

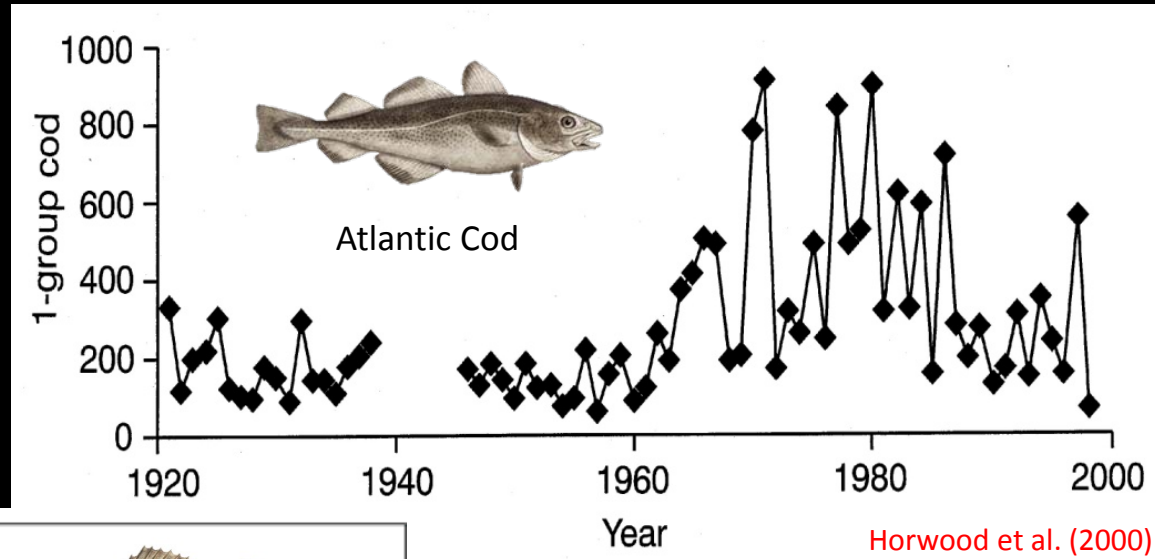
Physical-biological coupling and the challenge of understanding fish recruitment in the Great Lakes

Stuart A. Ludsin, Kristen M. DeVanna & Ralph E. H. Smith

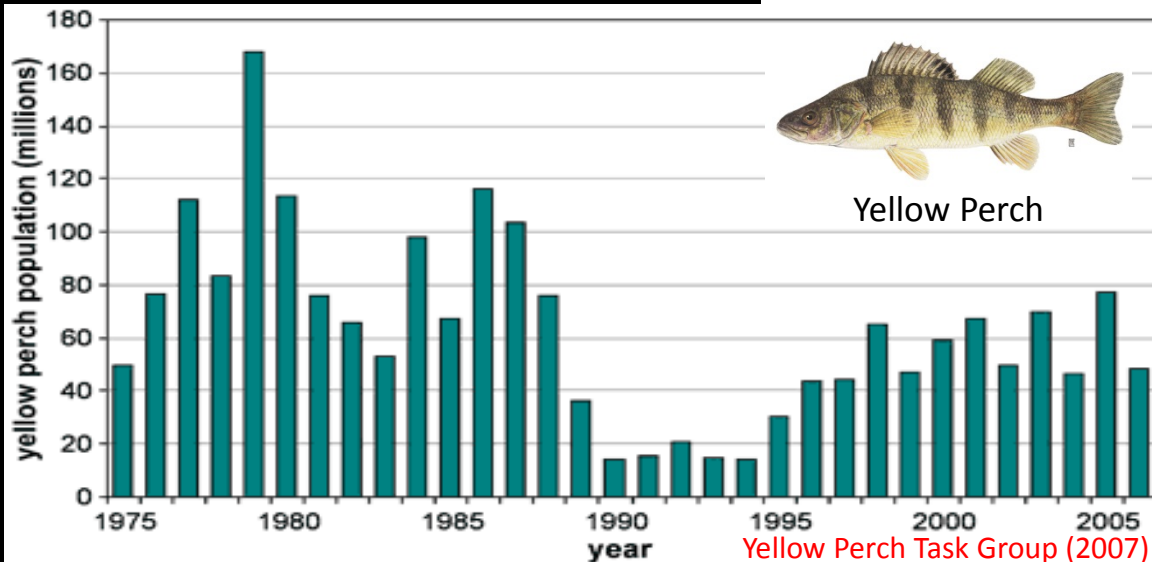


Background

- Recruitment to the fishery is highly variable



Horwood et al. (2000)



