

POTENTIAL OF ARTIFICIAL REEFS FOR ENHANCEMENT OF FISHERIES RESOURCES - CASE STUDY FROM JAPAN

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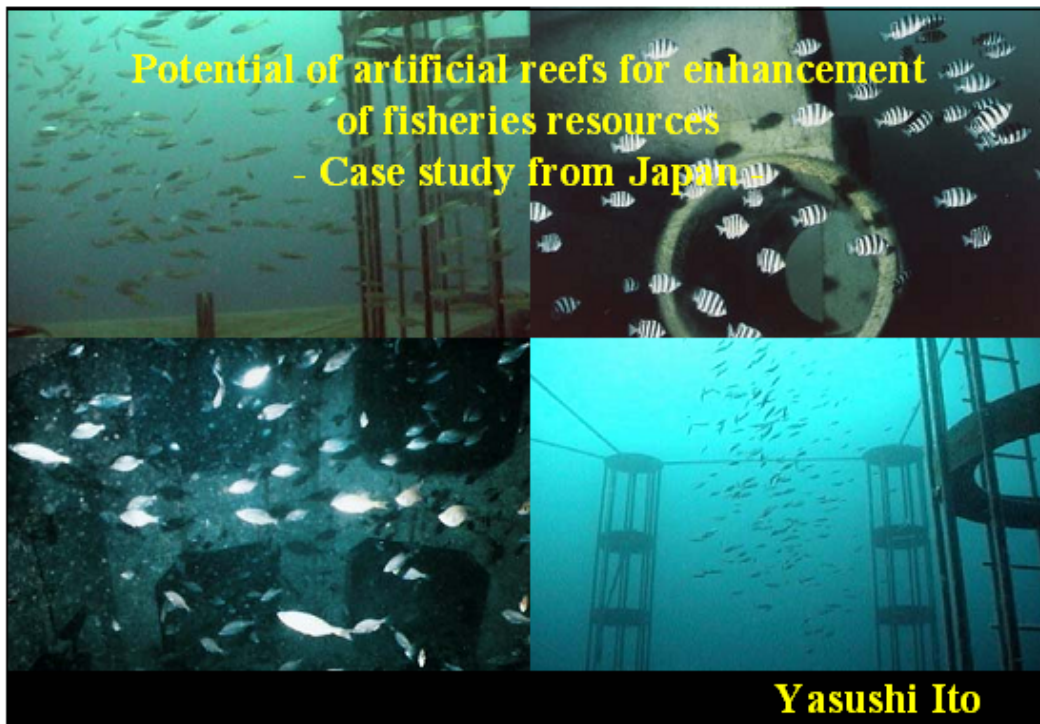
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Artificial reefs provide habitats to a multitude of marine organisms, which form a food web that supports a variety of fish species. Artificial reefs not only provide food, shelter and resting areas to fish but also serve as spawning grounds, hence enhancing fishery resources.

In recent years, many artificial reef projects implemented in shallow waters in Japan have focussed on nurturing bait organisms for enhancing fish growth, although artificial reef projects implemented in deeper waters have aimed at enhancing fish stocks, mainly of sedentary fish species.

This study detail the functions of nurtured bait creatures around shell covered stock enhancement structures in shallow waters of Seto inland sea.

In addition it shows the correlation between bait creatures and aggregation of fish. We also present results of a stock assessment study conducted on an artificial reef set in relatively deeper waters of Yamagata prefecture.



