Reassessment of the Unionid Community in Lake Erie and Lake St. Clair, 25 Years After the Dreissenid Invasion

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Dreissenid invasion and unionid plight

- *Dreissena polymorpha* arrived in Lake Erie in 1986 (Carlton, 2007)
- Effects on unionids:
  - Feeding
  - Respiration
  - Reproduction

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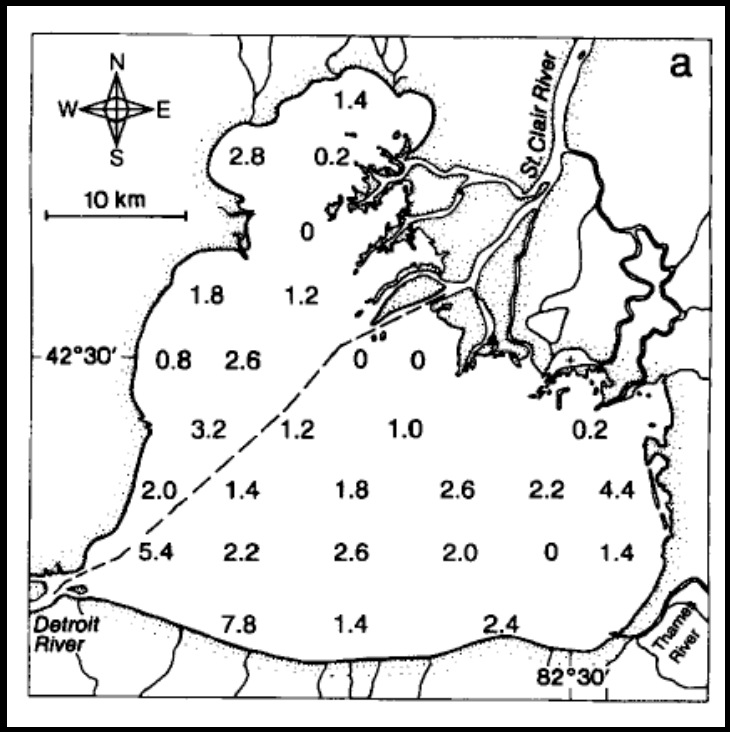
- Effects on unionids:
  - Feeding
  - Respiration
  - Reproduction
  - Movement

Unionids in Lake St. Clair

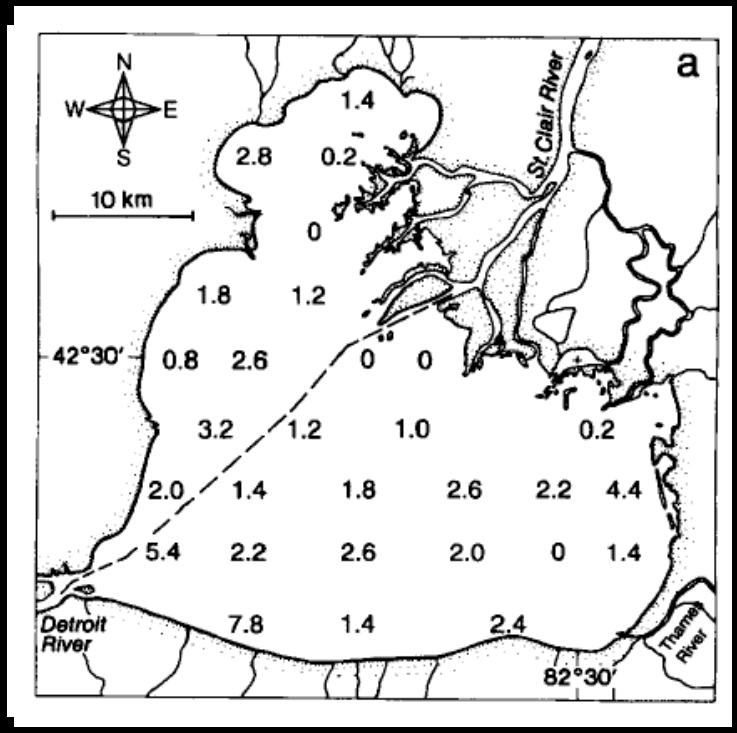
- 1986:
  - Unionids only
    - Species = 18
    - Density = 1.9/m^2
  - Already in decline?
    - Historically ~37 spp.
      (LaRocque & Oughton 1937; Graf 2002)



- Unionid densities in 1986
  (Nalepa & Gauvin 1988)

Enter *D. polymorpha*

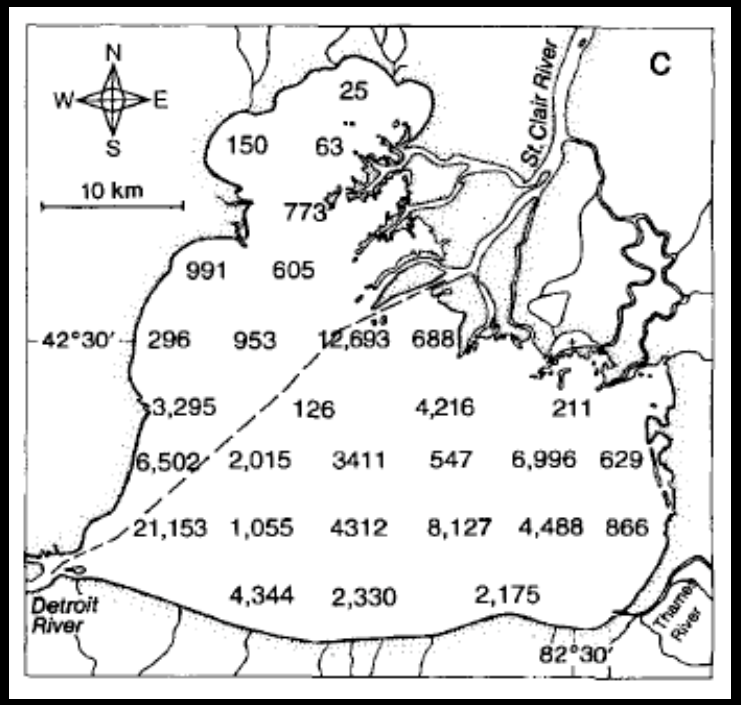
- ~1986:
  - *Dreissena polymorpha* arrives
  - First detected in 1988 (Hebert *et al.* 1988)



