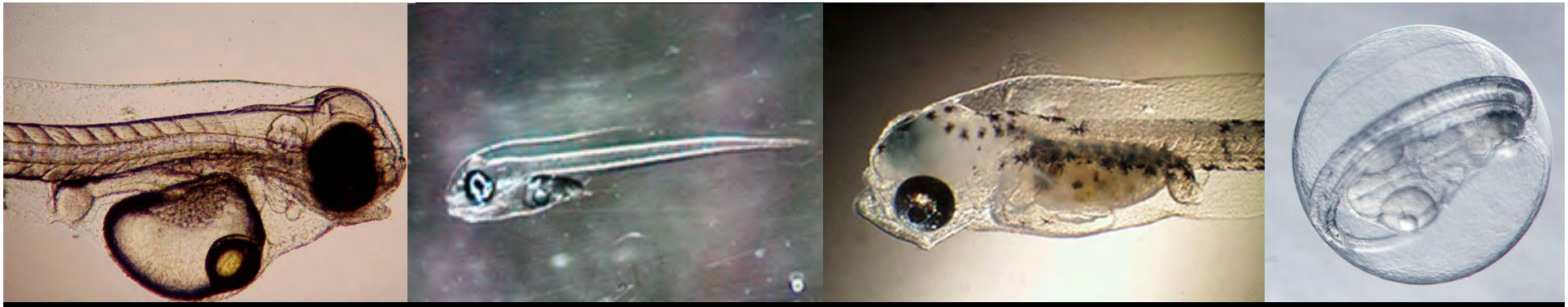

Quantifying mesoscale patterns of spatiotemporal variability of major larval fish species on Canada's west coast

