

The vertical and horizontal distribution of bigeye tuna (*Thunnus obesus*) and yellowfin tuna (*Thunnus albacares*) related to ocean structure

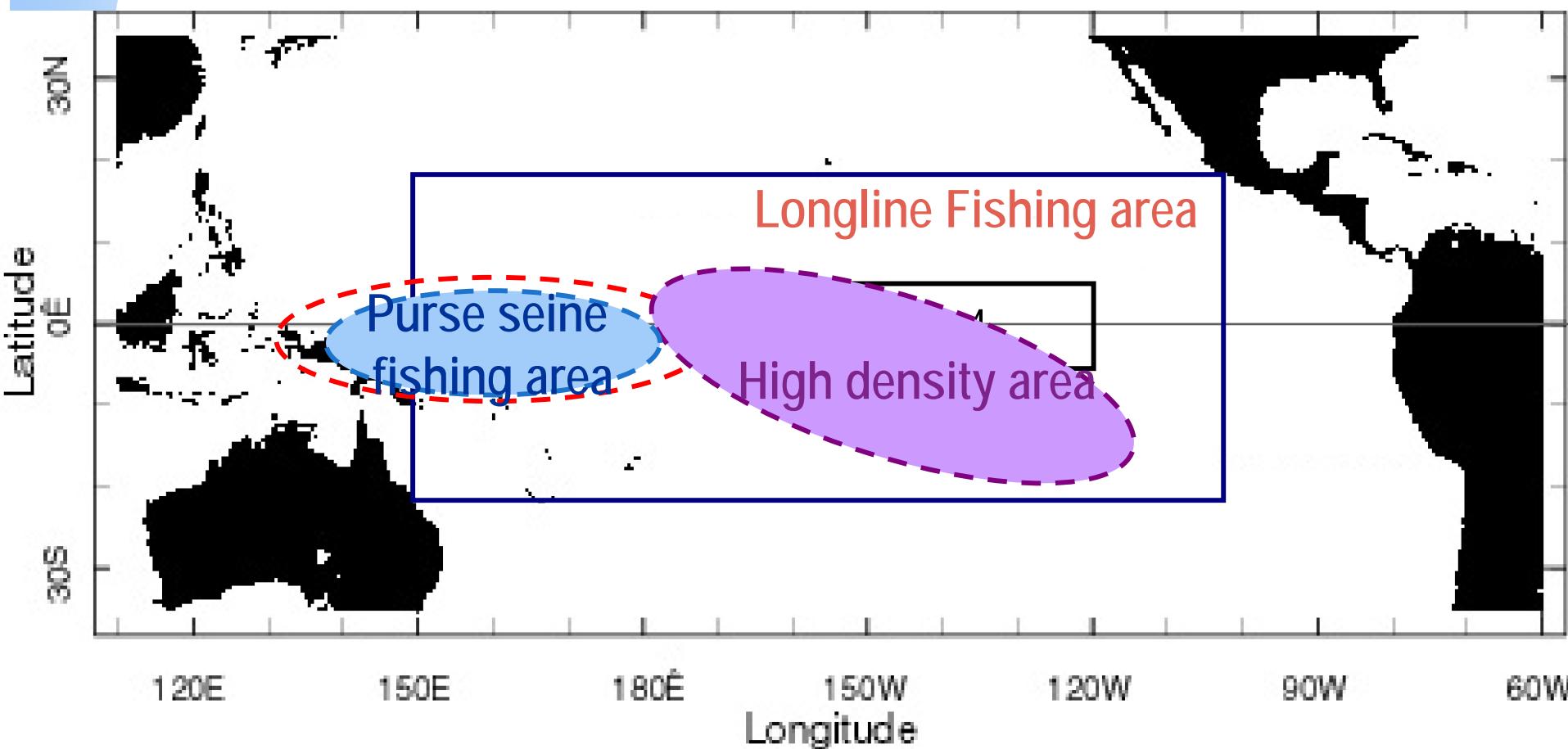
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¹Pukyong National University

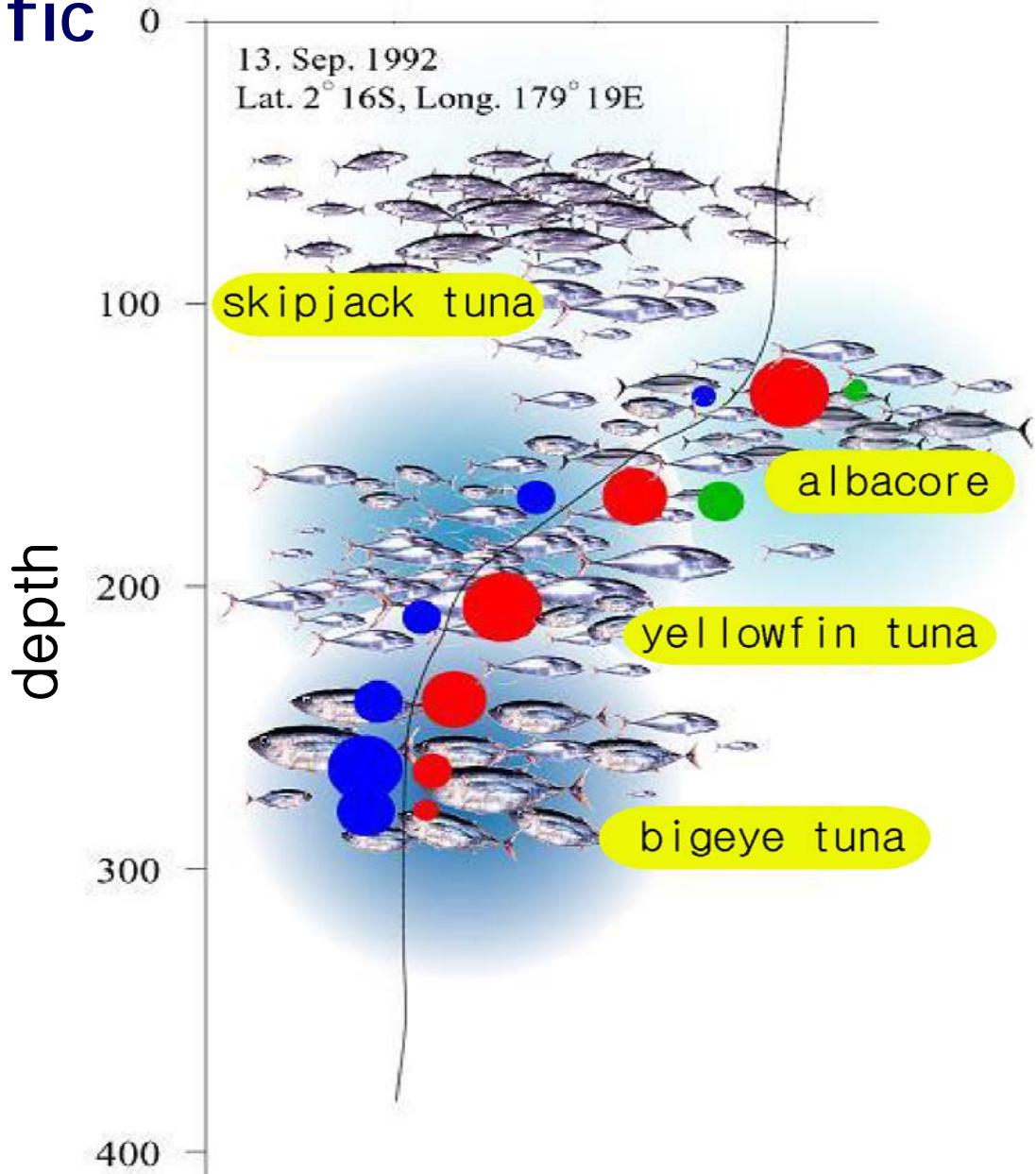
²National Fisheries Research & Development Institute

