

# Cetacean distribution relative to zooplankton biomass along southern CalCOFI survey lines, 2004-08



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## Introduction

- Traditional cetacean surveys in southern California conducted every 3-5 years over broad spatial scales (1)
- CalCOFI surveys provide comparatively high resolution in time and space and extensive suite of oceanographic measurements
- Several species of endangered baleen whales seasonally migrate and forage on zooplankton within southern California Bight, including blue, fin, and humpback whales (2,3,4,5)
- Region impacted by variety of human uses (shipping, fishing, military, industrial, etc.)
- Goals:
  - Identify spatiotemporal patterns in habitat variables and cetacean distribution
  - Formulate hypotheses that can be tested quantitatively

## Materials and Methods

Data were collected as part of the California Cooperative Oceanic Fisheries Investigations program.

**Temperature:** Ship-mounted underway data system (Seabird Electronics SBE-21 thermosalinograph or similar)

- sampling approximately 2 meters below waterline,
- 10 minute averages

**Zooplankton:** CalCOFI Bongo (paired 505 um mesh nets with 71 cm diameter openings) standard oblique plankton tow (300 meters, depth permitting)

- Removed high outlier values likely due to overabundance of gelatinous species

**Cetacean Observation:** Visual observations made by trained observers, beaufort 0-5.

- 7 x 50 power binoculars and naked eye used to locate and identify cetaceans
- Big eye (20 x 50, ship mounted) binoculars on some cruises to help species ID
- Included unidentified large whales, likely balaenopterids

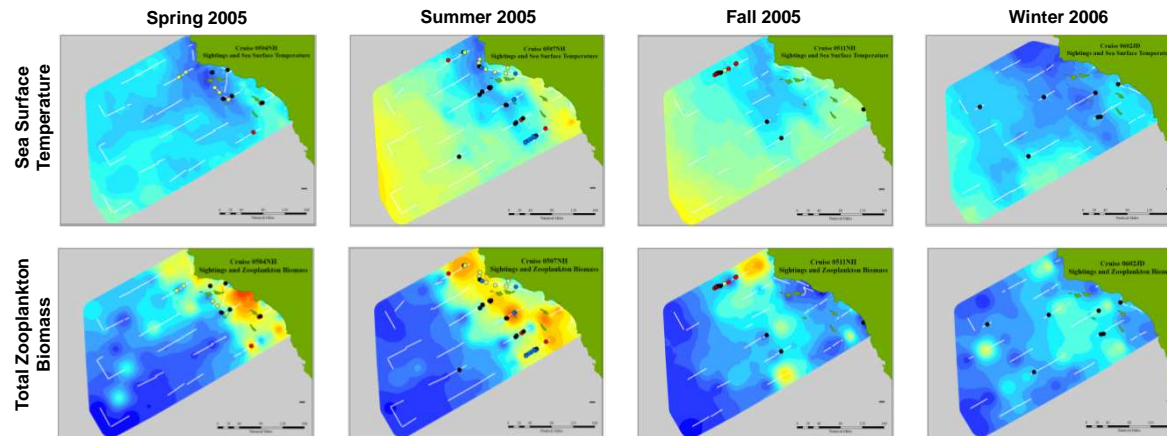
**GIS:** Zooplankton biomass, SST, and baleen whale sighting data analyzed using ArcGIS 9.2

- Zooplankton biomass interpolated using Inverse Distance Weighting
- Sea surface temperature interpolated by Kriging; second order polynomial applied to account for a Northwest temperature trend

## Results & Discussion

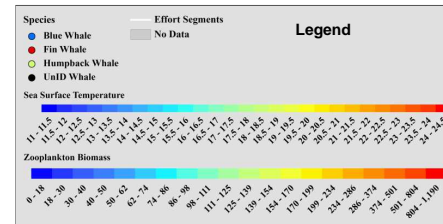
- Highest zooplankton biomass in colder waters and near islands, coast
- Spring through fall sightings concentrated inshore and within cold California current, close to areas of high zooplankton biomass
- Fewer sightings in winter, predominantly unidentified and fin whales (other cruises not displayed), scattered offshore
- Colder SST potentially indicates conditions leading to zooplankton production (e.g., coastal upwelling in spring) or physical mechanisms that entrain/concentrate prey (e.g. currents, fronts, eddies)
- 'Cluster' of baleen whale sightings observed offshore on northernmost line in fall (multiple years) warrants further investigation
- Seasonal and spatial differences between species may reflect differences in behavior, prey preferences
- Visual search effort does not always coincide with high zooplankton stations; zooplankton biomass may vary on finer spatial scales than sampled

## Contour maps of SST, Total Zooplankton Biomass, and large balenopterid whale sightings, 2005-2006



## Total Sightings July 2004 – Jan 2008

	Spring	Summer	Fall	Winter
● Blue Whale	0	35	9	0
● Fin Whale	5	27	25	3
● Humpback Whale	22	46	22	0
● Unidentified Baleen Whale				



## Future Directions

- Include additional datasets such as satellite imagery and acoustic data in habitat analyses
- Develop quantitative habitat models and relative abundance estimates

## Hypotheses

- Whale presence is correlated with zooplankton biomass, which is correlated with SST
- Whale foraging distributions shift depending on location of California Current and strength and timing of coastal upwelling
- Additional descriptor variables (e.g., salinity, bottom depth and slope, thermocline depth) may have predictive value in models



## Literature cited

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## For further information

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- More information on this and related projects can be obtained at <http://cetis.ucsd.edu>