The invasion risk of invertebrate species associated with Japanese Tsunami Marine Debris in North America and Hawaii

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PICES

Why be Concerned?

- Non-native species can result in the loss of native biodiversity

- They also pose significant socio-economic risks, including significant risks to sustainable fisheries and aquaculture and human health

- Impacts may be exacerbated by climate change

- Globally, introductions continue

- But we need to understand the risks …

Why risk assessments?

- Different species pose different risks to new ecosystems

- Screening Level Risk Assessment Tools can be applied quickly with available data (which may be limited)

- Score-based tools can prioritize species based on rank scores

- Prioritized species lists for monitoring

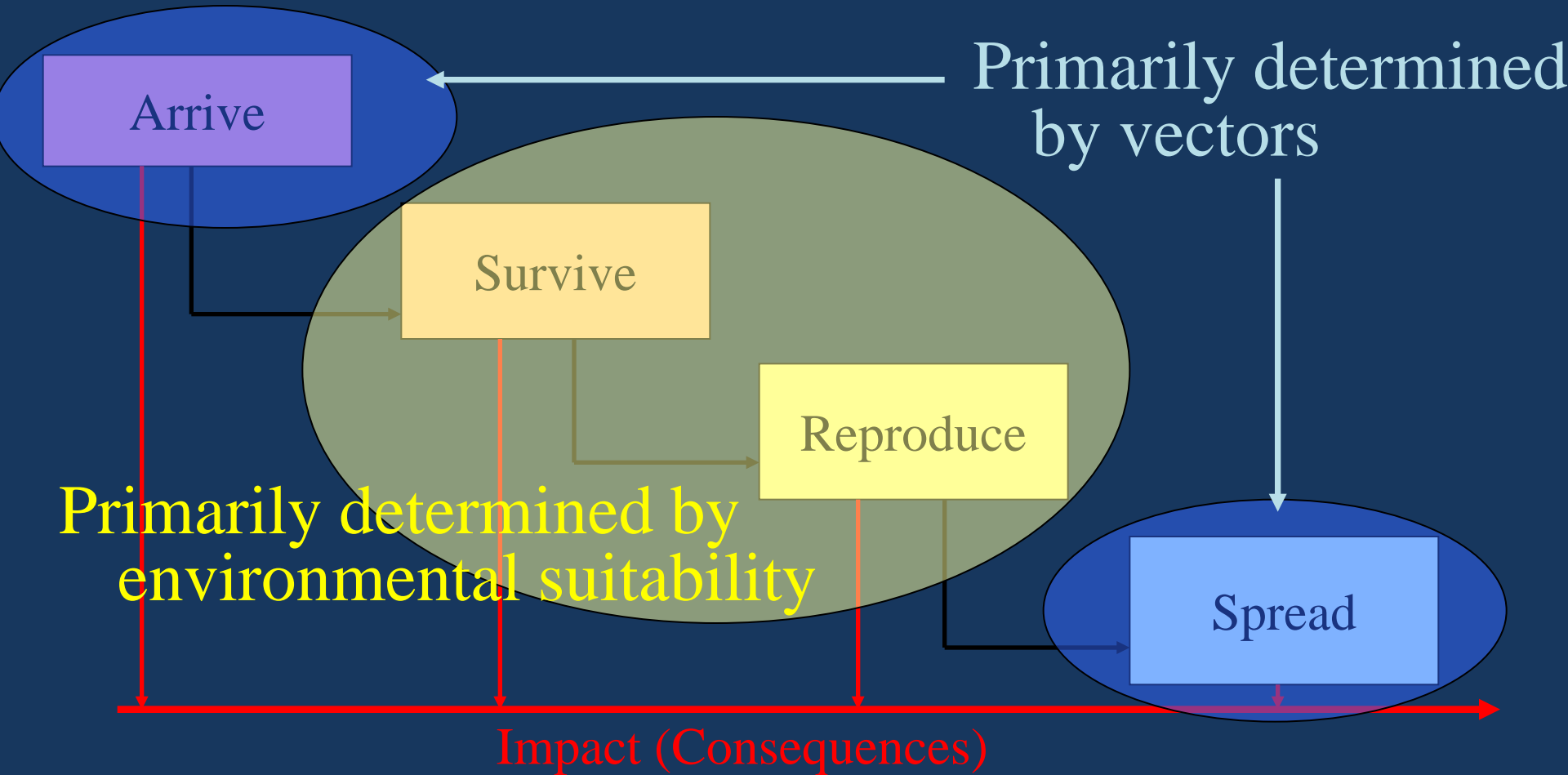- Public species watch lists per ecoregion

