Kelp forest dynamics: links to climate and long term trends

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Kelp Forest Dynamics

- Links to climate?
- Trends over the last century?
  - Strait of Juan de Fuca
  - South Puget Sound

Photo credit: Tom Mumford
Kelp Forest Dynamics

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Bull kelp
Nereocystis luetkeana

Giant Kelp
Macrocystis pyrifera
Annual monitoring of floating kelp canopy area along strait and outer coast (1989-present)

Dynamics in kelp canopy area along strait and outer coast (1989-present)

- Stable, yet high variability
- Abundance of two species positively correlated ($p < 0.001$)
- Best predictor of abundance was previous year’s abundance
- Extreme lows in kelp abundance during extreme high temperatures (1997 and 2014)

Cross-correlation from ARIMA models - kelp canopy area and environmental variables

<table>
<thead>
<tr>
<th></th>
<th>Same year</th>
<th>1 year previous</th>
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</thead>
<tbody>
<tr>
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Bold values are significant at p < .05

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* SST increased by 0.72°C during 1921-2015 (p < .001)

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Photo credit: Tom Mumford
Floating kelp area along the strait over a century

Explore the maps at geo.wa.gov - search for “kelp forests”

Rigg 1911-12
Fertilizer Resources

DNR 1989-2015
Annual Aerial Kelp Canopy Surveys
Kelp canopy generally stable in strait - except perhaps at eastern boundary (ca. 1911 – present)

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Photo credit: Tom Mumford
Changes in bull kelp distribution in South Sound?
1855-2017
Most sites absent recently in West and Central
After 1980, proportion of observations with bull kelp lower in West and Central
Concern over losses in inner reaches of Salish Sea

Candidate stressors:

- Elevated temperatures
- Urbanization
- Anthropogenic nutrients
- Sedimentation
- Over-fishing
- Community shifts
Kelp Forest Dynamics

• Climate drives kelp abundance
  • NPGO leading indicator along outer coast and strait

• Trends over last century are spatially distinct
  • Concerns about losses in the inner reaches