A Model Screening Process to Rapidly Assess Risks of Nonnative Species Establishment and Impacts

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Presentation Overview

- Summarize MRBP's Risk Analysis Process
  - With emphasis on Rapid Risk Screening Process
- Describe tools useful to support decisions to implement that process
- Describe Next Steps for MRBP
- Past recommendation to ANSTF
- Example Risk Screening
- Demonstration of CLIMATE software

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What is a Screening Process?

- A screening process
  - is a risk assessment system designed to RAPIDLY evaluate the invasiveness (establishment and impact) potential of a nonnative species,
    - prior to its importation into a jurisdiction

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Outcomes of Screening Risk Assessments

- Results of risk screening can be used by:
- Governments and industries to determine whether risk, of a nonnative species, impact on native species and ecosystems, is:
    - Uncertain
    - Low, or
    - High

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Outcomes of Screening Risk Assessments

- Governments can use results to regulate
- Industries can use results to keep “green”
- Both groups can work together

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Outcomes of Screening Risk Assessments

- If species impact risk is Uncertain, then:
  - a more detailed risk assessment is needed
    - ANSTF developed a protocol in 1996
      - Time to revisit this approach
        - » Use current scientific, information technology, and risk assessment advancements

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Outcomes of Screening Risk Assessments

- If species establishment and impact risk is clearly Low, then
  - the species is acceptable for importation and/or use in trade

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Outcomes of Screening Risk Assessments

- If species impact risk is clearly High, then:
  - a decision is needed about either voluntarily preventing/halting trade (industry), or regulating trade (government)

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MRBP Risk Analysis Process

1. Identify Species for Screening
2. Rapid Screening Process
   a. If risk is clearly low, then no action
   b. If risk is clearly high, then Step 5
   c. If risk is uncertainty, then Steps 3-4
3. Prioritize species for Detailed Risk Assessment
4. Agency Conducts Detailed Risk Assessment
5. Develop Agency Actions to Regulate and Manage
6. Implement Agency Priority Actions
7. Evaluate Agency Actions, and Adapt Management Programs

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Rapid Screening Process

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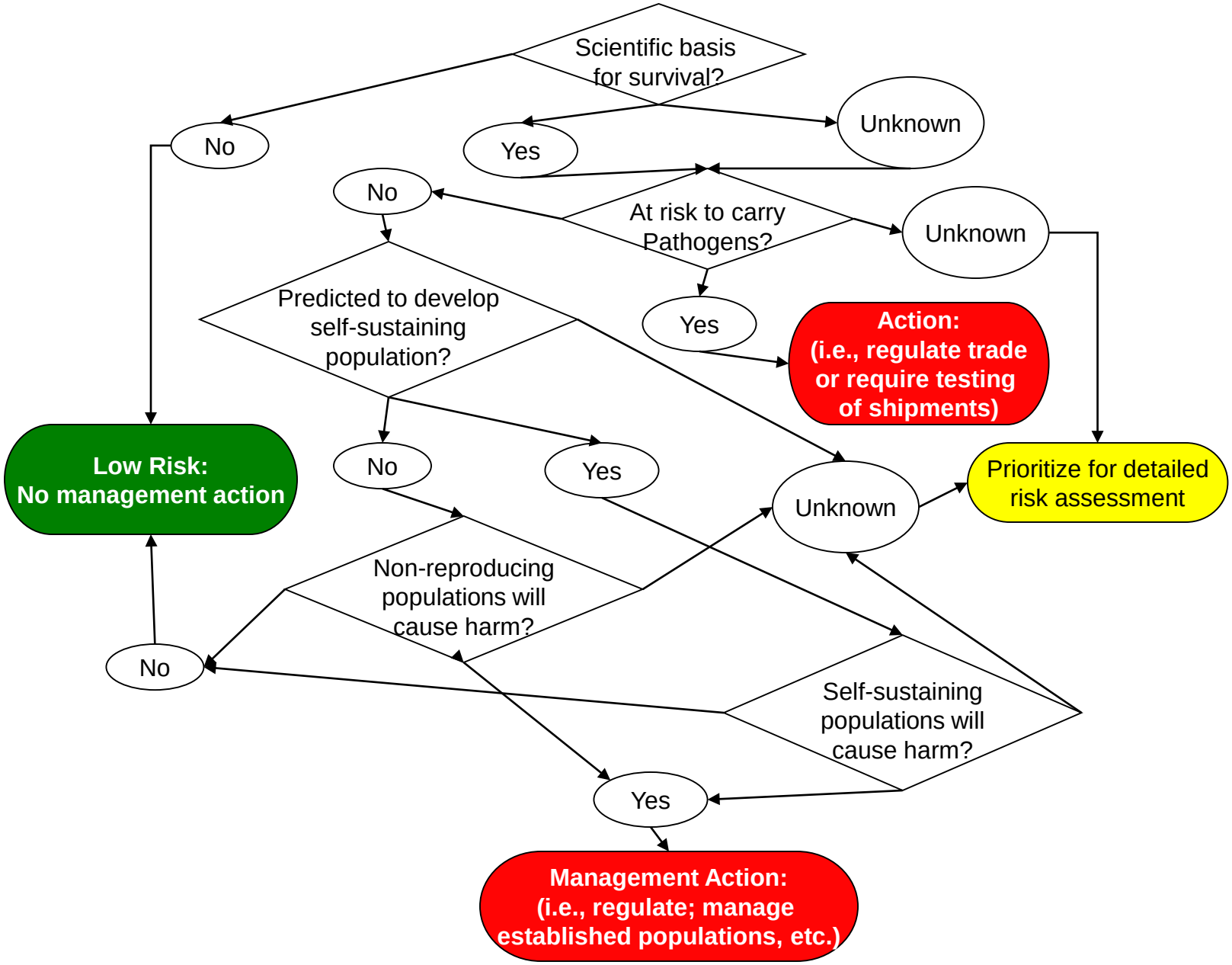
Model process for screening of live organisms.



Best Predictors of Species Invasion

- For a species, best predictors of invasiveness are:
  - History of invasiveness
  - Climate-habitat match for source and sink

