Characterising ‘Meso-Marine Ecosystems’ of the North Pacific

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The study

Ship-of-opportunity trans-Pacific transect

Collecting plankton samples (CPR) and marine bird and mammal observations

Supplementary physical and chlorophyll a data
Focus on June 2002 data:

**Directly measured:**
- 54 day-time plankton samples (each 18 km long, minimum spacing 56 km)
  - Taxonomic composition (large phyto to mesozooplankton)
  - Estimate of mesozooplankton biomass
- 109 day-time seabird observation periods (~20-25 km long, continuous)
  - Taxonomic composition
  - Seabird density
- Sub-surface temperature (~7 m) from a logger on the CPR, every 15 minutes
• Temperature profiles (6 XBT’s deployed along the transect)

**Indirect data:**
• Day-time Chlorophyll a (from SeaWiFS, 9 km resolution, binned to match bird data)
• Bathymetry along transect (ETOPO 5 dataset)
• Sea Surface Height (TOPEX/POSEIDON data)
• Surface circulation of the NE Pacific (Argo float dynamic height) courtesy H. Freeland
Beginning with the biology

Plankton

Samples were compared and all pair-wise similarities calculated (+/- taxonomic data)

Cluster and MDS analyses were carried out, then samples plotted above, according to cluster
Bird data treated the same way except abundances were used.
Both lower and upper-trophic level community structure changed in the same places along the transect, giving us 10 Meso-Marine Ecosystems (MME) defined by their biology:
For many of the regions, boundaries coincide with bathymetry, i.e. shelf break, ridges etc:

But not in the North-East Pacific……..
Surface circulation derived from Argo dynamic height data:
So, the MMEs are determined by a combination of topography and currents.

What are the characteristics of each MME?

(Note - full descriptions will be given in the manuscript, I will be brief here!)
A longitudinal (east-west) gradient in SST
TOPEX/POSEIDON data for June 2002:

Eddies introduce meso-scale variability
XBT profiles
Biological properties

Chlorophyll a (mg m⁻³)

Mesozooplankton biomass (mg sample⁻¹)

Sea bird (# per km⁻²)

Coastal N. Japan | W. Pacific | W. Bering | Sea | Central Bering Sea | W. Aleutian | Bering Sea | E. Aleutian | sh. | W. GoA | Central GoA | E. GoA | BC


Shelf/slope
Do these MMEs exist in other years?

(Value to management only real if they can be shown to persist)
Summary

3 scales have been described which relate to the type of organisms present and characteristics of the MMEs:

1. Onshore to offshore
2. Sub-arctic to temperate
3. Longitudinal (east to west)
Summary

MMEs persist from year to year, though more work needs to be done to establish this.

Ship-of-opportunity sampling, coupled with global-scale observing systems provides an interdisciplinary approach that is essential to our understanding of ecosystems.
Implications

Climate variability (ENSO, PDO) changes atmospheric pressure patterns, wind stress and surface circulation. This may alter MME boundaries and productivity.

Although fisheries are mainly on the shelf, many important species move between and forage in offshore MMEs: