Interdisciplinary monitoring for the ecosystem of Kuroshio warm current area in relation to climate change

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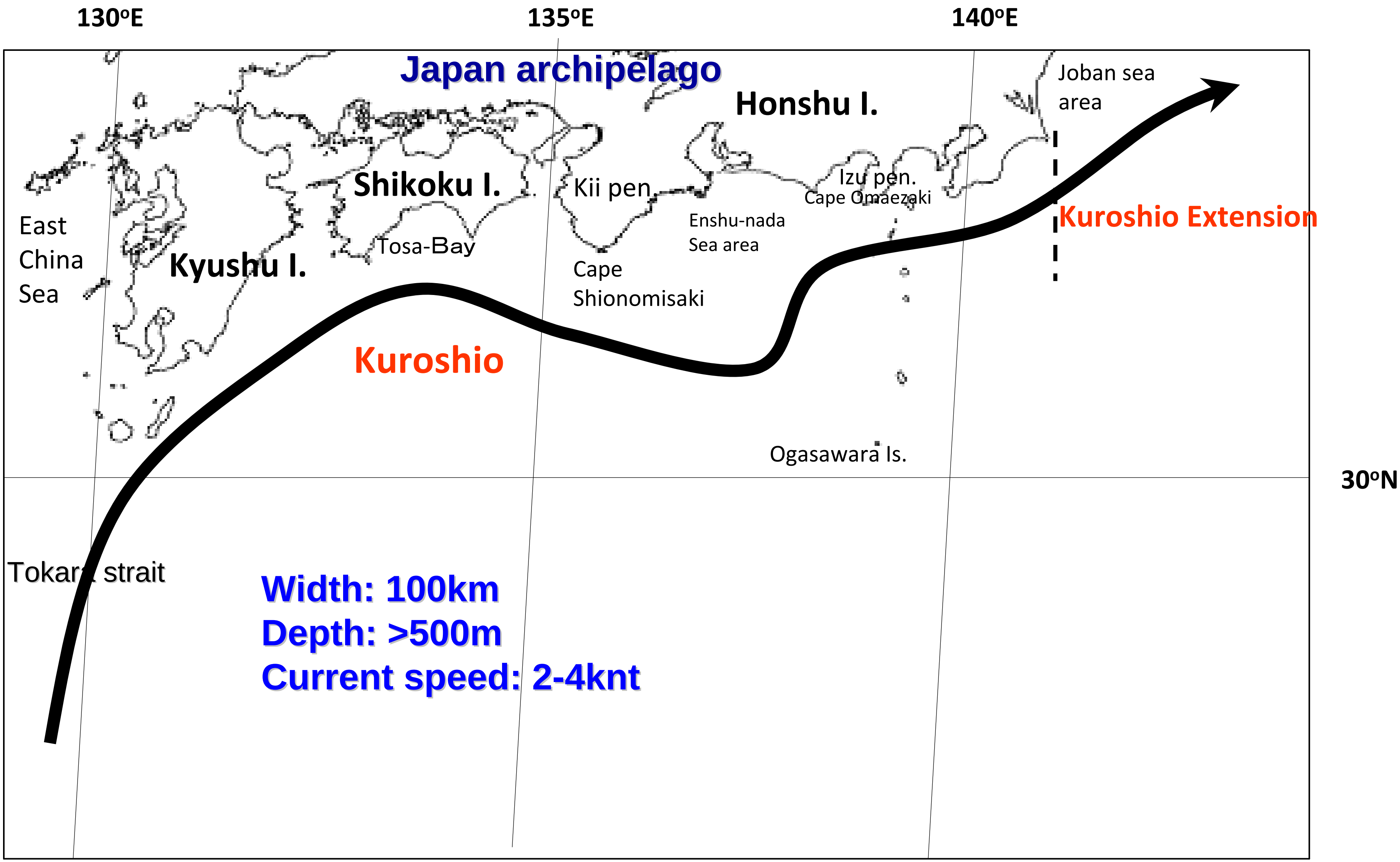
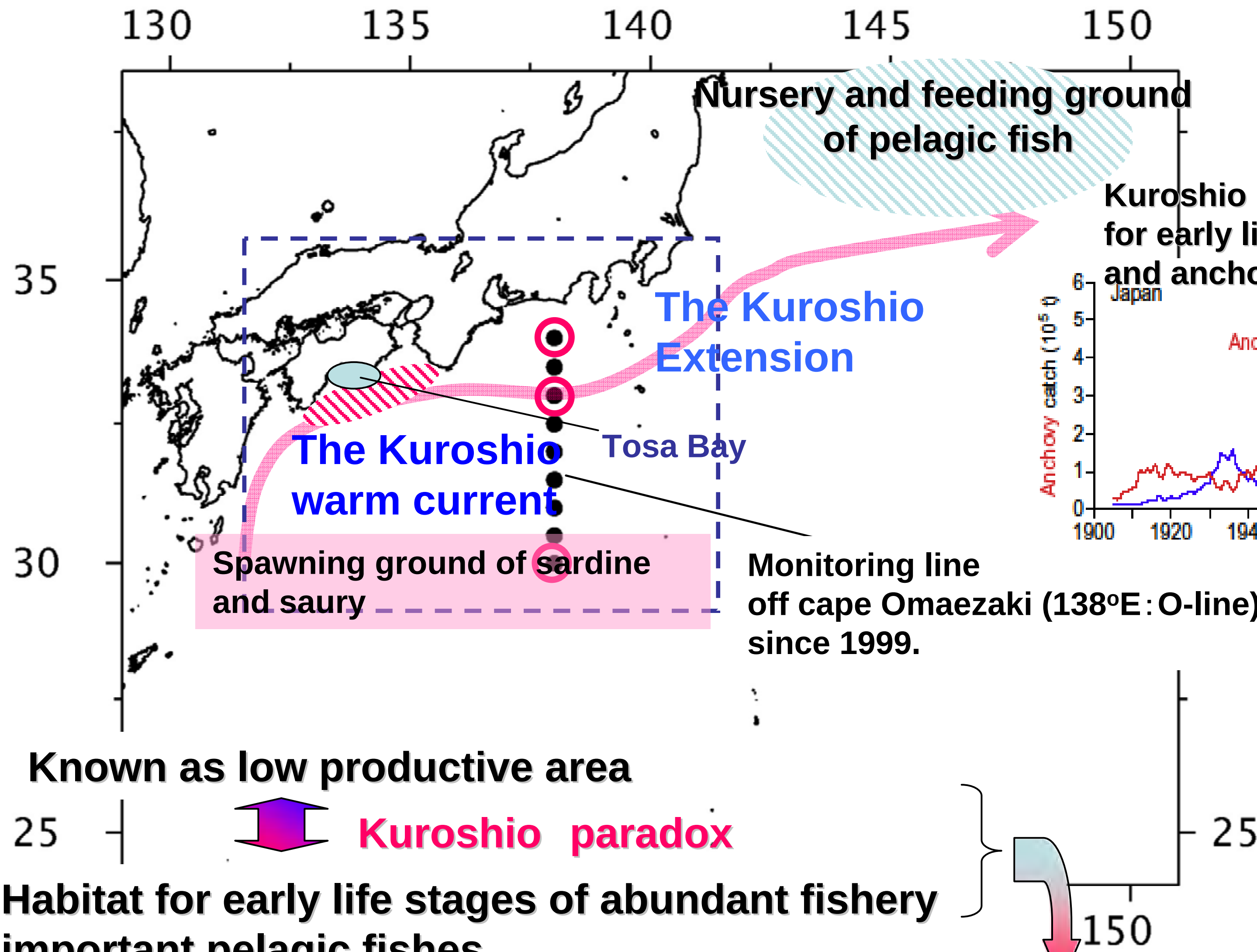
（NRIFS)

