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Lessons from long time-series of benthic invertebrate communities in the southern Salish Sea, and an expansion of parameters to assess nutrient loading and climate change pressures

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State of Washington

Puget Sound Sediment Monitoring Program

Lessons from long time-series of benthic invertebrate communities in the southern Salish Sea

Valerie Partridge*, Margaret Dutch, Sandra Weakland, Dany Burgess, and Angela Eagleston
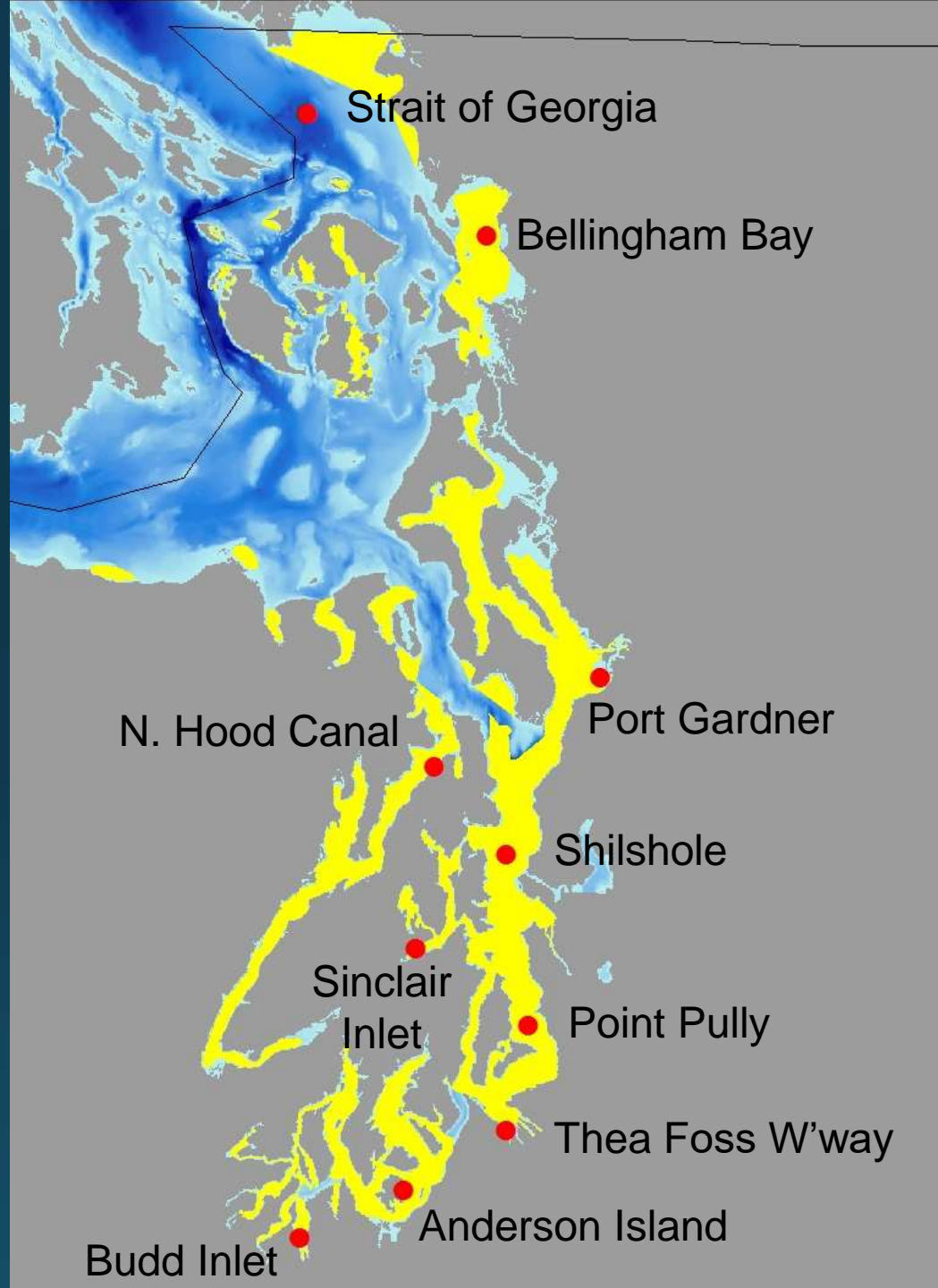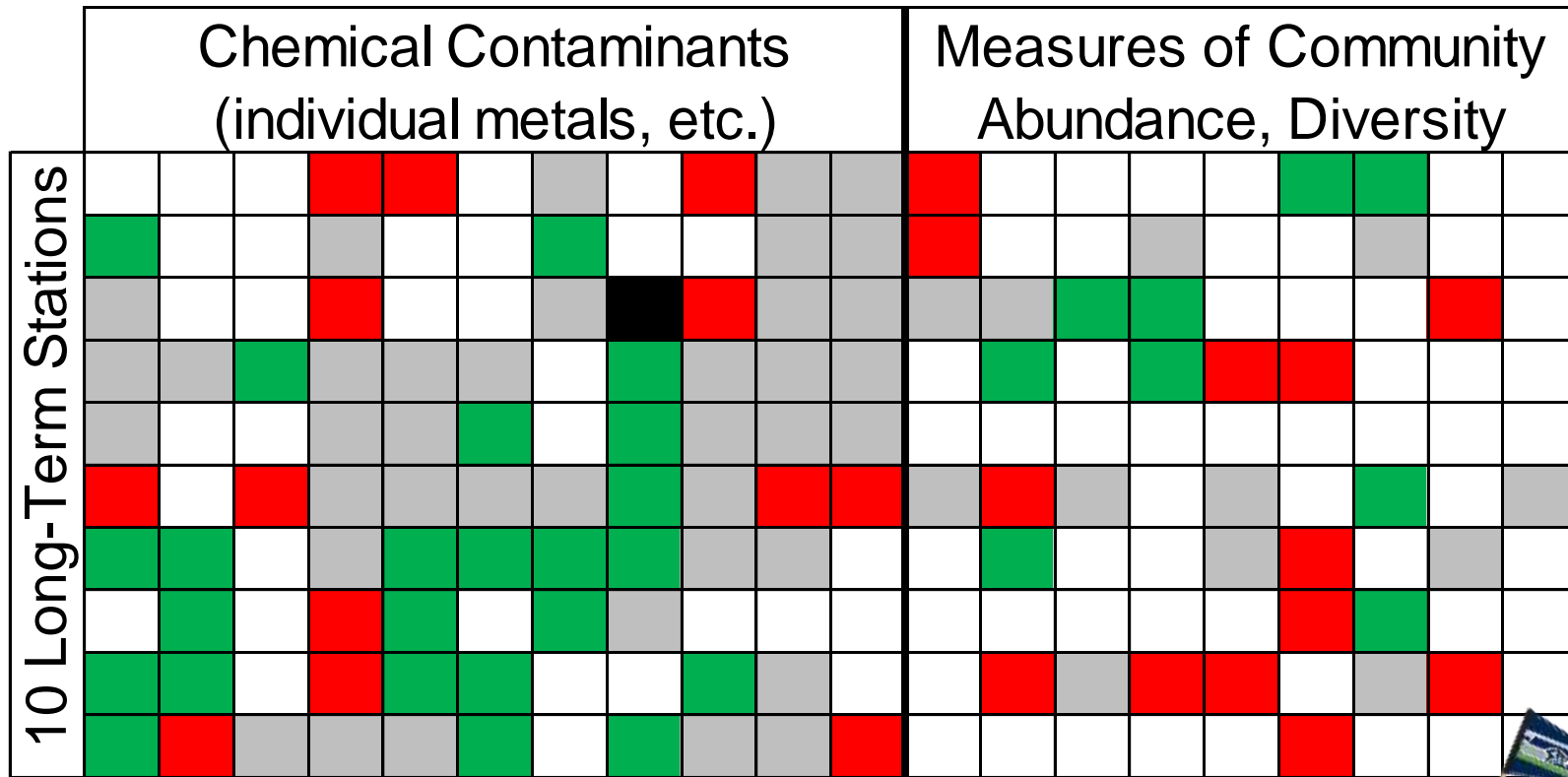
10 Long-term stations