Yellow Perch Task Group (2007)

Background

- Recruitment to the fishery is highly variable
- Mechanisms underlying this variation are poorly known
- Great Lakes agencies are seeking to improve ability to understand and forecast recruitment

GLFC Research Theme

“Physical Processes and Fish Recruitment in Large Lakes”

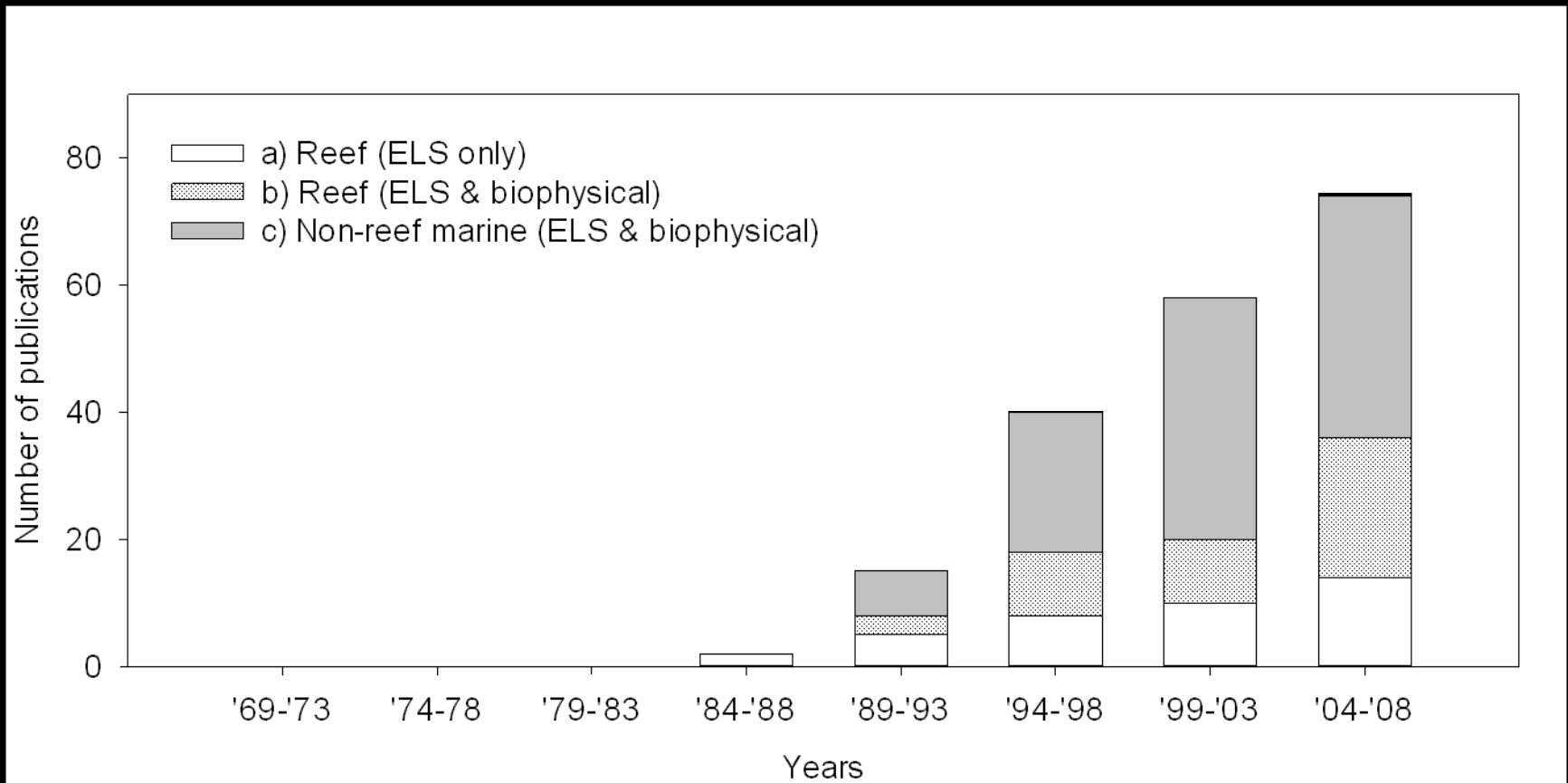
- **Start date:** 2010
- **Co-leaders:** Ralph Smith (U of Waterloo) & Stuart Ludsin (Ohio State)
- **Primary goal:** Benefit Great Lakes fisheries management by enhancing our understanding of how physical processes influence recruitment
- **Primary focus:** Processes that affect early life stages (eggs, larvae)

