Evaluating Aquatic Invasive Species Risk for Hawai‘i- Which Tool is Best?

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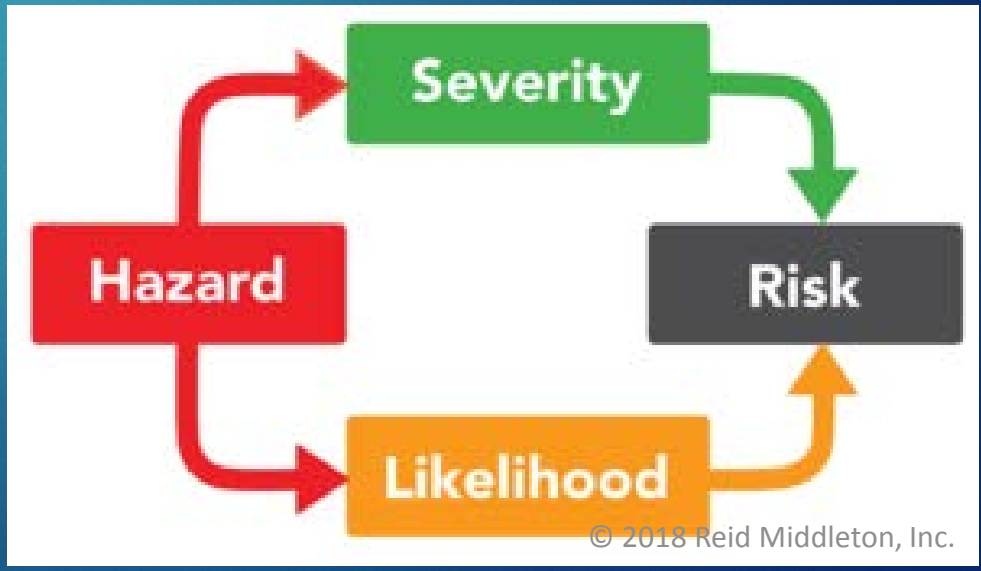
What is Risk?

- **Merriam-Webster:** Possibility of loss or injury



Risk Assessment

1) Hazard Identification

2) Hazard Assessment

3) Risk Management & Communication

4) Risk Review and Reporting

Uncertainty

(Copp *et al.* 2008)

Aquatic Invasive Species (AIS)

- A nonindigenous aquatic species that, if introduced into an ecosystem, may cause harm to Hawai‘i’s economy, environment, human health, or public safety and welfare. (HIBP 2016)

