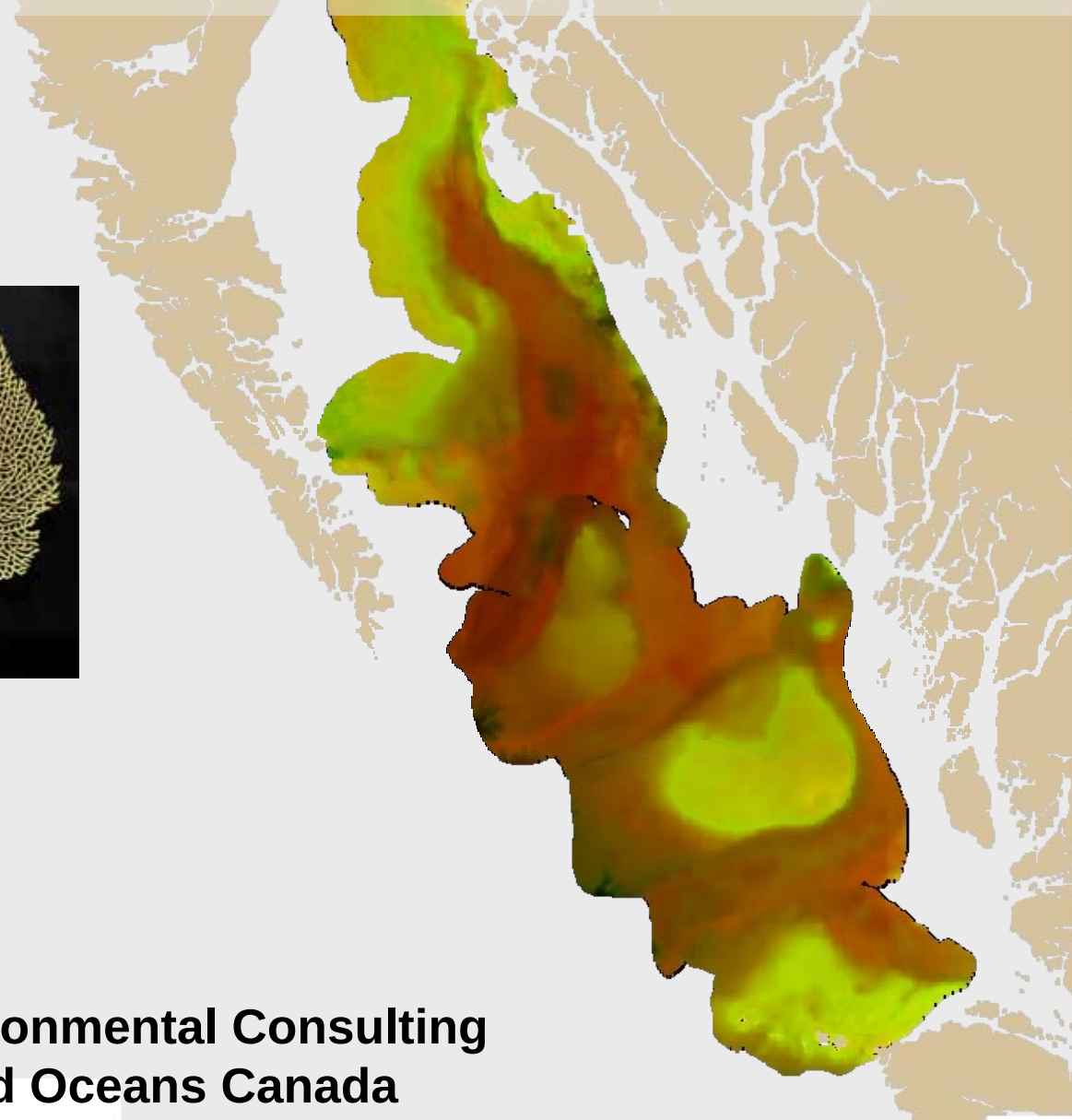
Ecological classification of sponge and coral habitat in Pacific Canadian waters



October 30, 2007

Edward Gregr, SciTech Environmental Consulting
Glen Jamieson, Fisheries and Oceans Canada

Rationale

- Habitat classification is central to marine protected areas design and ecosystem-based management

- Classification needs to be comprehensive
- Physical data are often the basis of such studies

- Many alternatives can be formulated
- Biological validation is therefore essential

Objectives

- Apply Southwood's (1977, 1988) habitat template to the benthic habitat in Pacific Canada
- Assess the relevance of the habitat template to various benthic species

Hexactelinidae
(glass sponges)

Soft corals
(i.e., sea pens)

Hard corals
(i.e., sea fans)


Study resolution:
500 x 500 m²
You are here!

The habitat template

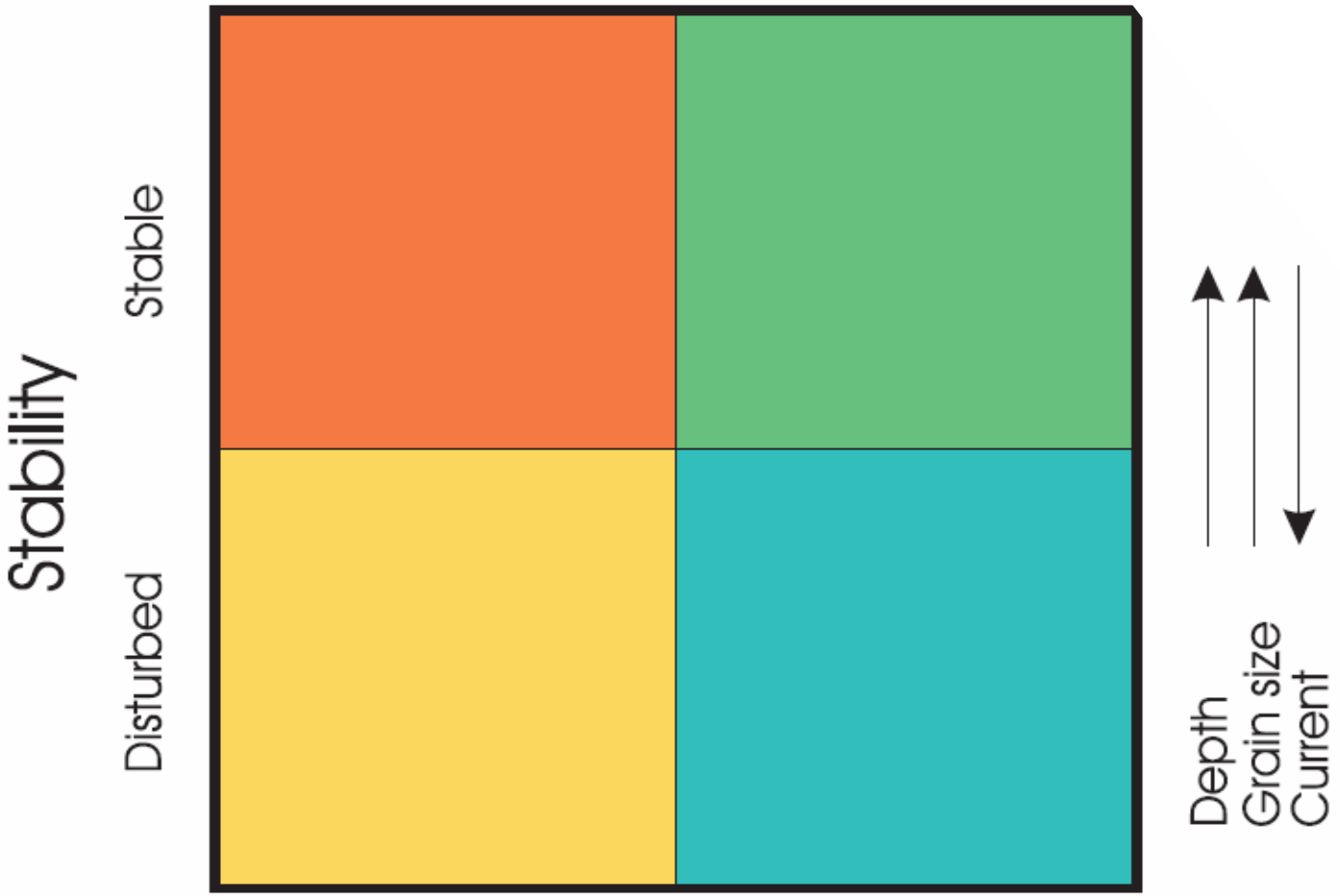
Southwood (1977, 1988)

- A species' habitat affect it's fitness, leading to the selection optimal life history strategies

- Life history strategies are comprised of tactics, selected for by:

  – Stability (frequency of disturbance)
  – Adversity (severity of the environment)

