Restoring Variability in Intertidal Ecosystems Through Shoreline Armor Removal

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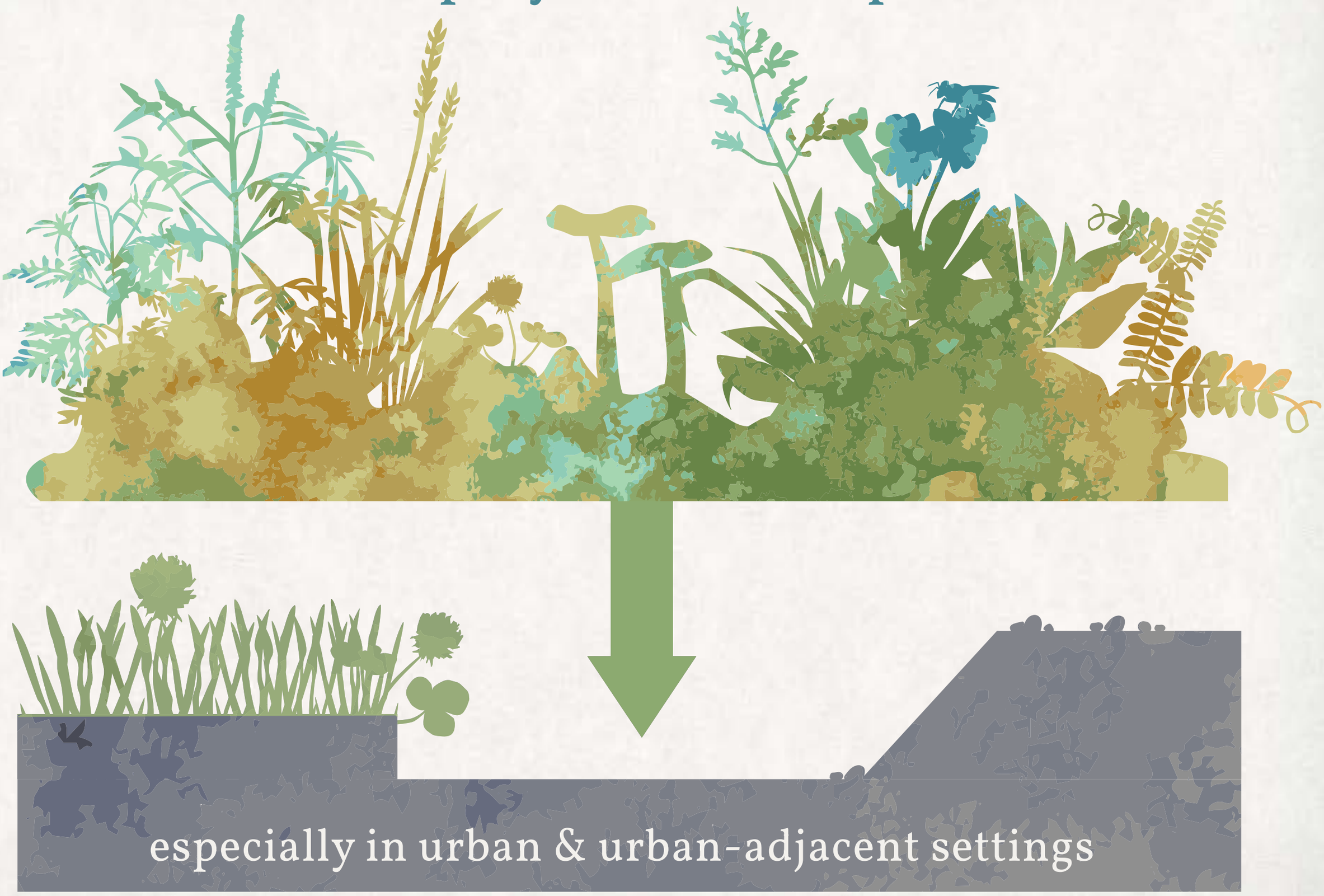
Humans often simplify our landscapes:



especially in urban & urban-adjacent settings

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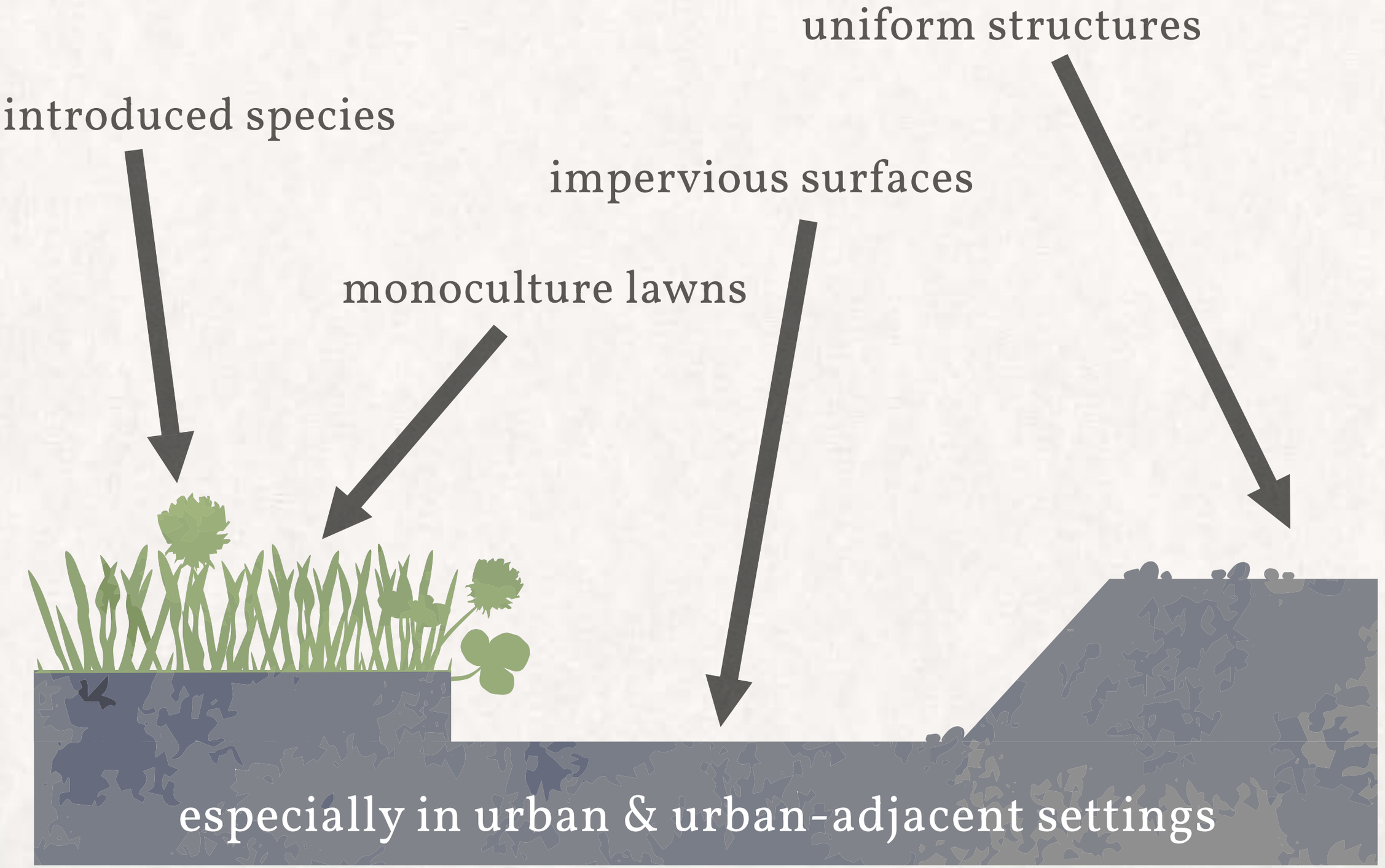
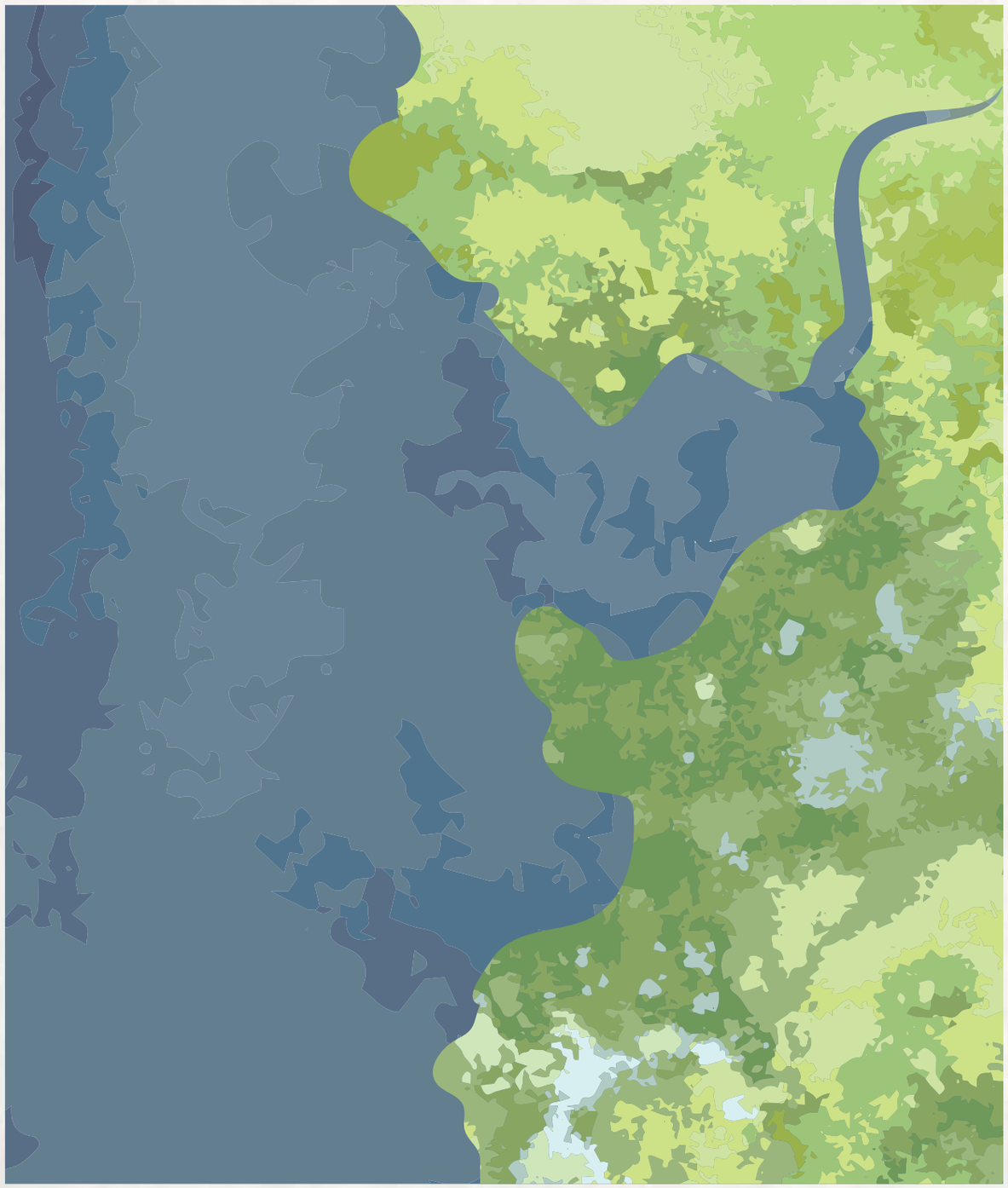
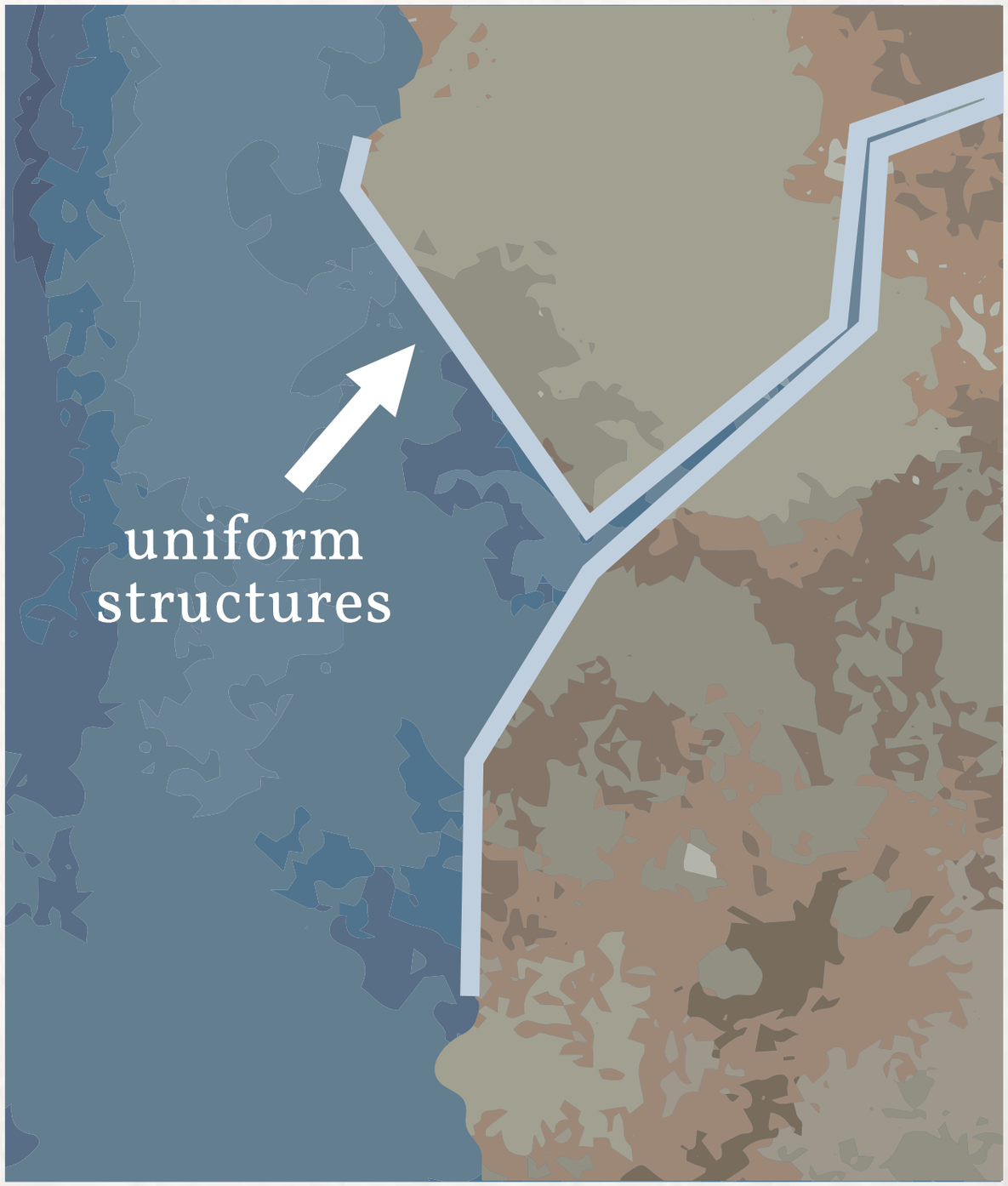


