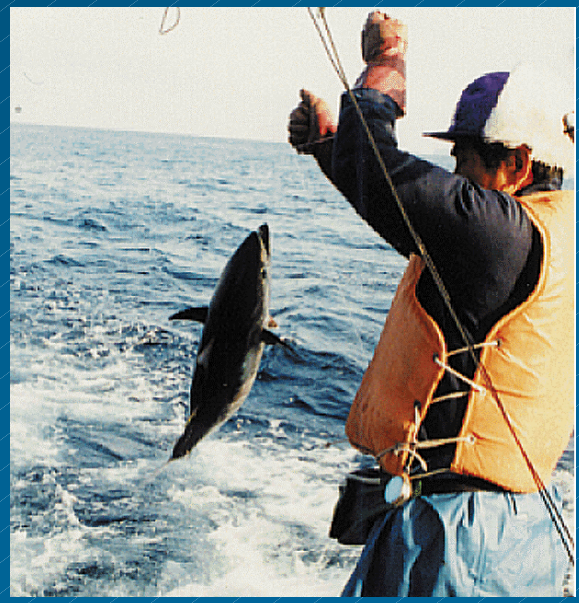
The PICES Thirteenth Annual Meeting Session 4 (FIS/BIO), 'Hot spots and their use by migratory species and top predators in the North Pacific'

Horizontal and vertical movements of juvenile bluefin tuna (*Thunnus orientalis*) in relation to seasons and oceanography in the eastern Pacific

Takashi Kitagawa[1], A. M. Boustany[1], C. R. Perle[1], C. J. Farwell[2], T. Williams[2], H. Dewar[3] and B. A. Block[1]

[1]Hopkins Marine Station of Stanford University
[2]Monterey Bay Aquarium
[3]Census of Marine Life, Tagging of Pacific Pelagics

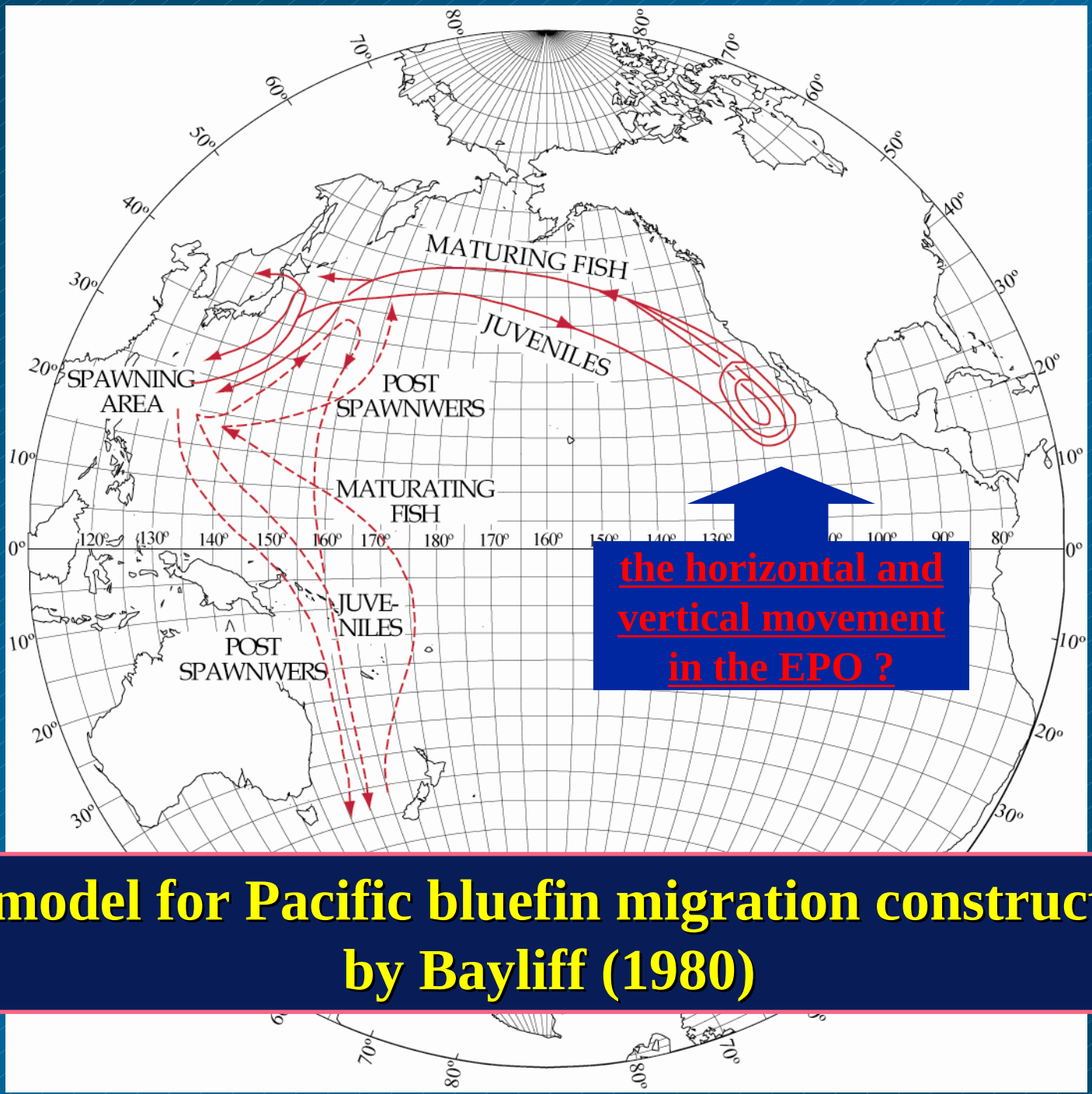
Tsukiji Fish Market,
Tokyo, 2004



Modern methods

Edo period

San Diego, 2003



A model for Pacific bluefin migration constructed by Bayliff (1980)

Objectives are:

- to examine the differences in horizontal and vertical movement patterns among seasons in relation to the oceanographic conditions in the EPO.

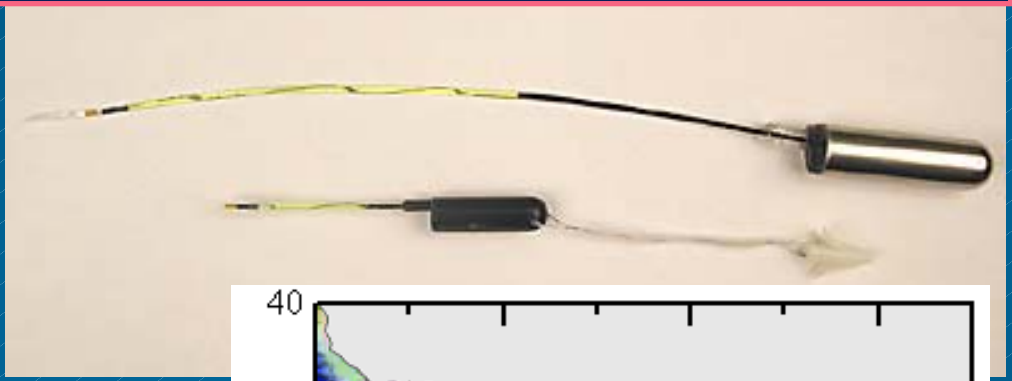
- and to examine their deep vertical movements through the thermocline in relation to the occurrence of feeding events.

