Mancha….



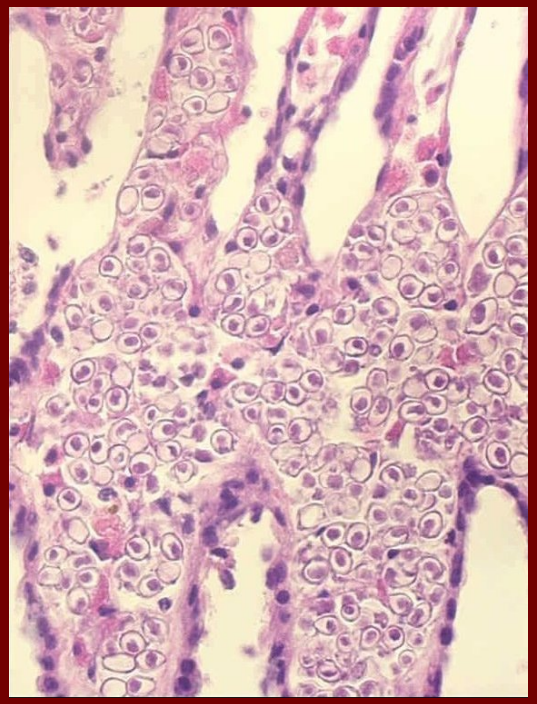
Biocontrol Dreamer ?

No, I’m not an unrealistic dreamer

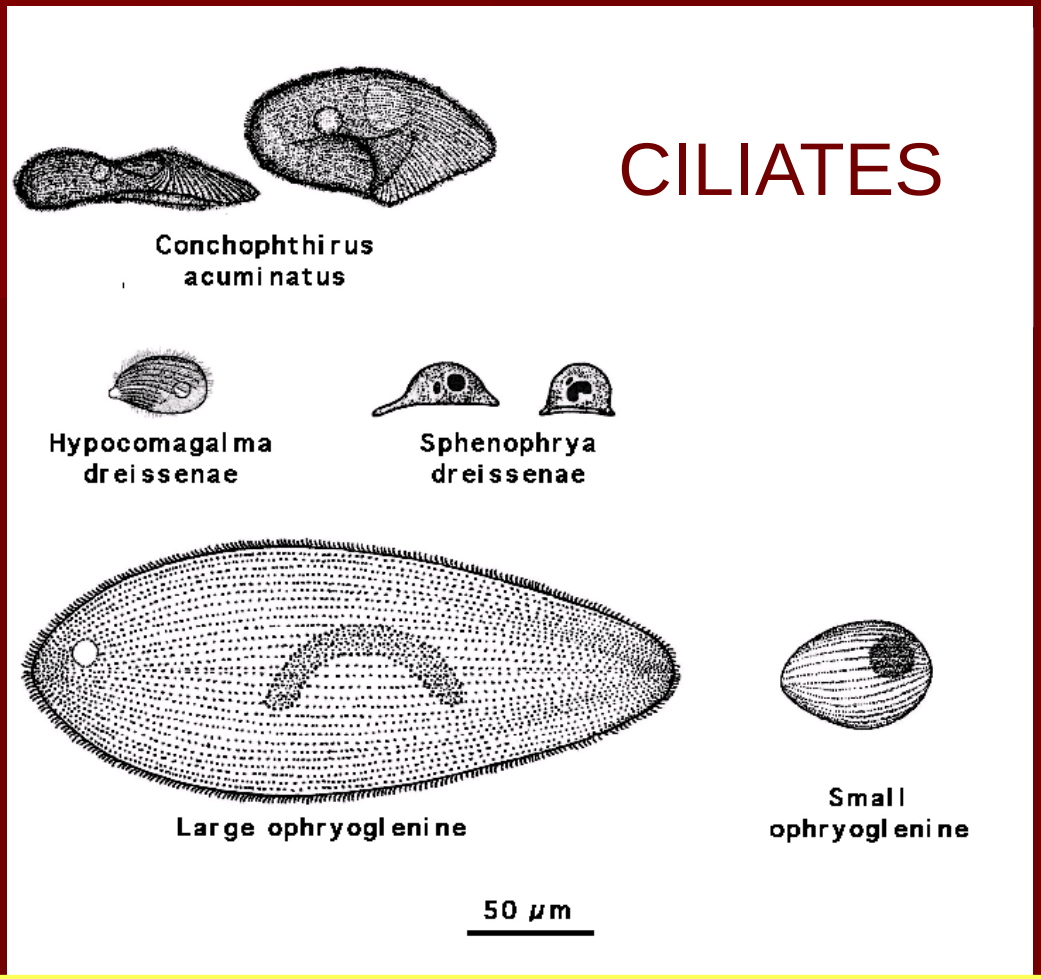
My lab has had major research successes in developing environmentally safe biological control agents against aquatic pests