- Sampled annually 1989 - 2015+

- Variety of habitats
  - depth
  - grain size
  - human influence

- Distinct benthic communities

What have we learned in ~30 years?

- Trends are complex

- Some communities remarkably stable; others unstable/impaired

- Context important
  - both spatial and temporal

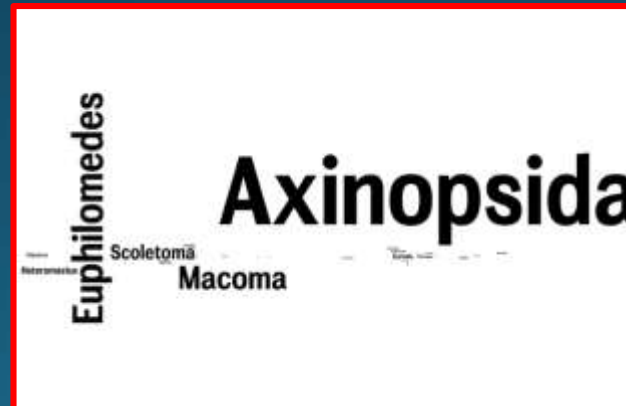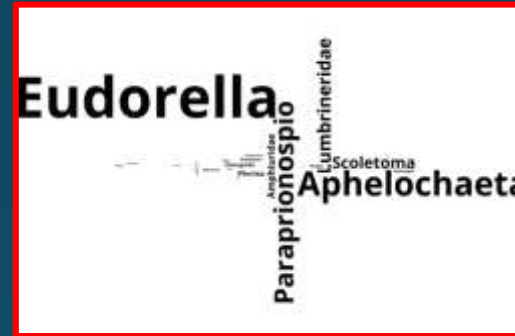# Complex trends over time
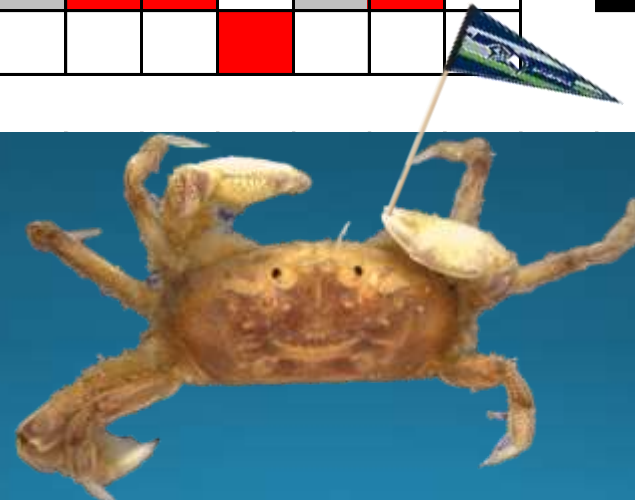
Communities differ in species, abundance

