

Invasion Impacts and Innovation in the North American Great Lakes



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Innovation Summit

Vision + Science + Technology = Solutions

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Invasive species

Problem:

Harm > Benefit

1938



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Small beginnings... great impact



photo: Brisbane City Council



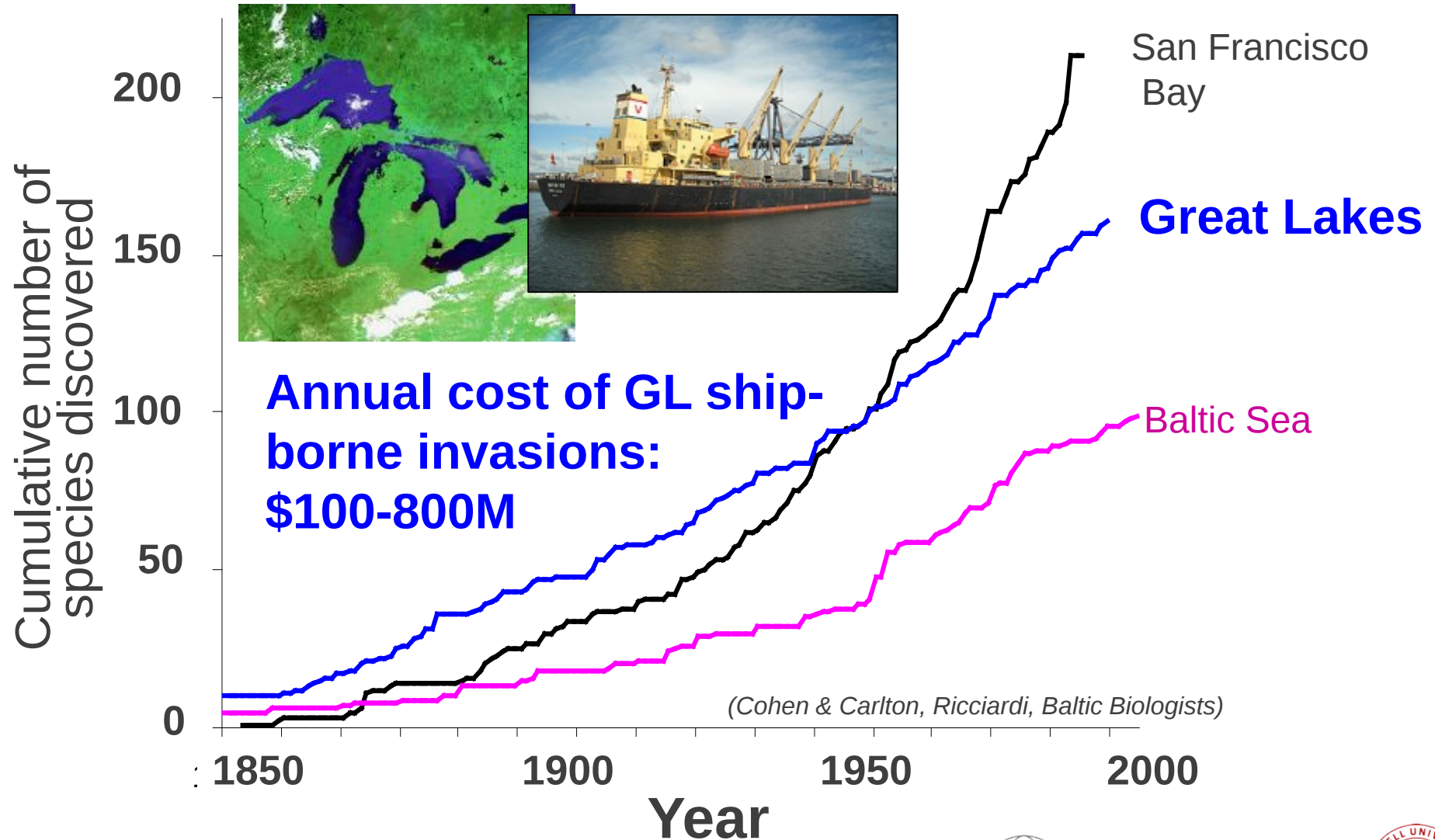
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Nonindigenous species in aquatic ecosystems