- <http://www.glfc.org/research/Physical%20Processes.pdf>



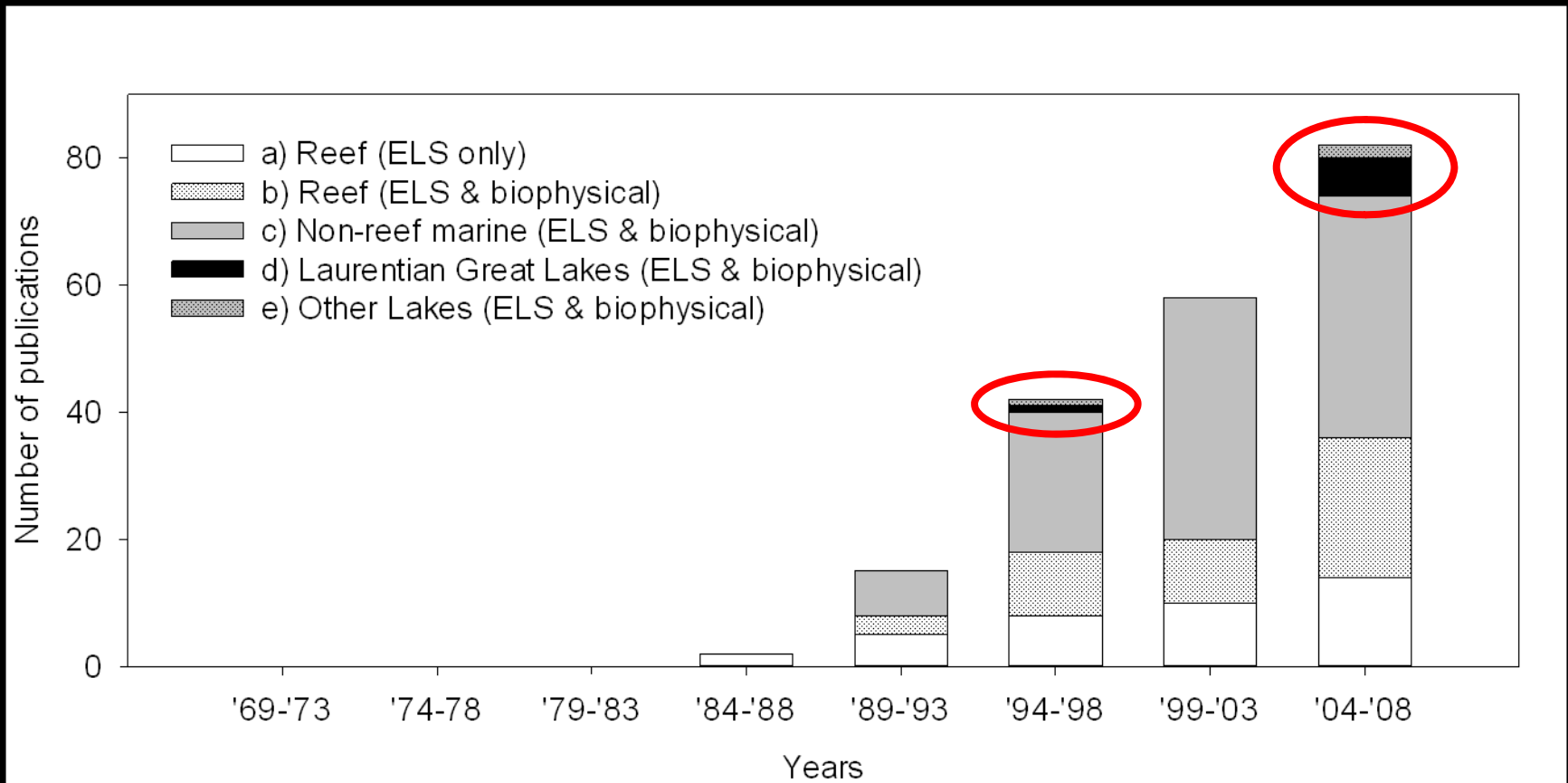
Why this thematic focus?

