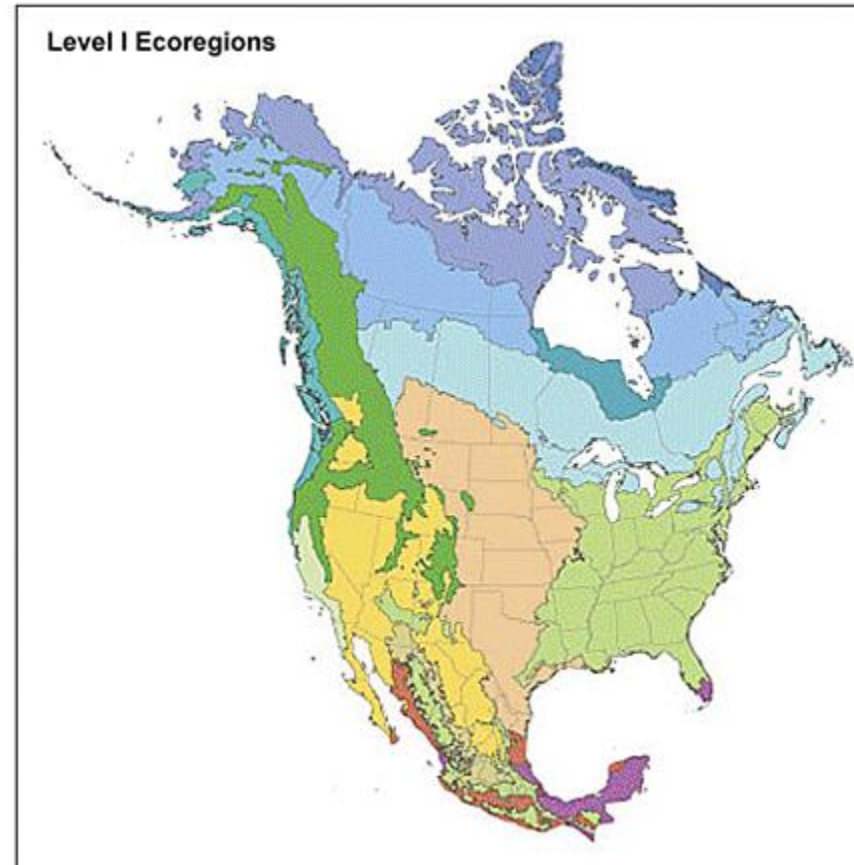


Ecosystems are very unforgiving of mismanagement of invasive species risk



<https://www.epa.gov/eco-research/ecoregions>

Like aircraft maintenance, Risk Analysis is always worth it



Dinosaurs didn't conduct Risk Analyses,  
and look what happened to them



# Risk Analysis Definition

- Integration of:
  - Risk Assessment
    - Horizon Scanning
    - Screening
    - Detailed assessments
  - Risk Management
    - Regulatory
    - Non-regulatory
  - Risk Communication

# Nationally: Management of Invasive Species

Historically, **our eyes have been wide shut**

*“Give me you tired, your poor, your...  
[invasive species]...yearning to breathe  
free”*



# ECOSTAR™ Rating System for Nonnative Species

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**Michael Hoff**

U.S Fish and Wildlife Service, Retired

**Hannah Hoff**

Brown University

**N. Marshall Meyers**

Meyers & Alterman



# Presentation objective

→ Summarize and synthesize ECOSTAR™ rating system, and demonstrate resulting products



## Presentation outline

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- Background of the issues and needs
- Project
  - Methods
  - Results
  - Synthesis of Findings and Implications
  - Possible Future Actions
  - Discussion



# Background of the issues and needs

- More than 3.2 billion **live animals were imported** into the US during 2000-14 (Eskew et al. 2020)
- Untold numbers of **live plants** were **also imported** during that time
- Pathogens hitchhike on imported species, goods, conveyances, humans
  - Dutch Elm disease
  - Chestnut blight
  - West Nile Virus
  - Viral Hemorrhagic Septicemia
  - COVID



