Evaluation of the Fish Invasiveness Scoring Kit (FISK) as a Screening Tool for Non-Native Fishes in Florida

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Risk Assessments and Screening Tools for Invasive Species

• **Risk assessments**
  - Likelihood of being invasive
  - Likelihood of successful:
    • Introduction, survival, reproduction, and spread
  - Identifies likely consequences

• **Screening tools**
  - Quickly assess large suite of species
  - Classes species as low, medium or high risk
  - Provides managers with actionable information
The Fish Invasiveness Scoring Kit (FISK)

• Concept
  – Adapted from the Australian Weed Risk Assessment (WRA)- Pheloung et al. (1999) by Copp et al. (2005) for FW fishes
  – “Weedy” species are likely to be “weedy” in novel environments
  – Excel spreadsheet with VisualBasic code:
    • Number of questions remains the same (49)
    • Questions and some scores altered
    • Format improved and ‘certainty’ assessment added
Florida-FISK Title Screen

Non-native freshwater fish risk identification toolkit
# Florida-FISK Species List

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>Assessor</th>
<th>Answered Q's</th>
<th>Score</th>
<th>U.K. (1:18)</th>
<th>Japan (1:19.8)</th>
<th>User-defined (7:15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carassius auratus</td>
<td>Goldfish</td>
<td>L. Vilizzi</td>
<td>49/49</td>
<td>35</td>
<td>High</td>
<td>High</td>
<td>High</td>
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<tr>
<td>Clarias batrachus</td>
<td>Walking catfish</td>
<td>G.H. Copp</td>
<td>49/49</td>
<td>37</td>
<td>High</td>
<td>High</td>
<td>High</td>
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<tr>
<td>Colossoma macropomum</td>
<td>Tambaqui/Pacu</td>
<td>G.H. Copp</td>
<td>49/49</td>
<td>11</td>
<td>Medium</td>
<td>Medium</td>
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<tr>
<td>Colossoma macropomum</td>
<td>Tambaqui/Pacu</td>
<td>L.L. Lawson</td>
<td>49/49</td>
<td>11</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
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<tr>
<td>Ctenopharyngodon idella</td>
<td>Grass carp</td>
<td>L. Vilizzi</td>
<td>49/49</td>
<td>30</td>
<td>High</td>
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<tr>
<td>Cyprinus carpio</td>
<td>Common carp</td>
<td>G.H. Copp</td>
<td>49/49</td>
<td>35</td>
<td>High</td>
<td>High</td>
<td>High</td>
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<tr>
<td>Cyprinus carpio</td>
<td>Common carp</td>
<td>L.L. Lawson</td>
<td>49/49</td>
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<td>High</td>
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<tr>
<td>Cyprinus carpio</td>
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<td>L. Vilizzi</td>
<td>49/49</td>
<td>42</td>
<td>High</td>
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<tr>
<td>Danio rerio</td>
<td>Zebra danio</td>
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<td>3</td>
<td>Medium</td>
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<td>Medium</td>
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<tr>
<td>Gambusia affinis</td>
<td>Mosquito fish</td>
<td>G.H. Copp</td>
<td>49/49</td>
<td>32.5</td>
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<tr>
<td>Hemichromis leteorneuxi</td>
<td>African Jewelfish</td>
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<td>49/49</td>
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<tr>
<td>Hoplosternum littorale</td>
<td>Brown hoplo</td>
<td>L.L. Lawson</td>
<td>49/49</td>
<td>18</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
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<tr>
<td>Hypophthalmichthys molitrix</td>
<td>Silver carp</td>
<td>L. Vilizzi</td>
<td>49/49</td>
<td>25</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>
The Fish Invasiveness Scoring Kit (FISK)

• 49 questions in total
  – Biogeography
    • Domestication/cultivation
    • Climate and distribution
  – Invasive History
    • Introductions/establishment
    • Impacts
  – Biology and ecology
    • Undesirable traits
    • Feeding guild
    • Reproduction
    • Dispersal
Output from climate matching can help answer this, combined with the known versatility of the taxon as regards climate region distribution. Otherwise the response should be based on natural occurrence in 3 or more distinct climate categories, as defined by Köppen-Geiger (see: www.hydrol-earth-syst-sci-discuss.net/4/439/2007/hessd-4-439-2007.pdf), or based on knowledge of existing presence in areas of similar climate.
Invasive History: Impacts

In the species' introduced range, are there impacts to rivers, lakes or amenity values?