- Increasing number of marine recruitment studies focusing on biophysical coupling & early-life stages (ELS)
 - Improved understanding or prediction in 2 of 163 studies



Why this thematic focus?

- Disproportionately few studies in freshwater systems
 - Increasing in the Great Lakes, however

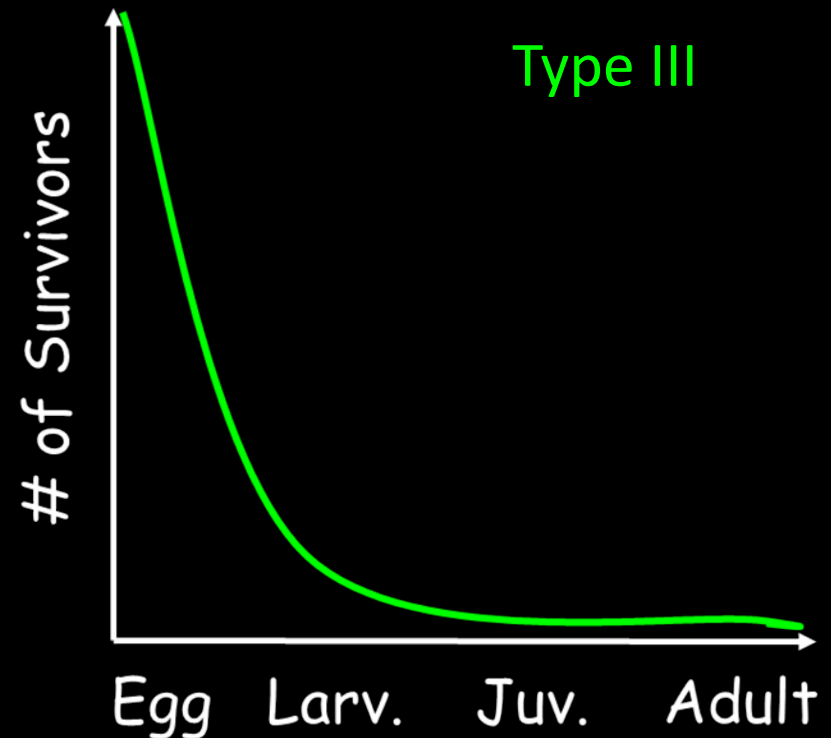


Why this thematic focus?

- Many similarities between Great Lakes & marine systems

Biology

- Highly variable recruitment
- Similar life-histories
 - High fecundity
 - Little or no parental care
 - Long planktonic larvae stage
 - High early life mortality

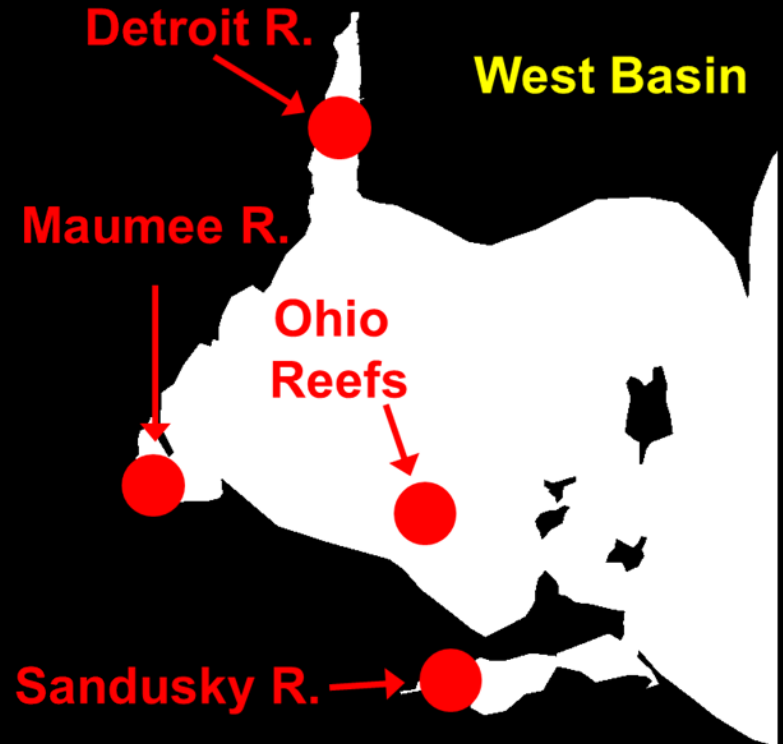


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- Many similarities between Great Lakes & marine systems

