Induced nest failure as a mechanism for controlling invasive bass

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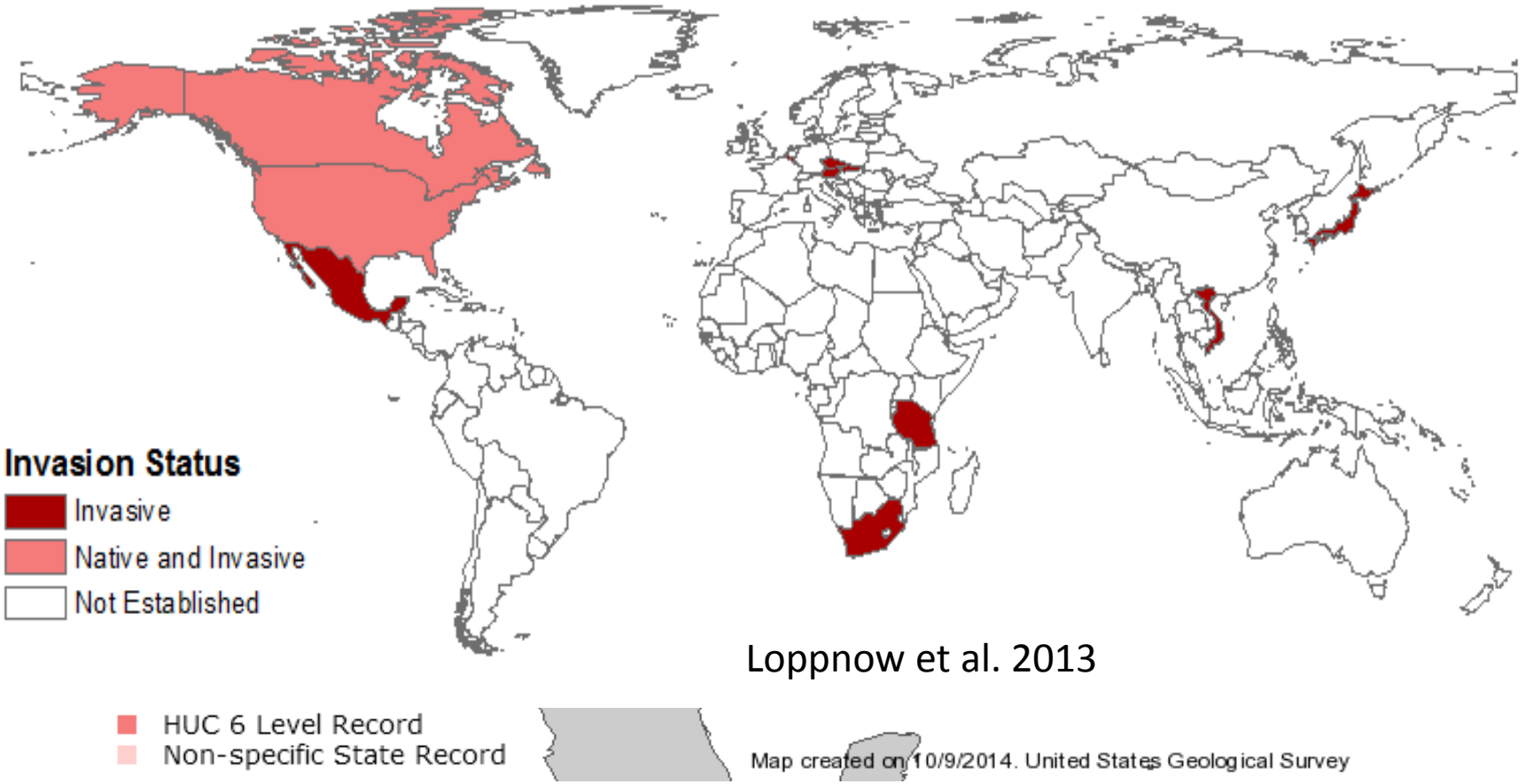
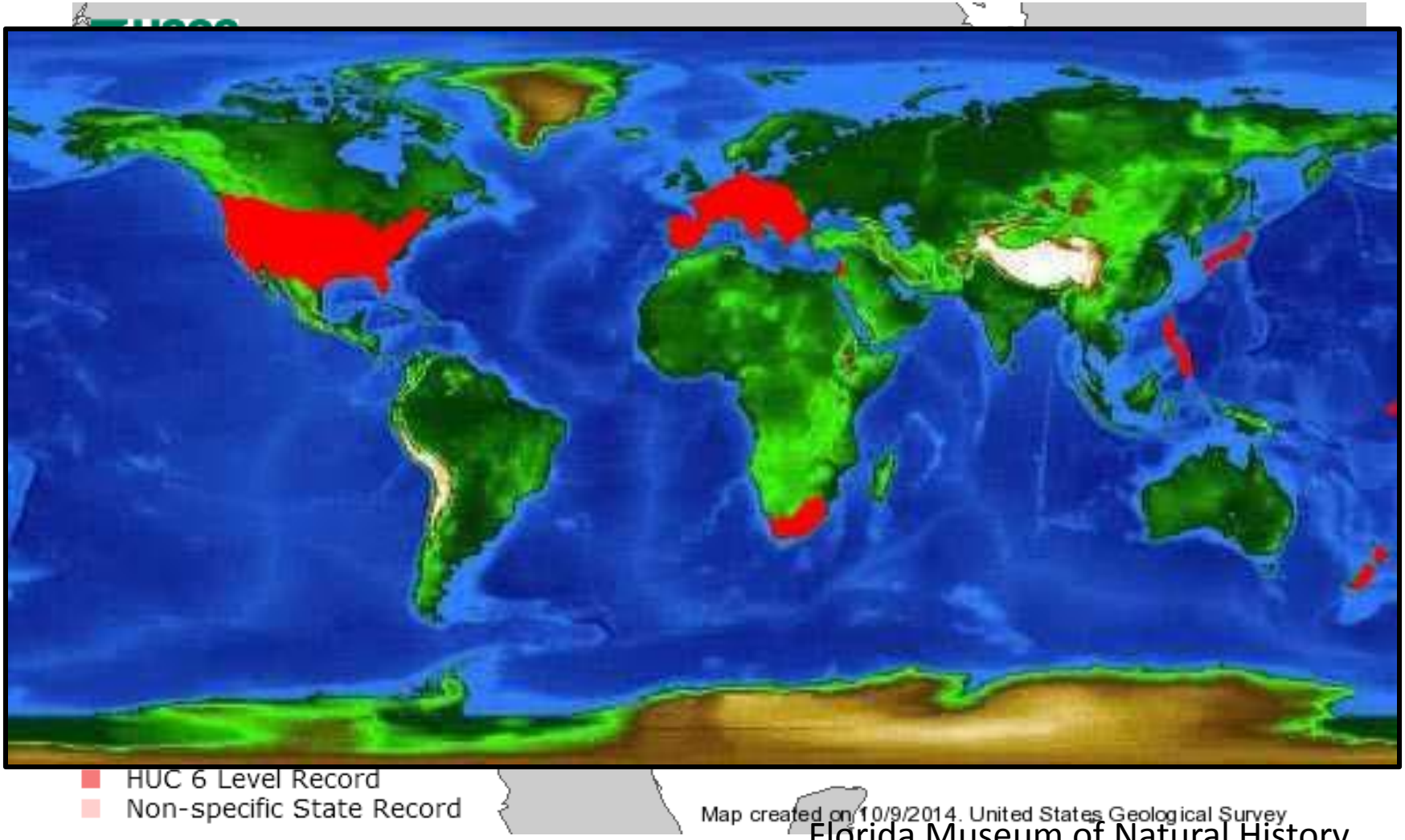
Smallmouth bass range maps