200+

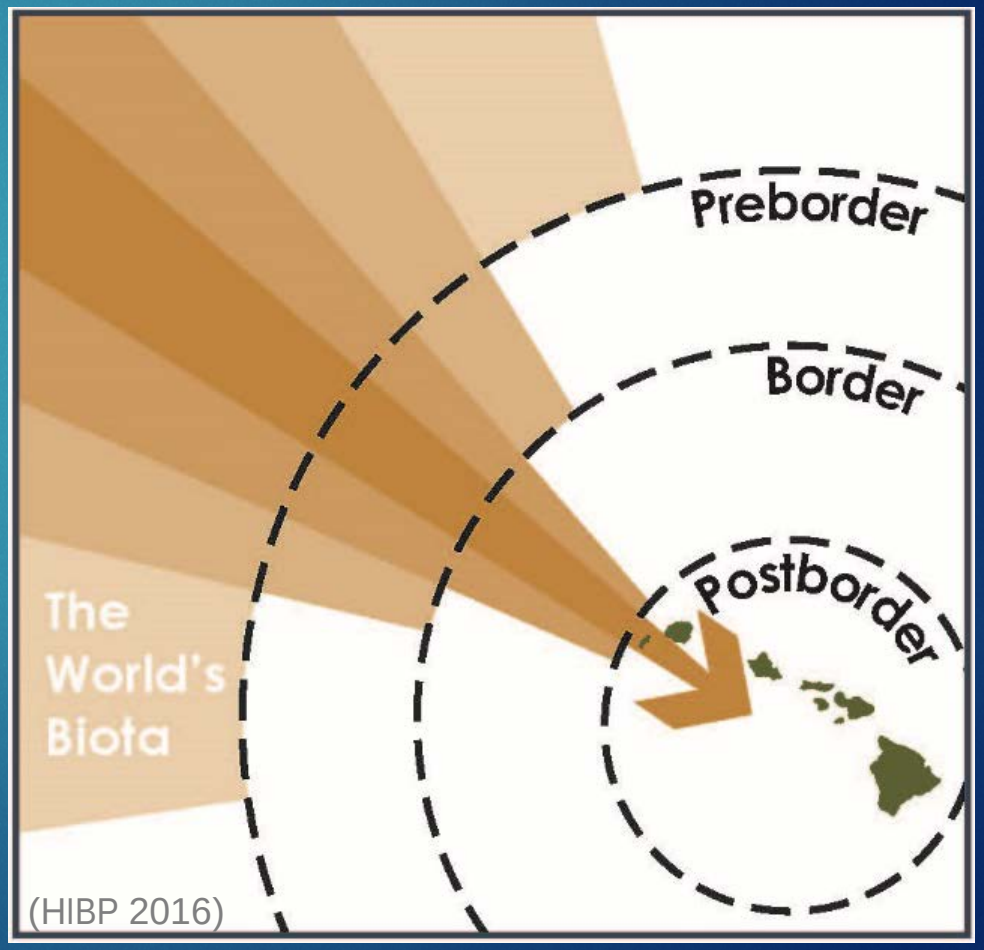
20 Marine
41 Freshwater

28

19

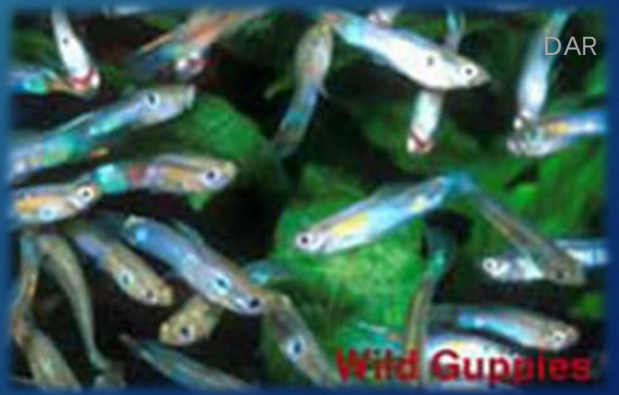
Biosecurity Management

- Biosecurity: measures taken to manage risk from invasive species
- Permits to Import- Hawai‘i Department of Agriculture
- Benefits vs. Risk
- List high-risk AIS

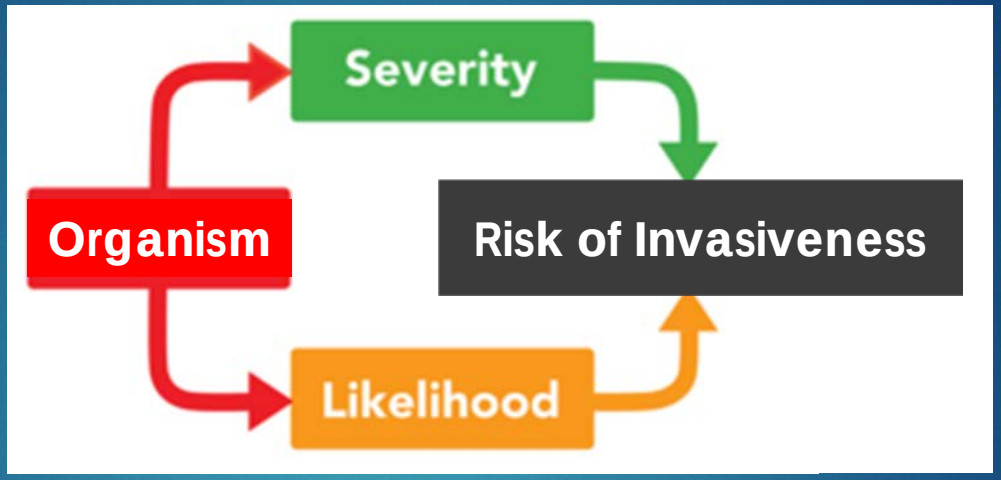


Risk Assessment Tools (RATs)

- Screening Level
- Systematic series of questions
- Semi-quantitative
- Repeatable
- Defensible
- Time efficient