Introduction

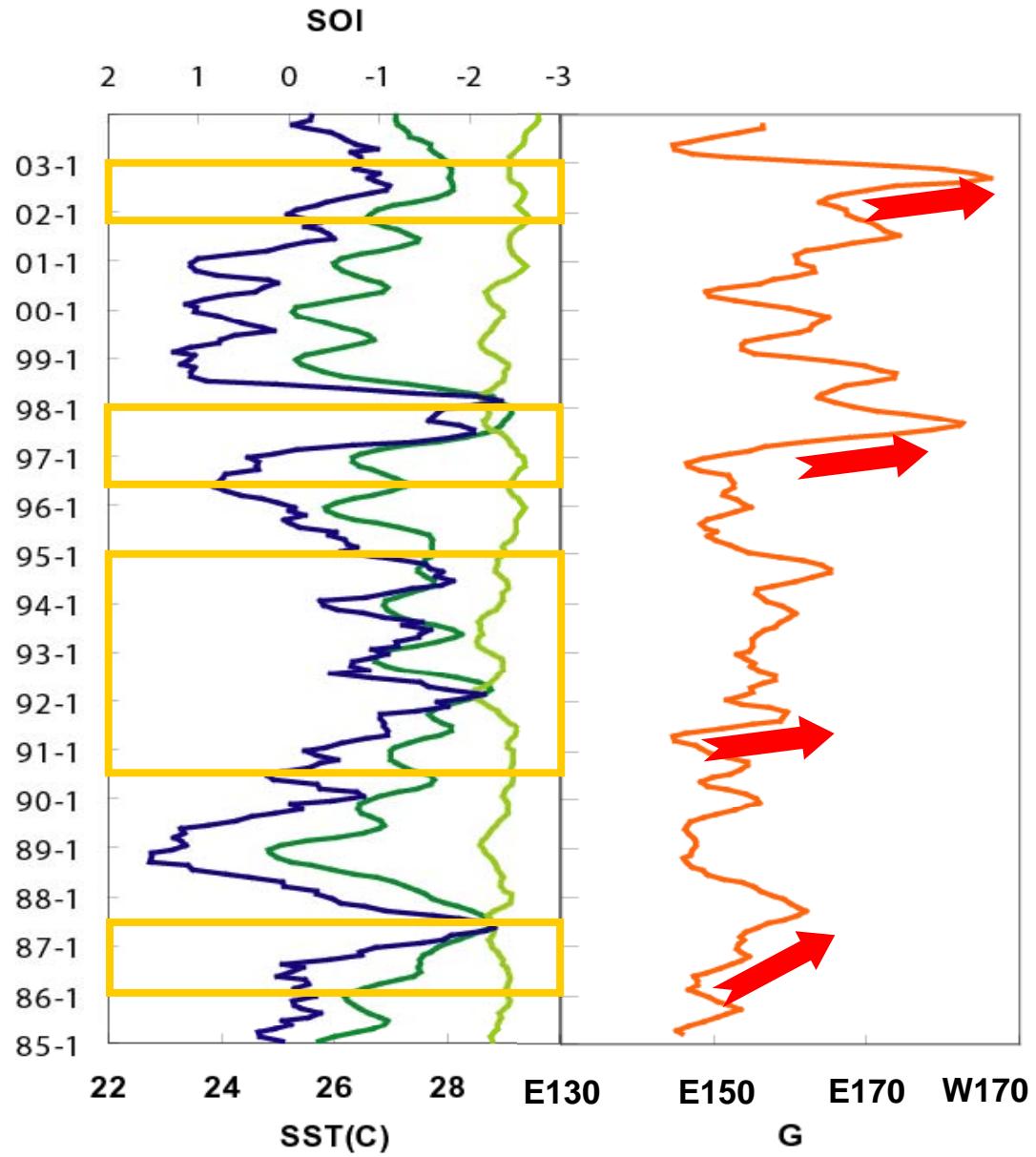
➤ The tuna fishing area in the Tropical Pacific



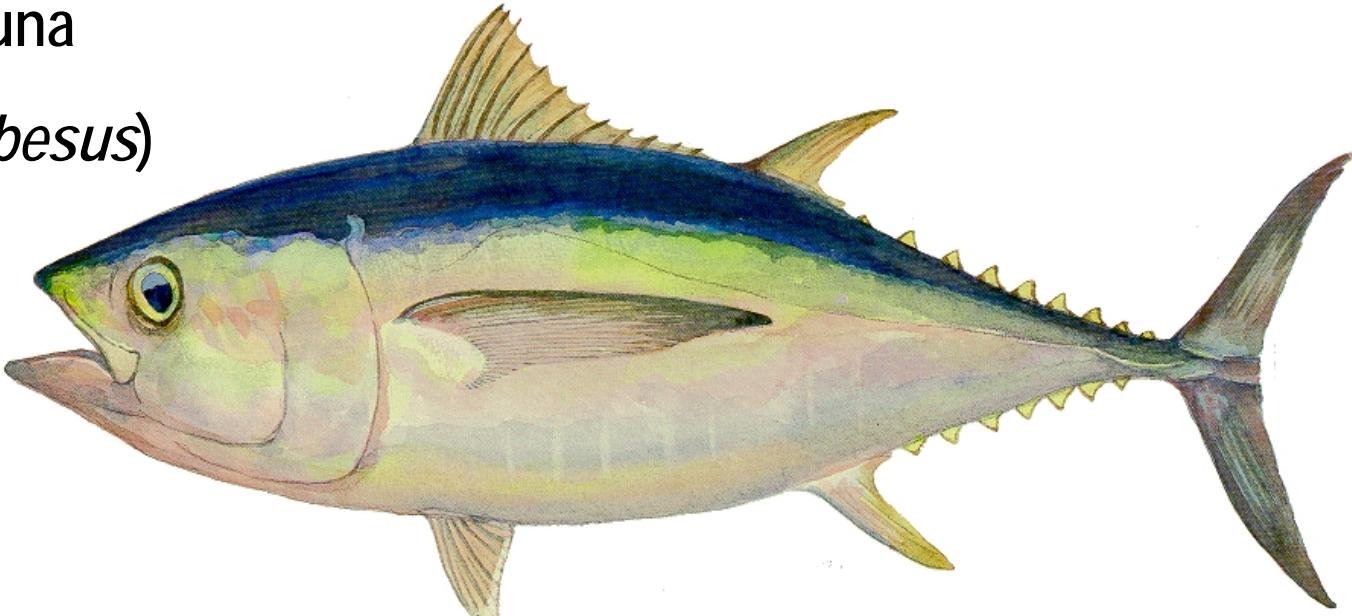
➤ Schematic vertical distribution of tuna species in Pacific



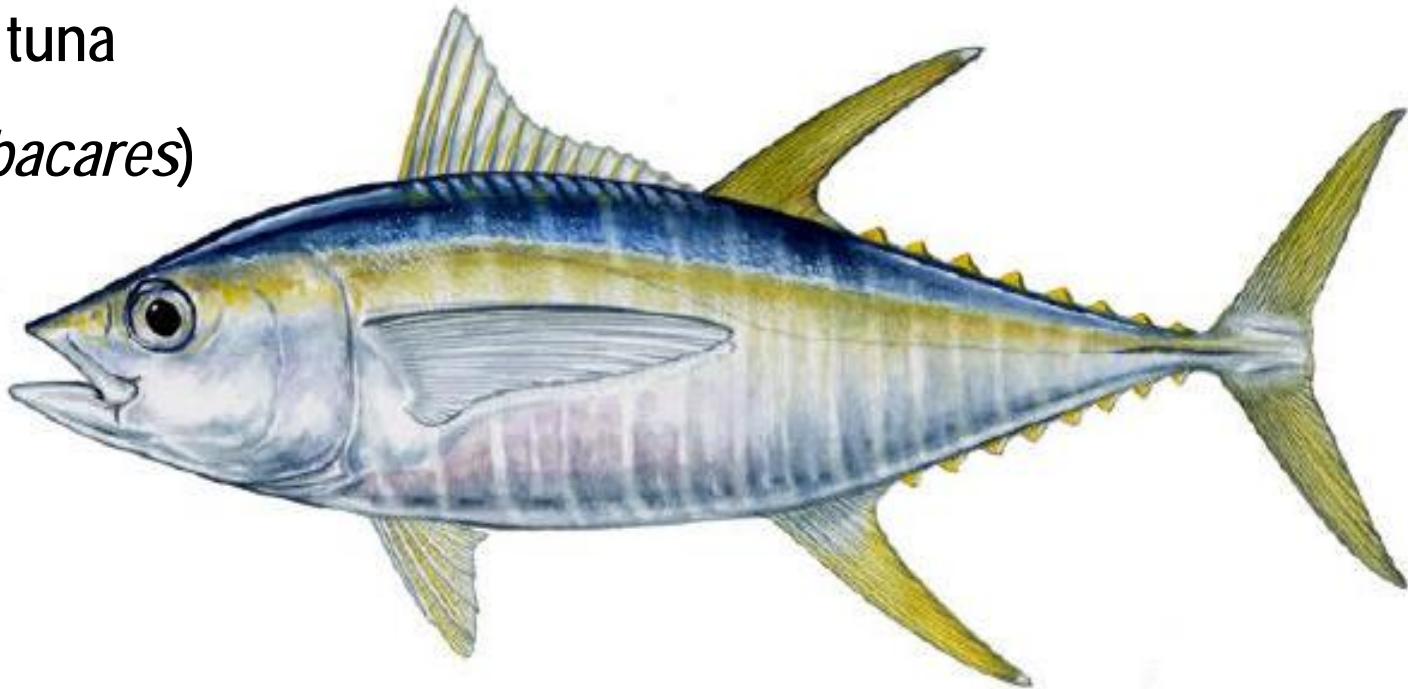
➤ Skipjack tuna & environmental factors



Bigeye tuna
(*Thunnus obesus*)