Loppnow et al. 2013

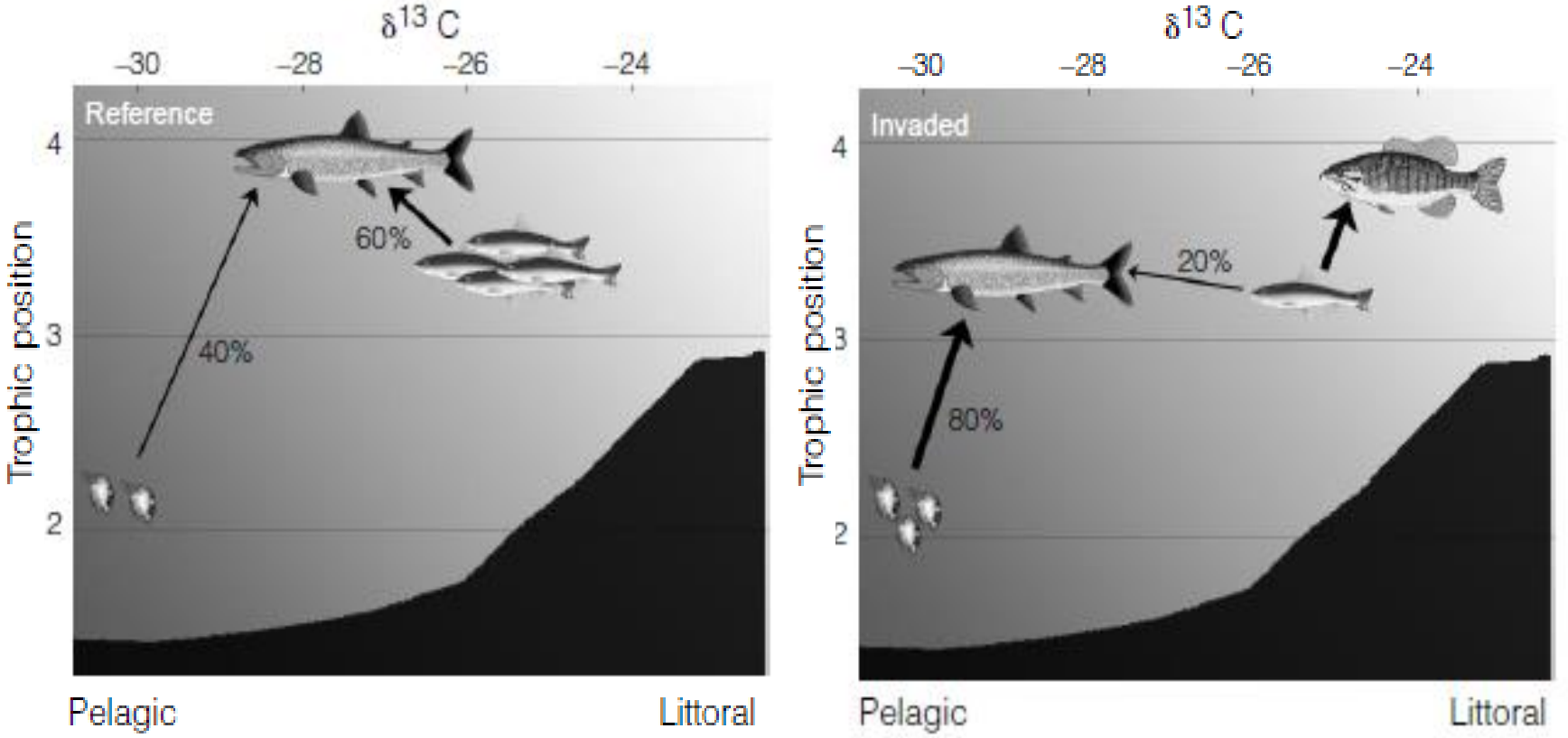
Largemouth bass range maps



Florida Museum of Natural History

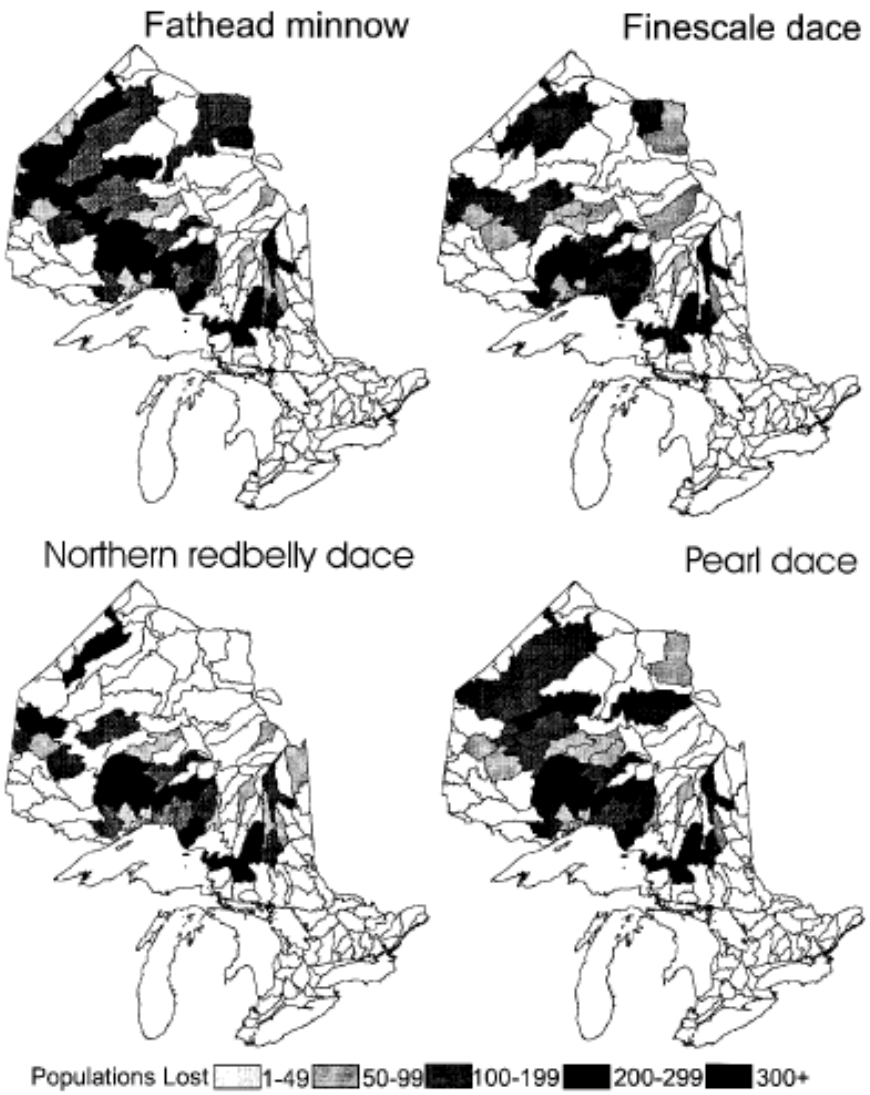
Impacts of invasive bass

Competition and predation on juveniles can cause trout, salmon populations to decline



Vander Zanden et al. 1999

Impacts of invasive bass



- Prey fish populations can be extirpated by invasive bass
- Endangered species at risk
- Future losses in Ontario: >25,000 cyprinid extirpations possible by 2100