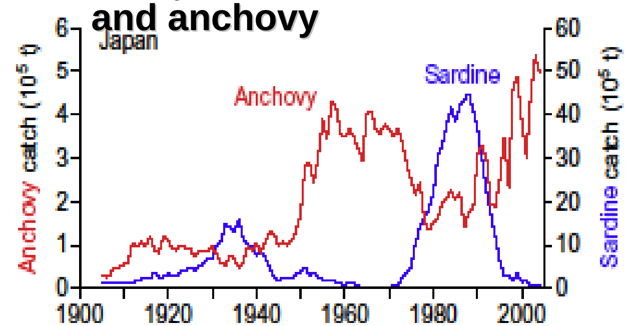
Kuroshio warm current area



Importance of Kuroshio area for pelagic fish production



Kuroshio is very important area for early life stage of sardine and anchovy



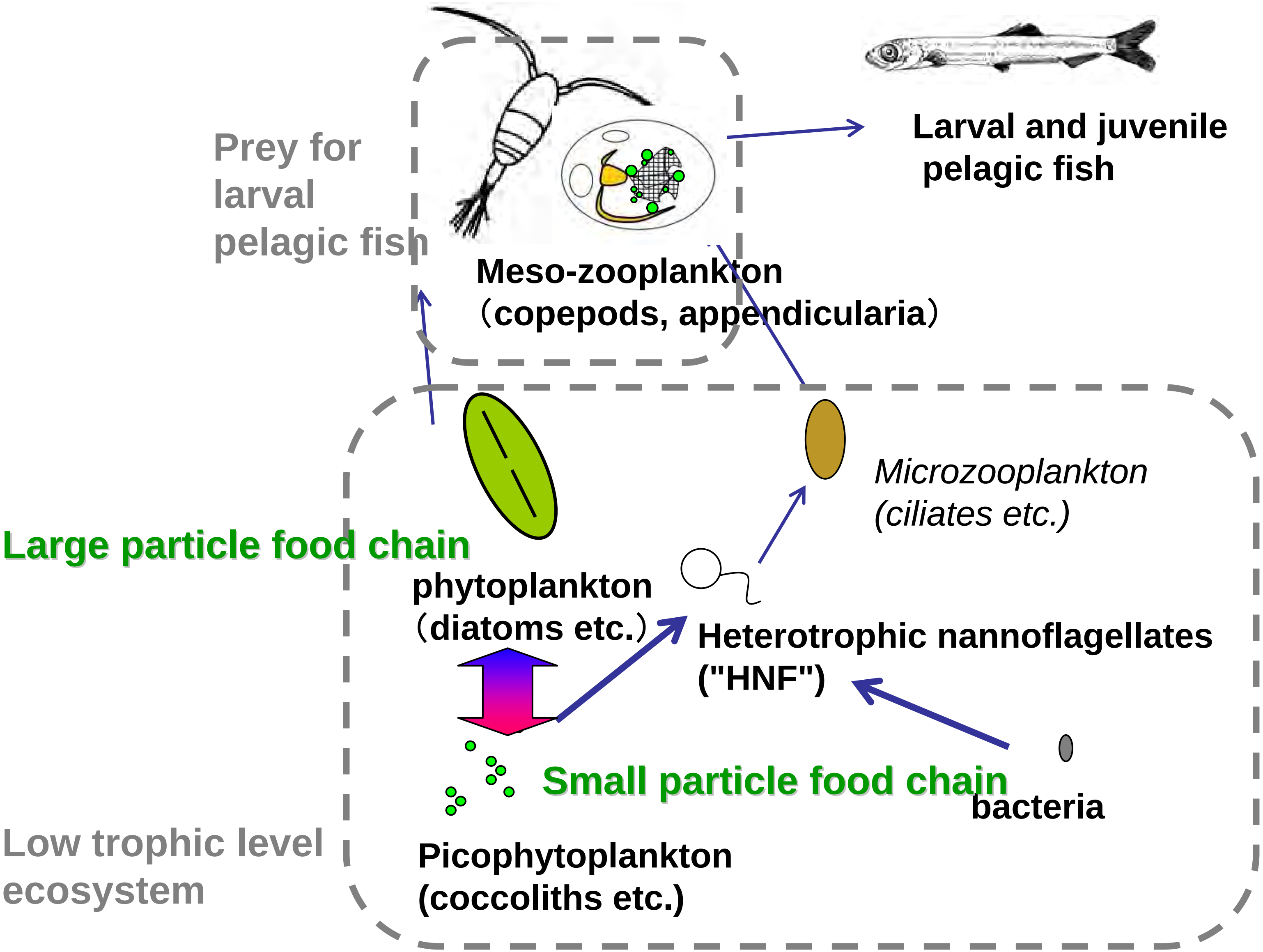
Long term variation of stock size of the pelagic fishes has been observed, and it implies that the variation is relating to climate change.

Known as low productive area

Kuroshio paradox

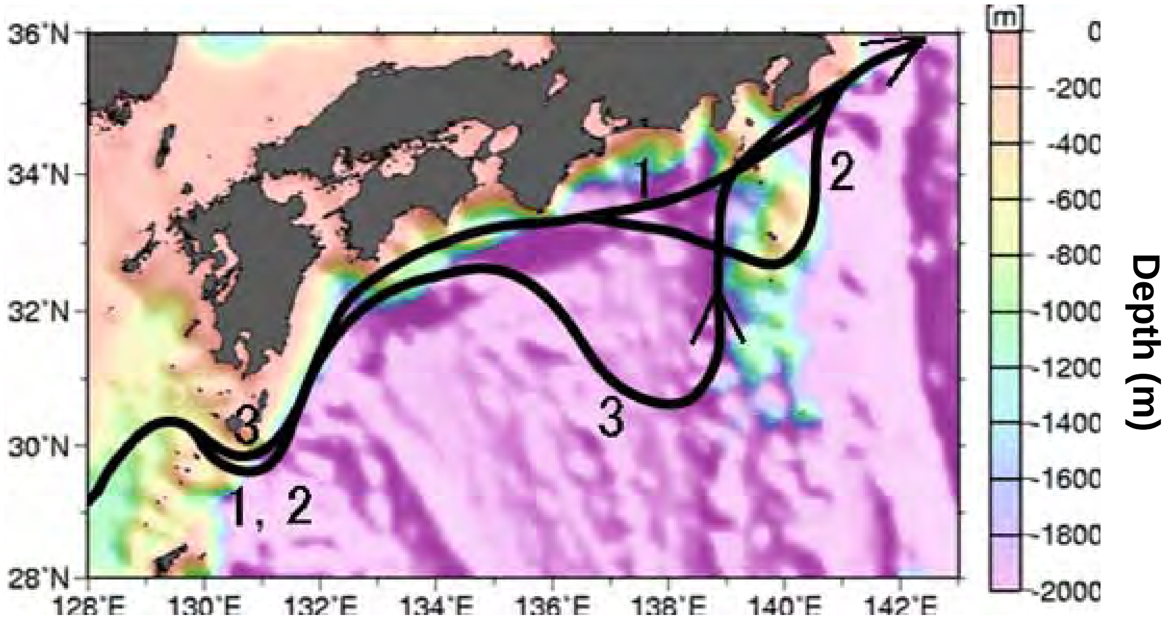
Habitat for early life stages of abundant fishery important pelagic fishes

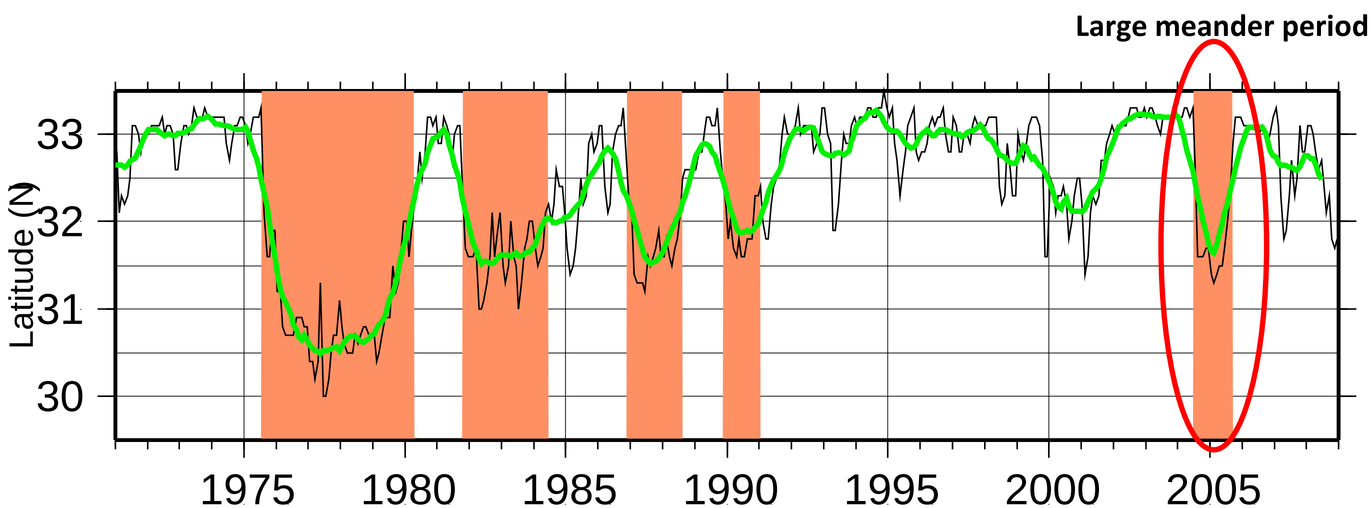
Field monitoring to clarify the mechanism of abundant pelagic fish production