- Unionid densities in 1986 (Nalepa & Gauvin 1988)

Enter *D. polymorpha*

- 1994:
  - Heavy *D. polymorpha* infestation throughout lake
  - *D. polymorpha* density = 3,241/m^2

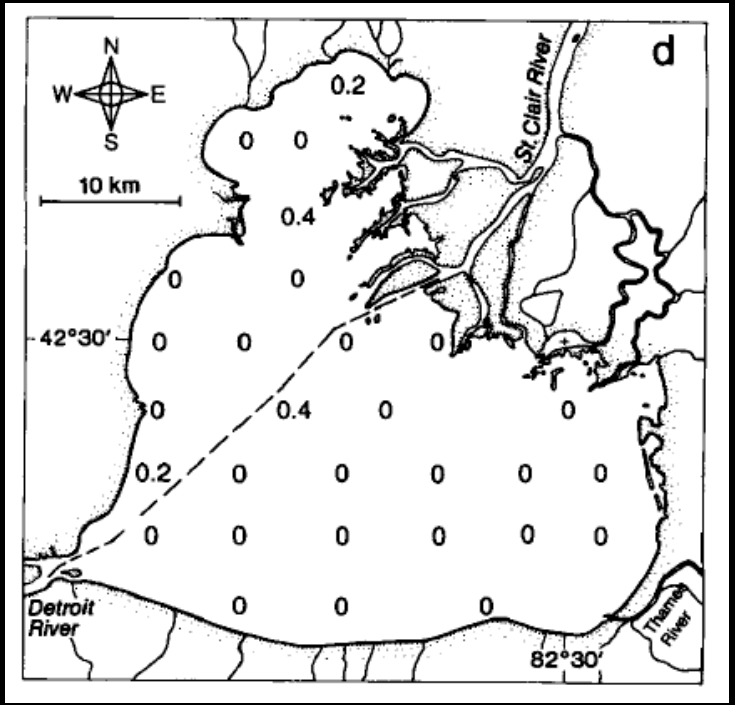


- *D. polymorpha* densities in 1994 (Nalepa *et al.* 1996)

Enter *D. polymorpha*

- 1994:
  - Heavy *D. polymorpha* infestation throughout lake
  - Unionids crash first on SE side of lake follow by crash on NW side of lake

  - Unionid Species = 0?
  - Density = <0.1/m^2

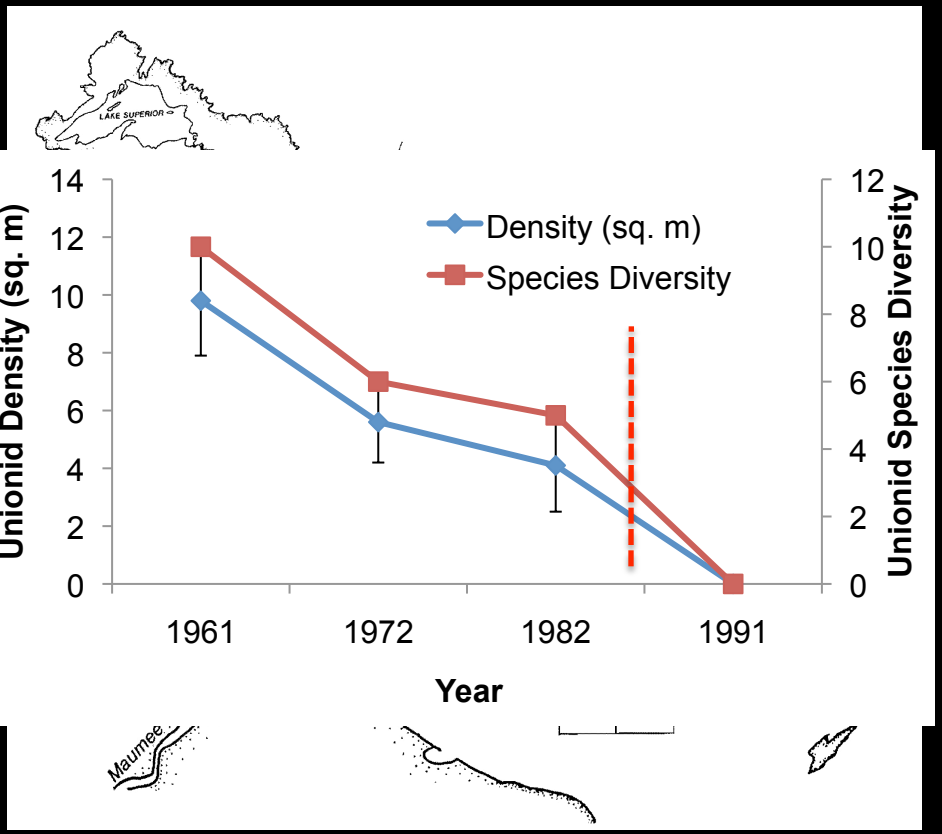


- Unionid densities in 1994

(Nalepa *et al.* 1996)