Structure of presentation

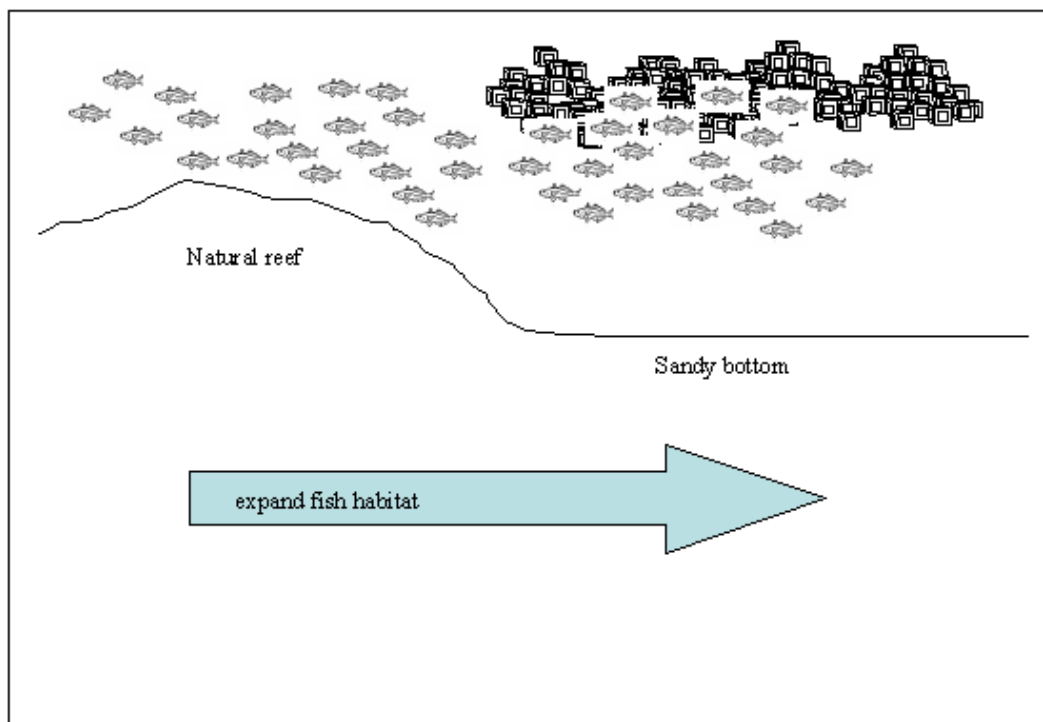
- General concept of artificial reef
- Case study in shallow waters
- Case study in deeper waters

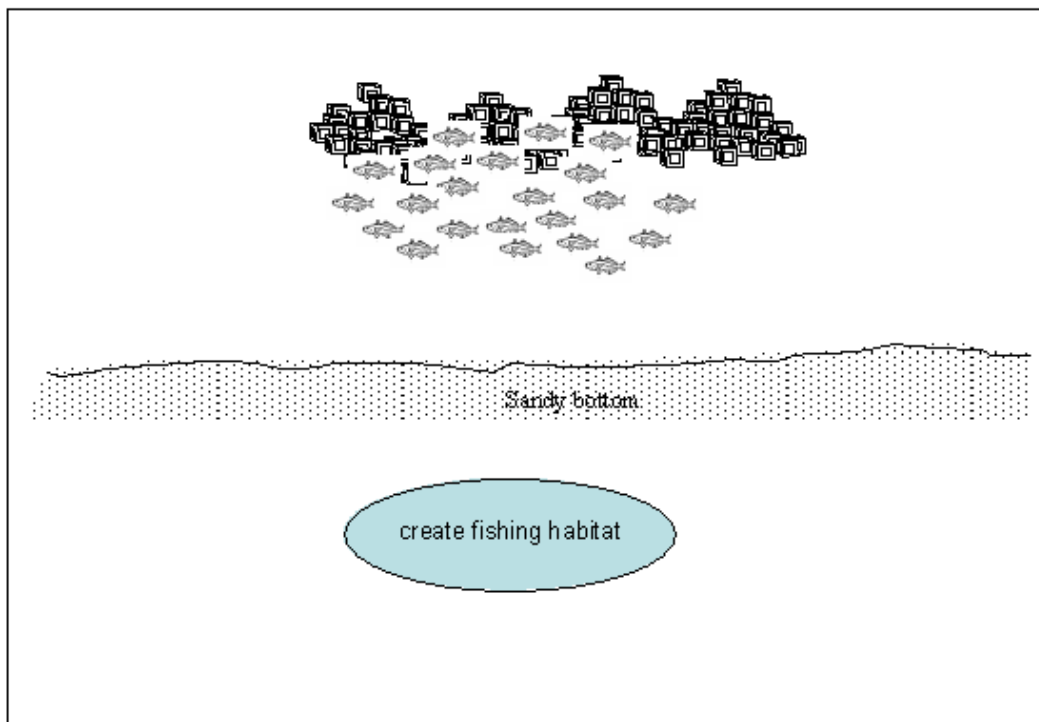
Uses of Artificial reef in marine environment