# Background of the issues and needs

- **Nonnative plants and animals** are also **domestically cultured & sold live** within the US

# Background of the issues and needs

- Those organisms were sold aquaria, water garden, scientific supply, aquaculture, live-food & other markets
- **No rating system** has been previously available to supply chains, **of the risk of live, nonnative organisms** to natural resources in the US

# Rating systems advising industries

- Advice is being provided to:
  - **Sustainable seafood** buyers (Monterey Bay Aquarium 2021)
  - **Native plant landscapers** (Ladybird Johnson Center Wildflower Center 2021)
  - **Sustainable land developers** (SITES 2021)
  - **iPhone app users (via app store rating system)** (Apple Inc. 2021)
  - **Appliance & electrical product buyers** & other products (Energy Star 2021)



# Federal food labeling requirements

- Nutrition Labeling and Education Act (**NLEA**) amended the Federal Food, Drug, and Cosmetic Act
- **NLEA requires most foods to bear accurate ingredient and nutrition labeling**
  - FDA Intent **“We have your back”**

# Food Labeling

**Nutrition Facts**  
 Serving Size 1oz. (28g)  
 Servings About 16  
**Calories** 170  
 Fat Cal. 130

Amount Per Serving	%DV*	Amount Per Serving	%DV*
<b>Total Fat</b> 14g	<b>22%</b>	<b>Total Carb</b> 6g	<b>2%</b>
Sat Fat 2g	<b>10%</b>	Dietary Fiber 2g	<b>8%</b>
Trans Fat 0g		Sugars 1g	
<b>Cholesterol</b> 0mg	<b>0%</b>	<b>Protein</b> 7g	
<b>Sodium</b> 0mg	<b>0%</b>		
Vitamin A 0% • Vitamin C 0% • Calcium 2% • Iron 4%			

\*Percent Daily Values (DV) are based on a 2,000 calorie diet.

**INGREDIENTS:** PEANUTS  
**ALLERGY STATEMENT:** PRODUCED IN A FACILITY THAT PROCESSES PEANUTS & TREE NUTS, MAY CONTAIN PEANUTS OR TREE NUTS

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 CHICAGO, IL USA 60631-2773  
<http://www.igainc.com>  
 PACKED IN THE U.S.A.  
 Peanuts from: U.S.A.

 YOUR ASSURANCE OF QUALITY

We Welcome Any Comments Or Questions You May Have.  
 When Writing, Please Include The Label Code.  
 Write To The Address Above.

0 41270 00838 9

Total Fat	Less than	65g	80g
Sat. Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

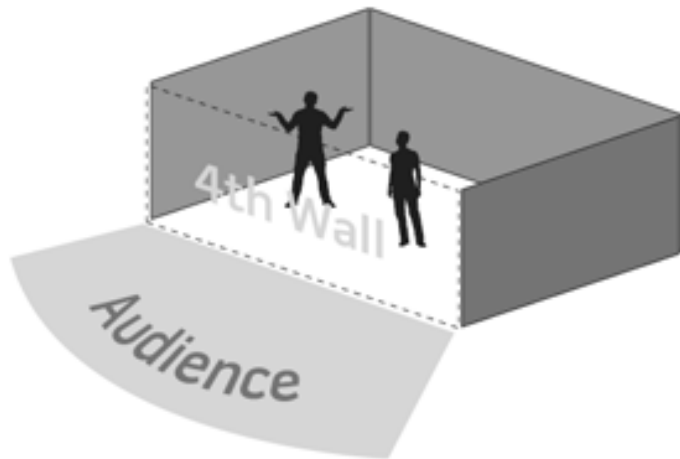
Calories per gram: Fat 9 • Carbohydrate 4 • Protein 4