Unionids in Western Lake Erie

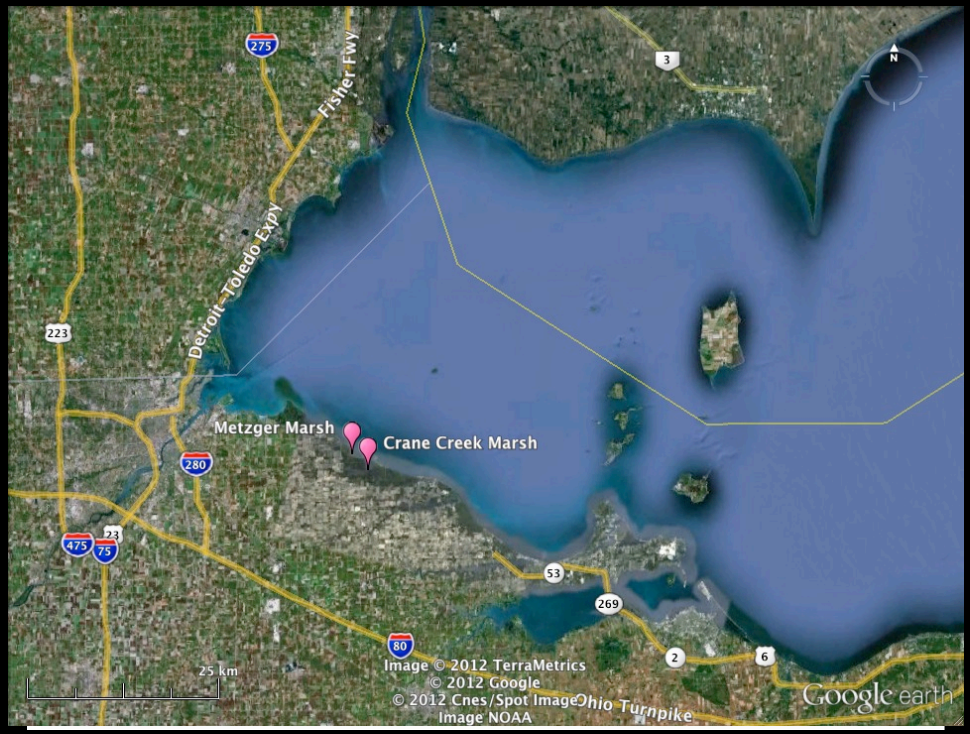
- Pre-*Dreissena*:
  - Documented declines in unionid density and diversity (Nalepa et al. 1991)
  - D. polymorpha arrives in 1986 (Carlton 2007)
  - Unionids crash by 1991 (Schloesser & Nalepa 1994)



- Unionid sampling 1989-91 (Schloesser & Nalepa 1994)

A New Hope?
Unionid Refuges

- First unionid refuges found in Lake Erie coastal wetlands (Metzger Marsh, Nichols & Wilcox 1997; Crane Creek Marsh, Bowers & De Szalay 2004, 2005, 2007)
- *Dreissena* densities showed significant declines between 1994 and 2001 in St. Clair (Hunter & Simmons 2004)
- Large unionid refuge discovered and documented in the St. Clair delta 1999-2001 (Zanatta *et al.* 2002)
  - Very shallow <1 m
  - only a single live unionid found in water >2 m