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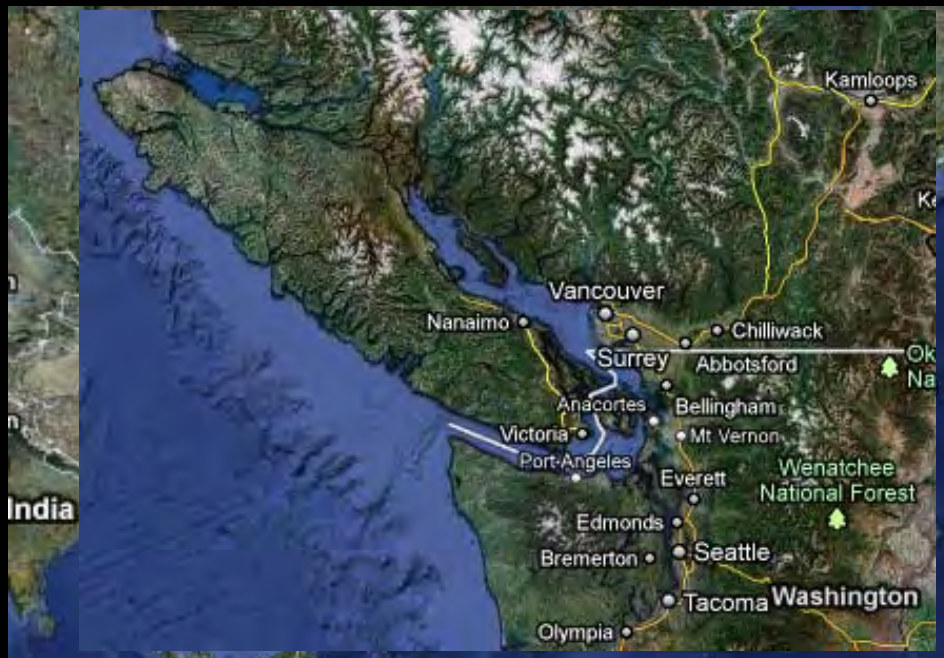
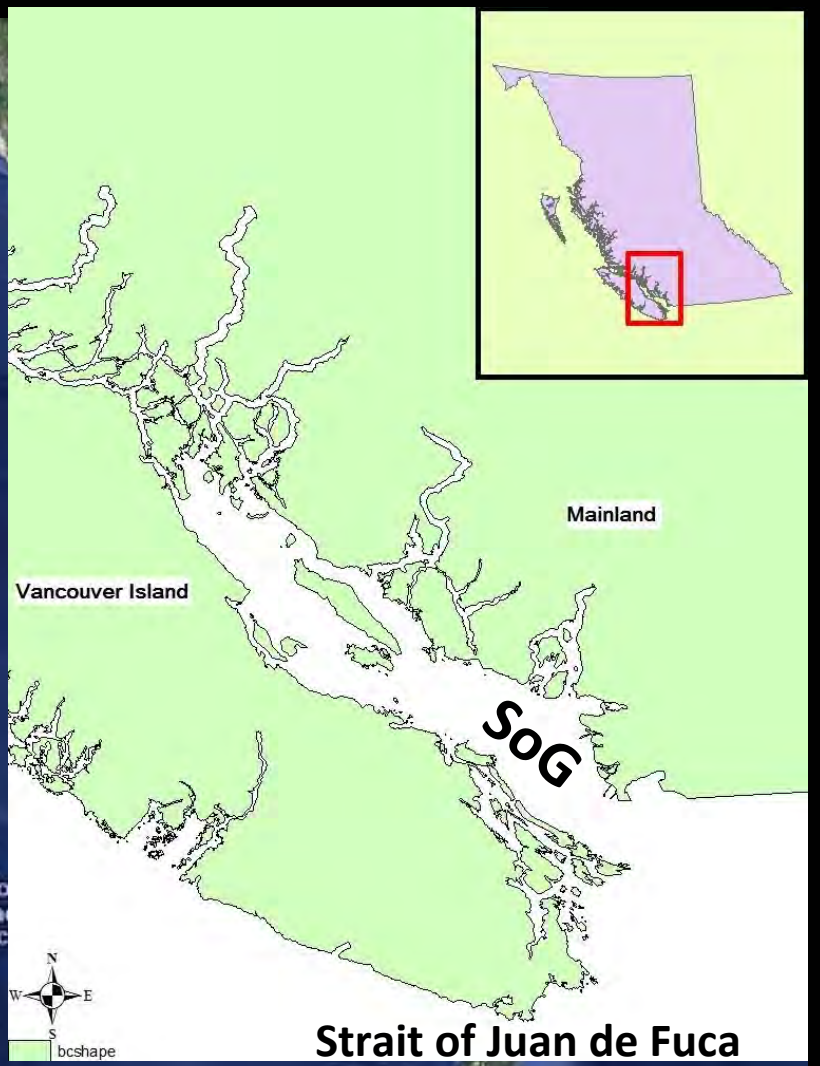
Strait of Georgia (SoG)