Stability / Adversity matrix



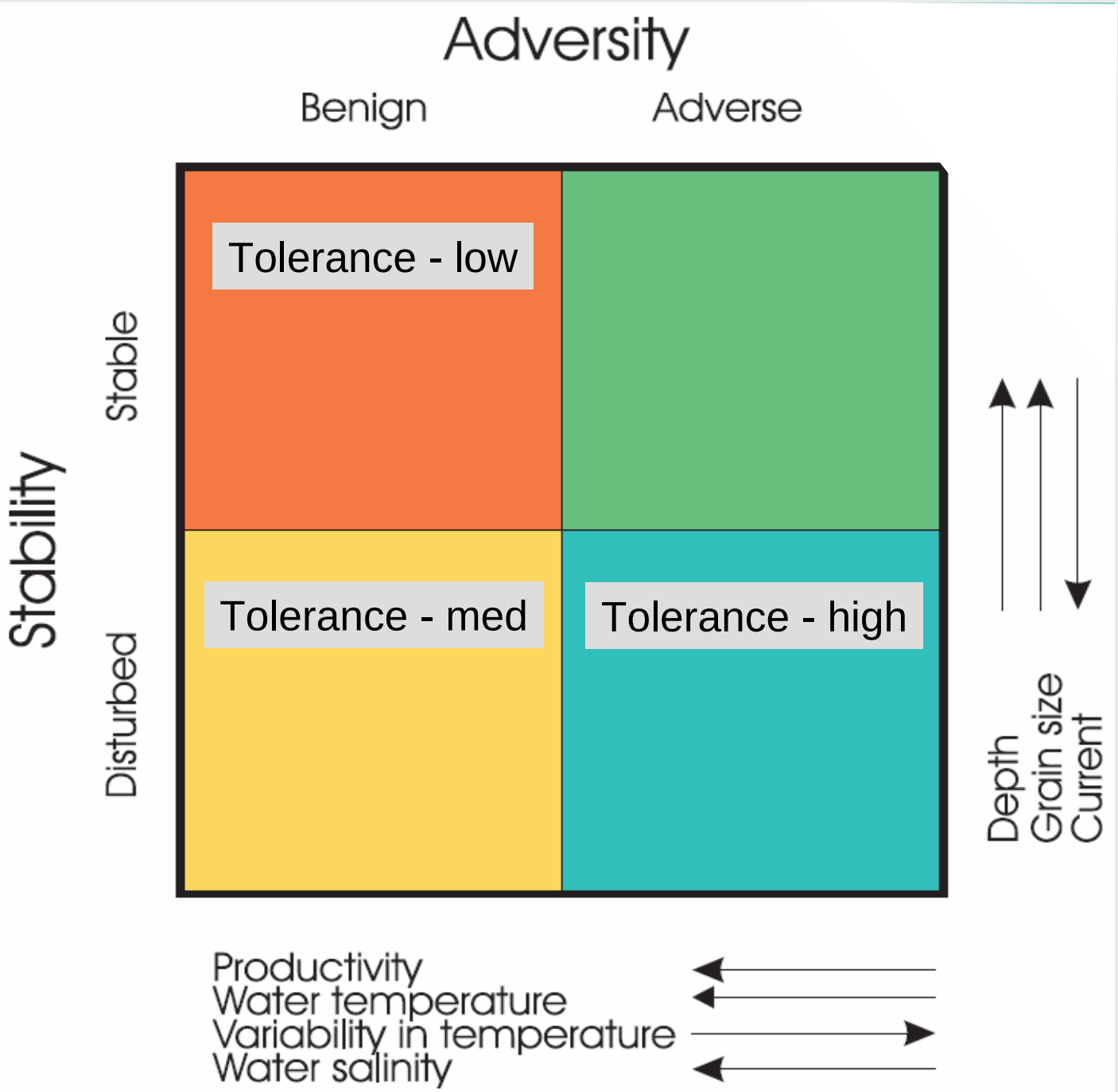
Kostylev (2005)

The habitat template

Southwood (1977, 1988)

5 main tactics :

1) Tolerance of inclement conditions
2) Predator defense
3) Foraging & somatic development
4) Reproduction
5) Use of refugea (spatial or temporal)


Adversity
Benign
Adverse
Stability
Stable
Disturbed
Tolerance - low
Tolerance - med
Tolerance - high
Depth
Grain size
Current
Productivity
Water temperature
Variability in temperature
Water salinity

Disturbance

- ***Disturbance*** depends on the ability of water flow to mobilize the substrate

$$D = \left(\frac{bottom\ current}{particle\ mobility} \right) \qquad D = \log\left(\frac{V_w + V_T}{H} \right)$$

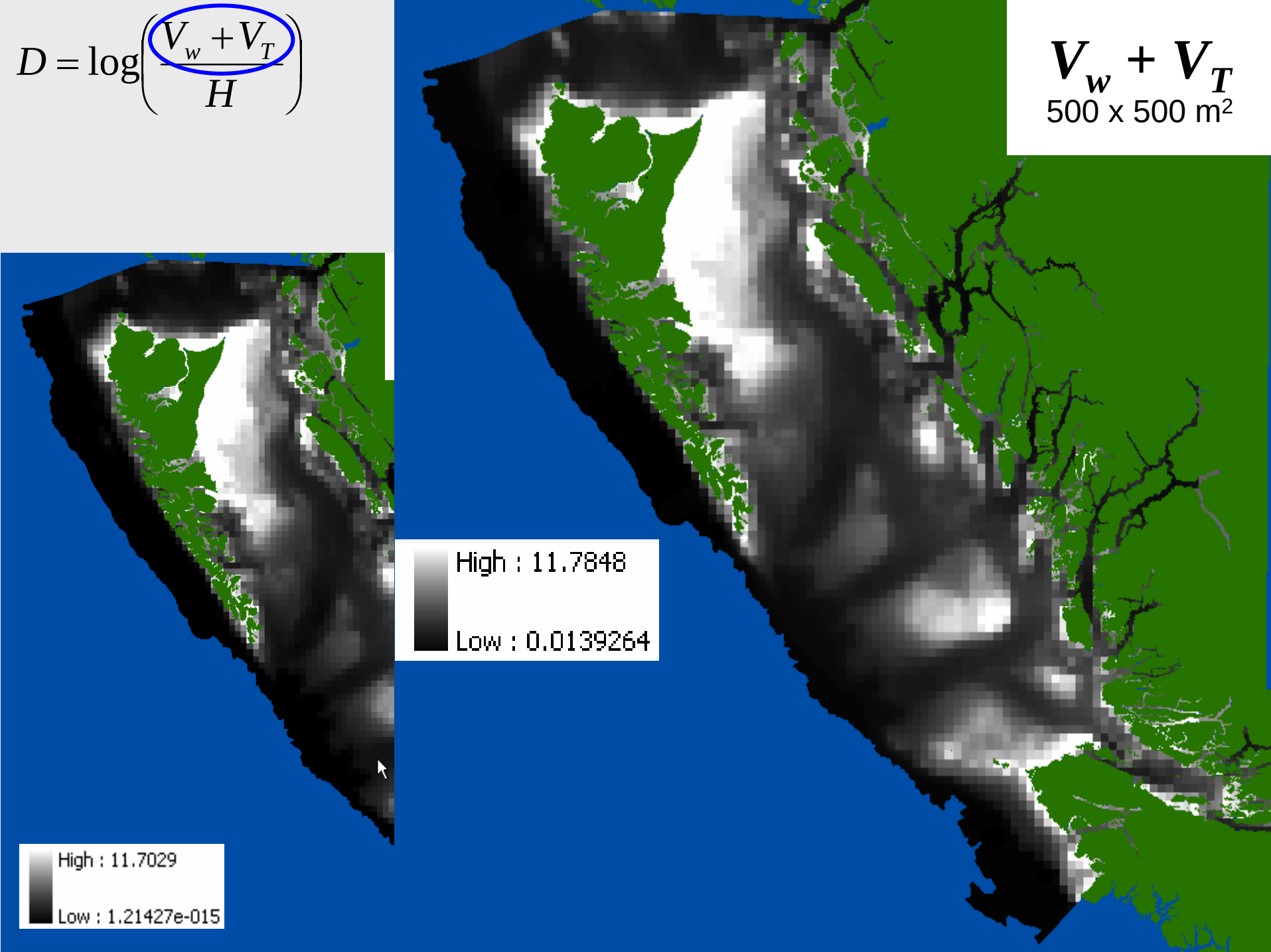
- V_w = Wave generated horizontal velocity (m/s)
- V_T = Tidally generated horizontal velocity (m/s)
- H = Critical current (m/s) based on particle size

Kostylev (2005)