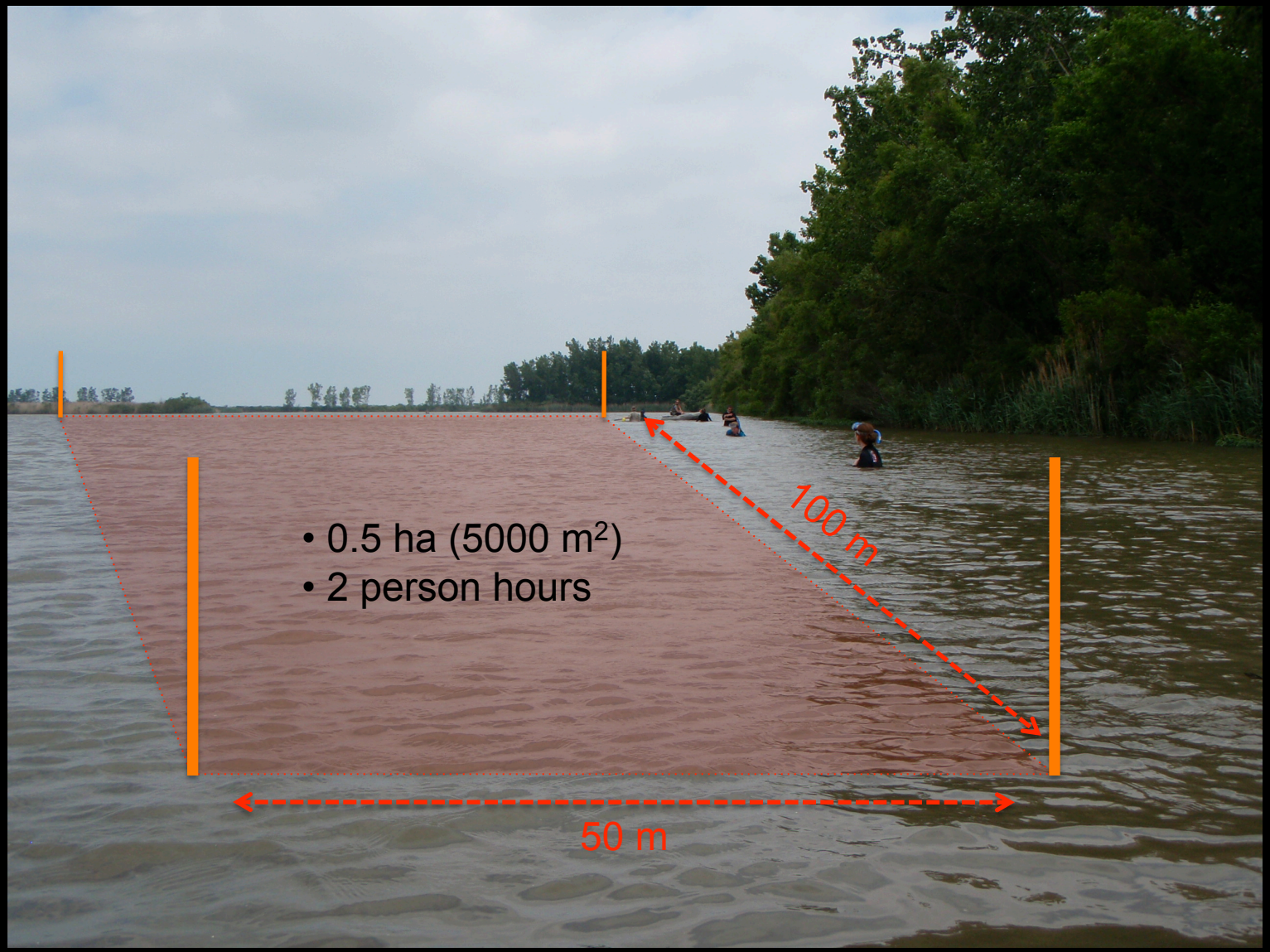


- Exhaustive sampling: 1999-2001, 2003, 2010 (Zanatta *et al.* 2002, McGoldrick *et al.* 2009, Lucy *et al.* in press)

Unionid Refuge Project Objectives

1. Assessment of unionid populations and their habitat in unionid refuges from the nearshore and coastal zone of the lower Great Lakes.
2. Investigate genetic diversity of unionid populations in coastal wetlands and gene flow between coastal wetlands and nearby riverine populations.
3. Develop and verify models based on habitat characteristics in unionid refuges that identify addition refuge locations, and develop management strategies that enhance unionid habitats.

Standardized Survey Methods



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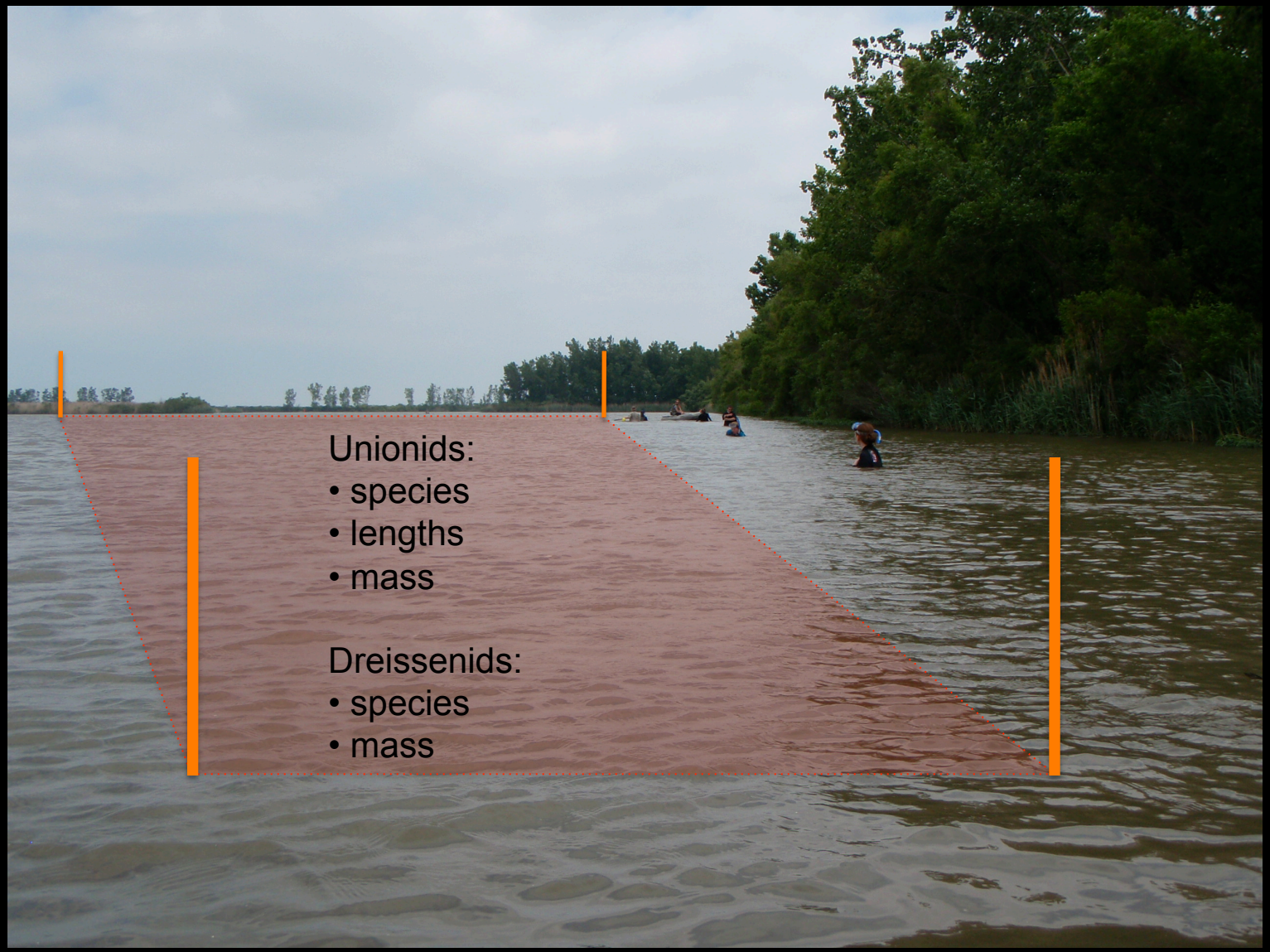