- Enhance fishery production
- Conservation or mitigation of marine resource
- Mariculture
- Tourism



Expansion or creation of fish habitat





Uses of Artificial reef in marine environment

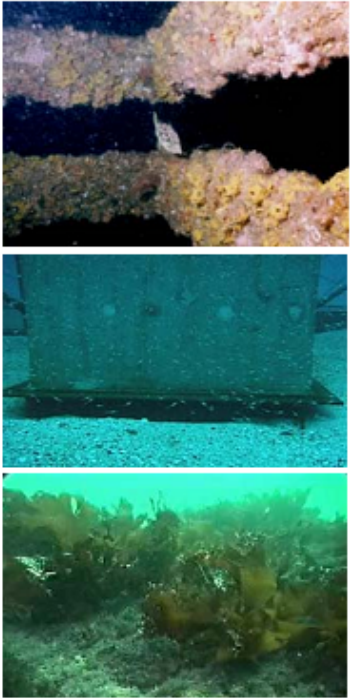
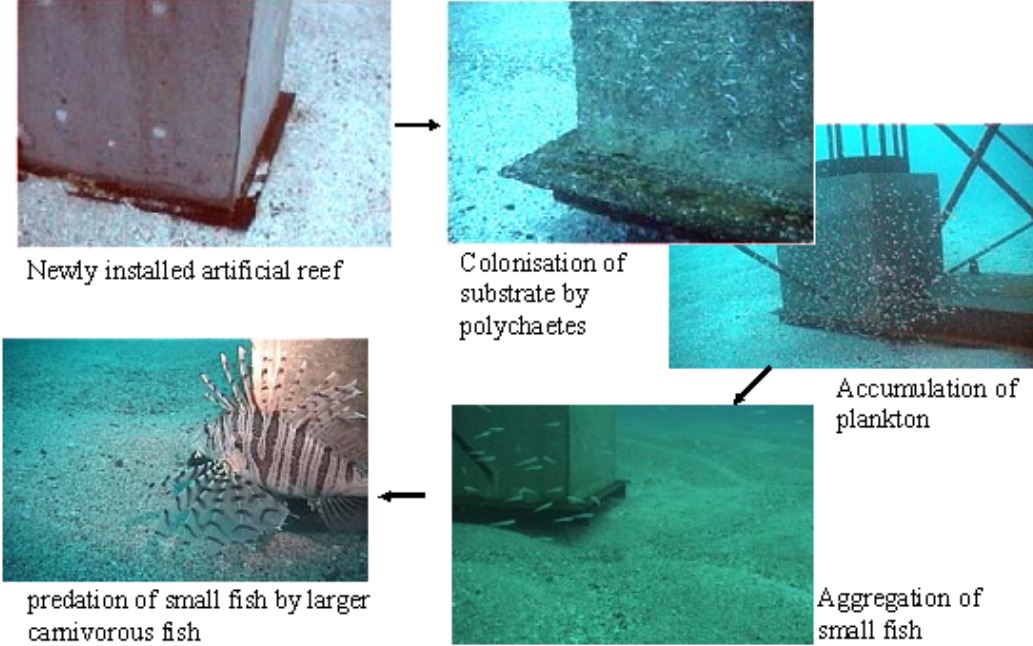
- Enhance fishery production
 - Conservation or mitigation of marine resource
 - Mariculture
 - Tourism
- ↓
- feeding ground
 - refuge
 - spawning ground
 - nurseries

Function as feeding ground

aggregation of prey organisms

- increase of periphyton on the surface of artificial reef
- increase of plankton & benthic organisms due to turbulence & topographic transitions around artificial reef
- increase of organisms associated with attached macroalgae

• Attract organisms from higher trophic levels
 • Promote growth and hence enhance fish stocks