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Dreissenid mussels



photo: Jim Carlton

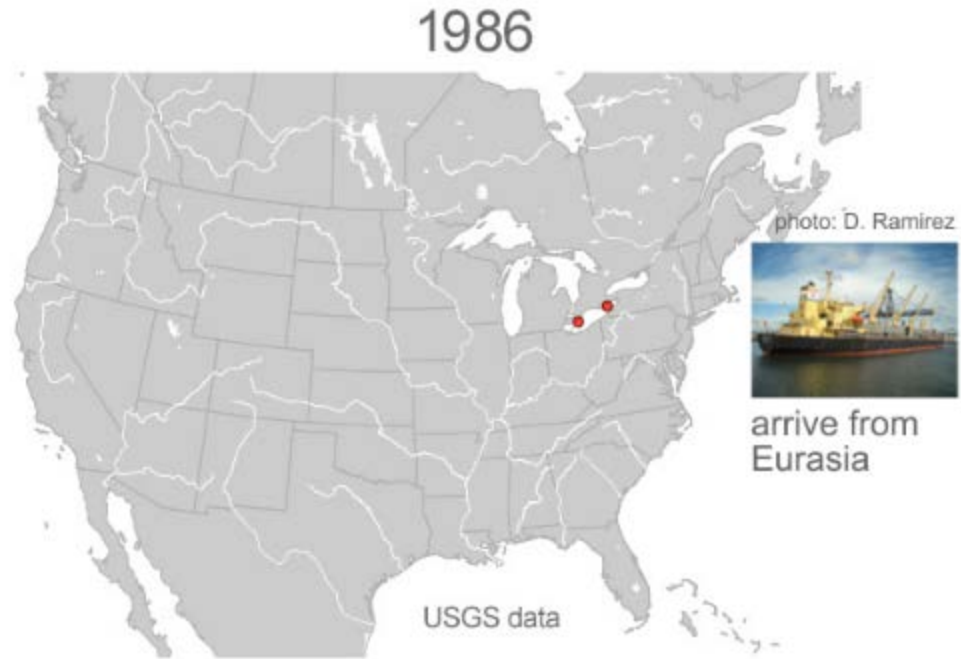


photo:
M. McCormick, NOAA



photo: Kim Martin, USFWS



photo: TownePost Network

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Dreissenid mussels



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Asian carps: imminent threat to Great Lakes . . .



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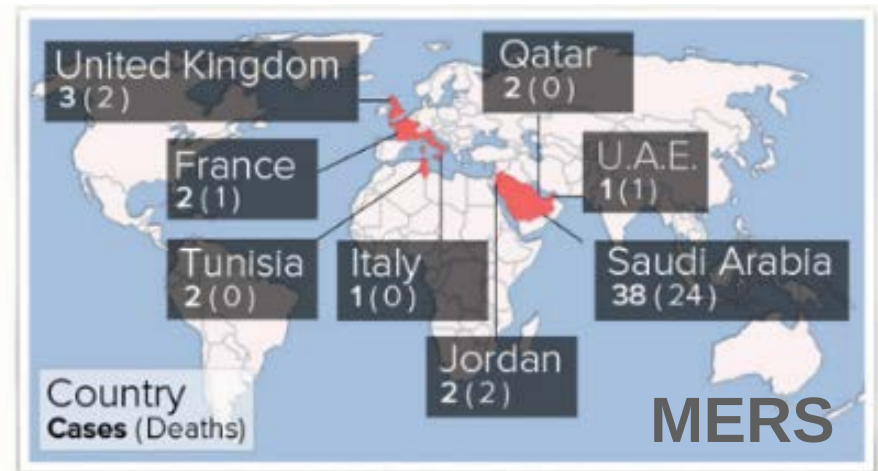
Aggregate costs of invasive species



- **Annual damages (\$B 2015):** US \$146; Canada \$31; Sweden \$1; EU \$19; China \$14; SE Asia \$34
- **Challenges:** exponential increase, apparently irreversible
- **Typical policy approach:** external costs not internalized; suffer, react, adapt;
- **Solutions:** innovative policy, science, technology

Risk-based management is common, effective, and cost effective

- Pharmaceutical safety
- Food safety
- Infectious disease



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Lessons from invasive pathogen: SARS



Invasive species solutions

Problem:

Harm > Benefit

Solution:

Improve policy, use recent science and technology to improve:

- Prevention via species profiling
- Surveillance programs
- Eradication of new invasions
- Slowed invasion spread
- Control of populations

Lodge et al. 2016.