**INGREDIENTS:** FILLING (HIGH FRUCTOSE CORN SYRUP, CORN SYRUP, STRAWBERRY PUREE CONCENTRATE, GLYCERIN, SUGAR, MODIFIED CORN STARCH, SODIUM CITRATE, CITRIC ACID, SODIUM ALGINATE, NATURAL AND ARTIFICIAL STRAWBERRY FLAVOR, DICALCIUM PHOSPHATE, MODIFIED CELLULOSE, CARAMEL COLOR, MALIC ACID, RED #40), ENRICHED FLOUR (WHEAT FLOUR, NIACINAMIDE, REDUCED IRON, THIAMIN MONONITRATE [VITAMIN B<sub>1</sub>], RIBOFLAVIN [VITAMIN B<sub>2</sub>], FOLIC ACID), WHOLE GRAIN OATS, SUGAR, SUNFLOWER OIL, HIGH FRUCTOSE CORN SYRUP, CONTAINS TWO PERCENT OR LESS OF HONEY, CALCIUM CARBONATE, DEXTROSE, NONFAT DRY MILK, WHEAT BRAN, SALT, CELLULOSE, POTASSIUM BICARBONATE (LEAVENING), NATURAL AND ARTIFICIAL FLAVOR, MONO- AND DIGLYCERIDES, PROPYLENE GLYCOL ESTERS OF FATTY ACIDS, SOY LECITHIN, WHEAT GLUTEN, CORNSTARCH, VITAMIN A PALMITATE, CARRAGEENAN, NIACINAMIDE, SODIUM STEAROYL LACTYLATE, GUAR GUM, ZINC OXIDE, REDUCED IRON, PYRIDOXINE HYDROCHLORIDE (VITAMIN B<sub>6</sub>), THIAMIN HYDROCHLORIDE (VITAMIN B<sub>1</sub>), RIBOFLAVIN (VITAMIN B<sub>2</sub>), FOLIC ACID.

**CONTAINS WHEAT, MILK AND SOY INGREDIENTS.**



# Breaking down the “4<sup>th</sup> wall”



- In films and theater, breaking down the 4<sup>th</sup> wall **means communicating directly with the audience**
- We **need to communicate** effectively & efficiently **with live organism supply chains about risk of nonnative species**

**HOW DO WE BETTER  
PROTECT U.S. BIOSECURITY?**

---

# A Christmas Carol

- Ghost of Christmas Present shows Scrooge two children that are the symbols of the children of man
  - Named **“Want”** and **“Ignorance”**
  - Of the two symbols
    - Ignorance symbolized the doom of man**



**ECOSTAR™** is a **rating system** for  
live, nonnative plants and animals



- **ECOSTAR™** rating **LABELS** are **based ecological risk** information of nonnative species by:
  - Hoff 2008 (later adopted by FWS)
  - the USDA (2021), or
  - others into simple, **plain-language information that can be understood within 1 minute**



# Project Goal

**Protect the environment** by **providing information**, to all in the supply chain, about **risk of harm** of a **nonnative species** in jurisdictions and regions within the U.S.





TM

## Project Objective – 2 Projects

- Complete 60 **ECOSTAR™ LABEL** for each of **60 nonnative species**
  - To **demonstrate products tested** in our project
  - **Inform sellers and buyers**

# METHODS

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# Methods

- **Labels based** on Ecological Risk Screening Summaries (**ERSS**), or other science-based risk assessments
  - I invented ERSS in 2008, and operationalized in 2009
  - **ERSS**
    - Seminal elements
      - **History of Invasiveness & Climate Match**
    - Peer reviewed 3X by ~150 people
      - MRBP, NISC/ANSTF, OMB processes

# Methods

- **ERSS Horizon Scanning**

- 70,000 species
- Databases, scientific publications, corporate websites, ...
- Aquaria, live food, scientific supply, water garden, horticulture, aquaculture, ...
- Includes known pathogens, parasites...

