Seasonal changes in plankton biomass, production and community structure in southern Japan\*

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# Contents

1. Background

2. Sampling and experimental methods

3. Results

Seasonal patterns Vertical distribution Biomass Production Community structure Growth rate Mortality rate Carbon budget

4. Summary





Satellite image of sea surface chlorophyll a

## Objective

Seasonal changes in biomass, production and community structure of phyto- and zooplankton in the Kuroshio

Carbon budget within phyto- and zooplankton

Structure of plankton food web

# Sampling



Sampling station 30°N, 131°E (Kuroshio)

Sampling period June 2002 - October 2003 (Monthly to Bimonthly)

Oceanographic observations Temperature, Salinity (CTD) Pico- to Micro-plankton (Niskin bottles) 0,10,20,30,50,75,100 m Meso-plankton (Plankton net) 0-100 m

# **Microscopic Analysis**

Pico-plankton (<2µm)

Bacteria Cyanobacteria Other pico-phytoplankton Nano-plankton (2-20µm)

Autotrophic Nano-Flagellate (ANF) Heterotrophic Nano-Flagellate (HNF) Micro-plankton (20-200µm)

Centric or Pannae Diatom Autotrophic Micro-flagellate (AMF) Heterotrophic Micro-flagellate (HMF) Naked Ciliate Tintinnid Ciliate Nauplii Meso-plankton (>200µm) Copepod Gelatinous zooplankton Other zooplankton

#### **Conversion Factors**

Picoplankton: cell numbers were directly converted to carbon

Bacteria Cyanobacteria Other picophytoplankton 12.8 fgC/cell 250 fgC/cell 220 fgC/cell

Nano- to Meso-plankton: carbon contents were estimated from biovolume

Autotrophic Nano-Flagellate (ANF) Heterotrophic Nano-Flagellate (HNF) Centric or Pannae Diatom Autotrophyic Micro-Flagellate (AMF) Heterotrophic Micro-Flagellate (HMF) Naked Ciliate Tintinnid Ciliate Nauplii Gelatinous mesoplankton Other mesoplankton

Log<sub>10</sub>C=0.863Log<sub>10</sub>V × -0.363 0.12 pgC/um<sup>3</sup> Log<sub>10</sub>C=0.758Log<sub>10</sub>V × -0.422 C=0.216V<sup>0.939</sup> C=0.216V<sup>0.939</sup> 0.19 pgC/um<sup>3</sup> C=444.5+0.053LV 0.05 pgC/um<sup>3</sup> 0.003 pgC/um<sup>3</sup> 0.06 pgC/um<sup>3</sup>

C: Carbon (µgC), V: Volume (µm<sup>3</sup>), LV: Lorica volume (µm<sup>3</sup>)

## **Dilution Experiments**

Following by Landry & Hassett (1982), Landry et al. (1995)

Experiments February to October 2003 (monthly)

Incubating sea waters Mesoplankton-Free SW + Particle-Free SW

Diluted series Enriched bottles: 30, 50, 75, 100% Unenriched bottles: 100% (to examine nutrient-limited growth)

**Enriched nutrients** 

 $NO_3: NH_4: PO_4: Fe = 7.5\mu M : 0.5\mu M : 0.5\mu M : 1nM$ 

# Vertical Distribution of Phyto- and Zooplankton Biomass



## **Phytoplankton Biomass and Community Structure**



## **Zooplankton Biomass and Community Structure**



\*sea surface only

# **Growth rate**



Month

#### Nutrient effects on growth rate



# **Vertical Profiles of Temperature and Salinity**



Month

# **Relationship between Growth and Mortality**



# **Carbon Budget in Plankton Food Web**

Production: mgC m<sup>-2</sup> Respiratory requirement : mgC m<sup>-2</sup>



Mixing period (February-May)

Stratified period (July-October)

# Summery

#### Seasonal pattern of phytoplankton

- Autotrophic nano-flagellates and cyanobacteria contributed to phytoplankton biomass.
- No seasonal pattern was observed for phytoplankton biomass.
- Seasonal phytoplankton dynamics might be affected by nutrients from the neighboring waters.

Seasonal pattern of zooplankton

- Bacteria and copepods dominated zooplankton biomass.
- Zooplankton biomass increased during the stratified period.
- Seasonal patterns of biomass might be resulted from temperature-dependent growth.

#### Plankton food web

- Grazing food web was functional along microbial food web during the mixing period.
- During the stratified period, microbial food web was predominated and carbon flow seems to be complicated.