Box size ~ Total abundance
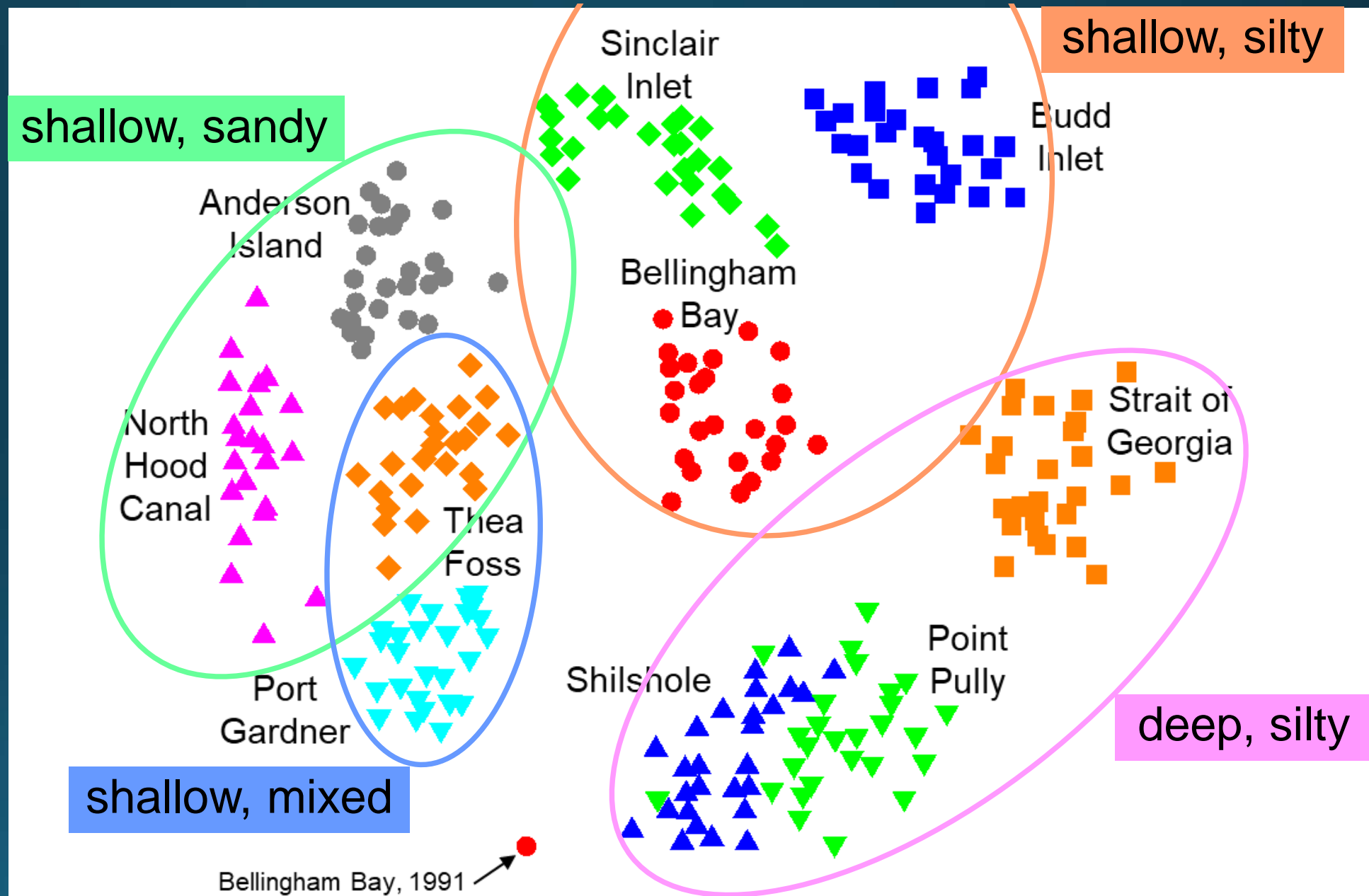
Font size ~ Species abundance

Community similarities

Each symbol =
    1 station in 1 year

Closeness = similarity
(both species & abundance)

