Identifying lake trout recruitment in southern Lake Michigan

Zach Zuckerman, Jeff Stein, & John Janssen
Lake trout in L. Michigan

- Extirpated by 1950s
- Lamprey control & stocking in 1960s
- High mortality, low recruitment
- 1985, prioritization of deep water stocking sites
  - Midlake Refuge
  - Julian’s Reef

[Image: Lake trout in L. Michigan]

[Image: Lamprey control & stocking in 1960s]

[Image: High mortality, low recruitment]

[Image: 1985, prioritization of deep water stocking sites]

[Image: Midlake Refuge]

[Image: Julian’s Reef]
Julian’s Reef

- Historical lake trout spawning reef
- Close proximity to Waukegan Reef Complex
- IL DNR annual fall assessments
Progress toward rehabilitation

Patterson et al. 2016, Progress toward lake trout rehabilitation at a stocked and unstocked reef in southern Lake Michigan. NAJFM.
Evidence of recruitment at Julian’s Reef?

• Objectives:
  1. Identify spawning success (viable eggs)
Evidence of recruitment at Julian’s Reef?

• Objectives:
  1. Identify spawning success (viable eggs)
  2. Identify recruitment (fry/sac fry)
Evidence of recruitment at Julian’s Reef?

• Objectives:
  1. Identify spawning success (viable eggs)
  2. Identify recruitment (fry/sac fry)
  3. Characterize habitat features where recruitment is successful
Availability of suitable habitat

- Fractured bedrock reef
- ~45m deep, crests at 30m and 25m
- 2.6 km²

Redman et al. 2017
Availability of suitable habitat

- Putative spawning substrate
  - Boulder cobble
  - Fractured debris
  - Total = < 1%

- Priority spawning habitat
  - Slope 15-60° < 0.5%

Redman et al. 2017
Methods:

Identifying recruitment

- Remotely operated vehicle (ROV)
- E-shocker w/ suction
  - Collect LAT fry & predators
- Microscale habitat ID
Methods:
Identifying recruitment
Findings:

Dreissenid cover

1990

Edsall et al., 1996

Edsall & Kennedy, 1993
Findings:
Dreissenid cover

1990

2016

Edsall et al., 1996

Edsall & Kennedy. 1993

Edsall & Kennedy. 1993

Edsall et al., 1996
Findings:
Round goby and sculpin

- Densities up to 25/m²
- 65 gobies, 11 slimy sculpin collected
- No fry predation observed
Findings:
Lake trout fry
lake trout fry
Findings:
Lake trout fry
Methods:

Spawning success
Methods:

Spawning success
Spawning success

Findings:

Egg traps
- 3 gangs yielded evidence of spawning
  - 2 chorion
  - 2/3 sculpin w/ eggs
Egg traps
• 3 gangs yielded evidence of spawning
  • 2 chorion
  • 2/3 sculpin w/ eggs

Findings:
Spawning success
Findings:
Spawning success
Adult LAT clip

03NOV16 037.7 145930
T 5.92

164 R00
Spawning success
Findings:

Spawning success

ROV sampling - suction

- 2 transects
  - 37 eggs collected
  - 8 raised to eyed stage
Spawning success

ROV sampling - shocking
- 2 roving shock transects
  - 14 round goby
  - 10 slimy sculpin

Findings:
- $R^2 = 0.8431$
- $R^2 = 0.5049$
Findings:
Spawning success

**ROV sampling - shocking**

- 2 shock transects
  - 14 round goby
  - 10 slimy sculpin
- Egg predation by whitefish & burbot confirmed from gillnets
Obj. 1: Spawning success

- Viable eggs collected
- Potentially high density of eggs considering limited suction time and observed predation
Obj. 1: Spawning success
• Viable eggs collected
• Potentially high density of eggs considering limited suction time and observed predation

Obj. 2: Recruitment
• Fry observed and collected
Summary

Obj. 1: Spawning success
• Viable eggs collected
• Potentially high density of eggs considering limited suction time and observed predation

Obj. 2: Recruitment
• Fry collected and observed

Obj. 3: Characterizing habitat features
• Locations of adult trout, egg deposition, and fry recruitment are in agreement
Spawning site

- Rubble and cobble on the reef is considered quality spawning substrate, but:
  - Dreissenids altered substrate
    - May impede settlement into interstices
    - Zebra mussels previously damaged eggs
    - Pseudofeces and syphoning by dreissenids may alter water quality within interstices
Spawning site

• Rubble and cobble on the reef is considered quality spawning substrate, but:
  • Dreissenids altered substrate
    • May impede settlement into interstices
    • Zebra mussels previously damaged eggs
    • Pseudofeces and syphoning by dreissenids may alter water quality within interstices

• Bleached shell deposits may be novel spawning substrate?
  • Damage to eggs, and ability for eggs to penetrate shells unknown
  • Massive egg loss if winter weather disturbs shell windrows
  • Accessible to egg predators
  • Mussel deposits, if successful habitat for recruitment, could increase availability of spawning habitat on reefs

Discussion:
Predation

• High egg predator burden
  • Densities of gobies can impact toll as epibenthic egg predator
  • Sculpin present and effective interstitial egg predator
  • Lake whitefish observed foraging on eggs
    • Effective epibenthic predator, but also observed rooting into mussel bed
Discussion:

Predation

• High egg predator burden
  • Densities of gobies can impact toll as epibenthic egg predator
  • Sculpin present and effective interstitial egg predator
  • Lake whitefish observed foraging on eggs
    • Effective epibenthic predator, but also observed rooting into mussel bed

• Ecological importance of lake trout spawning?
  • Pre-winter forage base for sculpin, whitefish, and other native species
  • Seasonal movements of whitefish for foraging opportunity?
Multiple reef complexes

- Successful spawning and recruitment to fry stage confirmed, but:
  - Similar abundances (CPE) and composition of spawners
  - Recent mapping of Waukegan South identified spawning habitats
  - Spent lake trout captured at Morgan Shoal
  - Addt’l reefs identified but not explored
Successful spawning and recruitment to fry stage confirmed, but:

- Similar abundances (CPE) and composition of spawners
- Recent mapping of Waukegan South identified spawning habitats
- Spent lake trout captured at Morgan Shoal
- Addt’l reefs identified but not explored

Do multiple, diverse reef complexes facilitate spawning success and maximize recruitment?
Assessing recruitment

Ongoing activities:

• Upcoming field seasons for spring fry & fall egg collection
Proposed activities:

Fine- & course-scale habitat use

• Research questions:
  1. How are spawning lake trout utilizing microhabitats at Julian’s reef?
  2. Do adult lake trout utilize multiple reef complexes within and across spawning seasons?
  3. Are lake whitefish movements timed to capitalize on lake trout eggs as forage?
• Funding: Great Lakes Fish and Wildlife Restoration Act
  PIs: Stein, Janssen, Patterson, and Czesny
• R. Paddock and A. Hamm - ROV operators
• Crew of R/V Neeskay
• Great Lakes Expeditions & crew of R/V Double Jameson
• S.Czesny, R. Redman, and J. Dub - INHS
• S. Robillard, D. Makauskas, and V. Santucci - IL DNR

QUESTIONS?