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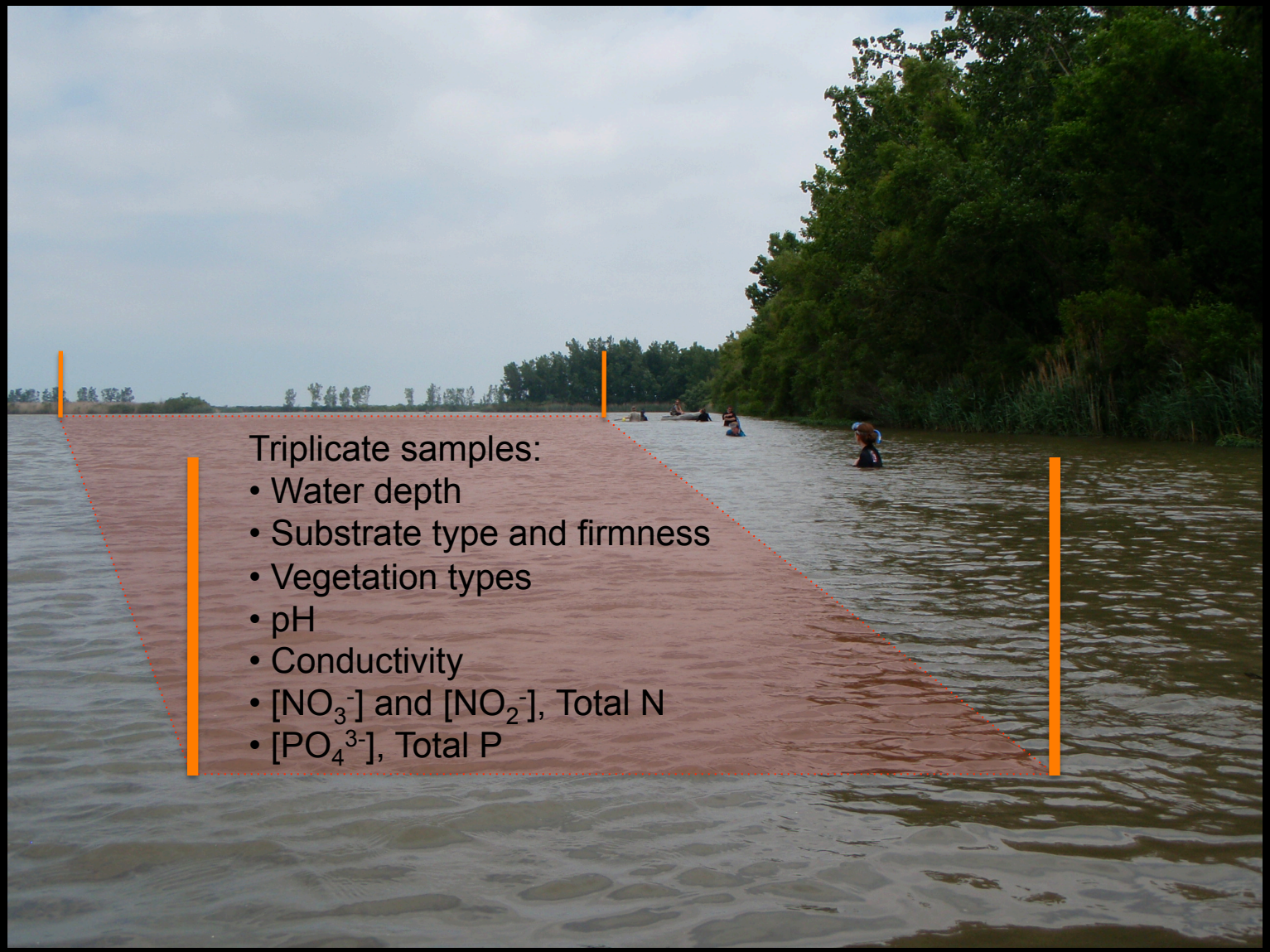