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)
United Kingdom
Ireland
France
Spain
Portugal
Germany
Poland
Belarus
Ukraine
Lithuania
Latvia
Estonia
Romania
Bulgaria
Italy
Greece
Turkey
Georgia
Armenia
Azerbaijan
Uzbekistan
Turkmenistan
Afghanistan
Iran
Iraq
Syria
Morocco
Tunisia

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



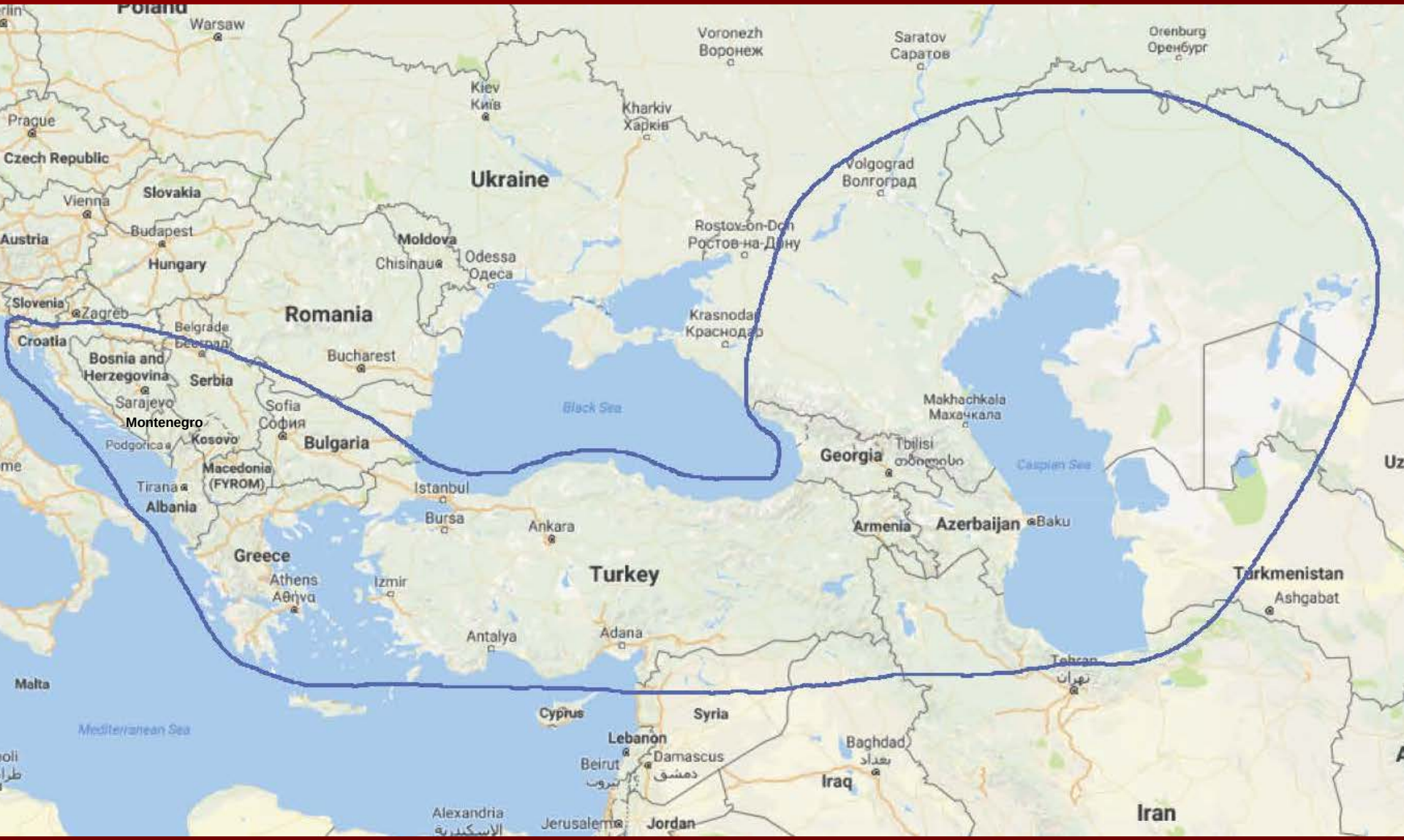
Haplosporidian spores consume connective tissues