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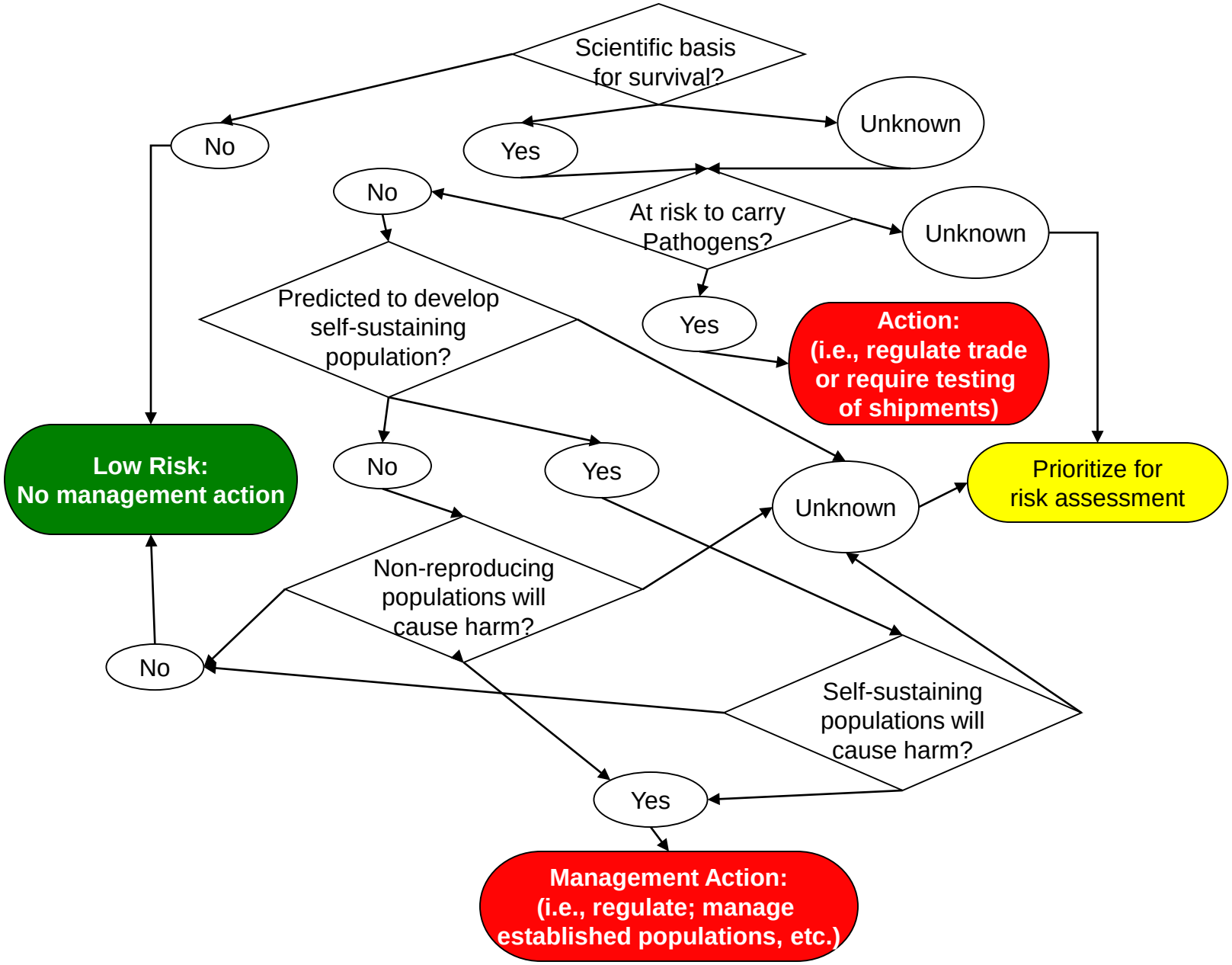
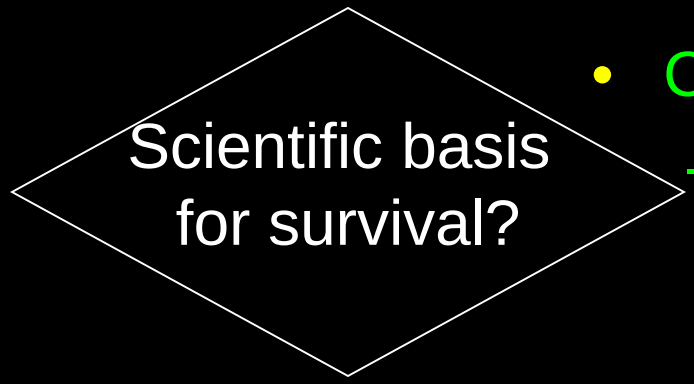
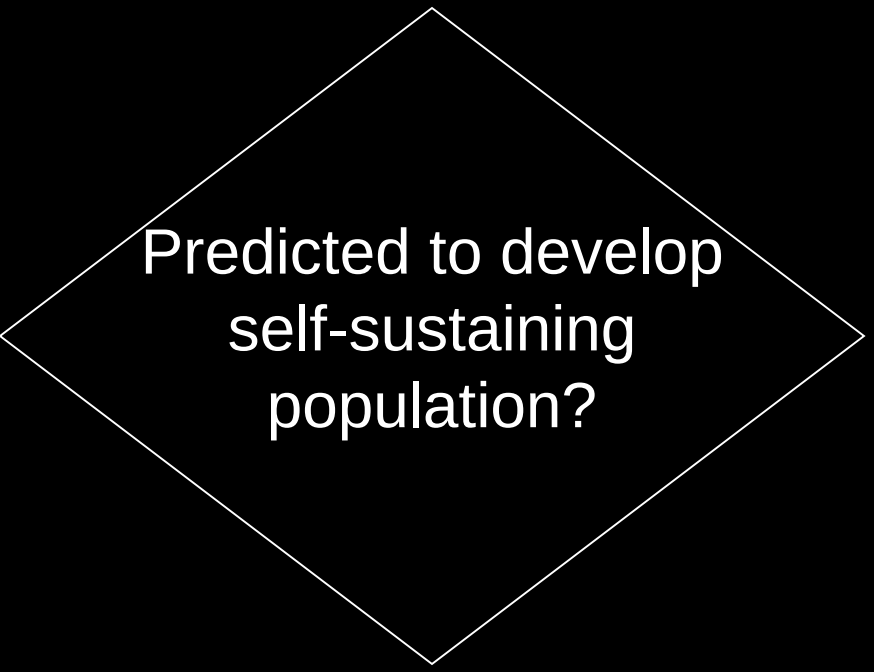
Model process for screening of live organisms.



Tools Needed & Available

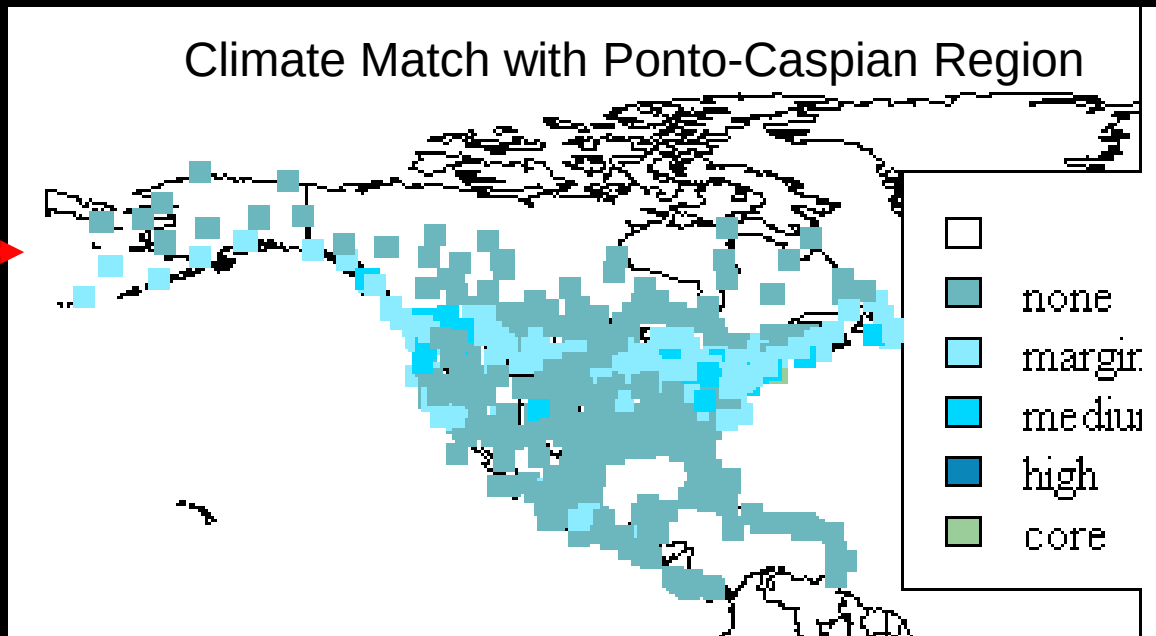




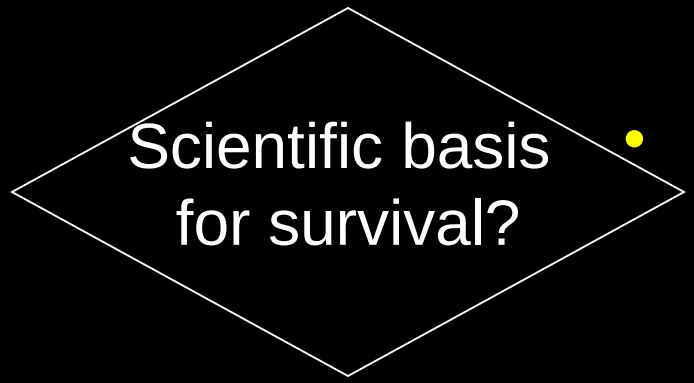
- Climate and Habitat Matching Tools
  - "CLIMATE/CLIMATCH" Software
    - Developed by Australian Gov.
    - Software matches climates of user-selected regions around the world
      - 16 variables available

