Early Detection Monitoring for Vulnerable Great Lakes Coastal Ecosystems

Building a model approach through case study experiences

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Contributions by many others in fieldwork, laboratory analyses, GIS/statistical design, taxonomy-DNA analyses, & communications
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United States Environmental Protection Agency

Office of Research and Development
Mid-Continent Ecology Division, DULUTH MN

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Case Study at an invasion "hotspot"

The Great Lakes have Invasive Species Problems

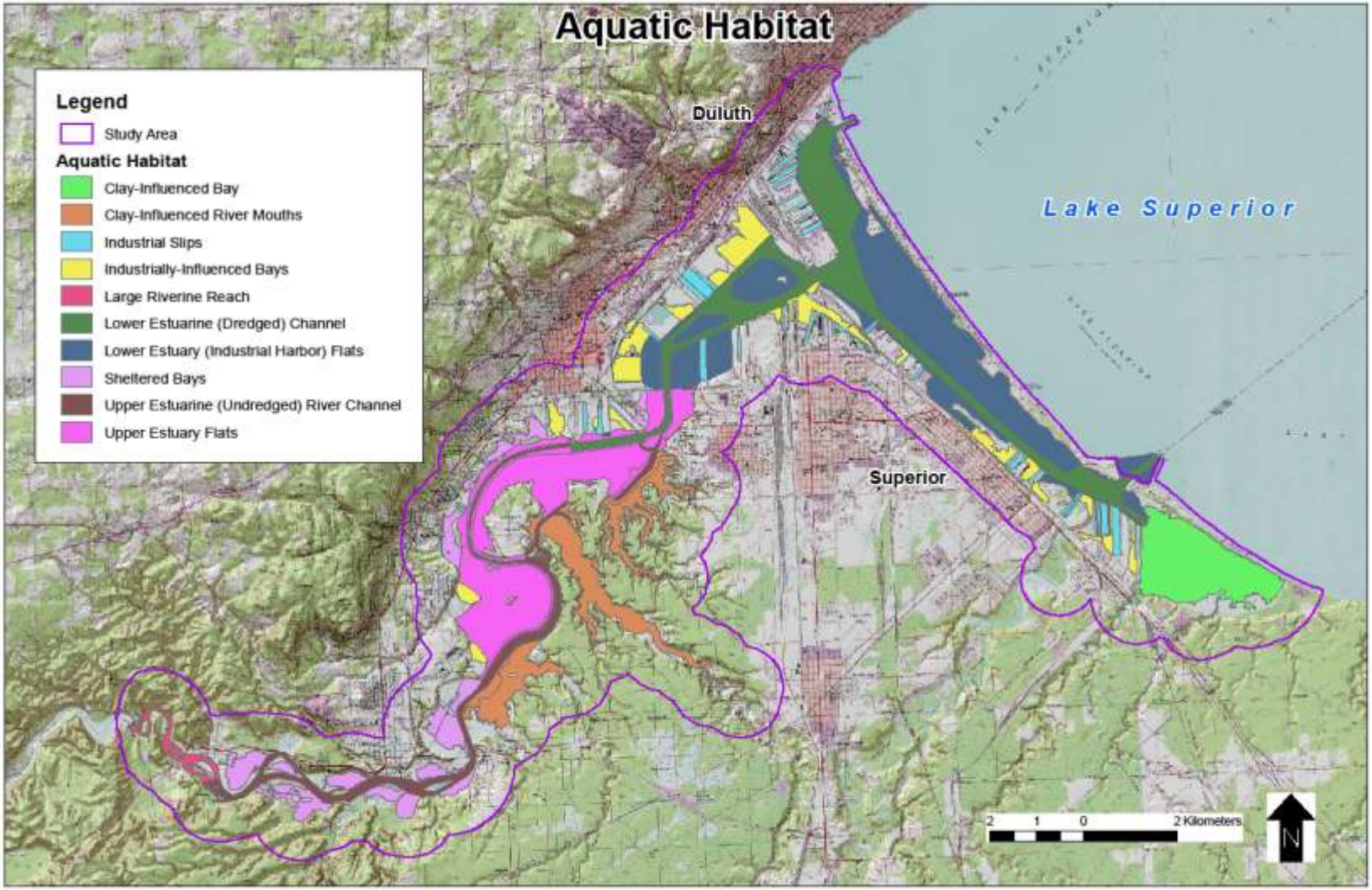
"Early Detection" Monitoring

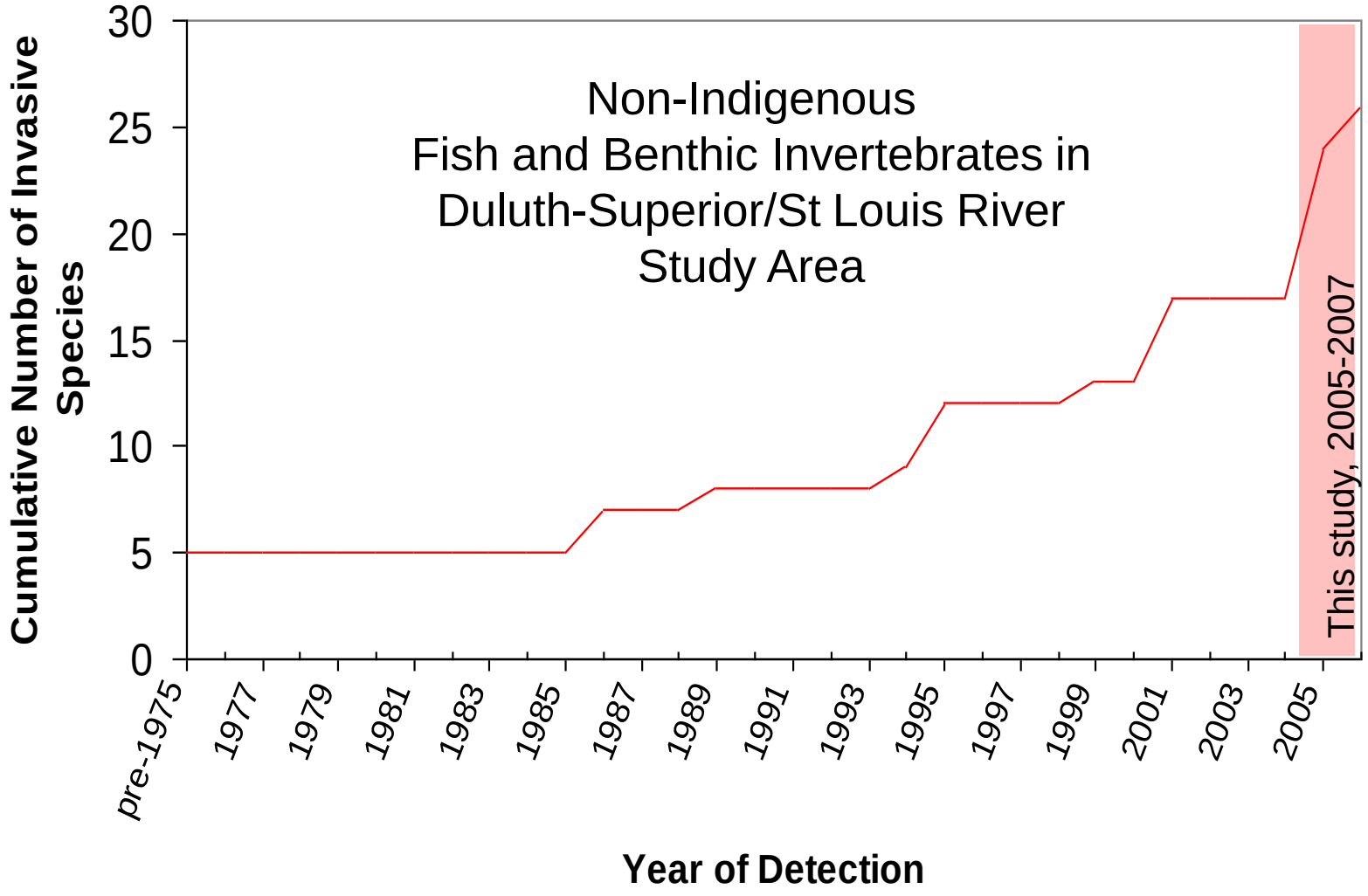
-Detect presence early in establishment of non-indigenous populations (i.e., at low abundance/limited distribution).

-Management/response possibilities; useful in system-wide assessments.

- **Technical Challenge**
  - Find "rare" before it is common.
    (*not specific to one path of introduction [vector], and general to all NIS*)
- **Technical Issue**
  - Efficiency (*ultimately, cost*). Finding "rare" takes effort.
- **Research Goal**
  - Develop and recommend monitoring model elements that could become a network.