Bacterial and trematode infections in dreissenid tissues


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)
United Kingdom
Ireland
France
Spain
Portugal
Germany
Poland
Belarus
Ukraine
Lithuania
Latvia
Estonia
Romania
Bulgaria
Italy
Greece
Turkey
Georgia
Armenia
Azerbaijan
Uzbekistan
Turkmenistan
Afghanistan
Iran
Iraq
Syria
Morocco
Tunisia


Area we have switched to… focusing on possible “novel” parasites from other dreissenid species
Oslo
Stockholm
Helsinki
St Petersburg
Санкт-Петербург
Tallinn
Edinburgh
United Kingdom
Isle of Man
Dublin
Ireland
Manchester
Liverpool
London
Denmark
Hamburg
Amsterdam
Netherlands
Berlin
Poland
Warsaw
Belarus
Brussels
Cologne
Germany
Belgium
Frankfurt
Prague
Luxembourg
Paris
Czech Republic
Slovakia
Munich
Vienna
Austria
Budapest
Hungary
Switzerland
France
Milan
Slovenia
Zagreb
Croatia
Belgrade
Romania
Bucharest
Bosnia and Herzegovina
Serbia
Sarajevo
Monaco
Italy
Rome
Andorra
Barcelona
Kosovo
Sofia
Bulgaria
Macedonia (FYROM)
Tirana
Albania
Porto
Madrid
Portugal
Lisbon
Spain
Valencia
Seville
Granada
Málaga
Gibraltar
Algiers
Tunis
Malta
Tunisia
Rabat
Casablanca
Morocco
Tripoli
Greece
Athens
Αθήνα
Izmir
Istanbul
Bursa
Ankara
Turkey
Antalya
Adana
Cyprus
Syria
Lebanon
Beirut
Damascus
Iraq
Baghdad
Jordan
Alexandria
Jerusalem
Iran
Ukraine
Kiev
Київ
Kharkiv
Харків
Voronezh
Воронеж
Saratov
Саратов
Orenburg
Оренбург
Volgograd
Волгоград
Rostov-on-Don
Ростов-на-Дону
Moldova
Chisinau
Odessa
Одеса
Krasnodar
Краснодар
Kazakhstan
Georgia
Tbilisi
Армения
Azerbaijan
Baku
Armenia
Turkmenistan
Ashgabat
Uzbekistan
Tajik
Dushanbe
Afghanistan
Kabul
Tehran
Makhachkala
Махачкала
Shymkent


Poland
Warsaw
Voronezh
Воронеж
Saratov
Саратов
Orenburg
Оренбург
Kiev
Київ
Kharkiv
Харків
Prague
Czech Republic
Ukraine
Volgograd
Волгоград
Slovakia
Vienna
Austria
Budapest
Hungary
Moldova
Chisinau
Odessa
Одеса
Rostov-on-Don
Ростов-на-Дону
Slovenia
Zagreb
Romania
Krasnodar
Краснодар
Croatia
Belgrade
Bucharest
Bosnia and Herzegovina
Serbia
Sarajevo
Black Sea
Makhachkala
Махачкала
Montenegro
Sofia
София
Podgorica
Kosovo
Bulgaria
Georgia
Tbilisi
Caspian Sea
Macedonia (FYROM)
Tirana
Albania
Istanbul
Bursa
Ankara
Armenia
Azerbaijan
Baku
Greece
Athens
Αθήνα
Izmir
Turkey
Turkmenistan
Ashgabat
Antalya
Adana
Tehran
تهران
Malta
Cyprus
Syria
Mediterranean Sea
Lebanon
Beirut
بيروت
Damascus
دمشق
Baghdad
بغداد
Iraq
Alexandria
الإسكندرية
Jerusalem
Jordan
Iran

A very high priority of this project is to sample the parasites from *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 *Dreissena* spp.

Thus infection may prove highly virulent to them.