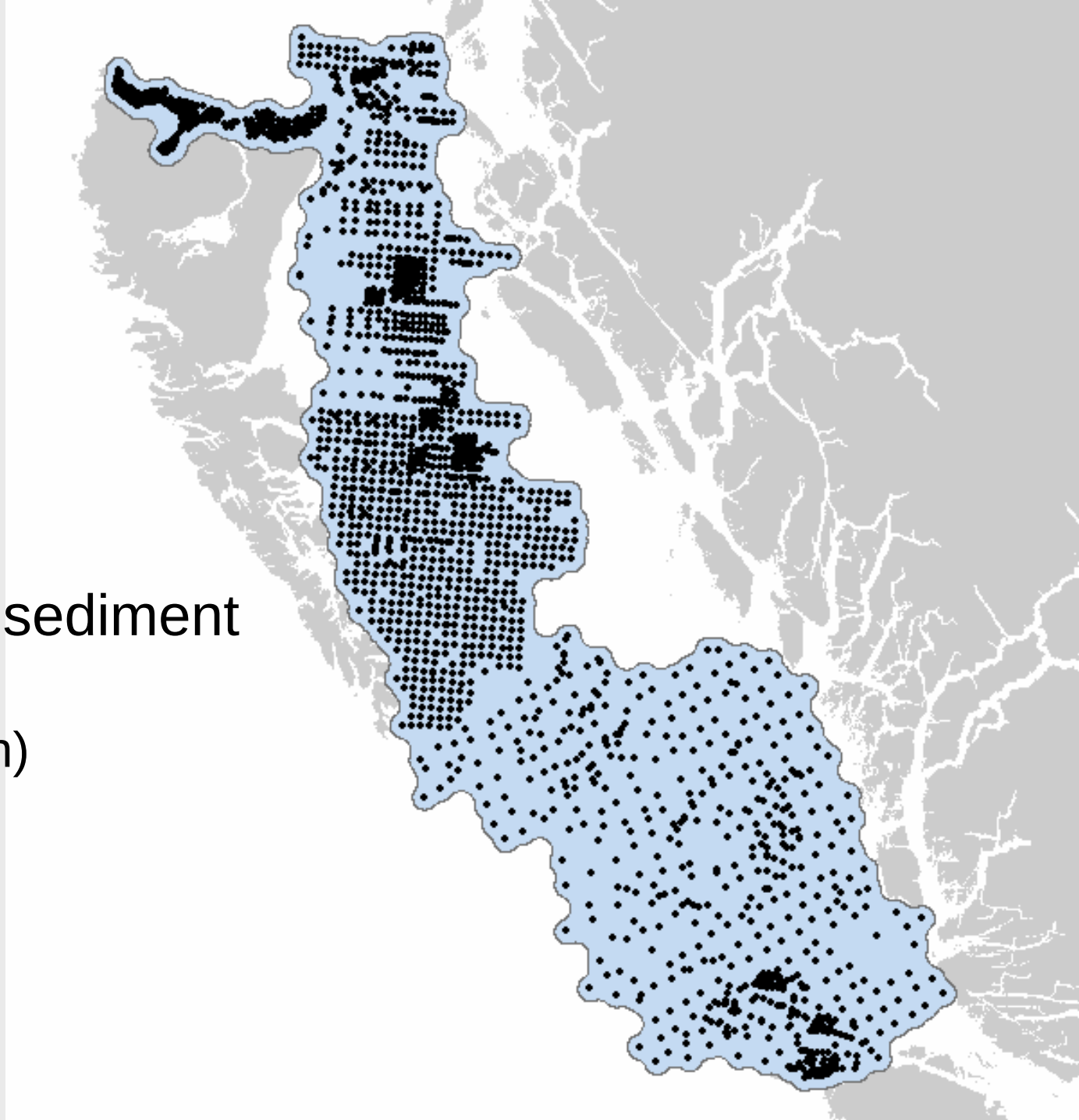
$$D = \log\left(\frac{V_w + V_T}{H}\right)$$

$V_w + V_T$

500 x 500 m²



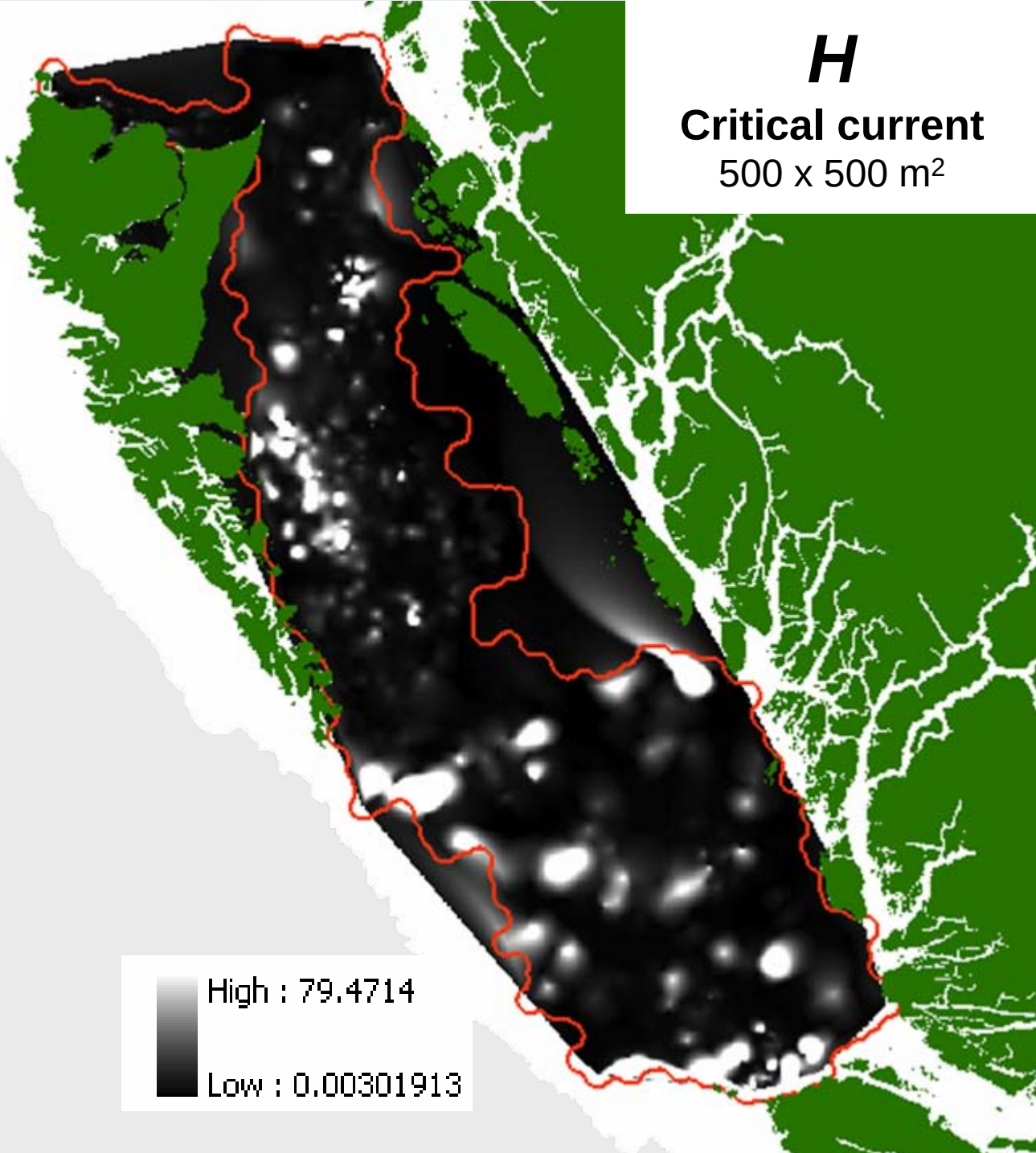
$$D = \log\left(\frac{V_w + V_T}{H}\right)$$



Distribution of sediment grab samples
(courtesy NRCan)

$$D = \log\left(\frac{V_w + V_T}{H}\right)$$

Interpolated particle size (mm)

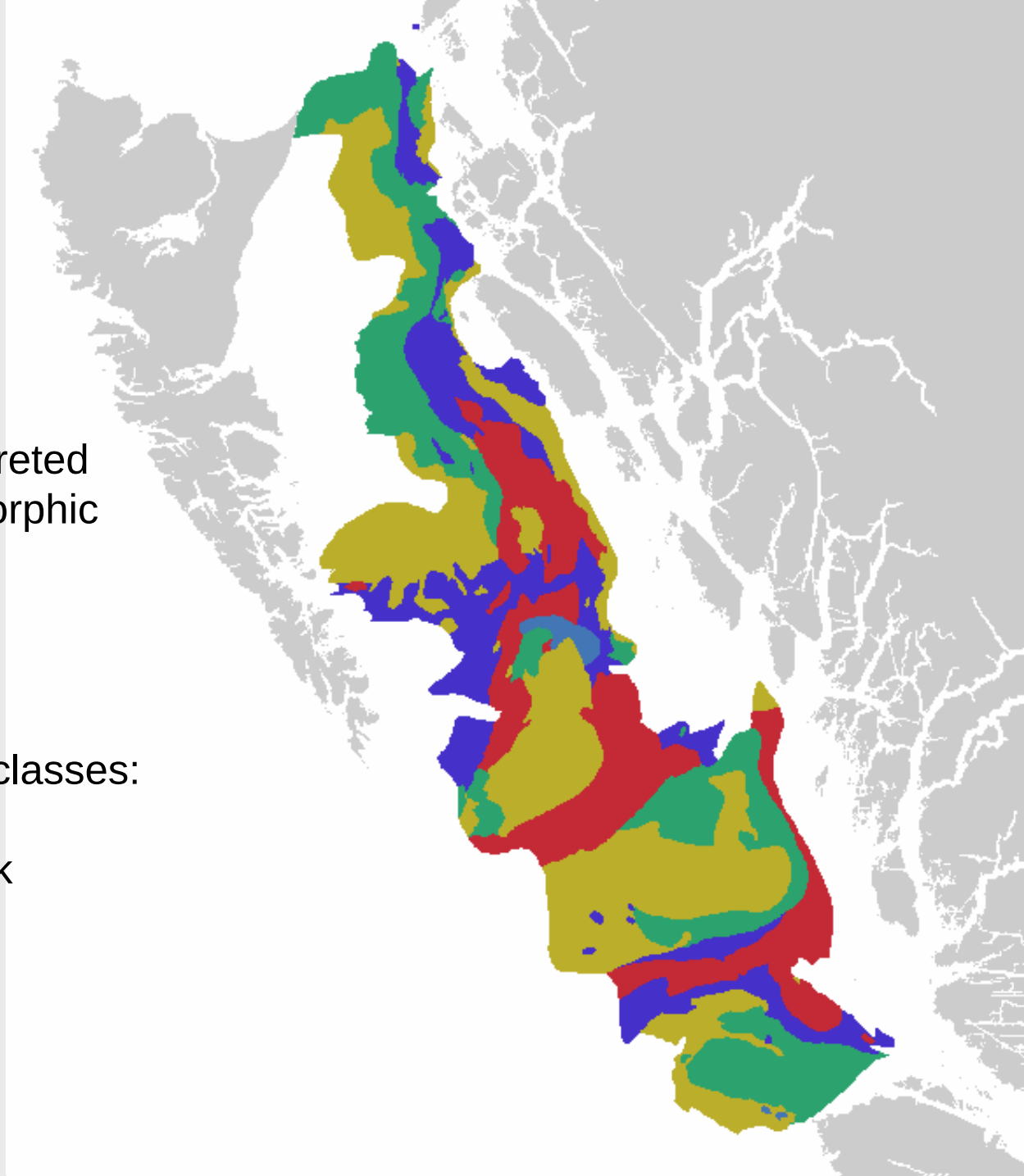


$$D = \log\left(\frac{V_w + V_T}{H}\right)$$

Barrie et al. (1991) interpreted grabs to create 20 geomorphic facies (bottom types)