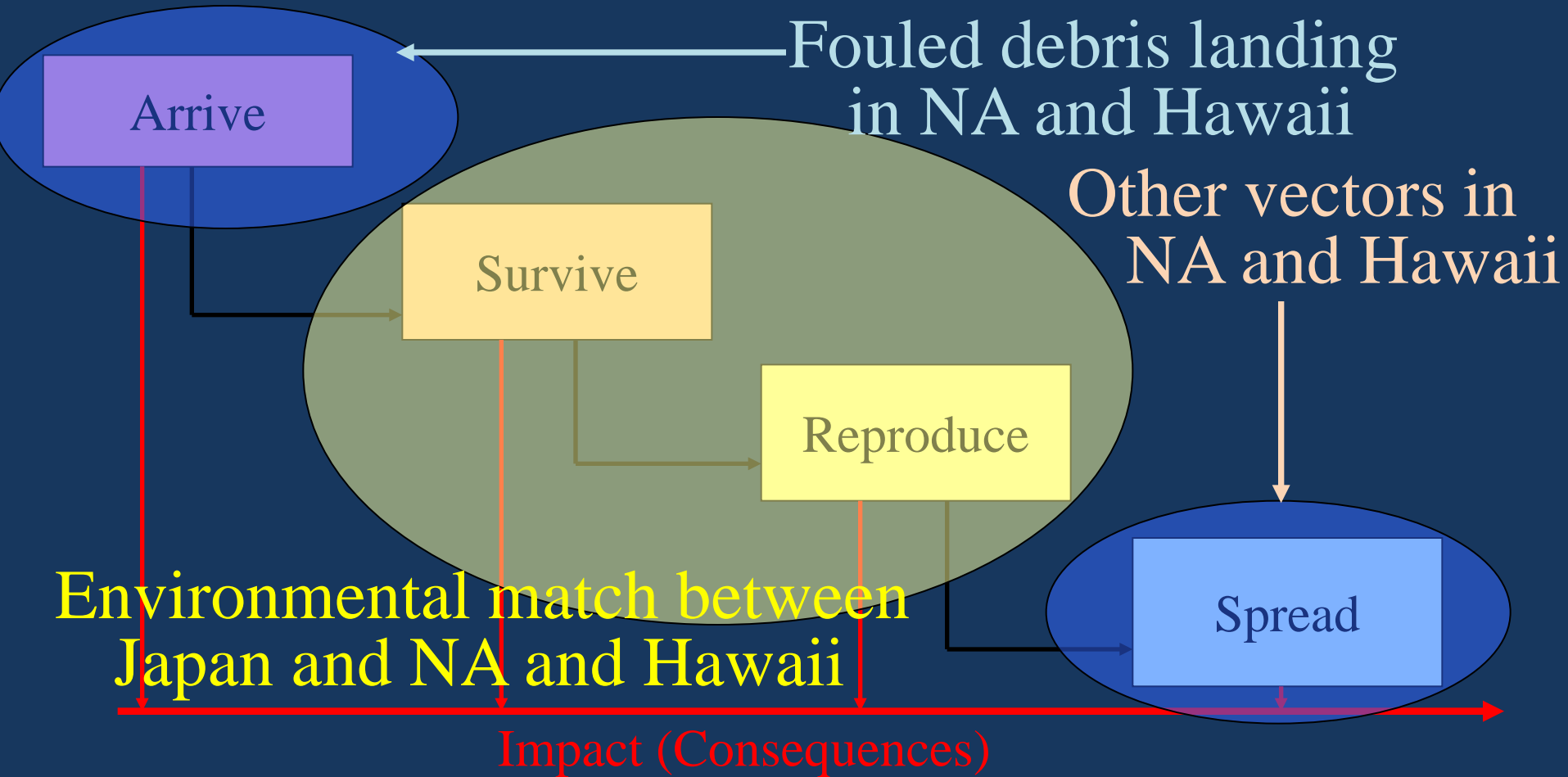Photo: US Navy

The General Invasion Process

Risk = Probability X
Impact (Consequence)

Arrive

Survive

Reproduce

Spread

Impact (Consequences)
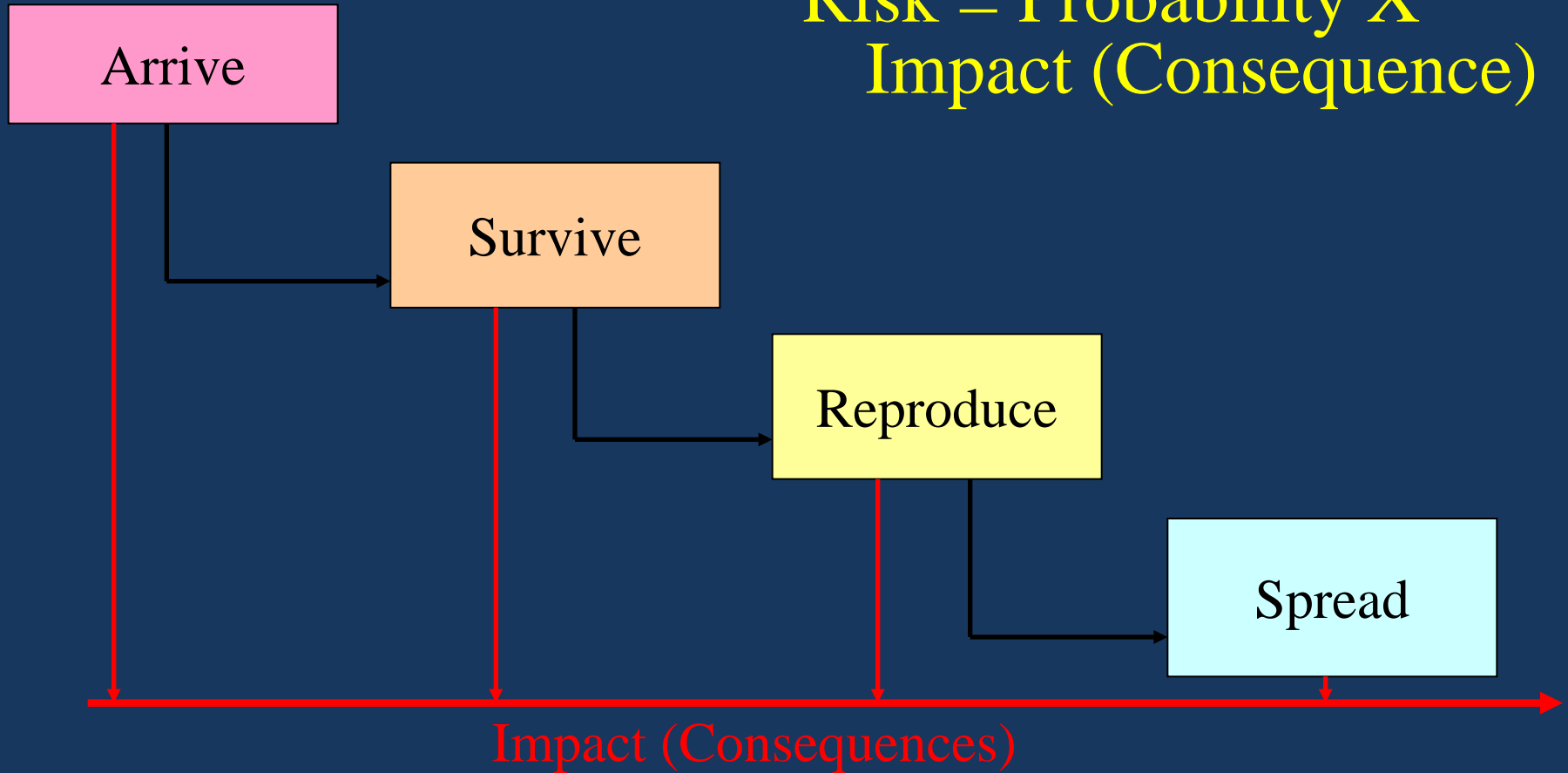
The General Invasion Process