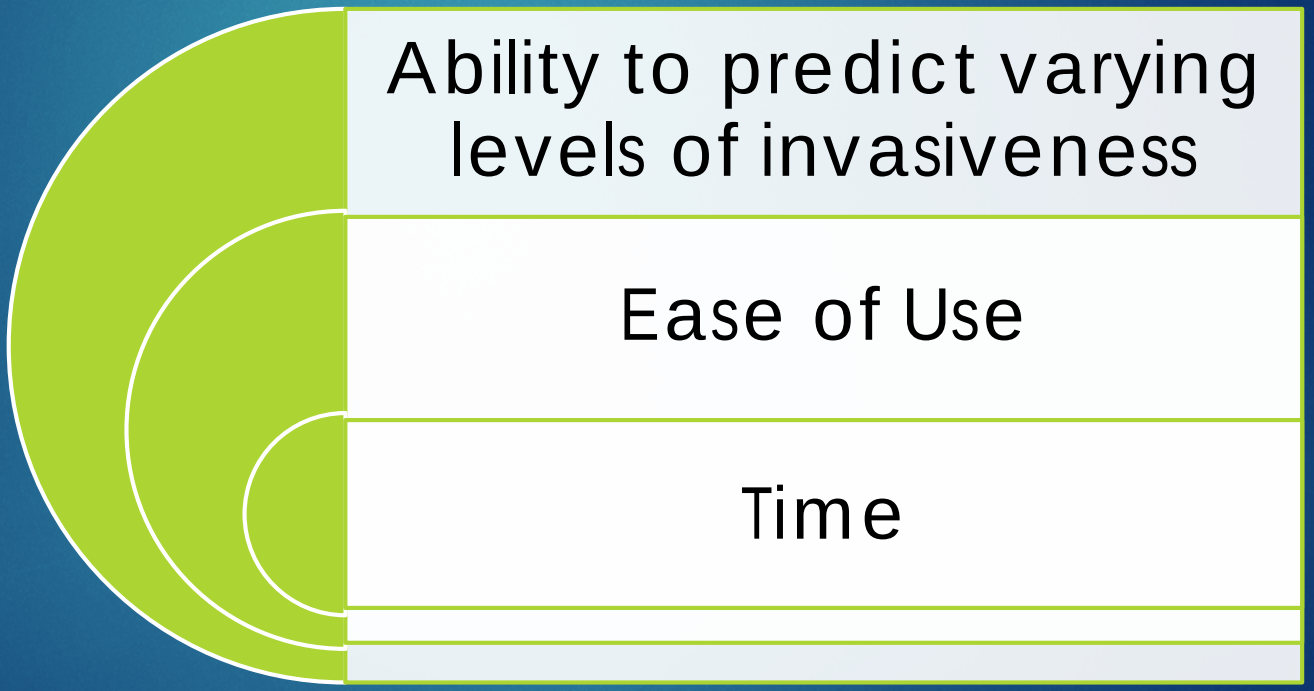


Methods

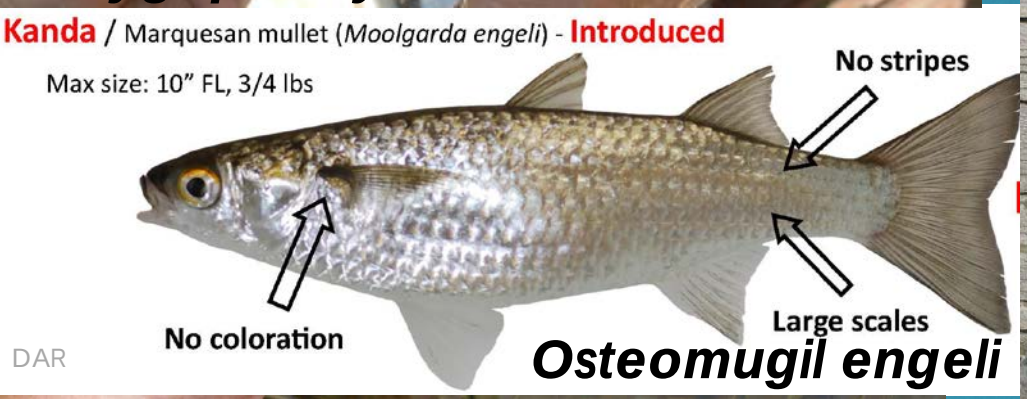


- Four Tools Tested
  - Hawaii Marine Invasive Species Risk Assessment (MIRA)
  - Canadian Marine Invasive Screening Tool (CMIST)
  - Freshwater Fish Risk Screening Kit (FISK) v2
  - Aquatic Species Invasiveness Screening Kit (AS-ISK)

Which Tool is Best?: Evaluation Criteria



Species Tested



Hawaii Marine Invasive Species Risk Assessment Tool (MIRA)

Hawai'i Marine Invasive Species Risk Assessment (MIRA) Tool

Date: January 16, 2018 DLNR:DAR Hawaii

For the marine species: **Long-fin Armored Catfish (Pterygoplicthys multiradiatus)**

