

Invasive Species: Impacts on Great Lakes Ecosystem Services

— David M. Lodge
Center for Aquatic Conservation
University of Notre Dame



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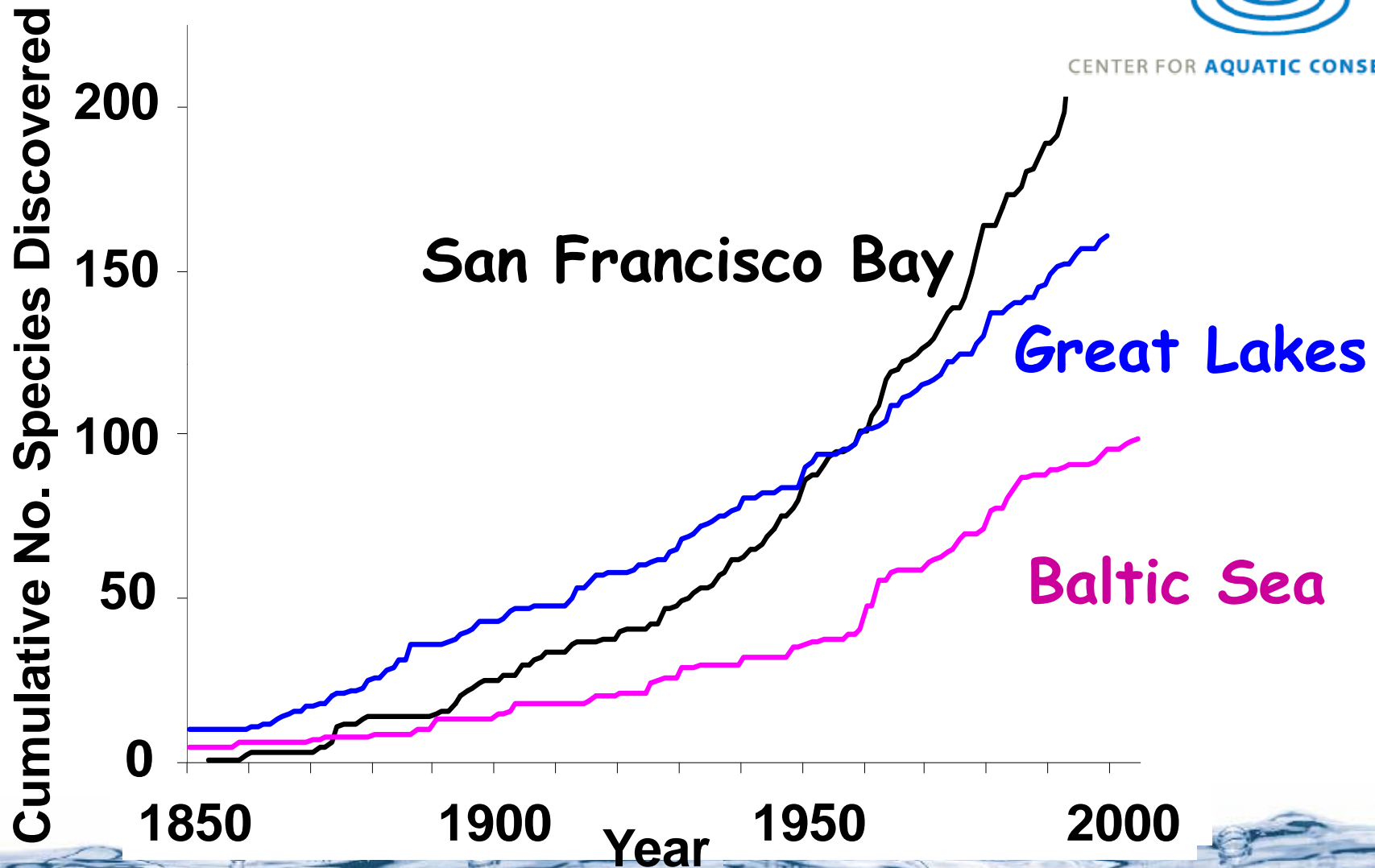
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Nonindigenous Species Numbers



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(Cohen and Carlton. 1995. *US Fish and Wildlife Service*), Ricciardi 2006, Baltic Marine Biologists. 2005.)



