

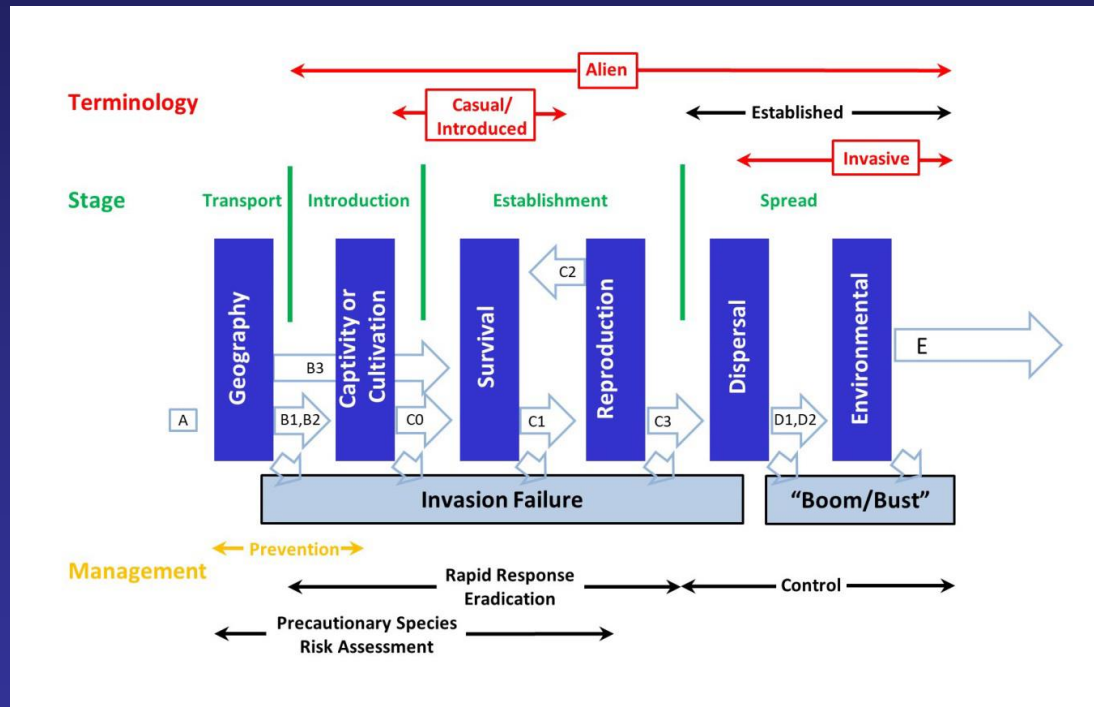
What it is to be established: policy and management implications for non-native species

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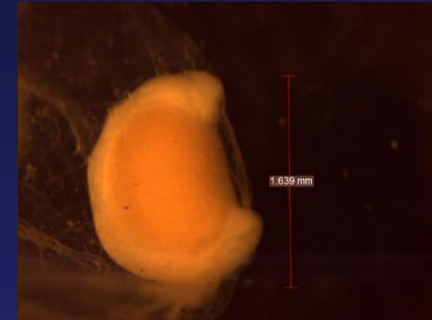
² Michigan Sea Grant, Michigan State University

³ US Environmental Protection Agency



A brief history

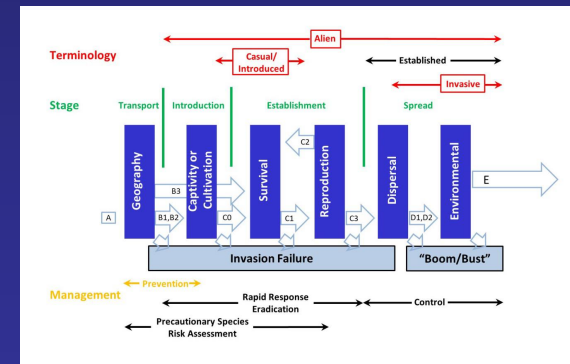
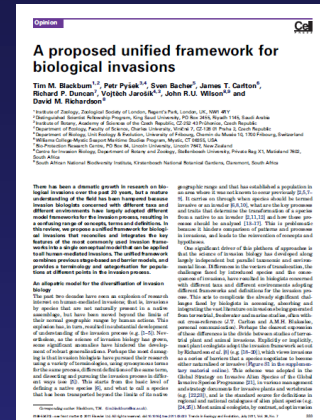
- GLPANS Grass Carp committee: Is GC established?
- Task from Grass Carp committee to research the use of the term established
 - Set a standard for GLPANS?