The Overall Hawai'i MIRA Score is (Note: this score is comparative only and is independent of the matrix below): **309** ***HIGH***

The Modified Tiered Risk Assessment Score is Highlighted Below:

Probability of Species in Question Establishment

Severity of Negative Impact	A	B	C	D
I	X			
II				
III				
IV				

Criteria:		Suggested Action:
X	Tier 1 = Critical – Very High Risk	No import allowed; full vector & Species control; no live trade.
	Tier 2 = Serious – High Risk	No import allowed; vector & Species control. Strongly regulated live trade.
	Tier 3 = Moderate Risk	Limited imports with strong conditions; limited vector and Species control. Regulated live trade.
	Tier 4 = Minor Risk	Conditional import; vector & species monitoring. Regulated live trade.
	Tier 5 = Negligible Risk	No limits.

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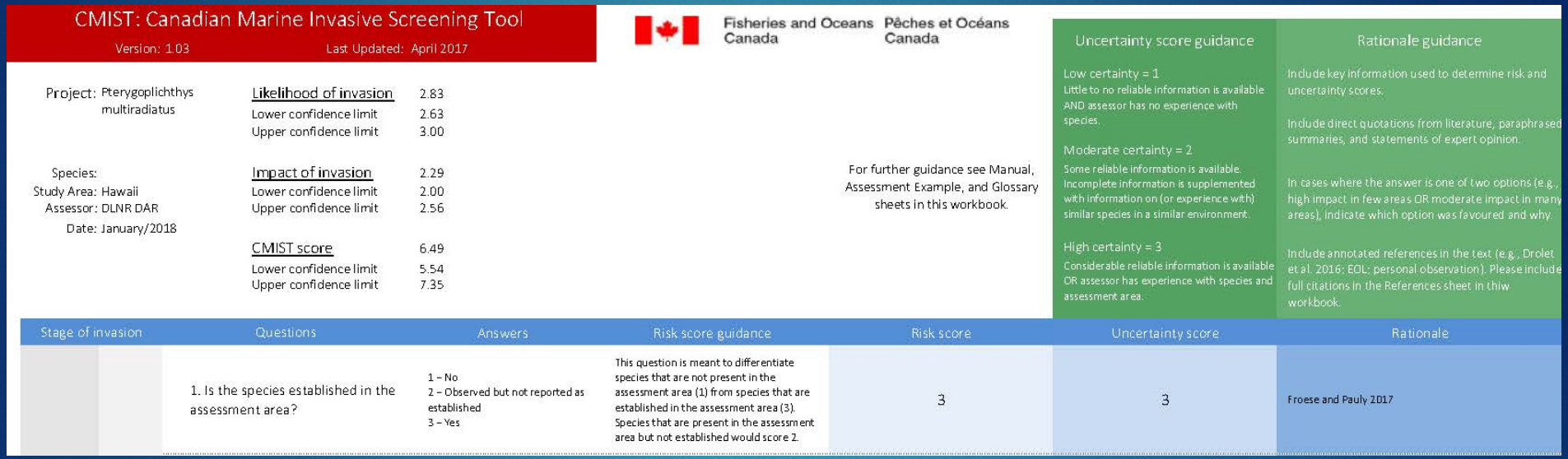
Canadian Marine Invasive Screening Tool (CMIST)



CMIST: Canadian Marine Invasive Screening Tool

Version: 1.03 Last Updated: April 2017

Fisheries and Oceans Canada / Pêches et Océans Canada

Project: Pterygoplichthys multiradiatus

Species:
Study Area: Hawaii
Assessor: DLNR DAR
Date: January/2018

Likelihood of invasion	2.83
Lower confidence limit	2.63
Upper confidence limit	3.00
Impact of invasion	2.29
Lower confidence limit	2.00
Upper confidence limit	2.56
CMIST score	6.49
Lower confidence limit	5.54
Upper confidence limit	7.35

For further guidance see Manual, Assessment Example, and Glossary sheets in this workbook.

Uncertainty score guidance

Low certainty = 1
Little to no reliable information is available AND assessor has no experience with species.

Moderate certainty = 2
Some reliable information is available. Incomplete information is supplemented with information on (or experience with) similar species in a similar environment.

High certainty = 3
Considerable reliable information is available OR assessor has experience with species and assessment area.

Rationale guidance

Include key information used to determine risk and uncertainty scores.