Case Study Approach:
Duluth-Superior Harbor/St. Louis River Embayment




Non-Indigenous
Fish and Benthic Invertebrates in
Duluth-Superior/St Louis River
Study Area
Cumulative Number of Invasive Species
0
5
10
15
20
25
30
pre-1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
This study, 2005-2007
Year of Detection

Adult size up to 4 cm

General approach -

"Oversample" to provide information base for analyses, tests of different spatial/temporal designs, optimizing of gears and habitats

Adult size ~ 5 mm

Lake Superior

First detected 2005
by our sampling

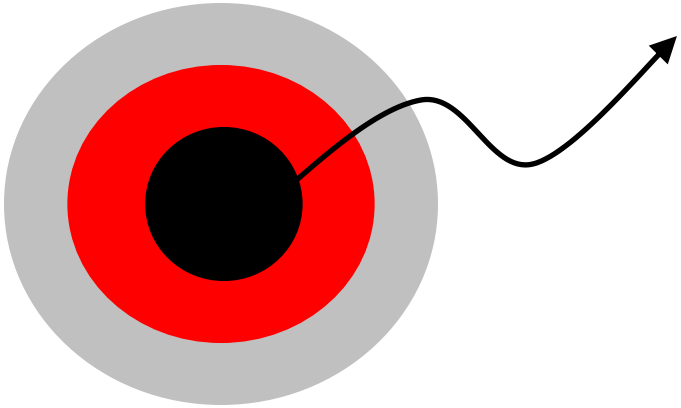
See Trebitz et al. 2010
J. Great Lake Res.

0 1 2 4 Miles

New Zealand Mudsnail
Potamopyrgus antipodarum
Absent
Present

Adult Size: 3.5 to 6.5 cm (max 8 cm)