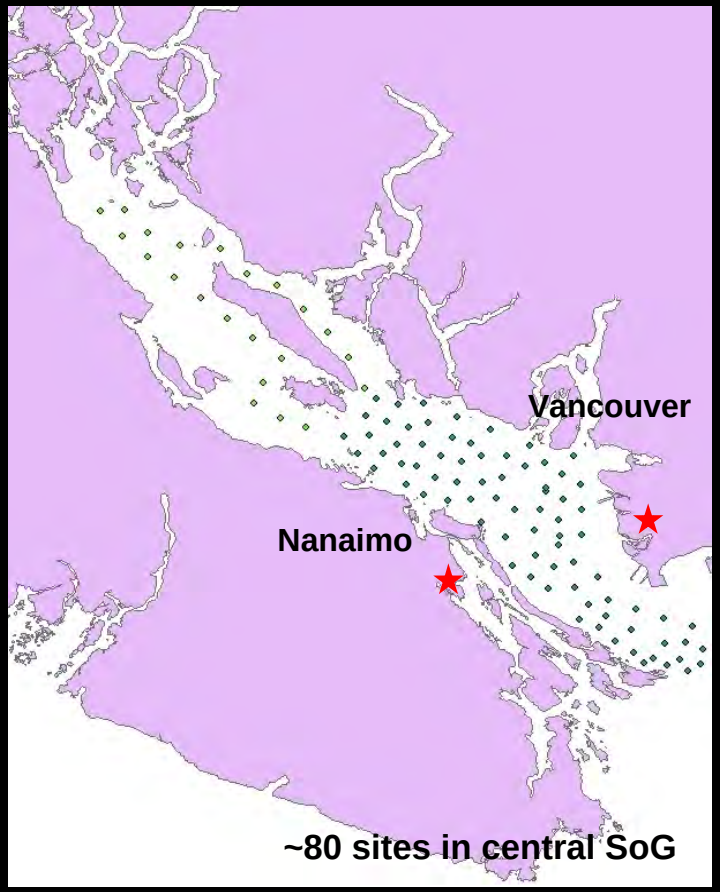
British Columbia, Canada





- **Long history of oceanographic study**
  - Estuarine circulation *(Li et al., 1999)*
  - Water mass *(Masson, 2006)*
  - Deep water renewal *(Masson, 2002)*
  - Chlorophyll distribution *(Masson and Pena, 2009)*
  - Long-term temperature trend *(Masson and Cummins, 2006)*
  - Major species of Phytoplankton *(Stockner et al., 1979)*
  - Zooplankton *(Parsons et al., 1970)*
- **Ichthyoplankton: barely known**

SoG Ichthyoplankton Surveys



Historical Surveys:

1979: Mar - Jun
1980: Jan - Jul
1981: Feb- Jun
} 1980s

Recent Surveys:

2006: April
2007: May
2009: Apr- May
2010: Mar, Apr & Jun
} 2000s

Research Questions and Methods

As part of the Canadian Healthy Oceans Networks (CHONe)

Ichthyoplankton Community (long-term)

Quantify long-term changes in ichthyoplankton community & Examine associated driving factors

Population Connectivity (short-term)

Quantify patterns of spatiotemporal variability in larval fish & Explore dispersal pathways

Consistent high larval abundance areas & dispersal patterns of individual species?

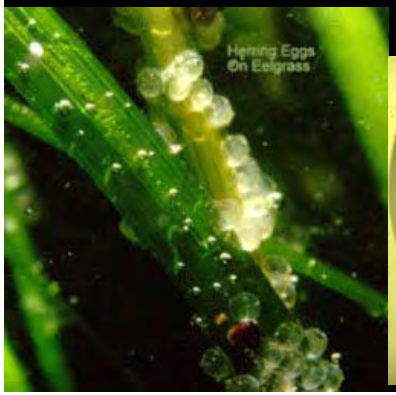
Spatial Analysis Methods: Geostatistical analysis (ArcGIS)

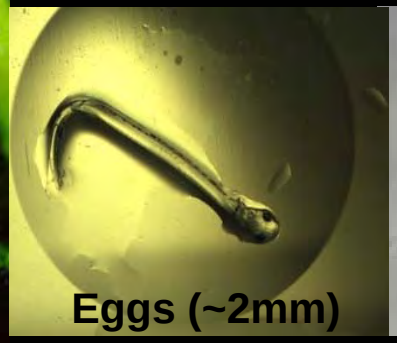
- **Identify high abundance areas :** Getis-Ord Gi*, Moran's I & Geary's C
- **Examine spatial structure:** Correlogram & Semivariogram
- **Spatial pattern model:** Trend surface analysis: check broad scale trend
  Local interpolation: Kriging