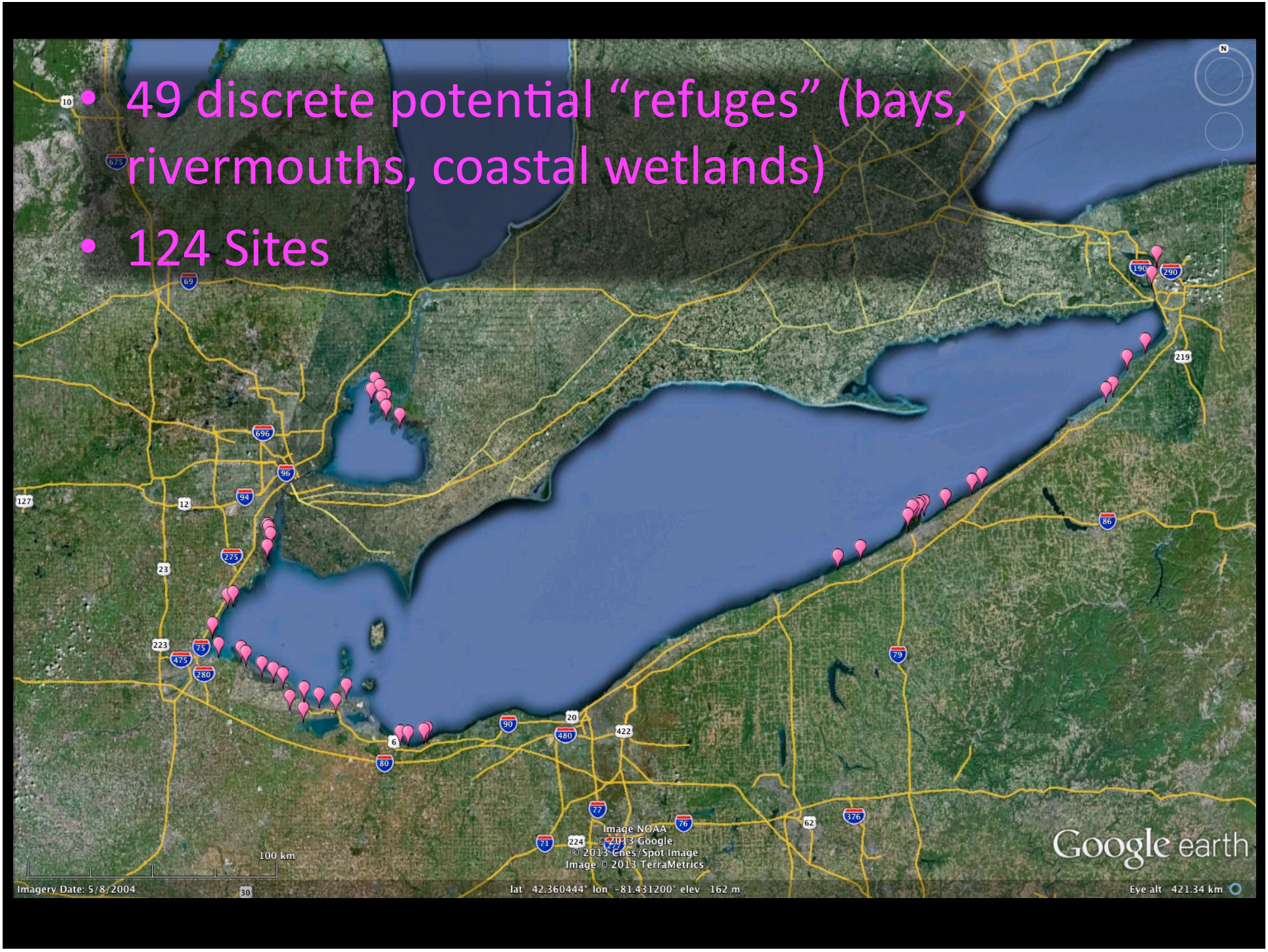
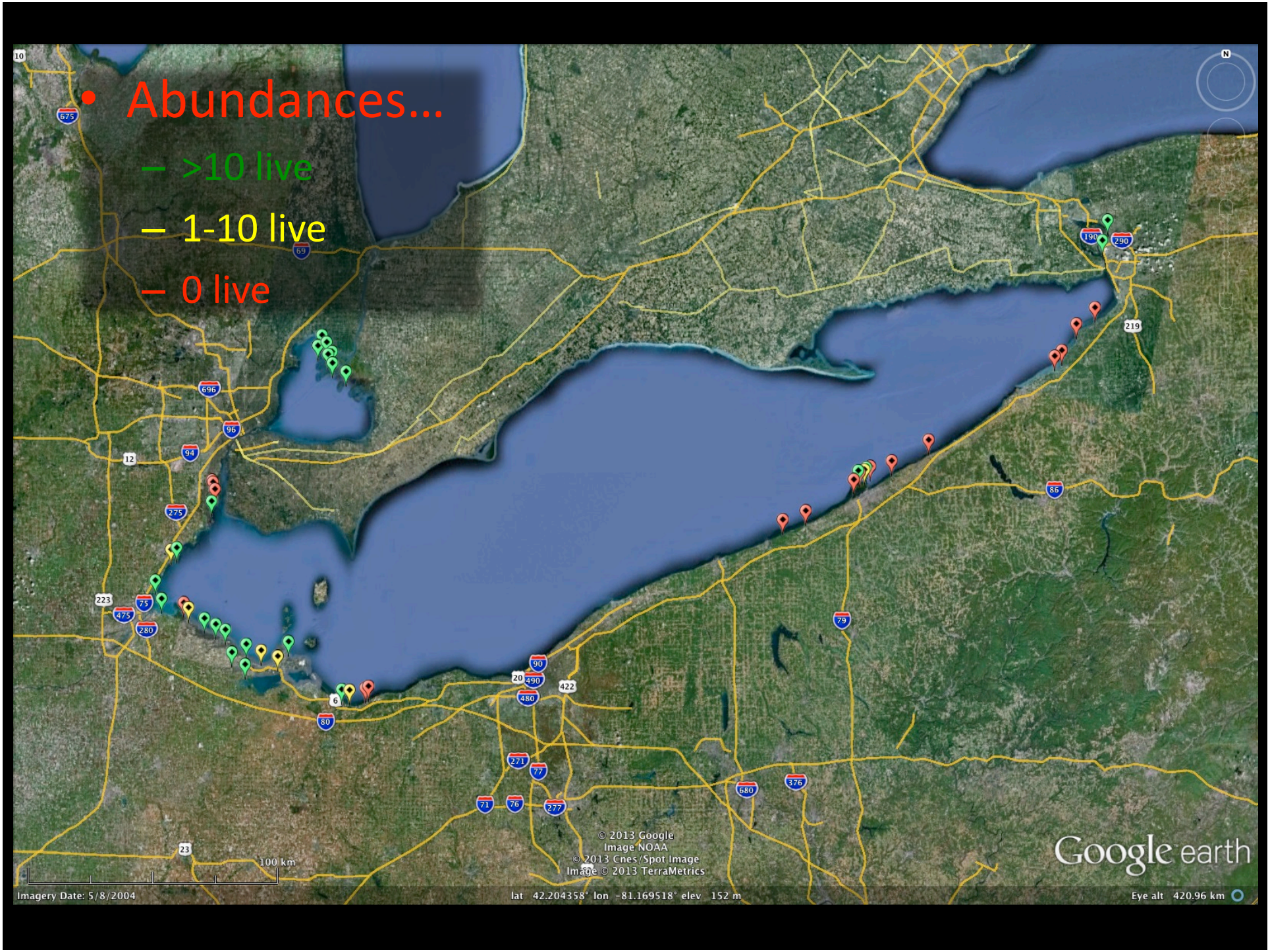