Trophic cascade from primary production to larval fish in Kuroshio area

Typical patterns of the meander of Kuroshio current

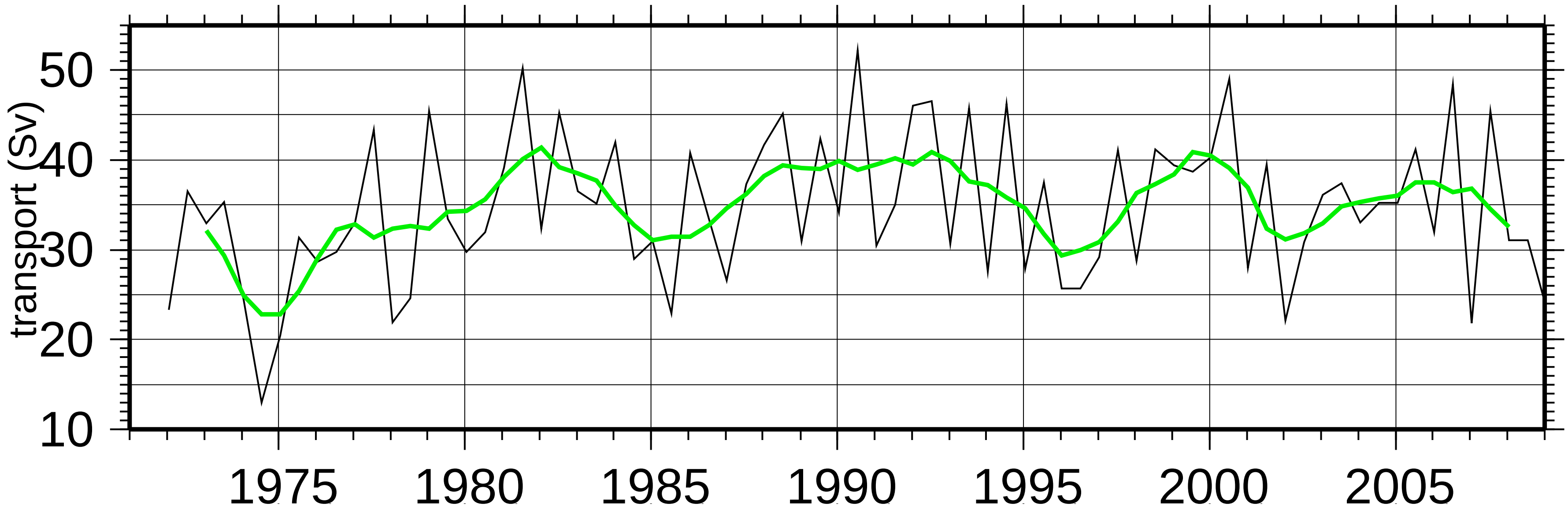




Souuthmost latitude of Kuroshio

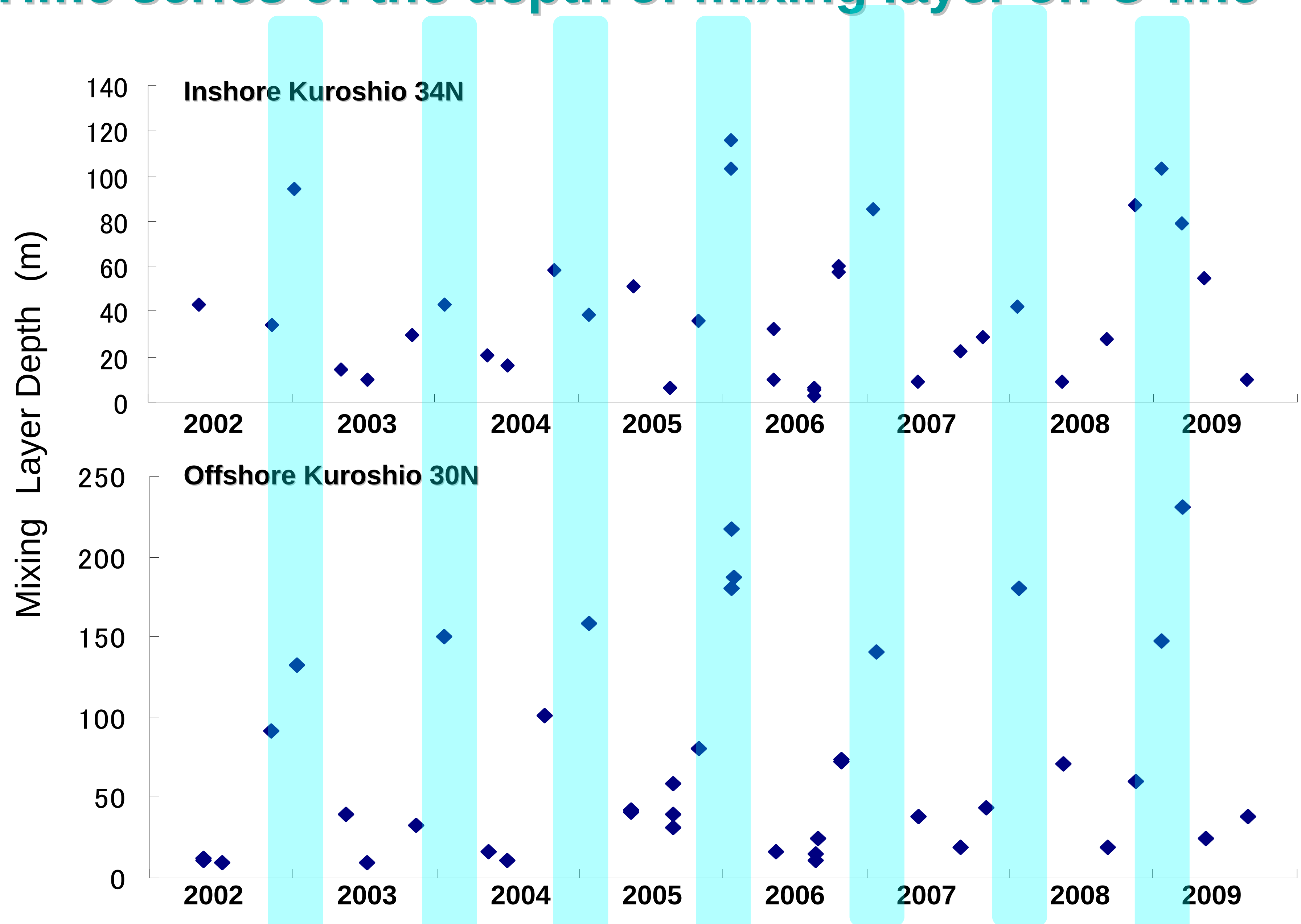
: large meander period

Annual variation of transport of Kuroshio current



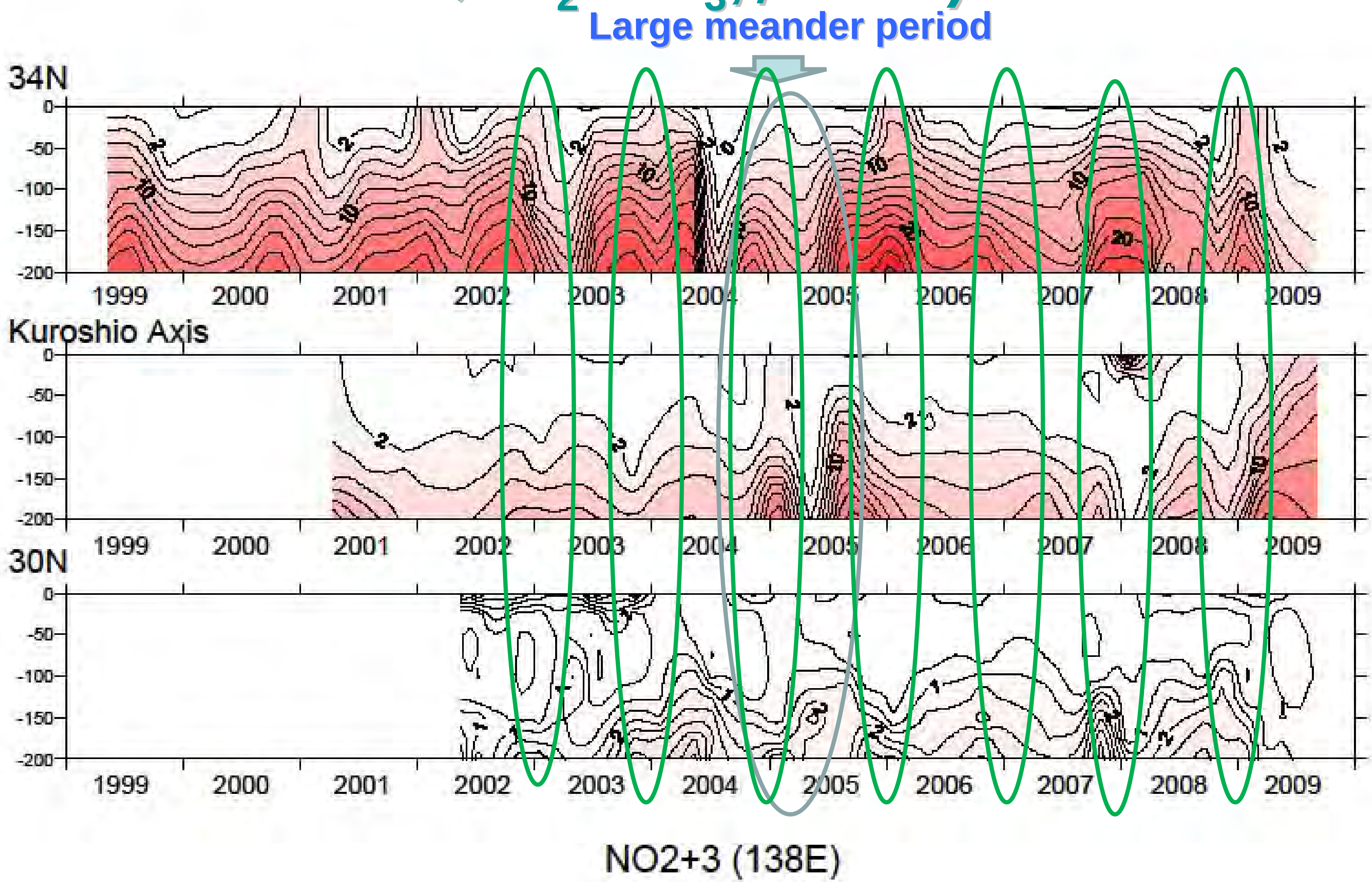