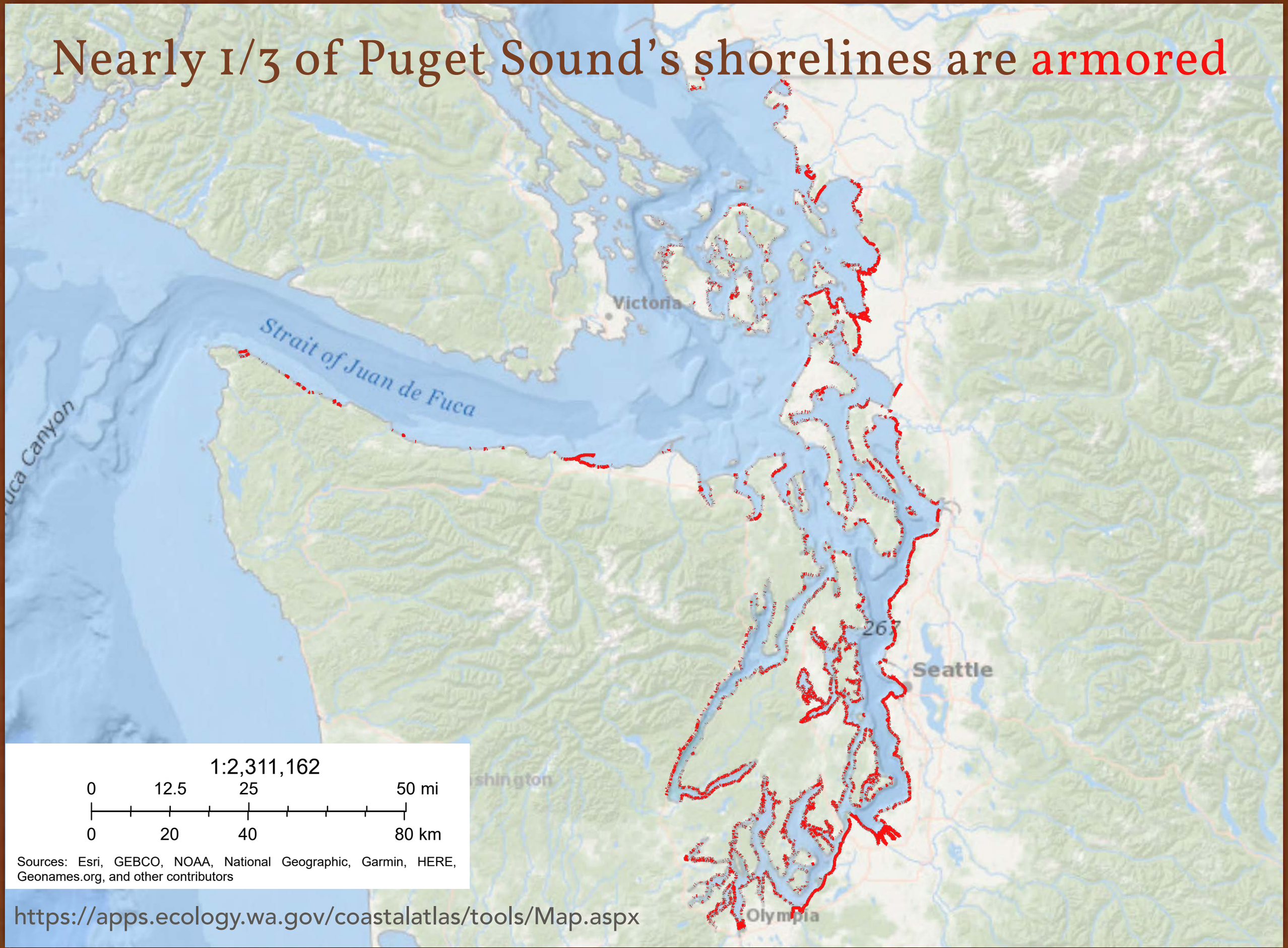
Humans often simplify our landscapes:

we simplify our shorelines with armor: seawalls & riprap



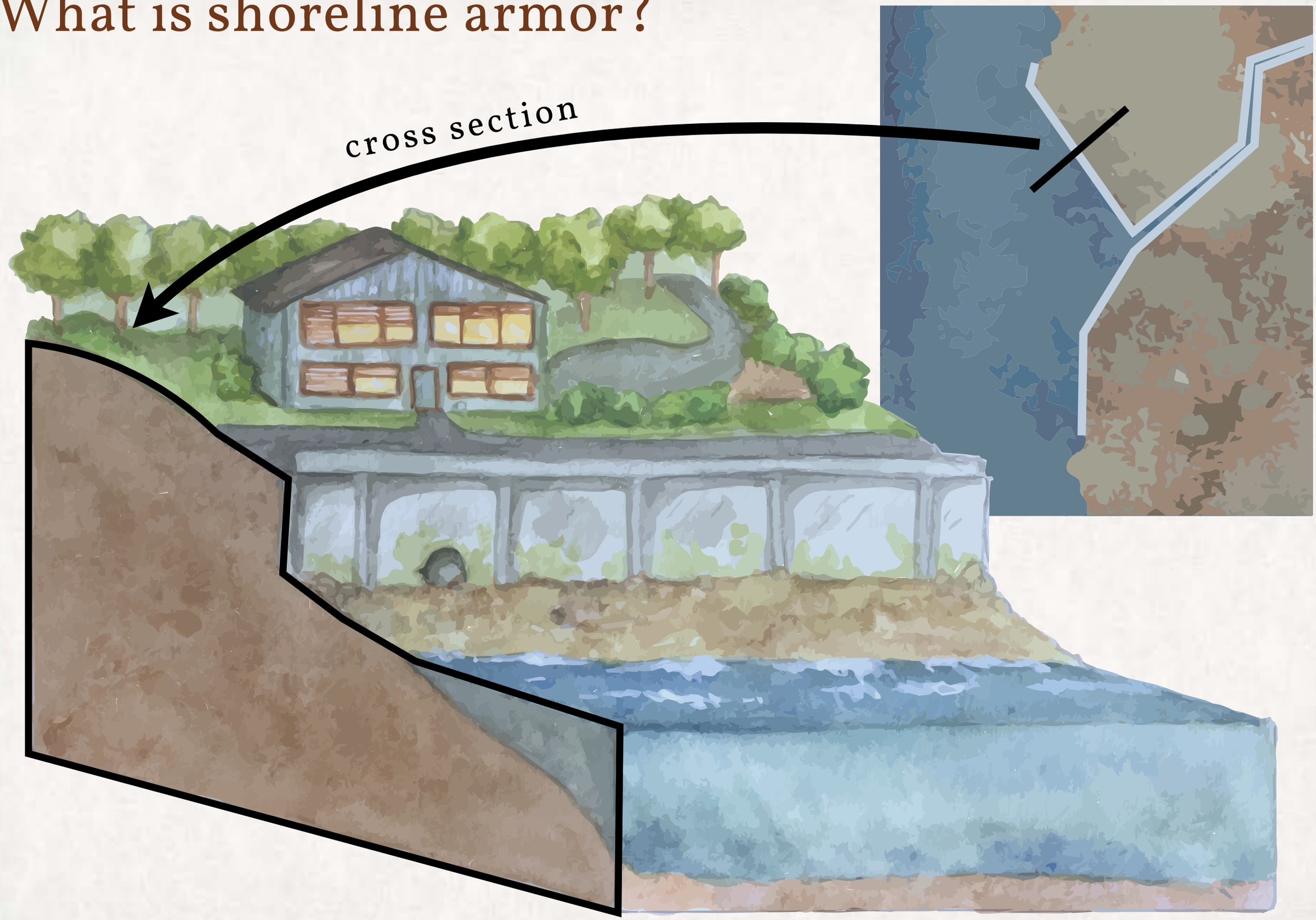


Nearly 1/3 of Puget Sound's shorelines are armored



https://apps.ecology.wa.gov/coastalatlas/tools/Map.aspx

What is shoreline armor?