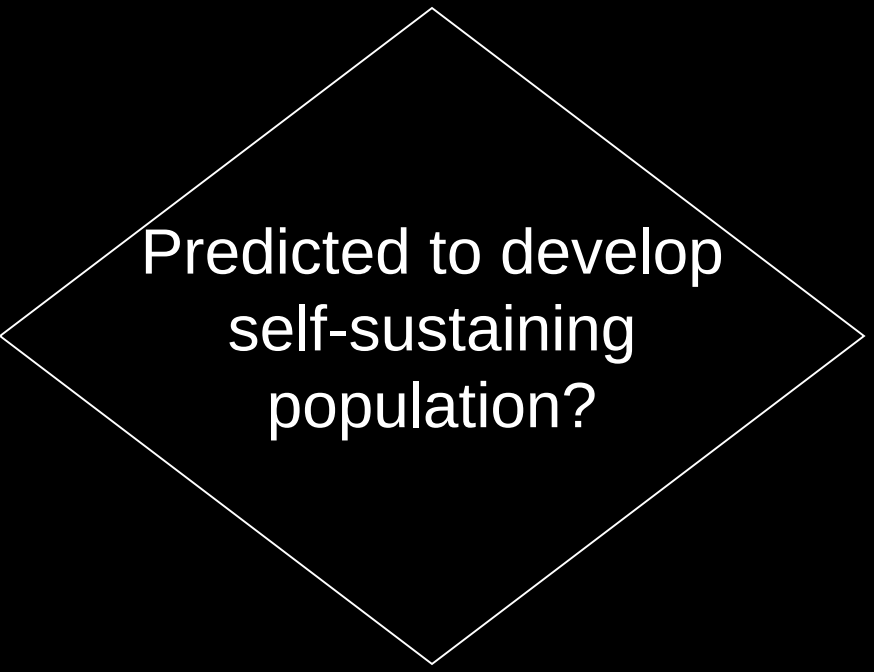
Output from “Climate”

- Match of Ponto-Caspian area with North America
  - Used data from all meteorological stations
    - And two parameters
      - Min. temp. coolest month
      - Max. temp. of warmest month



Tools Needed, & Being Developed





- Climate and Habitat Matching Tools
  - Habitat Software - Not yet accessible
    - "FRESHmap" being developed by Canadian DFO
    - Will match river basins of regions around the world
    - BETA version soon

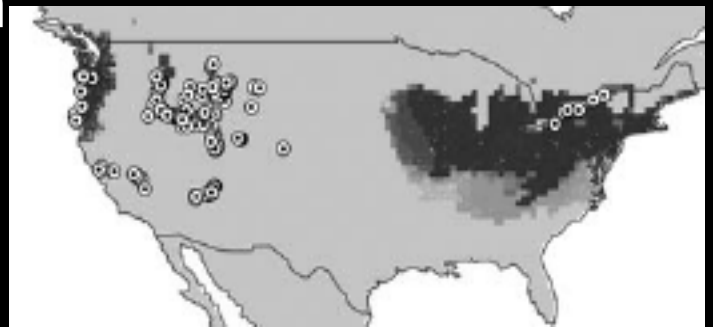
Tool Developed

- Climate and Habitat Matching Tools
  - Habitat Models
    - GARP
      - Algorithm designed for predicting potential distribution of species
        - » Using environmental and biological data
        - » Data intensive, and expertise needed
        - » Some studies discounted approach

Scientific basis for survival?

Predicted to develop self-sustaining population?

NZ mudsnail potential range: GARP model output



Tool Developed

Scientific basis for survival?

Predicted to develop self-sustaining population?

- Climate and Habitat Matching Tools
  - Habitat Models
    - Maximum Entropy
      - Projects species geographic distributions with presence-only data
      - Appears better predictor than GARP

Lowland sloth predicted range: Maxent model output

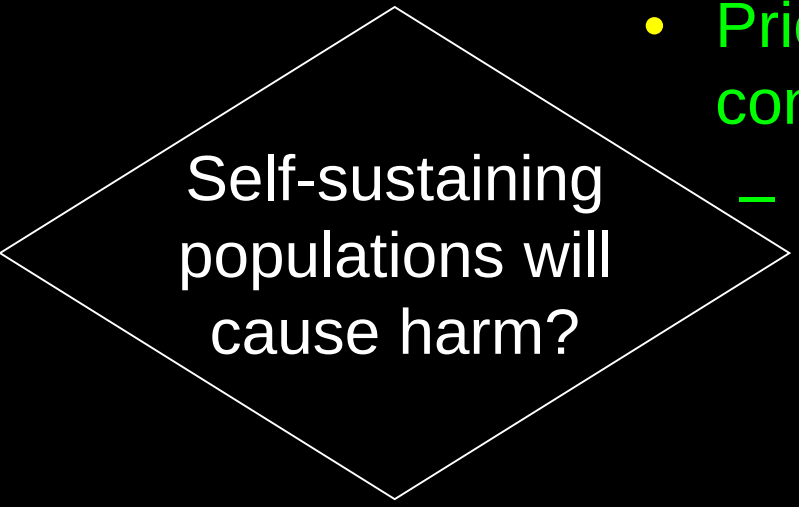
Tools Developed

Scientific basis for survival?

Predicted to develop self-sustaining population?

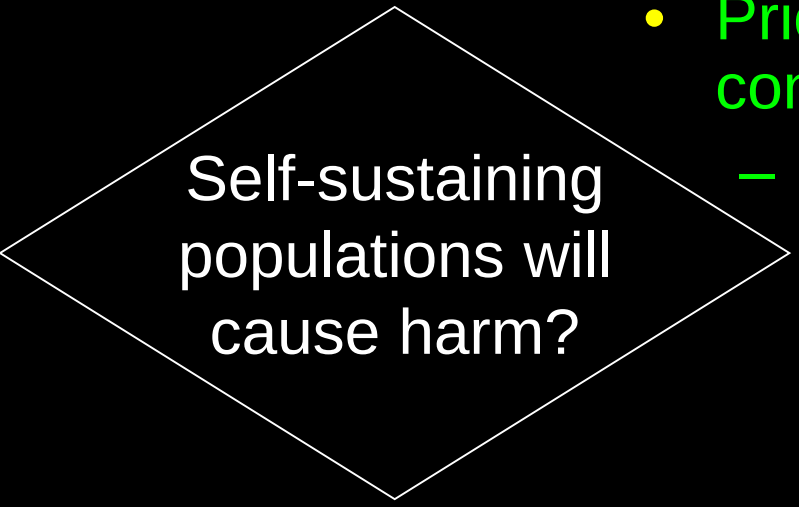
- Climate and Habitat Matching Tools
  - Habitat Models
    - Limiting factors
      - E.g., Model shows low risk of Asian carp establishment in softwater areas of U.S.