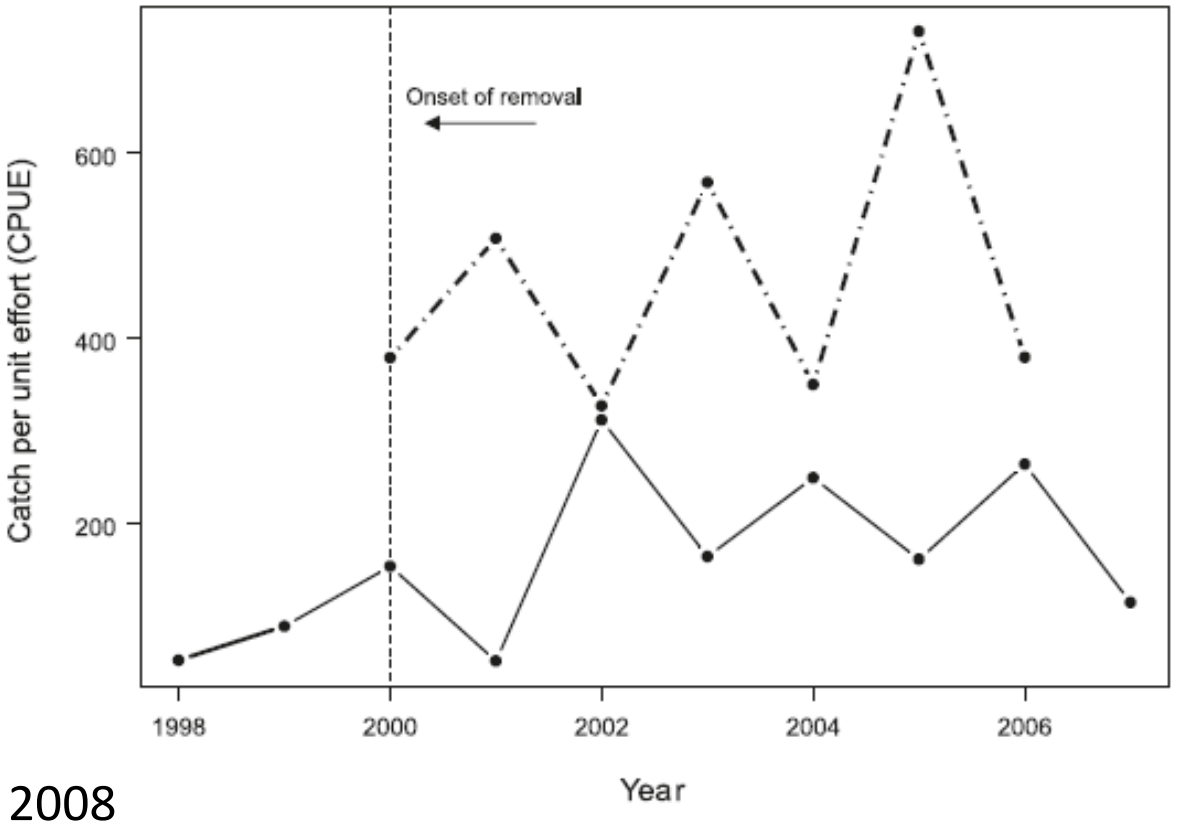
Jackson and Mandrak 2002

Lack of proven control methods

- Few attempts to control to date
- Netting and angling: low catch rate (Boucher 2006, Gomez and Wilkinson 2008)
- Electrofishing in Colorado River basin and a small Adirondack lake: unable to decrease population abundance (Weidel et al. 2007, Fuller 2009)
- In-stream water pulses: removed some fry, long-term effects unknown (Kleinschmidt 2008)
- Piscicides: yes, but expensive (Ward 2005)

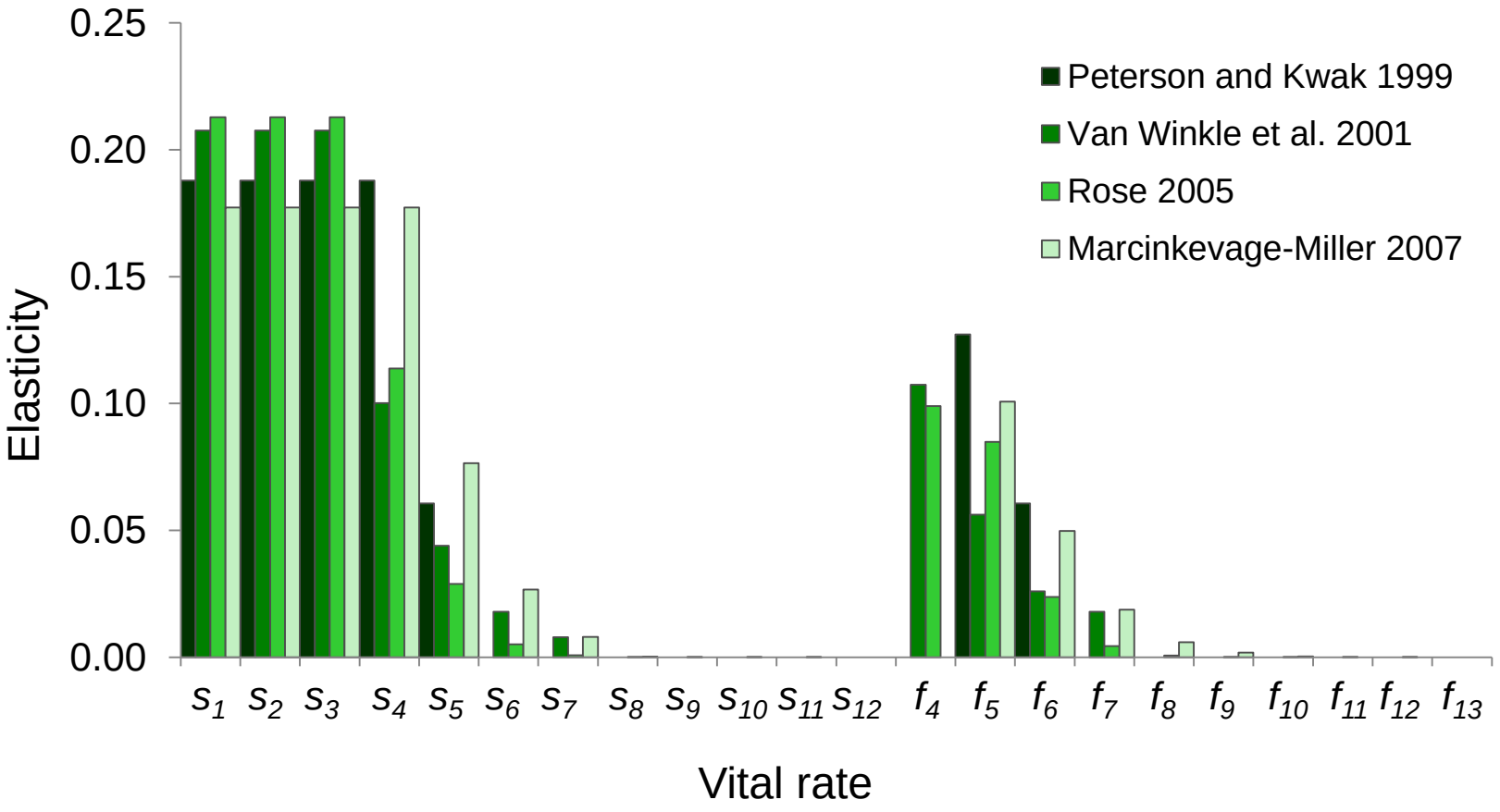
Overcompensation

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.



