Management of the Ecosystem in the Seto Inland Sea

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Chl. \( a \) concentration in summer

The distribution of current Chlorophyll \( a \) concentration in summer is shown in the map.

- **Tokyo Bay**
  - Area: 1,380 km\(^2\)
  - Depth: 38.6 m
  - Chl. \( a \): 28.9±13.0 µg l\(^{-1}\)

- **Ise Bay**
  - Area: 2,342 km\(^2\)
  - Depth: 16.8 m
  - Chl. \( a \): 12.6±8.6 µg l\(^{-1}\)

- **The Seto Inland Sea**
  - Area: 23,200 km\(^2\)
  - Chl. \( a \): 3.6±6.4 µg l\(^{-1}\)

Additional information:

- Tokyo Bay and Ise Bay: 2006-2015 Summer
- Seto Inland Sea: 2003-2012 Summer
How to manage these waters

- Ministry of the Environment has implemented The Total Pollutant Load Control System (TPLCS) since 1979 to reduce COD and T-N&T-P (from 2001) loading.
- Tokyo Bay and Ise Bay are still eutrophic.
  
  Continue to reduce the anthropogenic nutrient loading
- Eutrophic area is limited in the Seto Inland Sea
  
  How to manage?
Condition in the Seto Inland Sea

Nutrient load (t d⁻¹)

N&P load
- T-N
- T-P(×10)

Red tide occurrence (y⁻¹)

Fish catch (t y⁻¹)

Predatory fish

Planktivorous fish

Secondary production

Primary production

Nutrients

Sardine
Sand lance

Primary production

Secondary production

Red tide occurrence

Fish catch

Predatory fish

Planktivorous fish

Sardine
Sand lance
• Effects of nutrient reduction on
  – prevention of excessive growth of phytoplankton
  – primary production

• Coastal management
  – The sea combined with limited eutrophic areas and wide non-eutrophic areas
Distribution of Chl. a concentration in summer in 1981-1990

Chl. a

Occupied area

- < 2 μg l⁻¹: 32.0%
- 2–5 μg l⁻¹: 45.1%
- 5–10 μg l⁻¹: 13.7%
- 10–20 μg l⁻¹: 4.0%
- > 20 μg l⁻¹: 5.3%

Temporal change of Chl. a concentration and primary production in each Chl. a group in 1981-1990 was tracked to evaluate effect of nutrient reduction.
Temporal change of primary production in summer
Seasonal primary production
Relationship between Chl. a and secondary production
Need to control phytoplankton growth in summer near the coast

Nutrient reduction still needs to prevent excessive growth of phytoplankton near the coast.

How to solve it?

Excess reduction of nutrients from land has a risk of reducing the productivities in the whole Seto Inland Sea.
**Biomass of eelgrass**

\( g \ m^{-2} \)

**Spring to Summer**

*Uptake nutrients*

*Growth phase in eelgrass*

**Autumn to Winter**

*Flow out and release nutrients slowly*

\( \rightarrow \) *support production without excessive growth of phytoplankton*

*Zostera marina* is a typical eelgrass

Uptake of nutrients by eelgrass can reduce nutrients available to phytoplankton.
Impact of nutrient uptake by eelgrass in Hiroshima Bay

Present

100 ha

Potential habitat estimated

370 ha (2.3%)

Potential habitat
>20% of surface light intensity

Sediment property and water flow was not considered
Distribution of Chl. $a$ concentration in May

Present (100 ha)

In the case that eelgrass exists in all potential habitat (370 ha)
• The nutrient reduction from land was effective to reduce Chl.a concentration in the areas with high Chl.a concentration in 1980s without decline in Chl.a concentration and primary production in offshore areas.

• *Zostera marina* was found to be a suitable plant for nutrient management of the coastal areas with large freshwater input because the habitat is near the coast and it actively takes nutrients in warm season when excessive phytoplankton growth occurred.
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