

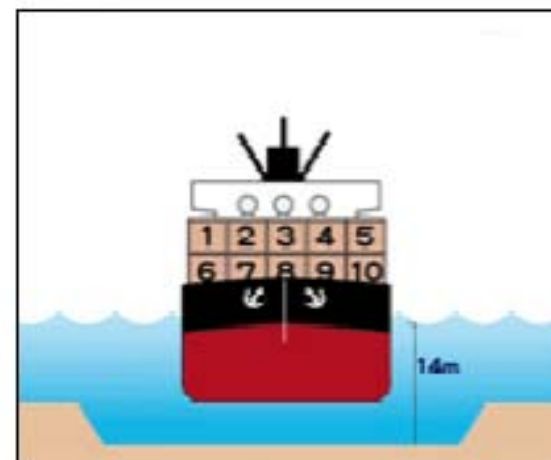
Effective Use of Dredged Sand To Create the Habitat of Bivalves in Mikawa Bay



Kisaburo Nakata
University of Tokai

Nakayama-Channel

- The depth of water way dredging is planned to be 14.0m and the length 2700m, and the width, 700m to ensure the safety of ship course
- The dredged sediment thickness is ca. 3m



The dredging work in Nakayama-channel in Mikawa Bay



The dredged sand was used to create habitat in shallows

- New habitat in Nishiura area



Process of creating shallows

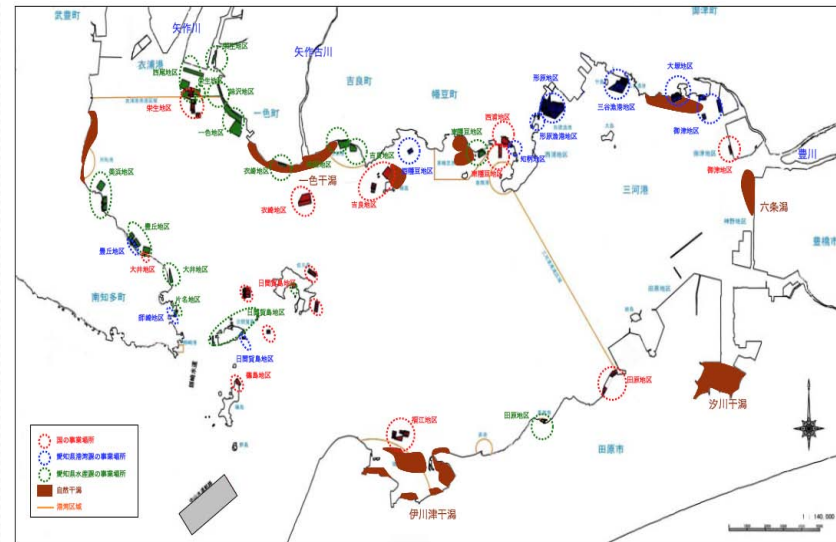


Tidal flat and shallows area in Mikawa Bay

- Before 1951, there exist large tidal flat area in the bay
- Lost shallows are in red color



- 620ha shallows are created by using Nakayama-channel sand



Why the dredged sand was used to create shallows including tidal flat?