Time series of the Kuroshio transport (Sv) along 137°E referenced to 1250m depth. Thick green line indicates its 2 years running mean value.

Time series of the depth of mixing layer on O-line



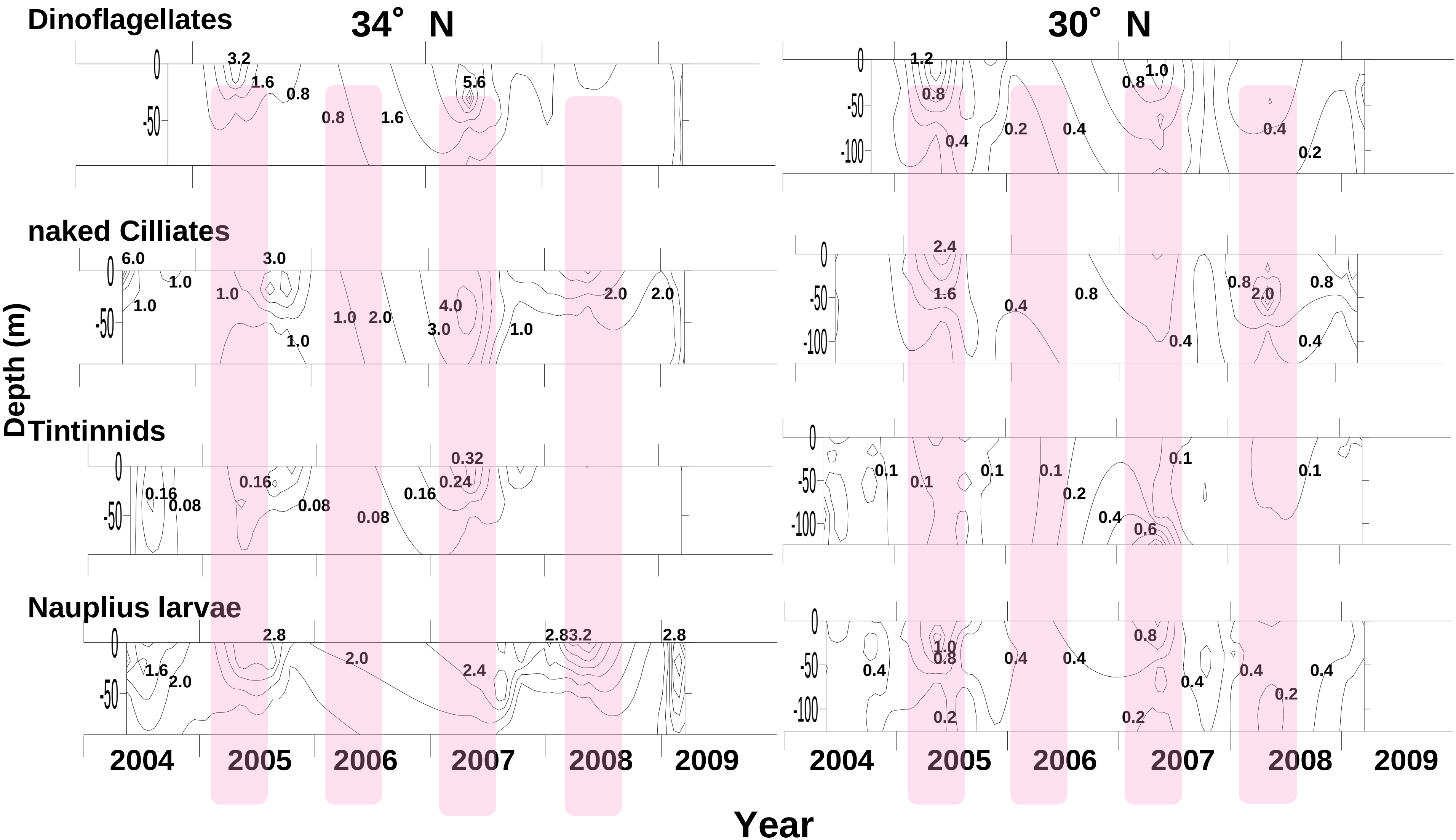
Seasonal variation is clearly observed (deep mixing layer → during winter)

Time series of nutrient condition on O-line (NO_2+NO_3; μ mol/l)



According to deep mixing layer during water high nutrient concentration has been observed during winter.