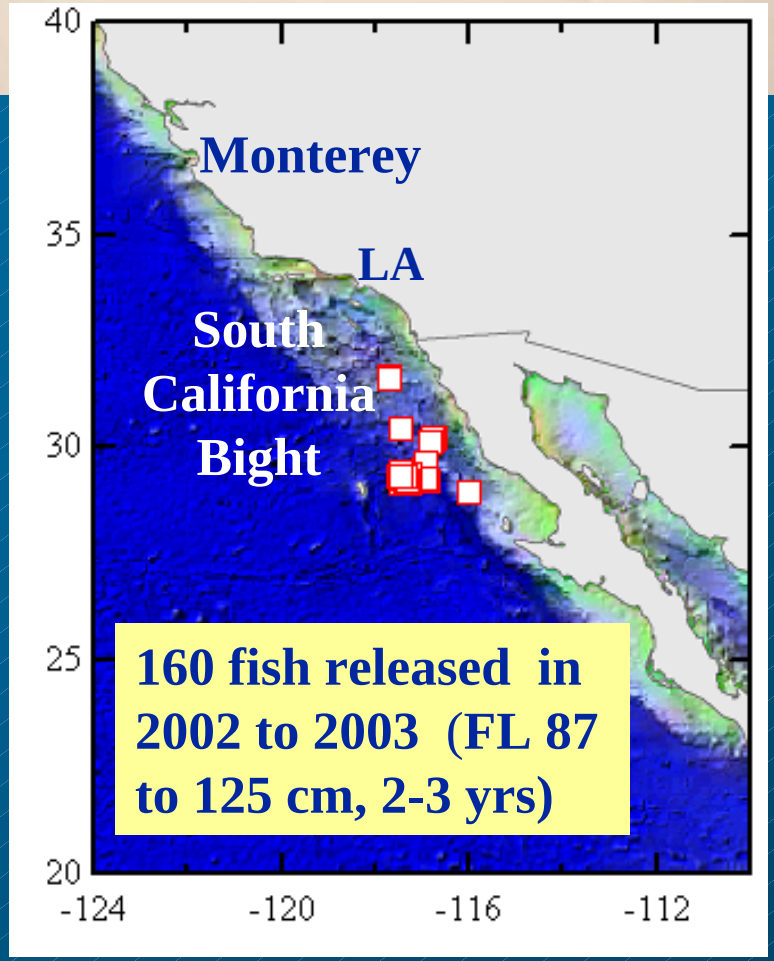
TAG
TAG A GIANT

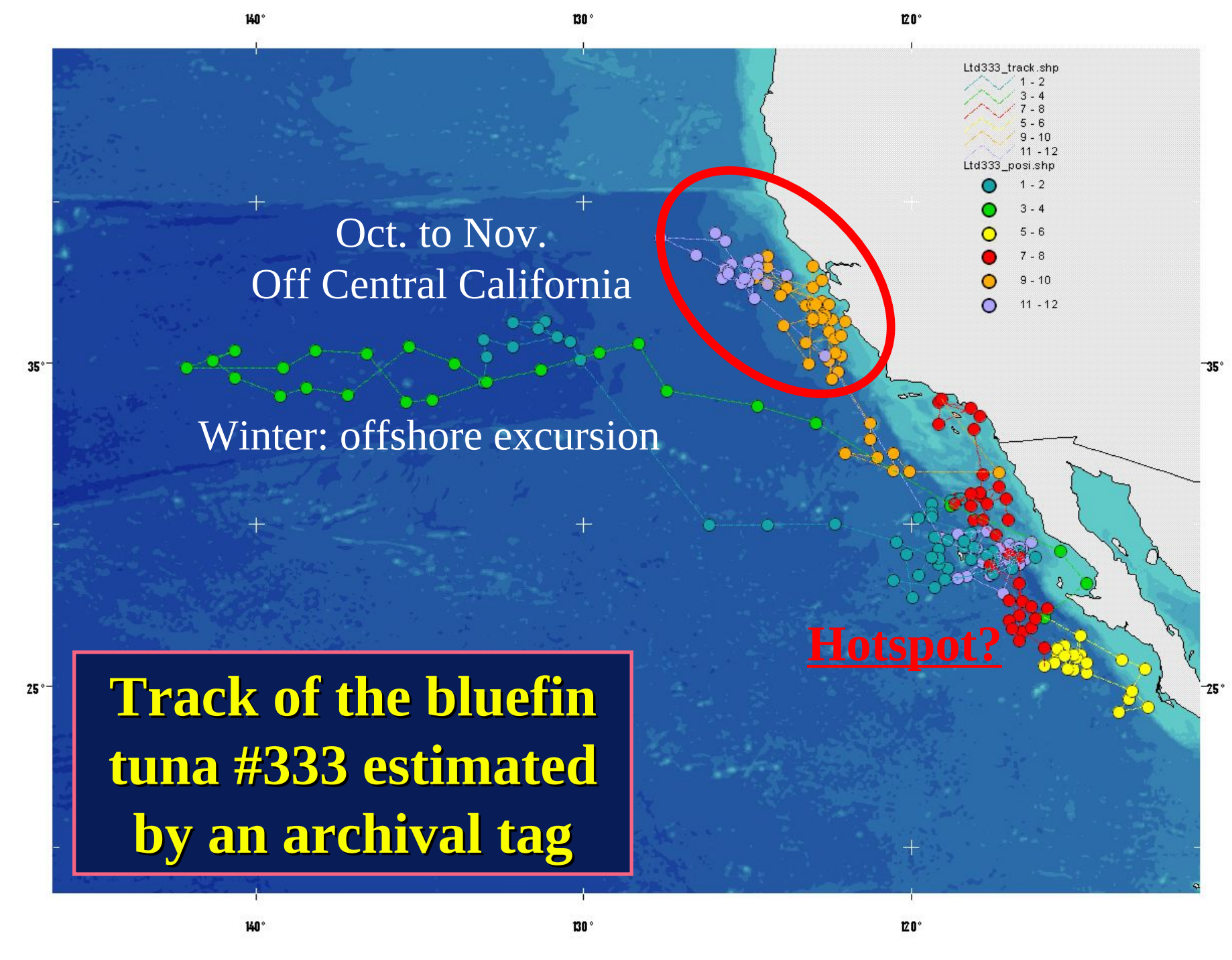
Archival tag (LTD2310, Lotek Wireless Inc., CA)