Newly installed artificial reef

Colonisation of substrate by polychaetes

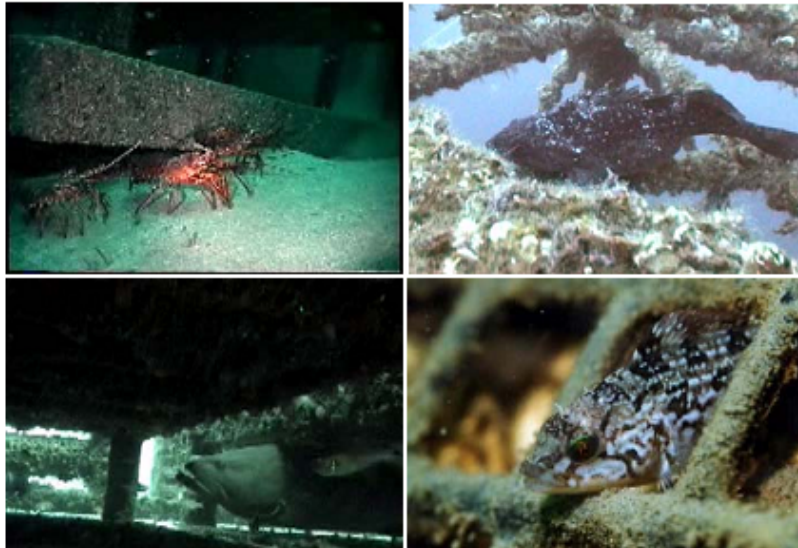
Accumulation of plankton

Aggregation of small fish

predation of small fish by larger camivorous fish

Function as Refuge

- Multidimensionality provides hiding places for demersal organisms



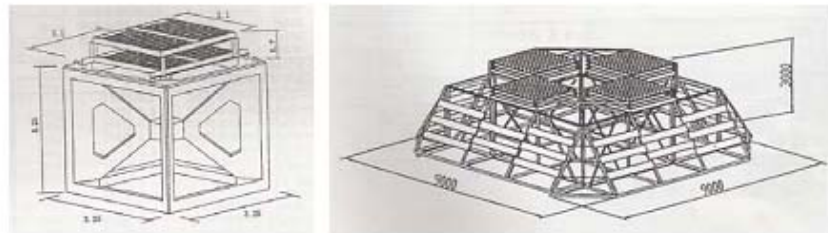
• Function as spawning ground & nurseries