Walleye pollock

Study Species & Life History Traits

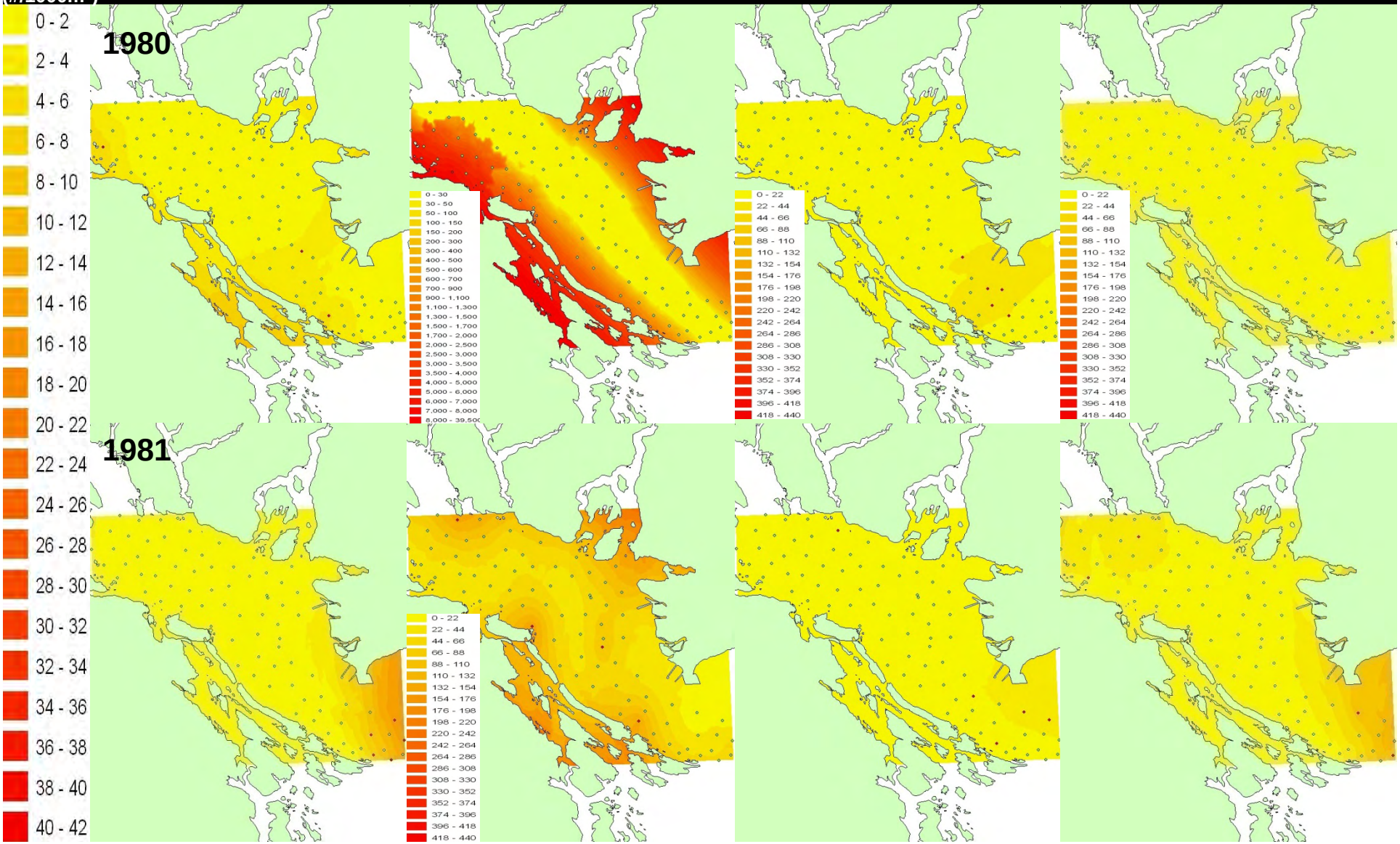
	Theragra chalcogramma (Walleye Pollock)	*Clupea pallasi* (Pacific herring)
Ecology	Epi, Meso & Bathypelagic	Nearshore & Shelf pelagic
Spawning	Areas: pelagic Season: Feb–Aug	Areas: Demersal & Nearshore Season: Jan–Apr
ELH Pattern	Pelagic eggs Pelagic larvae	Demersal & adhesive attached eggs Pelagic larvae
Mode	Schools	Schools