So for Japanese Tsunami Debris

# Canadian Marine Invasive Screening Tool (CMIST)

- Screening tool that evaluates risk based on invasion likelihood and impacts

- 17 Questions scored from low (1) to high risk (3):
  - Present status in the area
  - Rate of introduction
  - Survival
  - Establishment
  - Spread
  - Impact

- Captures assessor uncertainty

- We applied to 132 invertebrates on debris
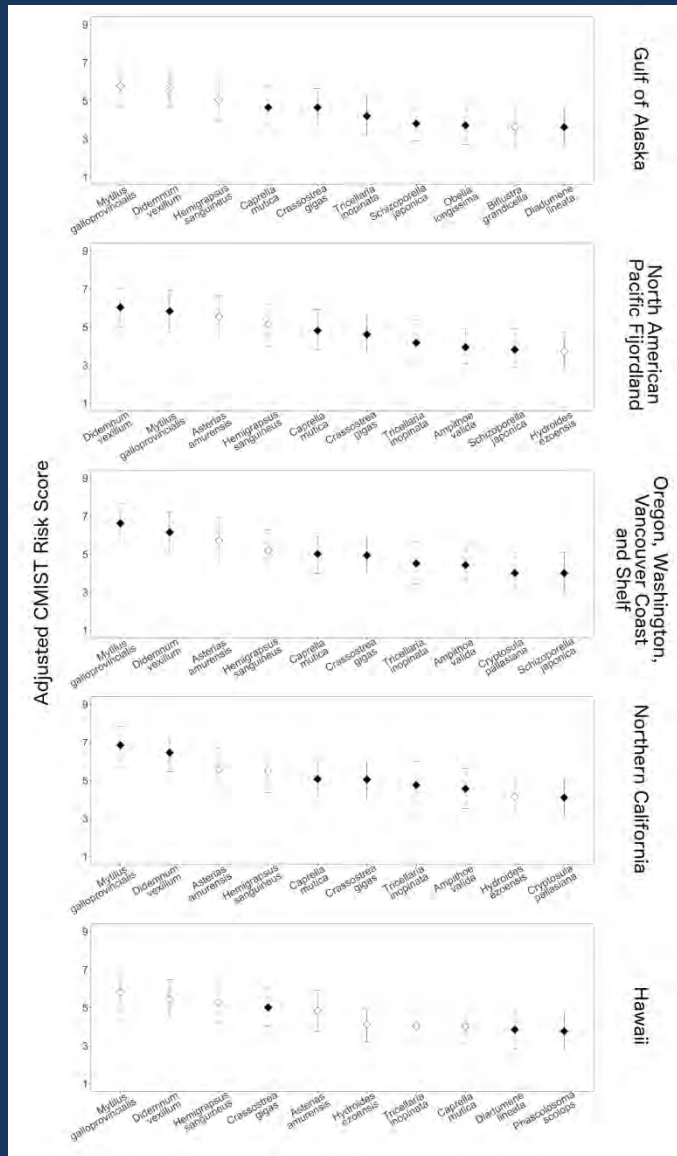
Spatial Scale for Assessments
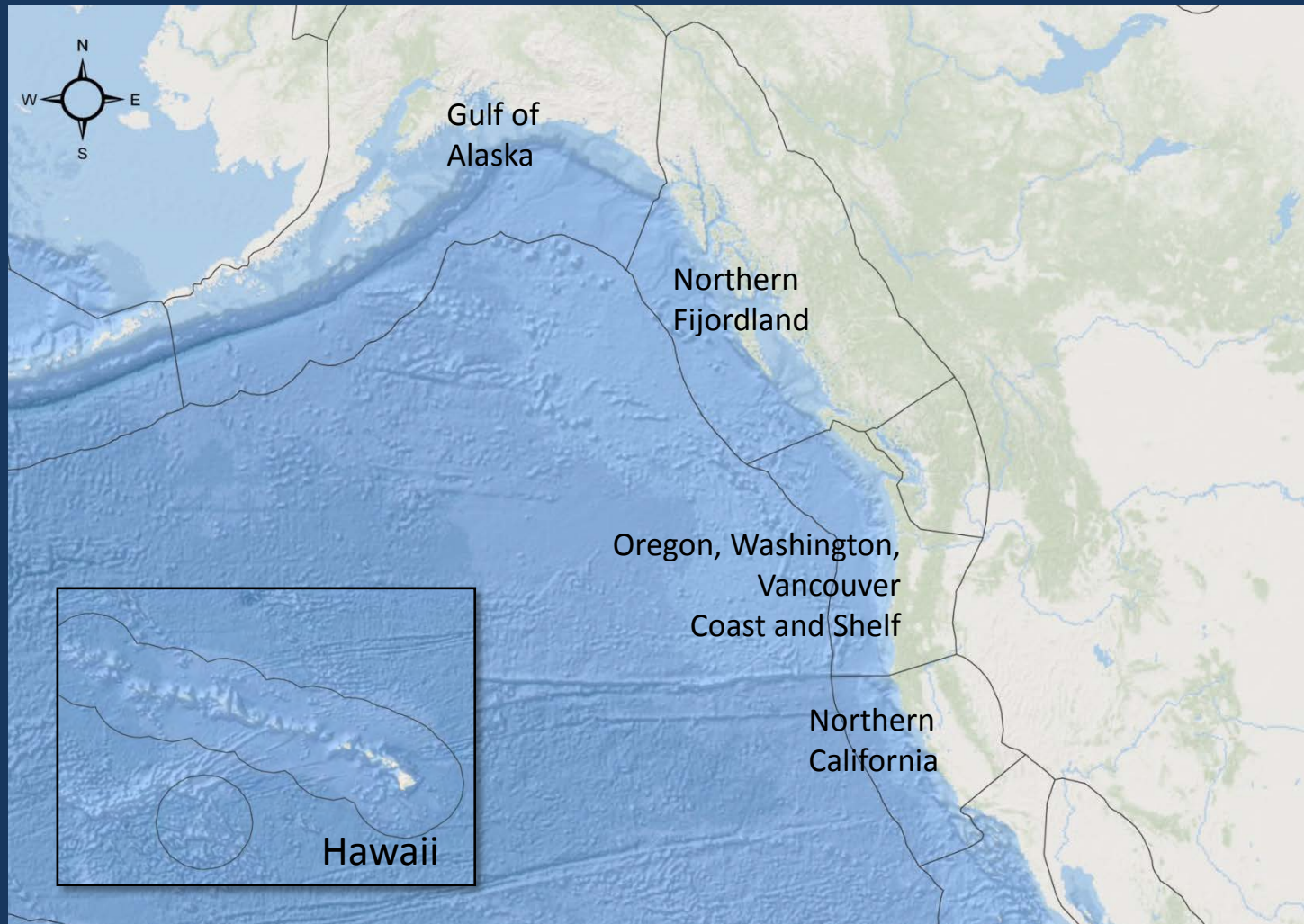
CMIST Results – All Species and Regions
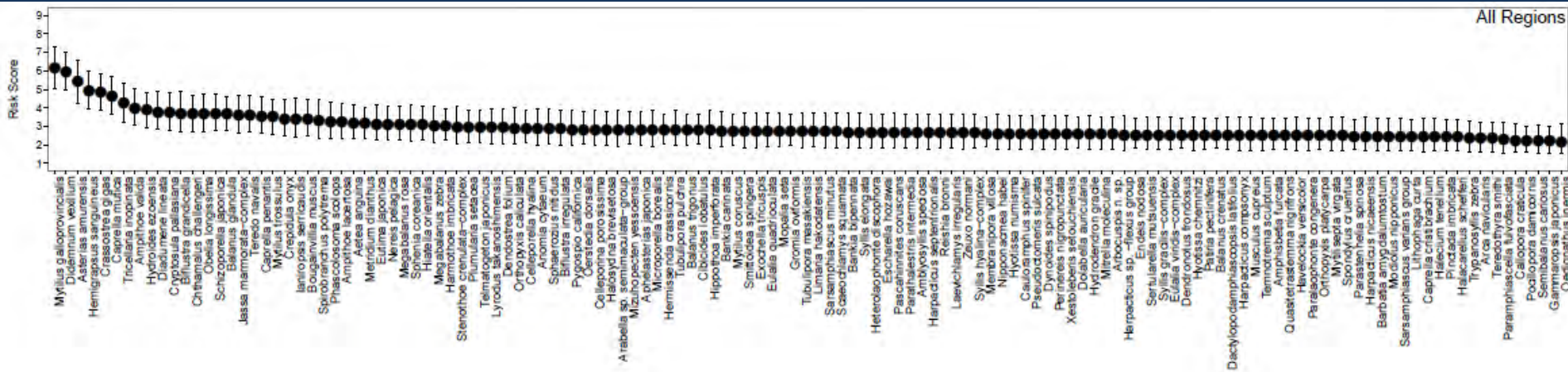
Higher Risk