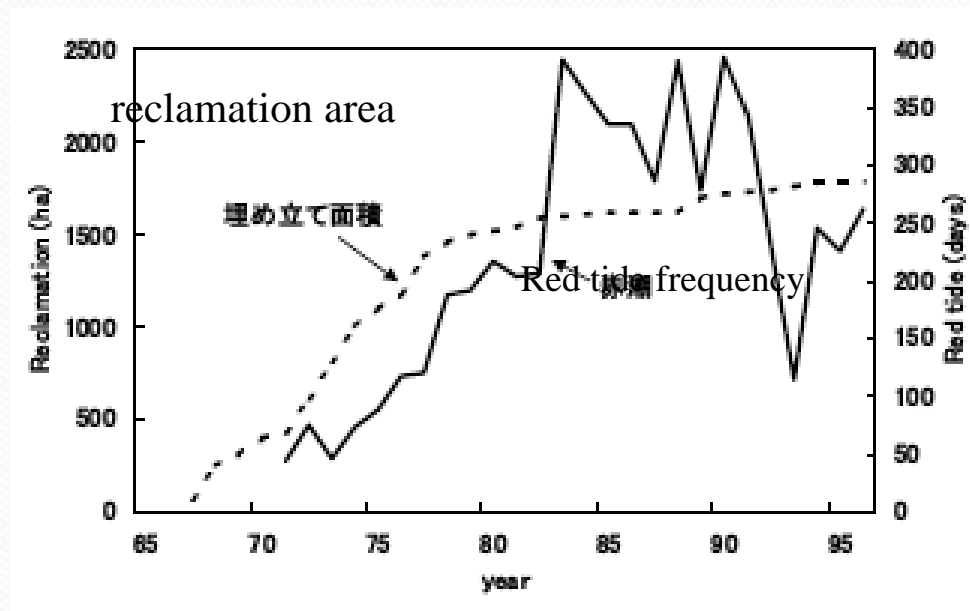
- The formation of oxygen depleted water is the most important issue in the bay system
- Why oxygen is depleted in the bay bottom water?
- First, we consider that this is the typical eutrophication problem, and that bulk loading control from terrestrial origin is countermeasure. But things are not so easy.

- Even after 6 times bulk control of organic substance and nutrients, the water quality is not improved.
- After doing researches from several aspects, the main reason why water quality has not been improved is revealed.
- Loss of tidal flat area and shallows is the main reason, at least, for oxygen depleted problem.

Circumstantial evidence

The relation between reclamation area and red tide frequency in Mikawa Bay
: shows positive correlation