Case Study Approach

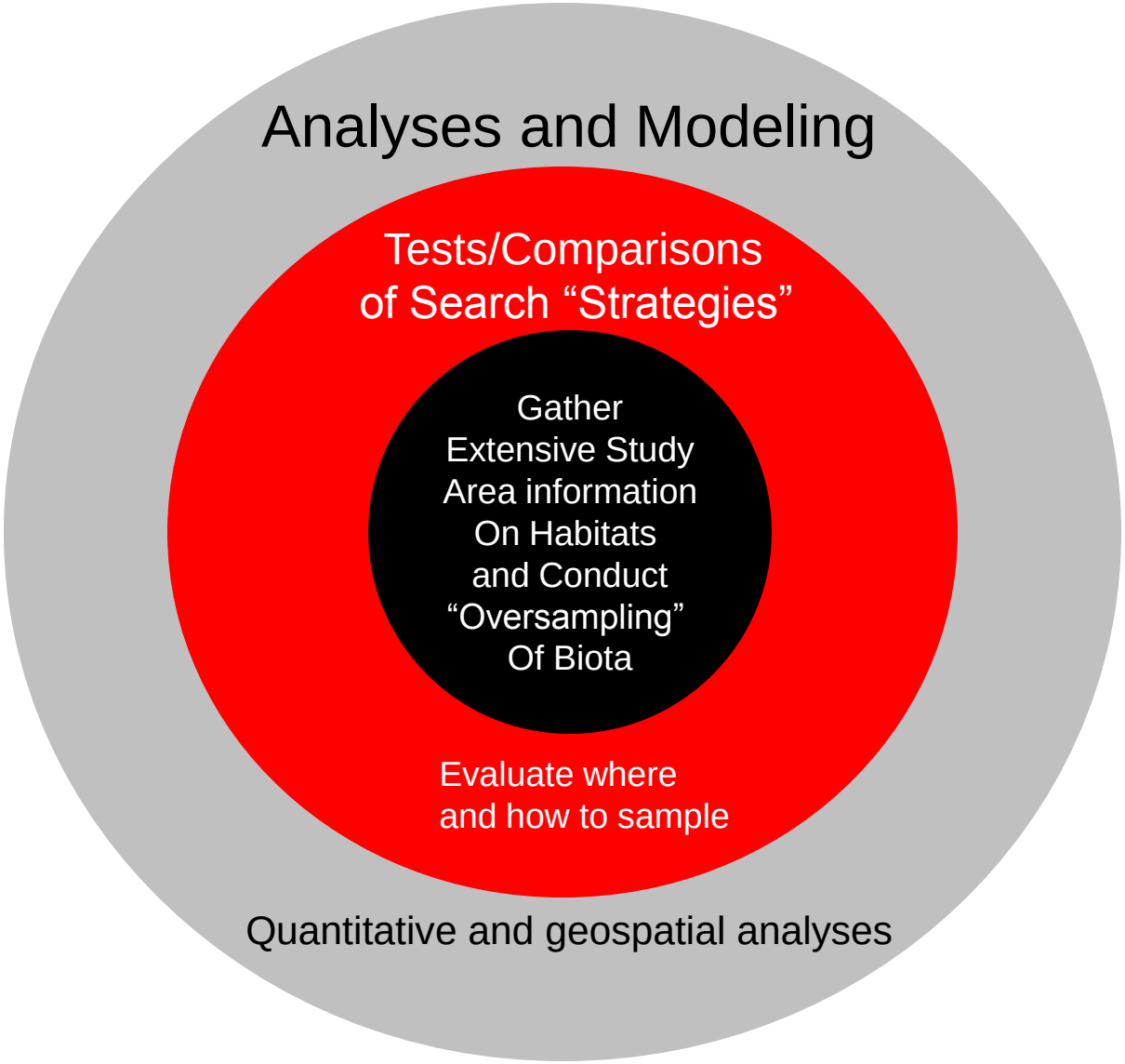


Duluth-Superior Harbor/
St. Louis River Embayment

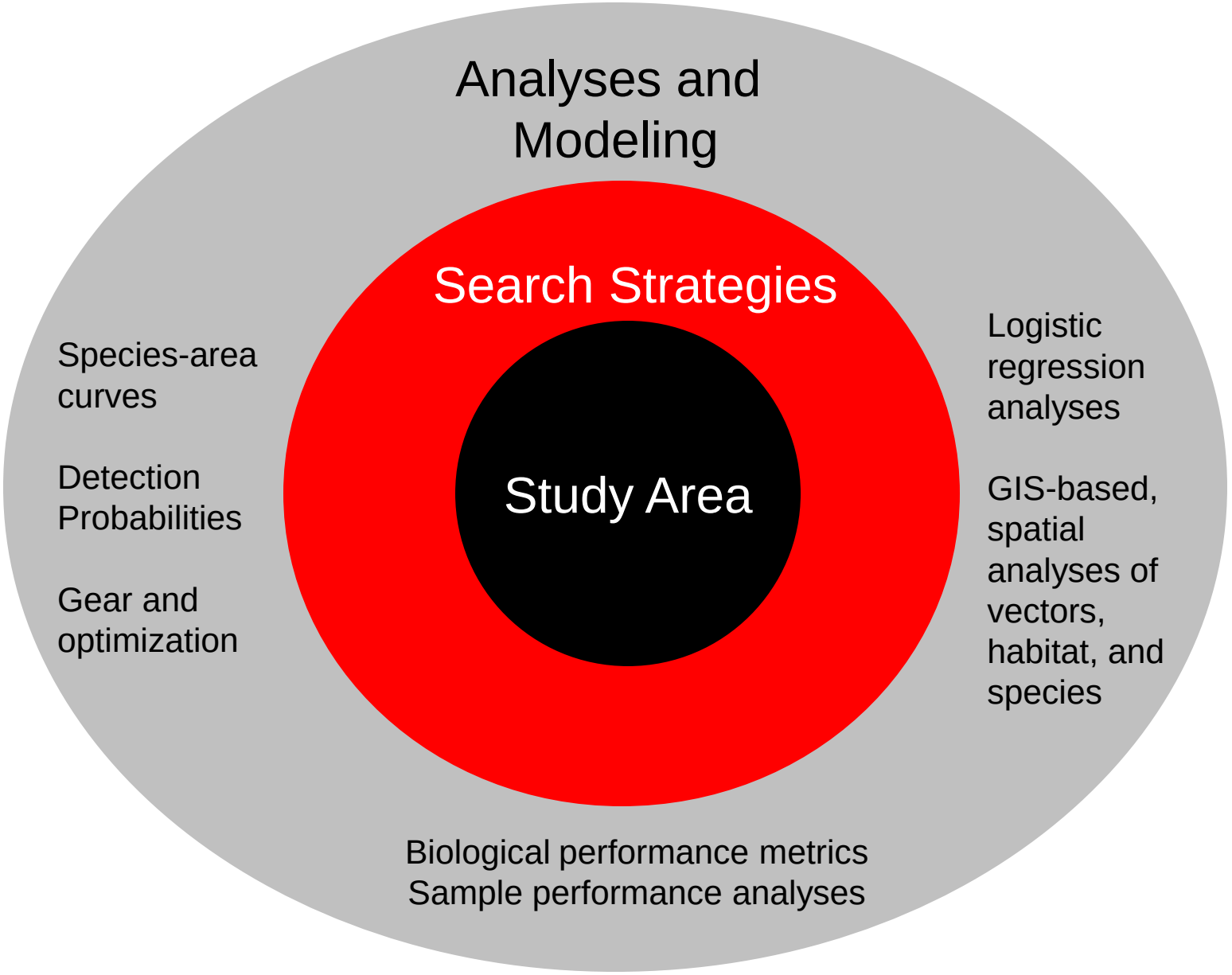
Overall Objective

All elements combine to develop **principles** that inform a generalized *model approach to early detection monitoring of potentially invasive species within vulnerable coastal ecosystems*