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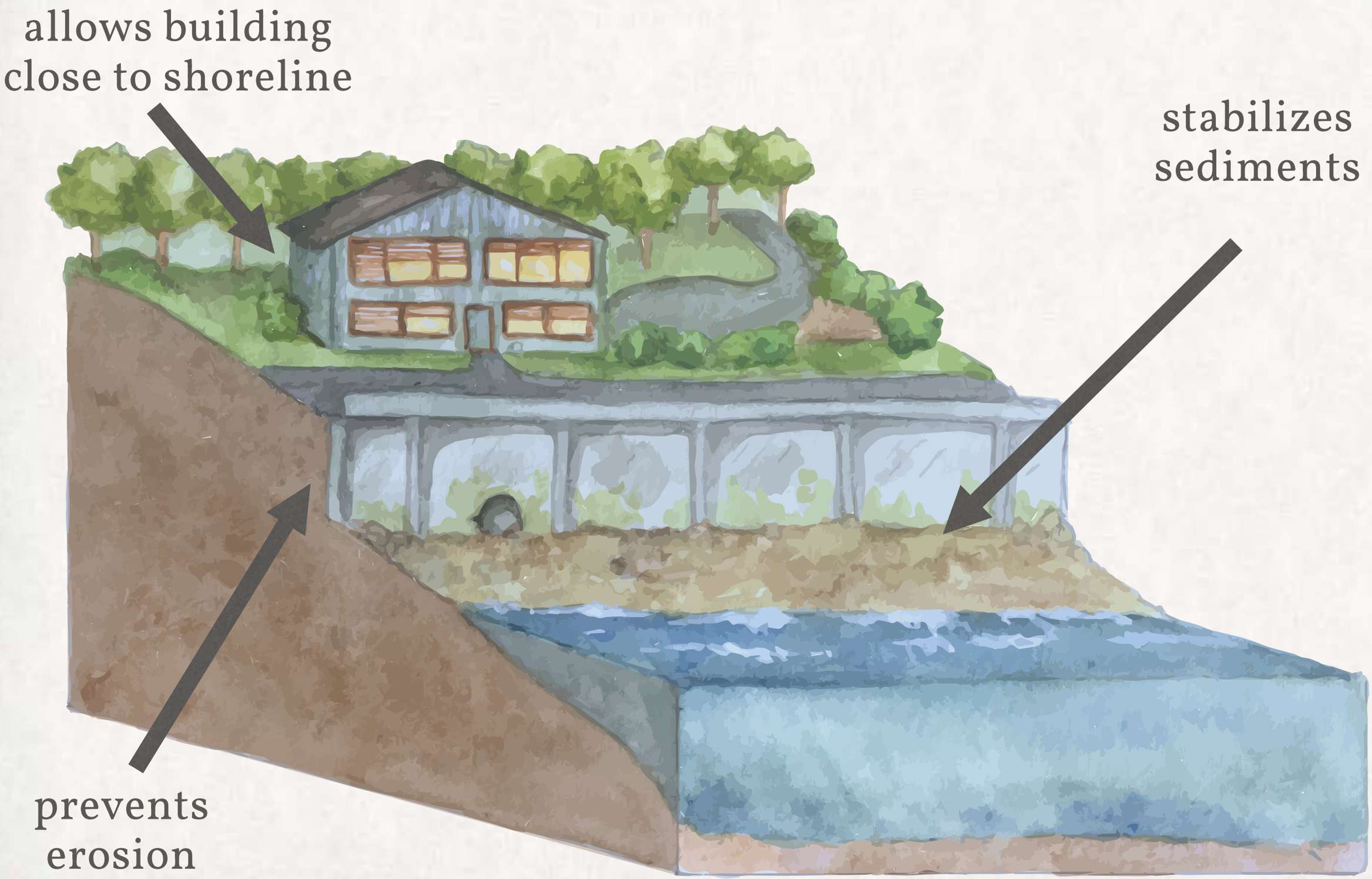

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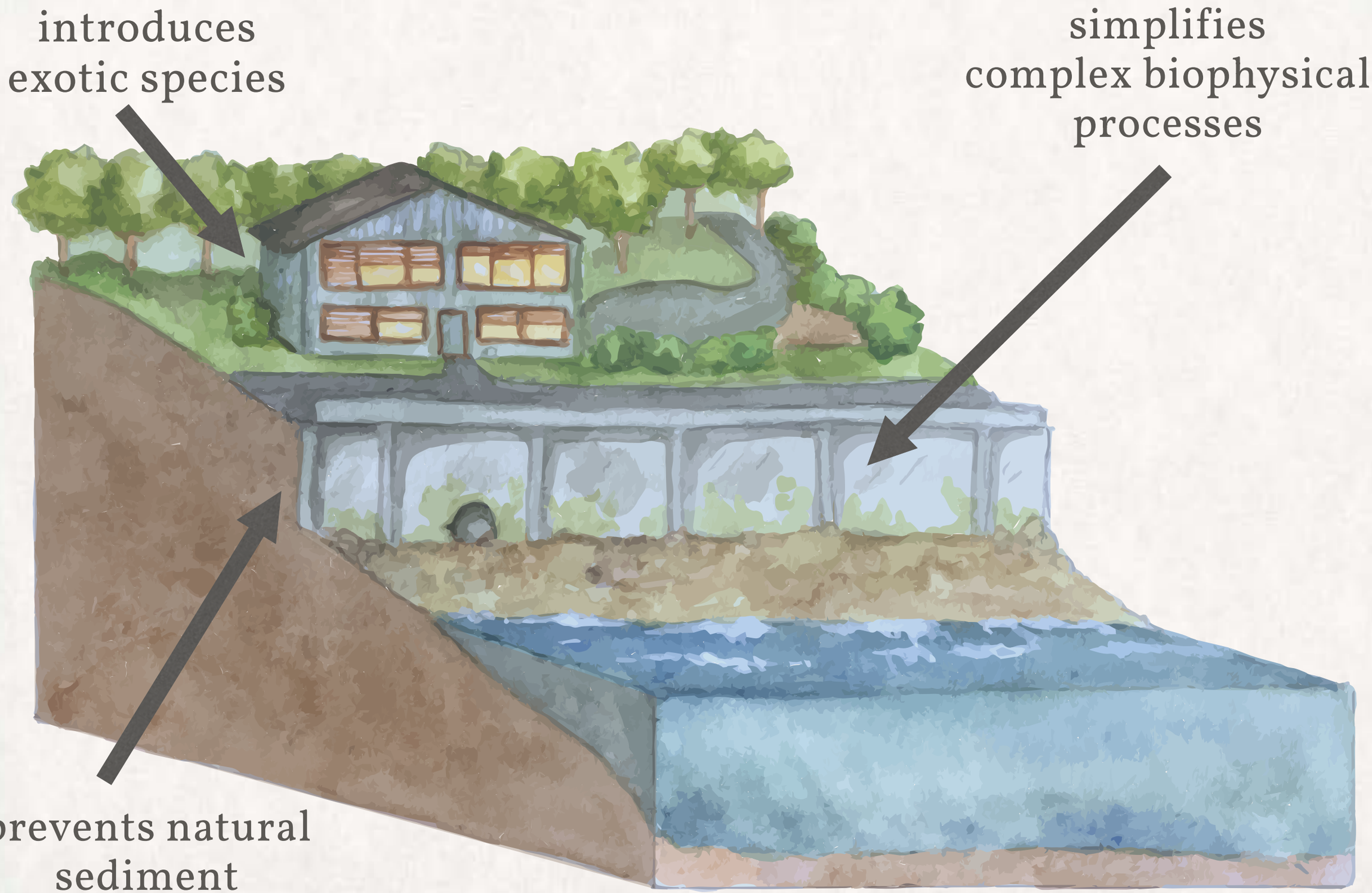
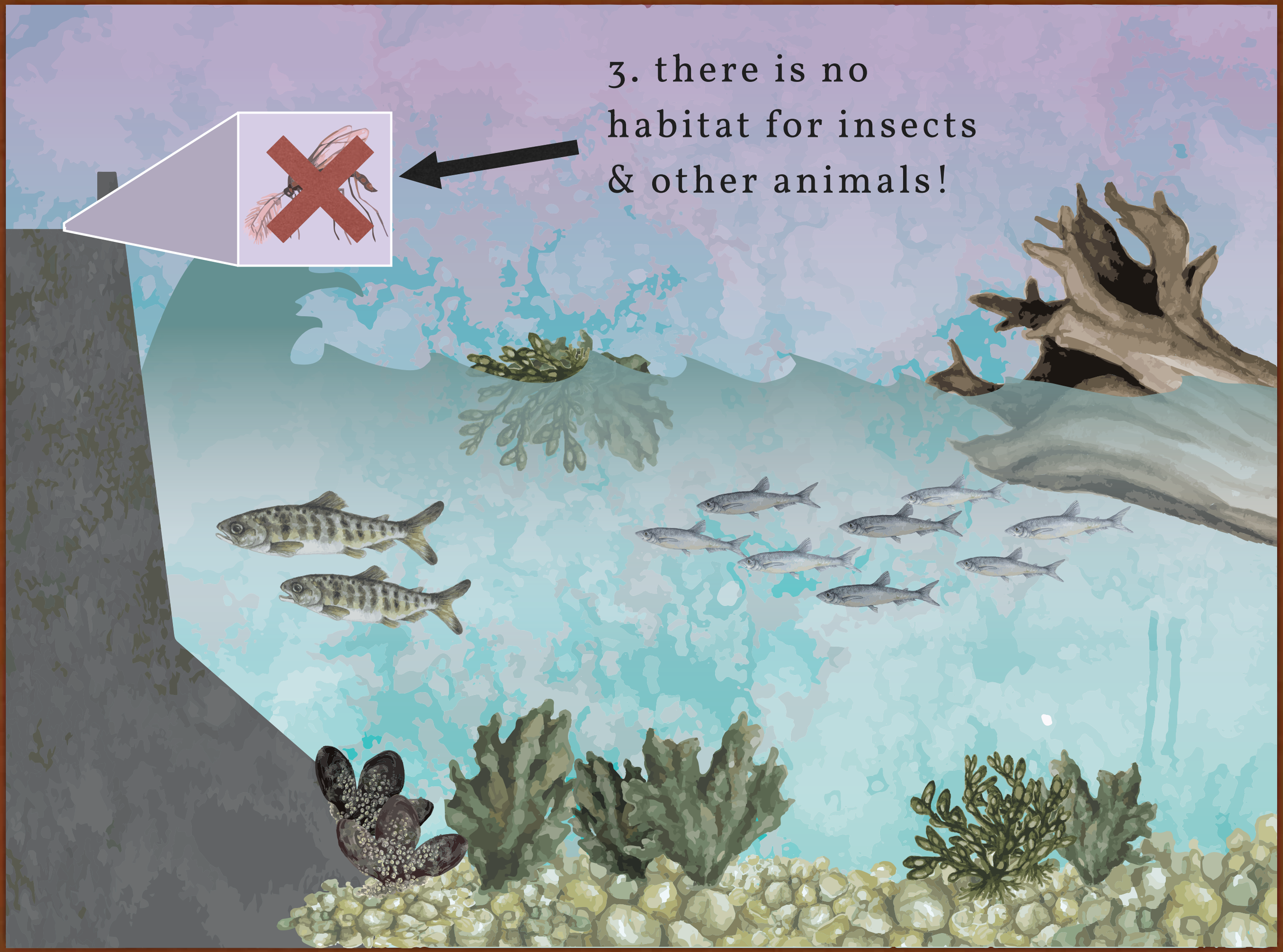