Reclamation was done in the tidal flat area in almost cases

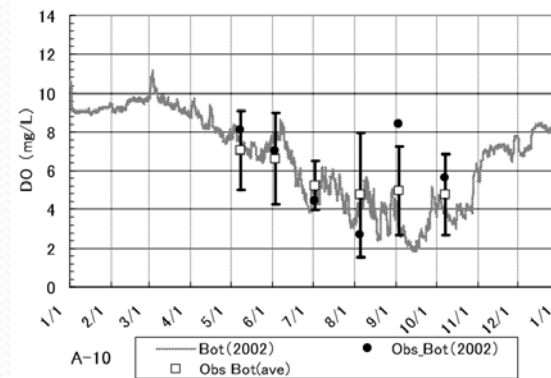


Redtide and Organic Particle deposition to sea floor

- Red tide produces a lot of sinking organic particles

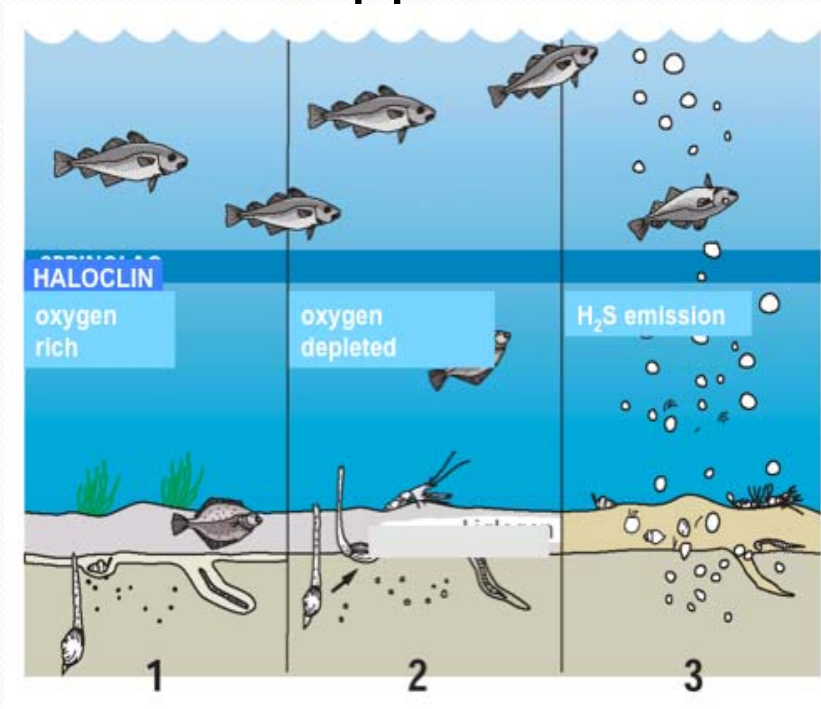


- Much organic matter in the sediment surface induce oxygen consumption there
- Oxygen depletion



Oxygen Depletion

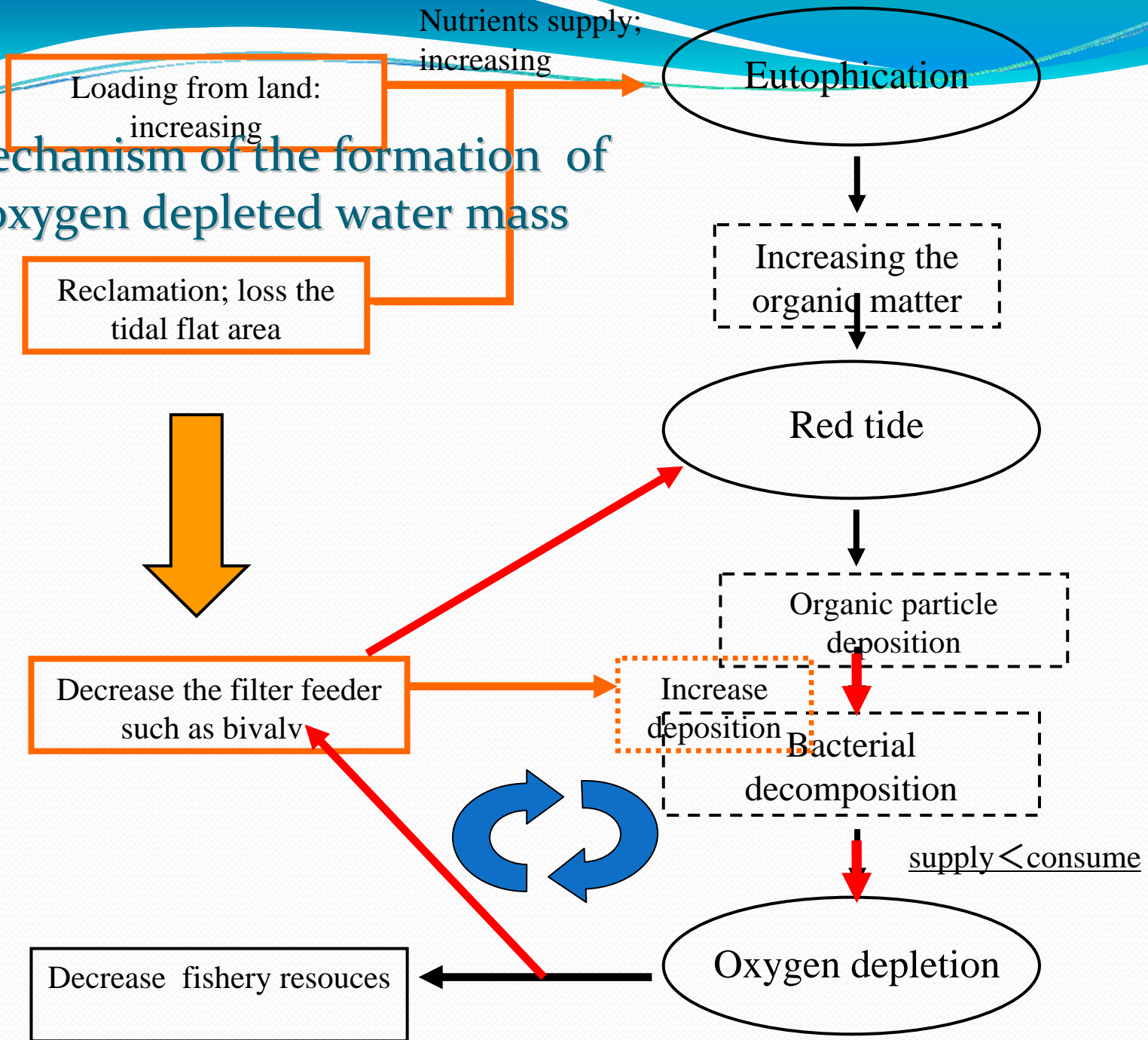
- What happens?