Time series of biomass of microzooplankton on O-line (mgC/m²)



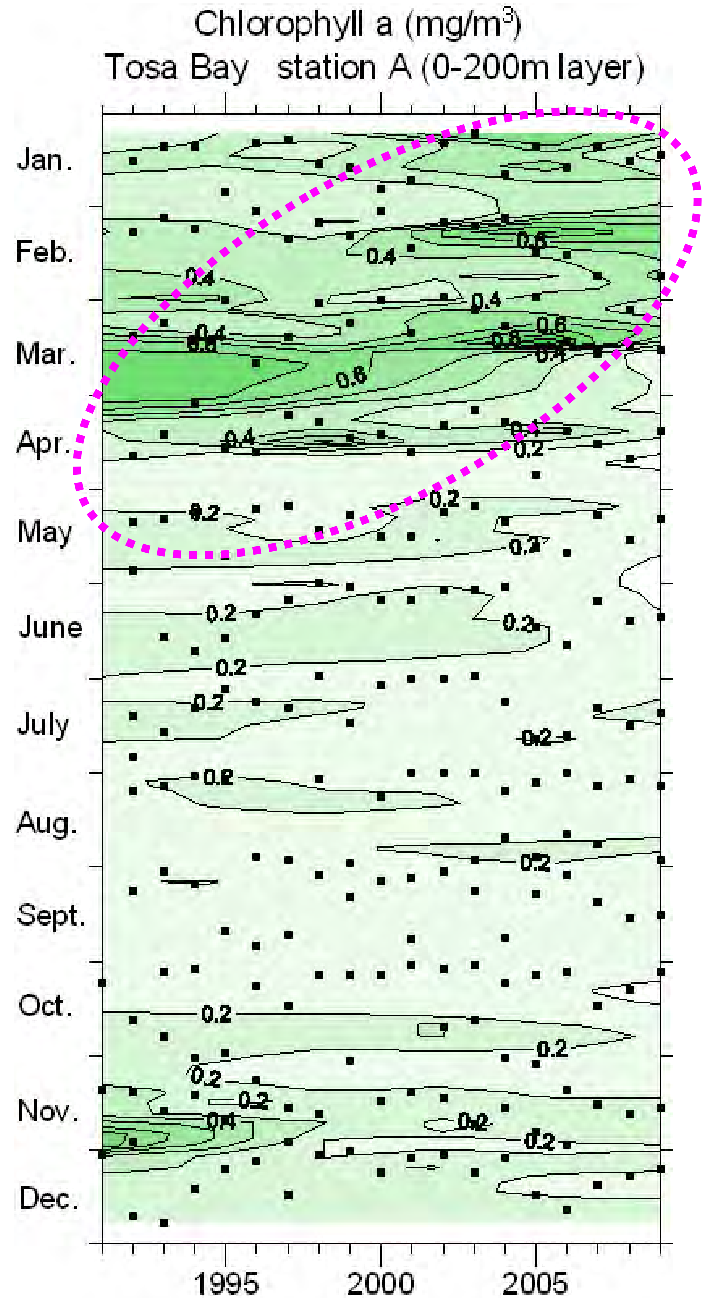
Clear annual trends or events were not observed from this dataset.

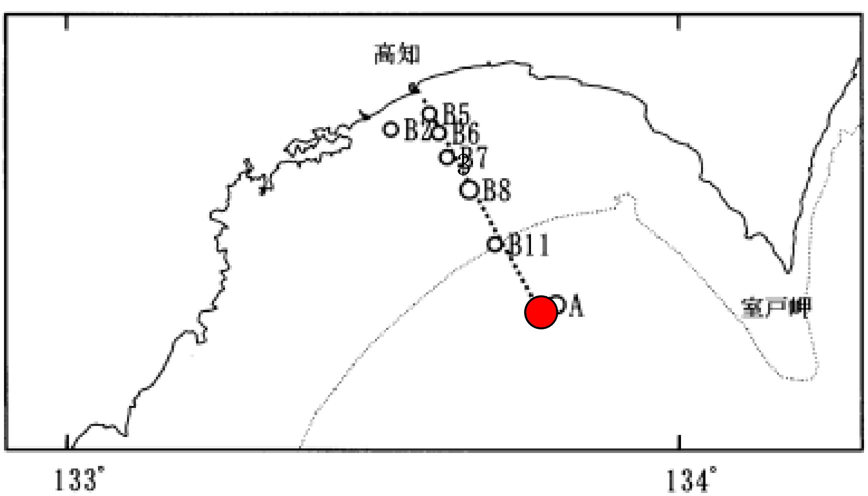
Seasonal variation has been observed. (high biomass during spring)

Good timing for feeding of early hatched larval fish (←Spawning peak is winter)

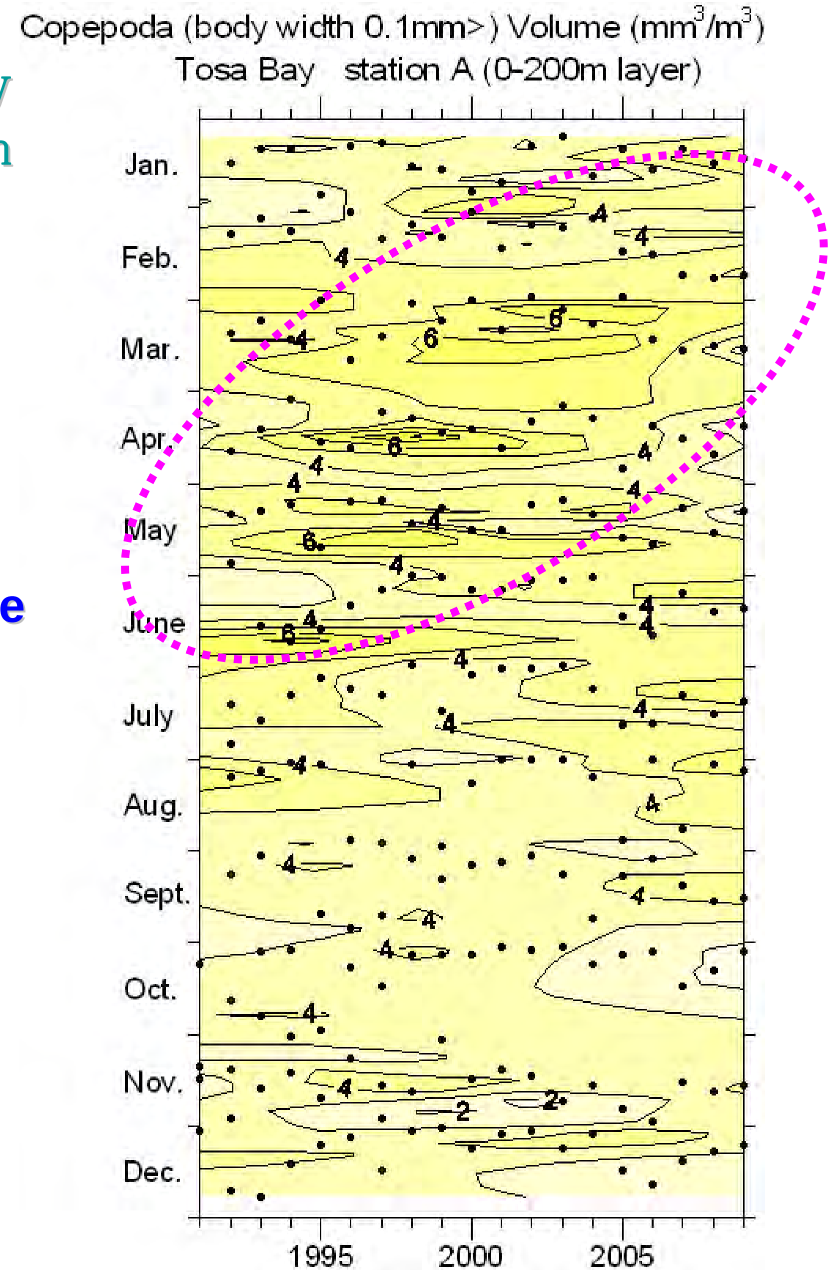
Time series of Chla concentration at the station in Tosa bay (mg/m^3)

Peak season become earlier recently?