Biology

- Highly variable recruitment
- Similar life-histories
 - High fecundity
 - Little or no parental care
 - Long planktonic larvae stage
 - High early life mortality
- Multiple local spawning populations (stocks)



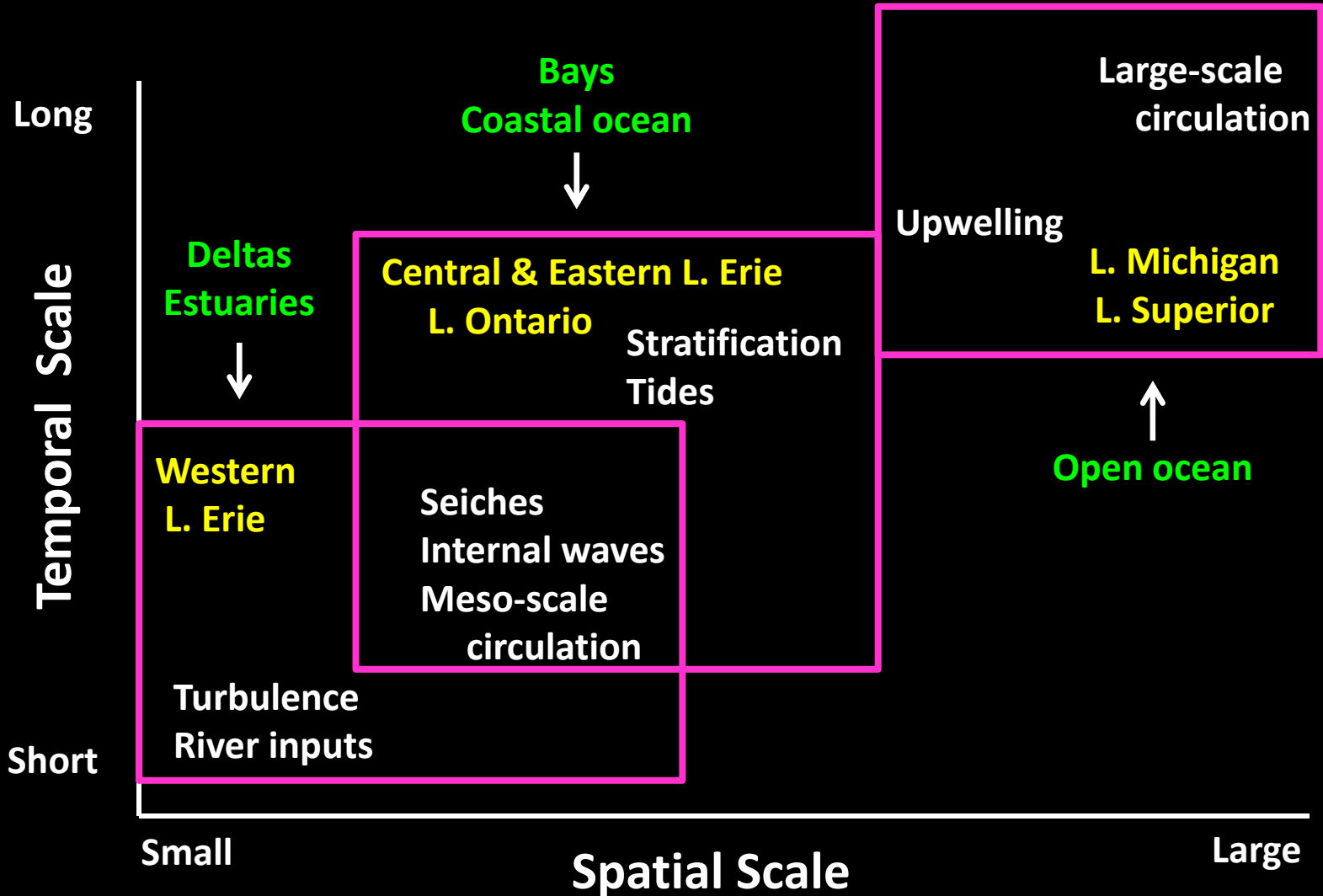
GLFC Research Theme Activities

“Physical Processes and Fish Recruitment in Large Lakes”

- **Workshop 1:** August 2011
- **Primary goals:**
 - Introduce concept of physical-biological coupling & its importance to fish recruitment
 - Identify where & when physical processes will be important