Annual Rev. Environment & Resources:

<http://arjournals.annualreviews.org/eprint/JnVyUqX9Bp8kC2Ny5Wqa/full/10.1146/annurev-environ-110615-085532>



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Prevention: Species profiling



Photo: N. Monks

Royal Plec
Panaque nigrolineatus



Photo: D. Vereeken

Oscar
Astronotus ocellatus



Photo:

Silver Arowana
Osteoglossum bicirrhosum



Photo: K. Jakubec

Red Bellied Piranha
Pygocentrus nattereri



Photo: F. Slattery

Zebra Tilapia
Tilapia buttikoferi



Photo: National Park Service

Arctic Grayling
Thymallus arcticus



Photo: D. Vereeken

Siamese Fighting Fish
Betta splendens



Photo: Marine Discovery

Red Shiner
Cyprinella lutrensis



Photo: USFWS

Westslope Cutthroat Trout
Oncorhynchus clarkii



Photo: V. Litvinov

Florida Gar
Lepisosteus platyrhincus

Statistical
modeling

Distinguish
harmful from
benign

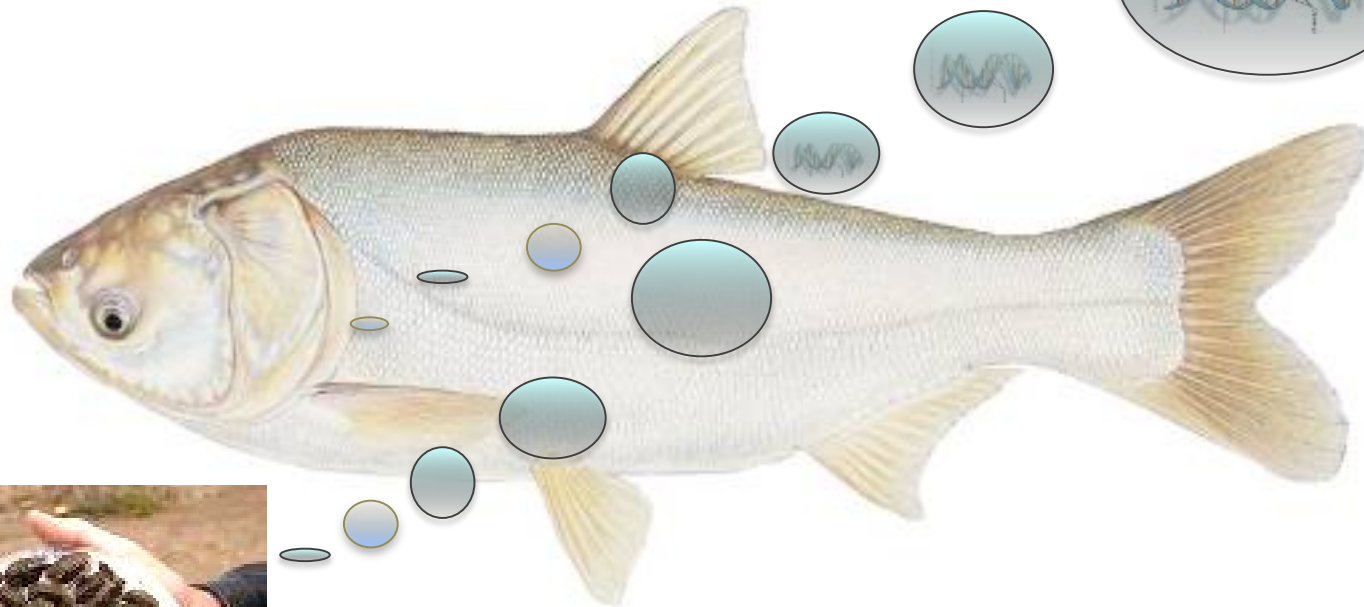
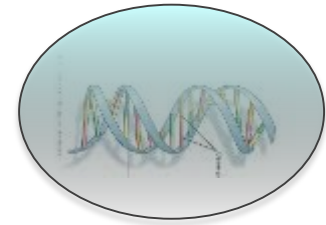


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Surveillance: eDNA

- create a baseline for species occurrence
- monitoring imperiled species
- surveillance for invasions



- greater geographic coverage
- less time
- extract increasing information from eDNA

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Eradication (not just for islands)

Feral Pig
Santa Cruz Island, CA



Rat
Rat Island, AK



Witchweed
Carolinas, USA



Caulerpa
Port-Cros Marine Park, France



Giant African Land Snail
Miami, FL

Black Striped Mussel
Darwin, Australia



Pampas grass
New Zealand



Caulerpa
San Diego, CA



Feral Cat
Ascension Island



Karroo Thorn
Western Australia



Anopheles gambiae
Brazil



White-spotted
tussock moth
New Zealand



Sandspur
Laysan

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Slow the spread



Inspection and boat washing stations



Ballast water treatment system



Electric barriers to fish invasion

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Control



Sea lamprey



Johnson grass

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Making solutions sustainable by monetizing net benefits:

The net economic benefits delivered by solutions = business opportunity



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