Lower Risk

CMIST Results – Top "10" by Region

- Some species already present in several ecoregions (filled circles)

- Hawaii has seen very few of these species before

- Highest risk species change slightly among ecoregions
  - different environmental conditions
  - different invasion vectors

CMIST Results – All Species by Region
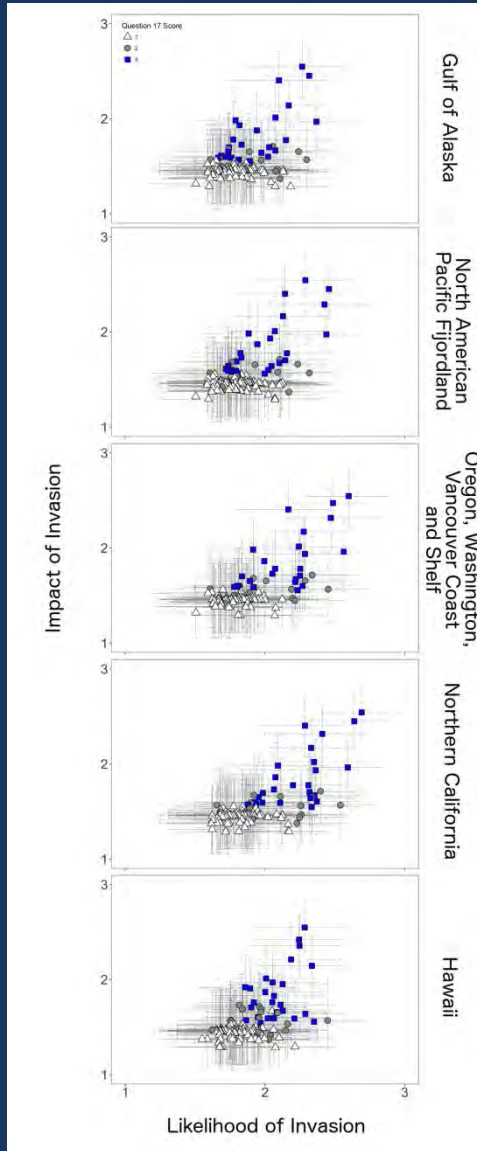
- Decomposing risk into its two main elements allows visualization of higher risk species