Our Approach

- Reviewed literature
 - High citation papers, influential authors
- Perused for uses of the E-word
 - Was it defined?
 - Context and implied/stated meanings

- Developed a revised framework of classification and authored a peer-reviewed article

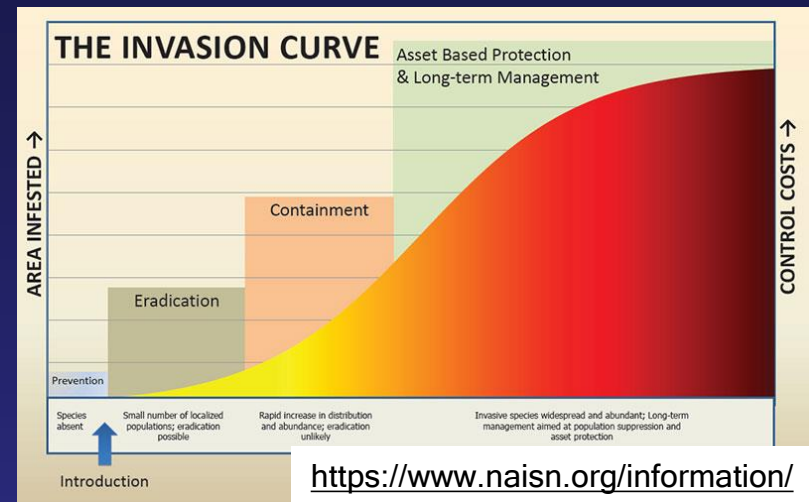


Highly-cited or otherwise informative literature

- **Kloot 1987**
 - Established is the last stage of naturalization
- **Richardson et al. 2000**
 - Reviewed the term “Naturalized” and found four meanings
 - E-word is used in definitions of or synonymized with naturalized
 - **Naturalized:**
 - Was equated with established with reproduction without human assistance (25%) or survival (1 paper)
- **Heger and Trepl 2003**
 - Spontaneously and permanently established

Highly-cited or otherwise informative literature

- **Henderson et al. 2006**
 - Naturalization occurs when a species becomes self-sustaining at point of establishment
 - First- and second-order established



- **Lodge et al. 2006**
 - Initially, newly, and well established
 - Eradication possible for initially or newly established



Highly-cited or otherwise informative literature

- **Blackburn et al. 2011**
 - **Merged plant-centric and animal-centric frameworks**
 - **Non-established species can have deleterious effects**
 - **Fox on Garden Island, Australia**



Established or Naturalized?

- Is “Established” even meaningful? Or is that naturalized?
 - Eshenroder et al. 1995: Common Carp are “naturalized” in the Great Lakes
 - But so are Steelhead: to managers, naturalized and established have different connotations

<http://www.adfg.alaska.gov/index.cfm?adfg=steelhead.photogallery>



How “established” is used

- Different kinds of established
 - Spontaneous, permanent
- Different degrees of established
 - Initially, newly, primarily, secondarily, well
- Different scales
 - Watershed vs basin vs ...
- Conflated with naturalized
- Established without deleterious effects
- Deleterious effects without established
- **REALLY?**

Has “established” been defined?