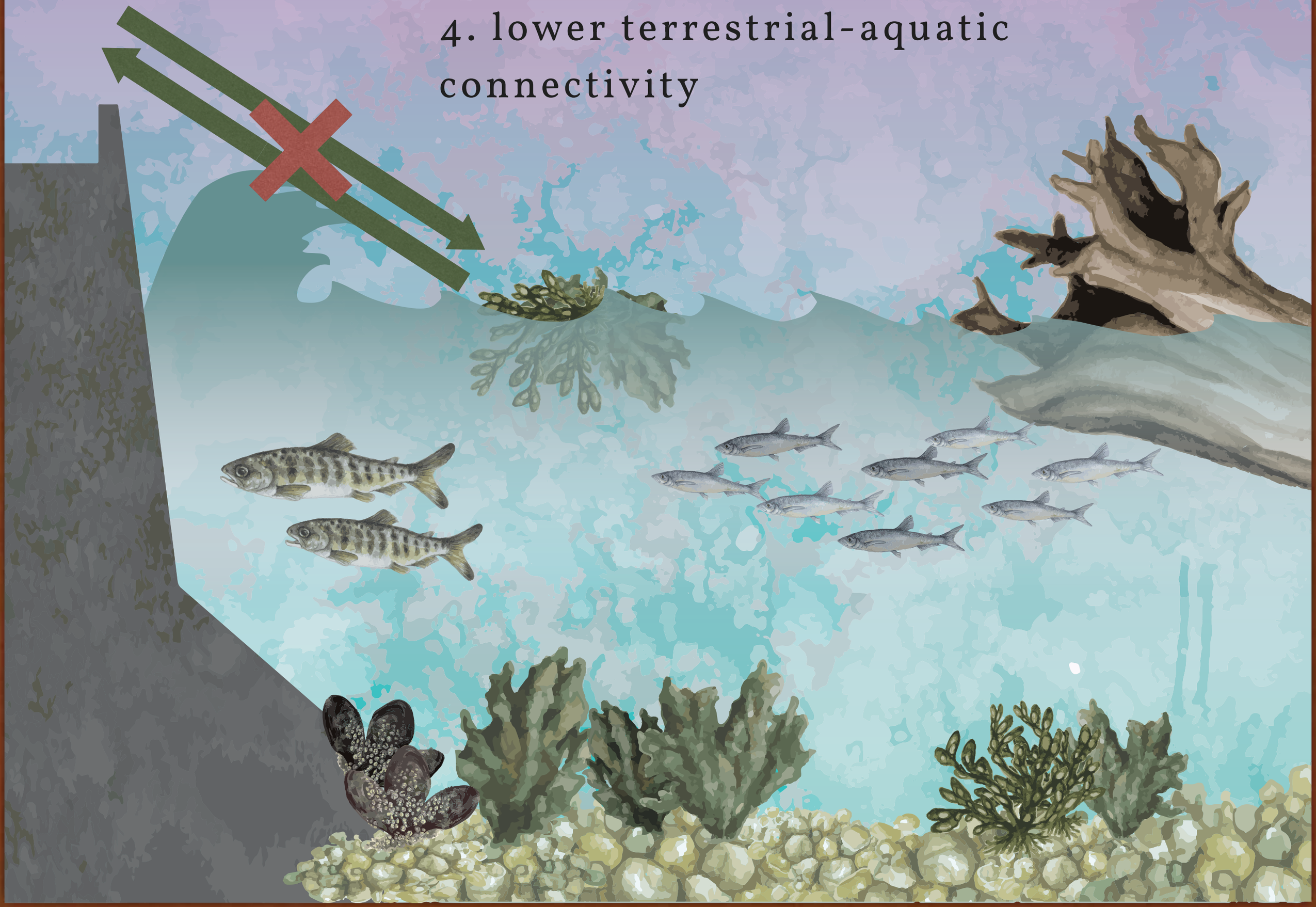
1. wrack and logs cannot be deposited on the beach

These illustrations are on display at the Vashon Nature Center!

2. armoring prevents establishment of riparian vegetation

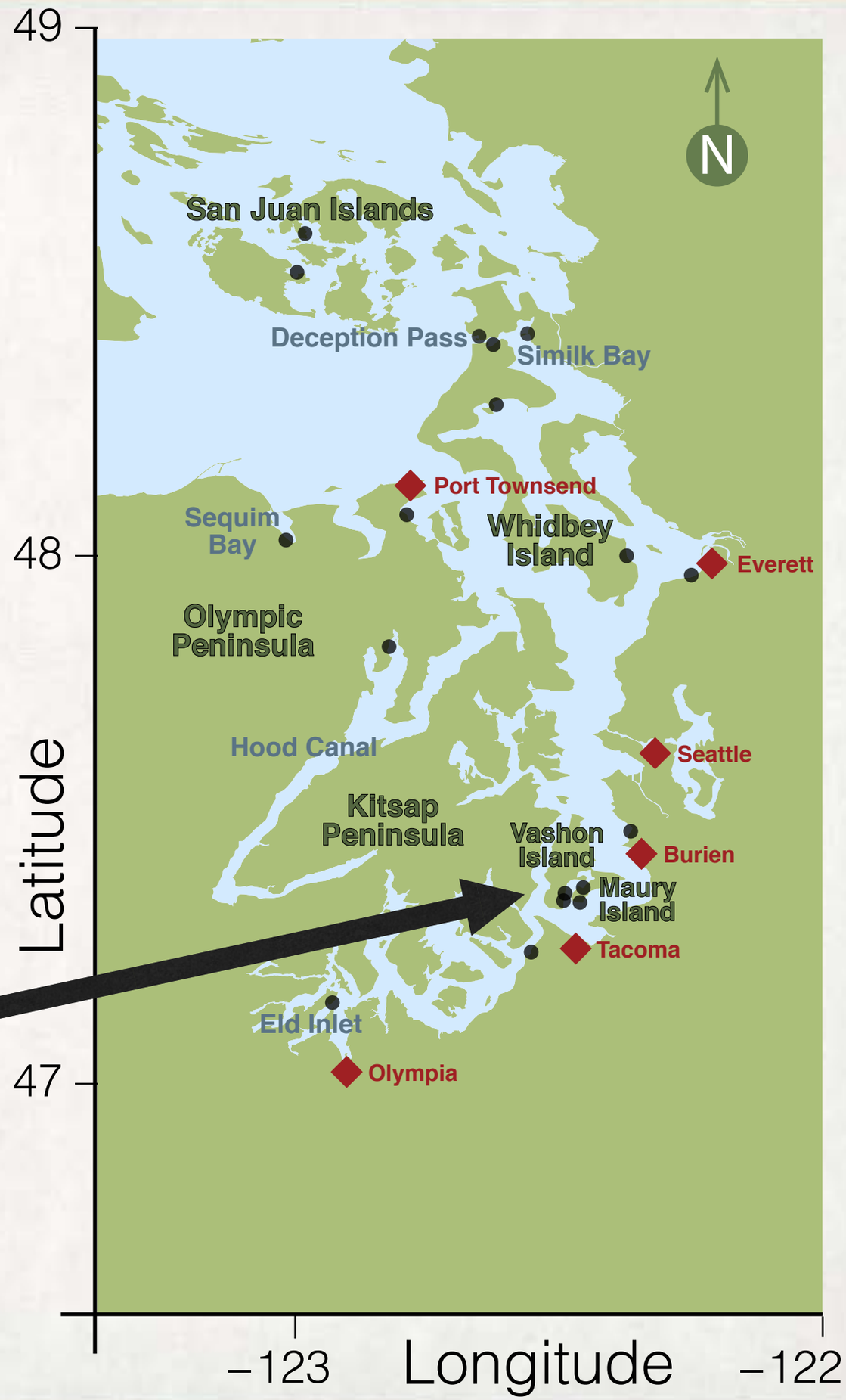

3. there is no
habitat for insects
& other animals!

4. lower terrestrial-aquatic connectivity



How are we measuring effectiveness of shoreline armor removal?

highlighting 18 sites out of over 100 monitored



We monitor 3 basic types of shoreline:

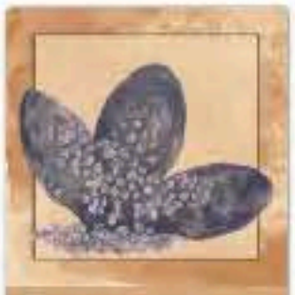
Photos by Hannah Faulkner

Shoreline Monitoring Database

Animals


Epibenthic invertebrates


Insects


Surface epifauna & algae


Benthic invertebrates


Birds


Fish


Forage fish eggs


Wrack invertebrates

Vegetation, Eelgrass, Kelp, Logs


Beach wrack


Logs


Riparian vegetation


Bull kelp


Eelgrass


Vegetation

Habitat

Armor mapping

Estuary extent & restoration

Photo points

Physical


Sediment size

Beach profile

multiple standardized protocols

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Beach profile

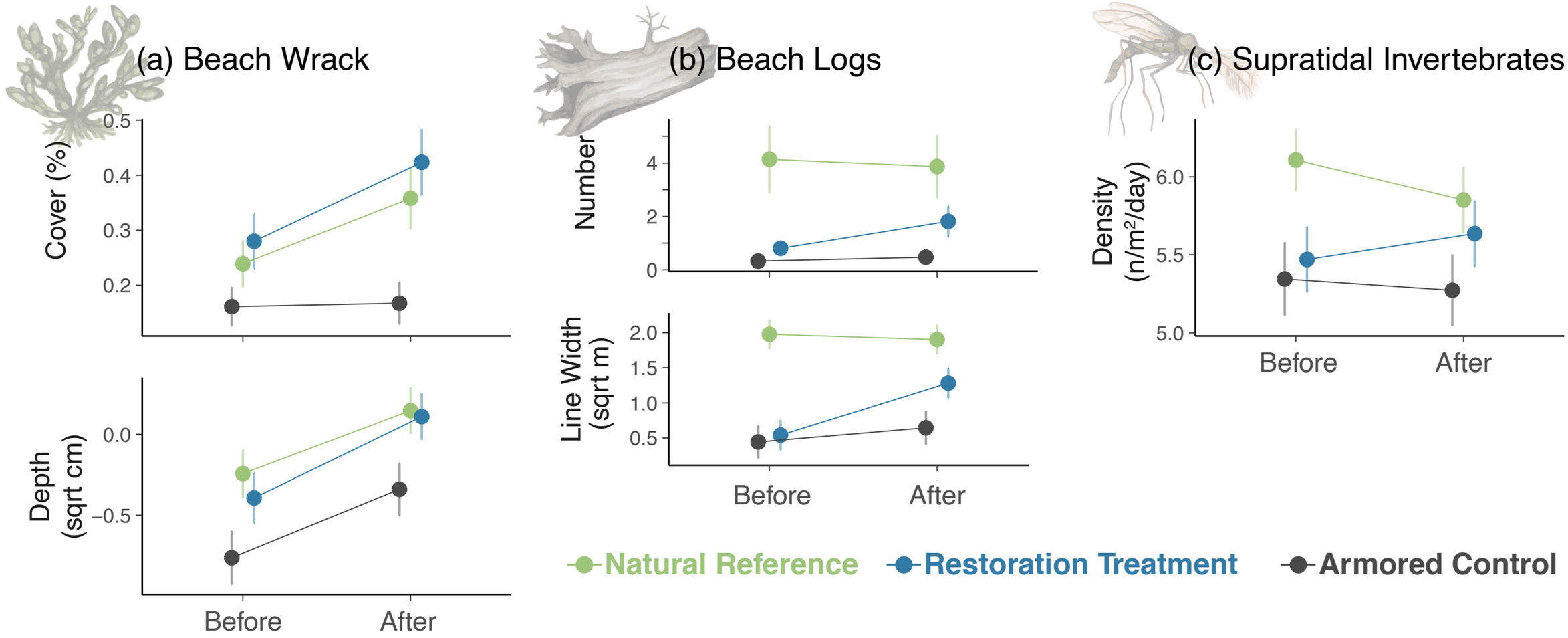
How has restoration - armor removal - affected different ecological response variables?