Zipkin et al. 2008

Targeting young life stages is best



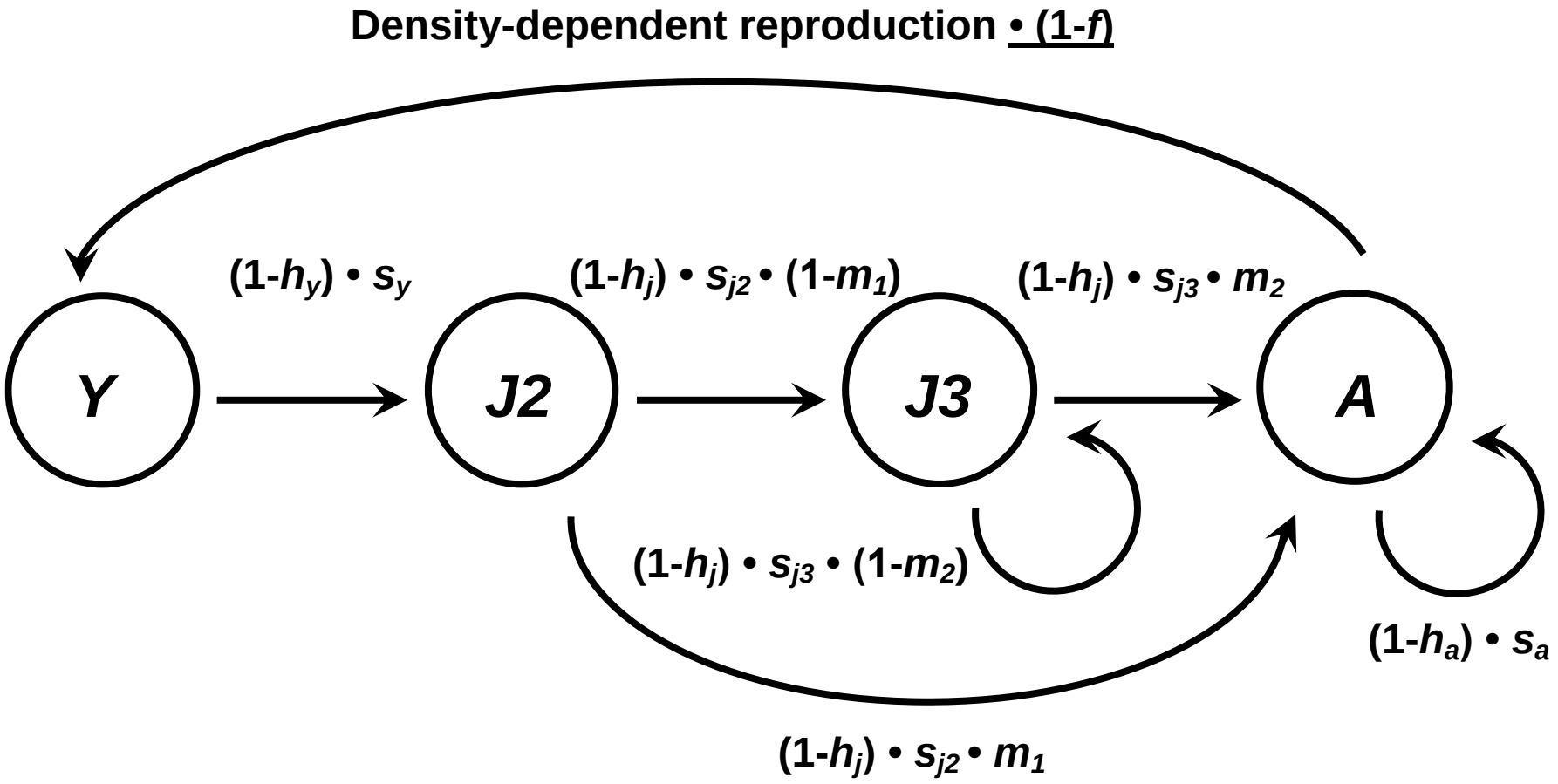
Induced nest failure

- Cause nests to fail, removing bass from population at the egg/fry stages
- Methods: physical/chemical destruction, enhancement of nest predators, water level changes, removal of nest-guarding males