# Climate Niche Matching

- **Most Important component of Labels**
  - Map with each state colored **RED**, **Yellow**, **Green**
  - **Based on** Risk Assessment Mapping Program (**RAMP**)
    - **Sanders, Castiglione, Hoff (2014)**
      - Uses algorithm & statistical approach published by Australians
      - And my statistically based climate match categories

# Risk Assessment Mapping Program (RAMP)

- Can **map and score climate niche for any species**
  - Using scientific **native and established range** data
  - Under **present and future projected climates**
    - Future based in IPCC's scenarios (called RCPs)

RAMP Output:  
Example for  
Rio Grande  
Cichlid  
from FWS  
(2019)

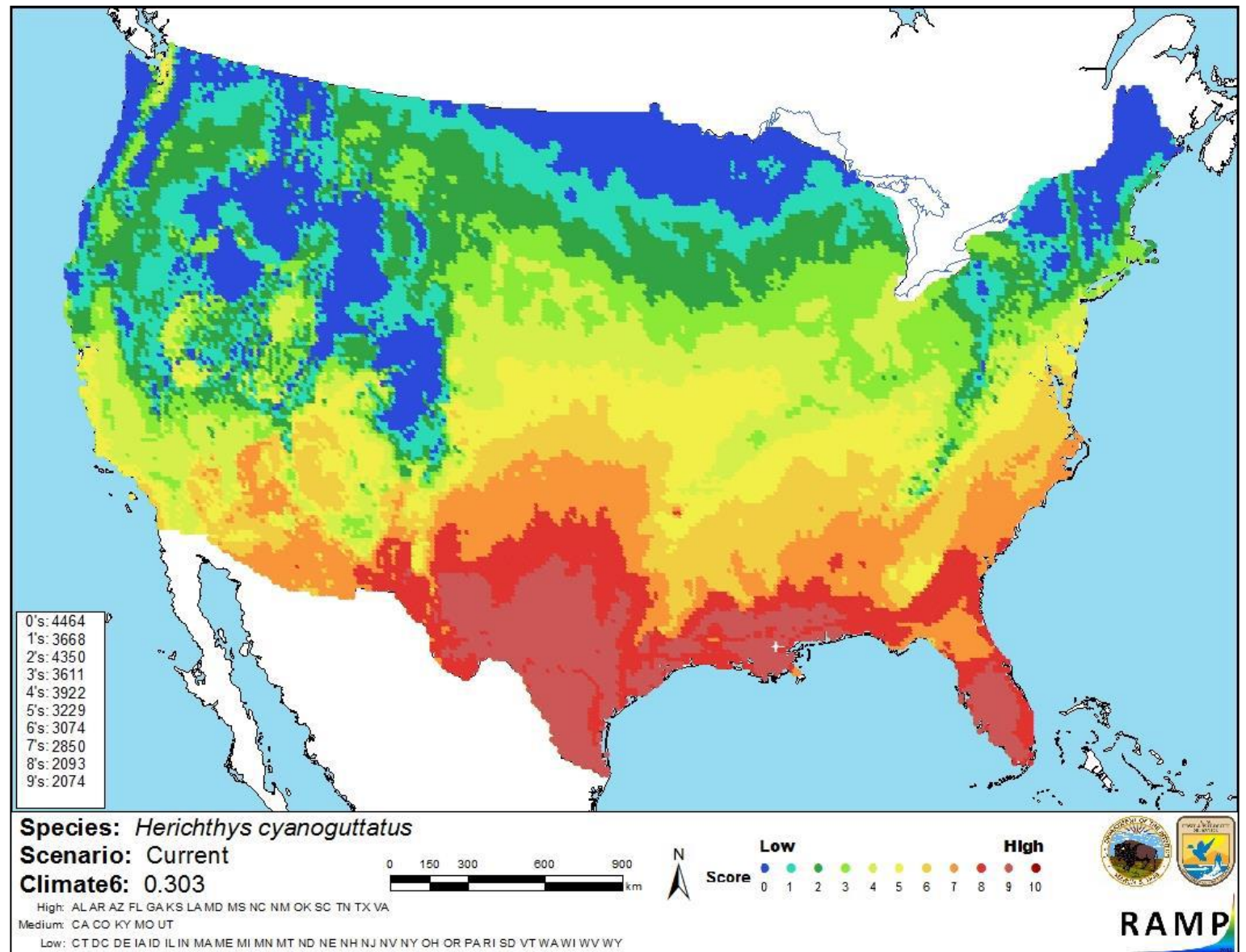


Figure 4. Map of RAMP (Sanders et al. 2014) climate matches for *Herichthys cyanoguttatus* in the contiguous United States based on source locations reported by GBIF (2016) and Nico et al. (2017). 0=Lowest match, 10=Highest match.

# Prototype, Simplified Labels

- **3** were developed
  - For review by invited experts – graphic artists, supply chain representatives
  - **Species:**
    - Water Hyacinth
    - Rio Grande Cichlid
    - Freshwater Angelfish



# Prototype, Simplified Labels

 TM  
**Freshwater Angelfish (*Pterophyllum scalare*)**  
ECOSTAR: Buy low-risk plants and pets


**Risk Summary:** The Freshwater Angelfish is not native to the United States, and is a low risk of causing harm to U.S. waters.

  
  
Legend: Low Risk (Green), Medium Risk (Yellow), High Risk (Red)

Photo: Daniel Mennhagen. Licensed under Creative Commons BY-NC-ND 2.0. Available: <https://www.flickr.com/photos/28889232@N00/797597473/> (October 6, 2020).  
Map created from information at <https://www.fws.gov/engines/ANS/engines/RSSE/Pterophyllum-scalare-Final.pdf>