Decision-Support Tool Available



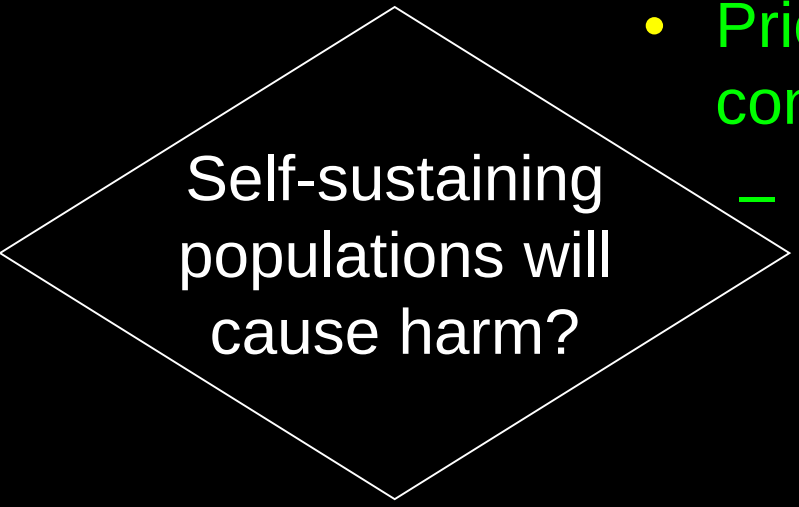
- Prior Invasiveness (of a species or its congeners)
  - Not yet web accessible
    - Global Register of Invasive Species (IUCN, ISSG)
      - Available for 16,051 invasive species
      - 38,606 annotated geographical records

Decision-Support Tools Available



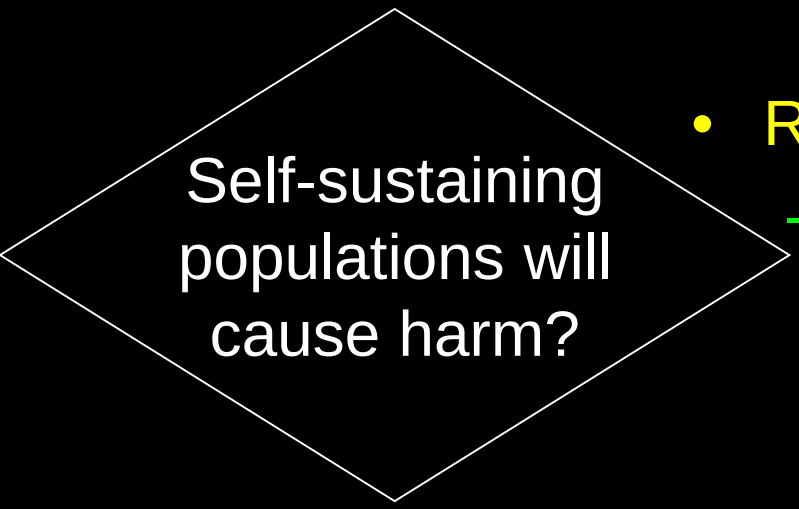
- Prior Invasiveness (of a species or its congeners)
  - Web accessible now
    - Fishbase
      - 30,600 Species
    - Global Invasive Species Database (IUCN)
      - 500 invasive species
    - FAO Database on Introductions of Aquatic Species (DIAS)
      - 5,612 introduced species

Decision-Support Tools Available



- Prior Invasiveness (of a species or its congeners)
  - Web accessible now
    - Googlescholar
      - Search for genus or genus and species along with “invasive” or other search words

Decision-Support Information Available



- Risk Assessments conducted by others
  - e.g., UK, Australia, others

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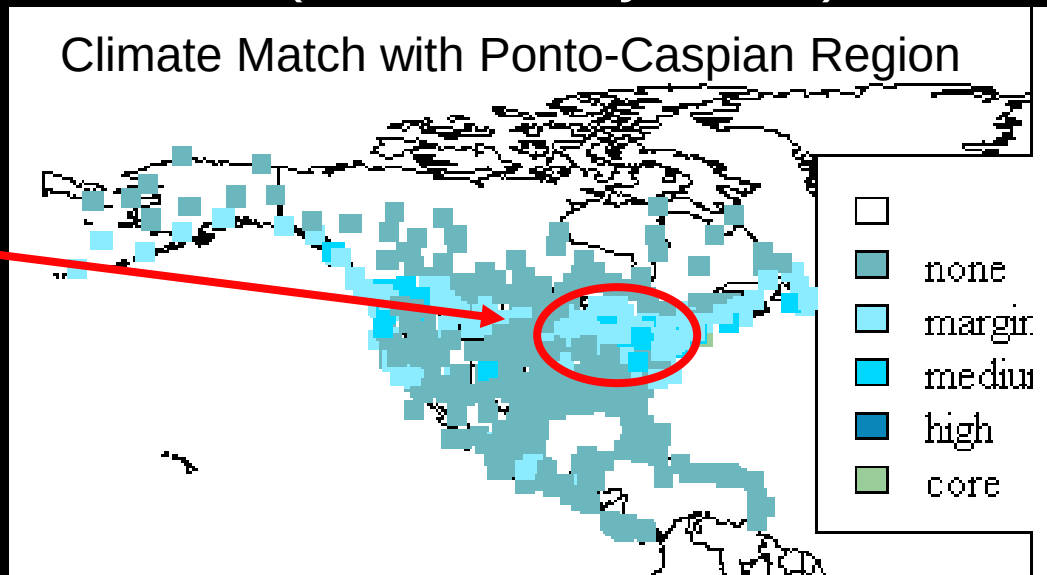
Rapid Screening: Accounting for Climate Change

- Can use "CLIMATE/CLIMATCH" Software to screen species under various climate scenarios
  - e.g.,
    - could compare min & max temps in existing range(s) of a species
    - with +2º C in States, US (or US ecosystems)



Other Tools Available

- Semi-Quantitative/Quantitative Risk Assessment
  - Freshwater Fish Risk Assessment
    - Developed in UK based on Australian weed RA
    - Expert-based scoring approach using literature
    - Score is compared with critical values

Other Tools Available

- Quantitative Risk Assessment Tool (QBRAT)
  - Developed by DFO Canada

Other Tools Available

- Trait-Based Models
  - Examples for Great Lakes
    - Mussels
      - Based on fecundity (Keller and Lodge)
    - Fishes
      - Based on quantitative, decision-tree approach (Kolar and Lodge)

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Next Steps - MRBP

- "Step 3: Prioritization for Detailed Risk Assessment
  - "The Panel directs the Prevention and Control Committee to develop a ranking system (using criteria and weightings for those criteria)….to prioritize the list of species recommended for detailed risk assessment…"