- Higher risk species are in the upper right of these panels

Ten highest risk species

Photos from iucngisd.org, cabi.org, invasions.si.edu, marlin.ac.uk, and Kishikawa (2011)
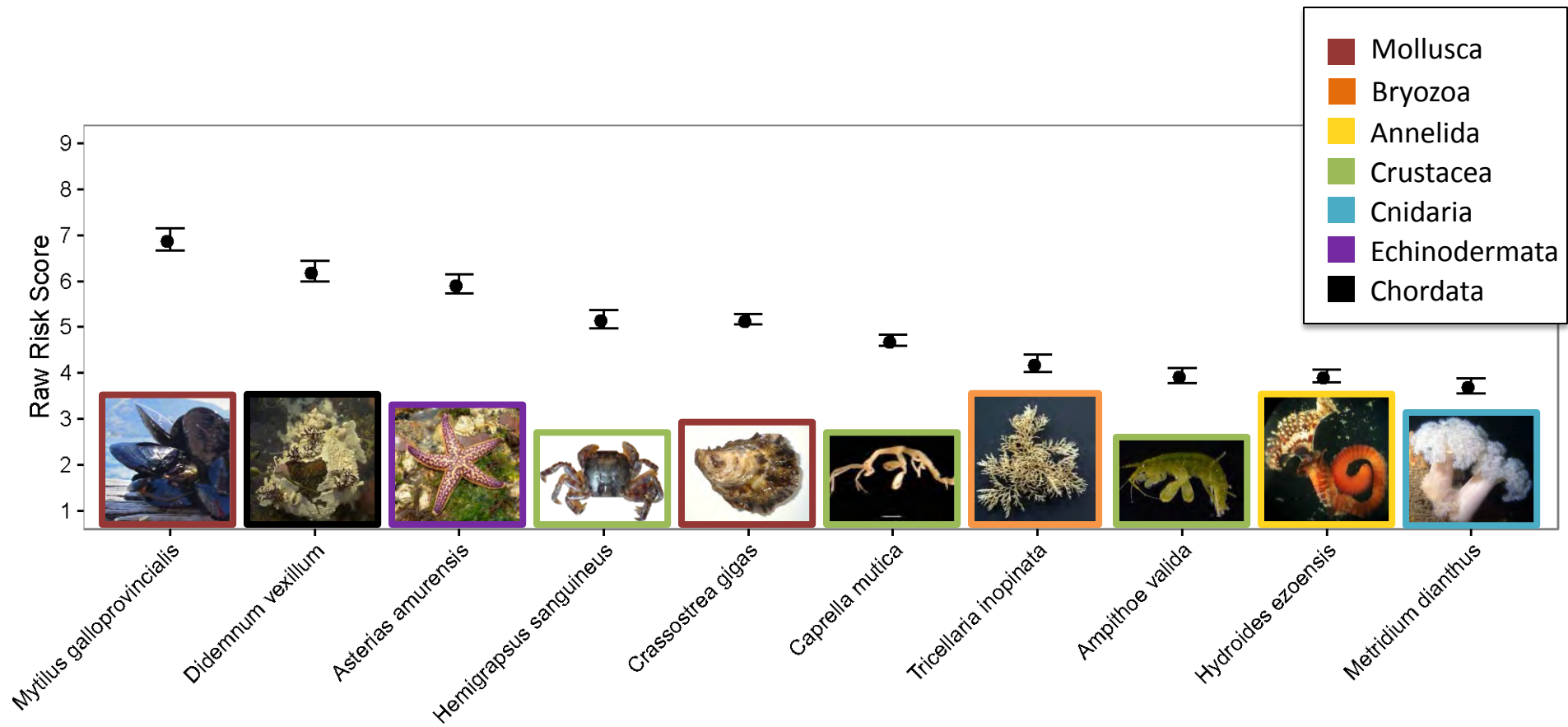
Many of these are already present

Photos from iucngisd.org, cabi.org, invasions.si.edu, marlin.ac.uk, and Kishikawa (2011)
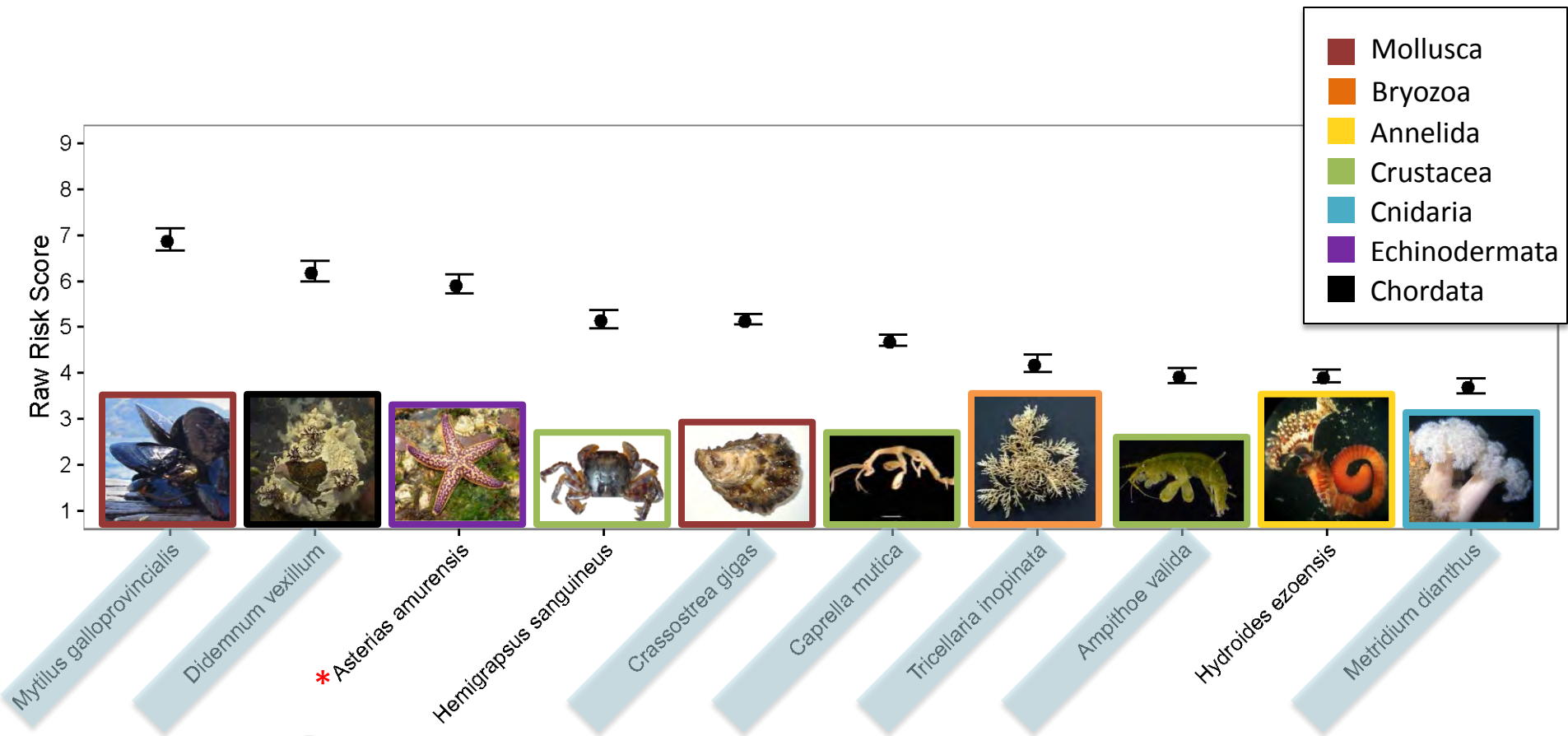
But all have a history of invasion