Time series of small copepod (body width<0.1mm) biomass at the station in Tosa bay (**mm³/m³**)



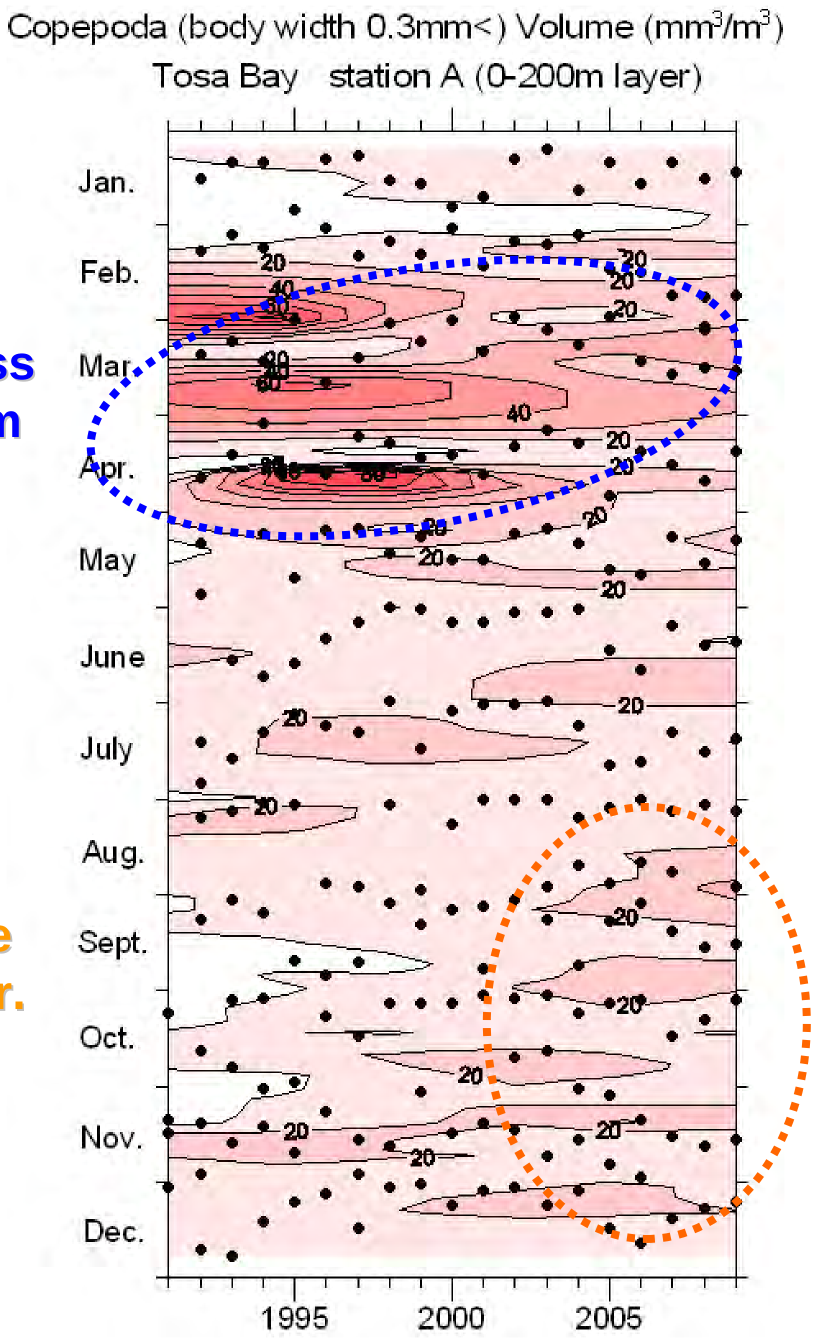
Peak season become earlier recently?

Time series of large copepod (body width>0.3mm) biomass at the station in Tosa bay **(mm^3/m^3)**

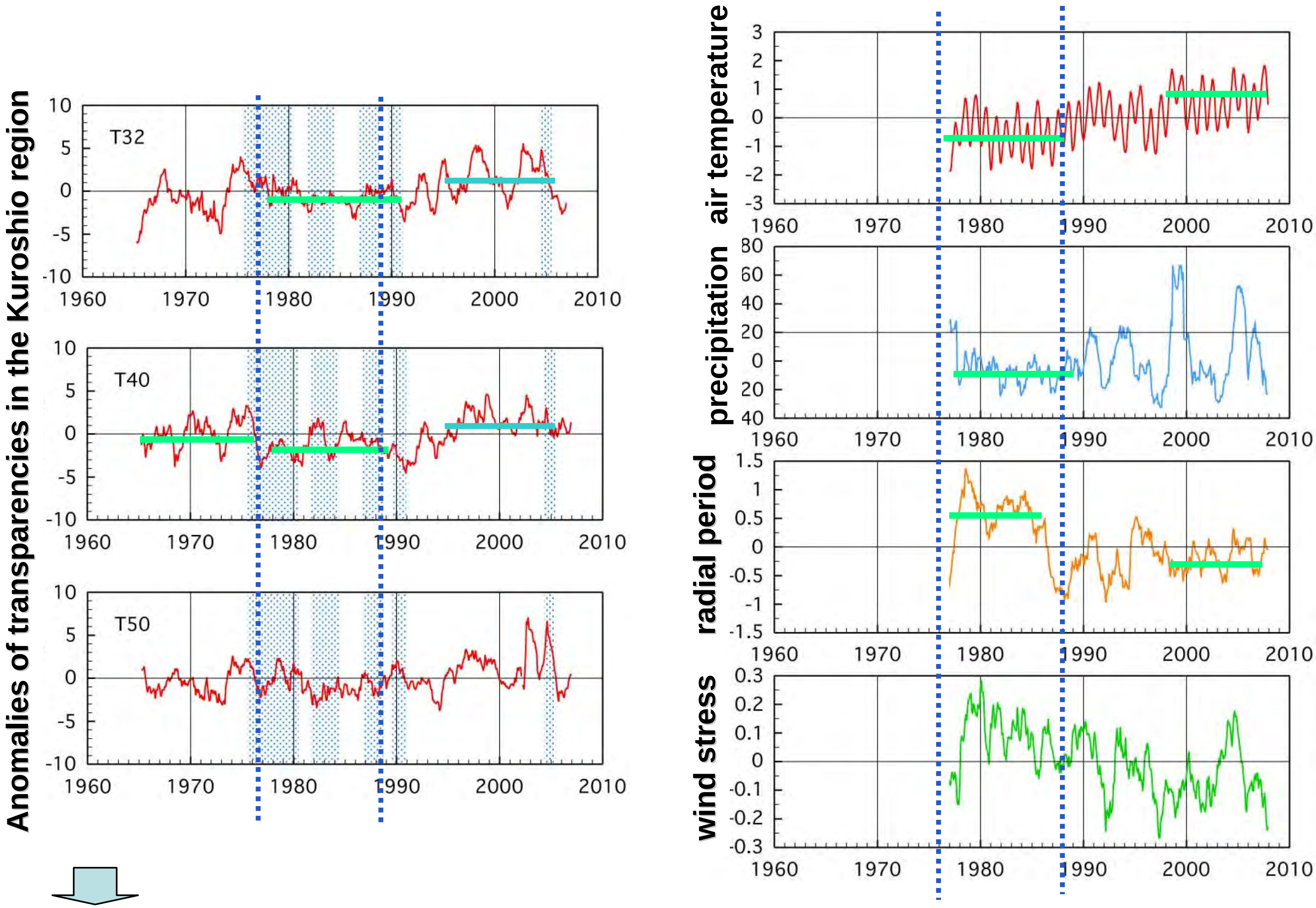
Before 2004, the high biomass peak had been observed from late winter to spring.

After 2004, spring peak was damped and biomass become relatively higher after summer.

Seasonal variation has become unclear during recent years.



Long-term variation of transparencies of Sardine spawning area in relation to climate change



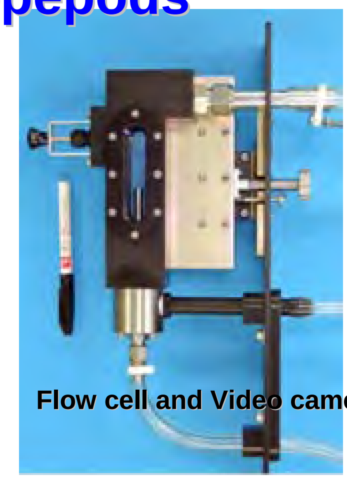
Climate regime shift seems to be related to the transparencies (≒biomass of primary producer）

Bench-top Video Plankton Sampler (B-VPR)

For ecosystem change analysis, plankton species composition are needed. But microscopic analysis of formalin preserved samples costs lots of time and effort.