Years within stations

Stations within habitat types

shallow, silty

shallow, sandy

Sinclair Inlet

Budd Inlet

Anderson Island

Bellingham Bay

North Hood Canal

Strait of Georgia

Thea Foss

Point Pully

Shilshole

Port Gardner

shallow, mixed

deep, silty

Bellingham Bay, 1991

Community shifts over time
Example: Thea Foss Waterway

Statistically similar years have same symbol

Community shifts possibly related to cleanups?
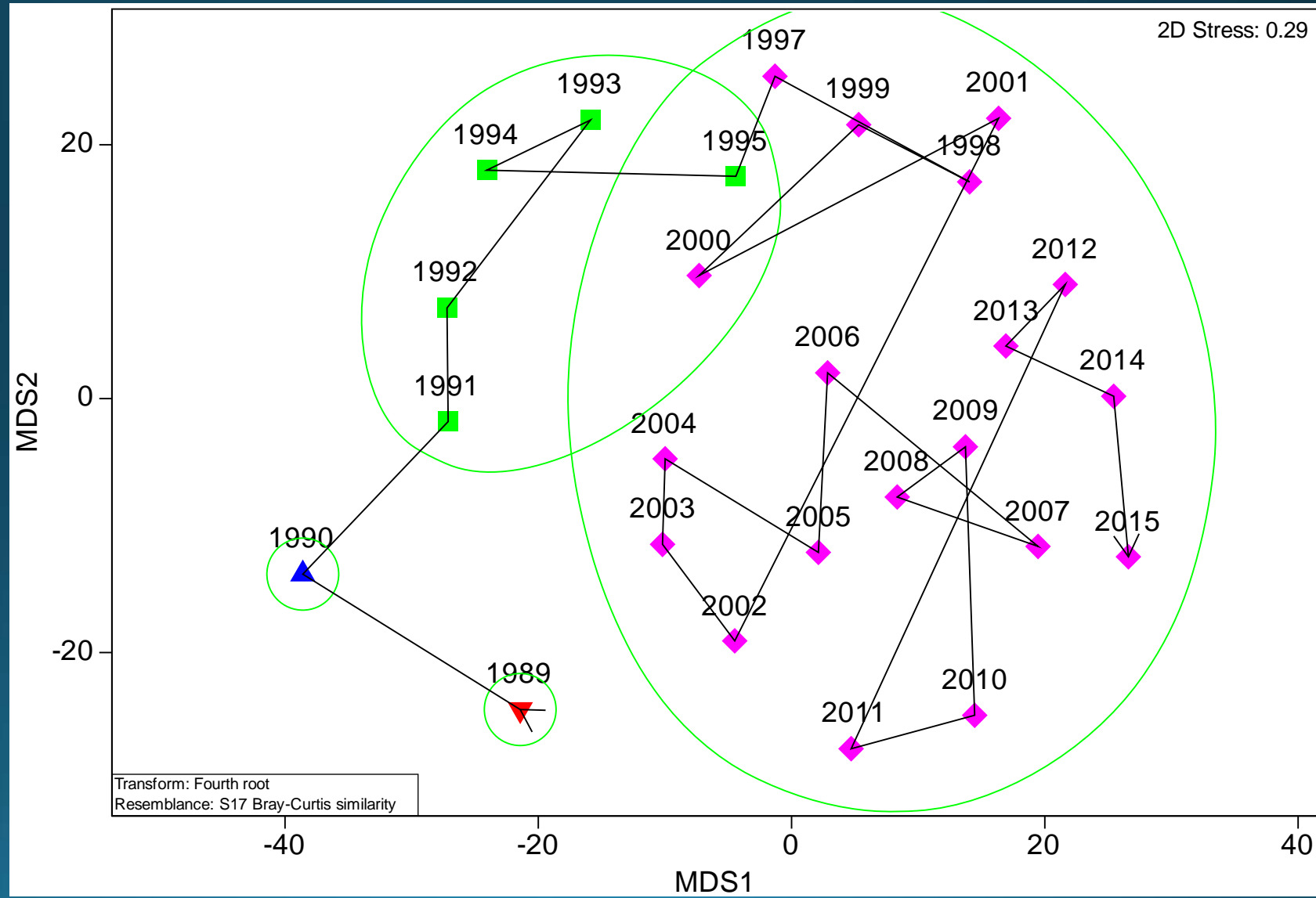
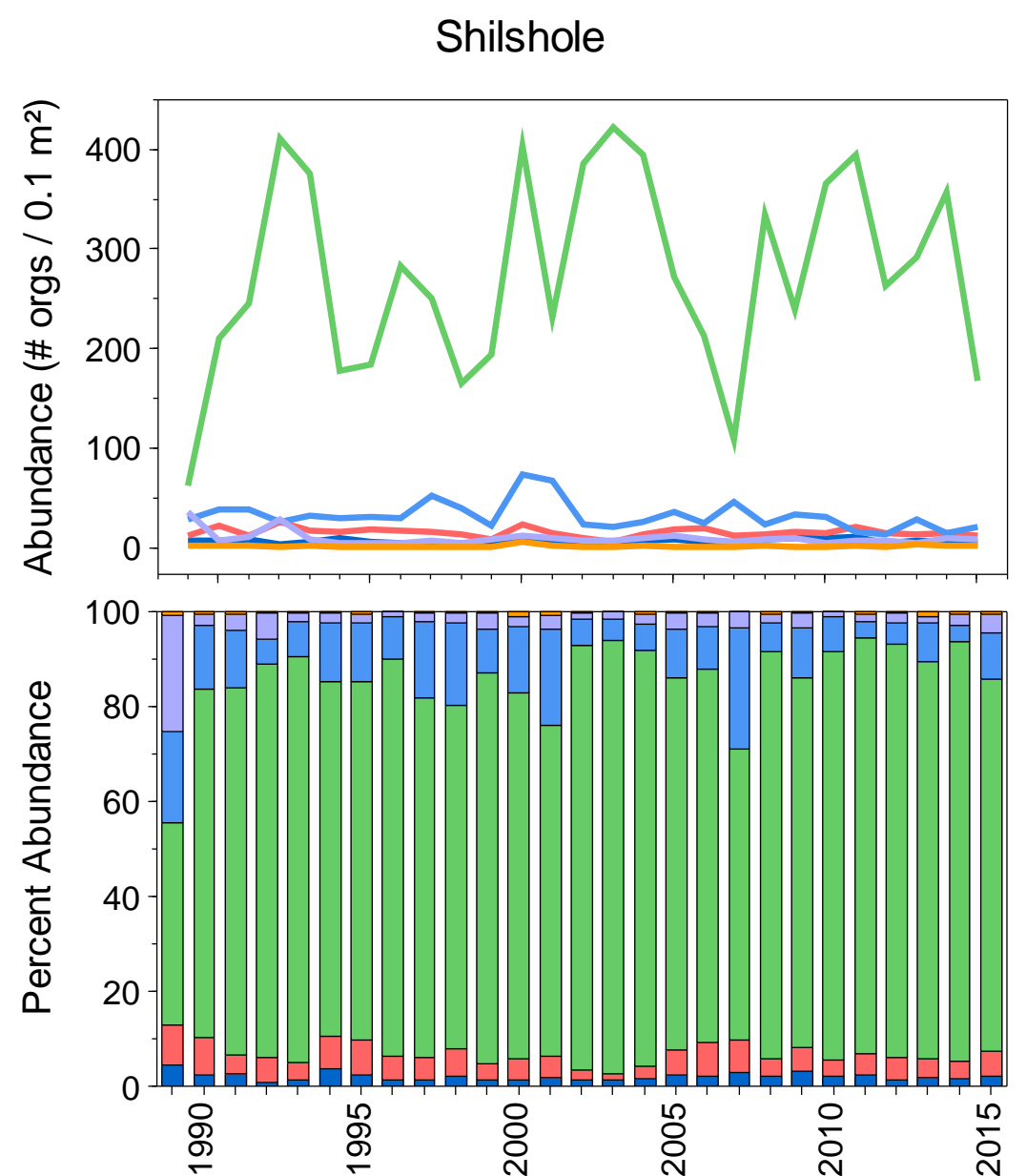# Functional feeding guilds - stable community

- Integrate what/where/how organisms eat
  (Macdonald et al., 2010, 2012)