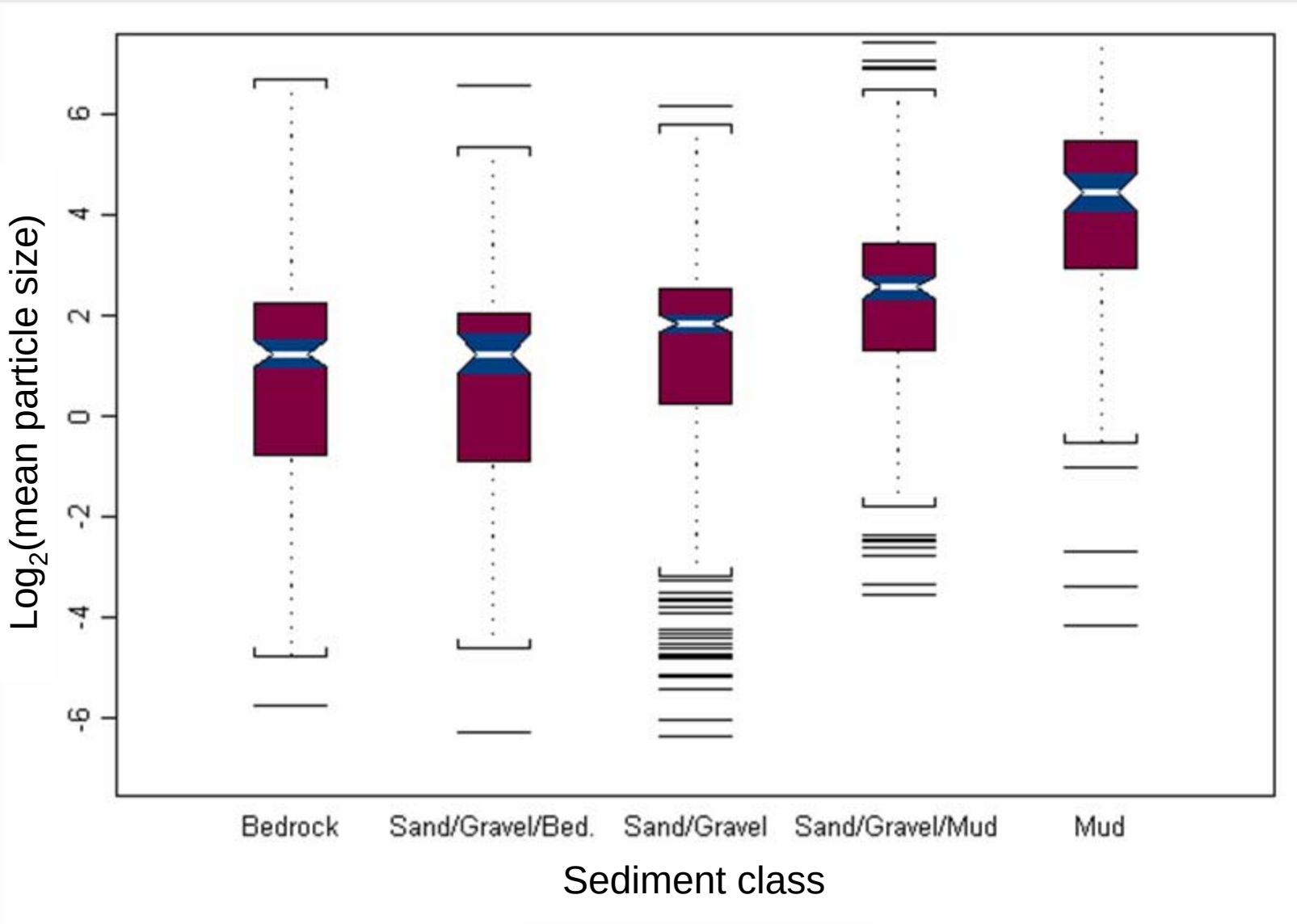
Generalized substrate classes:

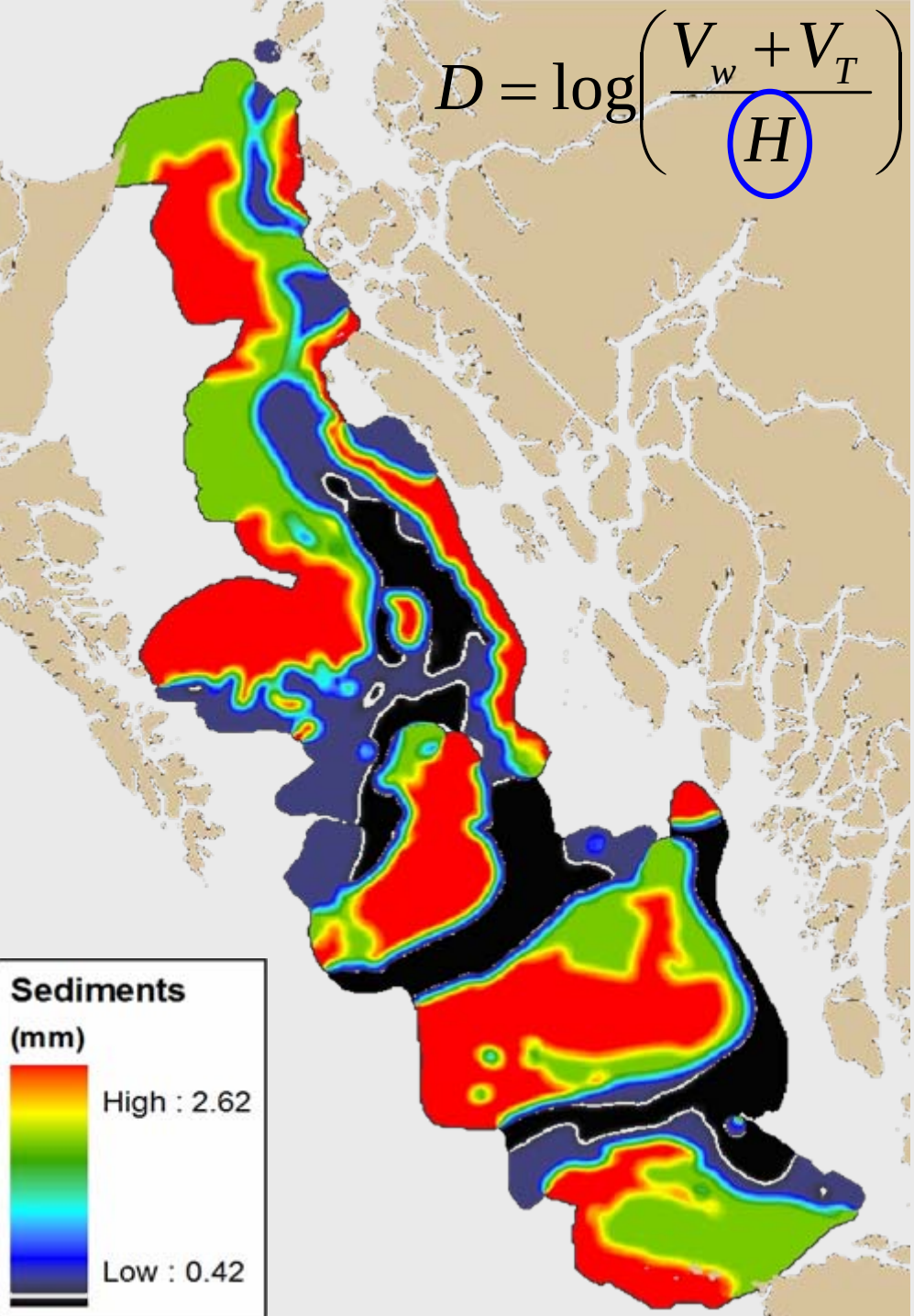
1. Bedrock
2. Sand/Gravel/Bedrock
3. Sand/Gravel
4. Sand/Gravel/Mud
5. Mud



