Relationship between Sei Whales distribution and the environmental conditions in the western North Pacific using multi-sensor remote sensing

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10, 10, 2003  PICES Annual Meeting
1. Background

The Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPN/JARPNII)

Ecosystem studies
Feeding ecology = competition between whales and fisheries

Many Sei Whales were sighted in 2001 JARPNII survey
A center area where the Oyashio cold current and the Kuroshio branch form anticlockwise eddy

High density area of Whales

(Uda, 1954)

A whaling ground in the sea near Japan

Relationship between Whales and oceanic conditions
Relationship between Whales and oceanic conditions

Distribution of Sei Whales and sea surface temperature in June, 1954

A west area of the moving Kuroshio System water mass northward

High density area of Whales

(Nasu, 1956)

another factor: bottom topographic feature
past observation methods
shipboard survey
monitoring limitation
ocean environmental change in vast area

objective

To investigate relationship between Sei Whales and oceanographic environment using multi-sensor remote sensing
2. Data and Methods

In situ data
JARPNII survey  5/10–8/4, 2001
  • sighting surveys
    sighting position of Sei Whales
  • oceanography observations
    sea surface temperature & salinity

Satellite data  May–August, 2001
  sea surface temperature (SST) : NOAA/AVHRR  monthly, 8days data
  chlorophyll a (chl-a) : Orbview-2/SeaWiFS
  sea surface height anomaly (SSHA) : TOPEX/ERS-2

  • bathymetry data : ETOPO5 data provided by NESDIS/NGDC

study area
30°N~50°N, 140°E~170°E

Western North Pacific
3. Result and Discussion

Sighting of Sei Whales

Sighting survey effort & sighting position of Sei Whales

Sea surface temperature
12.9°C–22.4°C

Salinity
32.7psu–34.5psu

- widely distributed
- two high density
Environmental conditions in A area

Sighting surveys during 25, May–17, June

A area
38°N, 146°E
High density area of Sei Whales
- edge of warm tongues of the secondary Kuroshio Front
- between negative and positive sea surface height anomaly
- edge of high chl-a concentration area > 0.2mg m^{-3}

higher biological productivity area
Environmental conditions in A area

- the accumulation of nutrient rich water of Oyashio Water
- complicated frontal structure

higher biological productivity area
Environmental conditions in B area

Sighting surveys during 26-30, June

B area
38°N, 160°E
Environmental conditions in B area

Sighting surveys during 26-30, June

High density area of Sei Whales

• North of the Kuroshio Extension
• SST monthly image at June moving northward
• SSHA at 28, June around positive sea surface height anomaly

consistent

SSHA at 28, June

around positive sea surface height anomaly

High density of whales

around positive sea surface height anomaly

inter-cool water

(Nasu, 1956)
Environmental conditions in B area

- High density area of Sei Whale
  - north of the Kuroshio Extension
  - around positive sea surface height anomaly
  - nutrient rich water in the subsurface layer

chl-a concentration $> 0.3 \text{mg m}^{-3}$

chl-a monthly image in June
Environmental conditions in B area
Sighting surveys during 26–30, June

SST monthly image at June

Water temperature of Sei Whale sighting position in B area

15.5°C~19°C

Appropriate water temperature for Sei Whale

14°C~24°C

(Uda, 1960)
Environmental conditions in B area
Sighting surveys during 26–30, June

- nutrient rich water in subsurface layer
- appropriate water temperature
- a secondary branch of the Kuroshio Extension

SST monthly image at June

suitable habitat for Sei Whales
5. Conclusion

the high density area of Sei Whales

|   |

higher biological productivity

suitable foraging habitats for Sei Whales