Case Study Approach



Case Study Approach



Simple Lessons of Case Study

1. Maximize sampling EFFORT to detect early, when rare

-non-detection issues are foremost

-you get what you design for

2. Cover SPACE

-Best if spread over space is strong at “macroscopic” and “microscopic” scales

-Mix of gears/microhabitats is advised

-Can partition effort to gain some efficiency in detection

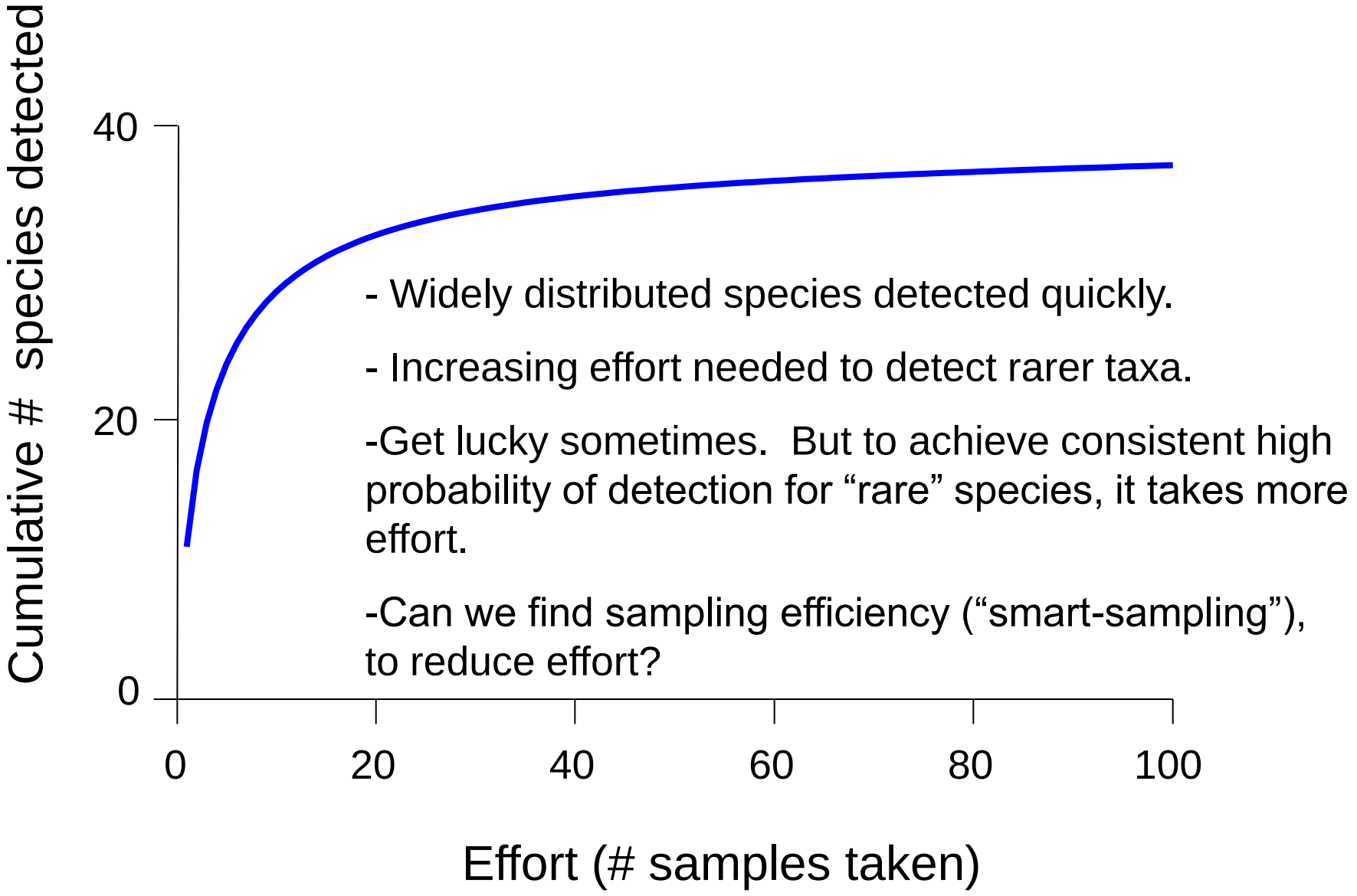
-More space may be better than repeated sampling at a set of sites