→Quick and automatic analysis are needed.

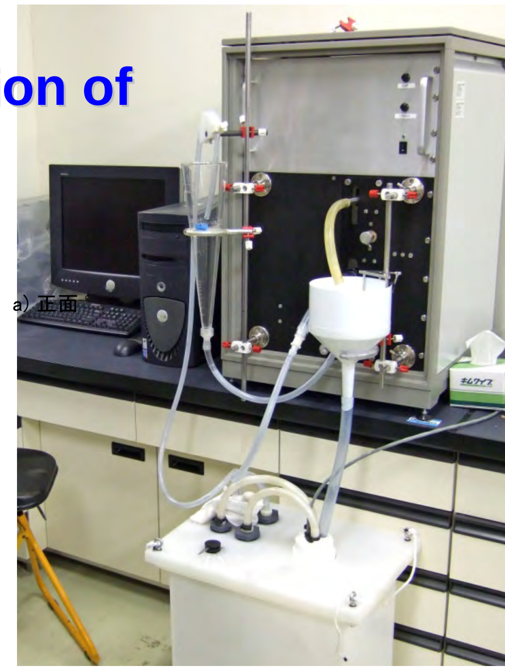
B-VPR →analysis on abundance and size composition of copepods

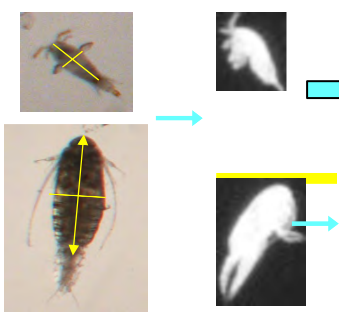


Flow cell and Video camera

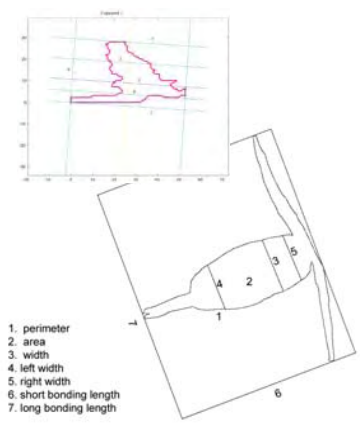
Resolution: 0.01 mm/pixel
（Prosome length>0.4mm）