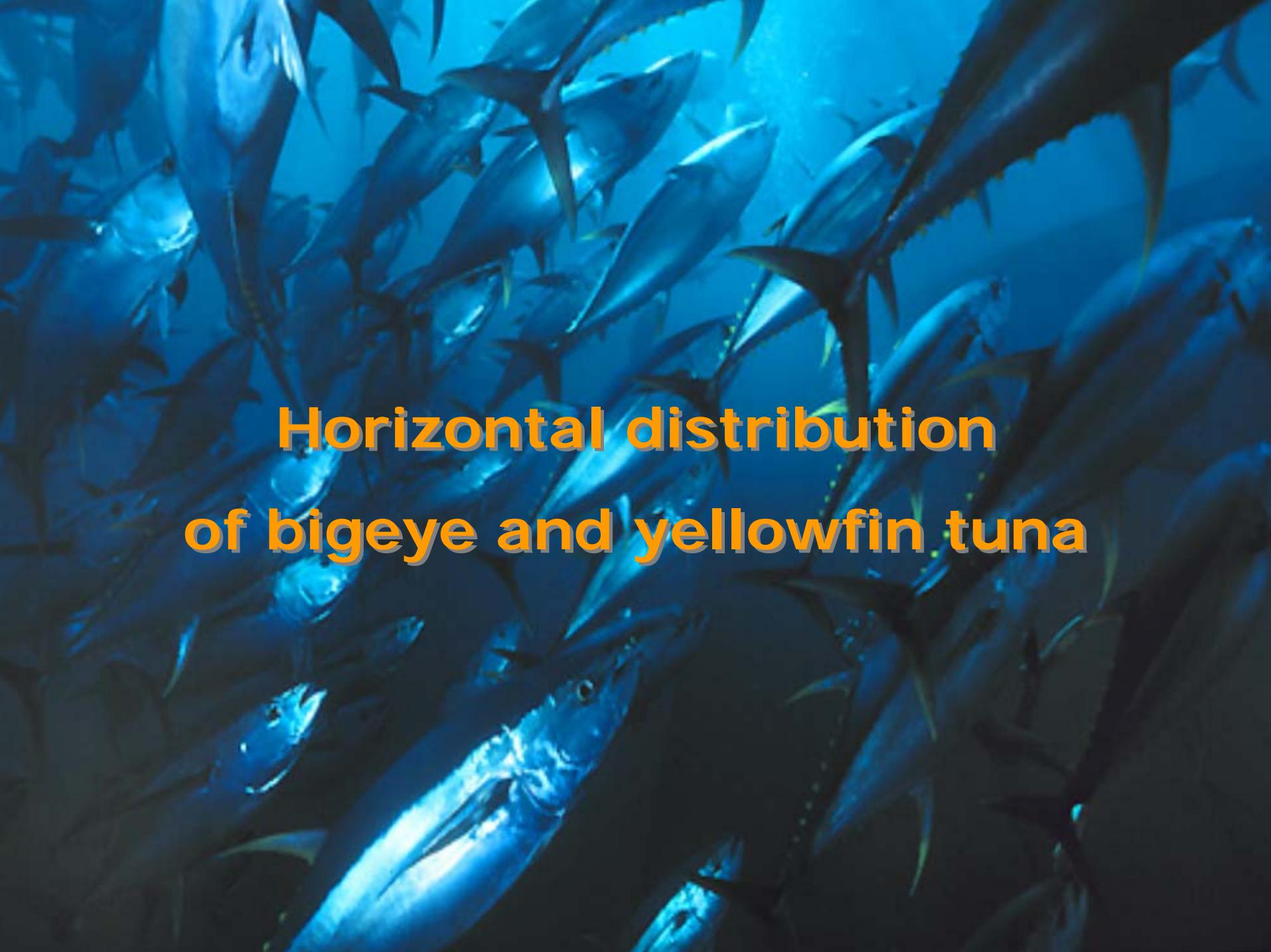


Yellowfin tuna
(*Thunnus albacares*)



Objective

➤ To find the response of spatial & vertical distribution of bigeye & yellowfin tuna related to the oceanographic condition

A large school of tuna, likely bigeye and yellowfin, swims in a dense, dark blue ocean. The fish are oriented horizontally, moving from left to right across the frame. Their bodies are elongated and silvery-blue, with darker fins and tails. The lighting is low, creating a sense of depth and movement.

**Horizontal distribution
of bigeye and yellowfin tuna**

Materials & Methods

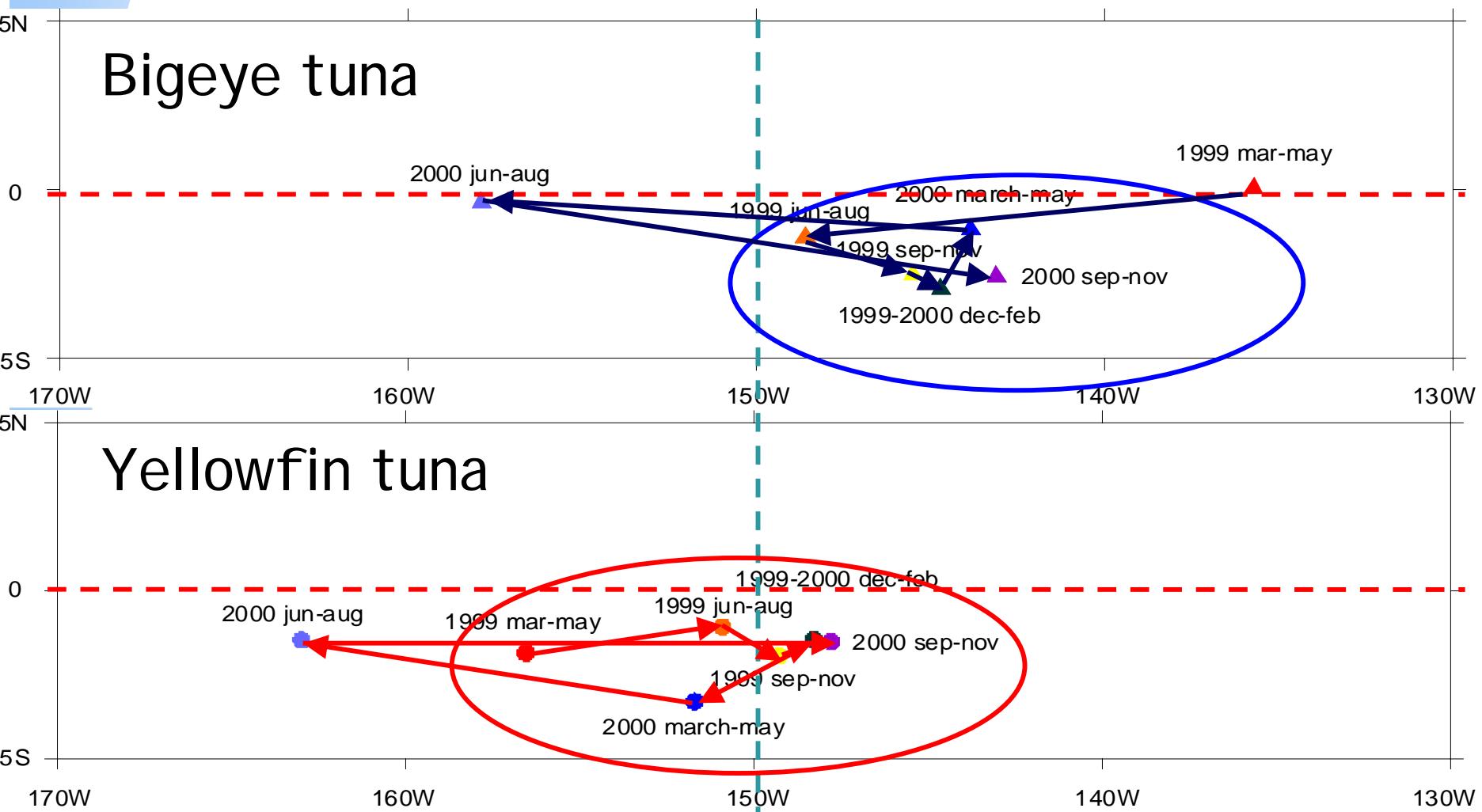
□ Fishing data

- About 200 Korean longline vessels
- Jan. 1999 -Dec. 2000
- Catch numbers of bigeye and yellowfin tuna georeferenced in 5° grids of latitude and longitude.
- Fishing gravity centre of CPUE(G) in month j

$$G_j = \sum_i L_i (C_{ij}/E_{ij}) / \sum_i (C_{ij}/E_{ij})$$

Results

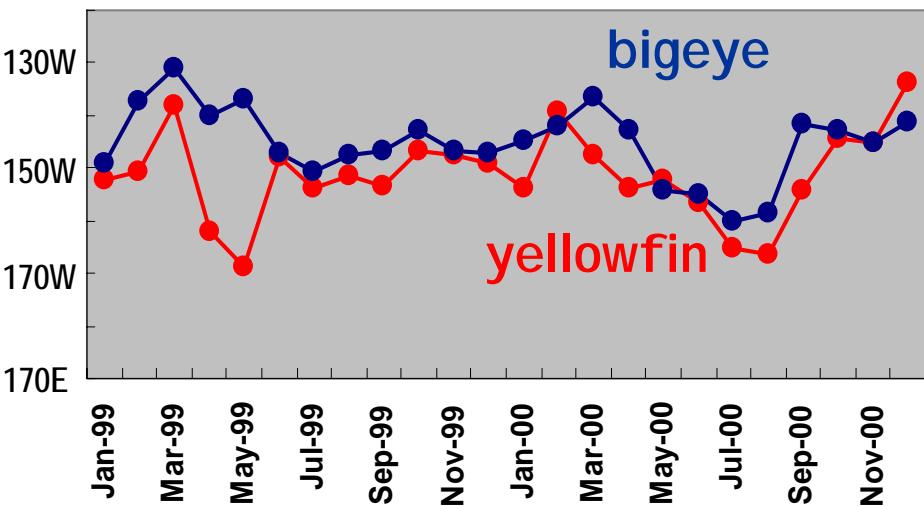
➤ Seasonal change (3 months) of fishing centroids