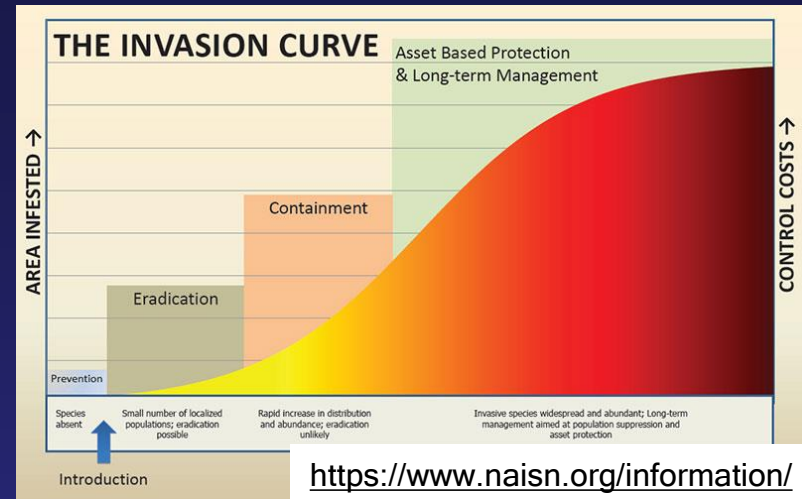
- **Kloot 1987:**
 - Wide-spread, reproducing freely
 - Limited distribution but long-term (25 years)
- **Shafland and Lewis 1994:**
 - permanent and not likely to be eradicated by either natural causes or human attempts
 - No criteria for determining permanence
- **Williamson and Fitter 1996:**
 - “With a self-sustaining population; naturalized”
- **Cudmore et al. 2017 (GC Risk assessment):**
 - Two-tiered: 1) self-sustaining and 2) reproduction by naturally-reproduced individuals

In Summary...

- **“Established” rarely defined explicitly**
- **Frequently loosely defined or used as if the meaning was intuitive**
- **Broadly used and befuddled**
- **None successfully addressed management challenges**
 - **A few invoked it but did not otherwise adequately address it**

Do we even need a definition??

- **Hodges 2008:**
 - Invasion is a **continuous process**
 - **Categorizing a continuous process carries risks**



- **Non-defined terms provide “wiggle room” for interpretation**
 - “practicable” in Uniform Vehicle Code
- **Should we even bother?**

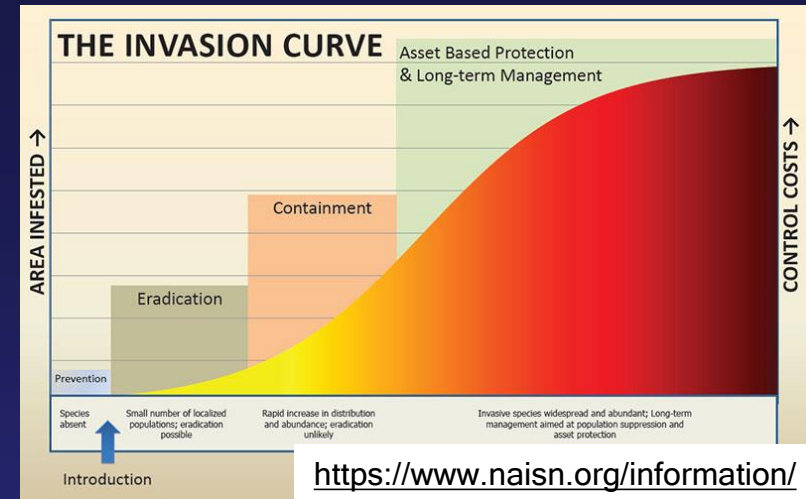


Do we even need a definition??

- **Funding mechanisms use *established* as criterion**
 - GLRI: prevention, rapid response, control
 - Too late to prevent GC; rapid response is for new species
 - Control money goes away if a species is “established”
- **Public perception**
 - If “established” why bother with eradication efforts?
- **Policy Paradox: designating a species as established may hinder the management process**
 - Policy makers and those who write rules based on policy rely on words like established, but management effectiveness can be hampered if the E-word is used too early in an invasion