$$D = \log\left(\frac{V_w + V_T}{H}\right)$$

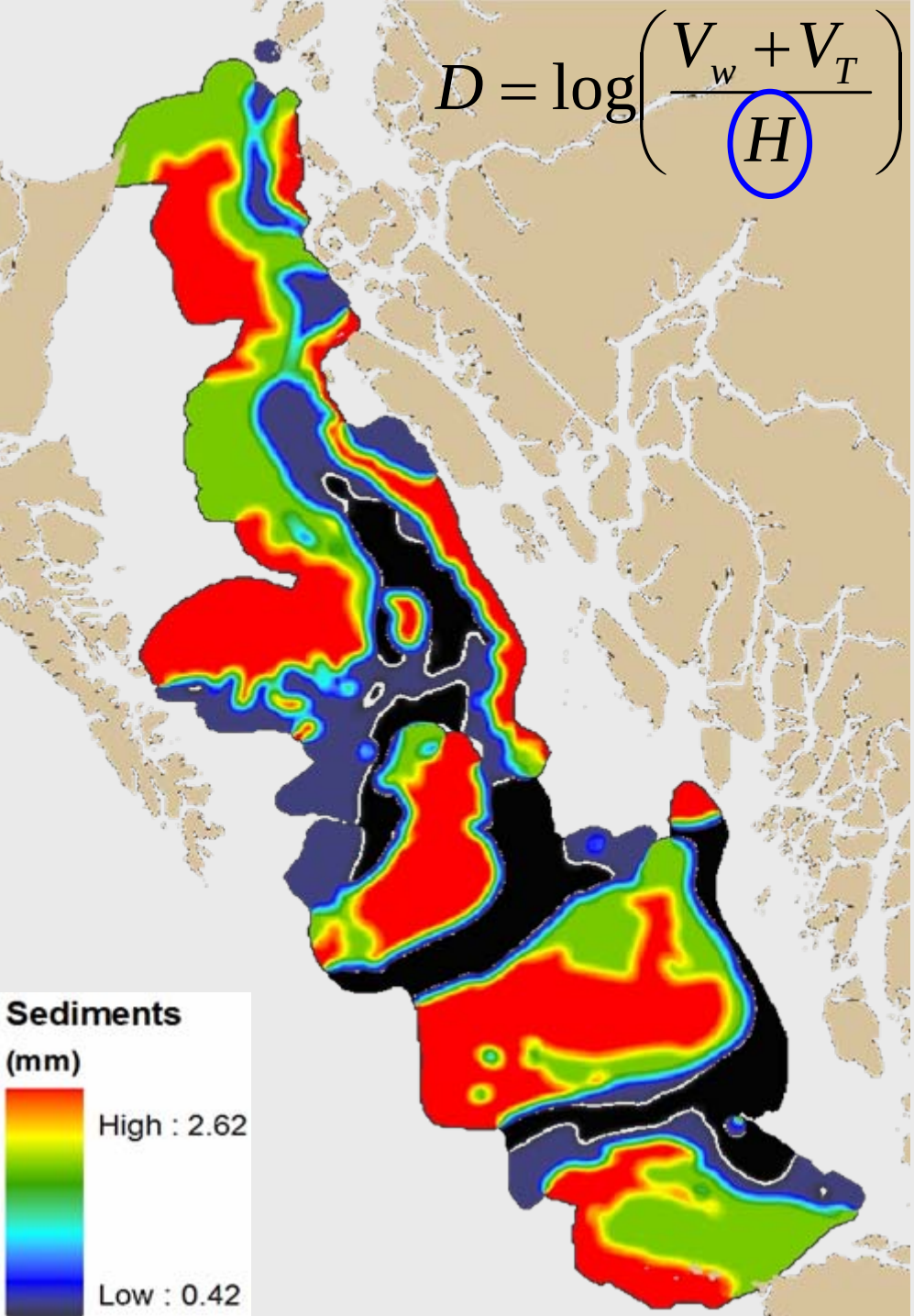
Particle size by substrate class



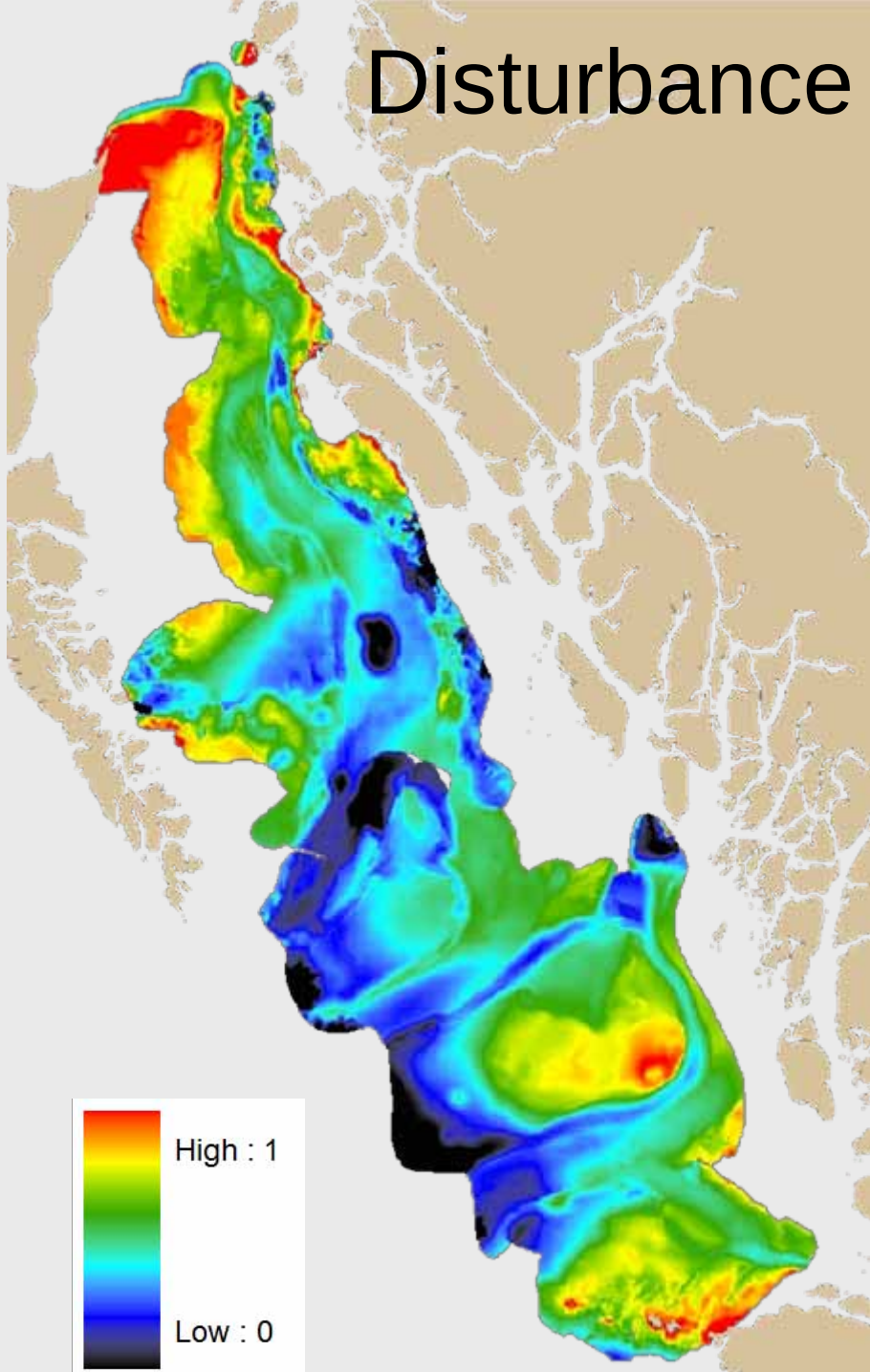


Sediment Class	Particle Size (mm)	
	Mean	Variance
Sand/Gravel/Bedrock	2.62	58.44
Sand/Gravel	1.91	43.00
Sand/Gravel/Mud	0.64	2.15
Mud	0.42	3.81

$$D = \log\left(\frac{V_w + V_T}{H}\right)$$



Disturbance



Adversity

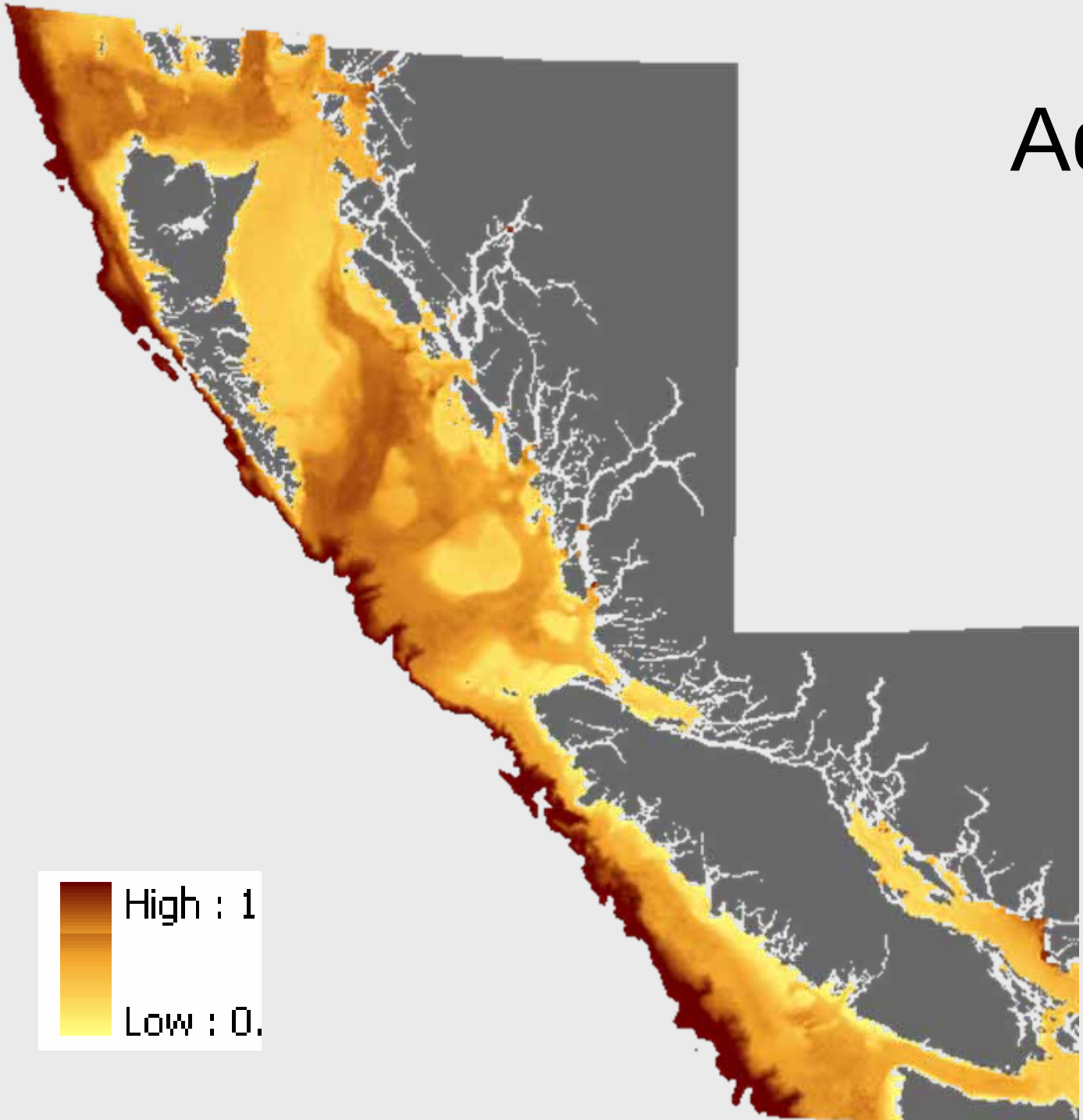
- Temperature
  - Mean summer bottom (T_m)
  - Seasonal range (T_r)