Photos from iucngisd.org, cabi.org, invasions.si.edu, marlin.ac.uk, Tilbrook (2012), and Kishikawa (2011)

Ten highest risk species

Mollusca

CMIST Risk Score

Photo by Jody Shields, via cabi.org
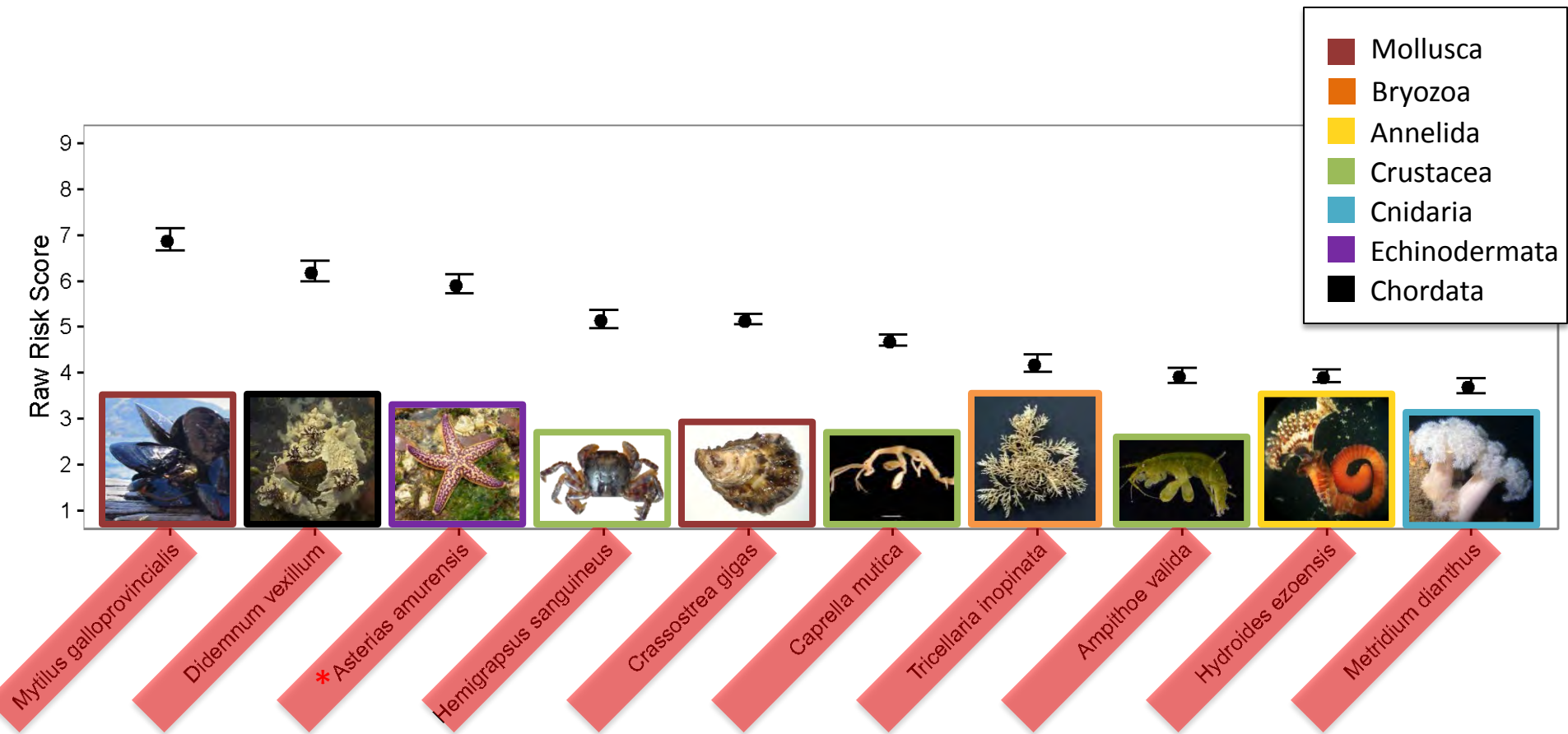
Mytilus galloprovincialis