**Take Action By:**

- Consulting local and state regulations prior to buying and keeping specimens of Freshwater Angelfish.

 TM  
**Rio Grande Cichlid (*Herichthys cyanoguttatus*)**  
ECOSTAR: Buy low-risk plants and pets

**Risk Summary:** The Rio Grande Cichlid is not native to the United States, and is a high risk of causing harm to waters in some of the U.S. (red states on the map).




  
  
Legend: Low Risk (Green), Medium Risk (Yellow), High Risk (Red)

Photo: Charles & Clint. Licensed under Creative Commons CC BY-SA 2.0. Available: <https://www.flickr.com/photos/20987781@N00/20989361/> (October 6, 2020).  
Map created from information at <https://www.fws.gov/engines/ANS/engines/RSSE/Herichthys-cyanoguttatus-Final.pdf>

**Take Action By:**

- Either buying Rio Grande Cichlids in green states or choosing a low-risk alternative to the Rio Grande Cichlid, such as the Cockatoo Cichlid (*Apistogramma cacatuoides*).
- Consulting local and state regulations prior to buying and keeping specimens of Rio Grande and Cockatoo Cichlids.

 TM  
**Water Hyacinth (*Eichhornia crassipes*)**  
ECOSTAR: Buy low-risk plants and pets

**Risk Summary:** The Water Hyacinth is not native to the United States, and is a high risk of causing harm to waters in most of the U.S. (red states on the map).



  
  
Legend: Low Risk (Green), Medium Risk (Yellow), High Risk (Red)

Photo: Andrew Davies. Licensed under Creative Commons BY-NC 4.0. Available: <https://www.naturalist.org/photos/7695016> (October 6, 2020).  
Map created from information at <https://www.fws.gov/engines/ANS/engines/RSSE/Eichhornia-crassipes-Final.pdf>

**Take Action By:**

- Choosing a low-risk alternative to Water Hyacinth, such as Pickerelweed (*Pontederia cordata*).
- Consulting local and state regulations prior to buying and keeping specimens of Water Hyacinth and Pickerelweed.