- Aoshio and mass mortality



Mechanism of the formation of oxygen depleted water mass

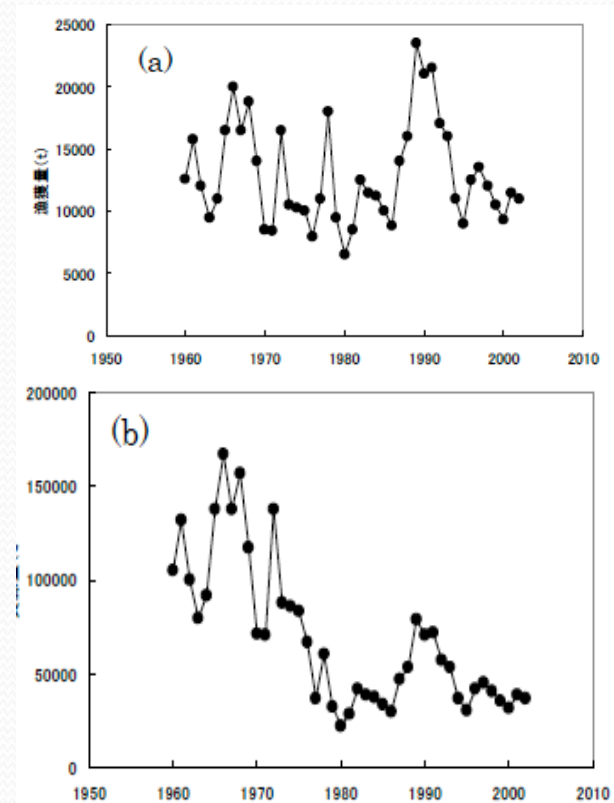


Asari; short necked clam is one of the representative fauna in the shallows

- Asari: bi-valve, feeding phytoplankton in the water column