- Depth
- Ambient temp
- Peritoneal cavity temp
- Light intensity → geolocation

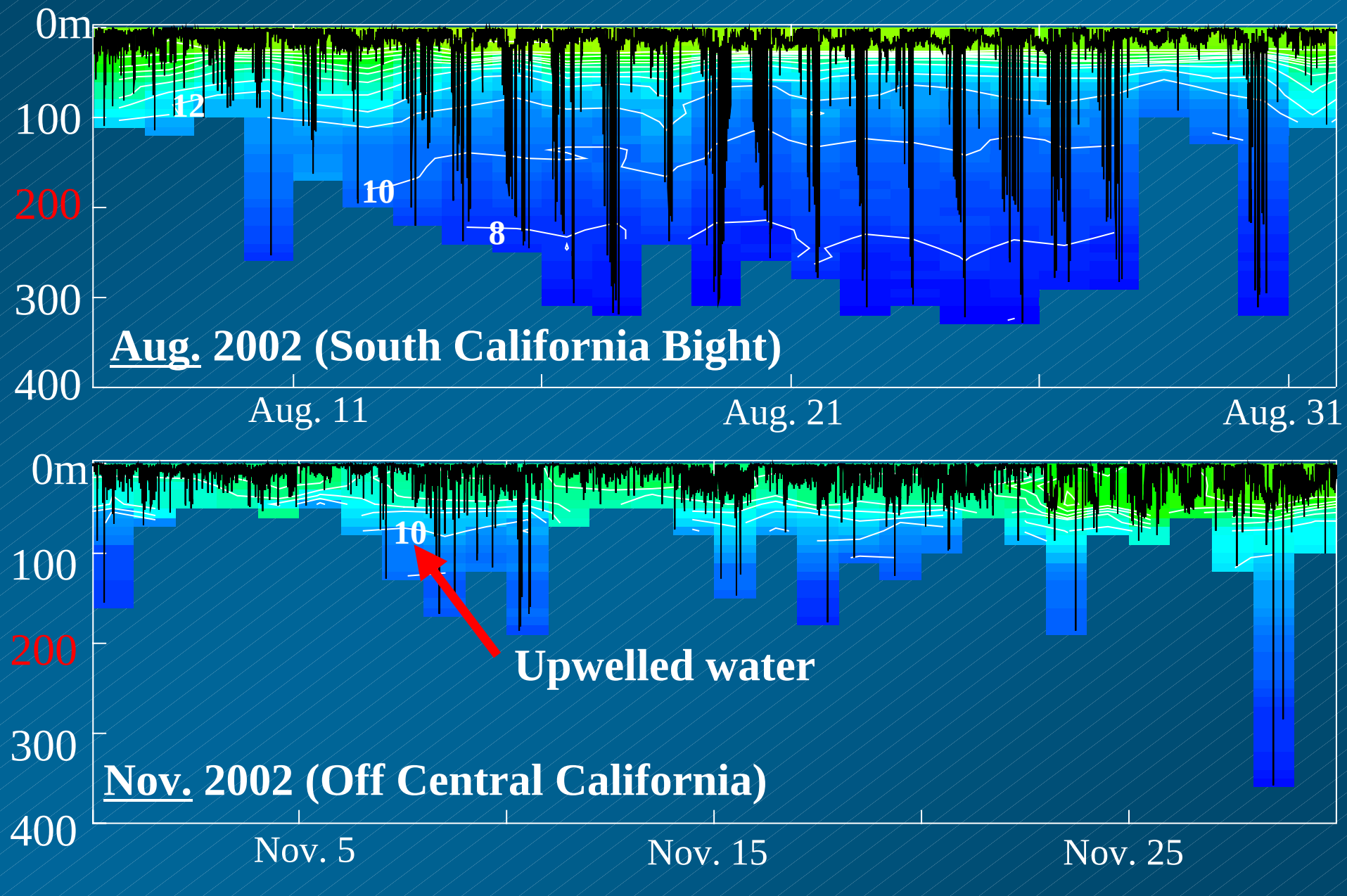
- Sampling interval 32-120 sec.