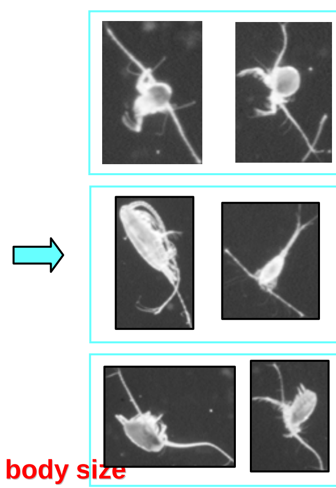
Ability: 15-30 min / bottle





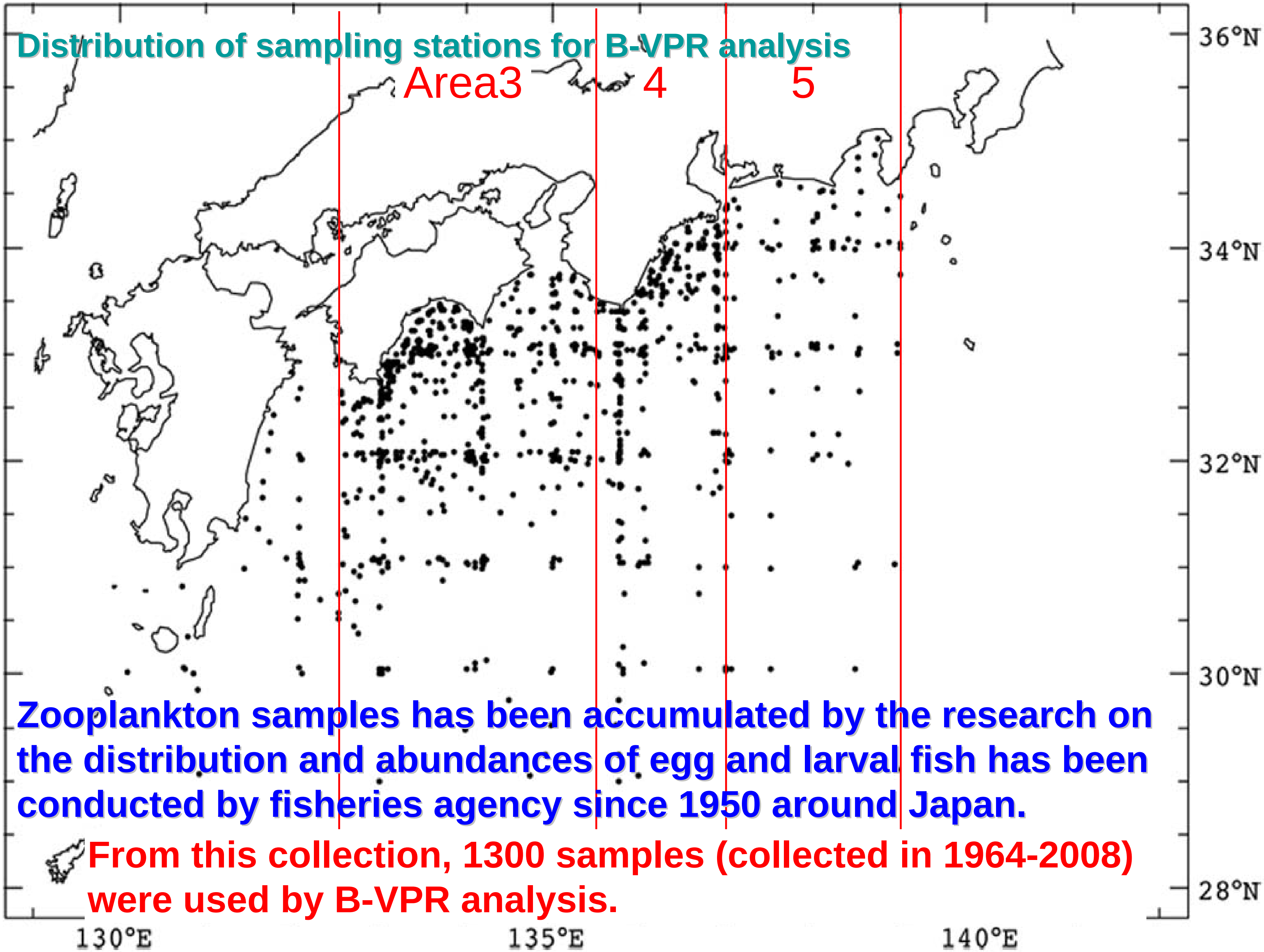
Copepod captured by Video camera





Automatic measurement of body size

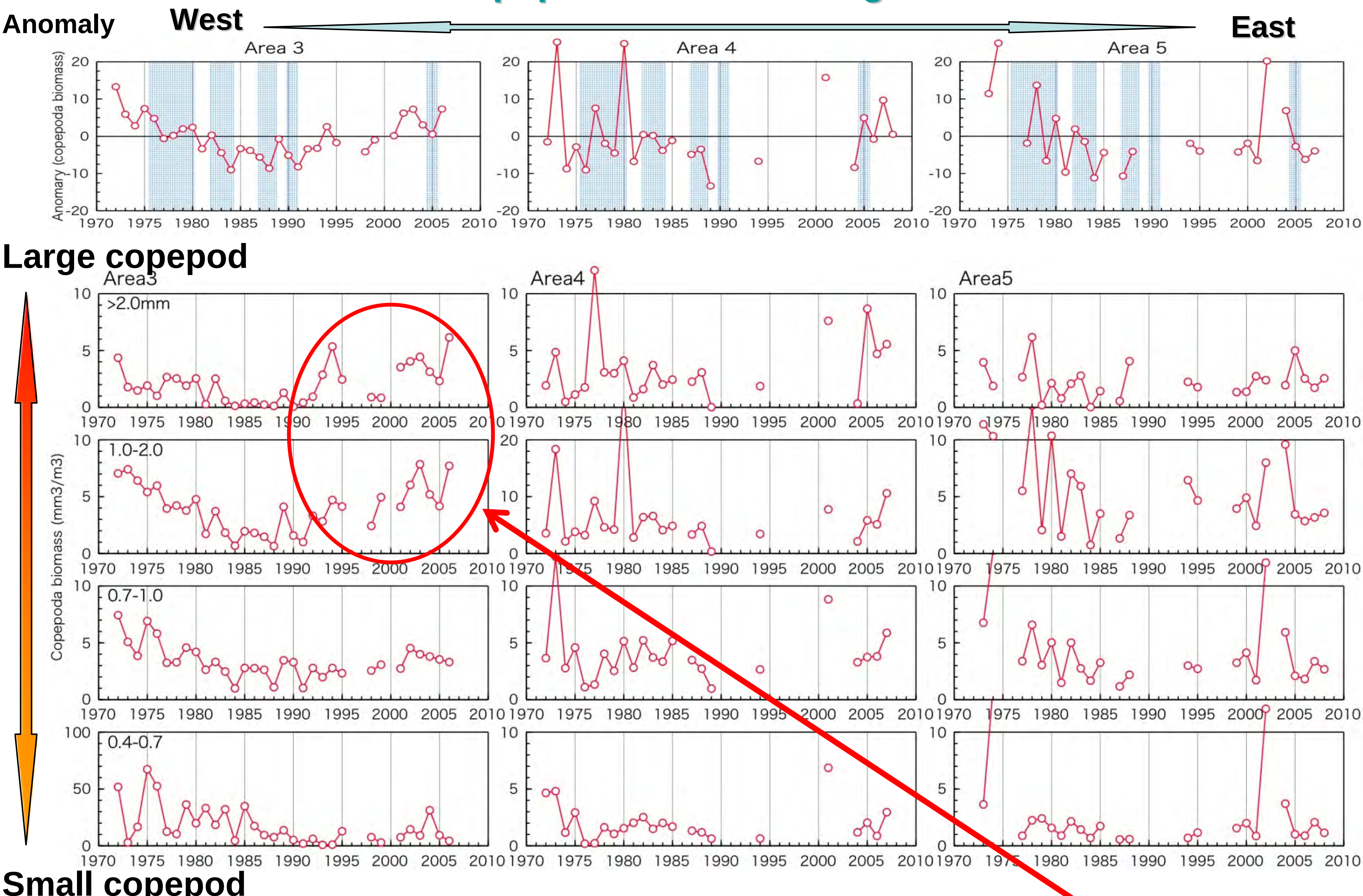
Distribution of sampling stations for B-VPR analysis



Zooplankton samples has been accumulated by the research on the distribution and abundances of egg and larval fish has been conducted by fisheries agency since 1950 around Japan.

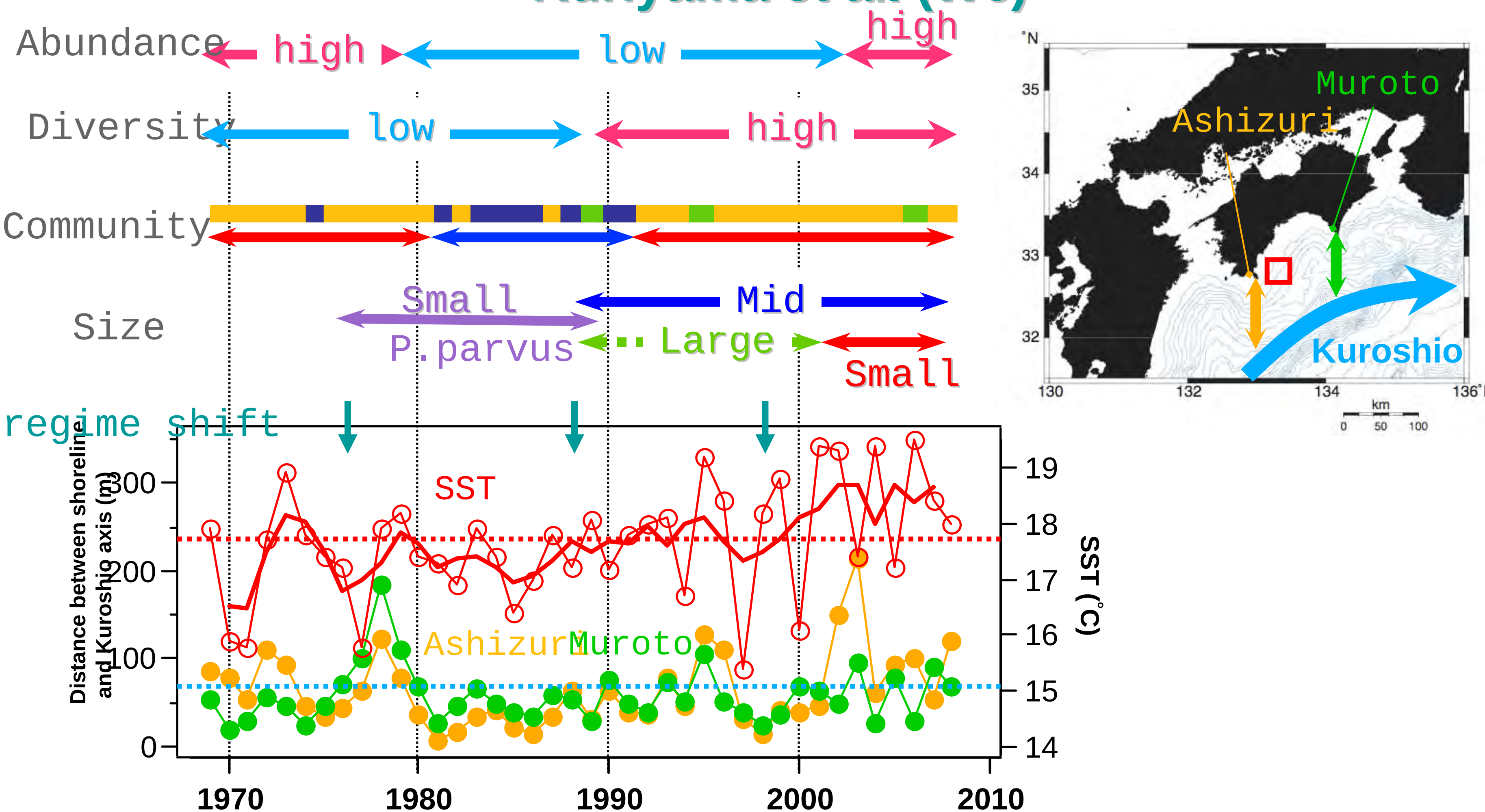
From this collection, 1300 samples (collected in 1964-2008) were used by B-VPR analysis.

Time series of copepod biomass using B-VPR



Biomass of small copepod has been low since '80s, while that of large copepod becomes high recently (especially at the western area; area3)

Long-term variation of copepod species composition in relation to climate change and path of Kuroshio (Microscopic analysis) →Kuriyama et al. (W6)



During the period of high abundance of sardine (before 1990), copepod biomass were high, and species diversity of copepods were low and small species (e.g. P parvus) were abundant. Microscopic analysis supported the result of B-VPR.

Conclusions

- Interdisciplinary monitoring (O-line)has been conducted at Kuroshio current area for more than 10 years.
- Recently, peak season of copepod bloom has tended to become earlier, and seasonal variation of large copepod biomass has become unclear.
- The timing of change of ecosystem may be related to the climate change and the change of meander pattern of Kuroshio.
- Long-term variation of ecosystem (e.g. species composition of copepods) in relation to climate change (regime shift) has been observed using newly designed Bench-top Video Plankton Recorder system using zooplankton samples accumulated around Japan for more than 50years.

Continuous long-term monitoring of ecosystem is necessary for analysis of climate change effect on survival and production of fish