Within feeding guild

- Abundance varies

- Species composition varies

Across feeding guilds

% Abundance ~ constant
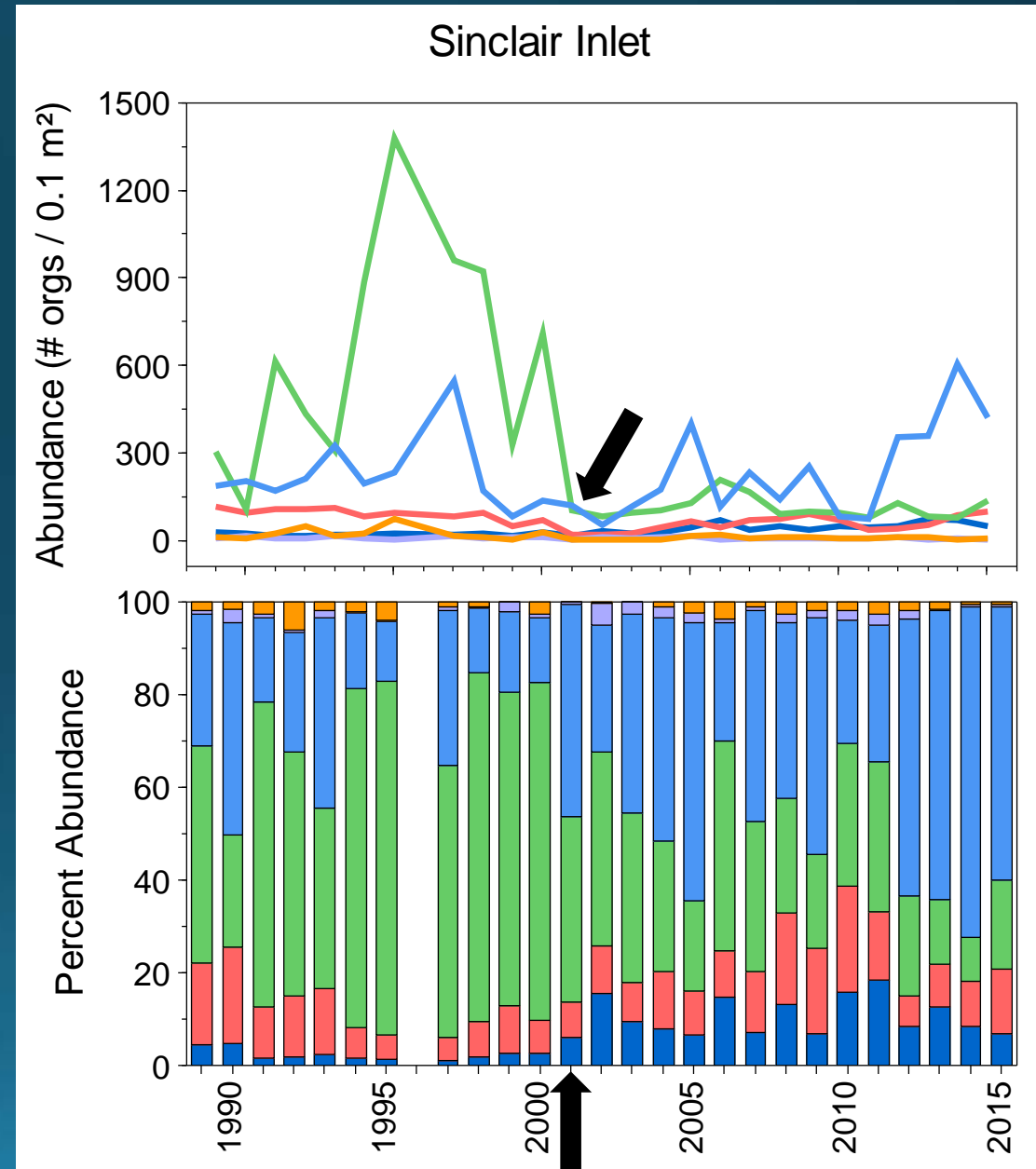
→ functions conserved

Shilshole

Functional feeding guilds - known impacted site

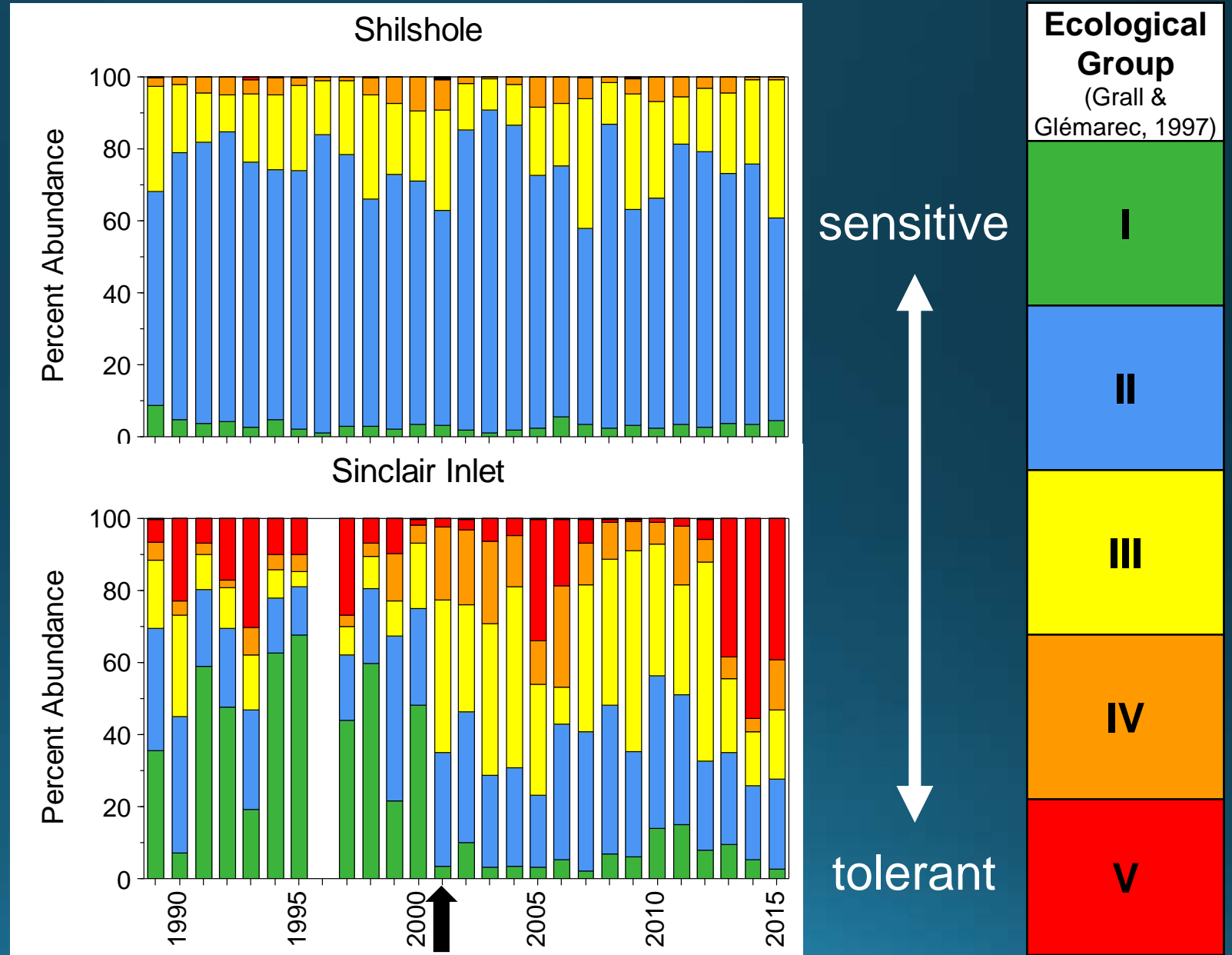Disturbance →
community changed
- abundance
- species