Workshop 1 Findings

- Similar physical processes in Great Lakes & marine ecosystems

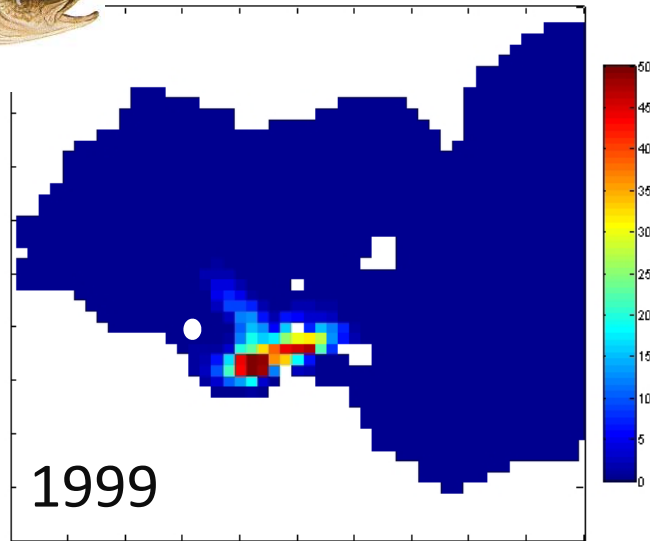


Workshop 1 Findings

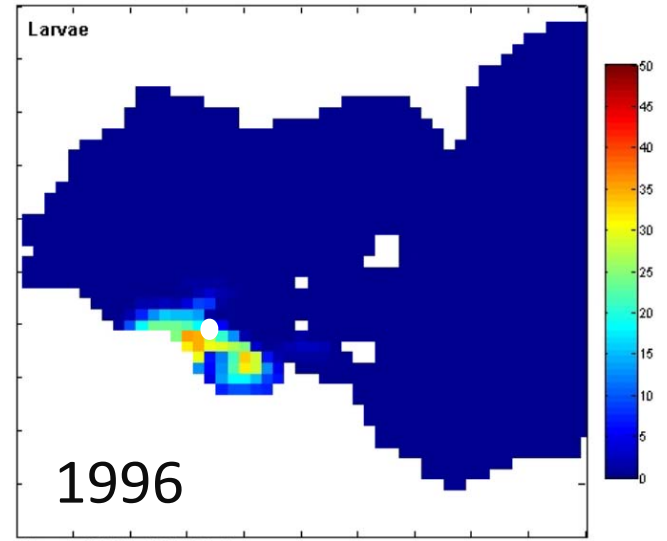
- Current-driven offshore advection can lead to poor recruitment



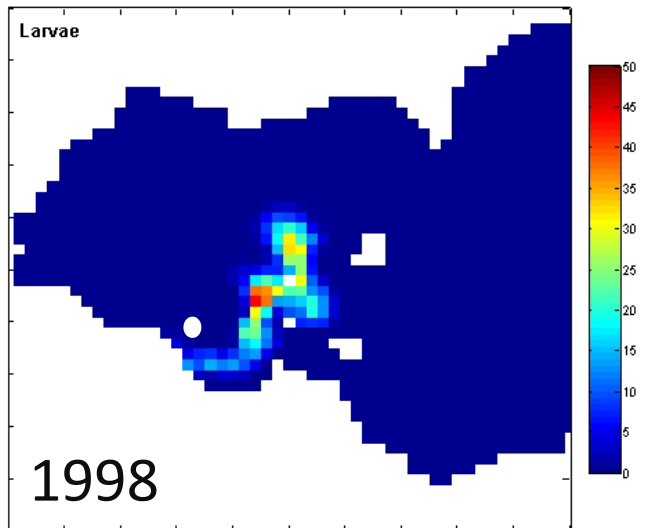
Strong
Walleye
recruitment
(nearshore)