Results

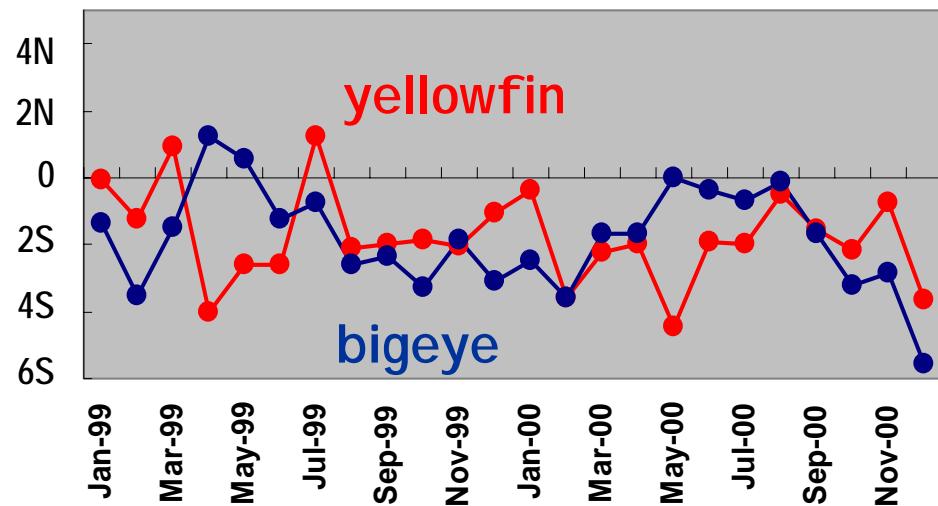
► Monthly change of centroids

Longitudinal centroids



$$r=0.449 (<0.05)$$

Latitudinal centroids



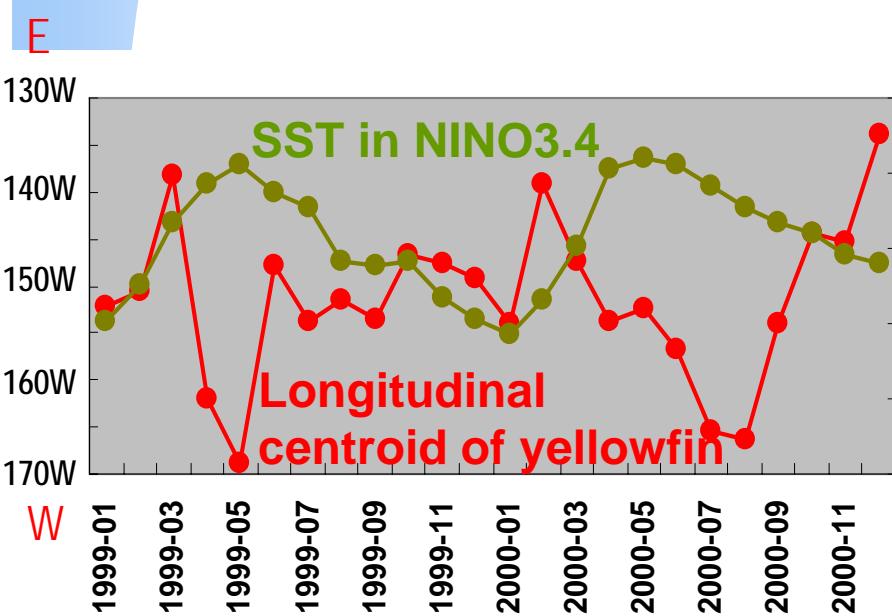
Not significant

What causes this change?

Results

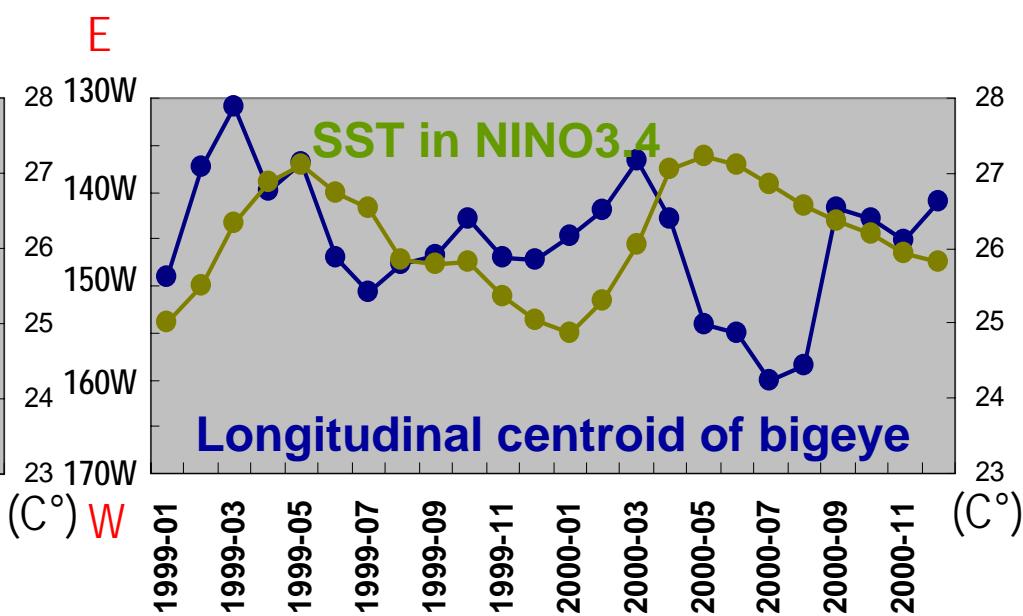
➤ Longitudinal centroids & SST of NINO3.4