→ Feeding guilds
continue to change
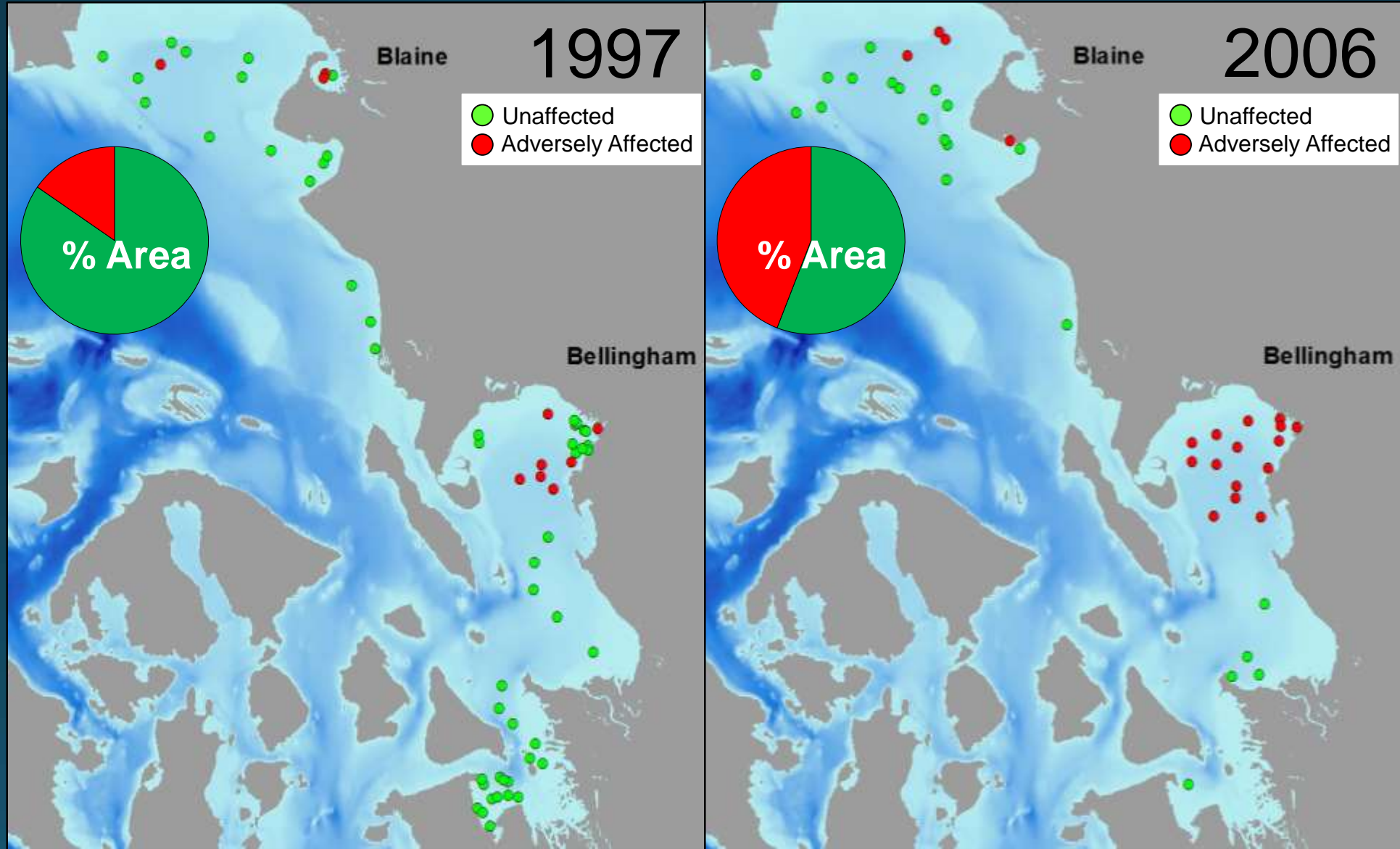
→ Functions impaired

Sinclair Inlet

Sensitive – Tolerant Taxa

- Basis of multi-metric indices (e.g., AMBI)