Ten highest risk species

Photo by Dann Blackwood, via iucngisd.org

Didemnum vexillum

Chordata

Photos from iucngisd.org, cabi.org, invasions.si.edu, marlin.ac.uk, and Kishikawa (2011)
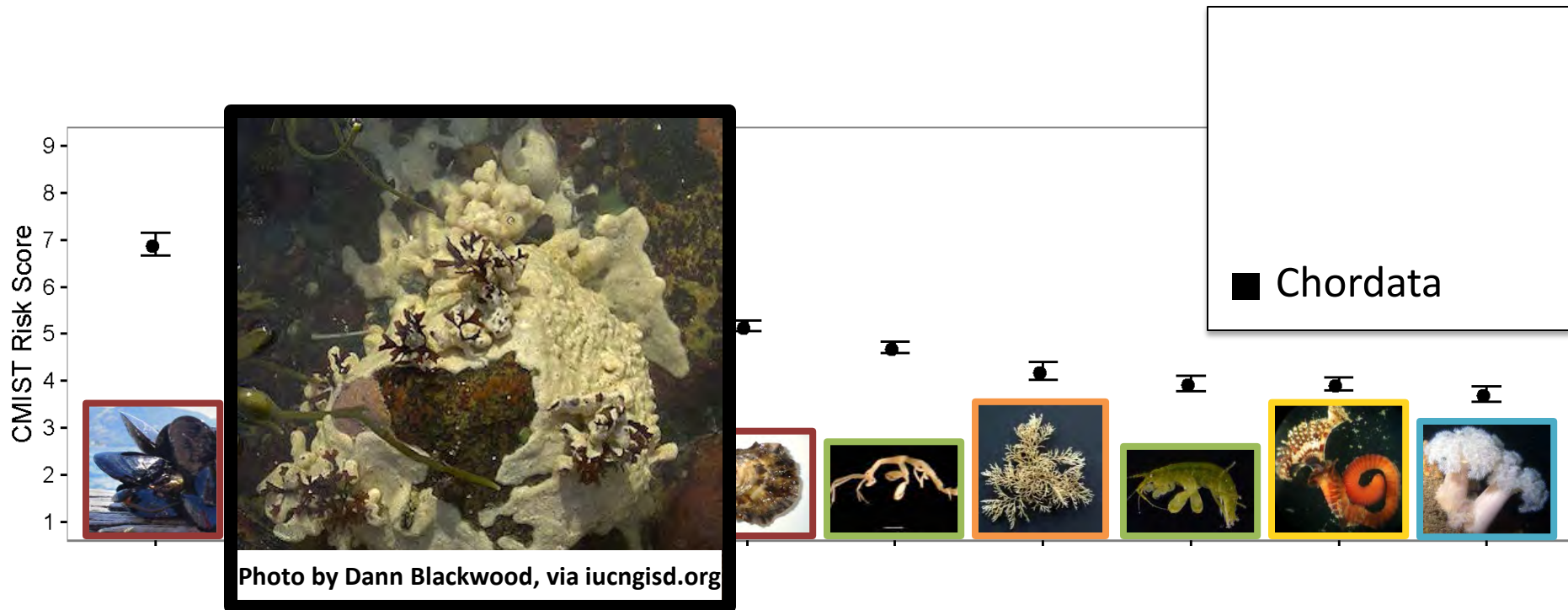
Ten highest risk species
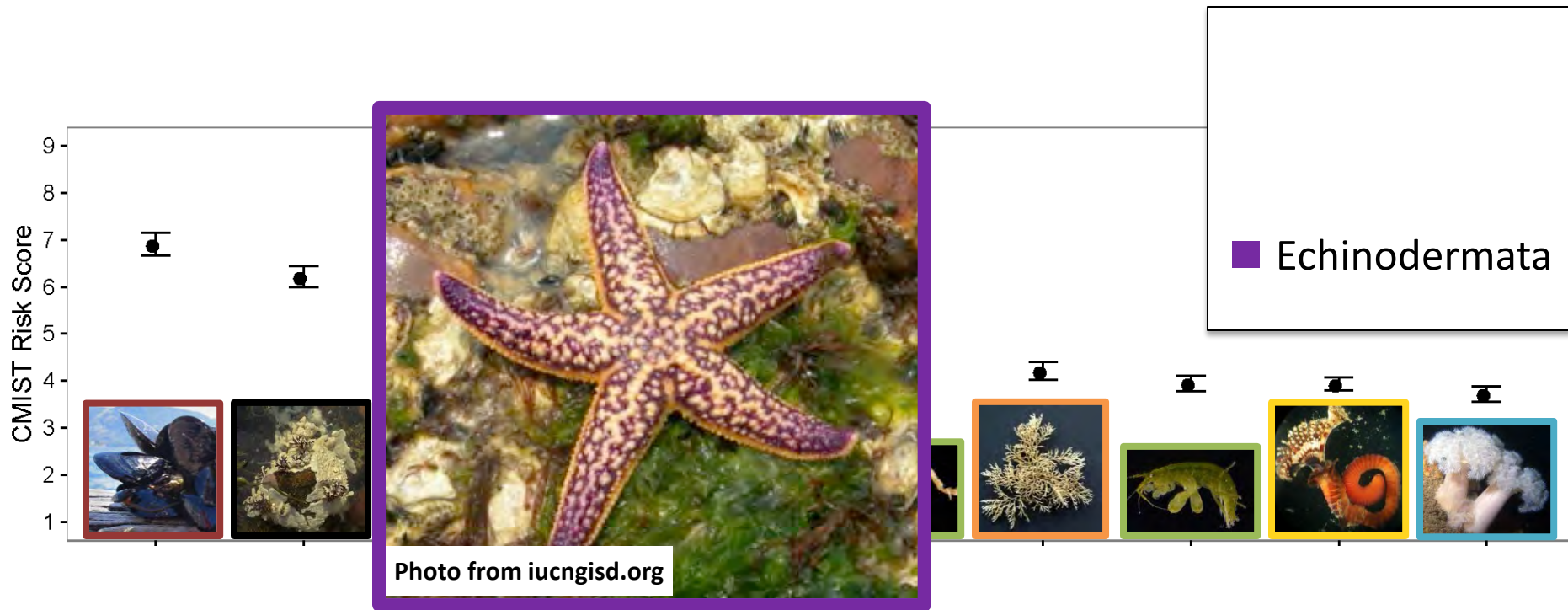
* *Asterias amurensis*

* Native to parts of Gulf of Alaska

Photos from iucngisd.org, cabi.org, invasions.si.edu, marlin.ac.uk, and Kishikawa (2011)

So still risky if already here?

YES

- New genetic material can increase invasiveness in NA/Hawaii
  - Greater impacts
  - Increased range