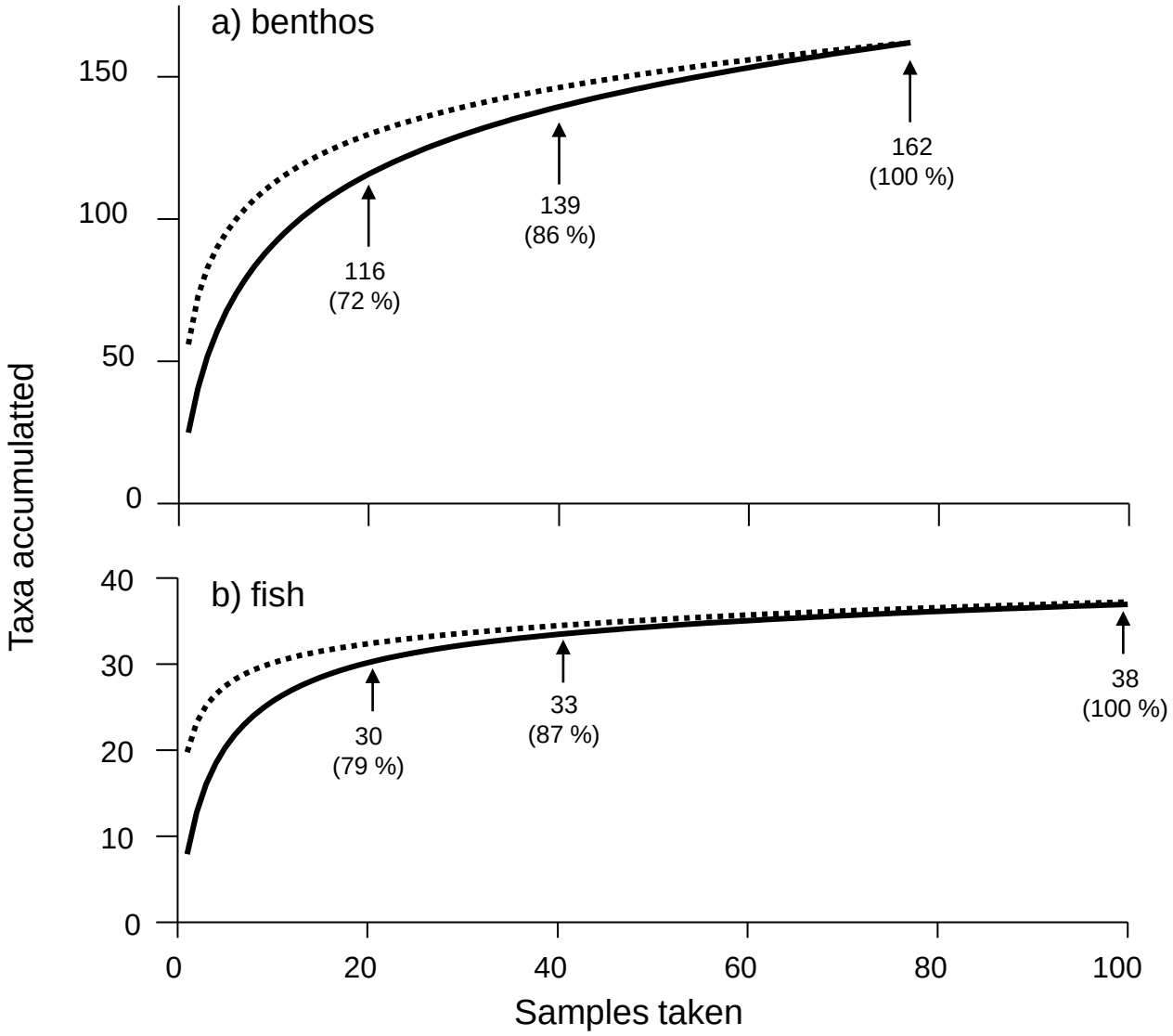
3. Always pay attention to TAXONOMY

-use vouchers, experts, DNA

1. More sampling effort is better

Species-area (effort) theory




a) benthos
150
100
50
0
116
(72 %)
139
(86 %)
162
(100 %)
b) fish
40
30
20
10
0
30
(79 %)
33
(87 %)
38
(100 %)
0
20
40
60
80
100
Samples taken
Taxa accumulatted