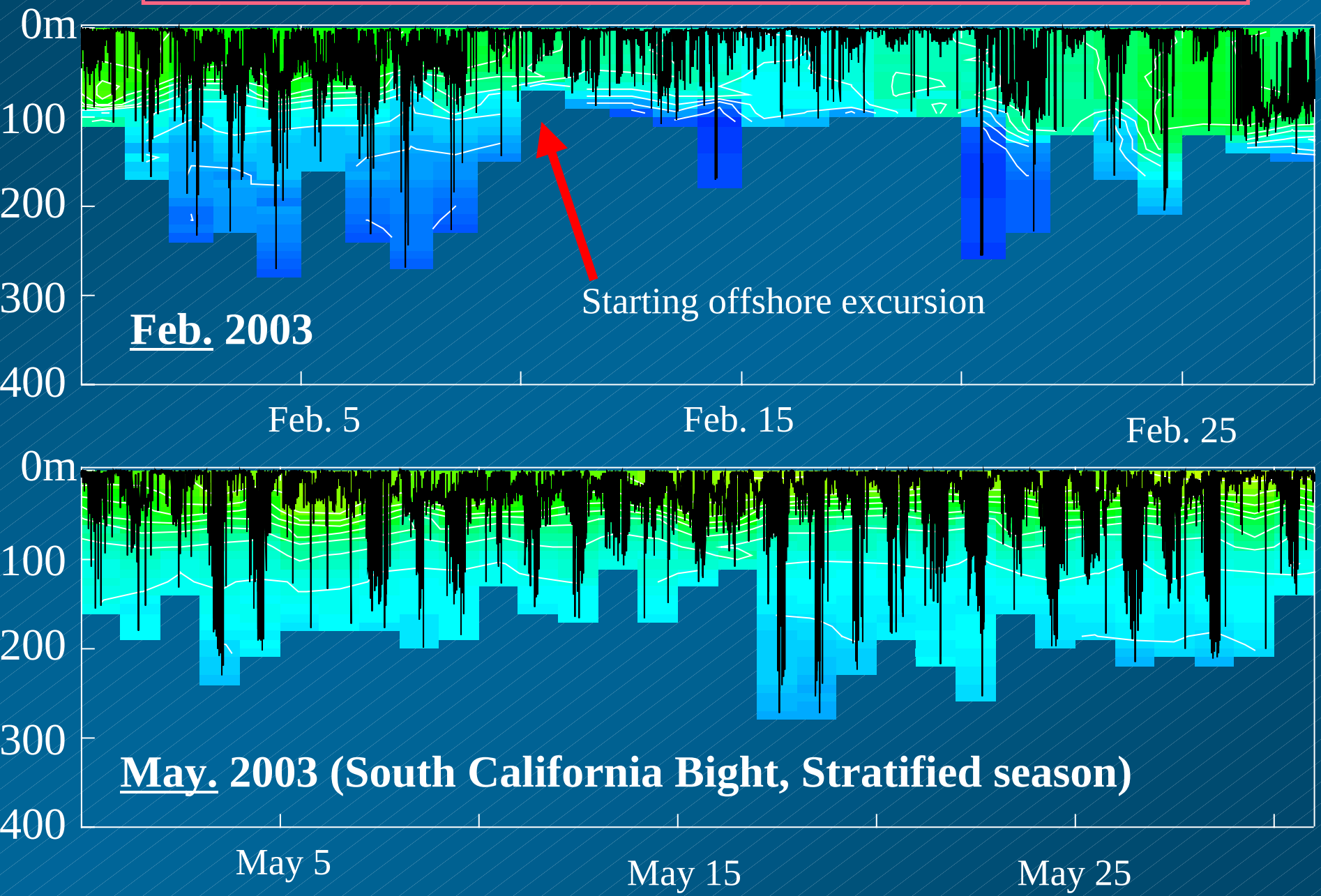



140°
130°
120°
35°
25°
Ltd333_track.shp
1 - 2
3 - 4
7 - 8
5 - 6
9 - 10
11 - 12
Ltd333_posi.shp
1 - 2
3 - 4
5 - 6
7 - 8
9 - 10
11 - 12
Oct. to Nov.
Off Central California
Winter: offshore excursion
Hotspot?
Track of the bluefin tuna #333 estimated by an archival tag

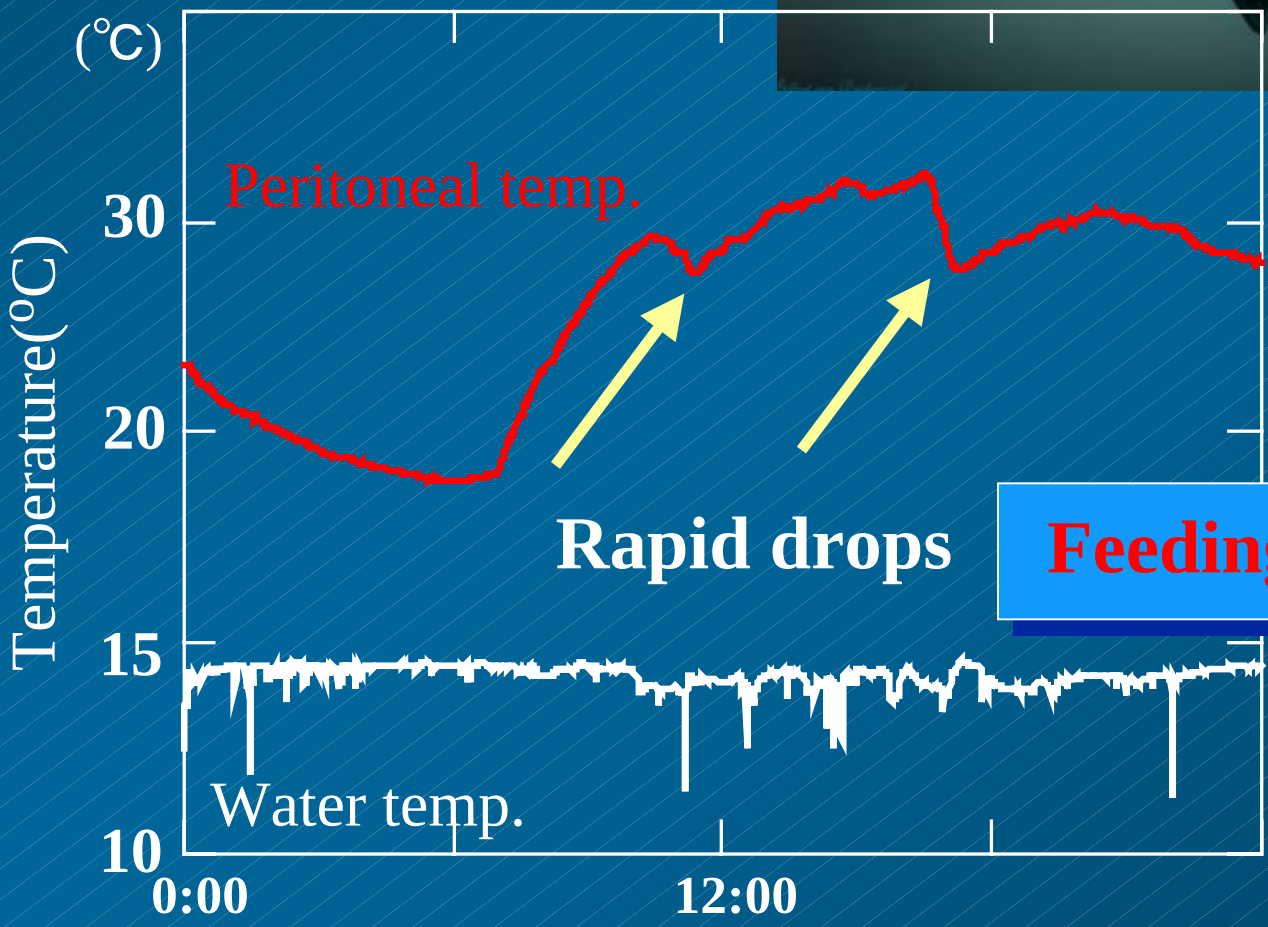
Time series data for bluefin #333 in 2002