Response: Yes
Certainty: Very Certain

Justification (References and/or Other Information):
Well documented evidence of carp increasing turbidity, reducing aquatic vegetation, and impacting benthic inverts more than native fishes do, e.g., Parkos et al. 2003 and others.

Go to Question:
12 - In the species' introduced range, are there impacts to rivers, lakes or amenity values?
Is the species highly fecund (>10,000 eggs/kg), iteropatric or has an extended spawning season relative to native species?

Response: Yes
Certainty: Very Certain

Justification (References and/or Other Information):

E.g. Santiago et al. (2004), Kolar et al. (2005)
Florida-FISK Outcomes

- **Question scoring**
  - Each response assigned a numerical value
  - Some questions are weighted

- **Total score**
  - Sum of response values
  - Range (-11 to 54) depending on responses
  - determines risk category

<table>
<thead>
<tr>
<th>Outcome UK:</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome Japan:</td>
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</tr>
<tr>
<td>Outcome User-defined:</td>
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<tr>
<td>Score:</td>
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<td>Biogeography</td>
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<tr>
<td>Score partition:</td>
<td>Undesirable attributes</td>
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<td>Biology/ ecology</td>
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<tr>
<td></td>
<td>Biogeography</td>
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<tr>
<td>Questions answered:</td>
<td>Undesirable attributes</td>
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<tr>
<td></td>
<td>Biology/ ecology</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>Aquacultural</td>
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</tr>
<tr>
<td>Sector affected:</td>
<td>Environmental</td>
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<tr>
<td></td>
<td>Nuisance</td>
</tr>
<tr>
<td>Total questions:</td>
<td>49</td>
</tr>
<tr>
<td>Answered</td>
<td>49</td>
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<tr>
<td>Unanswered</td>
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</tbody>
</table>
Evaluating FISK in Florida

Objectives

1) **Score** the fish species introduced to peninsular Florida using UK calibration

2) **Calibrate** score thresholds for Florida

3) **Compare** FISK scores and calibrated thresholds for Florida, Mexico, Japan and the UK
Applying the FISK in Florida

• In total, 98 fish species have been introduced (excl. dubious reports)
• Refined and modified current FISK to enhance clarity and widen climatic applicability
• Assess the 98 species
  – Up to 4 assessors
  – Multiple scores (assessor variability)
Preliminary Results

UK medium-to-high threshold

Mean FISK Score

LOW RISK

HIGH RISK

-5 -4.5 -4 -3.5 -3 -2.5 -2 -1.5 -1 -0.5 0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5

Evaluation

• Compare scores
  – FWC regulatory status
  – USGS database
  – Shafland et al. 2008

• Assessor Variability
  – Range of scores

• Evaluate components
  – Questions
  – Guidance
  – Scoring
Calibration

- **FishBase**
- **Survey**
  - $n = 25$ “experts”
  - Rate each species
    - Low Risk
    - Medium Risk
    - High Risk
    - “Don’t Know”
- **Adjust score thresholds**
  - Sensitivity
  - Specificity
  - Define “low risk” threshold
Objective 2: Calibrate FISK for Florida

AUROC Analysis

- FishBase
- Random
- Precaution Survey
- High Risk Only

Sensitivity vs. 1-Specificity
**AUROC analysis and Youden’s Index**

- **Evaluate**
  - AUROC value $> 0.5$
  - Fishbase best match
  - Precautionary worst

- **Calibration**
  - Youden’s index value
  - Maximize value by changing threshold
  - Score $\geq 15$ for Fishbase
  - Score $\geq 12$ High Risk only

<table>
<thead>
<tr>
<th>Category</th>
<th>Threshold</th>
<th>Youden’s Index</th>
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</thead>
<tbody>
<tr>
<td>FishBase</td>
<td>15</td>
<td>0.73</td>
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<tr>
<td>High Risk</td>
<td>12</td>
<td>0.56</td>
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<tr>
<td>Precautionary</td>
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<td>0.39</td>
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Acknowledgements

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Questions?