Stage-structured model

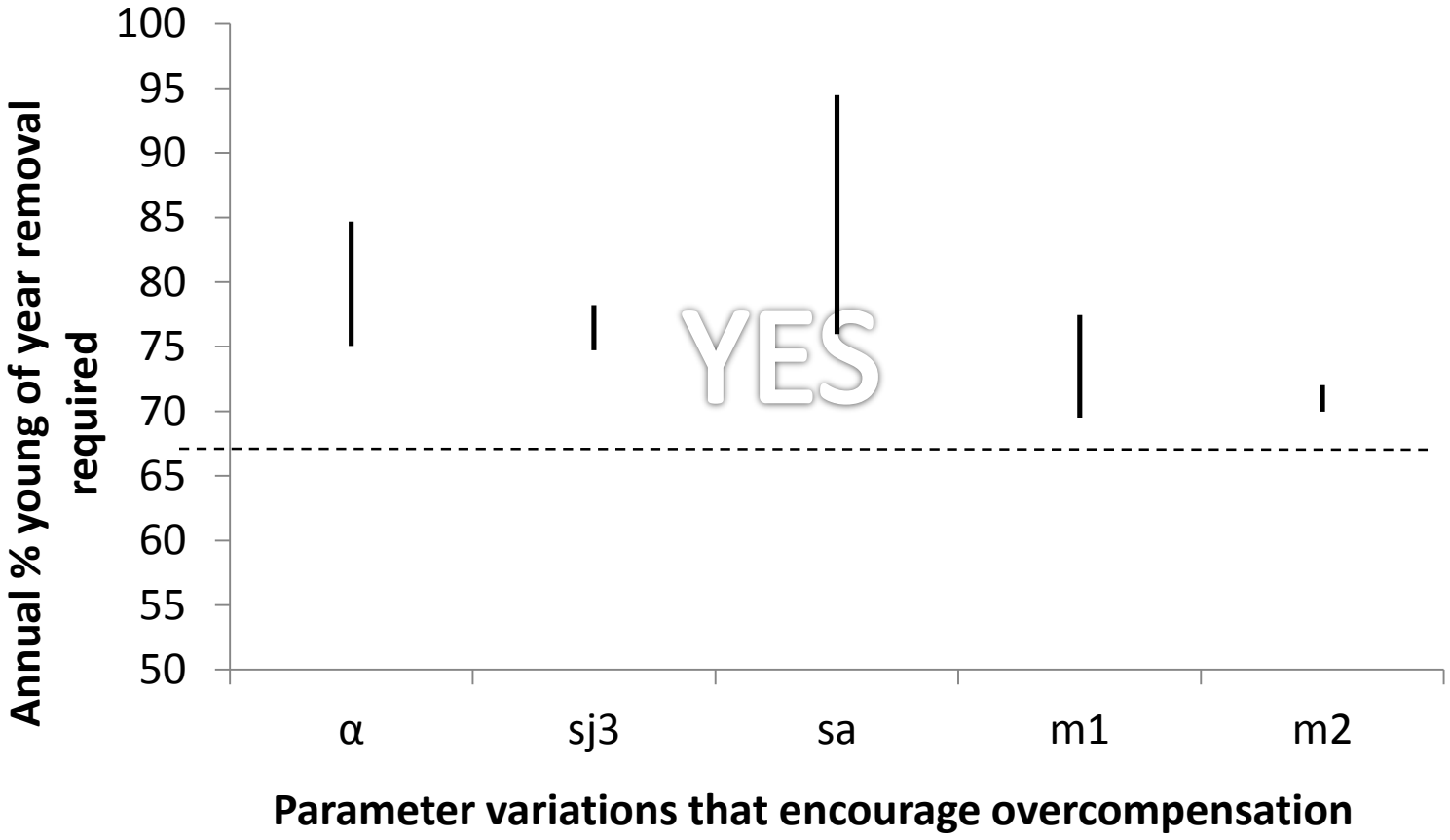
- Can inducing additional mortality in the first year of life (e.g. nest failure) control a simulated population of invasive smallmouth bass?
- Does this method ever lead to overcompensation?
- What are the best strategies for control?