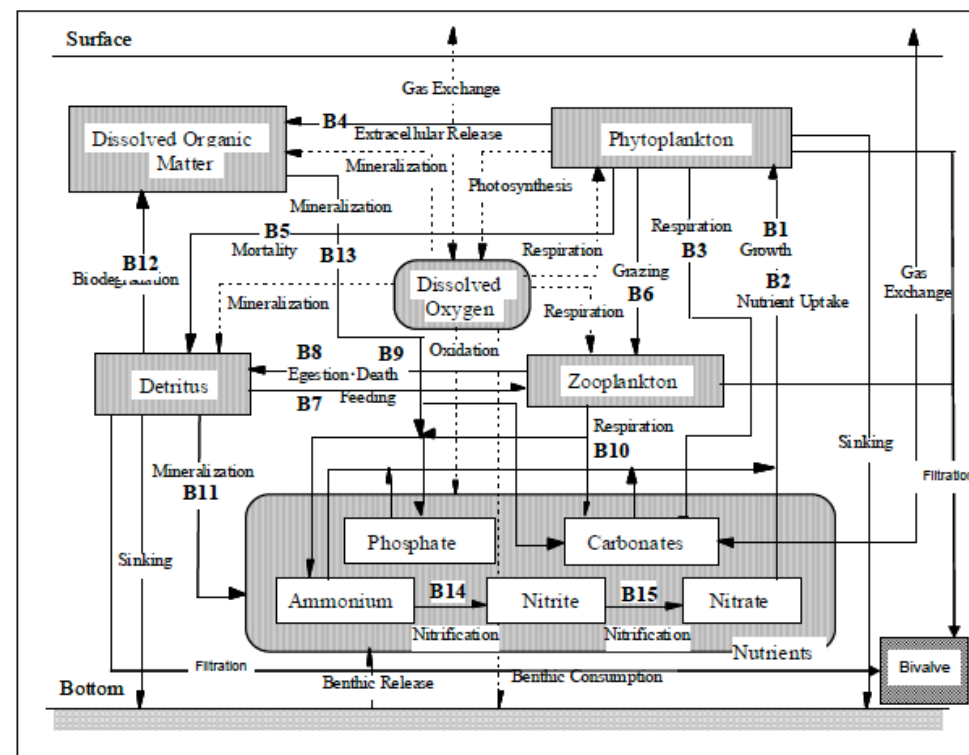


- Catch and resources of clam



Ecosystem Model

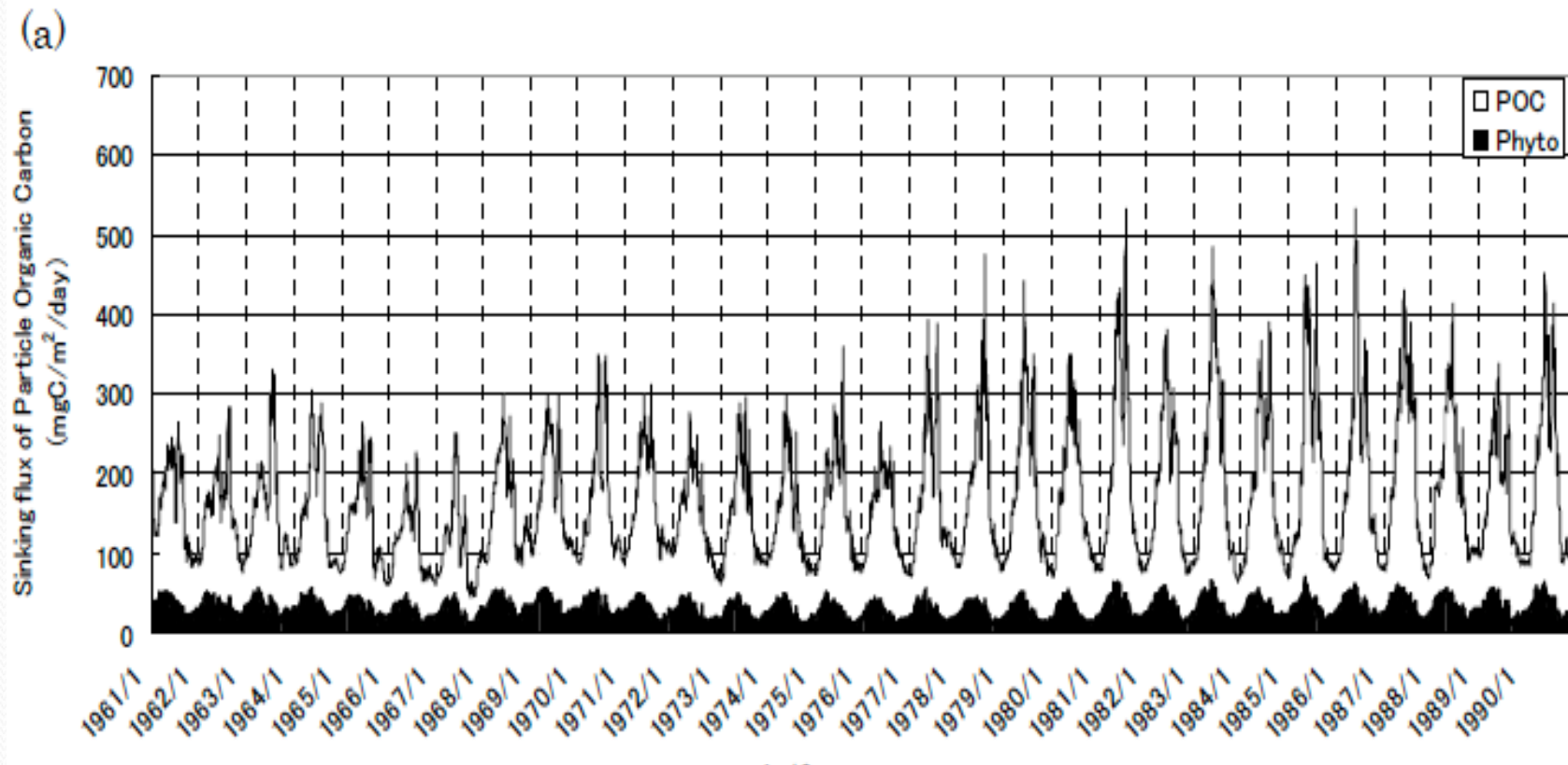
- Using ecosystem model, DO variation in Mikawa Bay from 1960 to 1990 is estimated