Summary of 2011 Sampling
Image NOAA
© 2013 Google
Google earth
Imagery Date: 5/8/2004
Eye alt 421.34 km


• 49 discrete potential “refuges” (bays, rivermouths, coastal wetlands)
• 124 Sites
Image NOAA
© 2013 Google
© 2013 Cnes/Spot Image
Image © 2013 TerraMetrics
Google earth
100 km
Imagery Date: 5/8/2004
lat 42.360444° lon -81.431200° elev 162 m
Eye alt 421.34 km


• Abundances…
– >10 live
– 1-10 live
– 0 live
© 2013 Google
Image NOAA
© 2013 Cnes/Spot Image
Image © 2013 TerraMetrics
Google earth
100 km
Imagery Date: 5/8/2004
lat 42.204358° lon -81.169518° elev 152 m
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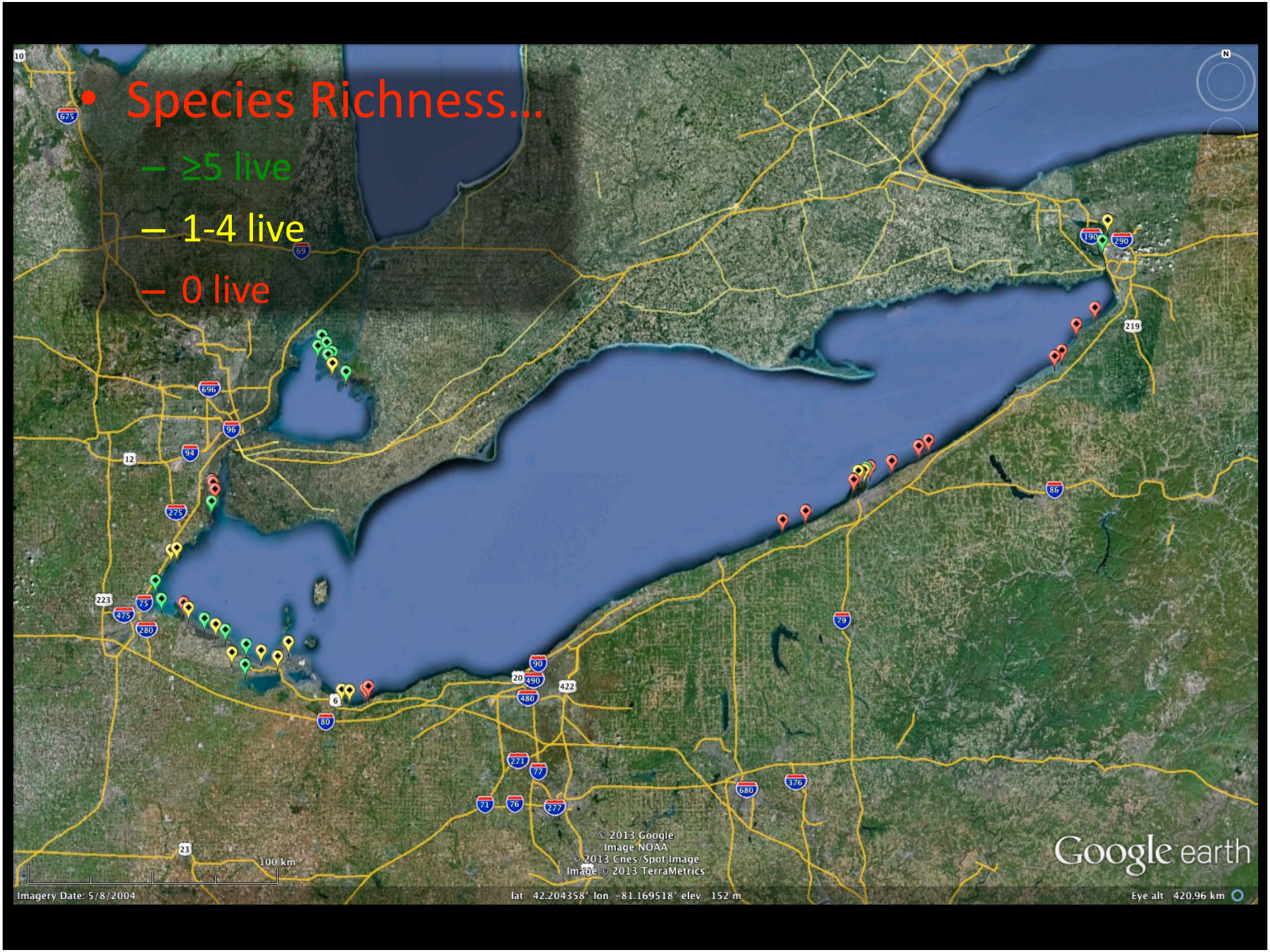
• Species Richness…
– ≥5 live
– 1-4 live
– 0 live
© 2013 Google
Image NOAA
© 2013 Cnes/Spot Image
Image © 2013 TerraMetrics
Google earth
100 km
Imagery Date: 5/8/2004
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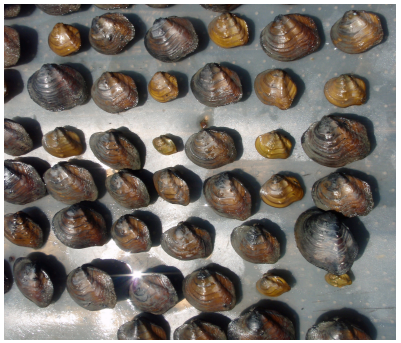
23 species
1923 individuals

Species List

Amblema plicata	199
Anodontoides ferussacianus	1
Elliptio dilatata	1
Fusconaia flava	43
Lampsilis cardium	15
Lampsilis siliquoidea	262
Lasmigona costata	5
Lasmigona complanata	23
Leptodea fragilis	92
Ligumia nasuta (T/E)	52
Ligumia recta (T/E)	1
Obliquaria reflexa (T/E)	10
Pleurobema sintoxia	3
Potamilus alatus	57
Pyganodon grandis	311
Quadrula pustulosa	5
Quadrula quadrula	780
Strophitus undulatus	12
Toxolasma parvum (T/E)	15
Truncilla donaciformis (T/E)	0*
Truncilla truncata	6
Utterbackia imbecillus	9
Villosa iris	21

* Many collected during October seiche at Bayshore (Maumee Bay)