Stage-structured model



Loppnow and Venturelli 2014, adapted from Zipkin et al. 2008

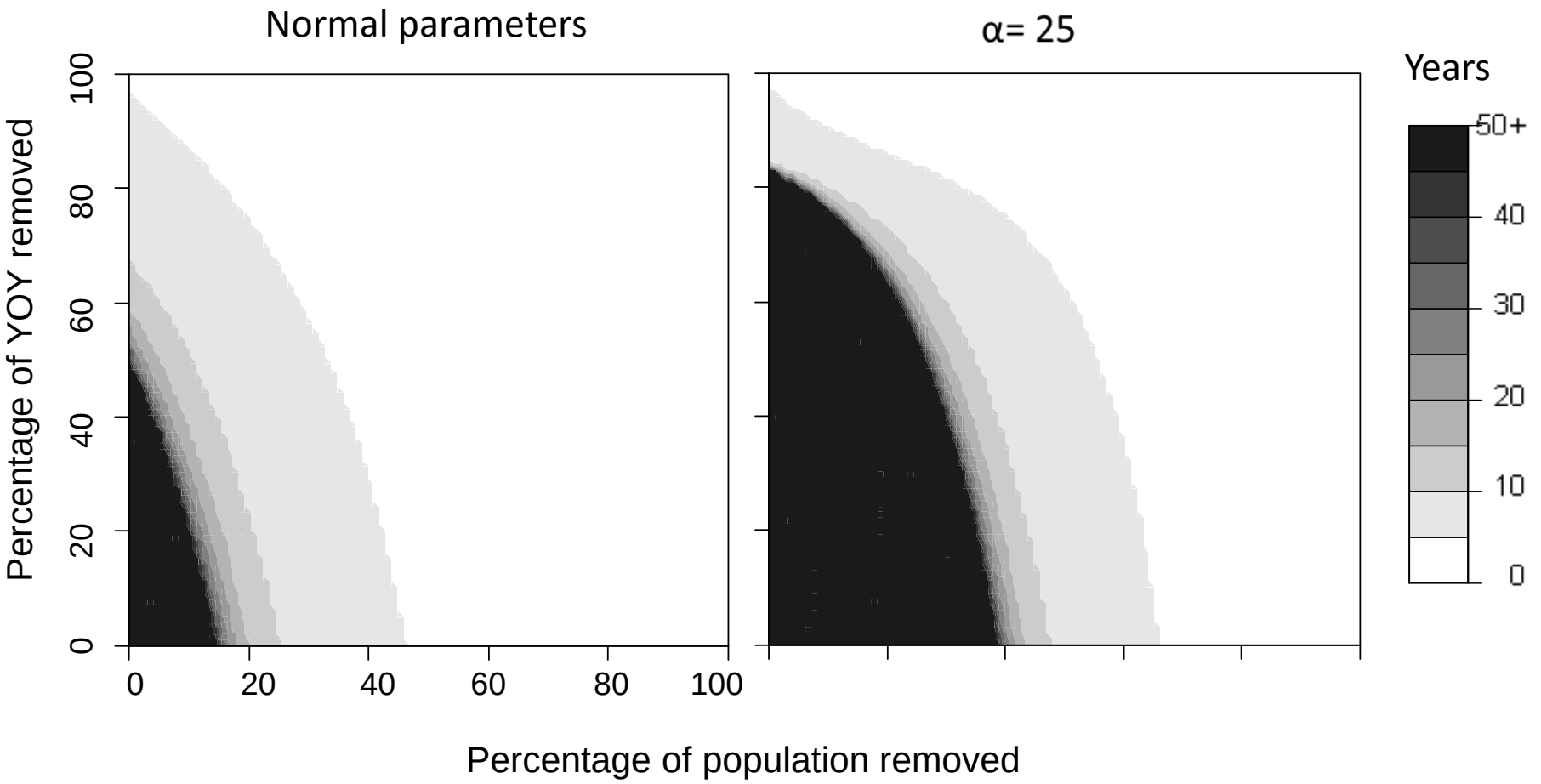
Can YOY removal control a population?