Ecological service in the tidal flat and shallows

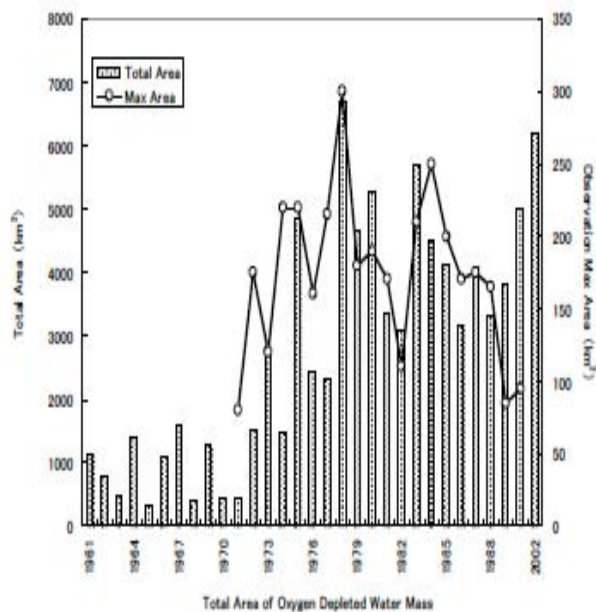
- Decomposition rate of organic matter
 - Nutrients budget with ambient area
 - Removal rate of nutrients (e.g. temporal reservation as biomass)
 - Removal rate of suspended matter *etc.*
- Ecosystem model can consider all these processes. The last function is the most effective in this case