Specifically...

their abundance
(density, amount, number)

their variability
(diversity, temporal variation, spatial variation)

Before-After-Impact-Control (BACI) design to evaluate restoration effectiveness

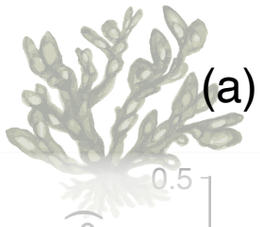


responses in **Restoration Treatment**...

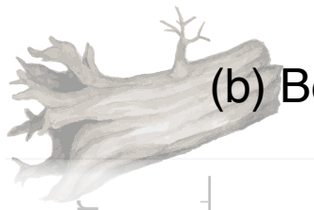
are more similar to **Armored Control** *before* restoration

are more similar to **Natural Reference** *after* restoration

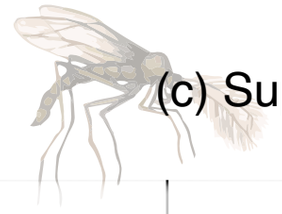
Before-After-Impact-Control (BACI) design to evaluate restoration effectiveness



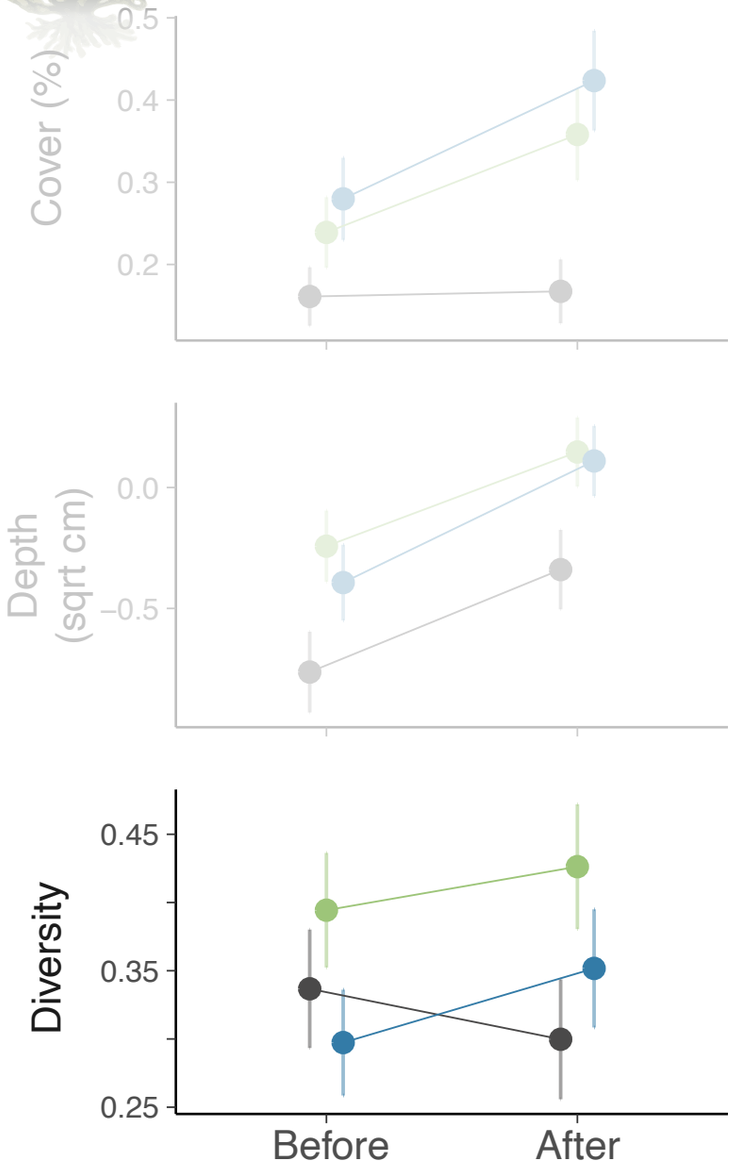
(a) Beach Wrack

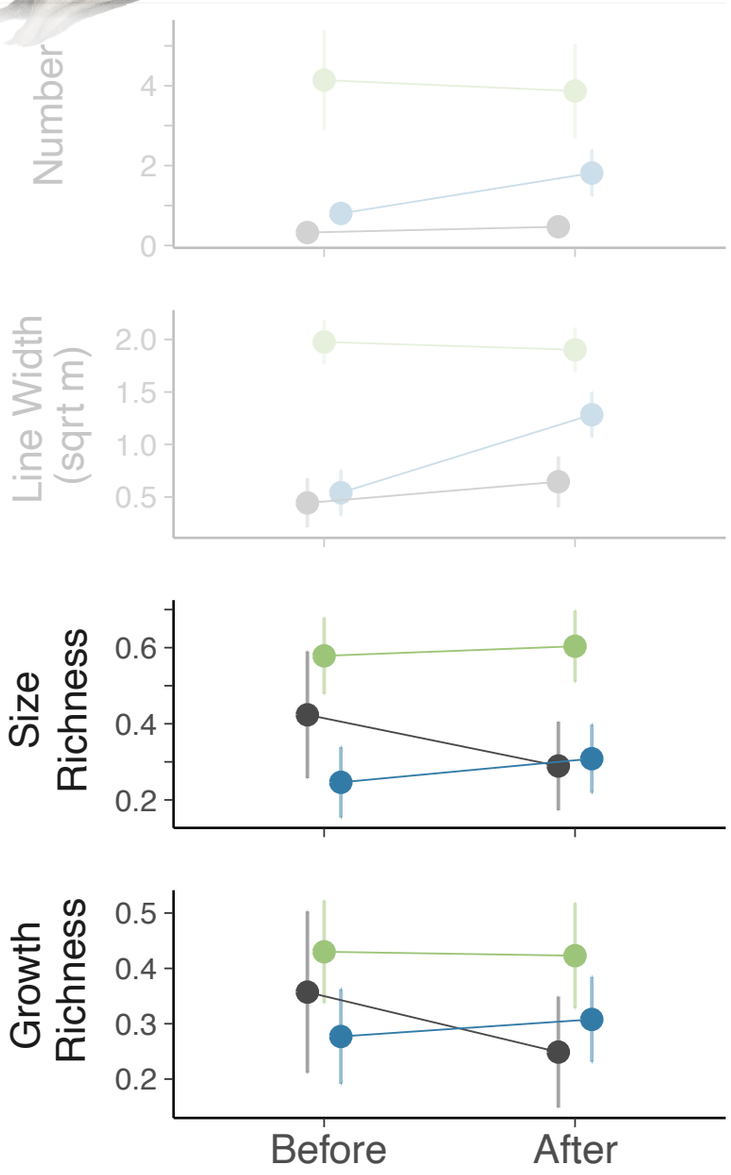


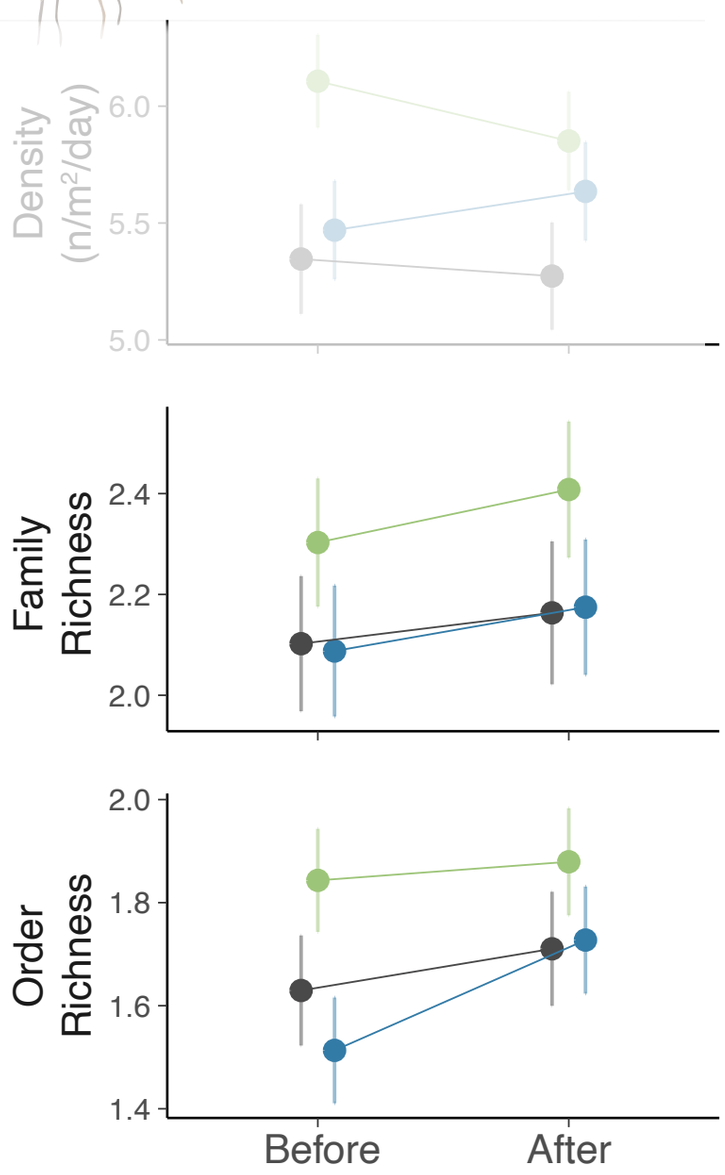
(b) Beach Logs



(c) Supratidal Invertebrates

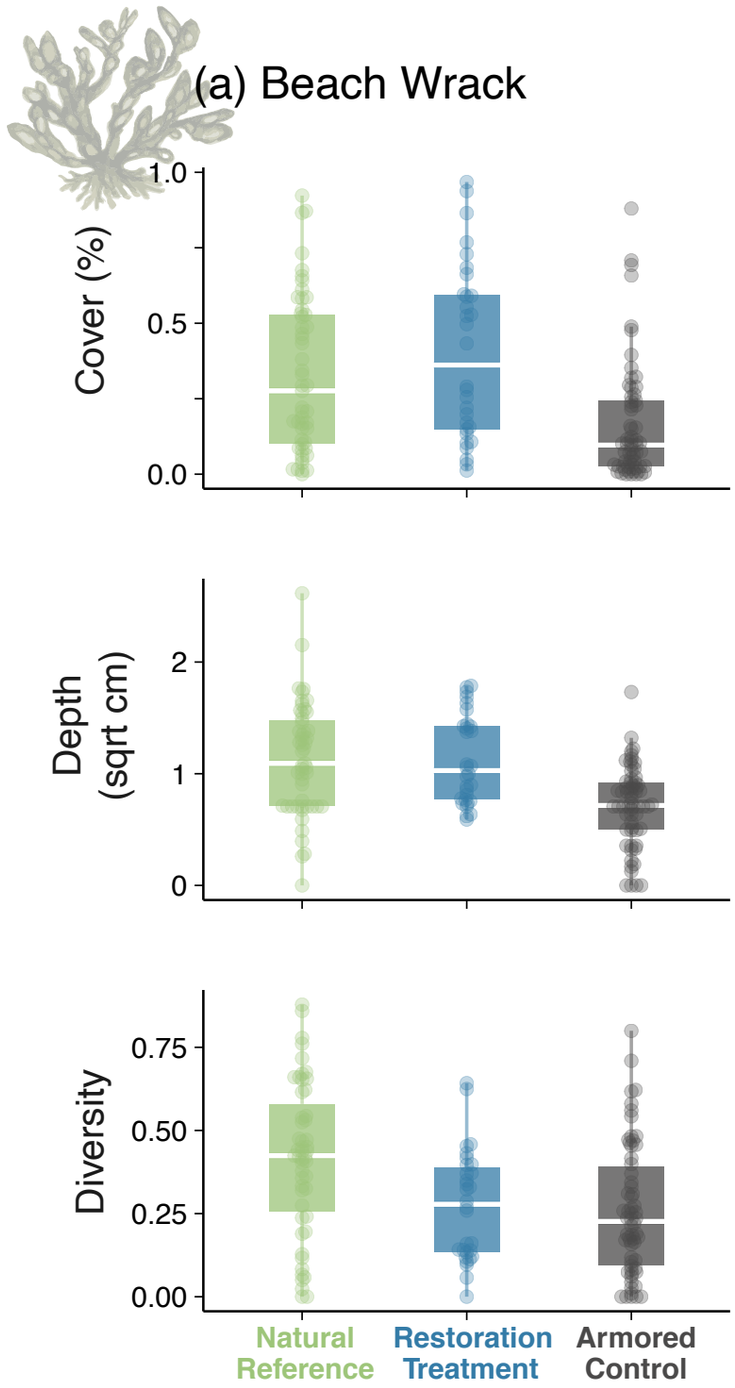


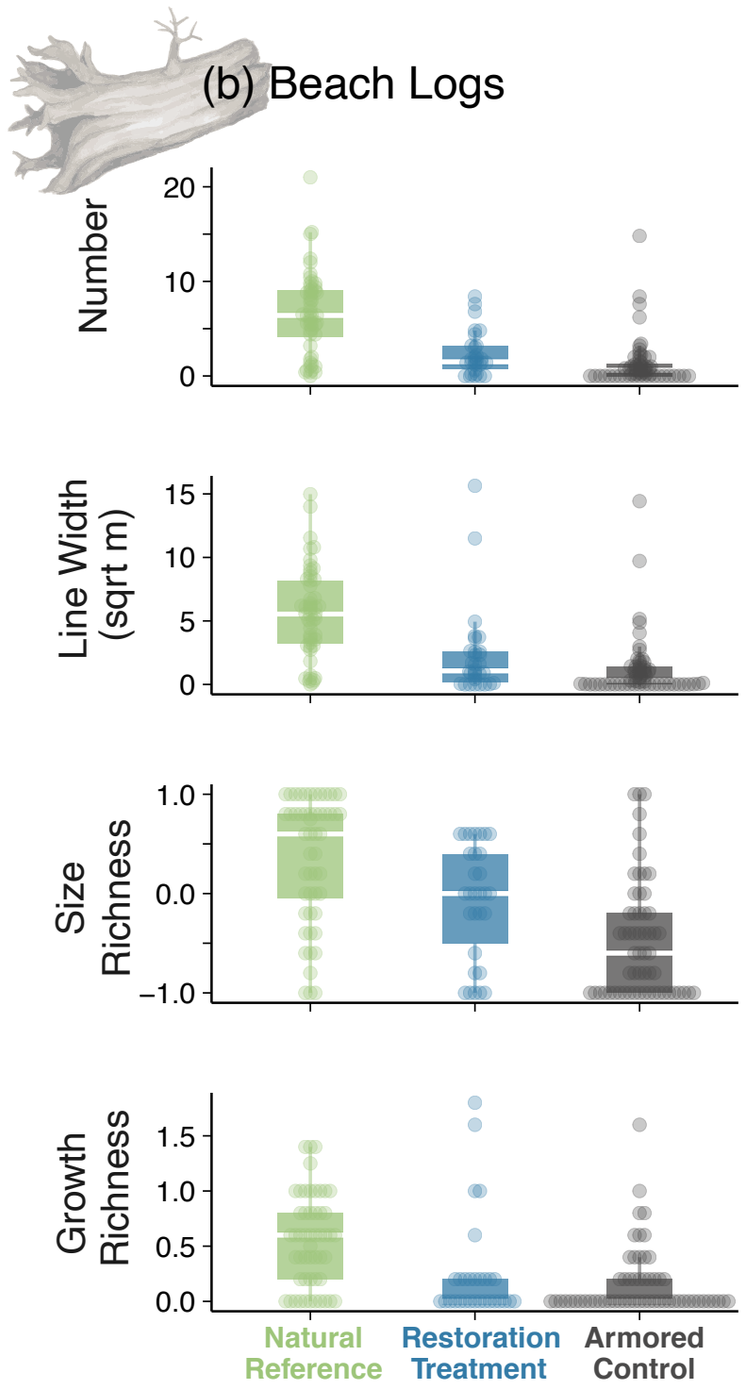


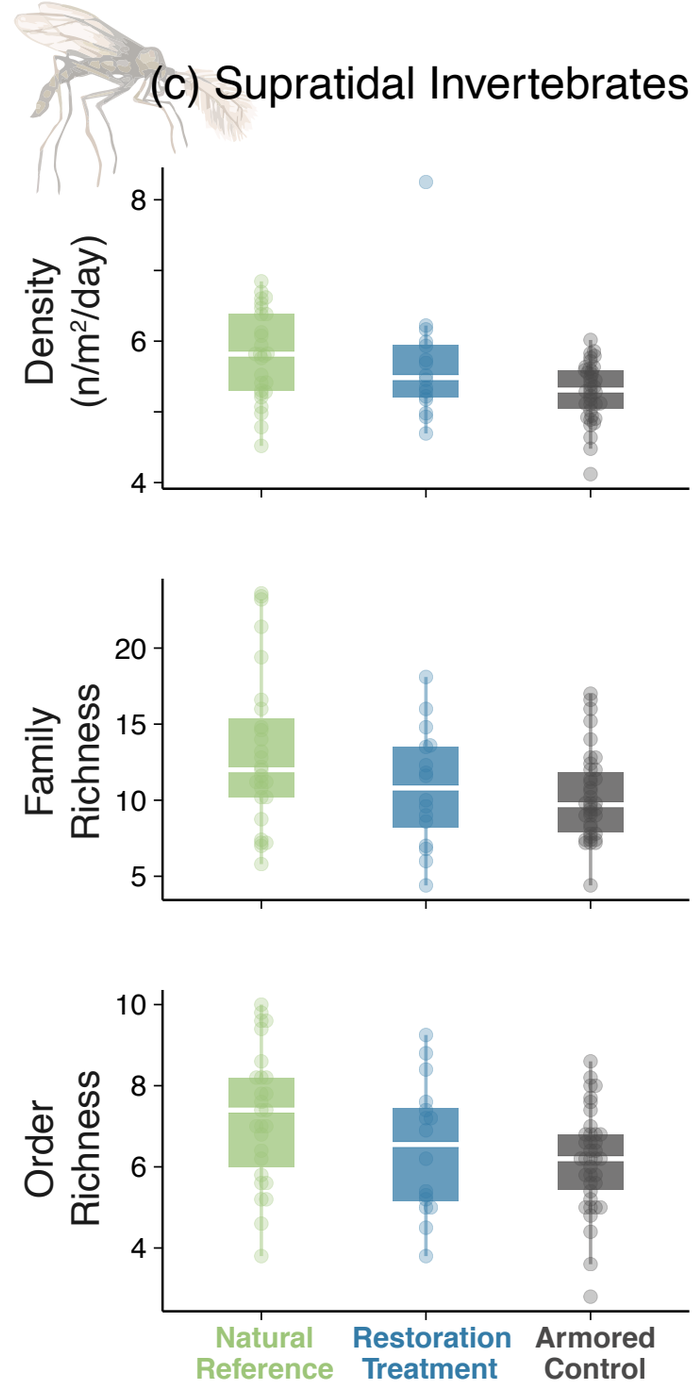


Natural Reference Restoration Treatment Armored Control

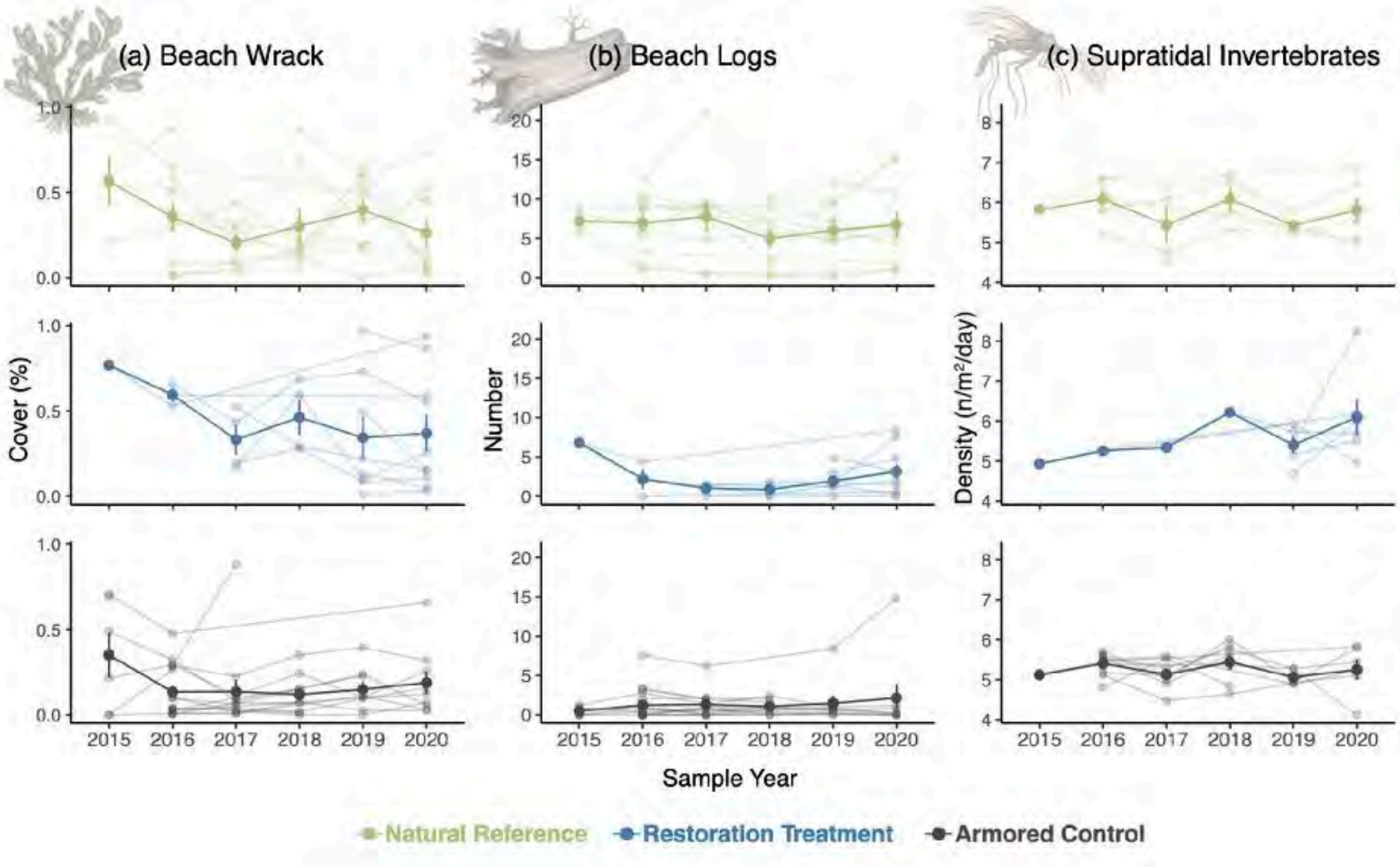
Variation around mean as a measure of restoration success