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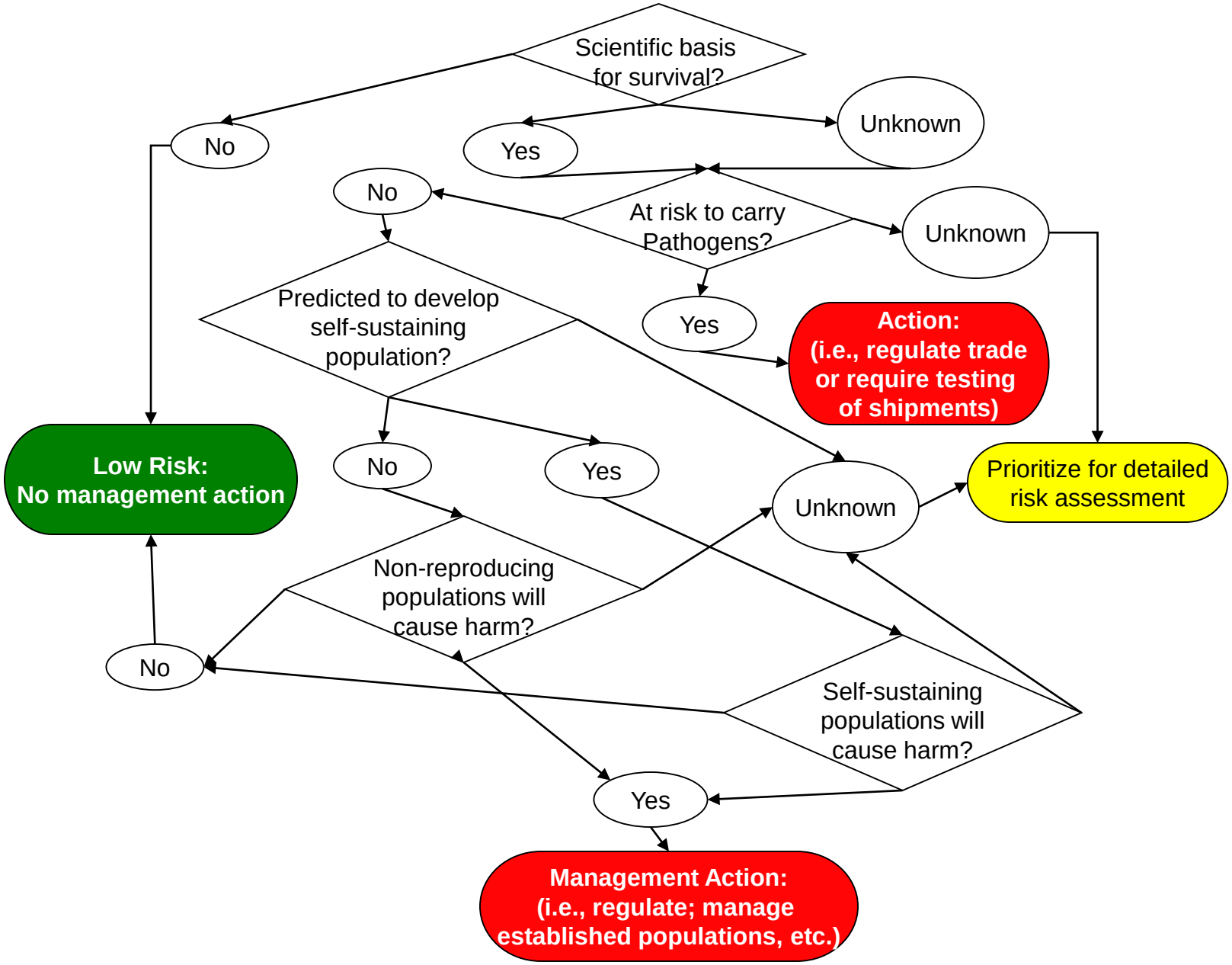
Model process for screening of live organisms.



Next Steps - MRBP

- Will continue to adapt the Risk Analysis system (including rapid screening process)
  - Will add decision-support tools and other materials, when they become available

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Recommendation to ANSTF

- From MRBP and GLP:
  - "If any member of the ANSTF will issue a RFP for AIS research, then we recommend consideration of…" a project

Recommendation to ANSTF

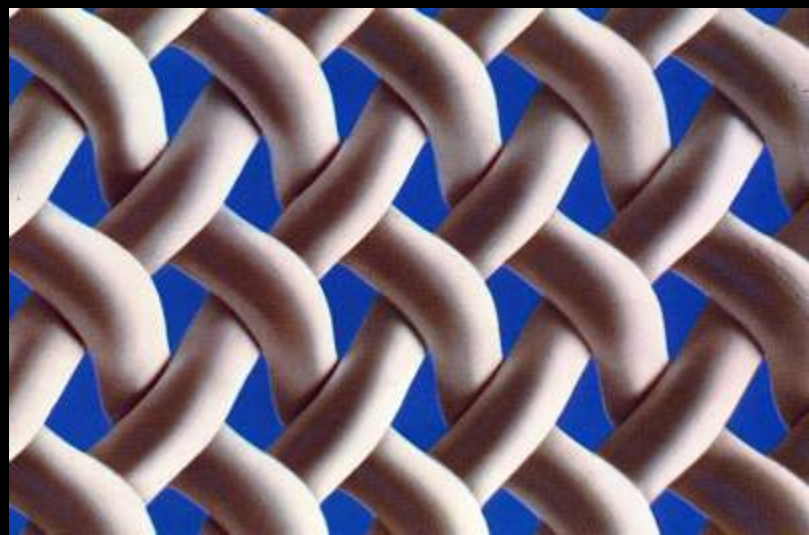
- To
  - (Recommended Objectives of Project Funded by RFP):
    - Scientifically evaluate existing Rapid Screening Processes
    - Report on strengths and weaknesses of each screening process

Recommendation to ANSTF

- Recommended Objectives of Project Funded by RFP:
  - Use results to recommend how to, or develop, gold standard screening process
    - Could be several of these
      - One for each of several ecosystems in US

Additional Tools Needed

- The Coarsest Screen:
  - History of Invasiveness
  - Climate-Habitat match
- Development of additional/more effective/more efficient TOOLS



Rapid Screening:
Use of Tools, and Results

History of Invasiveness
Using GRIS, GISD, Fishbase, Googlescholar
(Simple Example)

Database Output	History of Invasiveness
Not listed in GRIS, GISD; "Harmless" in Fishbase; no hits in Googlescholar	N
Listed in GRIS, GISD, and/or "Potential pest" in Fishbase; many hits in Googlescholar	Y

Simplest Screening Model
(For Discussion ONLY)

History of Invasiveness	Climate Match	Certainty	Action
Y	H	H	Regulate
Y	M	H	Regulate
Y	L	H	Restrict Use? (or Regulate?)
N (but history of >[10] introductions)	H	H	Allow (could restrict use)
N (but history of >[10] introductions)	M	H	Allow (could restrict use)
N (but history of >[10] introductions)	L	H	Allow

Invasive Animals Cooperative Research Centre

Risk assessment models for establishment of exotic vertebrates in Australia and New Zealand

Mary Bomford

Australian Government
Department of the Environment, Water, Heritage and the Arts

Australian Government
Bureau of Rural Sciences

Invasive Animals CRC

Australian Model

Discounted by Originator

Recommended by Originator

Australian Model 2:
Probability of Establishment

- P(estab.) = 1(1 + exp (3.2974 - 2.9611 * (prop.species) - 3.2948 * (prop.family) - s(climate 6) - family random effect

  - Using Data for fish introduced into 10 countries
    - Where…

Australian Model 2: Probability of Establishment

- Where:
  - Prop.species = No. countries establ./total no. countries where introduced
  - Prop.family = no. of success. introductions into all countries in the family/total no. of introductions to all countries of species in the family
  - Climate 6 = Sum of 5 scores (Categories 6-10) from CLIMATE
  - Family Random effect = Calculate for only families used in a pub.—analysis of species introduced into 10 countries