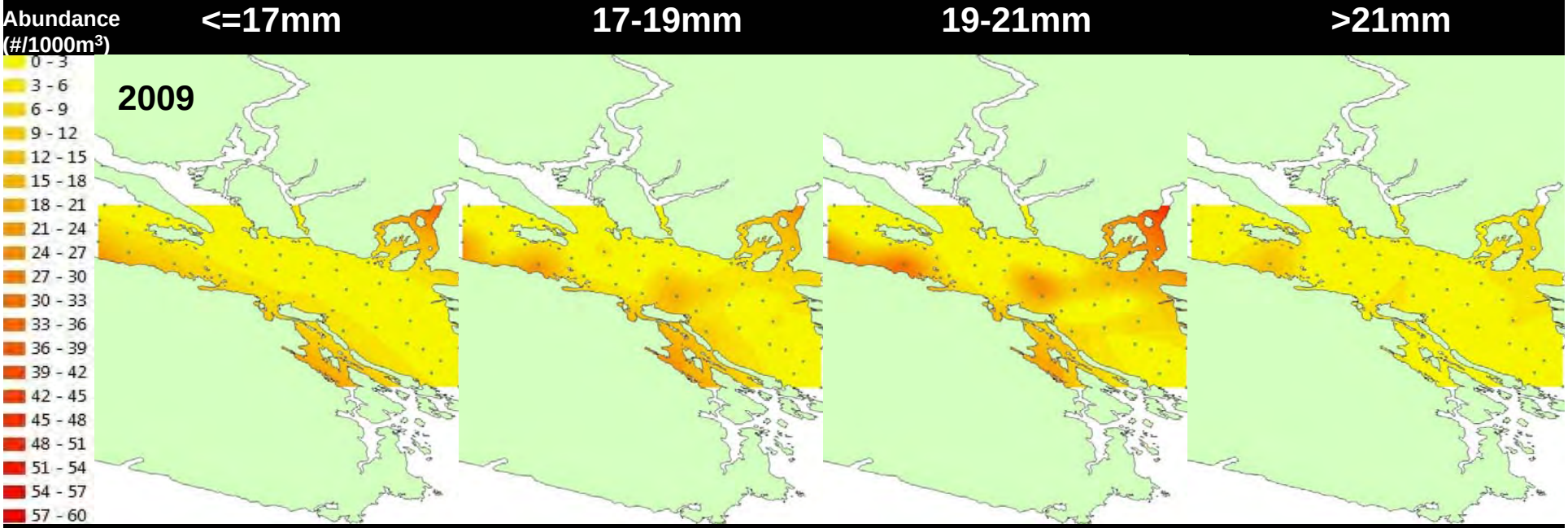
Pacific herring

Spatial Pattern of Larval Herring Abundance--1980s
(seasonal change)



Spatial Pattern of Larval Herring Abundance During Development

(April 24th – 27th, 2009)