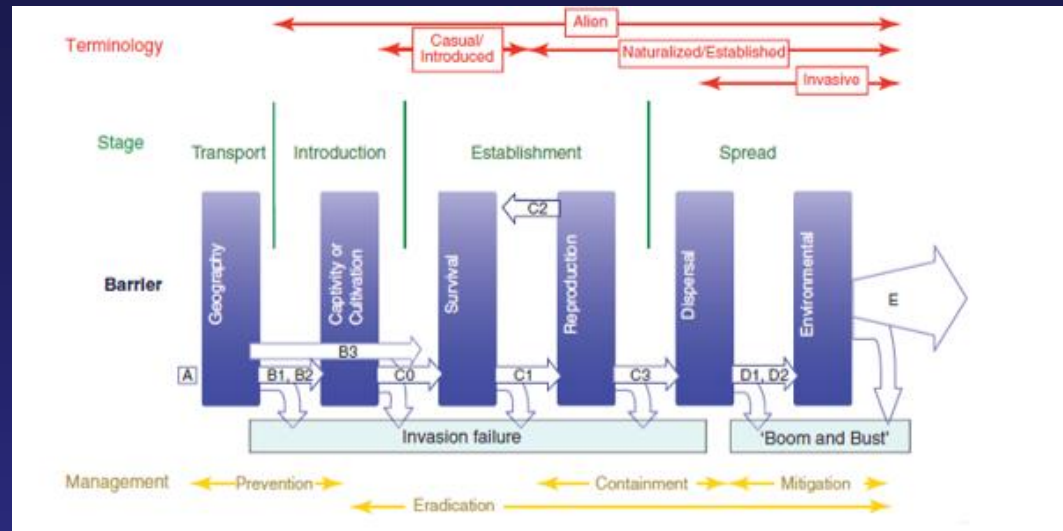
Are there alternatives?

- Follow Hodges advice (others advocate similarly) and eschew the E-word
 - Speak instead of position along the invasion continuum
- Work to improve understanding among public and policymakers
 - 'Established' is not the end
- Each case is different

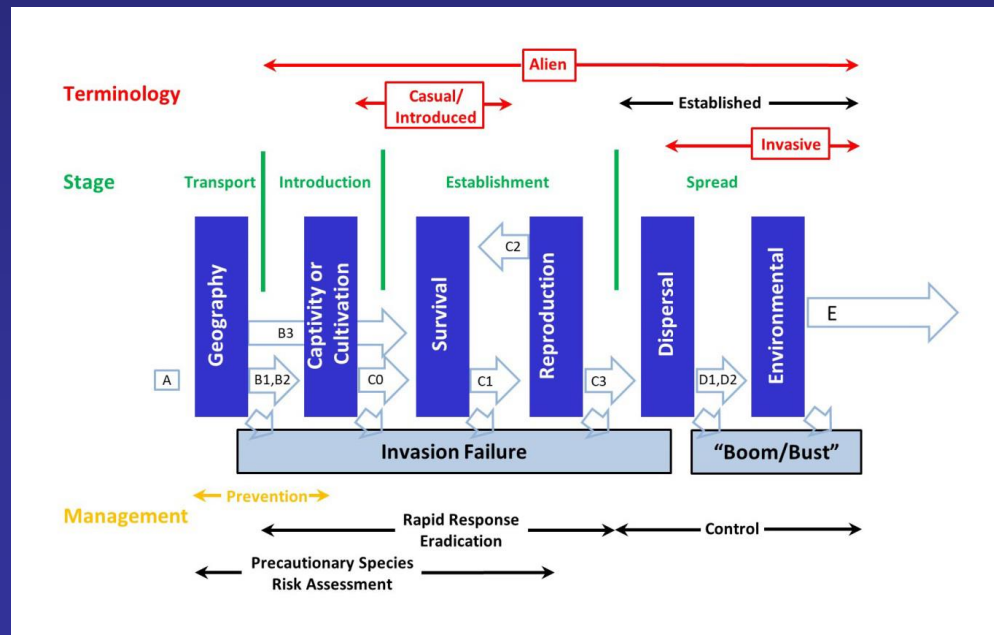


Congratulations, it's a Framework!

- Blackburn et al.



- Kočovský et al.



Acknowledgments