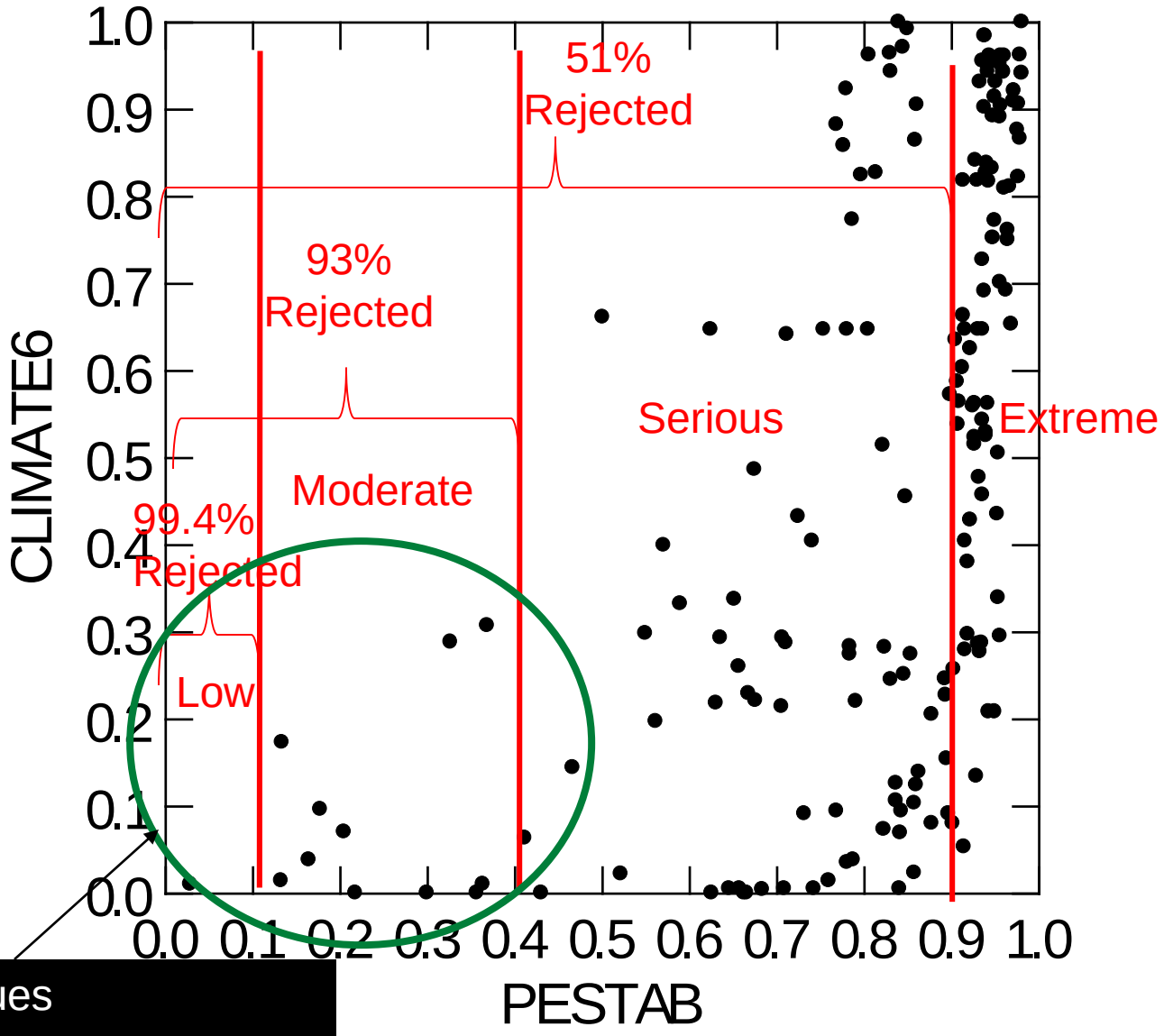
Australian Model 2:
Probability of Establishment

- Now, with excruciating detail I will calculate the result for round goby

- P(estab.) = 1(1 + exp (3.2974 - 2.9611 * (prop.species) - 3.2948 * (prop.family) - s(climate 6) - family random effect

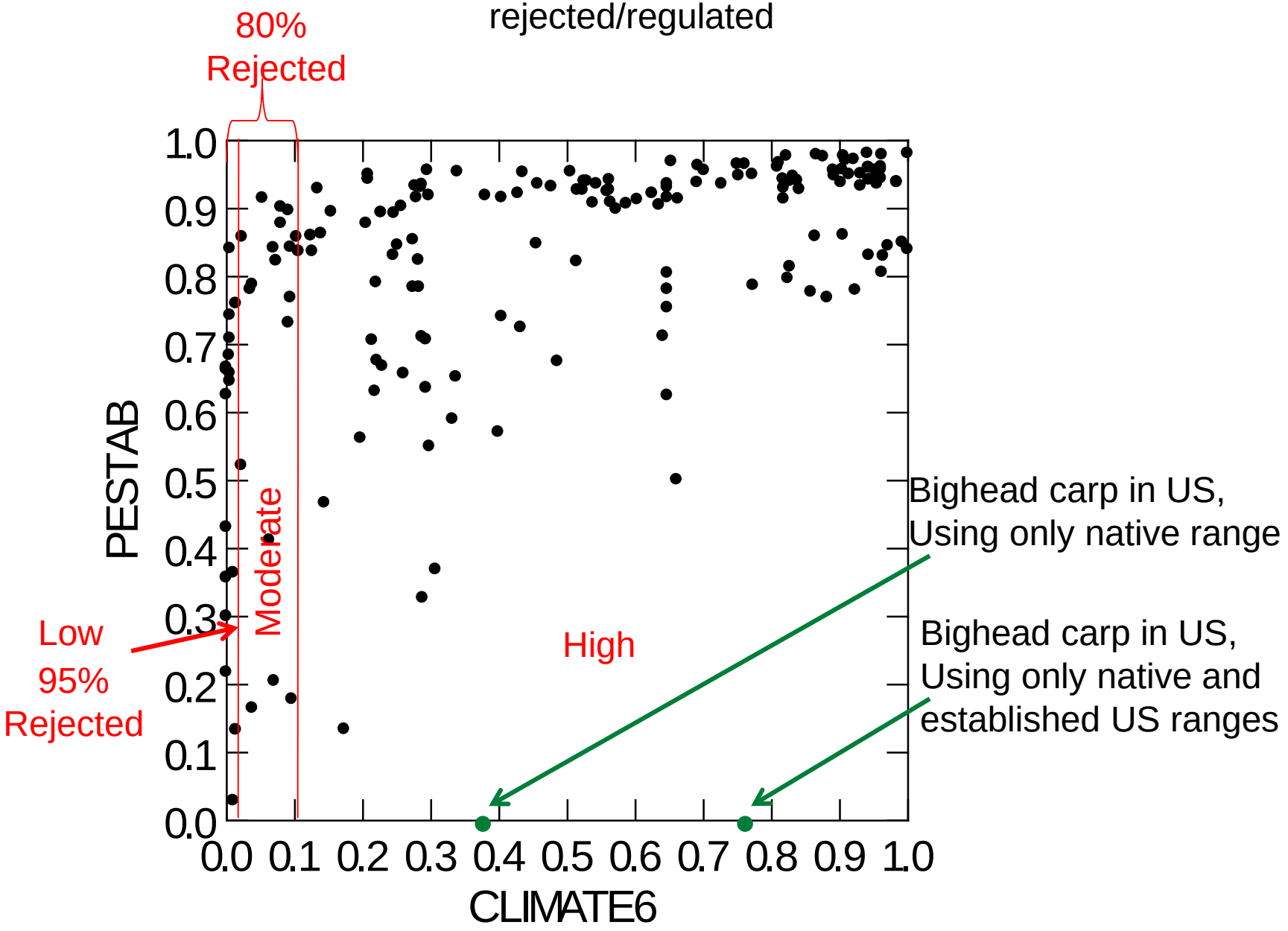
- Just kidding…

For actually established populations in 10 countries (n=256 populations),
Australian P(estab) and: 1) categories of establishment risk, and
2) % of species that would have been recommended for rejection (i.e., regulation)