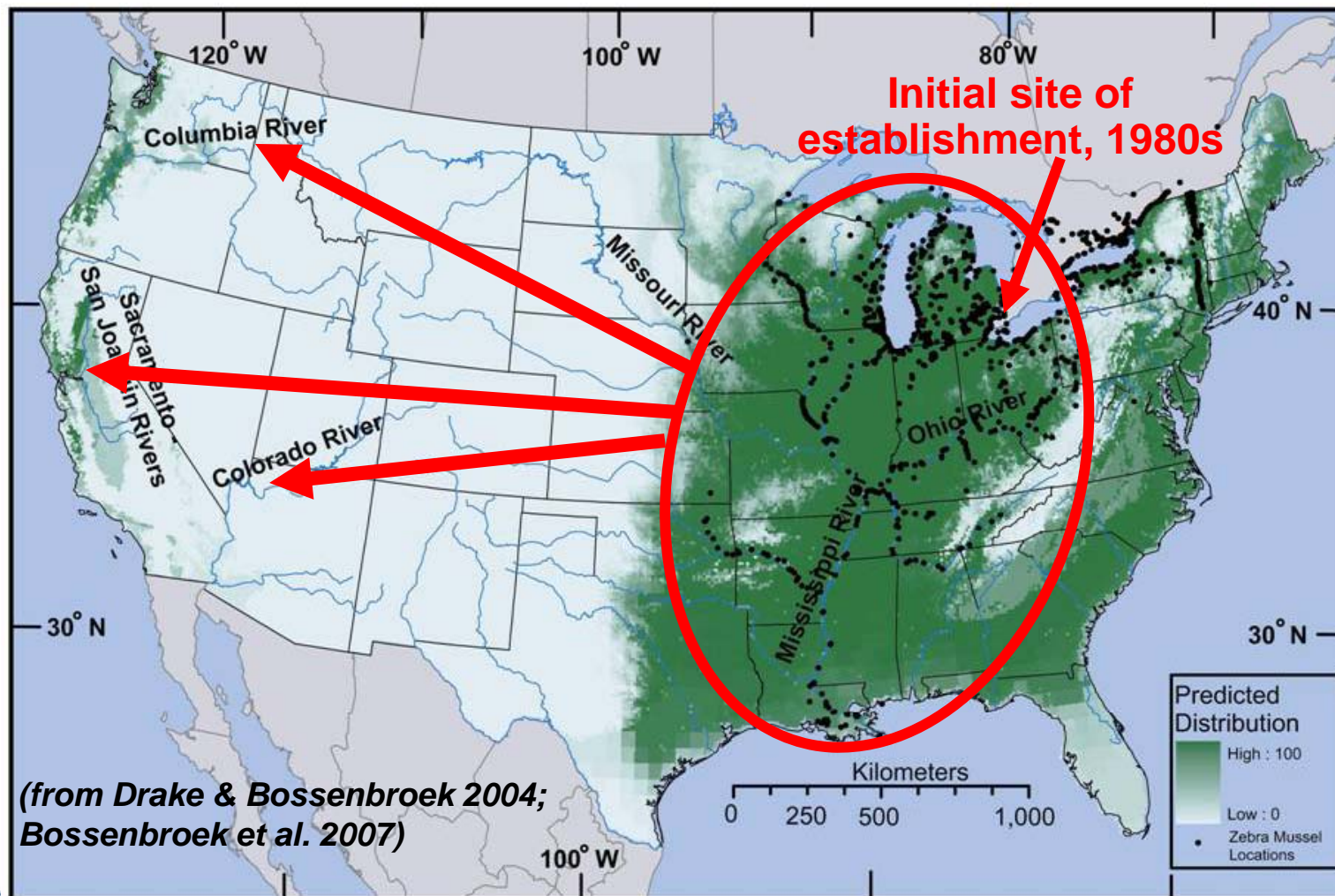
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Spread of Zebra and Quagga Mussels