2. Cover the space


USGS

Adult size up to 50 mm

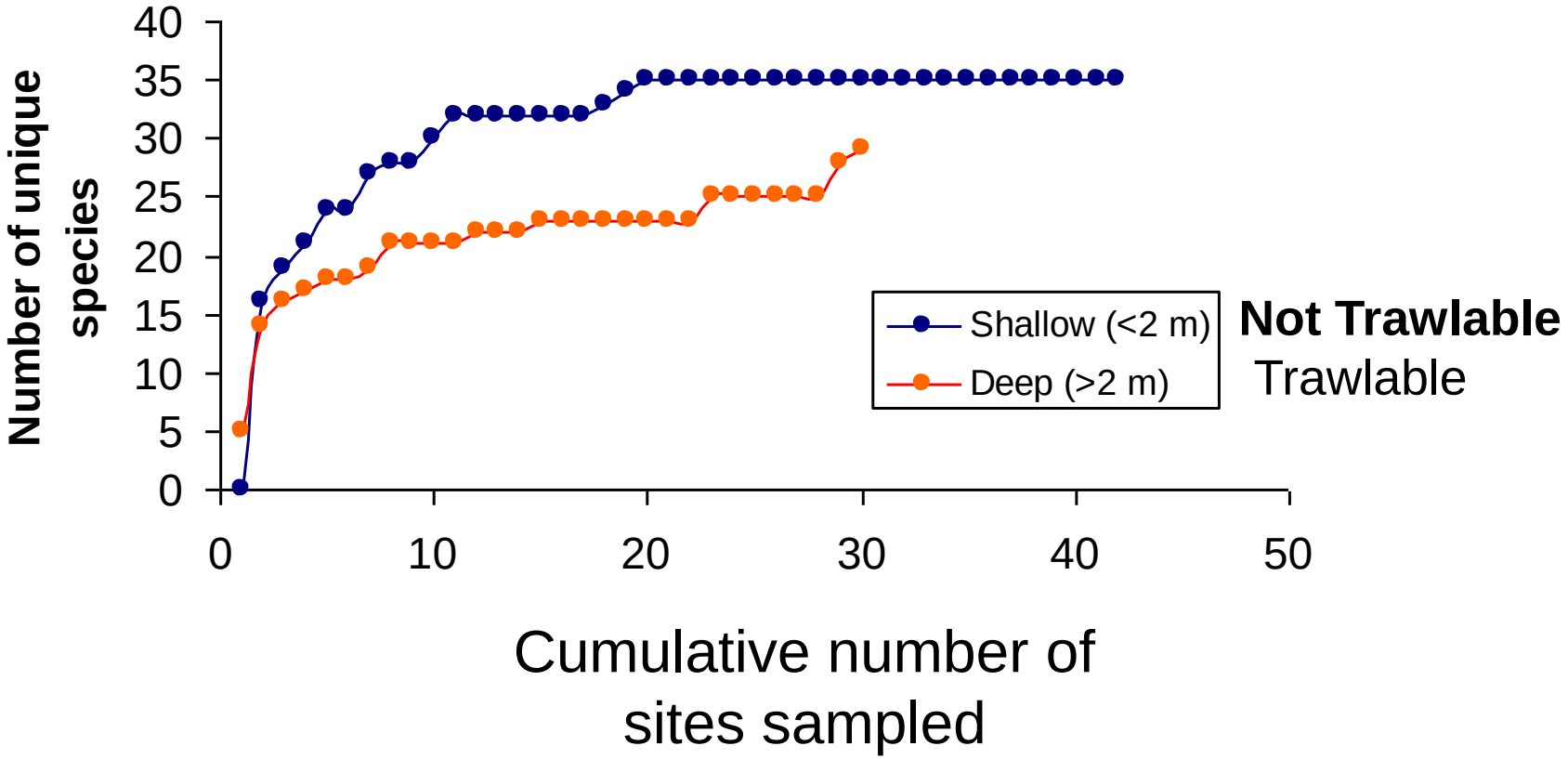
Asian Clam

Detected ~1999

Restricted, but abundant

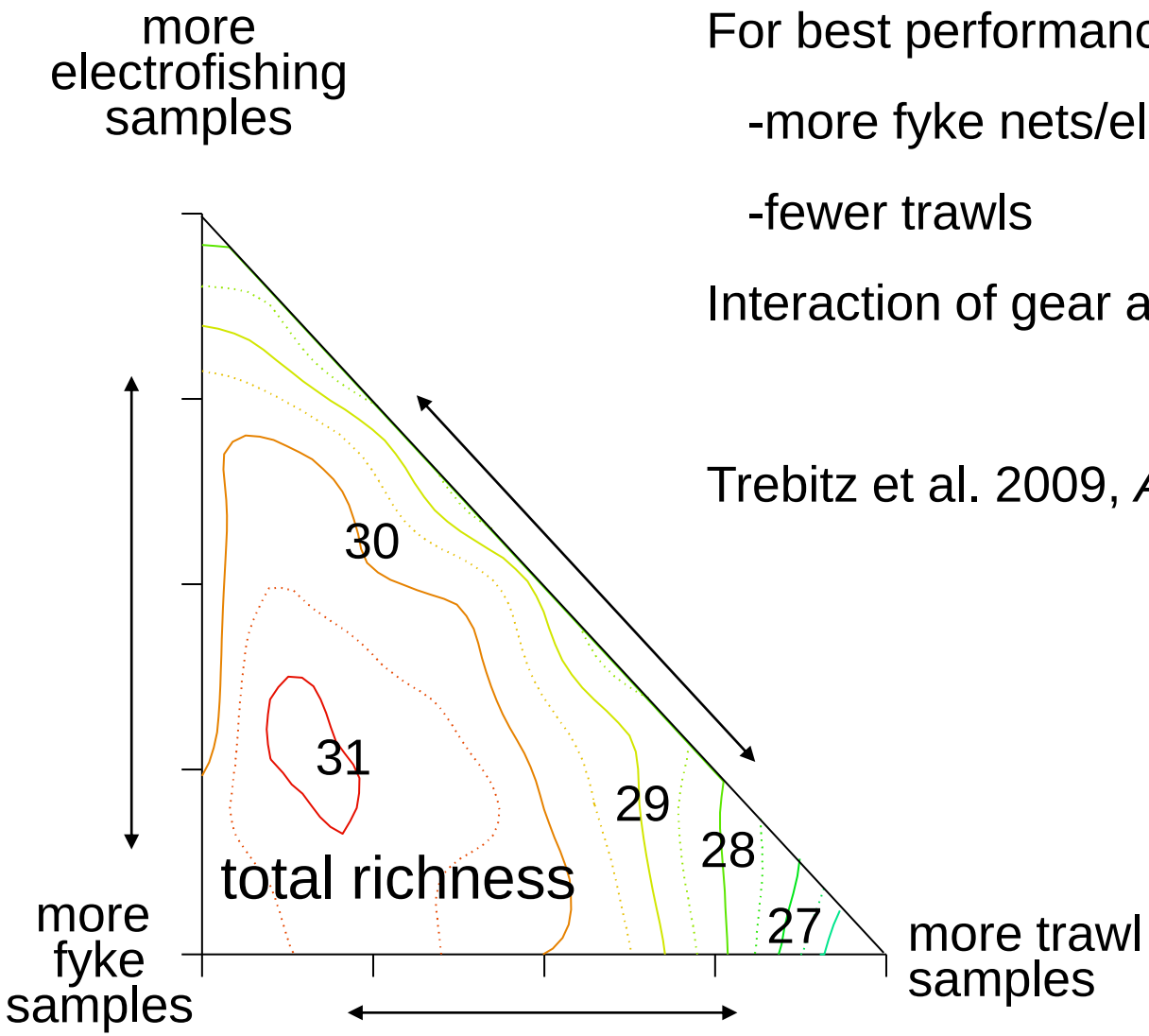
Unique environmental situation

Species - Area by Depth Class
FISH 2006



2a. Can bias sampling to achieve optimal effectiveness and/or efficiency in effort,
given some system knowledge

Optimal gear mix? Fish



For best performance, bias survey

-more fyke nets/electrofishing sites

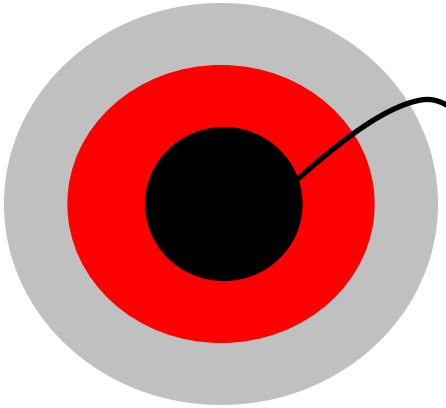
-fewer trawls

Interaction of gear and depth.

Trebitz et al. 2009, *Aquatic Invasions*

Principles that inform
a generalized *model approach*
to early detection monitoring of
potentially invasive species
within vulnerable coastal ecosystems

Case Study Approach



Duluth-Superior Harbor/
St. Louis River Embayment

1. More sampling effort is better
2. Cover the space
3. Pay attention to taxonomy

With sufficient site specific knowledge,

Can refine search space

Can exercise sampling bias to gain some efficiency

Additional case study area benefits:

-can specify effort/cost for defined probability of detection;

-provide design options to specified criteria

-can also provide an effective assessment/communication tool to show status, spread or check prevention/restoration success

EPA United States Environmental Protection Agency

Case Study at an invasion "hotspot"

What's next?

The Great Lakes have Invasive Species Problems

Conduct additional full case studies with oversampling strategy, testing concepts in different situations.

Have provided preliminary designs for continuing in DSH, Sault St Marie, Thunder Bay (USFW conducting pilots)

Discuss and establish network-level design criteria.

(Must build in possible response options)

GLRI Action Plan goal is network by 2014.