Include direct quotations from literature, paraphrased summaries, and statements of expert opinion.

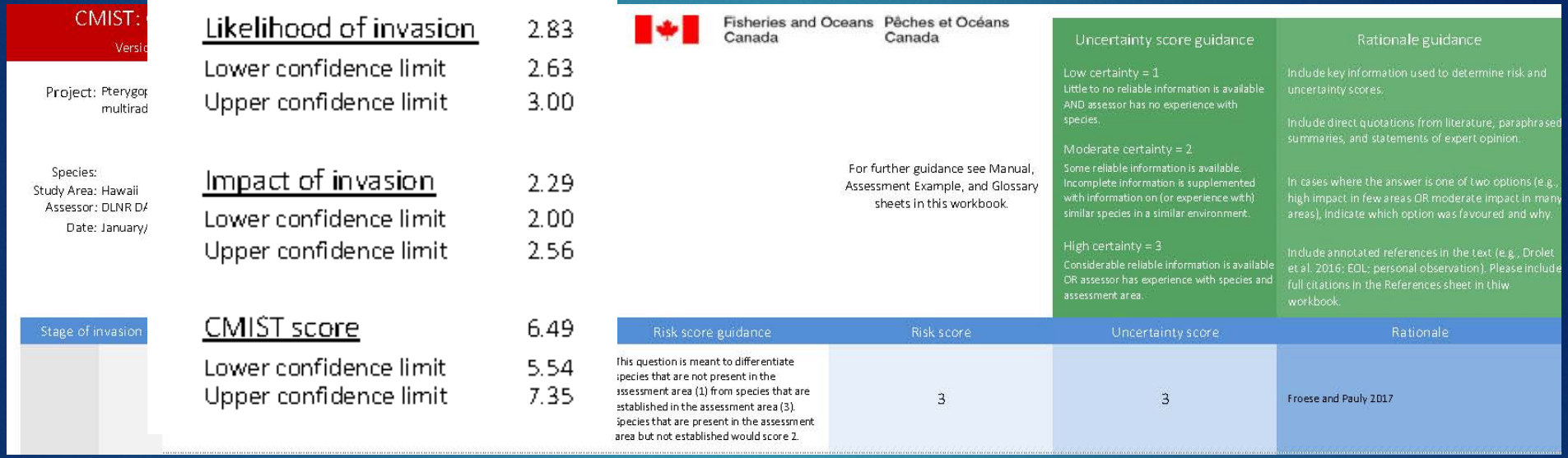
In cases where the answer is one of two options (e.g., high impact in few areas OR moderate impact in many areas), indicate which option was favoured and why.

Include annotated references in the text (e.g., Drolet et al. 2016; EOL; personal observation). Please include full citations in the References sheet in this workbook.

Stage of invasion	Questions	Answers	Risk score guidance	Risk score	Uncertainty score	Rationale
	1. Is the species established in the assessment area?	1 – No 2 – Observed but not reported as established 3 – Yes	This question is meant to differentiate species that are not present in the assessment area (1) from species that are established in the assessment area (3). Species that are present in the assessment area but not established would score 2.	3	3	Froese and Pauly 2017

- Designed and tested for Marine Invertebrates, but suitable for other organisms

Canadian Marine Invasive Screening Tool (CMIST)



CMIST:
Versi
Project: Pterygop
multirad
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- Designed and tested for Marine Invertebrates, but suitable for other organisms

Fish Invasiveness Scoring Kit (FISK) & Aquatic Species Invasiveness Screening Kit (AS-ISK)

Taxon and Assessor details	
Category	Fish (freshwater)
Taxon name	*Eleotris sandwicensis*
Common name	oopu akupa
Assessor	DLNR DAR

Statistics	
Scores	
BRA Score	**15.0**
BRA Outcome	**-**
BRA+CCA Score	**9.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**2.0**
1. Domestication/Cultivation	*0.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*0.0*
B. Biology/Ecology	**13.0**
4. Undesirable (or persistence) traits	*3.0*
5. Resource exploitation	*5.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*3.0*
C. Climate change	**-6.0**
9. Climate change	*-6.0*
Answered	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**4**
Environmental	**6**
Species or population nuisance traits	**3**
Date and time	
Date and Time	**17/05/2018 13:22:54**
Thresholds	
Medium	**-**
High	**-**
Confidence	**0.67**

Fish Invasiveness (FISK) & Aquatic Species Invasiveness Screening Kit (AS-ISK)