# Interviews of Experts

- **Experts** were asked to **review the 3 prototype Labels**, then
  - **Answered 10 questions** on the interview form
    - Answers to the questions were sought **guide modifications** of the format & content of **FINAL Labels**



# Enhanced Labels

- Drafted for use when a partner wishes to provide access (URLs) to **more detailed risk assessment** information **than in Simplified Labels**



# State-Specific Labels

- **Labels** that use modifications of the Simplified and/or Enhanced Label
- With **climate match color shown** for the subject **State**
  - Worked with state representatives to modify **Enhanced labels for 2 states**



# RESULTS

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# Interviews of Experts

- Synthesis:
  - Experts concurred with DRAFT, Simplified Labels
  - Therefore, 10 additional Simplified Labels produced

 TM  
**Freshwater Angelfish (*Pterophyllum scalare*)**  
ECOSTAR: Buy low-risk plants and pets


**Risk Summary:** The Freshwater Angelfish is not native to the United States, and is a low risk of causing harm to U.S. waters.

Photo: David Hemmerich. Licensed under Creative Commons BY-NC-ND 2.0. Available: <https://www.fishbase.org/species/ptersca> (October 6, 2020).  
Map created from information at <https://www.fishbase.org/species/ptersca> (October 6, 2020).

**Take Action By:**

- Consulting local and state regulations prior to buying and keeping specimens of Freshwater Angelfish.

 TM  
**Rio Grande Cichlid (*Herichthys cyanoguttatus*)**  
ECOSTAR: Buy low-risk plants and pets

**Risk Summary:** The Rio Grande Cichlid is not native to the United States, and is a high risk of causing harm to waters in some of the U.S. (red states on the map).




 

Photo: Charles & Dixie. Licensed under Creative Commons BY-NC 2.0. Available: <https://www.fishbase.org/species/hericyan> (October 6, 2020).  
Map created from information at <https://www.fishbase.org/species/hericyan> (October 6, 2020).

**Take Action By:**

- Either buying Rio Grande Cichlids in green states or choosing a low-risk alternative to the Rio Grande Cichlid, such as the Cockatoo Cichlid (*Apistogramma cacatuoides*).
- Consulting local and state regulations prior to buying and keeping specimens of Rio Grande and Cockatoo Cichlids.

 TM  
**Water Hyacinth (*Eichhornia crassipes*)**  
ECOSTAR: Buy low-risk plants and pets

**Risk Summary:** The Water Hyacinth is not native to the United States, and is a high risk of causing harm to waters in most of the U.S. (red states on the map).



 

Photo: Andrew Davis. Licensed under Creative Commons BY-NC 4.0. Available: <https://www.fishbase.org/species/eiccrass> (October 6, 2020).  
Map created from information at <https://www.fishbase.org/species/eiccrass> (October 6, 2020).

**Take Action By:**

- Choosing a low-risk alternative to Water Hyacinth, such as Pickerelweed (*Pontederia cordata*).
- Consulting local and state regulations prior to buying and keeping specimens of Water Hyacinth and Pickerelweed.

# State-Specific Labels

 TM  
**Carolina Fanwort (*Cabomba caroliniana*)**  
ECOSTAR: Buy low-risk plants and pets

**Risk Summary:** Carolina Fanwort is not native to Minnesota, and is a regulated species here. The species presents a high risk of causing harm to waters in Minnesota.


   
High Risk


Photo: Leslie J. Mehrhoff, licensed under Creative Commons BY 3.0. Available: <https://search.produccommons.org/photos/4132454-68ba-42db-9c5c-351492db18ba>, (February 11, 2021). Map created from information at <https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Cabomba-caroliniana-Final.pdf>.

**Take Action:**

- Choose a low risk alternative to Carolina Fanwort such as Pickerelweed (*Pontederia cordata*) or Anubias (*Anubias barteri*)
- Comply with Minnesota regulations prohibiting release and planting of Carolina Fanwort in public waters

**For more information:**

- [https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Cabomba-caroliniana\\_Final.pdf](https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Cabomba-caroliniana_Final.pdf)
- <https://www.dnr.state.mn.us/invasives/trade-pathways.html>

 TM  
**Nile Tilapia (*Oreochromis niloticus*)**  
ECOSTAR: Buy low-risk plants and pets

**Risk Summary:** Nile Tilapia is not native to Mississippi, and is a restricted species in MS. The species presents a high risk of causing harm to waters in Mississippi.