Simulated sinking flux of organic particles in the bay

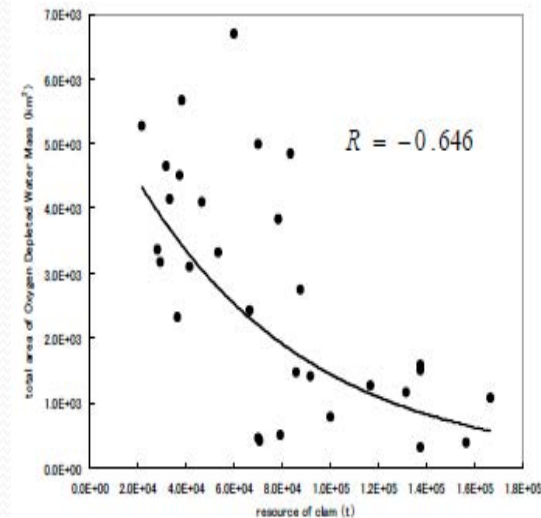


Clam resources and oxygen depletion

- Oxygen depletion area; model and observation

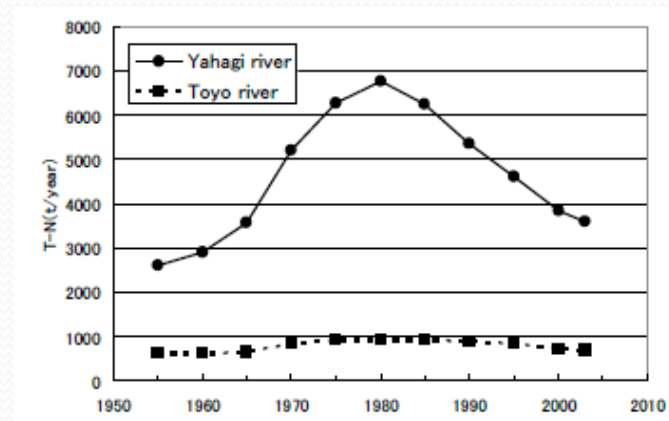


- Correlation between clam resources and oxygen depletion area



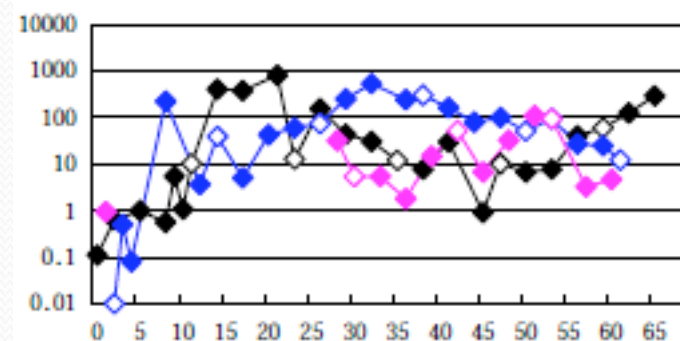
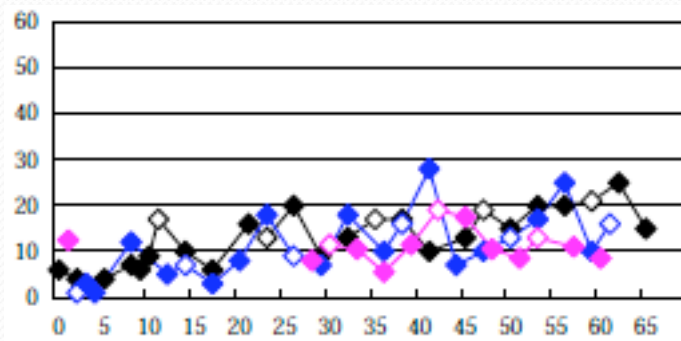
From model result, it is shown that oxygen depletion in Mikawa Bay is closely related to clam resources

- Loading from the land decreased from 1980
- Oxygen depletion did not decrease in 1980's
- Habitat creation is the most effective countermeasure