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Quantifying Impact on Ecosystem Services and the Economy



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57 NIS

Lots of other drivers besides NIS



Determining Impacts: Structured Expert Judgment



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Ecologists

John Rothlisberger, David Lodge,
University of Notre Dame

Economist

David Finnoff, University of Wyoming

Structured Expert Judgment

Roger Cooke, Resources for the Future

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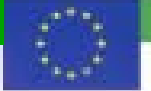
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Determining Impacts: Structured Expert Judgment

European Commission

Community research



Project report

Nuclear science and technol

Sector

Nuclear Applications

Chemical & Gas Industry

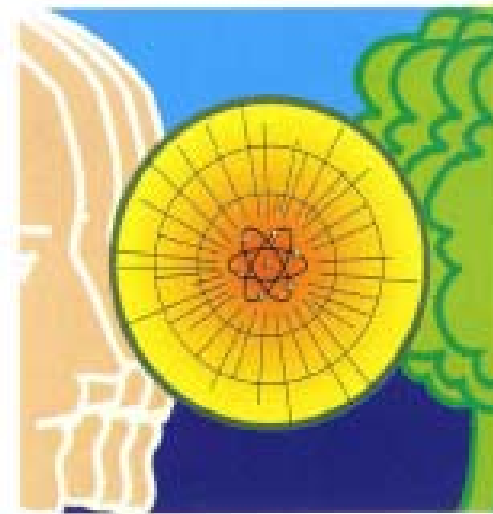
Water pollution (ground and surface)

Aerospace sector/space debris

Health: Campylobacter & SARS

Volcanoes & Dams

Procedures guide for
structured expert judgment



EURATOM

“Expert judgment is sought when
substantial scientific uncertainty impacts on
a decision process.”
(Cooke and Goosens 2005)

Types of Elicitation Variables

- Commercial Fish Landings
- Sport Fishing Effort
- Wildlife Watching
- Raw Water User Impacts



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What sort of Experts?

- Fishery biologists
- Environmental economists
- Leisure studies researchers
- GL food web ecologists
- Industry reps (e.g., power, shipping, angling)

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Who were *our* Experts?



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Richard Aiken (recreation economist, USFWS)
Renata Claudi (industry damages, Ontario Hydro)
Mark Ebener (fisheries, CORA, GLFC)
Leroy Hushak (economist, Ohio State U.)
Frank Lupi (economist, Michigan State U.)
Roger Knight (fisheries, Ohio DNR, GLFC)
Lloyd Mohr (fisheries, Ontario MNR, GLFC)
Chuck O'Neill (NY Sea Grant, industry damages)
Don Scavia (ecologist, MI Sea Grant, U. Michigan)
Roy Stein (ecologist, Ohio State U., GLFC)

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Elicitation Example: Calibration Variable

How many total lbs of fish were landed by U.S. commercial operations on the Great Lakes in 2006?
(units: pounds)

5% _____ 50% _____ 95% _____

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Elicitation Example: Target Variable - NIS Impacts



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IF NOT for the 57 navigation-associated NIS,
how many total lbs of fish **would have been** landed by
U.S. commercial operations on the Great Lakes in 2006?
(units: pounds)