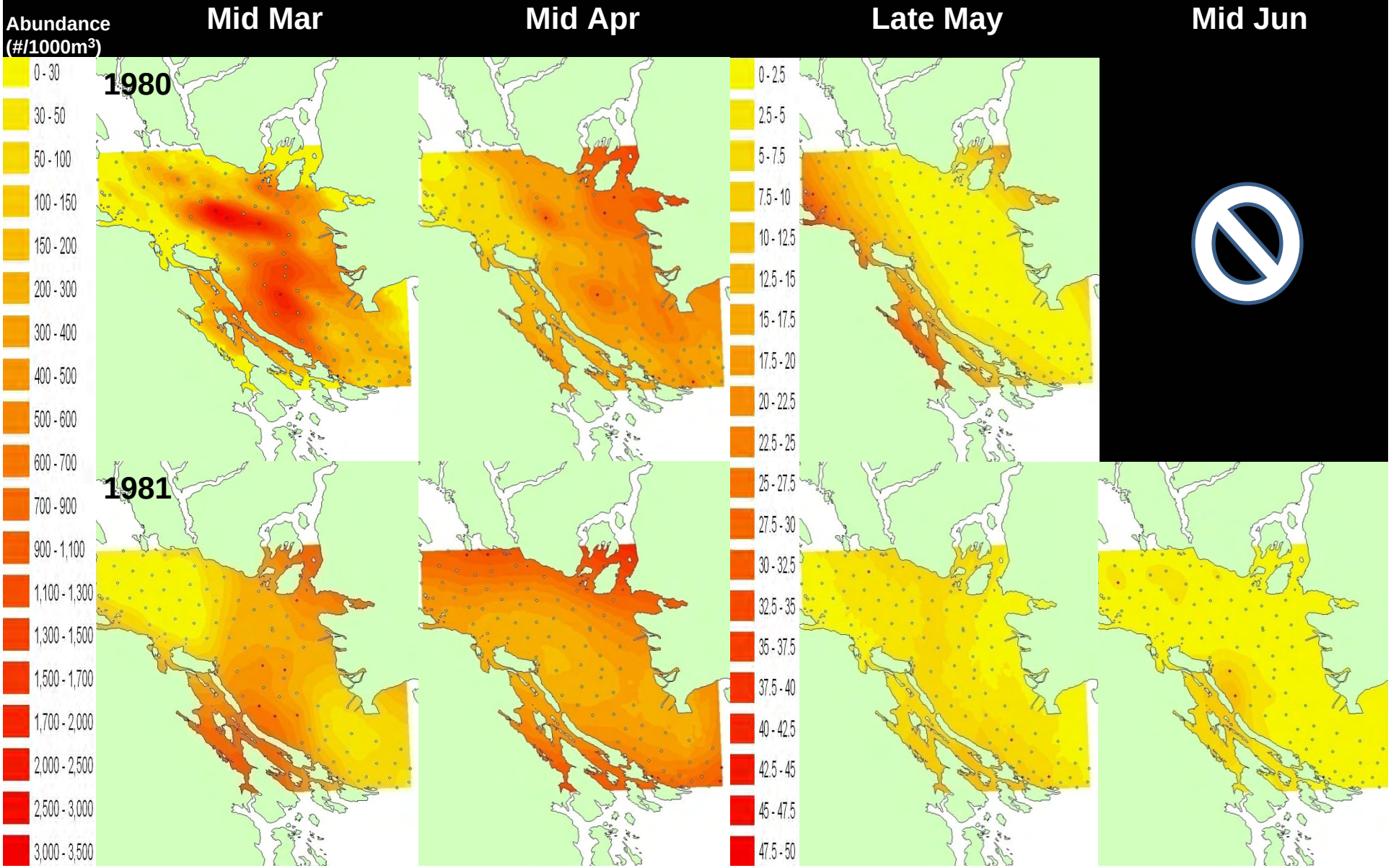
Recorded herring spawning area in 2009: along the west nearshore areas

Herring larvae: near surface waters, affected more by the surface circulation

Pattern: nearshore spawning area → central strait → nearshore nursery ground ??