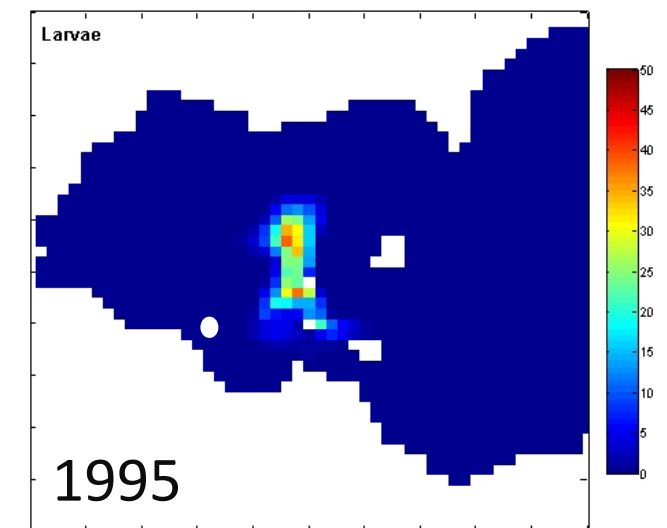
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Time: 1996-5-25 12:0



Time: 1998-4-25 12:0

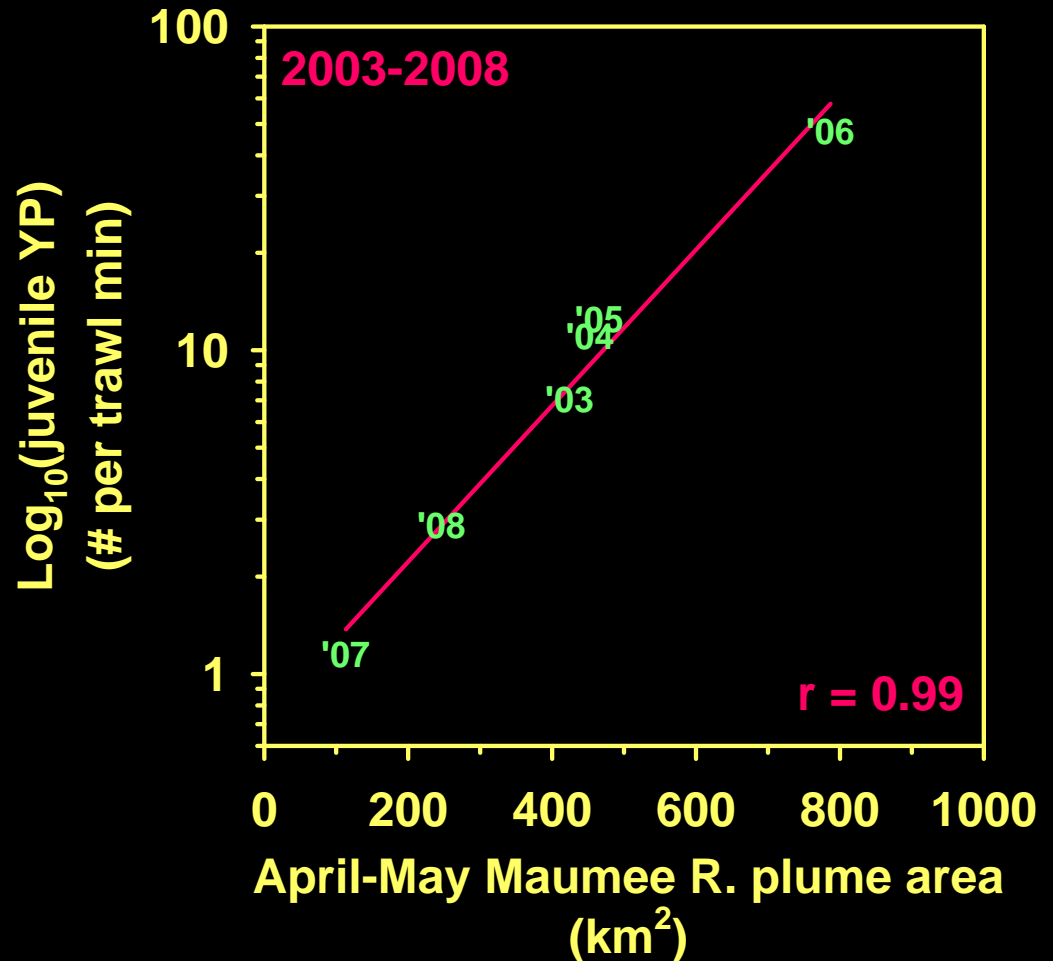


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Weak
walleye
recruitment
(offshore)

Workshop 1 Findings

- Maumee River inputs benefit fish recruitment through formation of turbid, open-lake plumes