Yellowfin tuna



$r = -0.465 (< 0.05)$

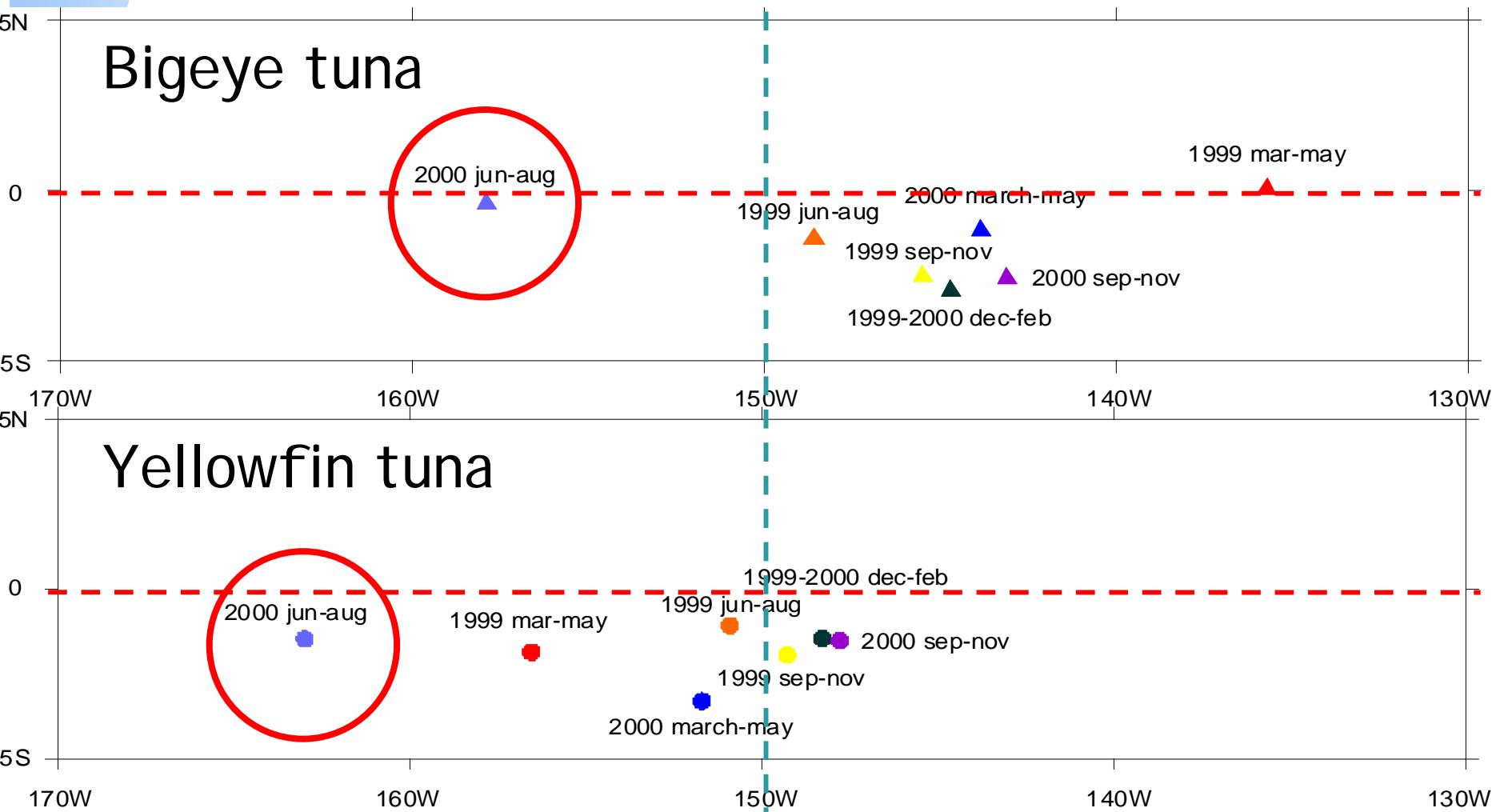
Bigeye tuna



Not significant

Results

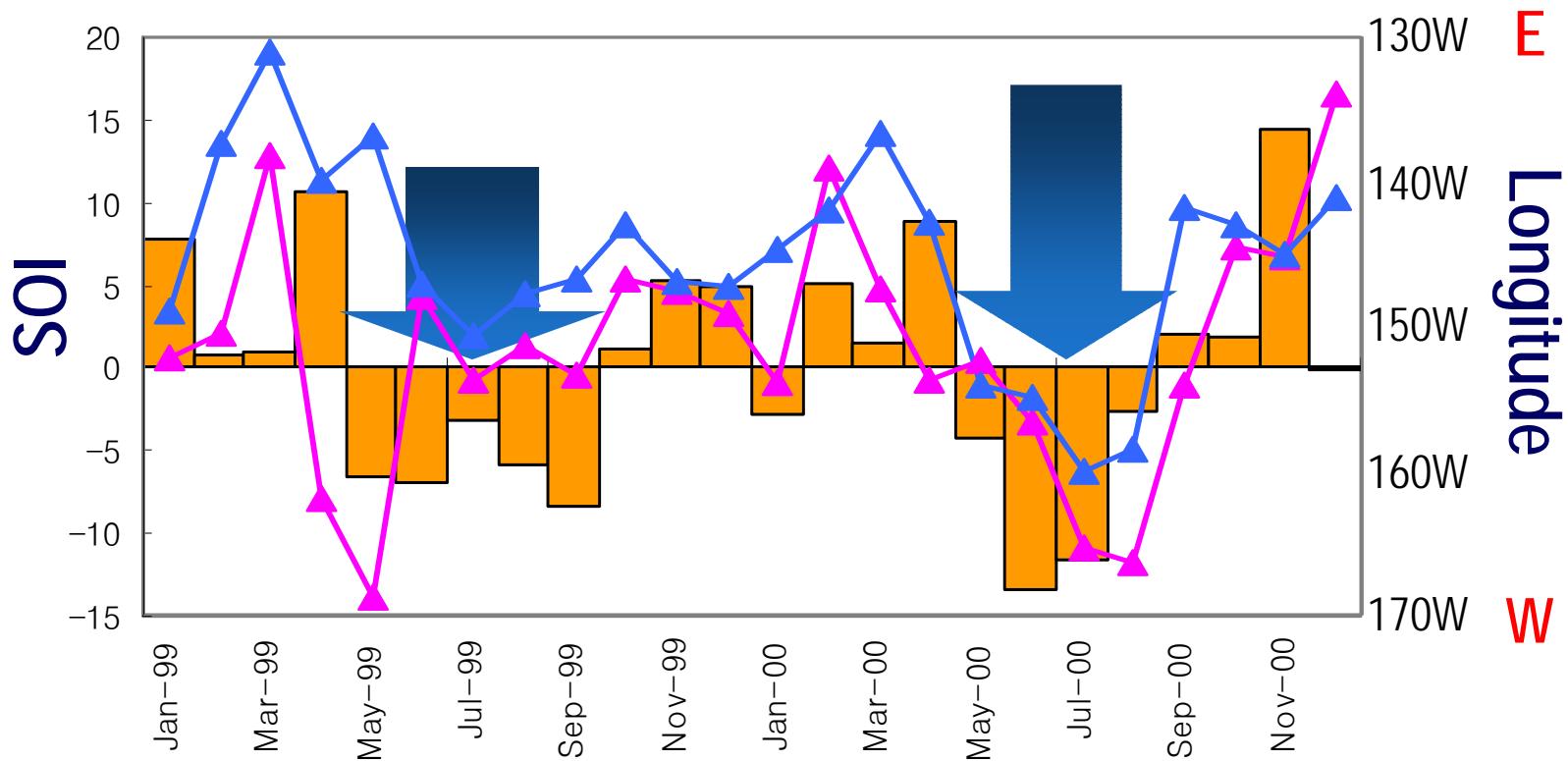
➤ Seasonal change (3 months) of fishing centroid



Results

Anomaly of SOI (Southern Oscillation Index)

with longitudinal centroids

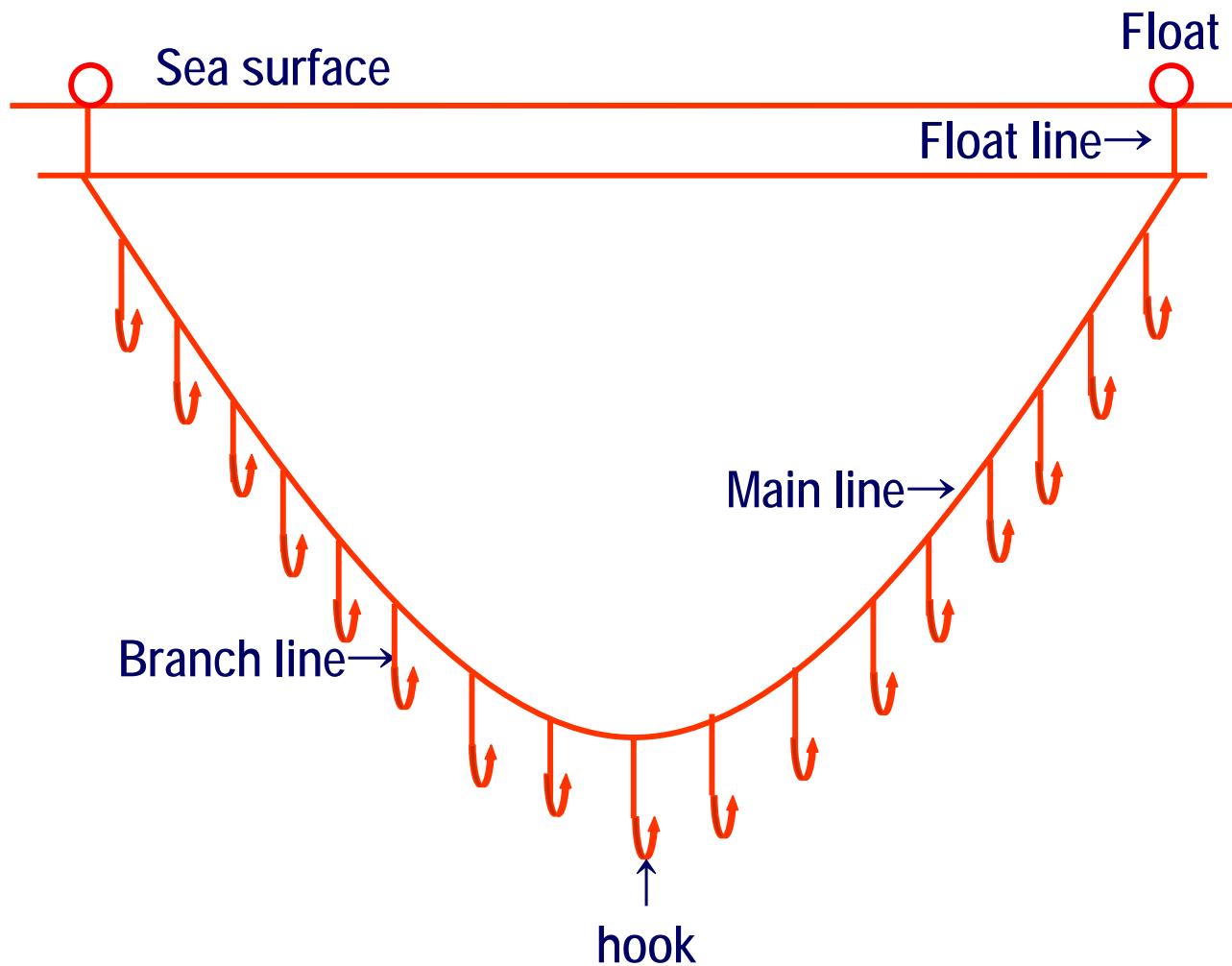


A photograph of two tunas swimming in the deep blue ocean. The water is a deep, saturated blue, with light filtering down from the surface in a bright, glowing band. Two dark, silhouetted figures of tunas are visible against this light. One tuna is larger and positioned higher up, while the other is smaller and lower down, suggesting depth.

Vertical distribution of bigeye and yellowfin tuna

Materials & Methods

- Schematic view of a “basket” of tuna longline gear



Materials & Methods

□ Fishing data

- One fishing vessel, Sinyoung 53
- August 1999 – October 2000
- Catch per hook of 211 sets of longline setting



Materials & Methods

- to calculate the depth of each hook...