5% _____ 50% _____ 95% _____

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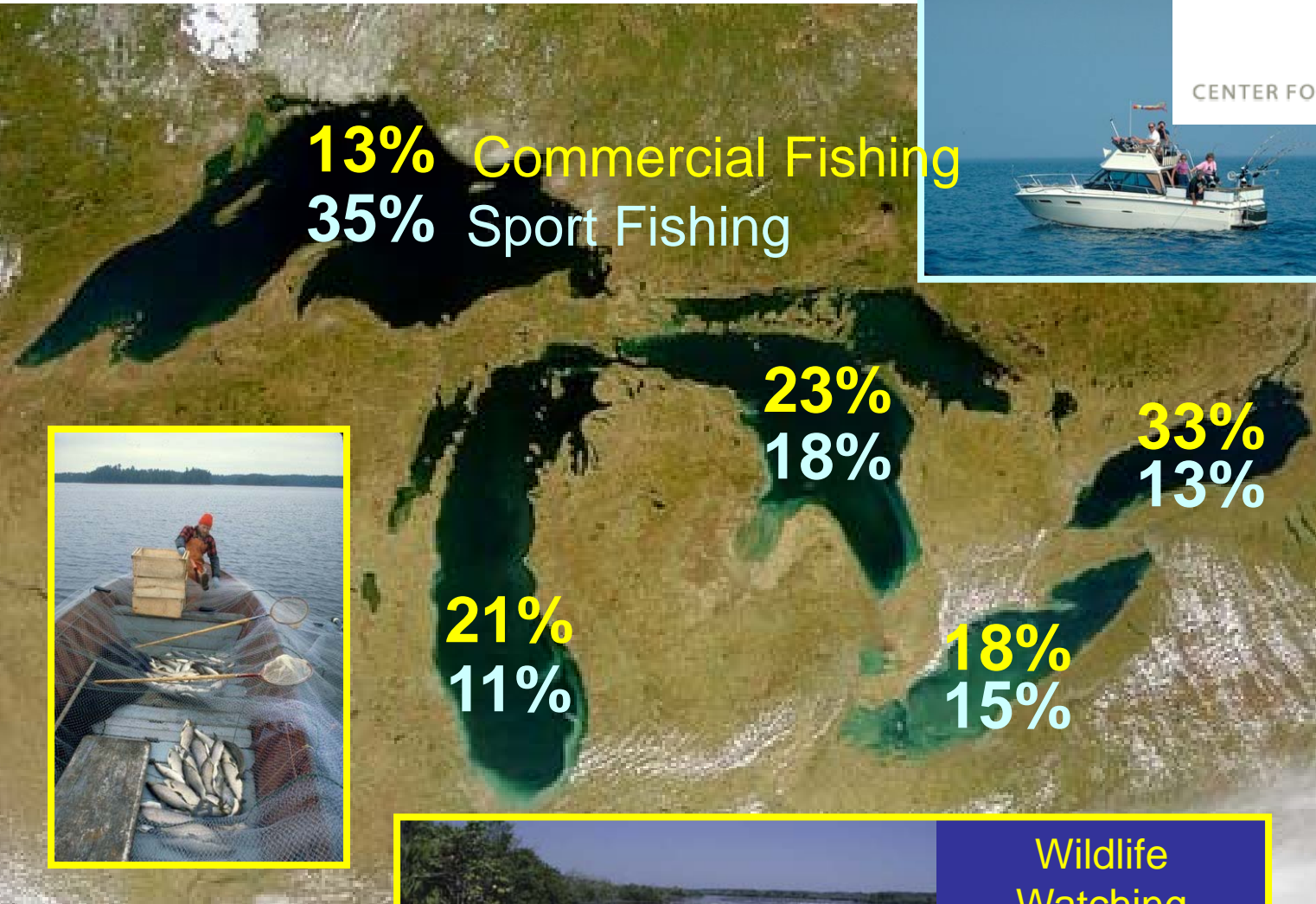
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Expert Judgment Median Results



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Raw Water

Nuclear Power Plants: \$118K /facility/year
Other facilities: \$30K /facility/year



Wildlife Watching
1%

Quantifying Impact on Ecosystem Services and the Economy



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Conservative Annual US Losses (\$M)



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Wildlife Watching
\$47

Raw Water
\$27
increased costs

Current Estimates are Lower Boundary Because ...



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- Includes only aquatic species
- Doesn't include costs outside GL region
- Doesn't include values for Canada
- Doesn't include other economic sectors
- Includes only consumer surplus (fishing, wildlife) or increased costs (water use); do not include producer surplus and interactions among sectors
- Next steps in research:
 - Incorporate uncertainties
 - Incorporate producer surplus
 - GCE model for region to capture interactions

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Preliminary Conclusions

- \$200 million represents a conservatively estimated opportunity cost borne by society as a result of the cumulative effect of 50 years of ship-borne aquatic invasive species
- If introductions were stopped tomorrow, these costs would continue undiminished
- If introductions continue, would future costs be like those in past?

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