Time series data for bluefin #333 in 2003

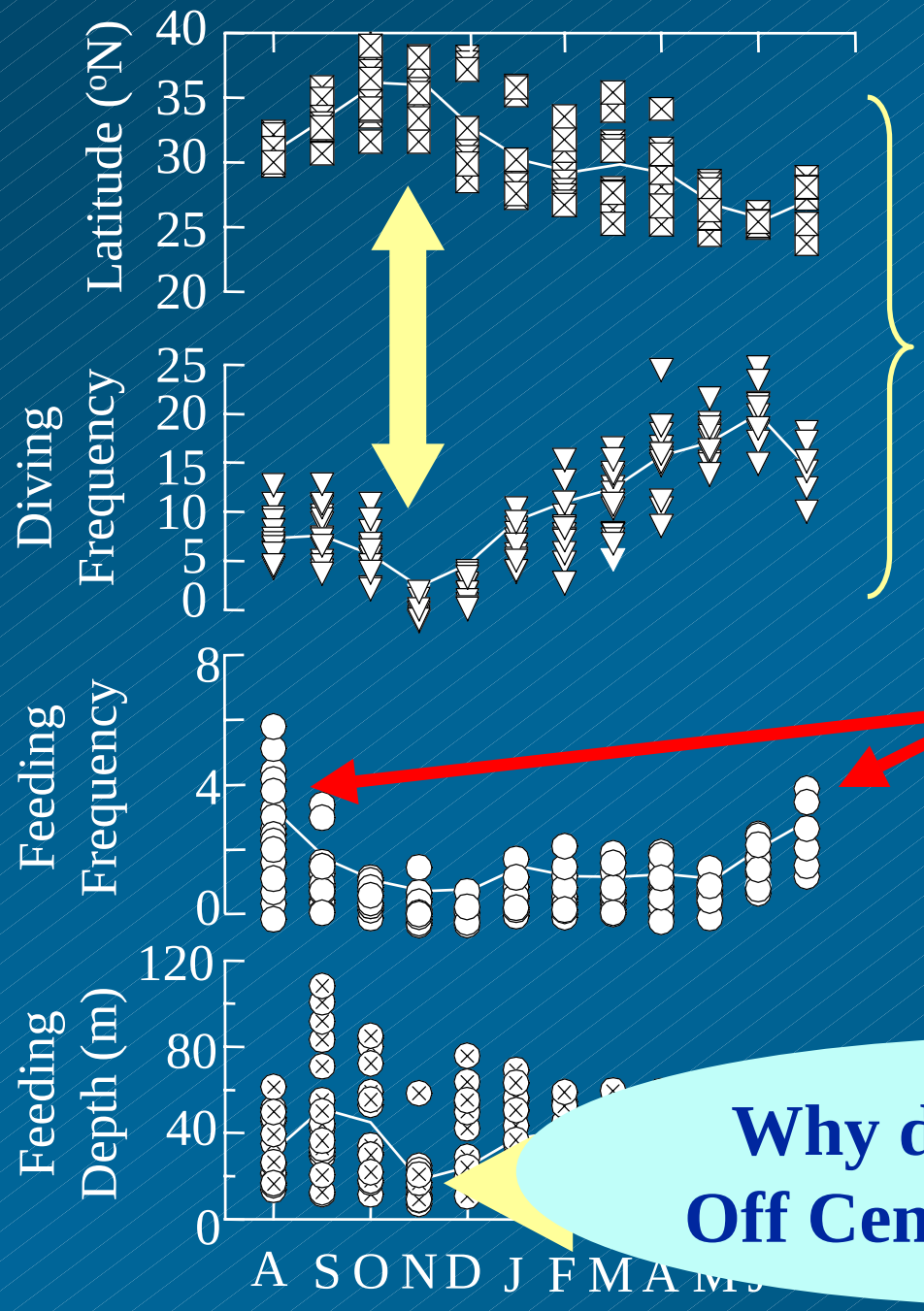


Ingestion of food and seawater



Feeding event

Nov. 05, 2002

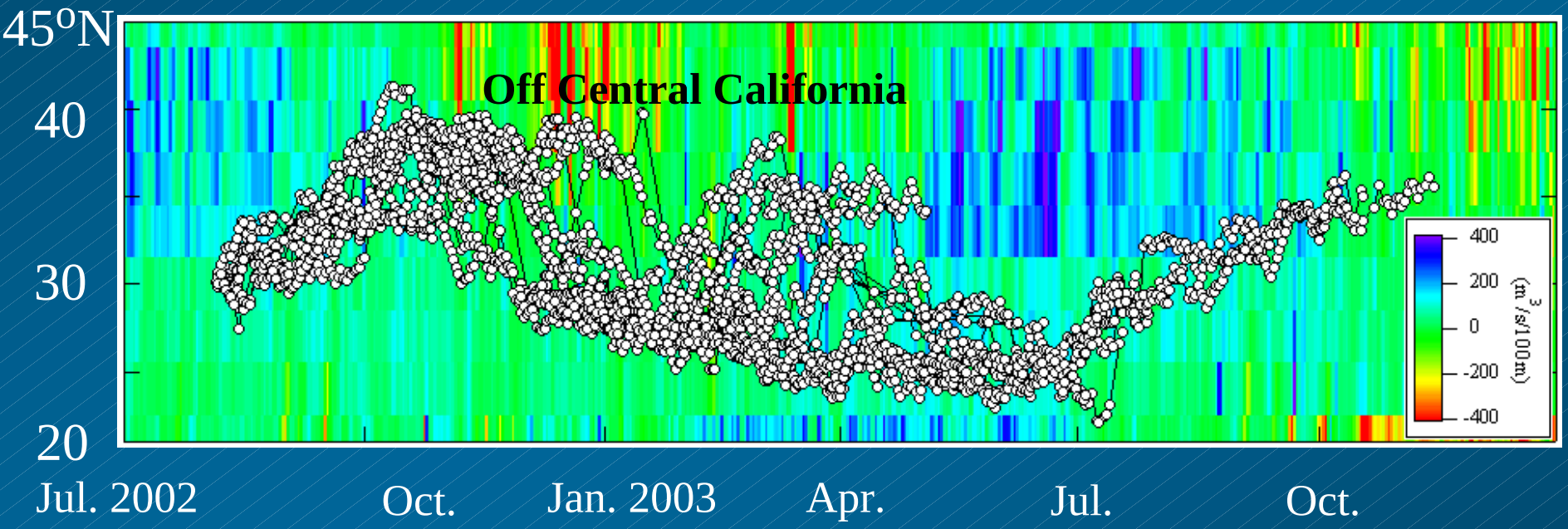


Pearson correlation:
r=-0.920,
p<0.0001

High frequency in summer in Southern California Bight－HOTSPOT

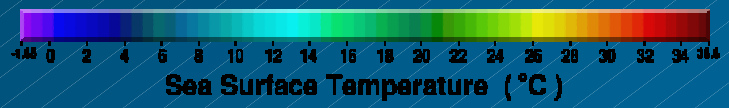
Why do they move to Off Central California?