BUT

- Shows other vectors still important

- Invasions are complex

Risk by Ecoregion

Gulf of Alaska
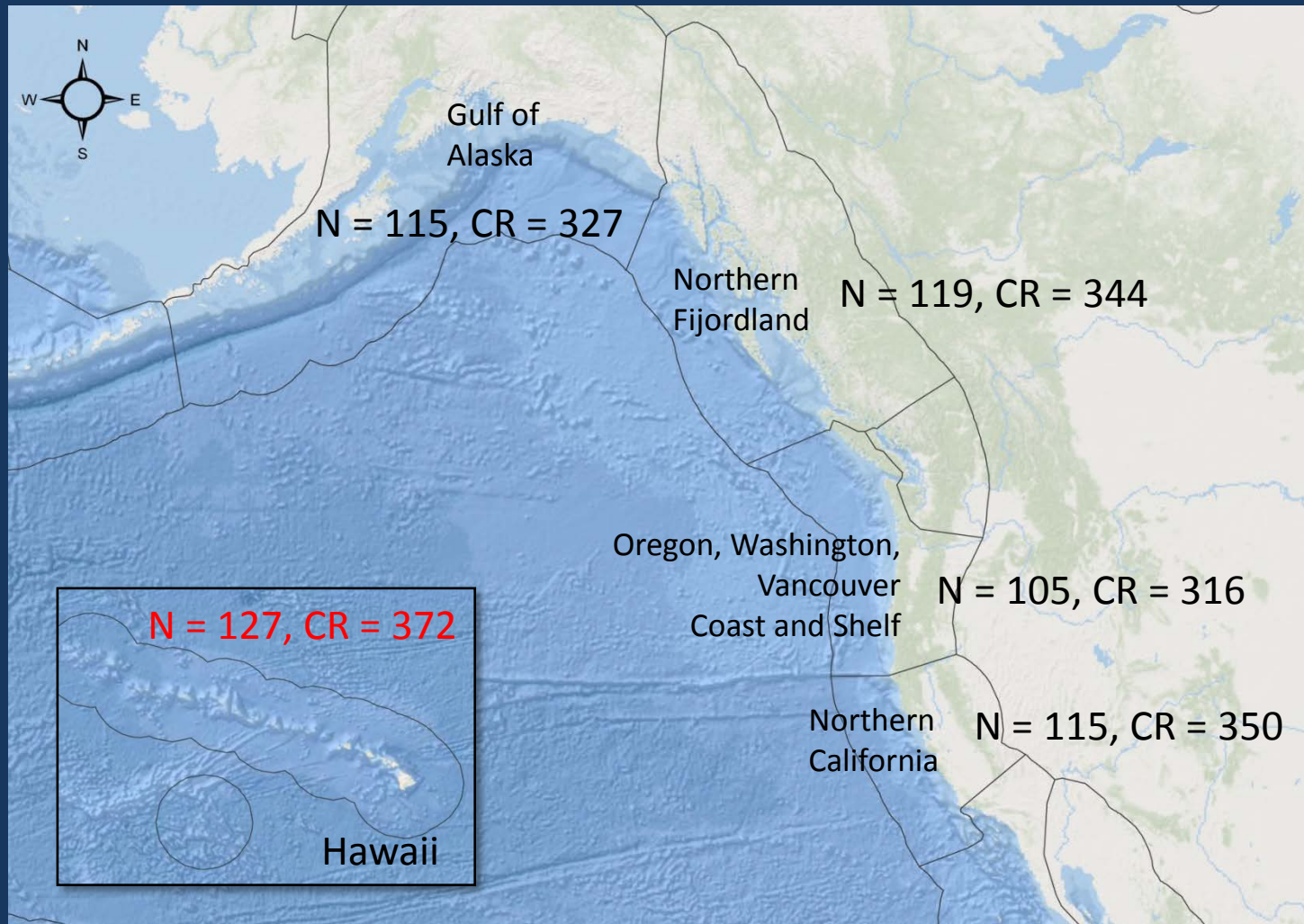N = 115, CR = 327

Northern Fijordland
N = 119, CR = 344

Oregon, Washington, Vancouver Coast and Shelf
N = 105, CR = 316

N = 127, CR = 372
Hawaii

Northern California
N = 115, CR = 350

Spalding et al. (2007) BioScience 57(7)

Data Uncertainties

- Impact of invasion scoring was based on known impacts. Thus, species without known impacts, due to lack of previous invasion history or lack of study, were scored lower but they could still have impacts in new ecosystems.

- Of the almost 400 species encountered thus far, many not known from other invasion vectors like commercial shipping.

Summary

- Risk assessments, via CMIST, allowed us to prioritize species for each assessed ecoregion
  - Results can inform monitoring and management options

- Although no **NEW** invasions have been attributed to tsunami debris, higher risk species were transported to NA/Hawaii on debris

- Continued monitoring is recommended due to invasion lag times

- Also are scoring algal species
  - *Undaria pinnatifida* is higher risk

Photo: Dann Cutter

Acknowledgements

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CMIST scorers: Lauren Liggan

PICES

CMIST Questions

Is the species established in the assessment area?
[1] No
[2] Observed but not reported as established
[3] Yes

How frequently and in what numbers is the species expected to arrive into the assessment area?
[1] Infrequently in low numbers
[2] Frequently in low numbers or infrequently in high numbers
[3] Frequently in high numbers

How much of the assessment area offers suitable habitat for the species?[
1] Negligible proportion of the assessment area
[2] Moderate proportion of the assessment area
[3] Most of the assessment area

How much of the assessment area offers suitable environmental conditions for the species to survive?
[1] Negligible proportion of the assessment area
[2] Moderate proportion of the assessment area
[3] Most of the assessment area

CMIST Questions

Are the species' reproductive requirements available in the assessment area?
[1] Almost never
[2] Sometimes
[3] Almost always

To what extent could natural control agents slow the species' population growth in the assessment area?
[1] Likely to severely restrict population growth
[2] Could slow population growth
[3] Unlikely to slow population growth

What is the range of the species' potential natural dispersal in the assessment area?
[1] Very limited range
[2] Moderate range
[3] Wide range

What is the range of the species' potential dispersal in the assessment area from anthropogenic mechanisms?
[1] Very limited range
[2] Moderate range
[3] Wide range

CMIST Questions

What level of impact could the species have on population growth of other species in the assessment area?
[1] Low or no impact
[2] High impact in few areas or moderate impact in many areas
[3] High impact in many areas

What level of impact could the species have on communities in the assessment area?
[1] Low or no impact
[2] High impact in few areas or moderate impact in many areas
[3] High impact in many areas

What level of impact could the species have on habitat in the assessment area?
[1] Low or no impact
[2] High impact in few areas or moderate impact in many areas
[3] High impact in many areas

What level of impact could the species have on ecosystem function in the assessment area?
[1] Low or no impact
[2] High impact in few areas or moderate impact in many areas
[3] High impact in many areas

CMIST Questions

What level of impact could the species' associated diseases, parasites, or travellers have on other species in the assessment area?
[1] Low or no impact
[2] High impact in few areas or moderate impact in many areas
[3] High impact in many areas

What level of genetic impact could the species have on other species in the assessment area?
[1] Low or no impact
[2] High impact in few areas or moderate impact in many areas
[3] High impact in many areas

What level of impact could the species have on at-risk or depleted species in the assessment area?
[1] Low or no impact
[2] High impact in few areas or moderate impact in many areas
[3] High impact in many areas

CMIST Questions

What level of impact could the species have on aquaculture and commercially fished species in the assessment area?
[1] Low or no impact
[2] High impact in few areas or moderate impact in many areas
[3] High impact in many areas

Is the species known or generally considered to be invasive anywhere in the world?
[1] No
[2] No, but is noted outside of its native range
[3] Yes (noted as invasive, or noted outside of native range with impacts)