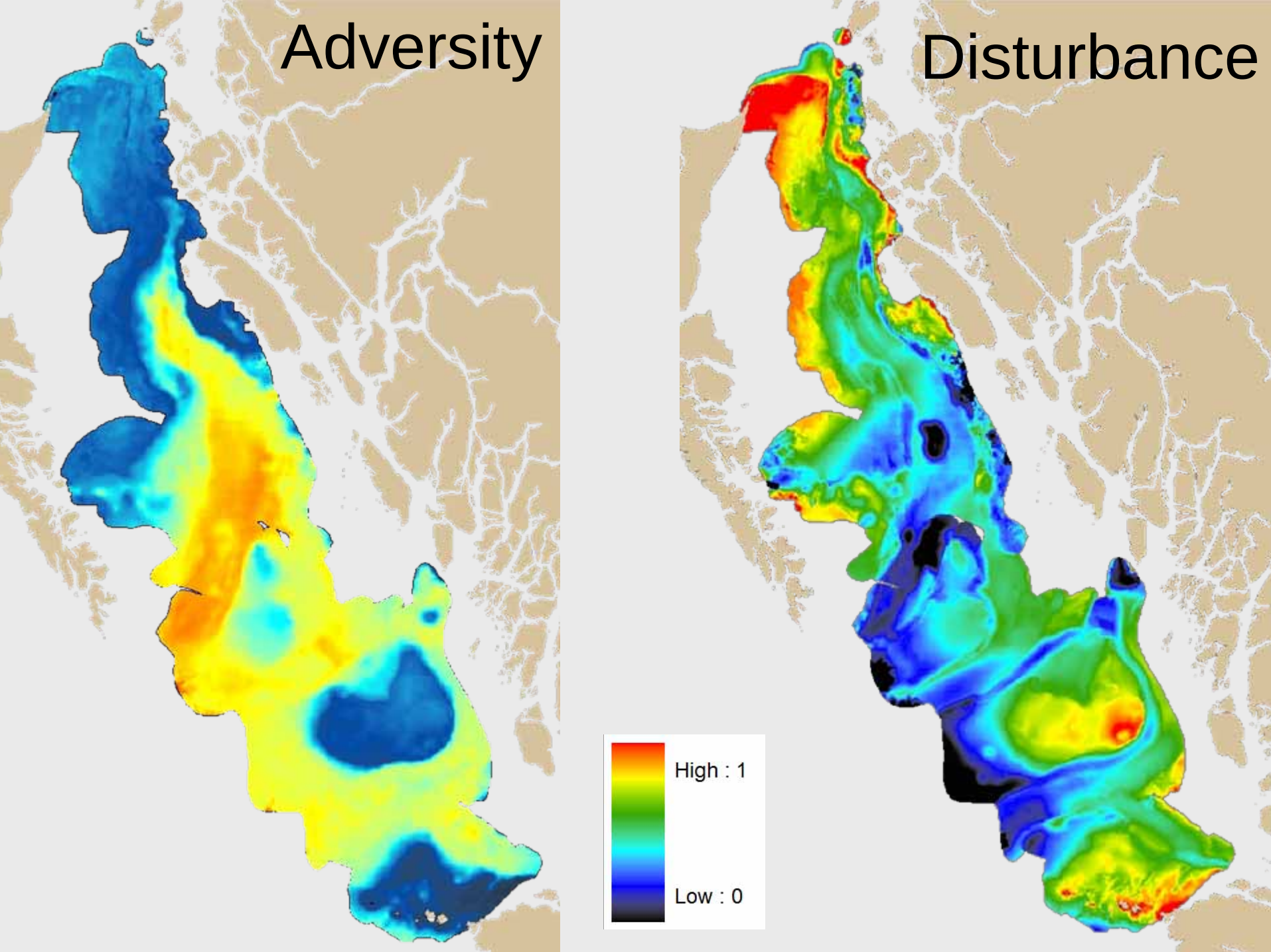
- Food availability (F_a)
  - *[Chl-a]*
  - *d* (depth)
  - s_d (density difference, 0 and 30 m)

$$F_a = \log(\frac{[Chla]}{d}) - S_d \qquad Adversity = \log\left(\frac{T_r - T_m - F_a}{3}\right)$$

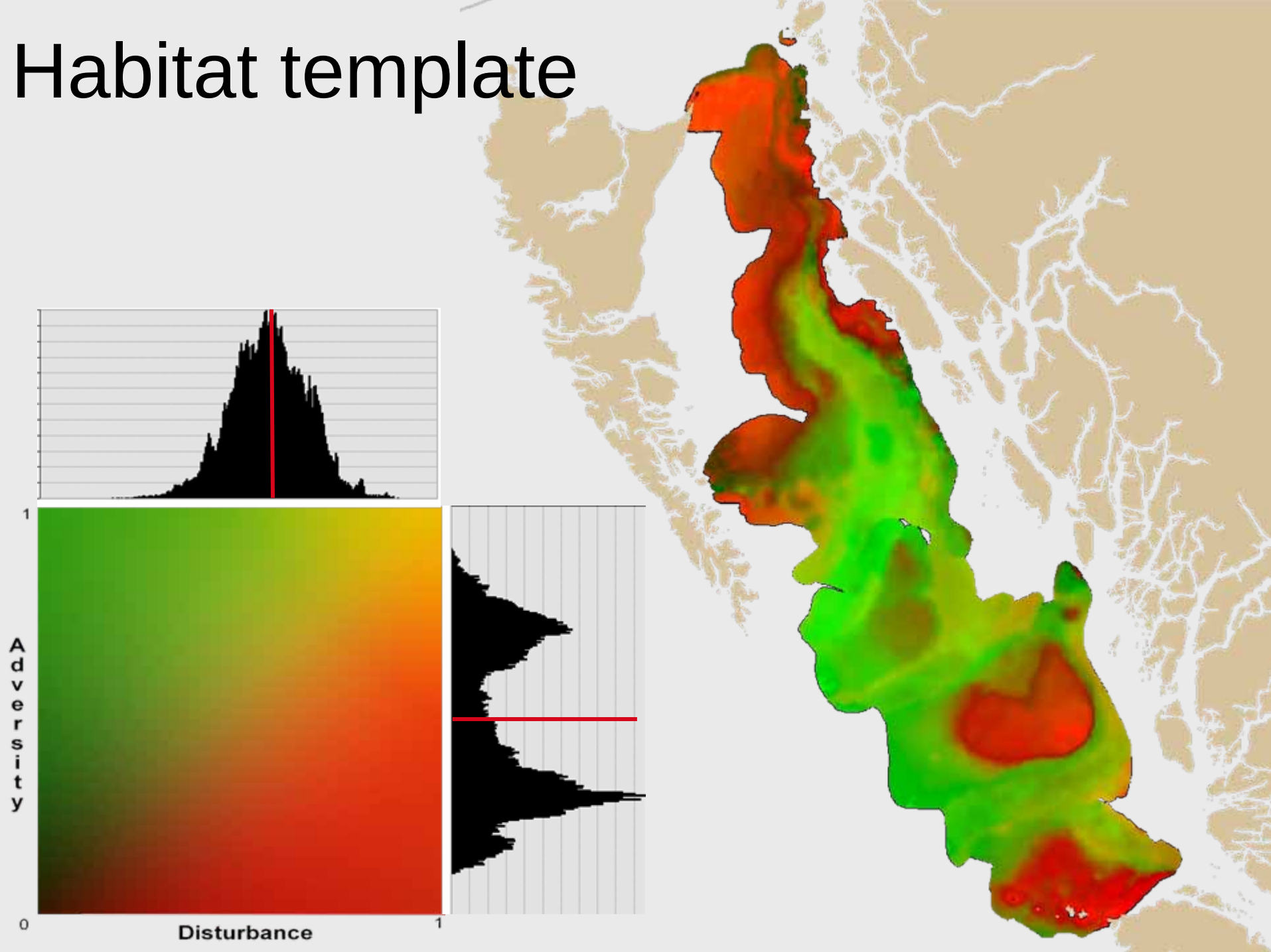
Kostylev (2005)