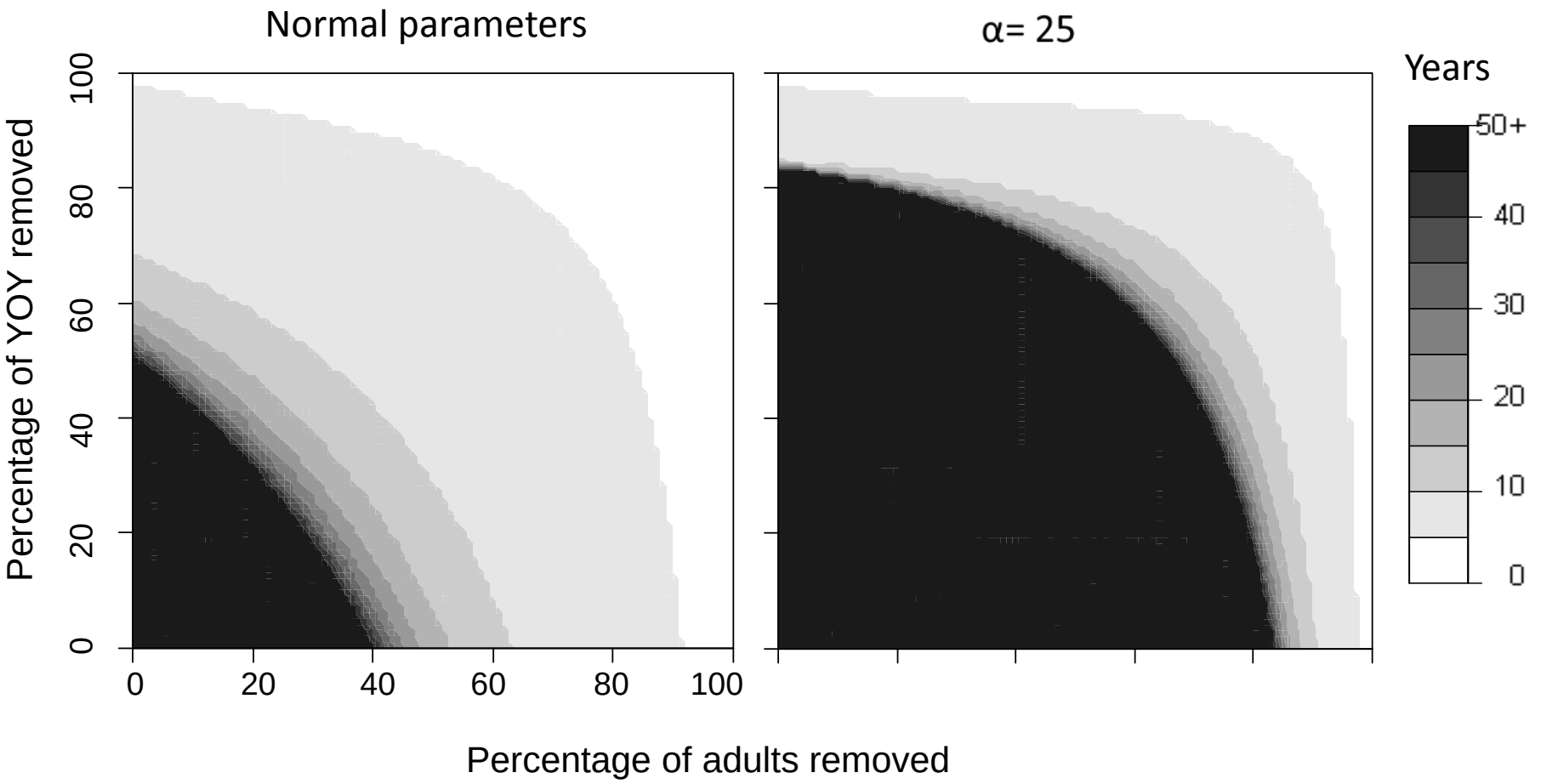
Does YOY removal ever lead to overcompensation?

- Varied annual YOY removal from 1 to 100%
- Varied population parameters as before (encourages overcompensation)
- Ran simulations to new equilibria
  - New smaller equilibrium
  - Population crash
  - New higher equilibrium (overcompensation)
- Result: **No overcompensation**

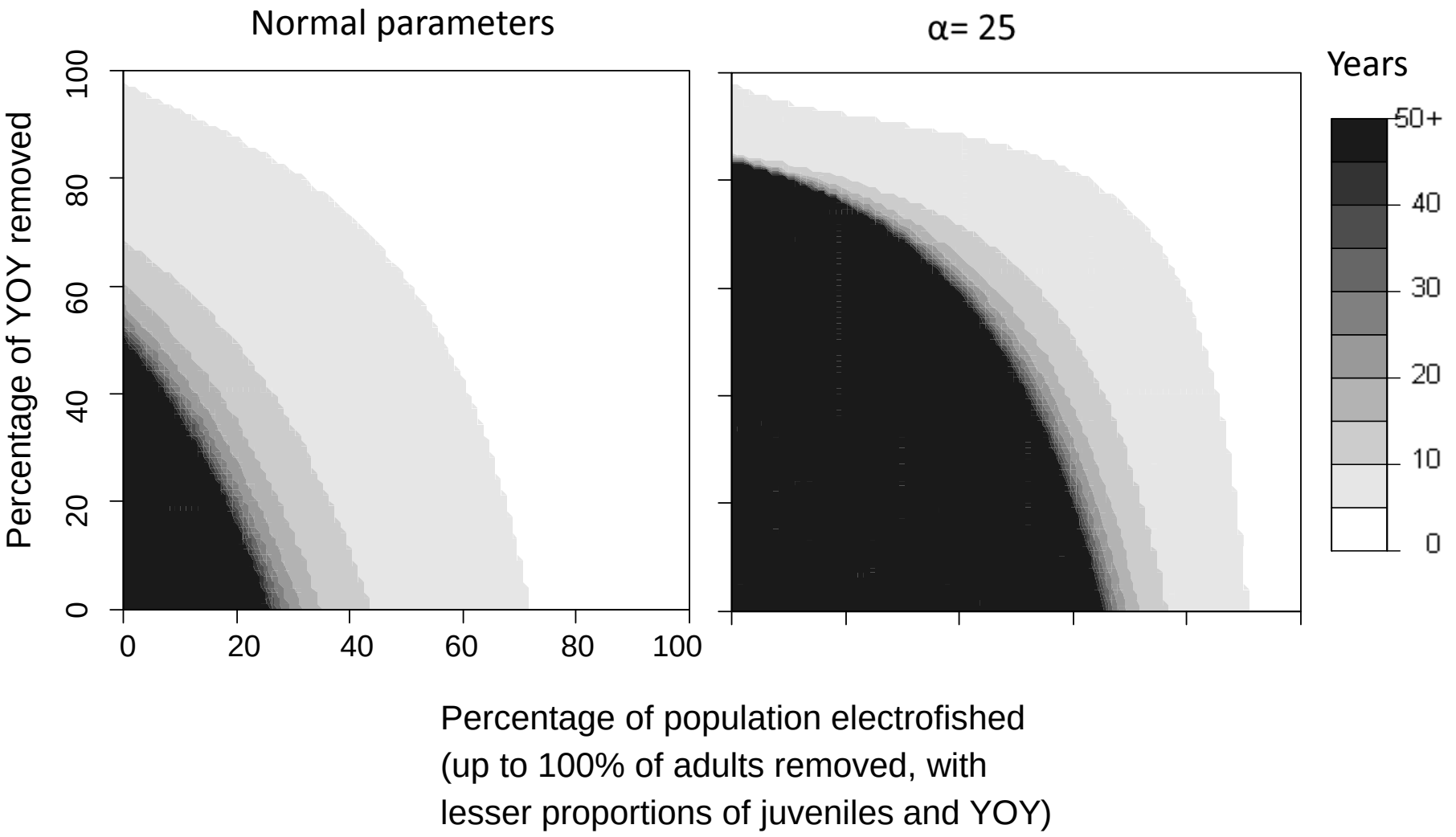
Best management strategies?