   
High Risk

Photo: Sakai Ratanuangkhaeng, licensed under Creative Commons BY 3.0. Available: <https://search.produccommons.org/photos/4086067-8d43-423d-9c1c-3a3e0f9e1d13>, (February 12, 2021). Map created from information at <https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Oreochromis-niloticus-Final-April2018.pdf>.

**Take Action By:** Complying with MS regulations prohibiting the release of Nile tilapia in public waters. Never release any nonnative species into public waters.

**For more information:**

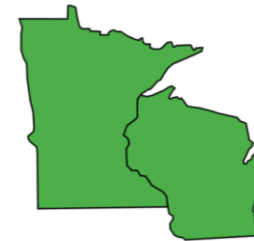
- <https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Oreochromis-niloticus-final-April2018.pdf>
- <https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=468>
- <https://www.cabi.org/isc/datasheet/72086>



# EcoStar™ Rating: Nonnative species Zebra Danio (*Danio rerio*)

EcoStar™: *Buy low-risk plants and animals*

EcoStar Rating™: **Zebra Danio is low risk to Minnesota and Wisconsin**



**Low Risk**



Photo: Tohru.murakami is licensed under CC BY-NC 2.0.  
Available: <https://openverse.org/image/18aff84c-8825-4424-b37d-c76a573c72c67q=danio%20rerio>. March 7, 2023.

### Take Action:

- Use native species or low-risk, nonnative alternatives
- Contain nonnative species. It is illegal to introduce nonnative aquatic plants and animals into state waters

### For more information:

- <https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=505>
- <https://www.dnr.state.mn.us/invasives/trade-pathways.html>
- EcoStar [add the QR code for a brief description of this rating system]

# PROJECT FINDINGS AND IMPLICATIONS

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# Findings

- Experts concurred **that great amounts of scientific risk assessment analytical results can be summarized and synthesized into Labels** for use in informing the entire supply chain
  - Using Simplified Label construct

# Implications

- **Climate niche match map** is **THE key** information in each label
- **ECOSTAR™ label development** protocol **requires RAMP, or similar,** climate niche mapping and scoring

# Implications

- **4-step plan** for supply chain:

1. **Identify** non-native species being sold or traded by companies
  - Best to work within 1 state (or several neighboring states)
2. **Create** ECOSTAR™ labels, warehouse labels in website/database
3. **Educate** internally (within industry/company/state), so supply chains can **Search** for ECOSTAR™ label in database
4. **Share** information by including labels in sale/trade of nonnative species

# POSSIBLE FUTURE ACTIONS

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# ECOSTAR™ Team

- **Seeking funding to operationalize ECOSTAR™ production**
  - Objective to **produce hundreds of Labels**
  - Could be developed in partnership with states, regional consortiums of states, NGOs, and/or others

Communication of  
Nonnative Species Risk  
to the Supply Chain:

A 50-ft, 38-ton gorilla  
for invasive species  
prevention





## My Greatest Fear

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...is not that we are powerless [to  
manage invasive species risk]

but instead that we are powerful,  
and choose not to use that power





## Acknowledgments

- Funding was provided by the Mississippi River Basin Panel on Aquatic Nuisance Species, and USFWS
- Experts in graphic arts and supply chains of species in trade completed interview form
- Chelsey Blanke and Dennis Riecke provided advice, and guidance on development of state-specific labels for Minnesota and Mississippi, respectively



For More Information

[www.ecostarratings.com](http://www.ecostarratings.com)



## Questions and Discussion

- "Intellectuals solve problems; geniuses prevent them."  
- Albert Einstein



Without ECOSTAR™ supporting science-based Citizen Decision Making, we are working without a net.  
Are you comfortable with that?