Adversity

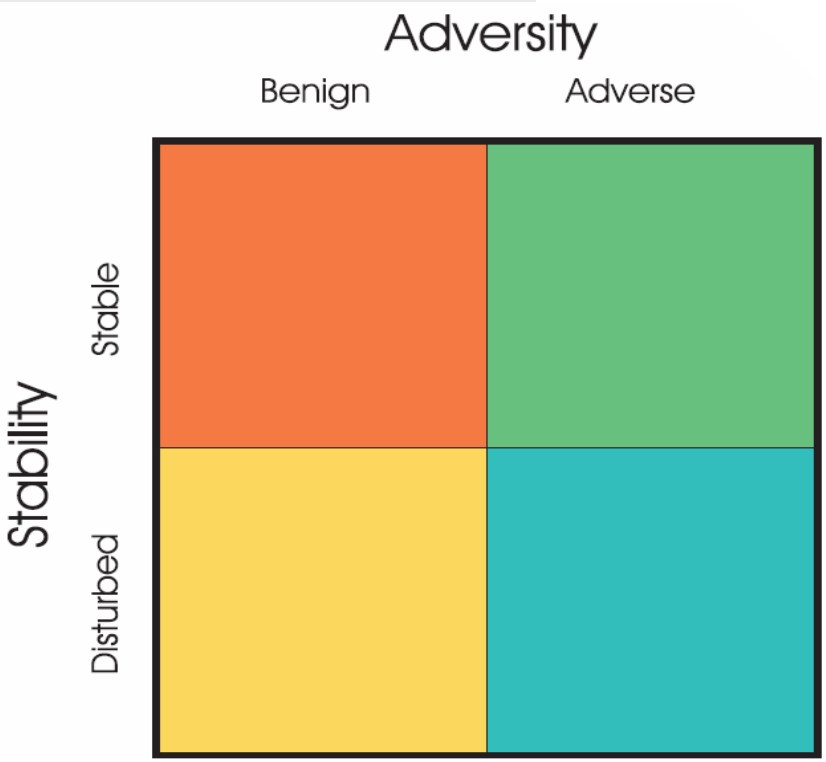



Adversity
Disturbance
High : 1
Low : 0

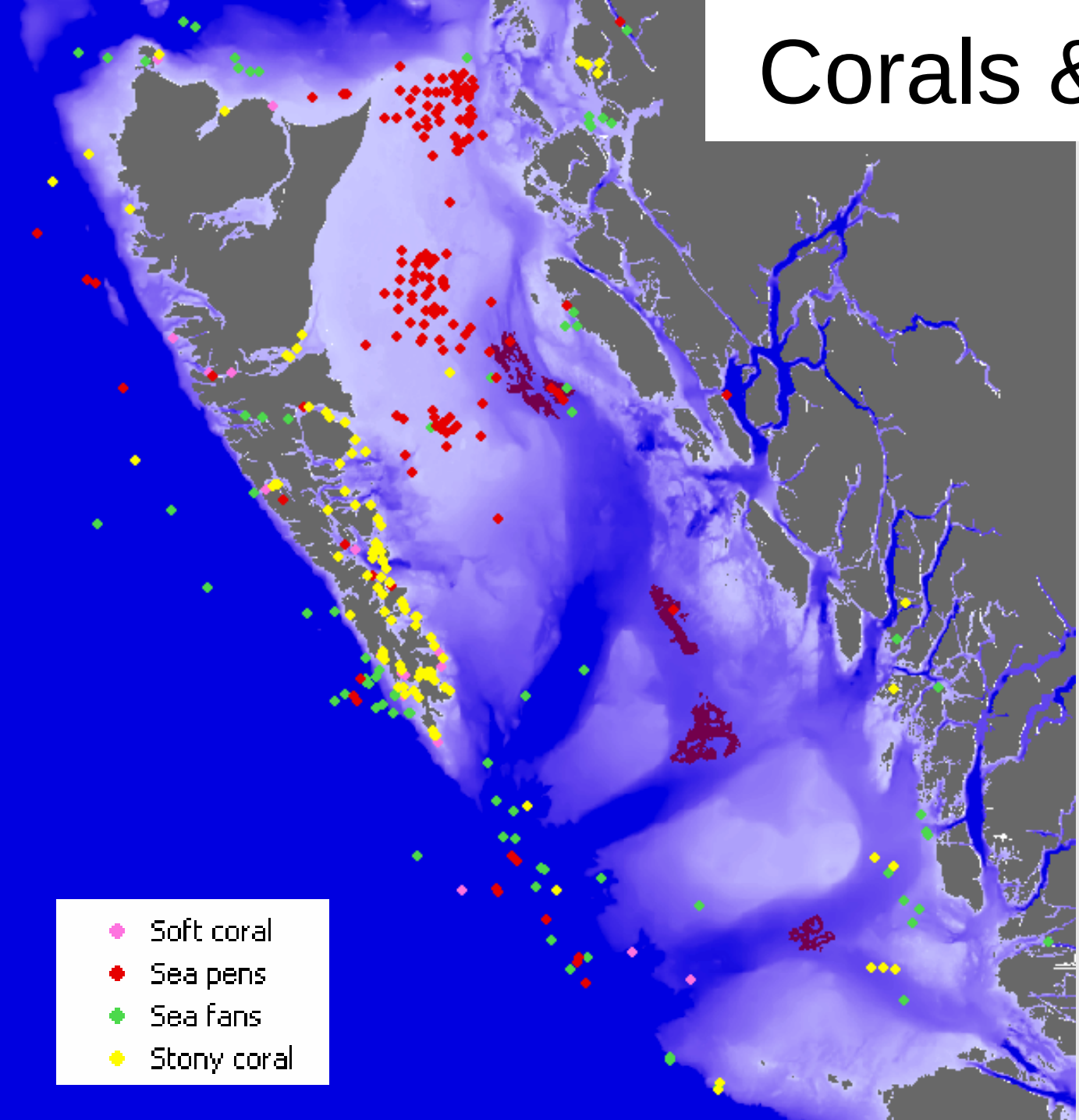
Habitat template



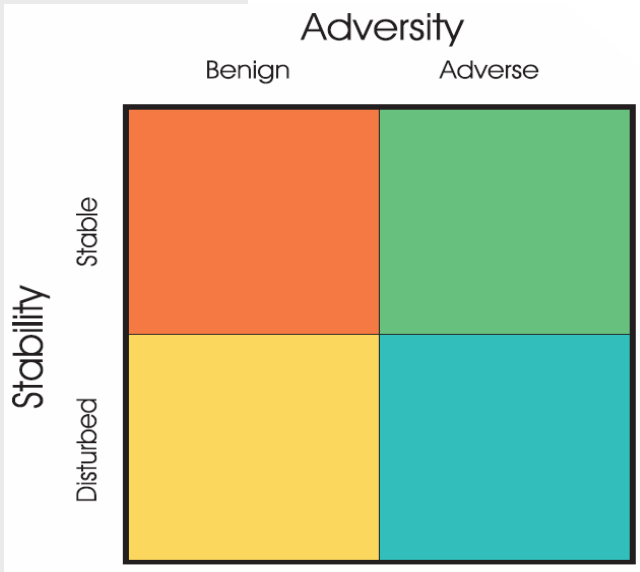
Habitat template (as matrix)



Corals & sponges

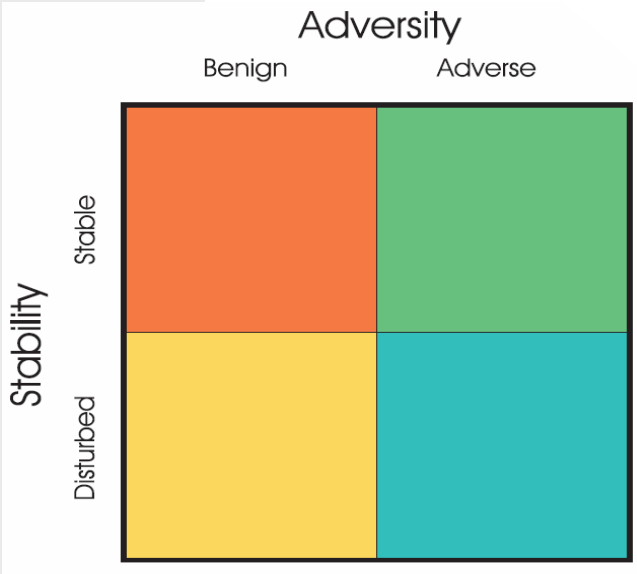


Hexactinellid sponges significantly associated with ***stable***, ***adverse*** conditions.