- Creation of spawning grounds
- Creation of nursery grounds



Case study 1 - Artificial reef in inland shallow waters (10-15m) of Japan

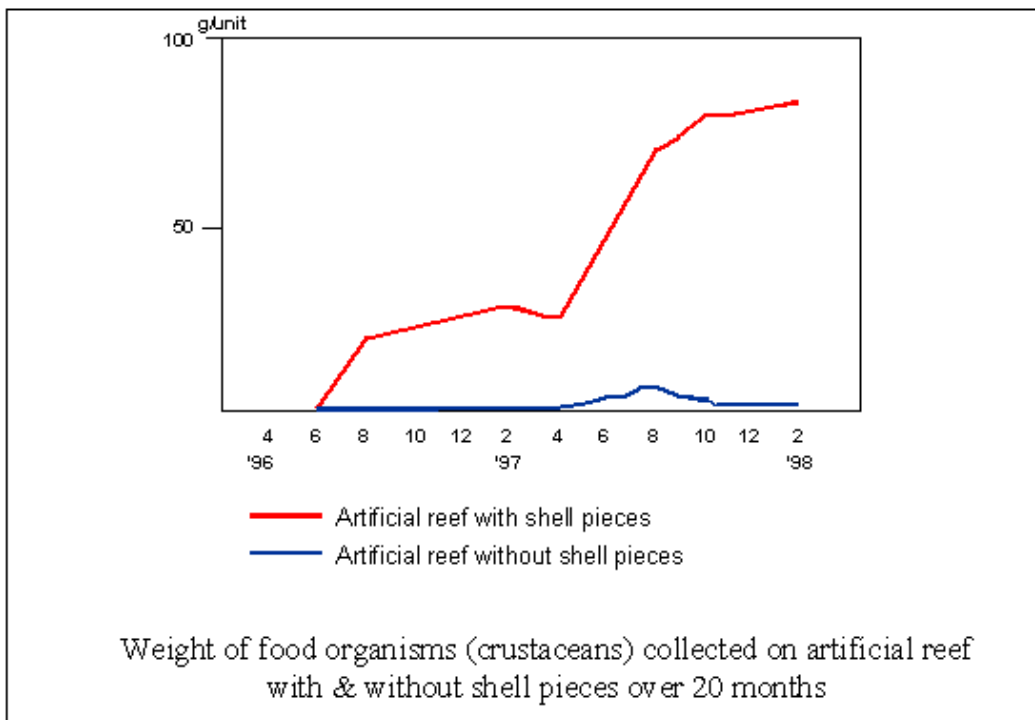
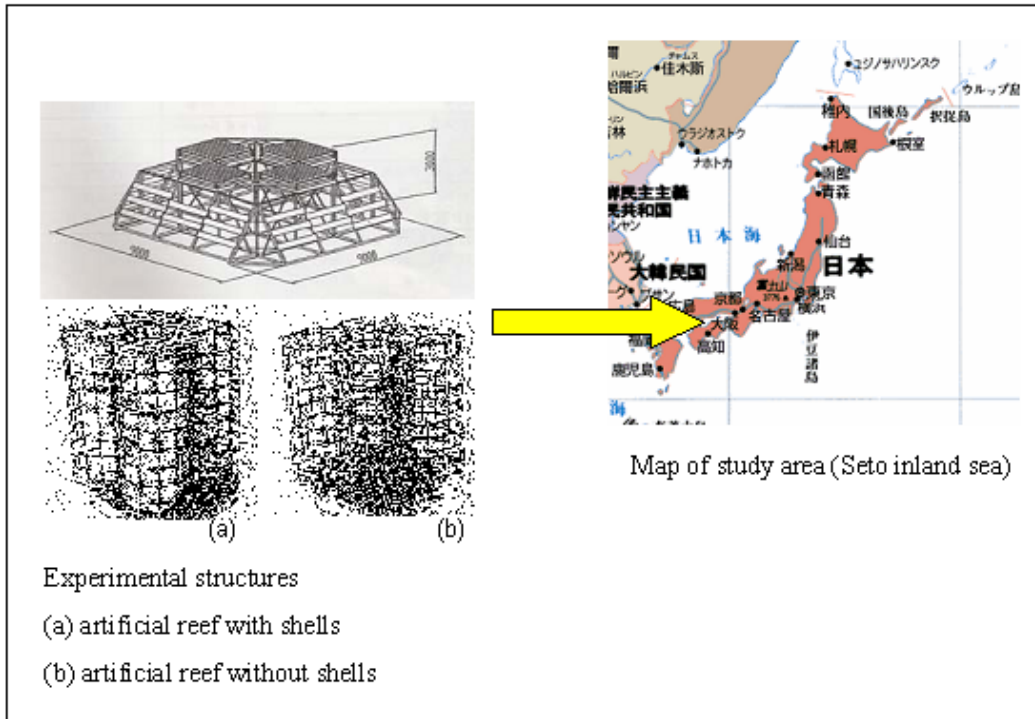
Nurturing of bait organisms for enhancing fish growth.