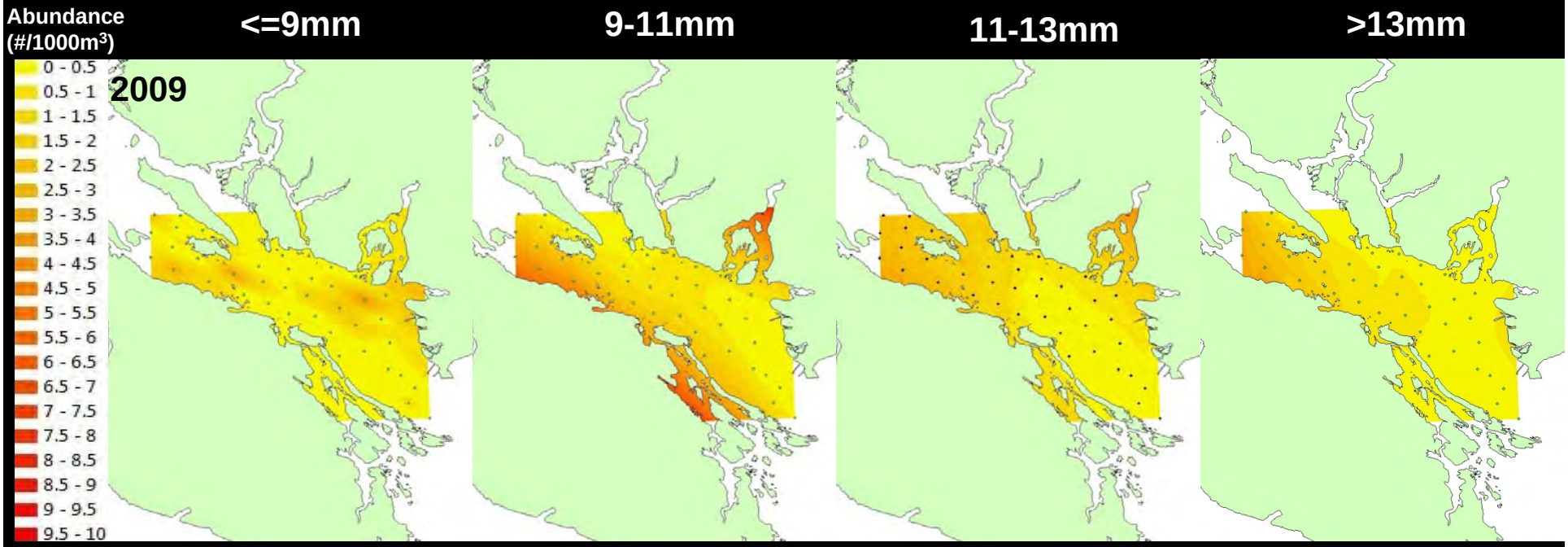
Test interpretation: coupled biophysical model

Spatial Pattern of Larval Pollock Abundance--1980s
(seasonal change)



Spatial Pattern of Larval Pollock Abundance During Development

(April 24th – 27th, 2009)