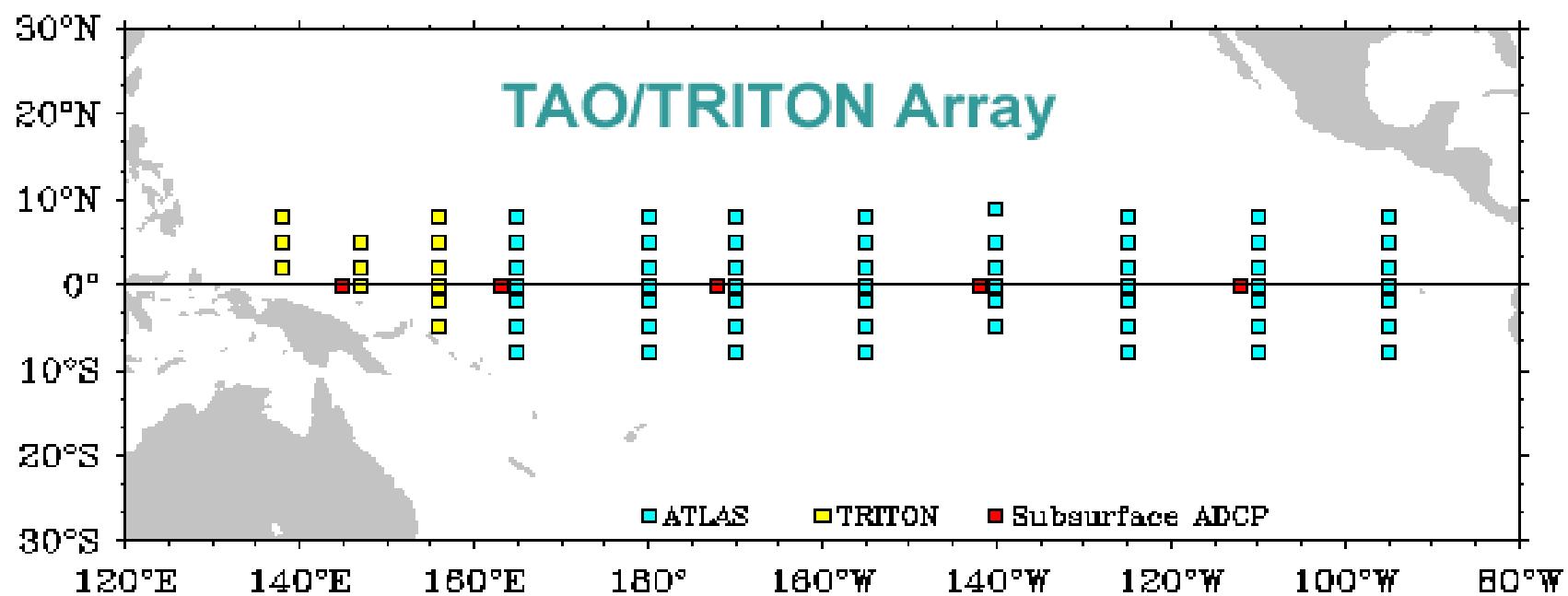
➡ Yoshihara formula (1951, 1954)

$$D_j = h_a + h_b + L \{ (1 + \cot^2 \phi^\circ)^{1/2} - [(1 - 2j/n)^2 + \cot^2 \phi^\circ]^{1/2} \}$$

No. of hook	120-190m	191-260m	261-330m	331-400m
Dept h (m)				

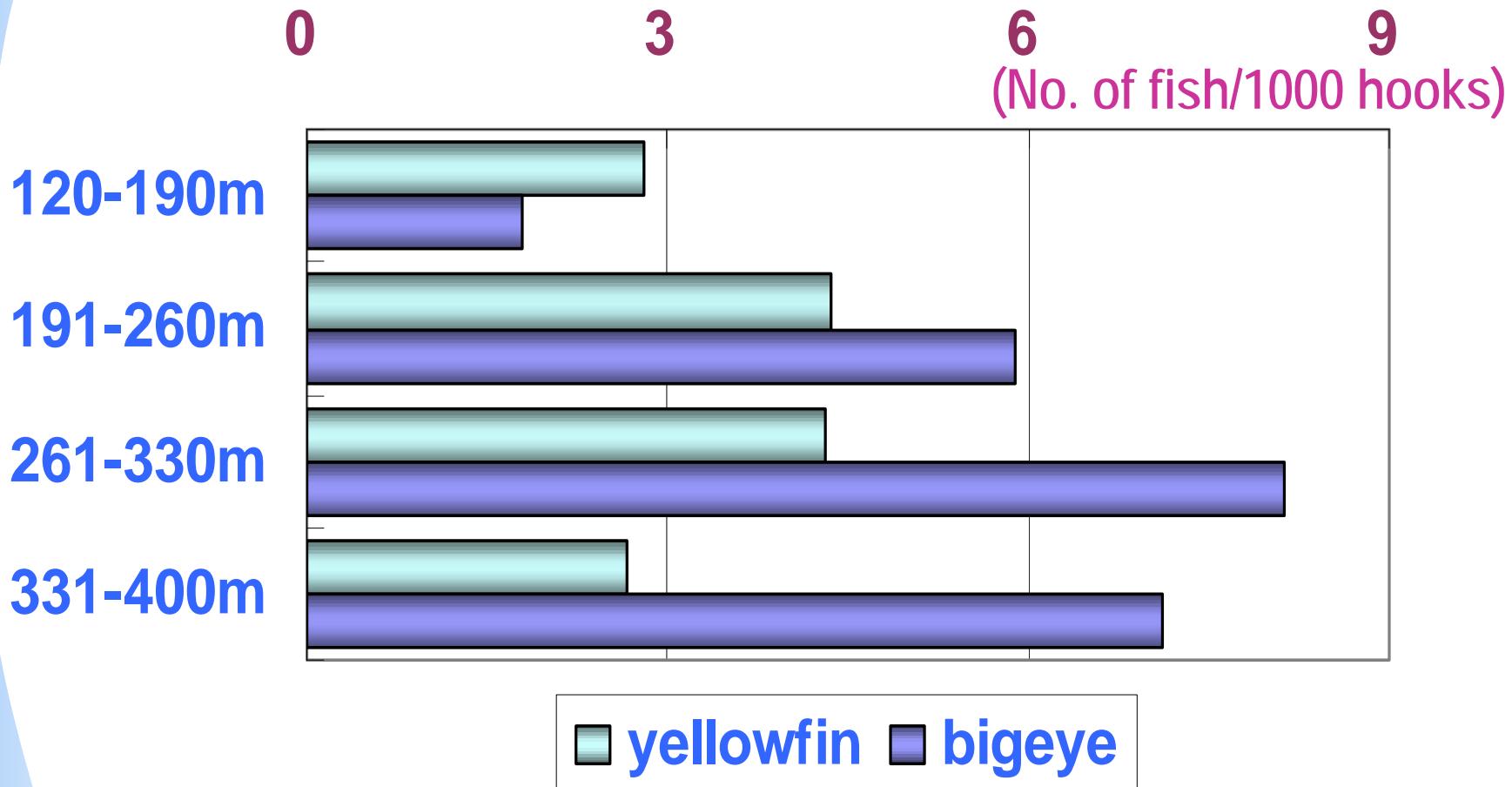
Materials & Methods

- Environmental data (TAO buoy data)
(<http://www.pmel.noaa.gov/tao/index.html>)
Subsurface temperature (0-500m)