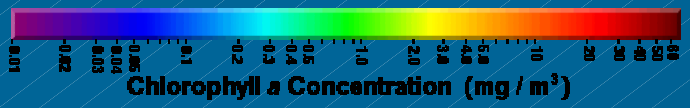
The relationship between upwelling indices and fish geolocations

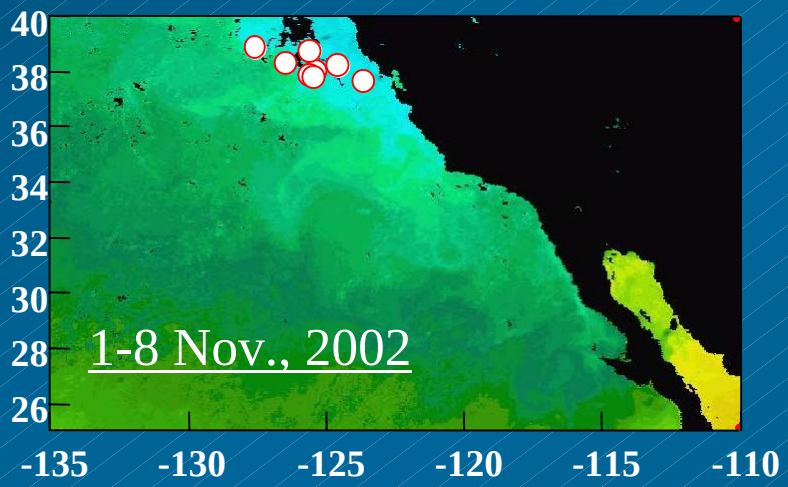


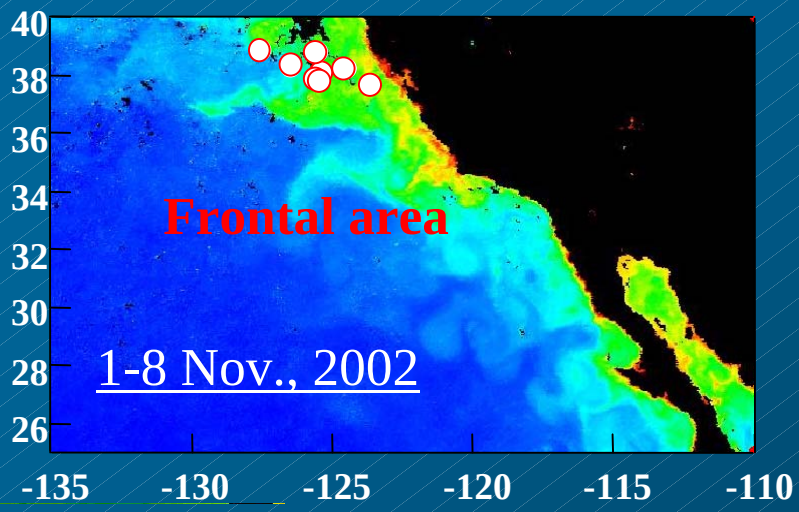
- Upwelling indices: the magnitude of the offshore component of Ekman mass transport is considered to be an index of the amount of water upwelled from the base of Ekman layer (m^3/S/100m).

Composite satellite images and estimated distribution for Bluefin #333.