Near 0 values
But all of these
Are established populations

For populations established in 10 countries (n=255 populations), Hoff's Climate 6 risk categories, and % of species that would be rejected/regulated

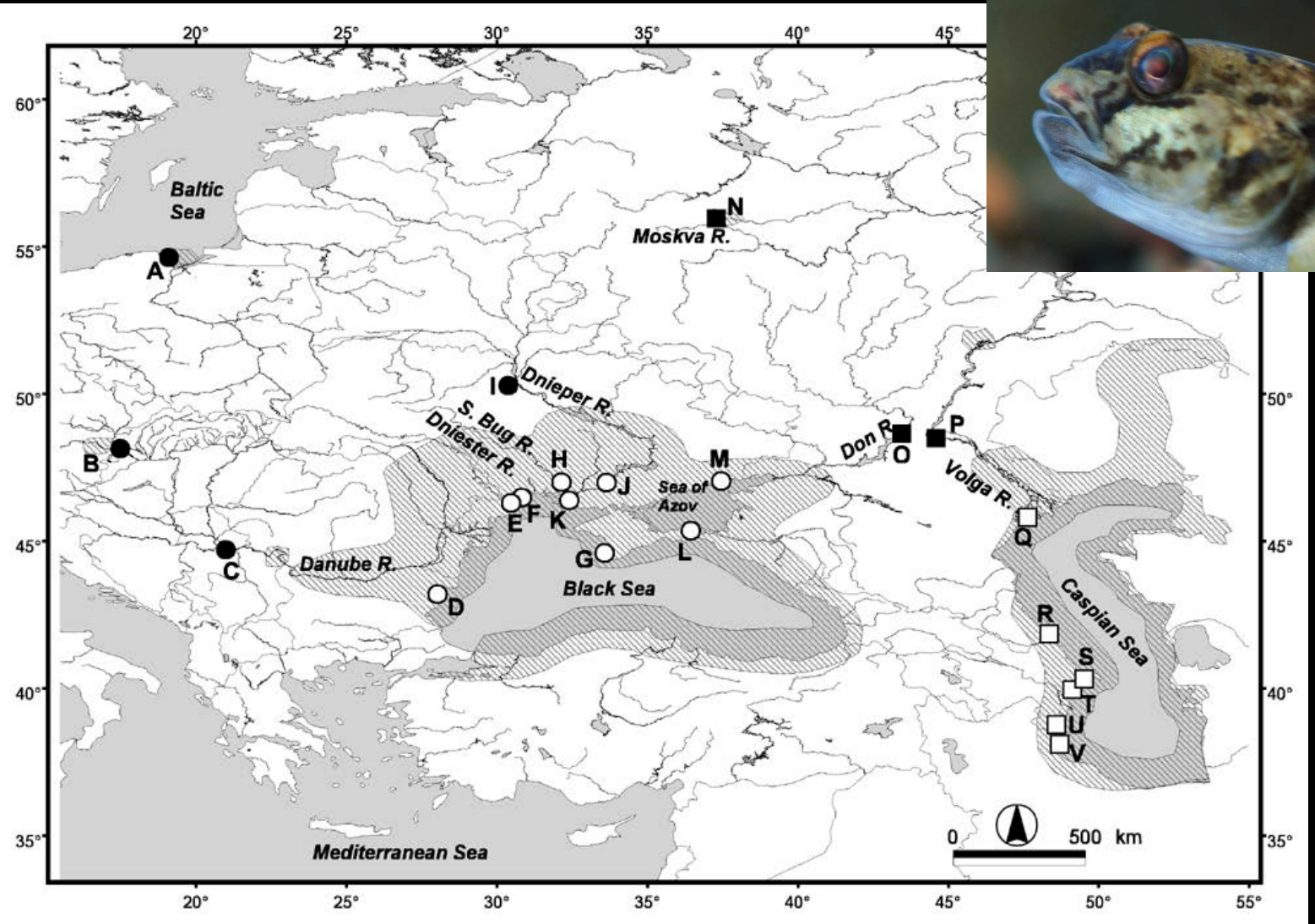


Climate 6 Scores with Hoff's Risk Categories, and Proportion of actually established populations (in 10 Countries, N=255 populations) that would have been rejected

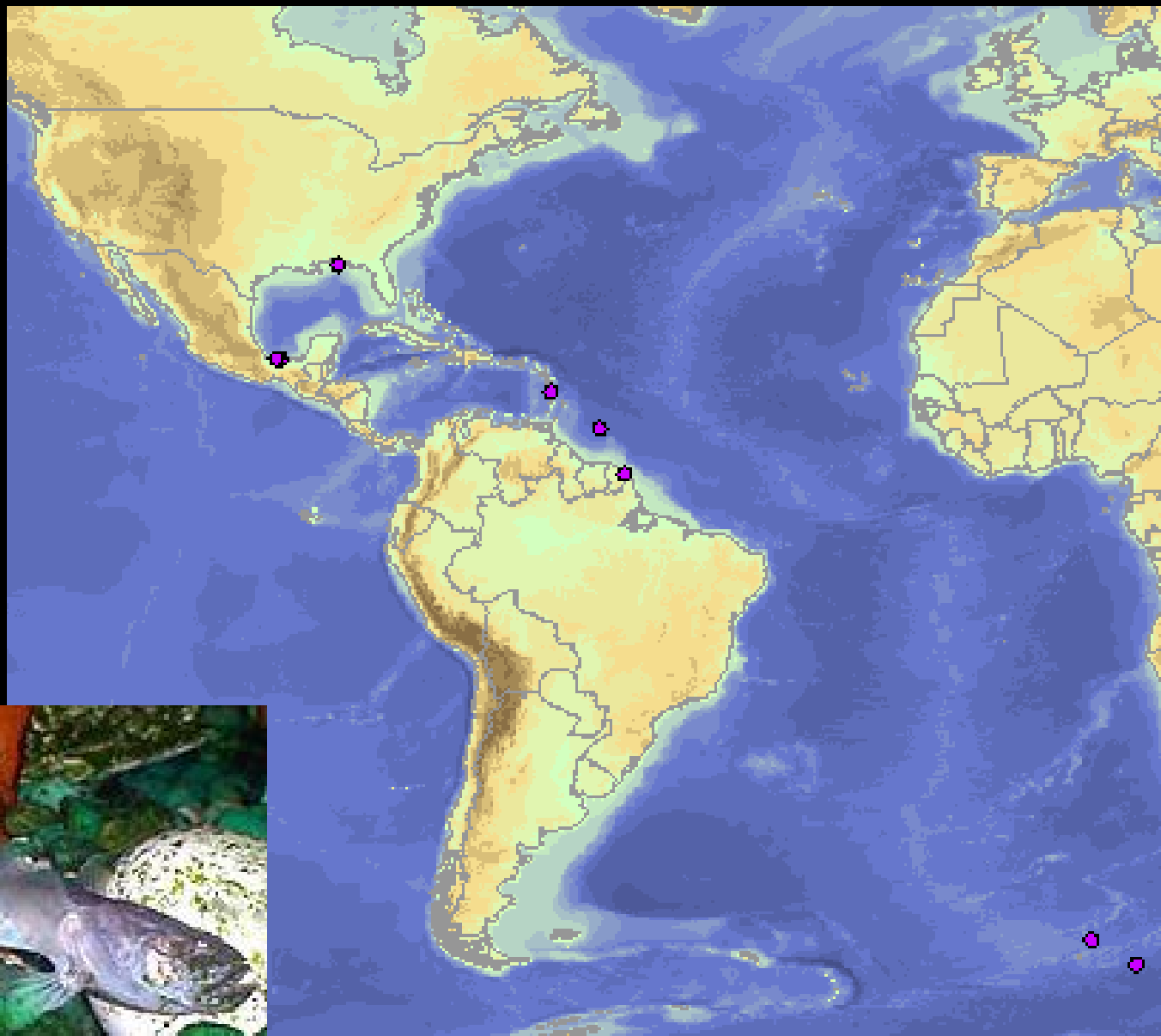
Proportion of CLIMATE Scores 6-10 to total Climate Scores	Hoff's Risk Category
0.0-0.005 (95% of established species rejected)	L
0.005>X≤0.103 (80% of established species rejected)	M
>0.103	H