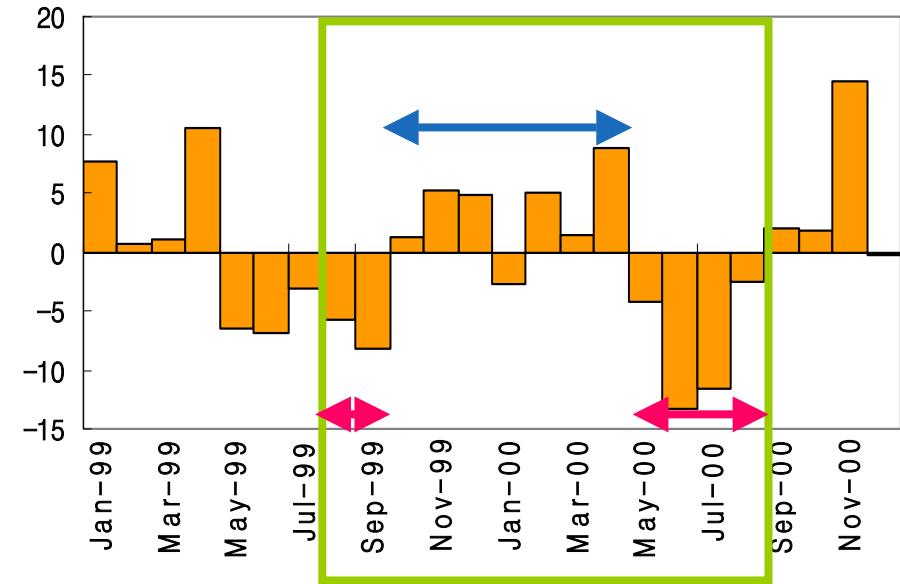


Results

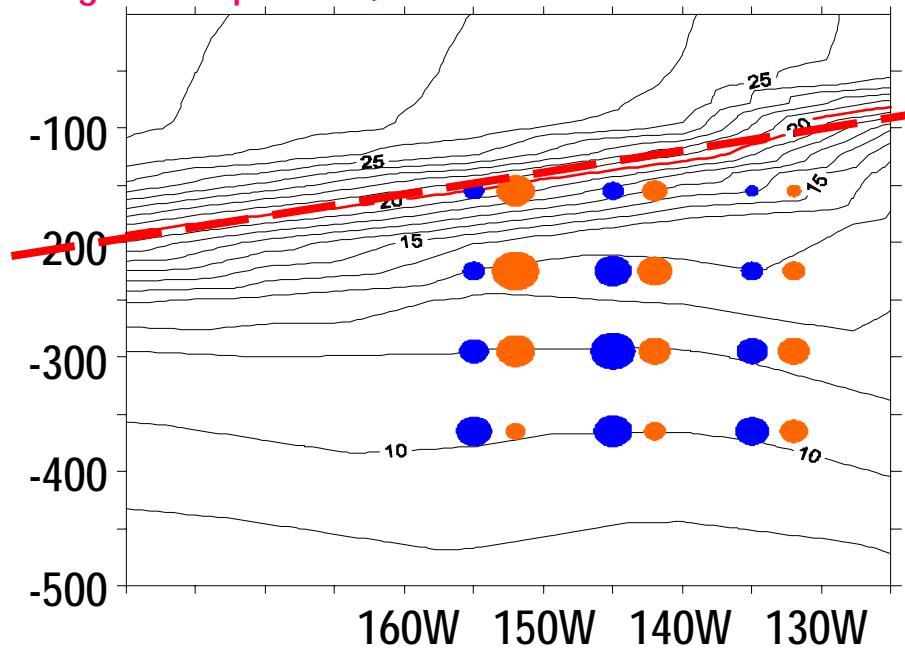
- CPUEs of bigeye and yellowfin tuna in four depth



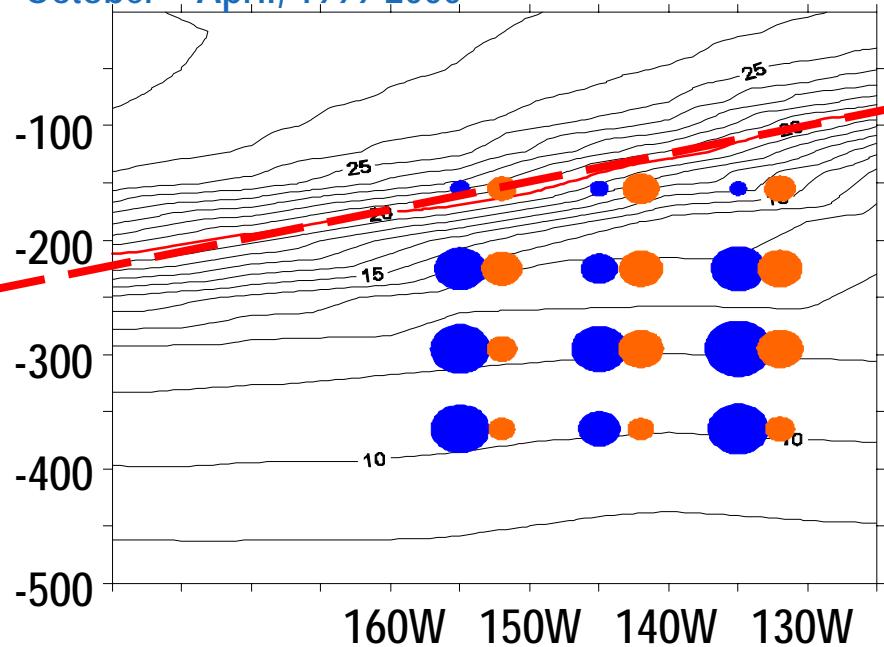
SOI anomaly



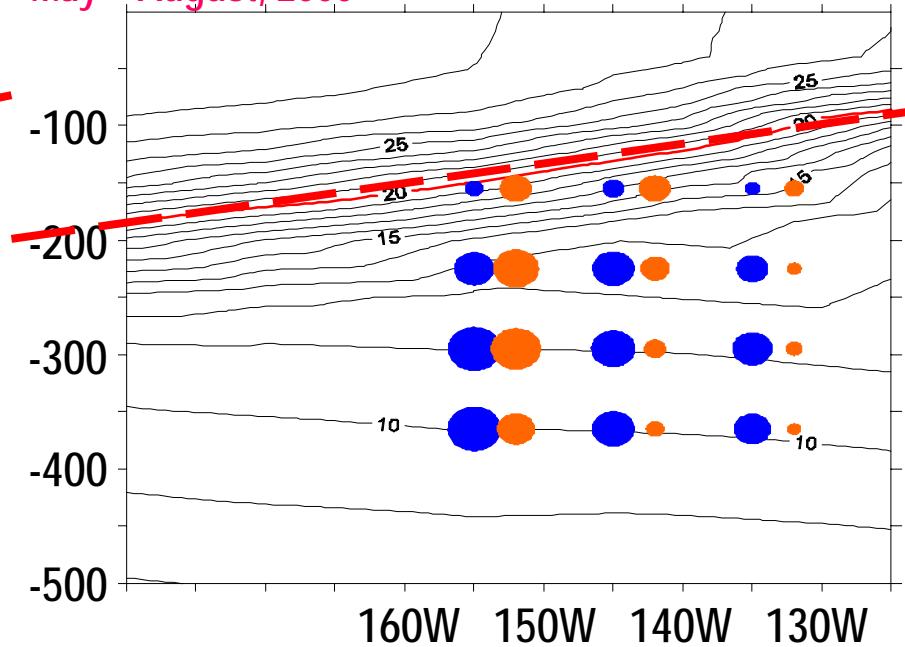
August – September, 1999



October – April, 1999-2000



May – August, 2000



Summary

- Spatial distribution with season was not clear, but catch locations of both species look coherent longitudinally.
- Bigeye tuna seem to distribute further east than yellowfin tuna.
- El Niño might affect on the longitudinal fishing grounds of both species. However, yellowfin tuna response more sensitively to the environmental change than bigeye tuna.

Summary

- Bigeye tuna located in deeper depth than yellowfin tuna.
- When the SOI was negative (i.e., thermocline was shallow in the western area), the tuna distributions seemed to be located more in the western area, and vice versa.
- The vertical movement was not clear from our study.

Future study

- ✓ Use of more vertical data over longer period
- ✓ Investigation on distribution of several tuna species under dynamical ocean structure

A close-up, low-angle shot of a massive school of fish, likely sardines or a similar small species, swimming in a deep blue ocean. The fish are densely packed, filling the frame. Their bodies are silvery-blue with dark vertical stripes. Some fish are oriented vertically, while others are angled, creating a sense of movement. The lighting is natural, coming from above, which highlights the fish's scales and creates a shimmering effect.

Thank You!



Part 3.

Bait selectivity

Materials & Methods

- Bait were used...