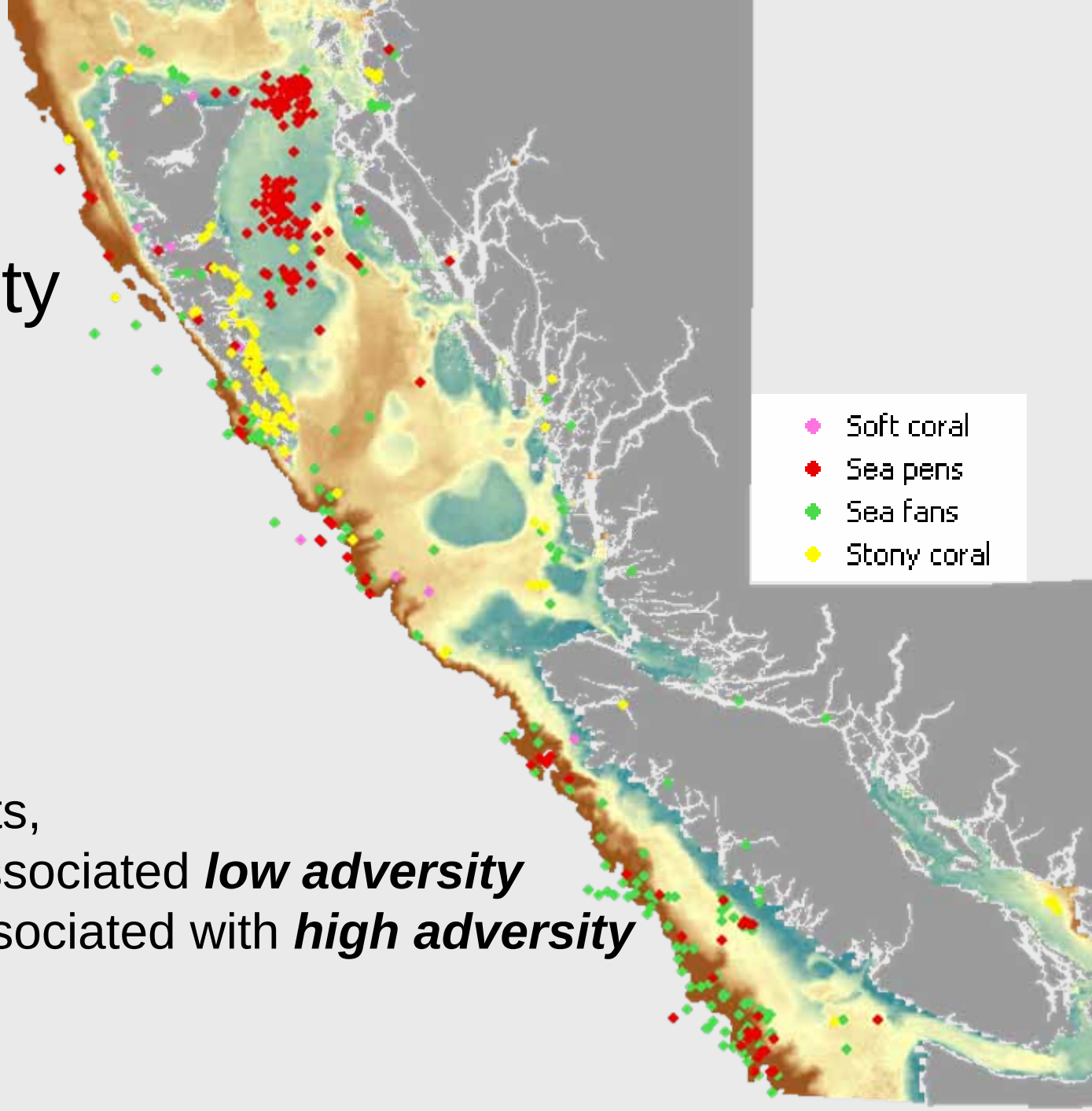


Sea pens significantly associated with ***disturbed***, ***benign*** conditions

Other corals not adequately distributed within habitat template

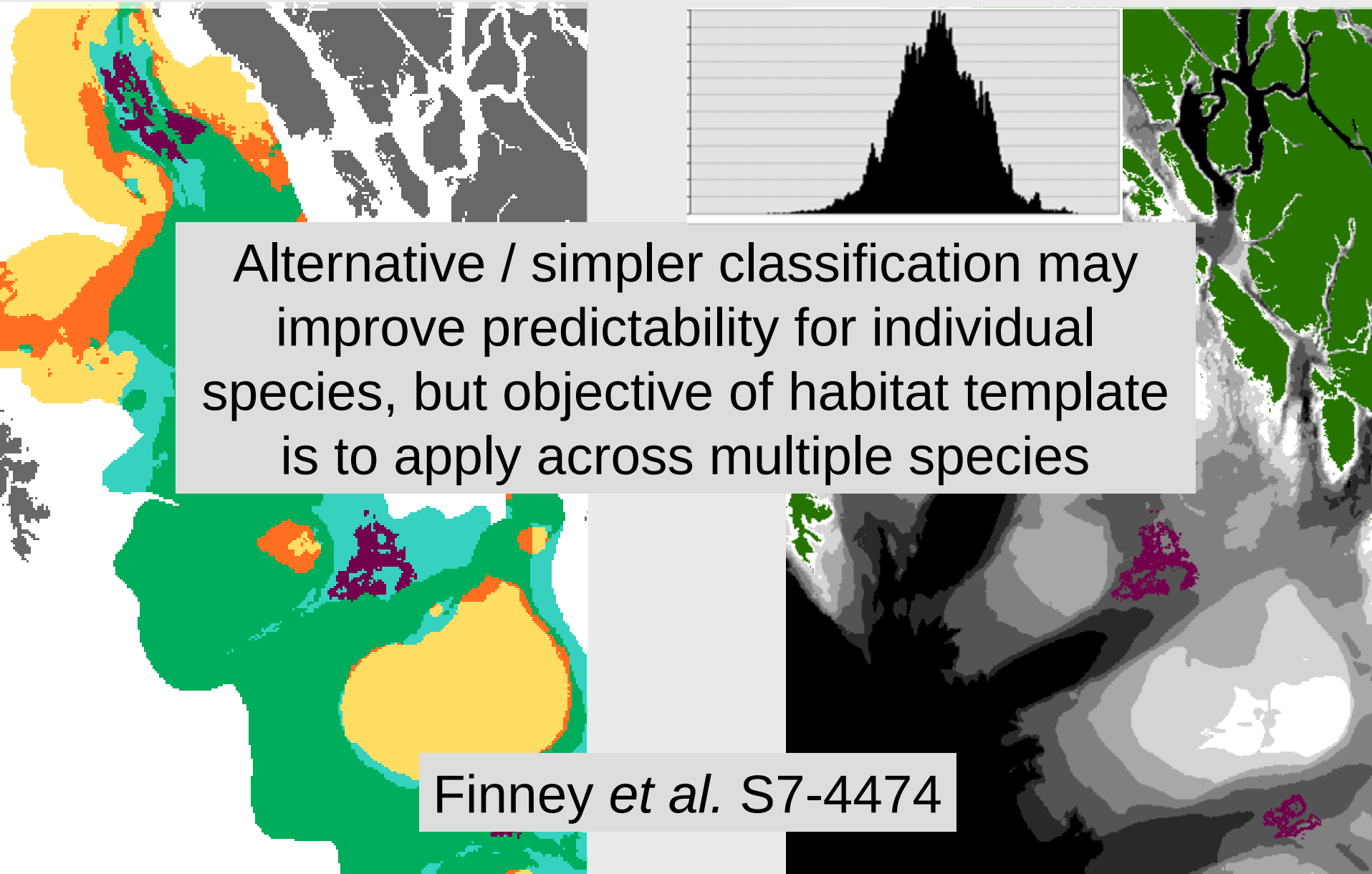


Corals vs. Adversity



Over larger extents,
Sea pens were associated ***low adversity***
Sea fans were associated with ***high adversity***

Alternative Grassland Approaches?

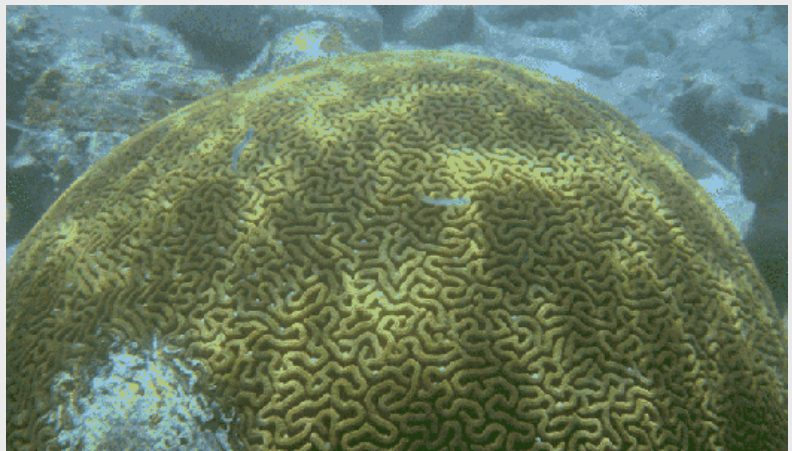


Alternative / simpler classification may improve predictability for individual species, but objective of habitat template is to apply across multiple species

Finney *et al.* S7-4474

Conclusions

- Observations of sponges and corals fit well within the habitat template
- Validation with additional species will reinforce the utility of the habitat template
- Biological validation of classification systems is essential to determine their ecological relevance



Thank you!

Vlad Kostylev provided guidance in the application of the methods

Ryan Coatta provided GIS support

Alan Sinclair, Mike Foreman, Kim Conway, and Mike Collier provided feedback on earlier versions of the classification

Funded by Fisheries & Oceans Canada

Questions, comments?
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