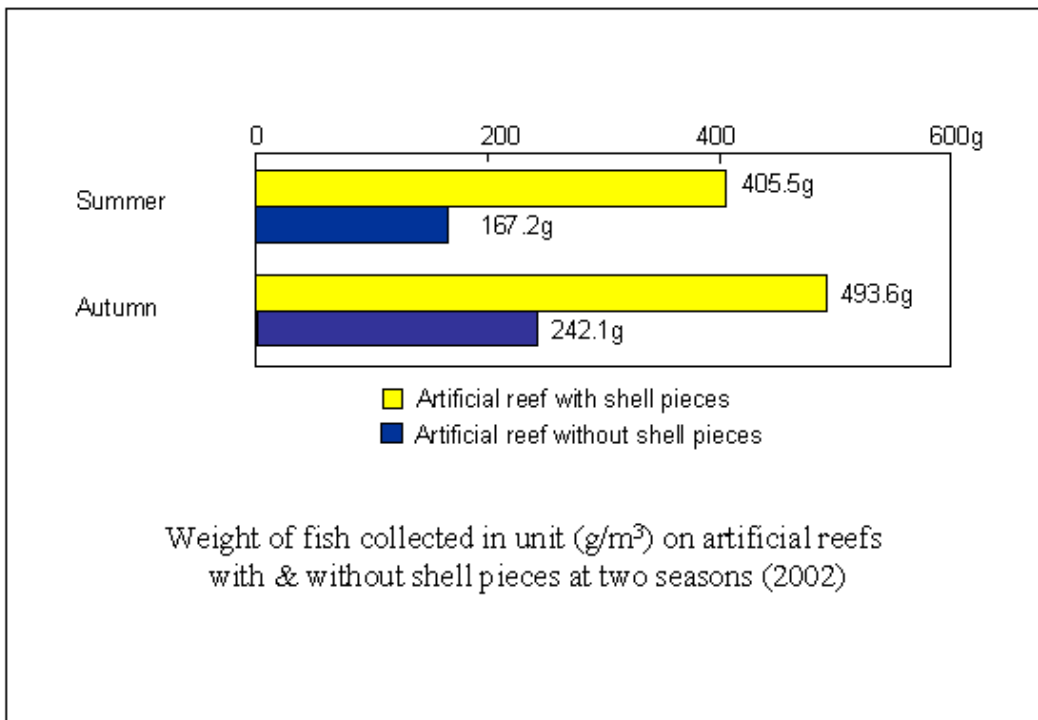
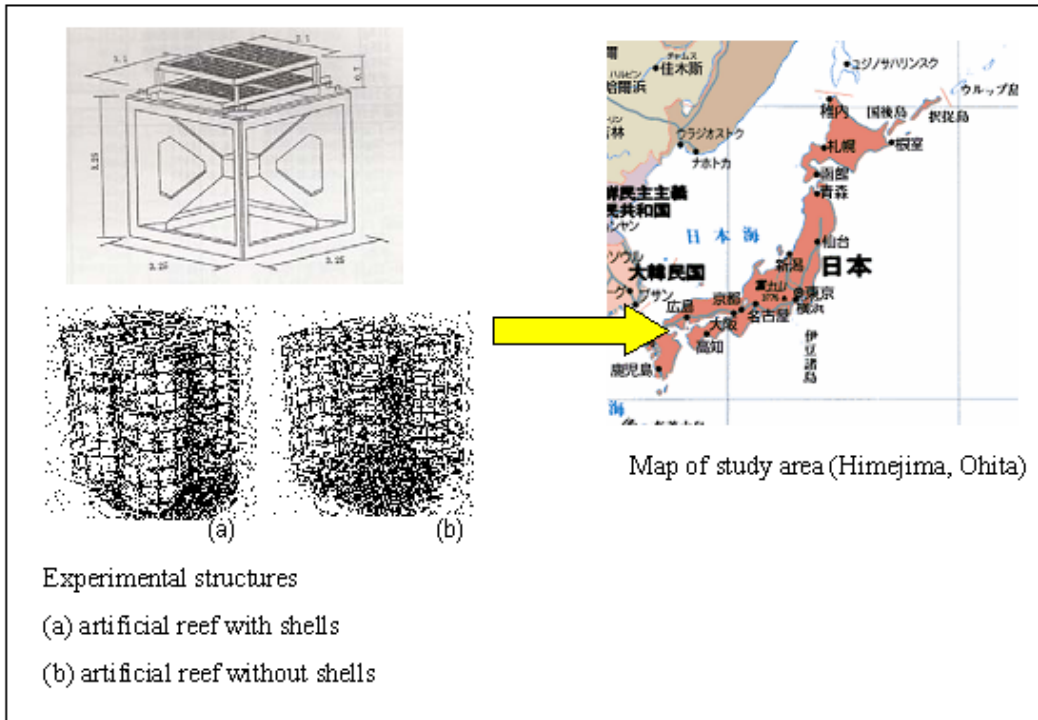