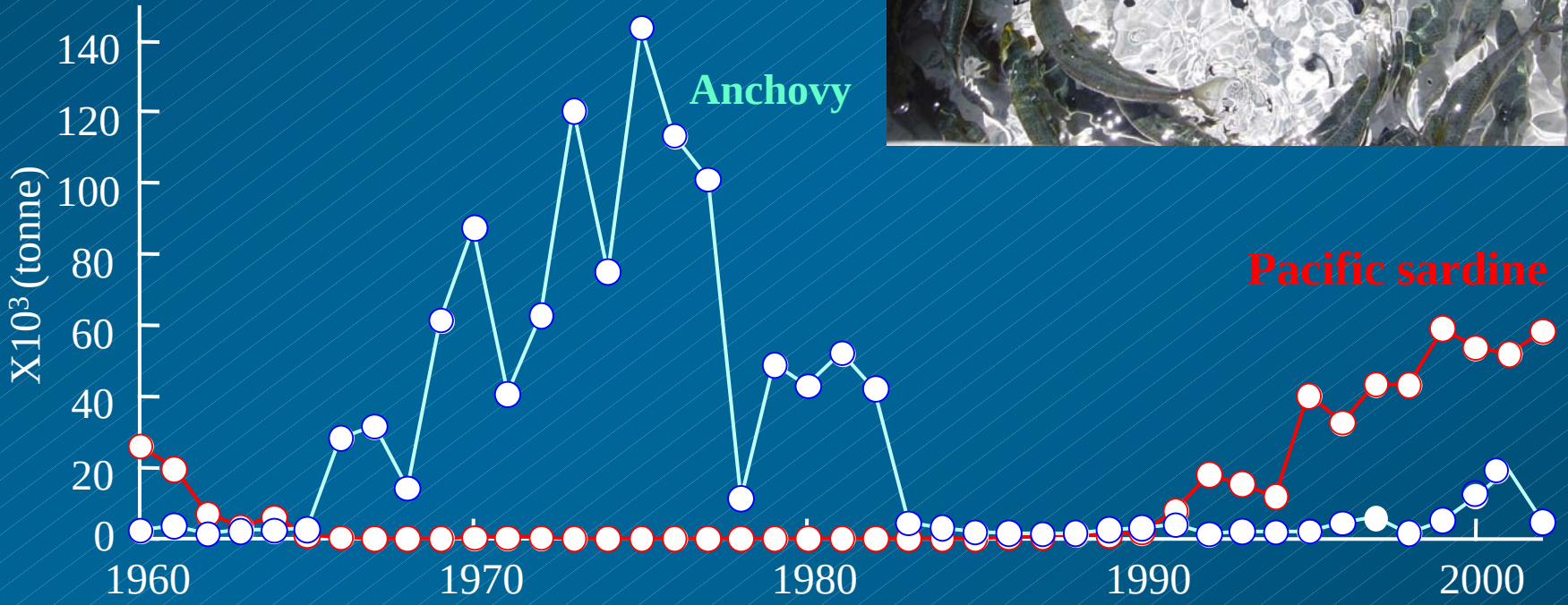






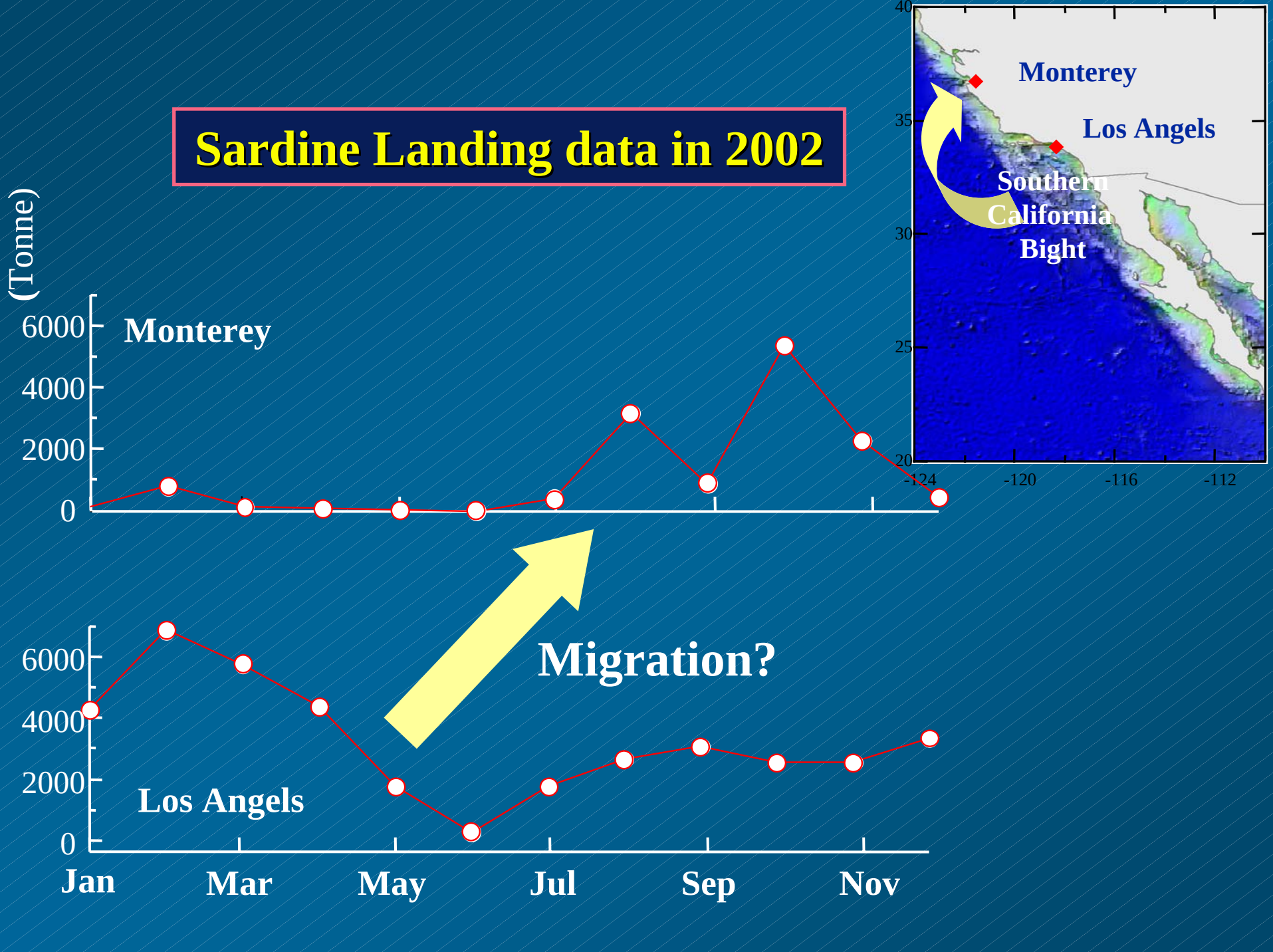


Food item for Bluefin in EPO

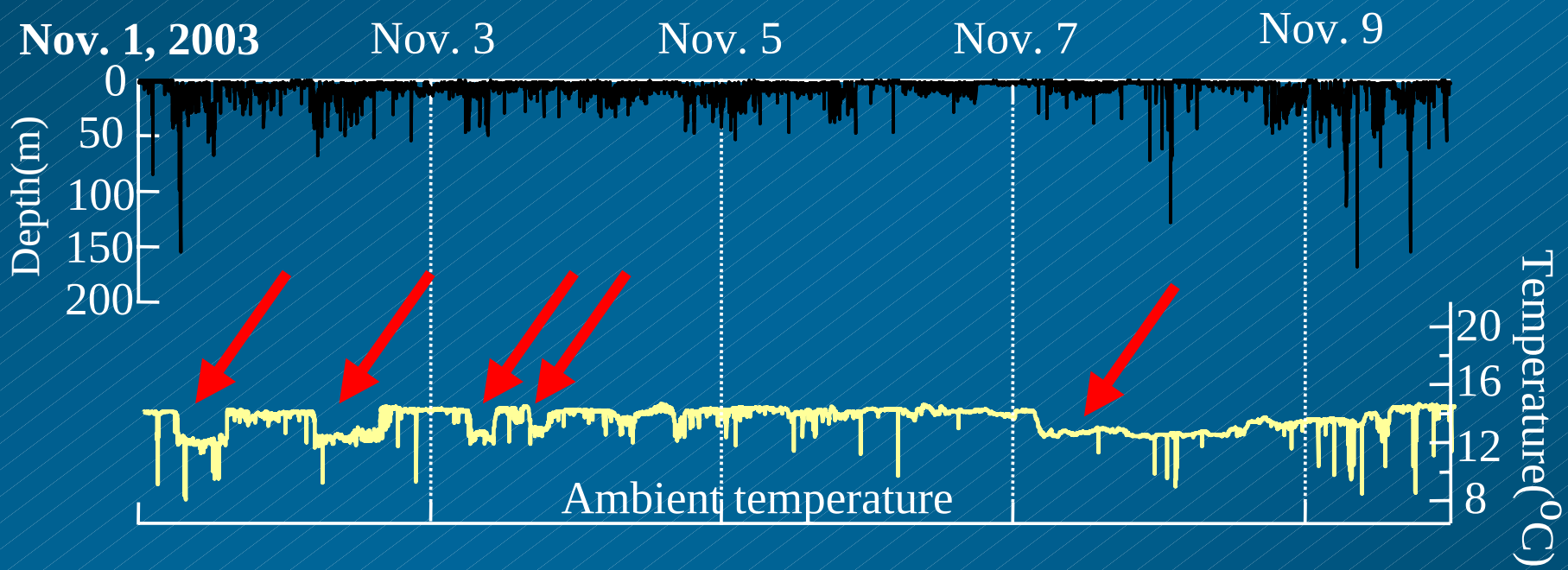


Fish landing in California

Sardine Landing data in 2002

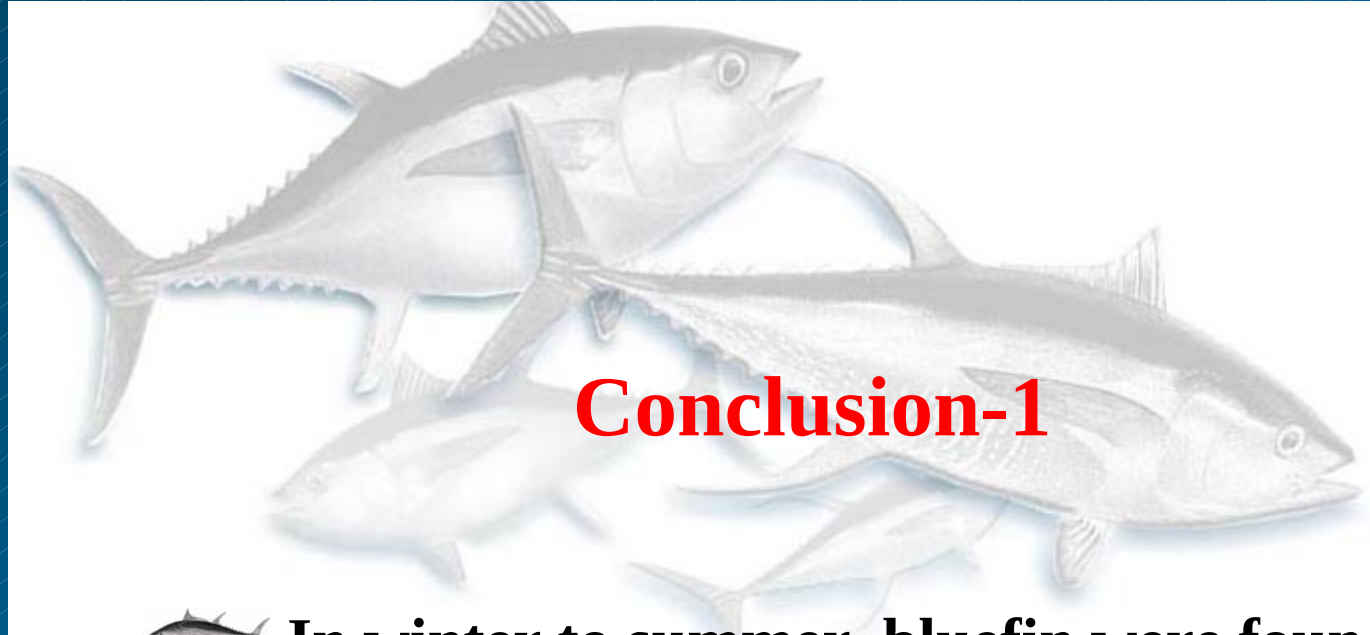


Time series in Nov. for obtained from # 333 swimming off Central California



Temporary drops in ambient temperature

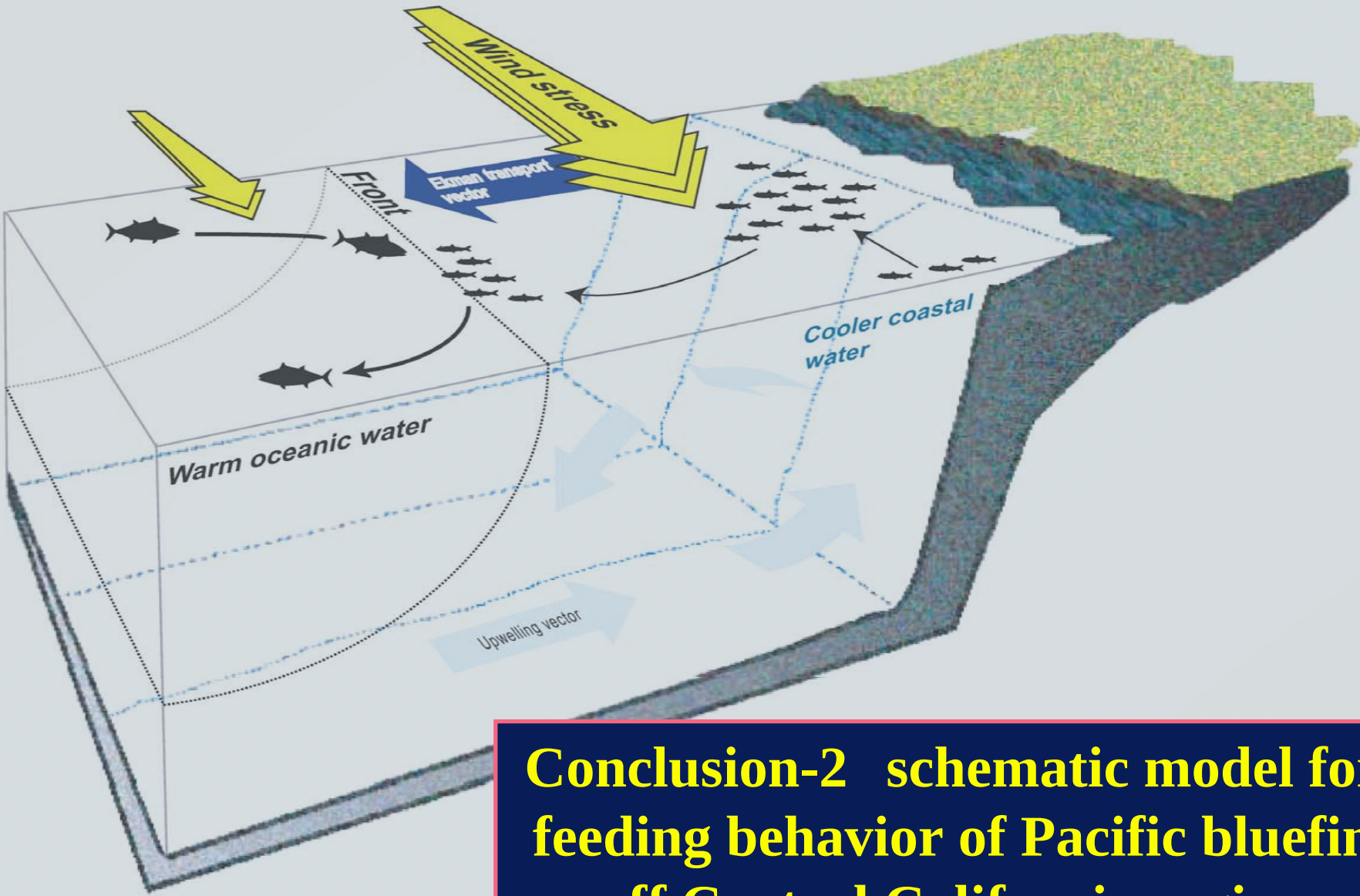
Passing through the front



Conclusion-1

In winter to summer, bluefin were found primarily in the Southern California Bight and along the continental shelf of Baja California (HOT SPOT FOR BLUEFIN TUNA).

→the fish made use of the top of the water column undertaking frequent, brief forays to depths below the thermocline.



Conclusion-2 schematic model for feeding behavior of Pacific bluefin off Central California region


Thank you for your attention.