Larval pollock abundance: low for all size categories

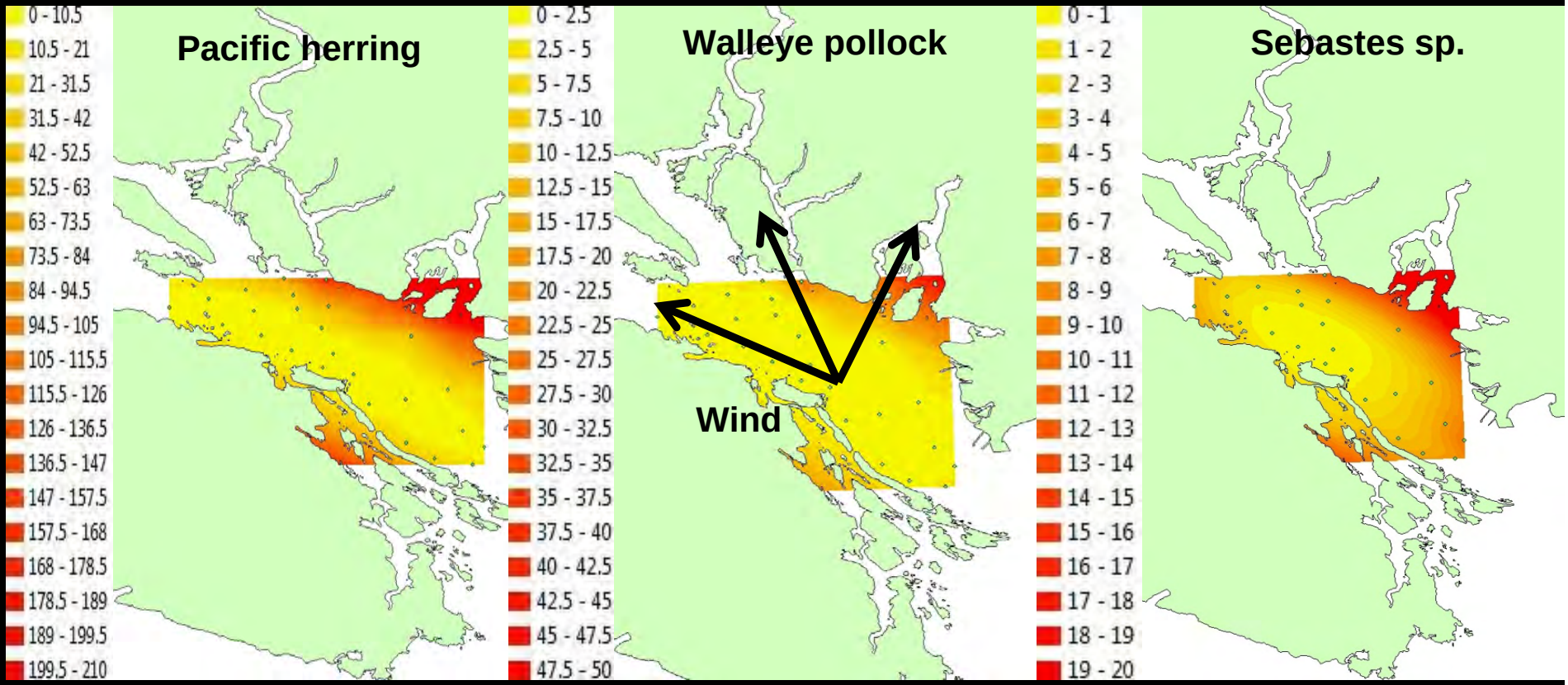
Pattern: central strait → sides

One possible interpretation: onshore transport take place??

Test interpretation: coupled biophysical model

Spatial pattern of different species during the wind storm

(Late-March, 2010)



Wind speed and direction: over 40km/h, 130 -150 degrees & 220 degrees

Fish Larvae: more larvae accumulate along the east side of the strait
pushed against the eastern shoreline by strong wind-driven currents

What do we learn from these species?

➢**Source sink regions & dispersal patterns: species-specific**

Herring: nearshore → central → nearshore

Pollock: central → nearshore

- thus far, no evidence of clear dispersal corridors, only general pattern
- the SoG might be better considered as a regional 'larval pool'?

➢**Biological factors:**

where / when to spawn
demersal/pelagic eggs
spatial variability in mortality
active larval behavior

➢**Physical oceanographic factors:**

surface layer circulation
tidal current
wind-driven current
freshwater discharge

➢**Coupled-biophysical model (collaboration with Susan Allen, UBC)**

Ichthyoplankton data ⟶ 3D Circulation Model (ROMS) ⟵ Particle tracking Larval behaviour

Ongoing Analysis

- **Spatial Ecology**

  Quantitatively compare variability in spatial patterns

- **Community Ecology (Multivariate Analysis)**

  Decadal change in larval fish abundance?

  Decadal change in larval fish species composition?

  What are the driving factors of these changes?

- **Phenology**

  Changes in the timing of larval occurrence and development?

  What are the environmental driving factors? Temperature?

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