Best management strategies?



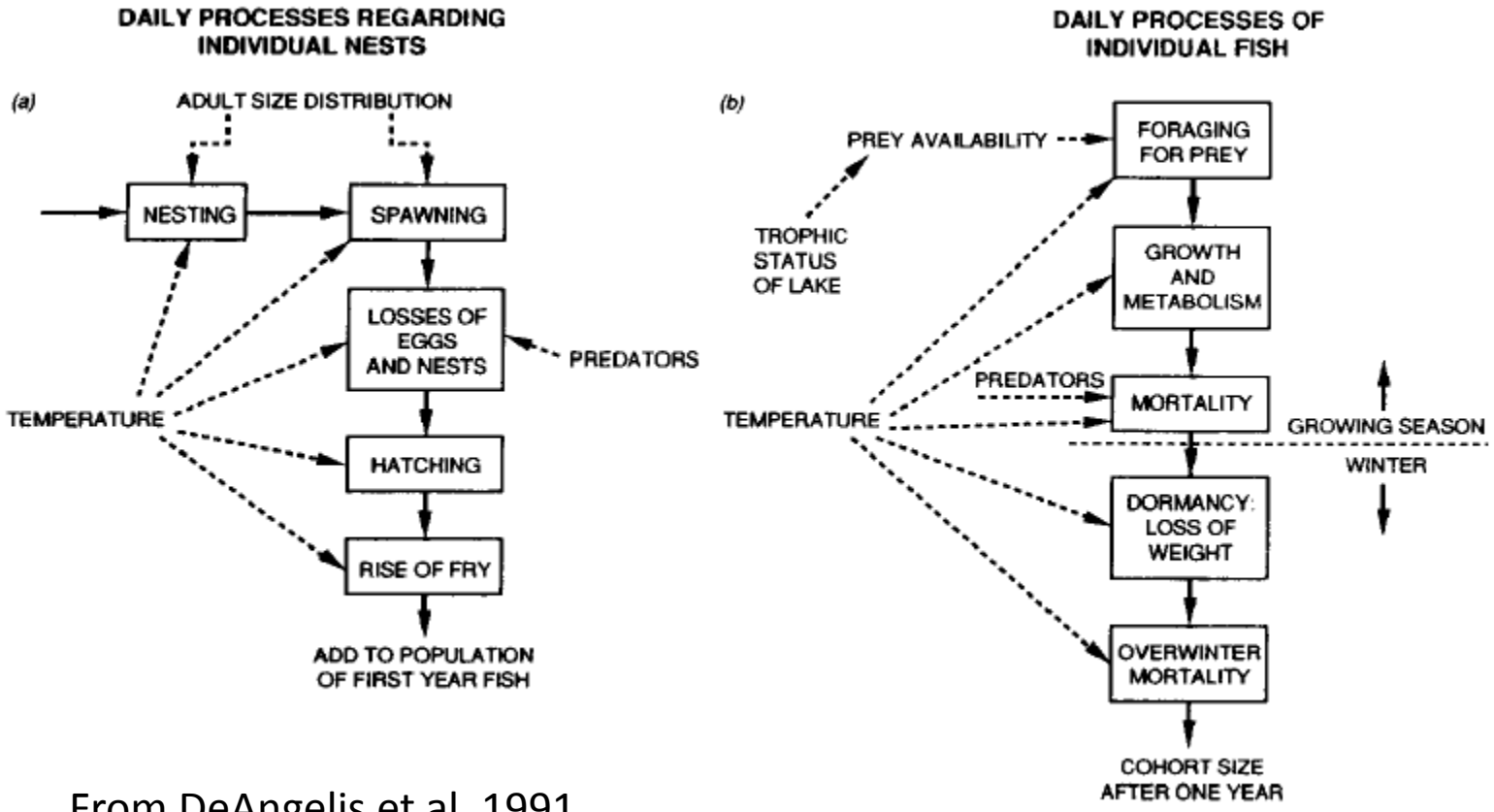
Best management strategies?



Future research

- Individual-based model (underway)
  - Able to include competition
  - More realistic density dependence
  - Could capture overcompensation better
  - Examine growth, size/age structure effects
  - Environmental factors
  - Nest failure vs. YOY removal

Individual-based model



From DeAngelis et al. 1991

Future research

- Ongoing field trials in small MN lakes
  - Does removal of nesting males increase rate of nest failure?
  - Can enough nest failure be induced to see an effect on the population?

End goal: Efficient, effective control

- Relieves competitive/predatory pressure on native community
- Low cost
- Applicable to a variety of systems via different methods

Acknowledgments

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Questions?
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