Lake Ohrid

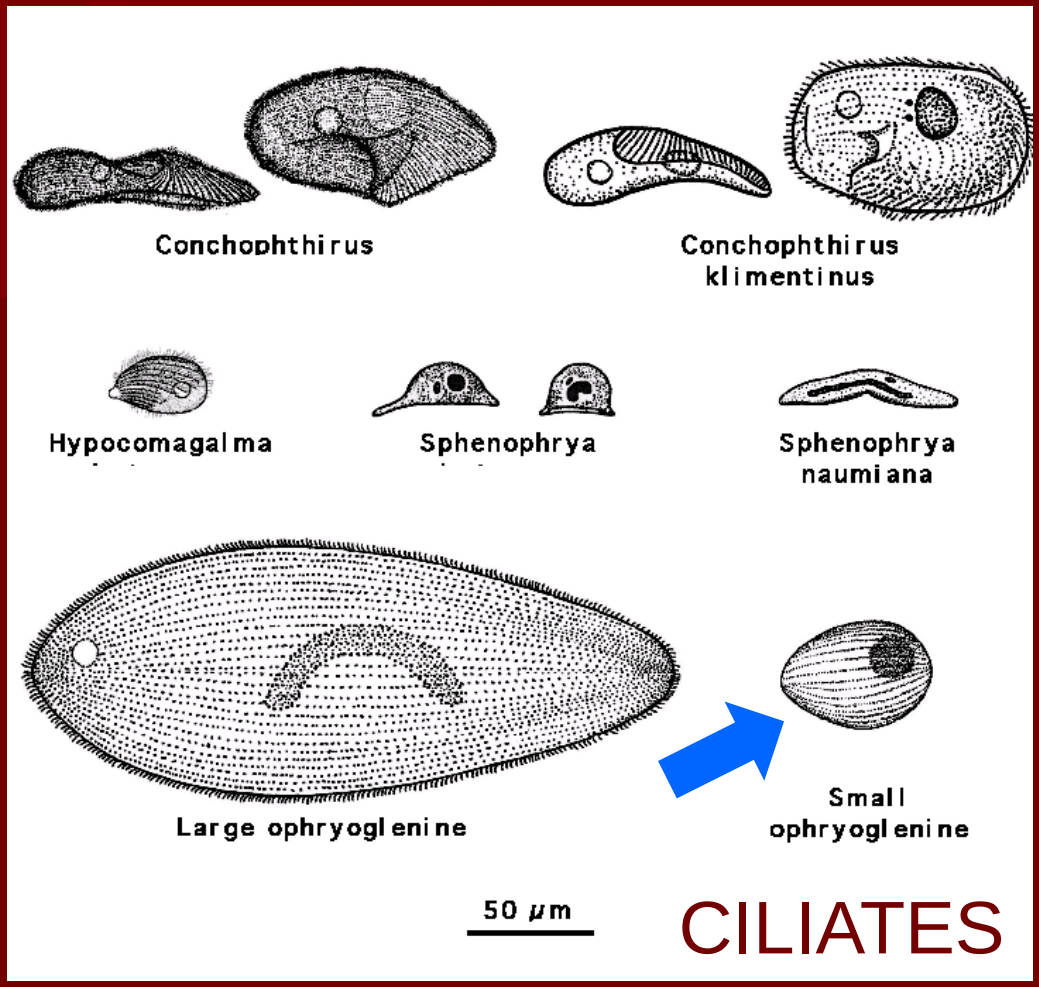
Skadar Lake

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

…and we have already found parasites in this dreissenid

…. and in in *D. carinata* we are finding morphologically similar parasites …… that sequencing indicates are NOT the same species as in zebra and quagga mussels

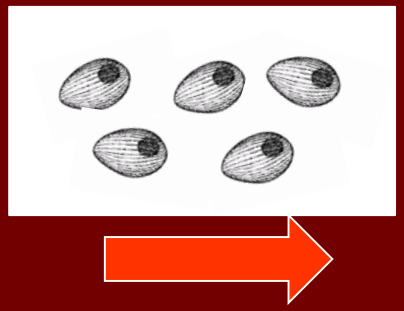
These are examples of potentially “novel” parasites that need to be screened for possible “hypervirulence” to zebra and quagga mussels



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



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, as they can have long-term devastating impacts on naïve host populations.

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

…a parasite from a distant related dreissenid species found outside the native range of the zebra mussel or quagga mussel, as for example from *Dreissena carinata* in Lake Ohrid or Lake Skadar

Thanks for your attention !