Climate effect on interannual variation in winter-spring plankton community in the slope water and Kuroshio

Kiyotaka Hidaka and Kaoru Nakata
(National Research Institute of Fisheries Science)
Ecosystem process in February-March

Wind Speed

Sea surface chlorophyll

SST
Migration of Japanese sardine

Spawned in slope water
Transported by Kuroshio

Egg abundance of Japanese sardine in 1999
Ecosystem change in 1998/1999

SST Anomaries in Nino 3.4 region

Mixed layer depth in Gulf of Alaska

ZP biomass in Alaska gyre

ZP biomass in southern California

NPESR #1
PICES 2005

Nakata and Hidaka 2003, FO

Copepod biomass
DWmg/m², log-transformed

PL <1mm
PL >1mm


Calanus sinicus
Nannocalanus minor
Cosmocalanus darwini
Rhincalanus nasutus
Euchaeta rimana

Individuals m⁻³

0 5 10 15 20

Year

Further examination of slope water - Kuroshio ecosystem, 1990-2002

**Slope water**
- local wind
- local SST
- local chl. a
- copepod community

**Kuroshio**
- global climate indices
- local wind
- local SST
- local chl. a
- copepod community
Wind speed

NCEP/NCAR reanalysis data
30-35°N, 135-137.5°E
February-March average
SST

AVHRR Pathfinder v5.0
135-137.5°E
February-March average
Sea surface chlorophyll concentration

Level-3 SMI
135-137.5°E
February-March average

Sea surface chlorophyll (µg/L)

Year

slope water
Kuroshio
Copepod biomass

Norpac net, 0-150m vert. tow
135-137.5°E
February-March

PL > 1mm

PL <1 mm

slope water
Kuroshio
Abundance of *Calanus sinicus*

Norpac net, 0-150m vert. tow
135-137.5°E
February-March
Abundance of *Calanus sinicus*

Norpac net, 0-150m vert. tow
135-137.5°E
February-March
Scenario

"Enhanced mixing - enhanced production"
Scenario
"freshwater runoff
- enhanced production"
Scenario
"freshwater runoff
- enhanced production"
Phytoplankton composition

Sea surface chlorophyll

Dynamics of large phytopl. taxa might be masked by those of small species

Phytoplankton composition in 2003

>10µmESD
Diatoms
Dinoflagellates
Others
<10µmESD

[Graph showing phytoplankton composition and dynamics over different months]
Monitoring strategy for plankton community

One population
One life cycle event (spawning) / year

Broad area
Once / year

diverse community
short life cycles

selected small areas
frequent obsv. in critical period
Advection of plankters between slope water and Kuroshio

- Calanus sinicus
- Nannocalanus minor
- Cosmocalanus darwini
- Rhincalanus nasutus
- Euchaeta rimana

Graph showing changes in populations of different plankton species over years 1990 to 2002.
Conclusion

"Enhanced mixing - enhanced production" scenario was successfully applied to 1998/1999 ecosystem change and several SST trends in 1990s.

"Enhanced mixing - enhanced production" scenario failed to explain zooplankton biomass in early 1990s.

Among ecological factors,

- fast life cycles and food web complexity
- advective process between Kurosho and slope water

should be important in the ecosystem dynamics and should be observed with monitoring system designed adequately.