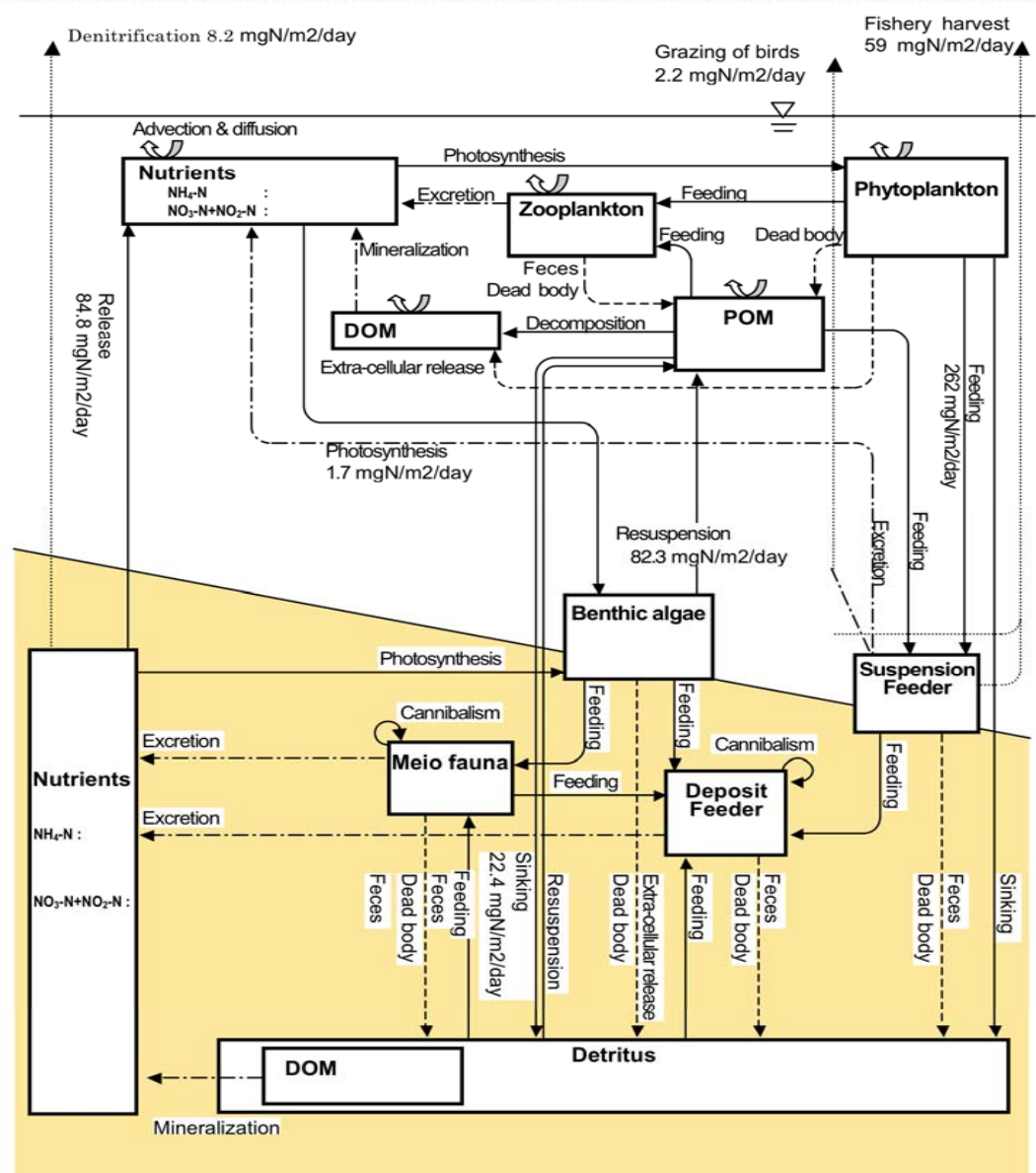


Monitoring results in the new habitat

- Species number and wet weight in three representative habitat with elapsed time (unit; month)



Nitrogen budget in the new habitat based on the monitoring data using benthic ecosystem model



Nitrogen budget ; one of the method to evaluate the effectiveness of this work

- Inflow organic nitrogen 1347.5 mgN/m²/day
 inorganic nitrogen 667.3 mgN/m²/day
- outflow organic nitrogen 1347.5 mgN/m²/day
 inorganic nitrogen 667.3 mgN/m²/day

Organic nitrogen disappears by 162.4 mgN/m²/day in the new habitat

Multiply this value with 620 ha, removal flux becomes 1% of loading from rivers.

Conclusion

- Here I explain why we create a new habitat for mainly bi-valve in the Mikawa Bay using dredged sand.
- The method to evaluate whether the work is effective or not using benthic ecosystem model.
- The model shows that the creating new shallow is very effective and has a function of ecological services.
- This is one of the good example for usage of dredged materials.