- No change where community stable

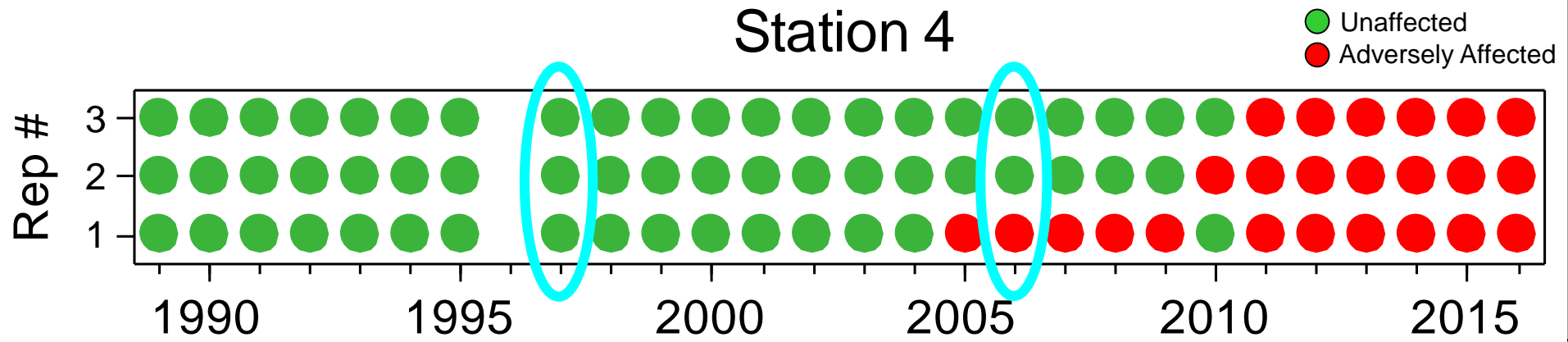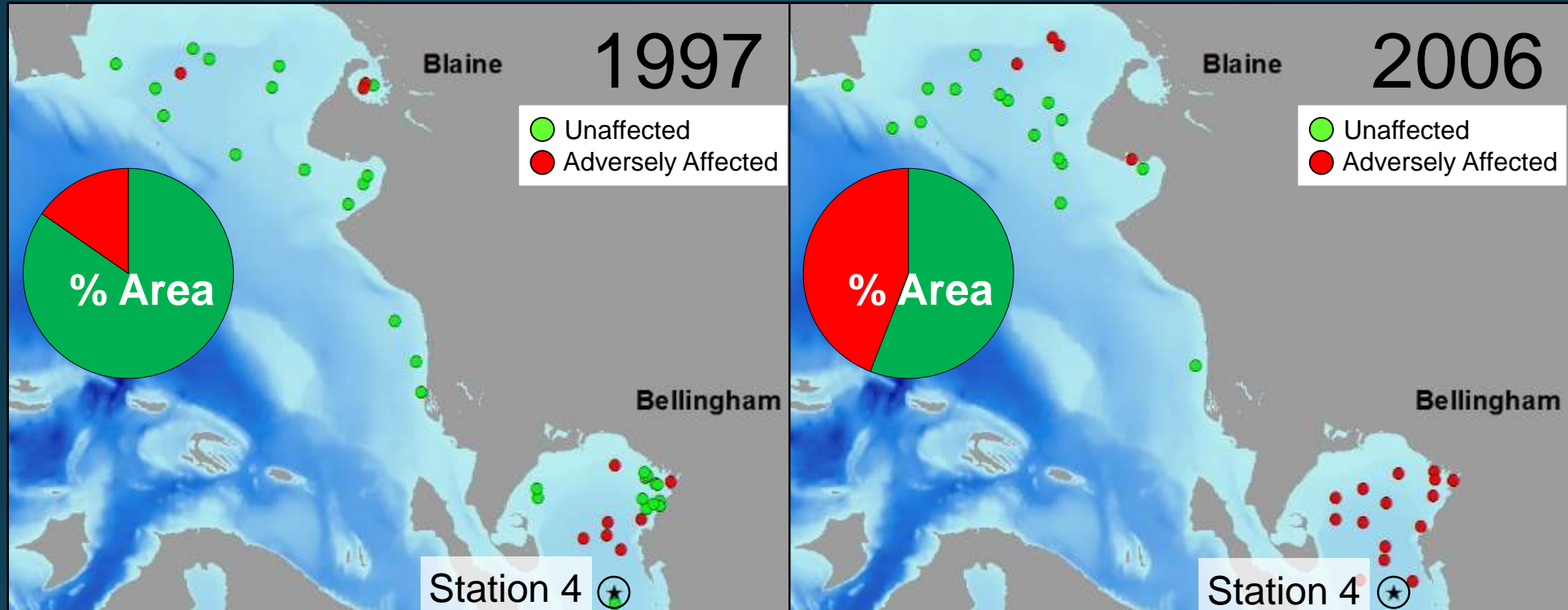- Sensitive taxa ↓ , tolerant taxa ↑ in impaired community

Regional results comparison
Example: Strait of Georgia region

...and Long-Term station
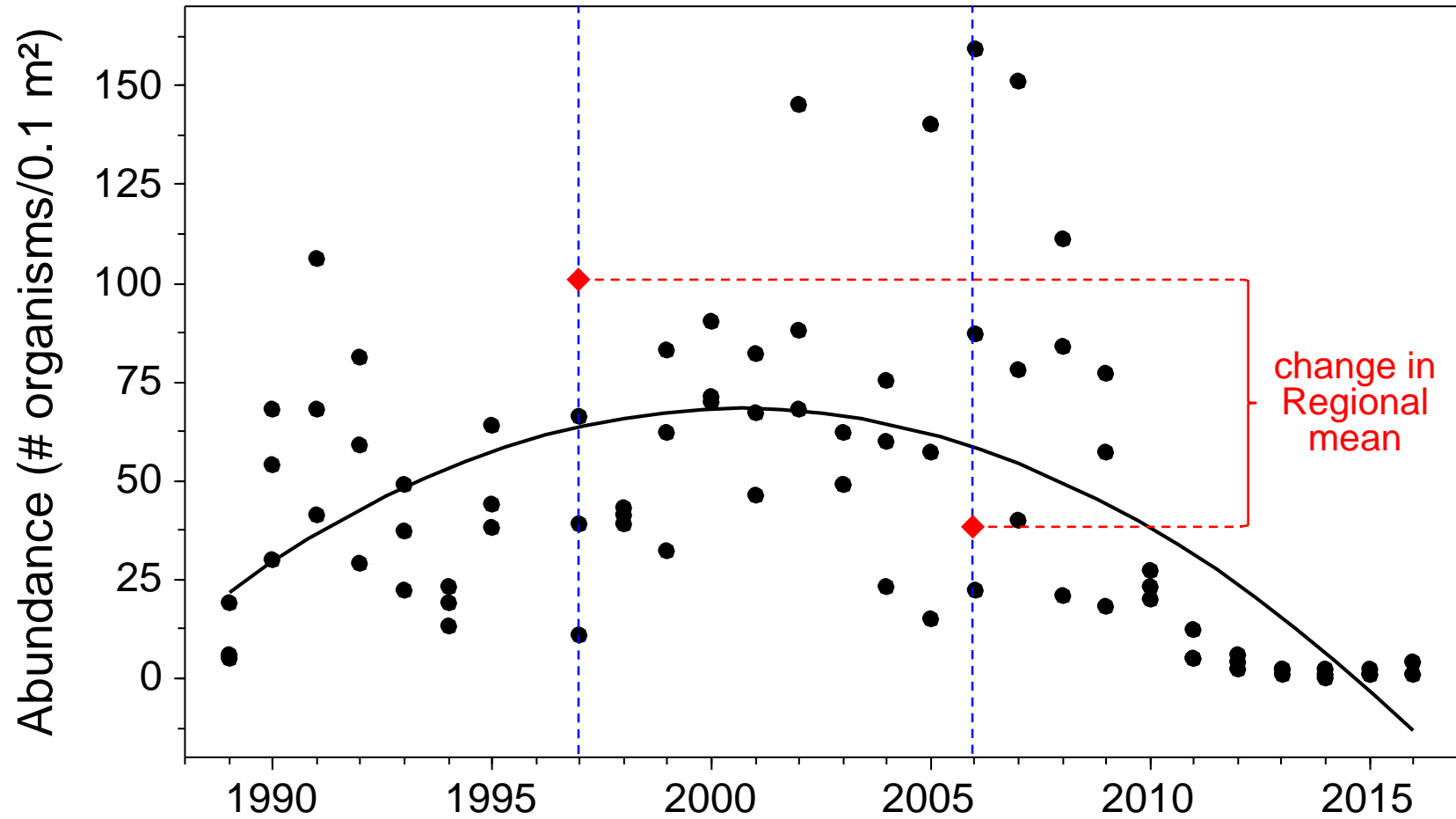
Regional changes vs. long-term trends