Variation over time & space



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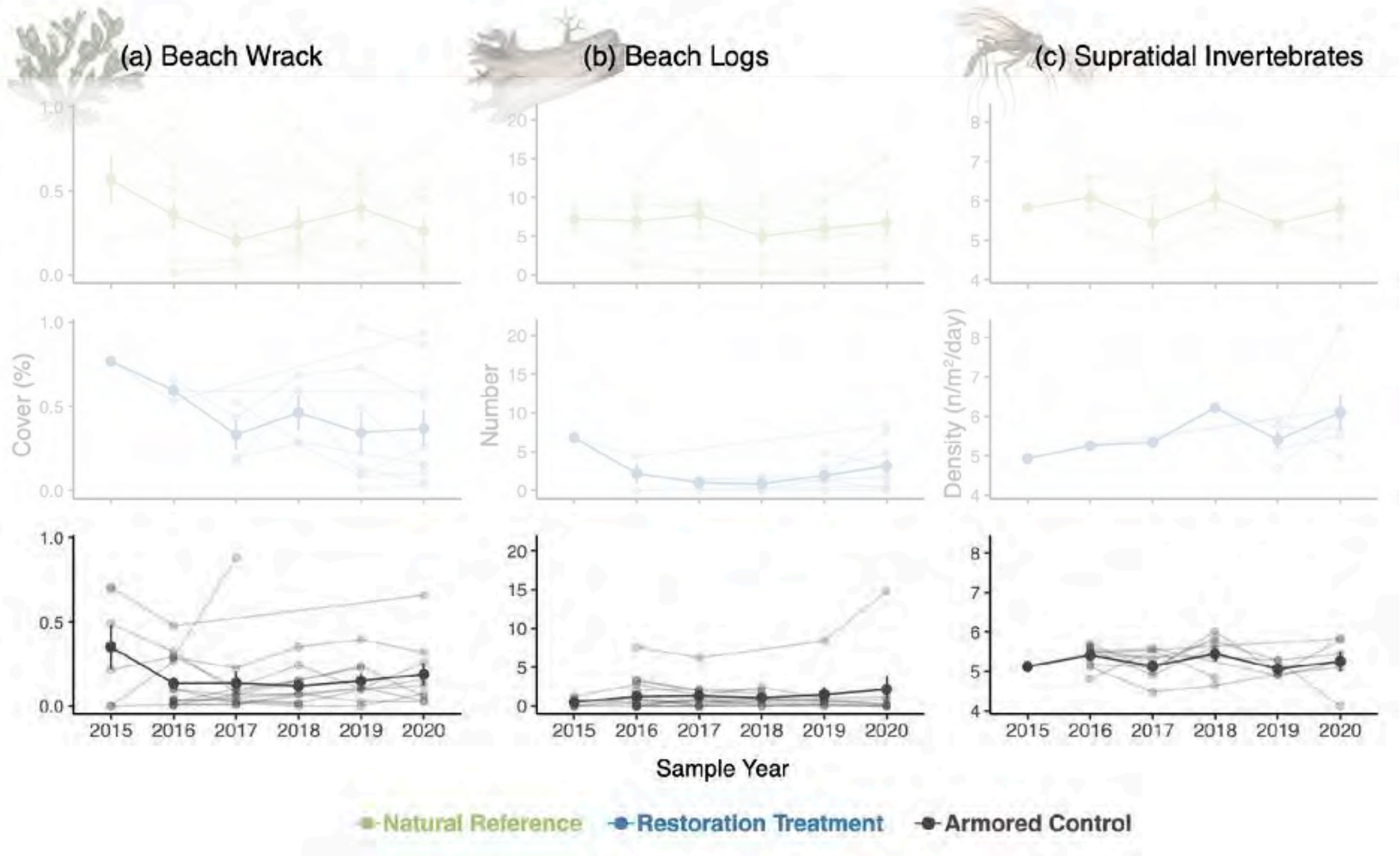

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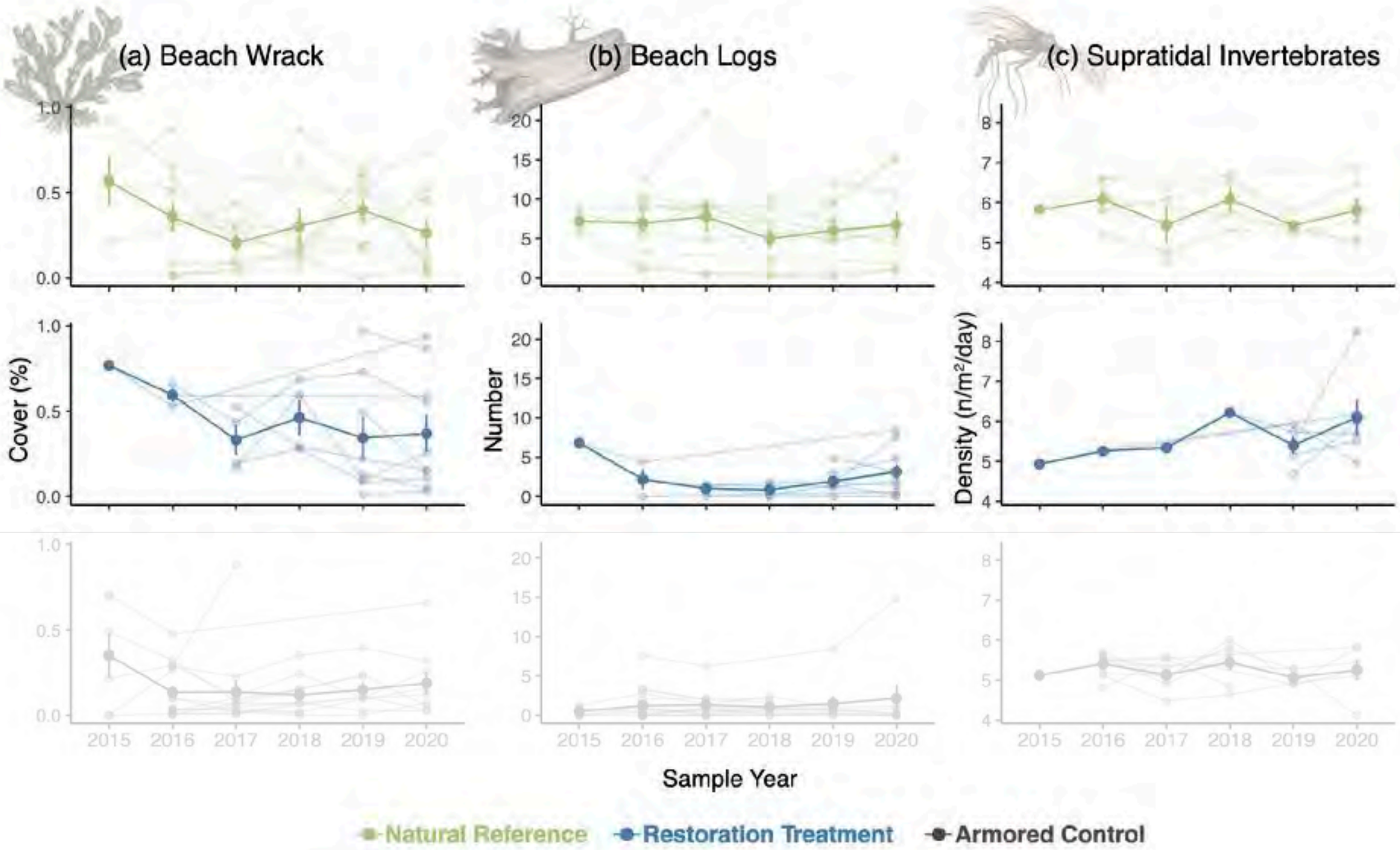
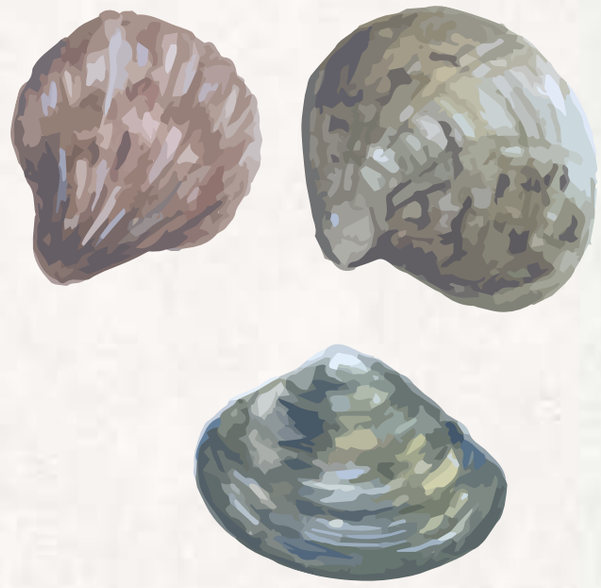
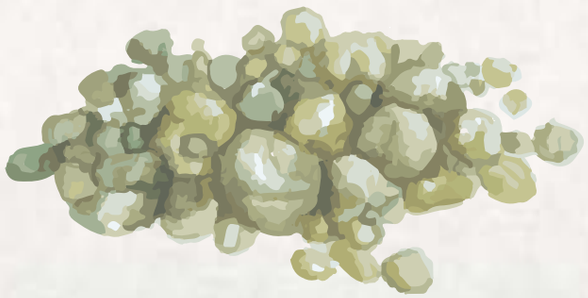


Variability manifests in many different ways...