Mackerel

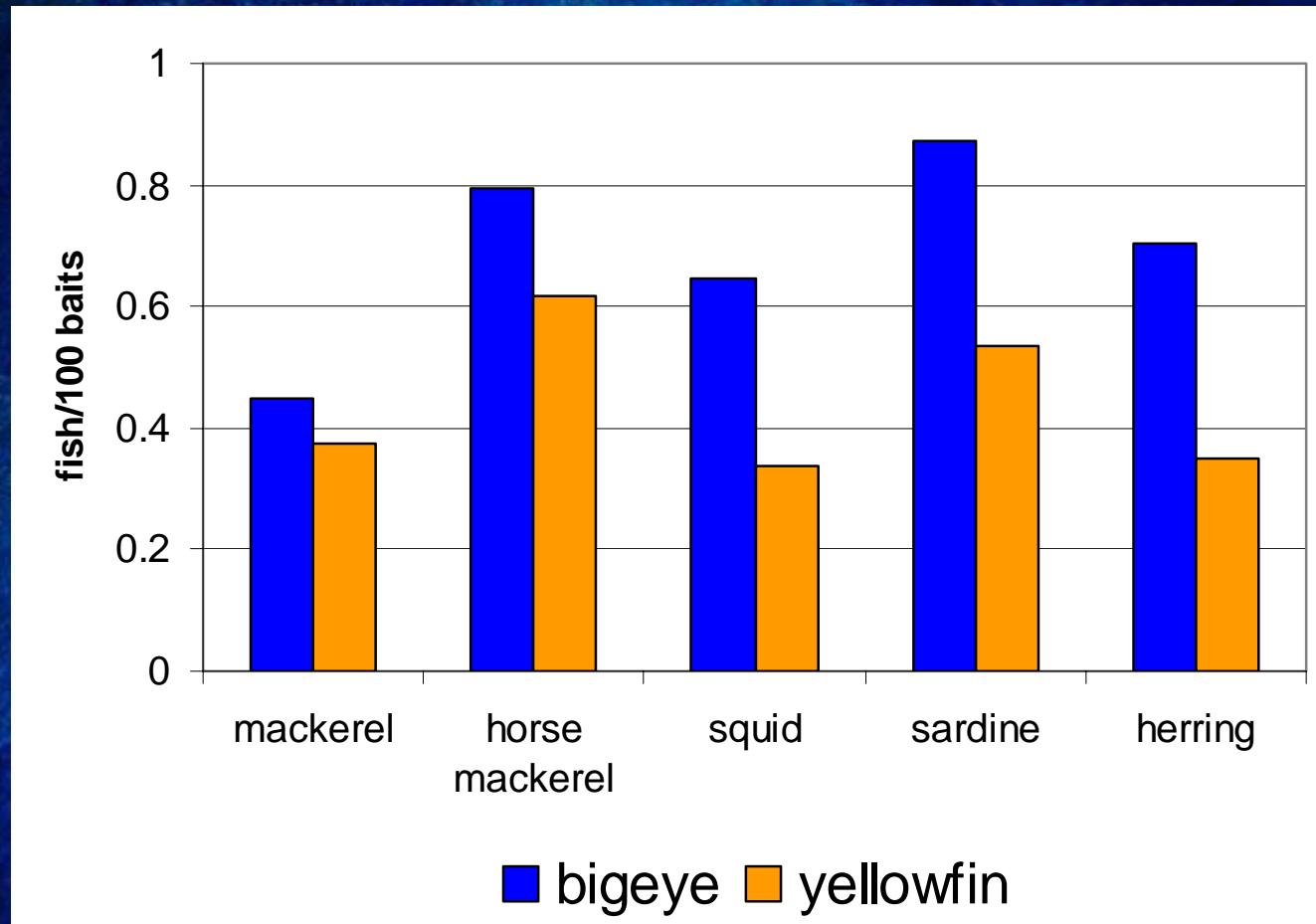
Horse mackerel

Squid

Sardine

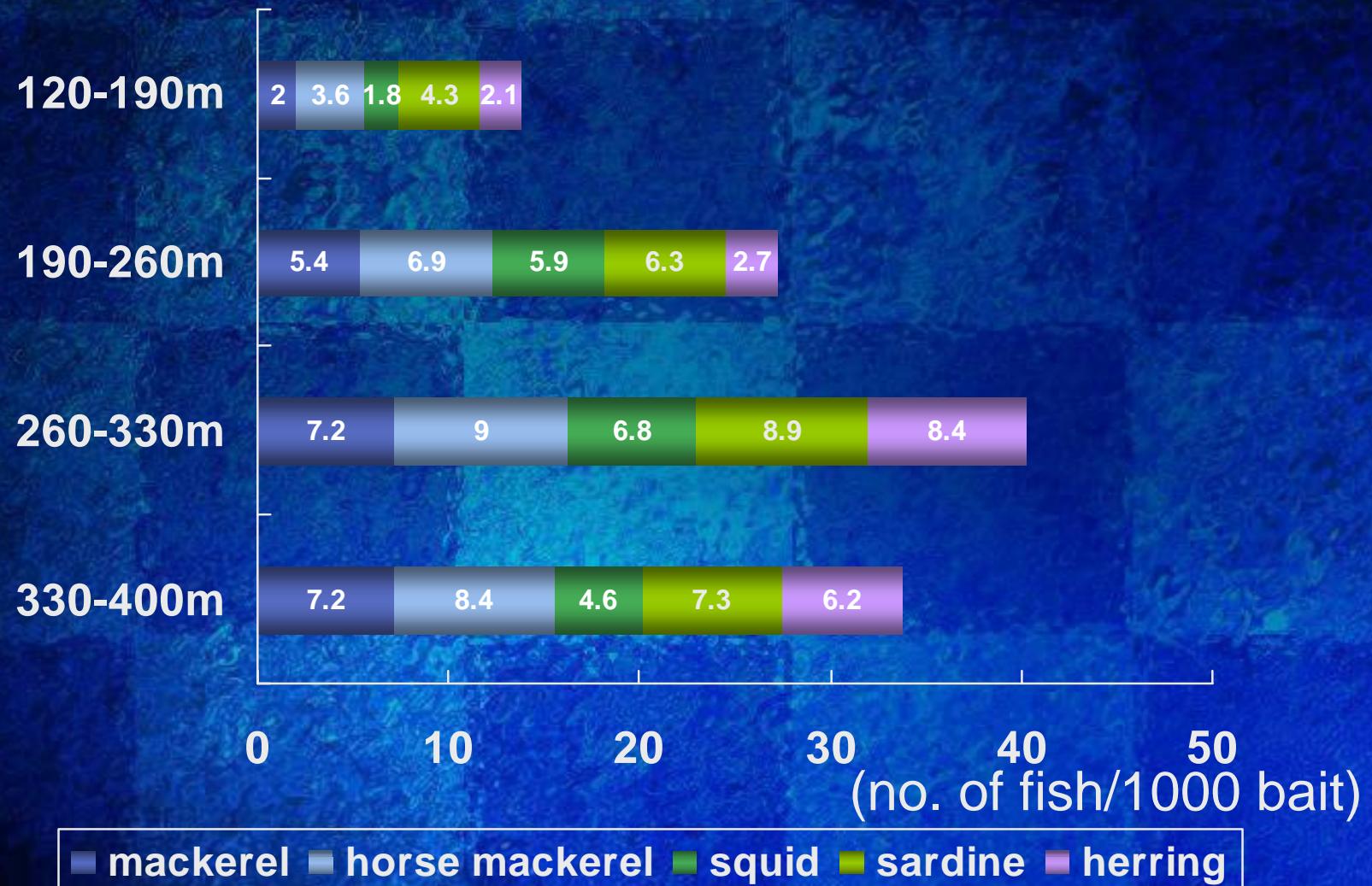
Herring

Results & Discussion



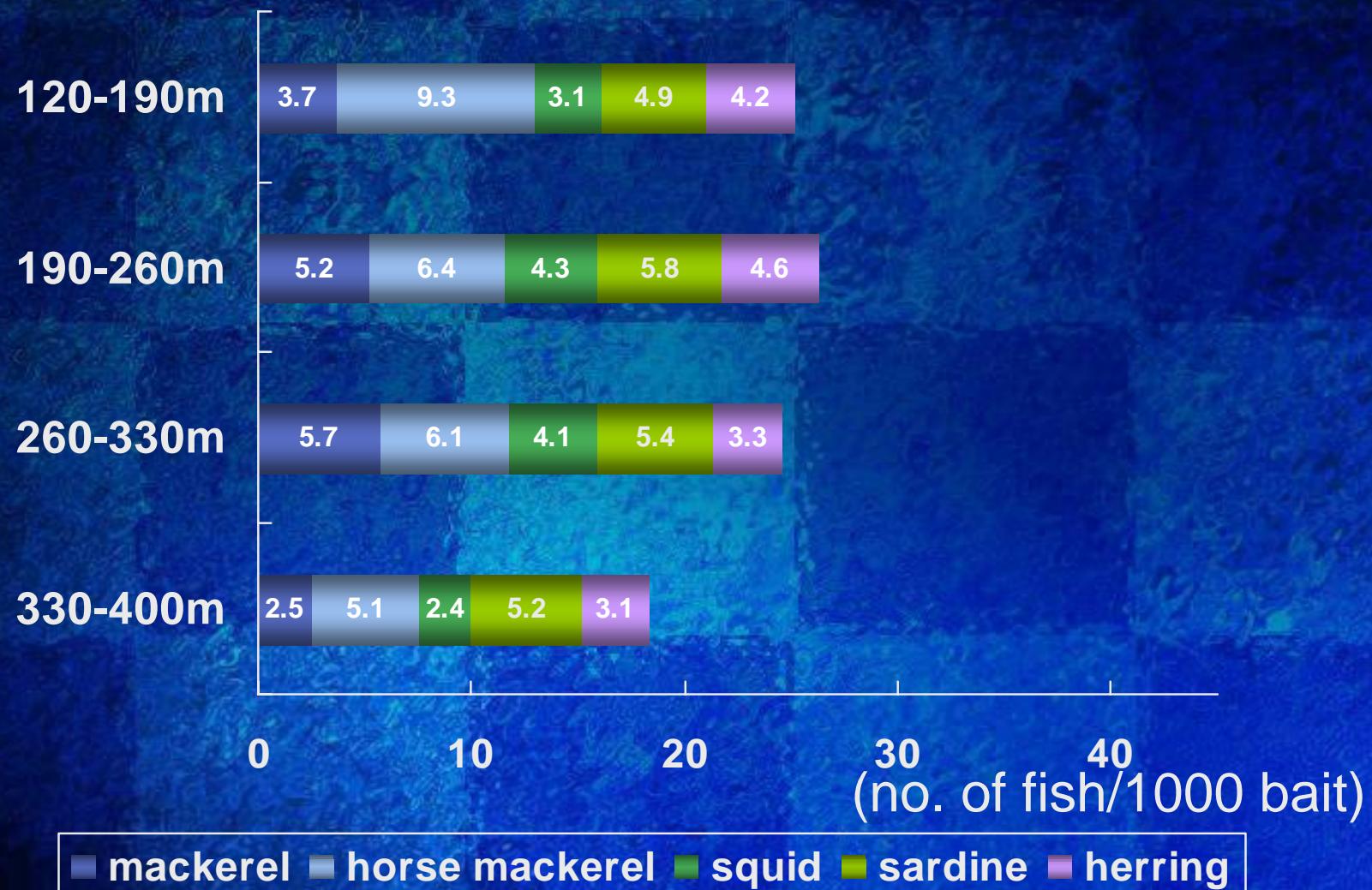
Results

□ Bait selectivity of bigeye tuna



Results

□ Bait selectivity of yellowfin tuna



Summary

- Sardine and horse mackerel are the efficient bait for bigeye and yellowfin tuna.
- The order of bait efficiency is not change even the depth difference in both species.