Measures of abundance & diversity

Sometimes different picture

	CHANGE	TREND
	Str Georgia region 1997 vs. 2006	**Bellingham Bay station 1989-2015**
Total Abundance	▼ (red)	▲ (red)
Taxa Richness	(white)	(white)
Evenness	(green)	(white)
Dominance	(green)	(grey)
Annelids	▼ (red)	(white)
Arthropods	(red)	(white)
Echinoderms	(red)	(grey)
Molluscs	(white)	(white)
Misc. Taxa	(white)	(white)

Legend:
- green: improvement
- red: deterioration
- white: no change
- grey: mixed up/down trend
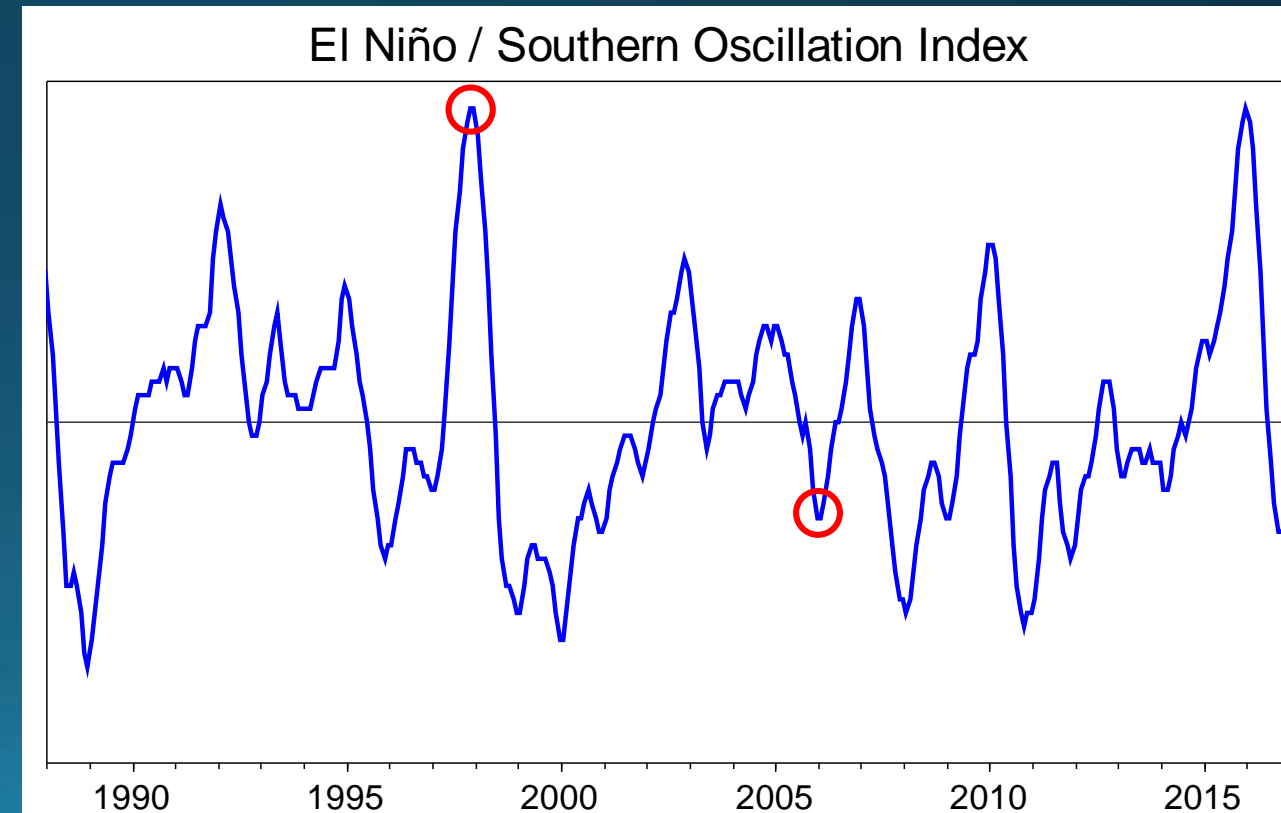- ▲ increase
- ▼ decrease

Regional changes vs. long-term trends

Echinoderm Abundance, Bellingham Bay station

Regional changes vs. Long-term trends

- Sample sizes
  - local variability

	Region	LT Station
Space	40+	1
Time	2	27
Replicates	1	3

- Timing
  - natural cycles
  - before vs. after bloom

- Confounding
  - spatial
  - temporal

El Niño / Southern Oscillation Index

A few more thoughts

- Regional vs. Long-term

  – Complement each other

  – Best of both → new design

- Unique, very important dataset