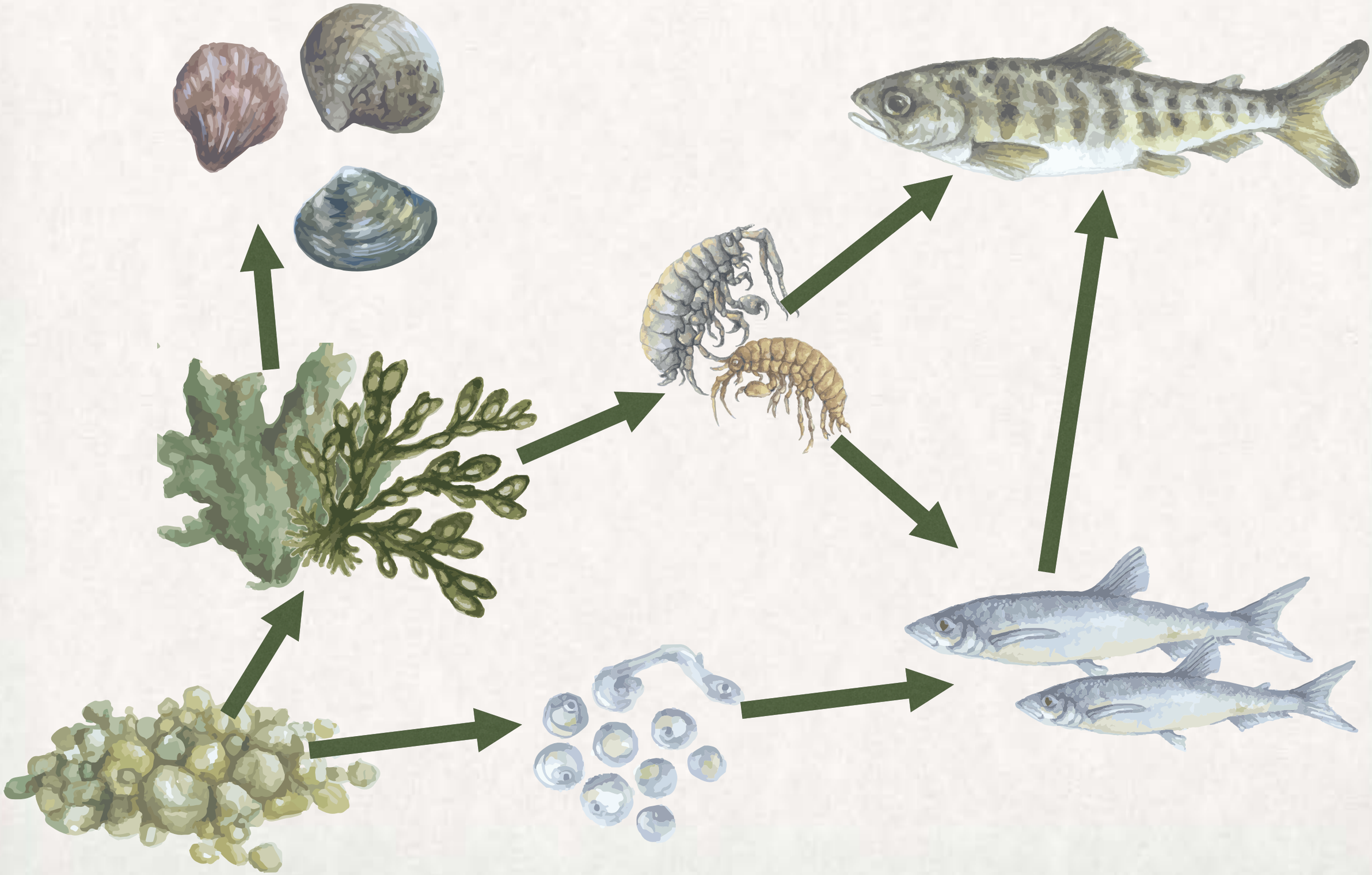
species compositional variation
within-species variation
migrational variability
structural heterogeneity
seasonal fluctuations
within-site complexity



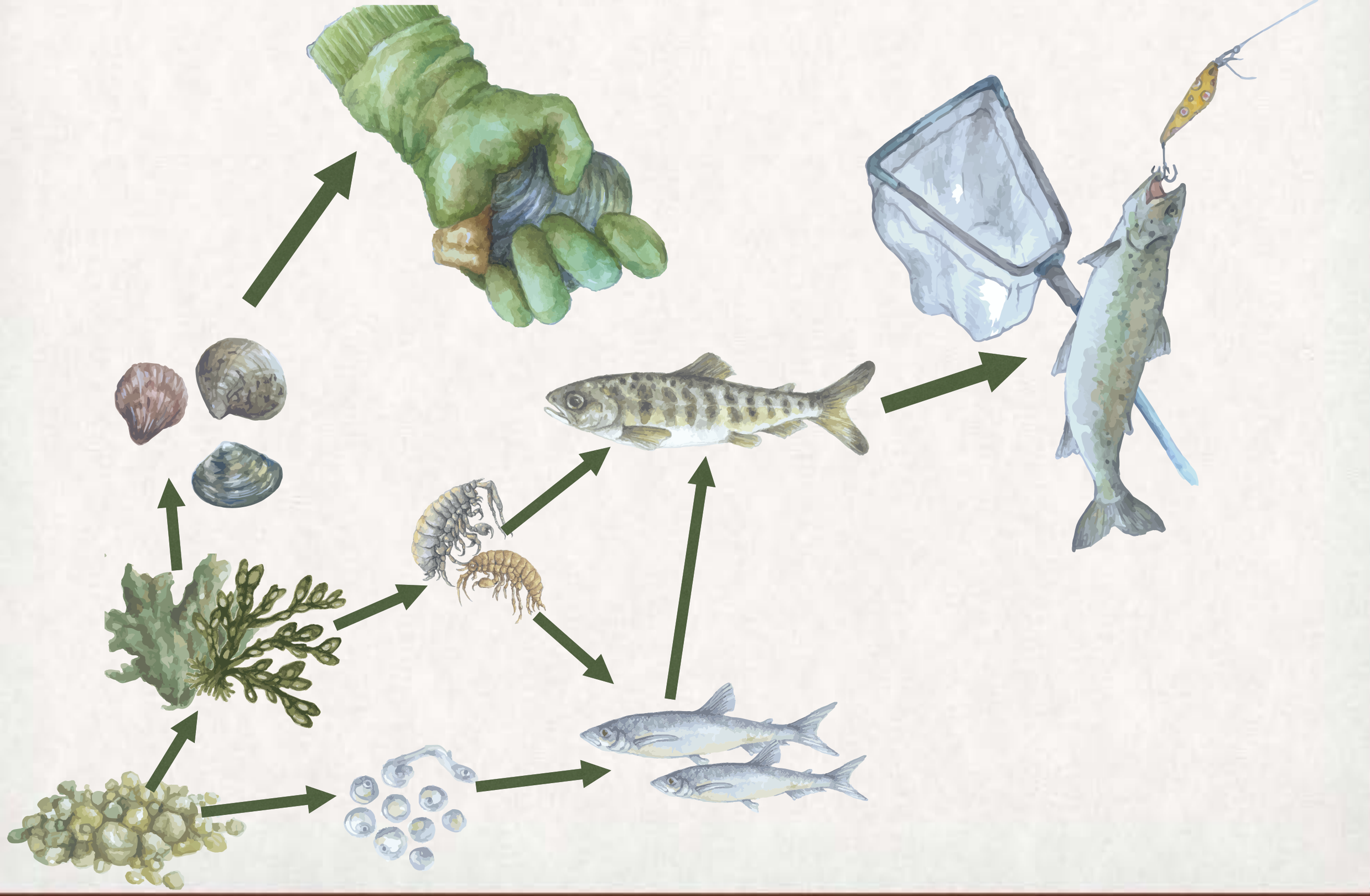
but is often less commonly considered a measure of restoration success



Diversity & variability are good for ecosystems, yielding increased productivity, abundance, & more diversity



Diversity & variability are good for humans & the resources we use



Humans can interact with & react to this variability in different ways

"There are so many different species to see!"

"The beach has something different every time I visit!"

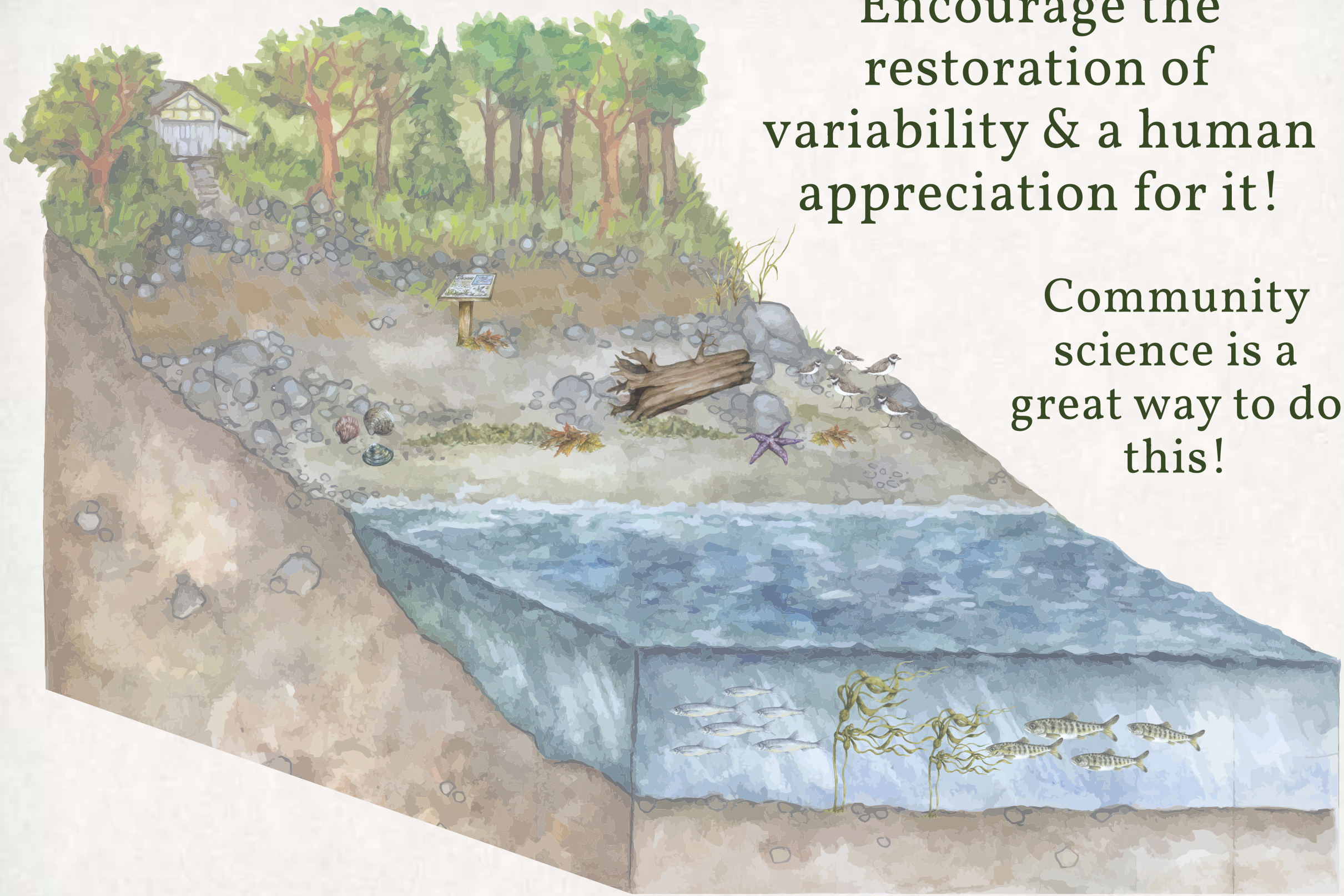
"I can visit different beaches, and none of them look the same!"

"The beaches are messy & look unmaintained."

"The beach habitat is unpredictable."

"Accessibility is uncertain and I don't know what to expect."

*quotes are examples & not actual responses



Encourage the restoration of variability & a human appreciation for it!

Community science is a great way to do this!

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