Workshop 1 Findings

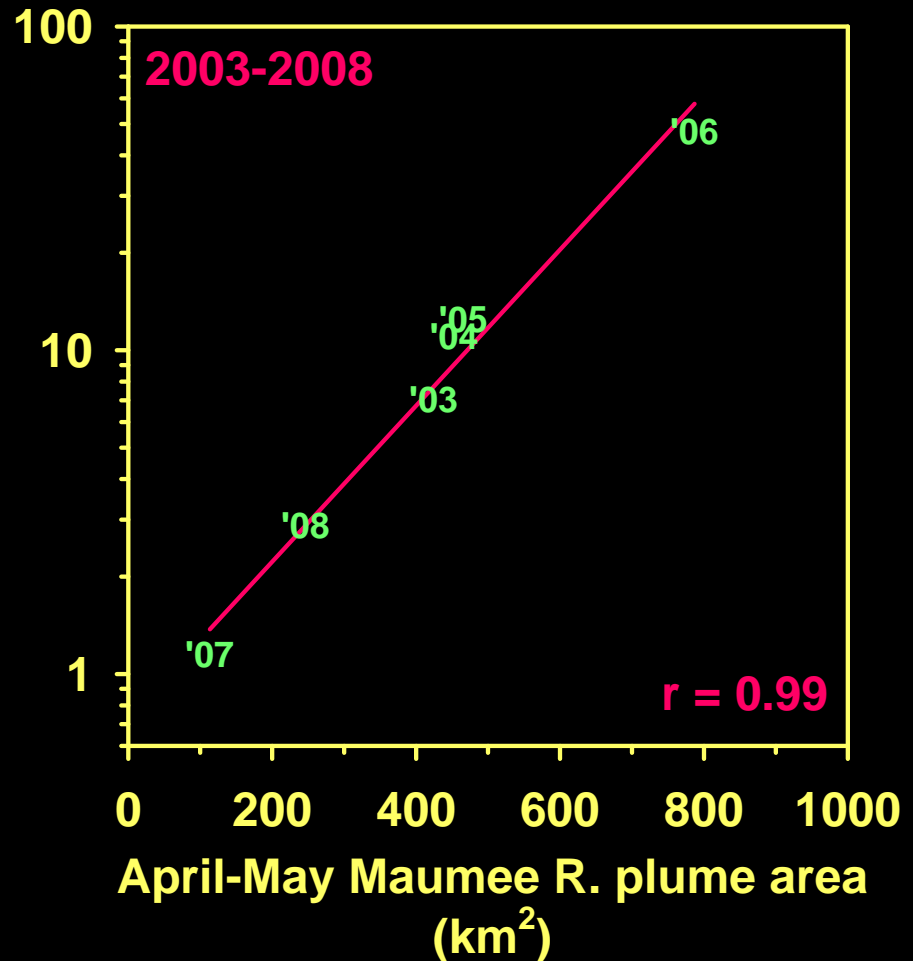
- Maumee River inputs benefit fish recruitment through formation of turbid, open-lake plumes

Plumes benefit YP
through reduced
predation mortality

(Carreon-Martinez 2011,
Ludsin et al. 2011)



$\text{Log}_{10}(\text{juvenile YP})$
(# per trawl min)



GLFC Research Theme Activities

“Physical Processes and Fish Recruitment in Large Lakes”

- **Workshop 2:** August 2013
- **Primary goal:**
 - Identify the value of using physical-biological coupling approaches to understand & forecast fish recruitment in the face of ecosystem change (altered climate & nutrient regimes)

Workshop 2 Findings

- With continued changes in climate:
 - Importance of physical processes will increase, especially those that affect overlap b/w early life stages & habitat (prey, temperature, predation refugia)
 - Understanding interactions with other stressors will be critical, to prevent ecological surprises
 - Maintaining a diverse “portfolio” of stocks & development of mechanistic stock assessment models are critical

General Conclusions

Given similarities between Great Lakes & marine ecosystems in terms of their biology & physical processes, we strongly encourage:

- Continued erosion of barriers between marine & freshwater recruitment research
- Continued exploration of the role of physical processes in the recruitment process

Doing so will help agencies keep Lake Erie's fisheries diverse & sustainable

Questions?

GFLC Research Theme Future Activity

“Physical Processes and Fish Recruitment in Large Lakes”

- **Workshop 3:** Summer 2014
- **Preliminary Title:** Physical-biological modeling in the Great Lakes: past, present & future
- **Primary goals:**
 - Identify the state-of-the-art of physical biological modeling
 - Determine key information needs & research gaps
 - Manual for using physical-biological coupling approaches to understand fish recruitment