A novel approach to a growing problem:
Induced nest failure as a method for controlling invasive bass

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Largemouth bass (*Micropterus salmoides*) and smallmouth bass (*Micropterus dolomieu*). Source: USGS.
Largemouth bass

Courtesy of Florida Museum of Natural History
Smallmouth bass

Sources: FishBase and the FAO Fisheries and Aquaculture Department
Future range?

Sharma et al. 2007
Predation, competition can cause walleye, trout, salmon, cyprinid populations to decline

Vander Zanden et al. 1999
Prey fish populations can be extirpated by invasive bass

Some endangered spp. have been affected

Predictions for future losses in Ontario: >25,000 cyprinid extirpations by 2100

Jackson and Mandrak 2002
Invasive smallmouth bass pose largest threat to small fishes in the Yampa River, CO
Invasive bass control

* No effective, efficient method for control—Zipkin et al. found more bass (yearlings, juveniles) after harvest
* “Overcompensation”
* Barriers to spawning grounds proposed for streams, not tested

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Zipkin et al. 2008

**Fig. 1.** Catch-per-unit-effort (CPUE) in number of smallmouth bass individuals captured (and removed starting in 2000) from Little Moose Lake (per hour of electrofishing run time) from 1998 to 2007. The solid and broken lines show results from spring and fall sampling periods, respectively.
Goals

* Develop an effective, efficient control method that can be easily implemented, preferably by affected stakeholders
* Reduce bass abundance to relieve pressure on native sport fish (walleye, trout)
* Avoid overcompensation
Induced nest failure

1. Male bass aggressively guard their nests during spring spawning season
2. An angler removes the bass from their nests
3. Nest predators consume eggs from unguarded nests while bass are held ~1 day
4. The nests have failed
5. The male bass are returned to the lake to avoid competitive release
Testing this idea: 3 phases

- Phase I: Modeling
  - Stage-structured model
  - Individual-based model
  - How much nest failure is necessary? Best strategies for control?
- Phase II: Small lake experiments
- Phase III: Large lake trial through annual springtime bass fishing tournament
Stage-structured model

Density-dependent reproduction

\[(1-h_y) \cdot s_y\]
\[(1-h_j) \cdot s_{j2} \cdot (1-m_1)\]
\[(1-h_j) \cdot s_{j3} \cdot m_2\]
\[(1-h_j) \cdot s_{j3} \cdot (1-m_2)\]
\[(1-h_j) \cdot s_{j2} \cdot m_1\]

Reproduced from Zipkin et al. 2008
Nest failure required to reduce total population by 90%

Treatments applied over 10 and 20 years: A. nest failure only; B. culling captured males; C. 15% harvest of all stages; D. electrofishing (50% adults, 20% juveniles, 10% yearlings). Original parameters: \( a \approx 5.5, \ sj_3 \approx 0.6, \ sa \approx 0.5, \ m_1 \approx 0.06, \ m_2 \approx 0.4 \)
Nest failure required to reduce total population by 75%

Treatments applied over 10 and 20 years: A. nest failure only; B. culling captured males; C. 15% harvest of all stages; D. electrofishing (50% adults, 20% juveniles, 10% yearlings). Original parameters: $a \approx 5.5$, $s_{j3} \approx 0.6$, $s_{a} \approx 0.5$, $m_{1} \approx 0.06$, $m_{2} \approx 0.4$
Overcoming Overcompensation: Equal Proportion Harvest

Time horizon: 10 years; population decrease goal: 75%
Overcoming Overcompensation: Juvenile Harvest

Time horizon: 10 years; population decrease goal: 75%
Overcoming Overcompensation: Adult Harvest

Time horizon: 10 years; population decrease goal: 75%
Stage-structured model supports nest failure as a viable method for bass control

- Can avoid overcompensation

- Future individual-based model to more realistically portray factors like competition

- Models are simplified, theoretical—hard evidence?
Small lake experiments

Locations:

- Third Bisby Lake in Adirondack Park, NY (19 ha)
- Speckled Trout Lake in Algonquin Provincial Park, ON (20 ha)
Small lake experiments

- Will induce nest failure, examine recruitment (age/size structure)
- Preliminary results:
  - Angling to induce nest failure possible but may be easier/harder depending on lake conditions (nest predator presence, bass abundance)
  - Recruitment in Speckled Trout Lake (ON) may not be occurring as is—new lakes in northern Minnesota? North or South Dakota?
Bass tournament for control

* Location: Fish Lake Reservoir, Fredenberg, MN
* Working with the DNR-led Structured Decision Making group and MN-BASS
* Hope to establish annual springtime tournament, sample to determine efficacy
End goal: Effective, efficient control

- Ready-to-use
- Applicable to a variety of locations
- Can be implemented by stakeholders without agency expenditures
- Relieves competitive/predatory pressure on other fish
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