Community Shift in W. Lake Erie



Species	1951-52*	1961*	1972*	1982*	2011-12 (Refuges)
Amblema plicata	1.5%			15.4%	12.4%
Elliptio dilatata	4.2%	2.6%			
Fusconaia flava	3.0%				1.5%
Lampsilis cardium	4.2%	5.1%	8.3%		
Lampsilis siliquoidea	62.4%	30.8%	62.5%	46.2%	0.7%
Lasmigona complanata					1.5%
Leptodea fragilis	6.9%	2.6%			6.0%
Ligumia nasuta	7.8%	25.6%	8.3%	23.1%	1.9%
Obliquaria reflexa	0.6%	2.6%			0.7%
Obovaria subrotunda	0.3%				
Pleurobema sintoxia	0.3%				
Potamilus alatus	3.0%	2.6%	4.2%	7.6%	1.5%
Potamilus ohiensis		5.1%	8.3%		
Pyganodon grandis	3.3%	20.5%	8.3%	7.6%	19.8%
Quadrula pustulosa	0.3%				0.3%
Quadrula quadrula					51.7%
Toxolasma parvum					1.0%
Truncilla donaciformis	2.4%	2.6%			
Truncilla truncata					0.4%
Utterbackia imbecillus					0.6%

*Nalepa et al. 1991

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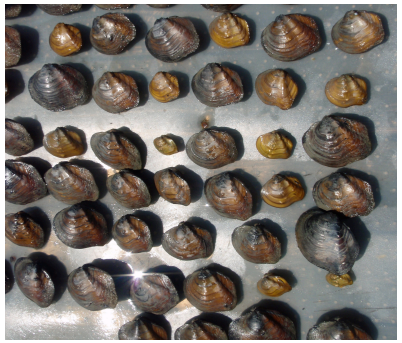

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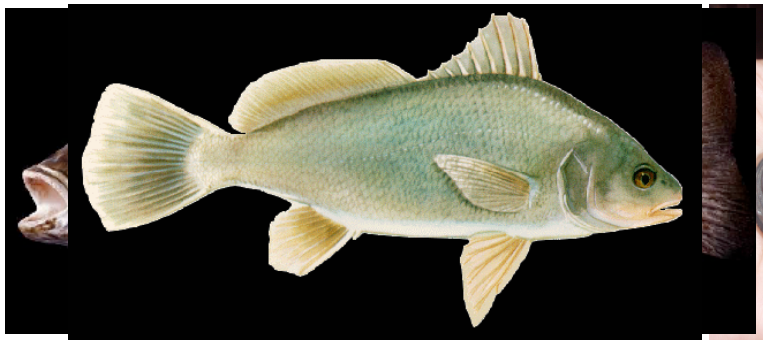

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Different communities in Lake St. Clair and Erie

	Lake St. Clair		Lake Erie	
Amblema plicata	12	2.9%	187	12.4%
Anodontoides ferussacianus	1	0.2%	0	0.0%
Elliptio dilatata	1	0.2%	0	0.0%
Fusconaia flava	21	5.1%	22	1.5%
Lampsilis cardium	14	3.4%	1	0.1%
Lampsilis siliquoidea	251	60.5%	11	0.7%
Lasmigona complanata	0	0.0%	23	1.5%
Lasmigona compressa	5	1.2%	0	0.0%
Leptodea fragilis	2	0.5%	90	6.0%
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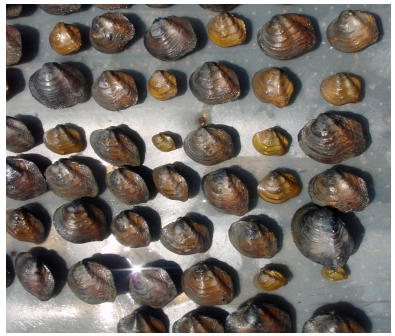
Villosa iris	21	5.1%	0	0.0%
	415		1508	
	17 sites		92 sites	
	15 species		16 species	



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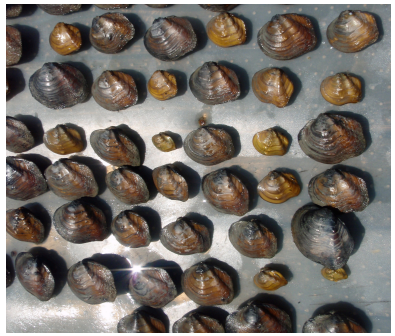

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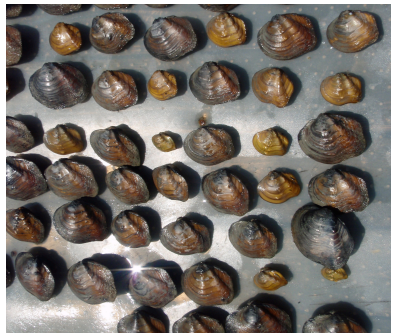

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Preliminary Conclusions

- High-quality refuges (diversity and abundance) mostly found in western Lake Erie and St. Clair delta.
  - Few unionids collected from central and eastern basins.
  - Major community shift from pre-*Dreissena* in W. Lake Erie.
  - Remnant species assemblages very different between in St. Clair and Erie.
- Analysis of abiotic and biotic correlates ongoing:
  - See other talks and posters on Great Lakes unionids…

Acknowledgments

- CMU: Jay Twichell, Dan Auer, Erin Bertram
- Fisheries and Oceans Canada: Dr. Todd Morris
- Walpole Island First Nation

- **FUNDING SUPPORT:**
  - U.S. Fish and Wildlife Service
    - Great Lakes Fish and Wildlife Restoration Act, 2010 Grant
  - Central Michigan University


Questions?
Great Lakes Unionid Refuge Project Webpage:
http://people.cst.cmich.edu/zanat1d/unionidrefuges.html
More video of our research in the Great Lakes:
http://www.teaching.gregorylab.org/?page_id=10
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