Statistics	
Scores	
BRA Score	15.0
BRA Outcome	-
BRA +CCA Score	9.0
BRA +CCA Outcome	-

Statistics	
Scores	
BRA Score	15.0
BRA Outcome	-
BRA+CCA Score	9.0
BRA+CCA Outcome	-
Score partition	
A. Biogeography/Historical	2.0
1. Domestication/Cultivation	*0.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*0.0*
B. Biology/Ecology	13.0
4. Undesirable (or persistence) traits	*3.0*
5. Resource exploitation	*5.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*3.0*
C. Climate change	-6.0
9. Climate change	*-6.0*
Answered	
Total	***55***
A. Biogeography/Historical	13
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	36
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	6
9. Climate change	*6*
Sectors affected	
Commercial	4
Environmental	6
Species or population nuisance traits	3
Date and time	
Date and Time	17/05/2018 13:22:54
Thresholds	
Medium	-
High	-

Confidence	0.67

Results- MIRA

Species	Invasive History	Invasive in Hawaii	MIRA Score (350 max)	Tier
Long-Fin Armored Catfish (Pterygoplicthys multiradius)	Yes	Yes	309 (High)	1- very high risk
Rainbow Trout (Oncorhynchus mykiss)	Yes	No	257 (High)	1- very high risk
Nile Tilapia (Oreochromis niloticus)	Yes	No*	311 (High)	1- very high risk
Kanda (Osteomugil engeli)	No	Yes	151 (Medium)	1- very high risk
Ayu (Plecoglossus altivelis)	No	No	158 (Medium)	1- very high risk
O'opu Akupa (Eleotris sandwicensis)	No	No	101 (Medium)	4- minor risk

Results- CMIST

Species	Invasive History	Invasive in Hawaii	CMIST Score (1 to 9)
Long-Fin Armored Catfish (Pterygoplicthys multiradius)	Yes	Yes	6.5
Rainbow Trout (Oncorhynchus mykiss)	Yes	No	3.5
Nile Tilapia (Oreochromis niloticus)	Yes	No*	4.88
Kanda (Osteomugil engeli)	No	Yes	4.34
Ayu (Plecoglossus altivelis)	No	No	2.9
O'opu Akupa (Eleotris sandwicensis)	No	No	3

Results- FISK

Species	Invasive History	Invasive in Hawaii	FISK Score (-15 to 57)
Long-Fin Armored Catfish (Pterygoplicthys multiradius)	Yes	Yes	36
Rainbow Trout (Oncorhynchus mykiss)	Yes	No	11
Nile Tilapia (Oreochromis niloticus)	Yes	No*	36
Kanda (Osteomugil engeli)	No	Yes	11
Ayu (Plecoglossus altivelis)	No	No	10
O'opu Akupa (Eleotris sandwicensis)	No	No	8

Results- AS-ISK

Species	Invasive History	Invasive in Hawaii	ASISK Basic Score (-20 to 68)	ASISK Climate Change Score (-32 to 80)
Long-Fin Armored Catfish (Pterygoplicthys multiradius)	Yes	Yes	44	46
Rainbow Trout (Oncorhynchus mykiss)	Yes	No	28.5	20.5
Nile Tilapia (Oreochromis niloticus)	Yes	No*	43	47
Kanda (Osteomugil engeli)	No	Yes	20	24
Ayu (Plecoglossus altivelis)	No	No	14	10
O'opu Akupa (Eleotris sandwicensis)	No	No	15	9

Which Tool is Best?

Screening Level RATs

- **MIRA**
  - Ease of questions
  - Ability to input Native
  - 3-5 hrs
- **CMIST**
  - Potential for invasiveness detection
  - 2-5 hrs
- **FISK**
  - Question guidance
  - 1 point difference
  - 2 hrs*
- **ASISK**
  - Climate change
  - Larger gap for threshold
  - 2-7 hrs

Main Findings

- Effort and Time- comparable
- CMIST- scoring best detected varying levels of invasiveness (i.e. Kanda and Trout)
- Eliminate FISK
- Further Assessment
  - Climate matching, Pathway and Facility Assessment
- Management suggestions to HDOA
- Need to be Validated for Hawai‘i- peer reviewed and published
- Larger and more taxonomically diverse sample size

Questions?

Acknowledgements

State of Hawaii, DLNR, DAR, AIS Team, Brian Neilson, Justin Goggins, Kendall Tucker, Daniel Lager, Kimberly Peyton, Eva Schemmel, Glenn Higashi, Annette Tagawa, Scott Godwin, David Gulko, Rachael Wade