Risk Screening Examples:
Round Goby and Violet Goby—should Montana care?

Round Goby Range: Eurasia



Violet Goby Range: Atlantic Ocean and Gulf



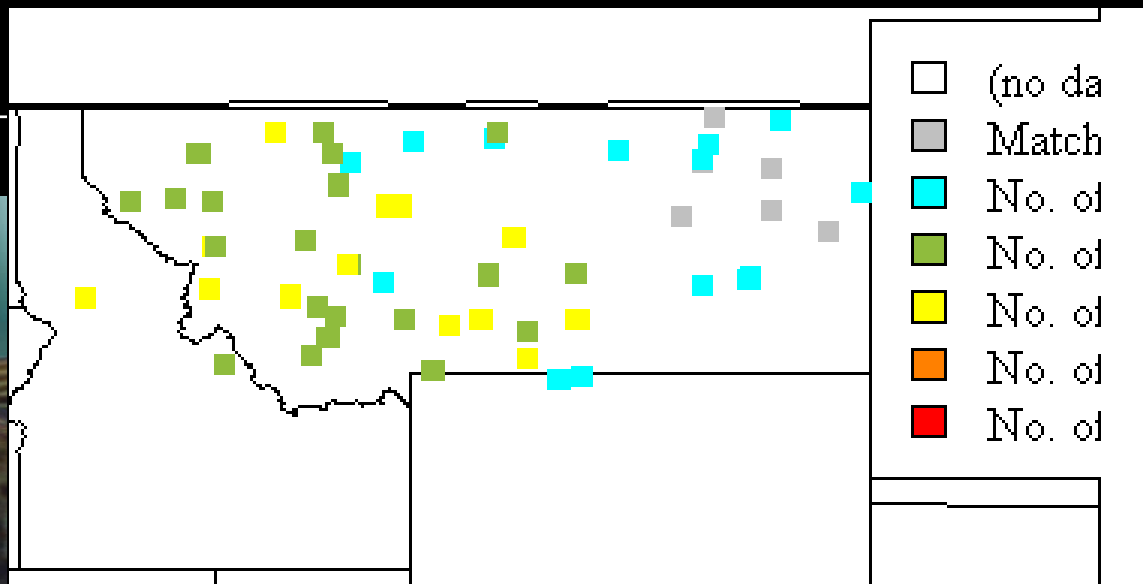
Violet Goby

Simplest Screening Model

History of Invasiveness	Climate 6 (Yours or Hoff's)	Certainty	Action
Y	H	H	Regulate
Y	M	H	Regulate
Y	L	H	Restrict Use? (or Regulate?)
N (but history of >[10] introductions)	H	H	Allow, but restrict use?
N (but history of >[10] introductions)	M	H	Allow but restrict use?
N	L	H	Allow

Risk Assessment: Round Goby in MT

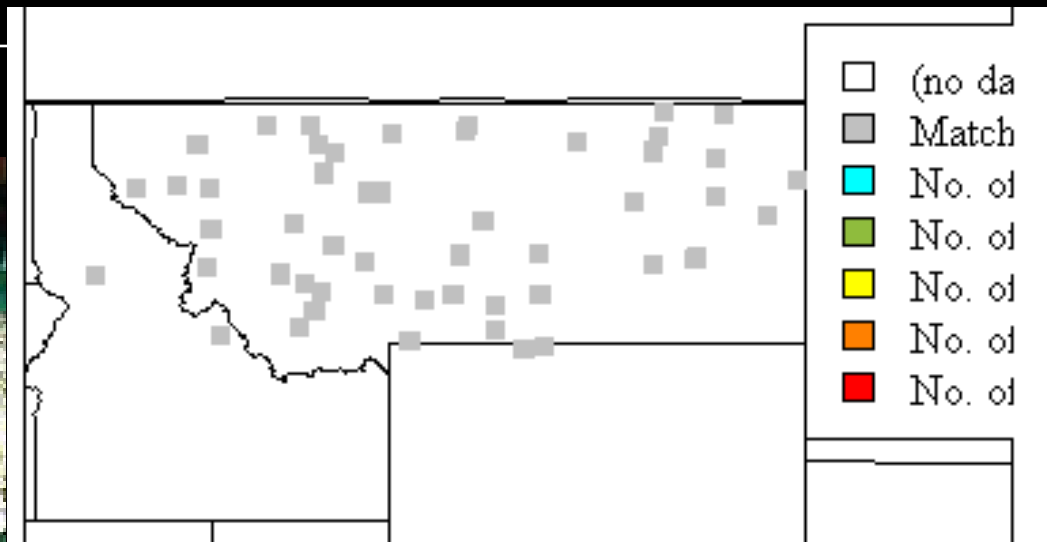
History of Invasiveness	CLIMATE Match	Certainty	Action
Y	H	H	Regulate
(Listed in GISD and as "potential pest" in Fishbase; 448 hits for 'invasive" in googlescholar)	(Climate 6 = 0.8)		



Risk Assessment: Violet Goby in MT

History of Invasiveness	CLIMATE Match	Certainty	Action
N	L	H	Allow
(Not listed in GISD, and as “harmless” in Fishbase; no hits for “invasive” in googlescholar)	(Climate 6=0; N=58)		

Gobioides broussonnetii



Demo: CLIMATE Software analysis of Climate Match in Source and Sink Locations

Needs to Implement MRBP Version of Rapid Screening (Coarsest Screen)

- Use CLIMATE, Fishbase, GISD, (Access to GRIS?), Googlescholar
- Development of YOUR categories for Climate 6 Risk
  - Using CLIMATE

Options for Next Steps

- Do Nothing
- I can come and train
  - You in your location
  - Or GSAP??
- You could use, adapt, or not use this screening approach
- Contact me, to discuss
  - Michael_Hoff@fws.gov

Screening:
A 50-foot, 38-ton gorilla
for invasive species prevention

Mississippi River Basin Panel's Risk Analysis Process

- Working Version of Document available at http://wwwaux.cerc.cr.usgs.gov/MICRA/MRBP/MRBP_Working_Version_Model_Risk_Assess._&_Management_Process_5-12-09.pdf
- Or google Mississippi River Basin Panel's website, and look for the link

Questions and Discussion