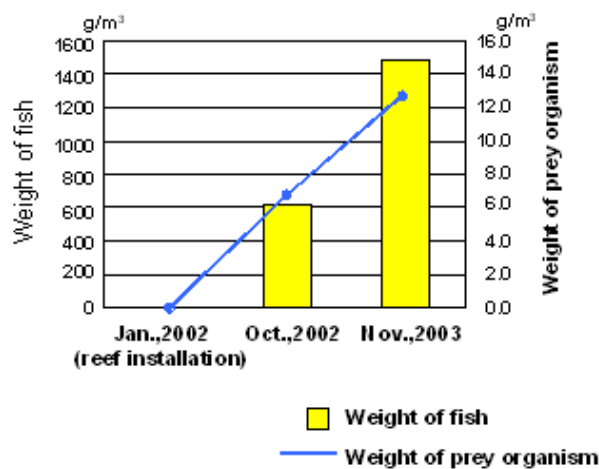
Artificial reefs with shell plates



Procedure used for installing test pieces of oyster shells on artificial reef







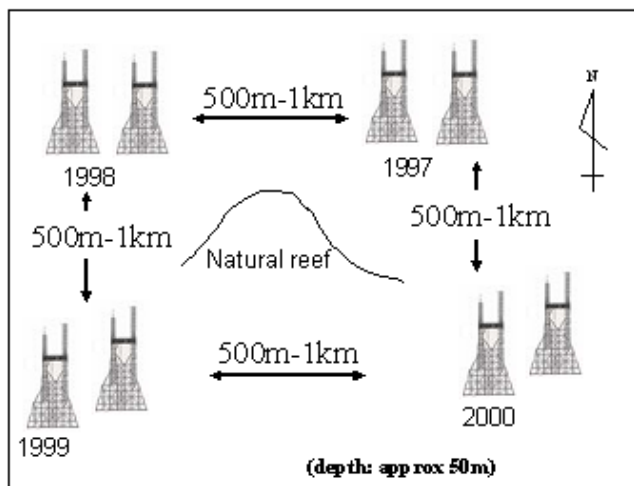
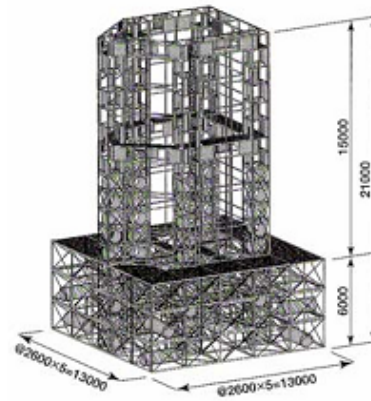
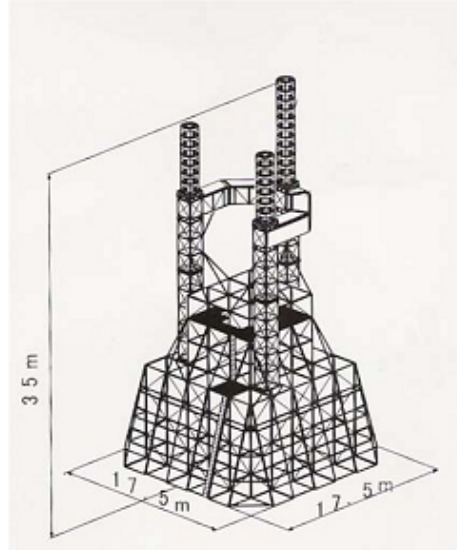
Weight of fish (g/m^3) and prey organisms over 22 months on artificial reef with shell pieces

Conclusion

- Small organisms (e.g. amphipods, decapods) colonise more abundantly structures offering much topographic (habitat) complexity.
- These become preys for larger organisms in the food web e.g. commercially important fish.
- May be used as nursery and refuge by juvenile fish.
- Oyster shell can be utilised at minimal cost in Japan for enhancing fish production in shallow waters.

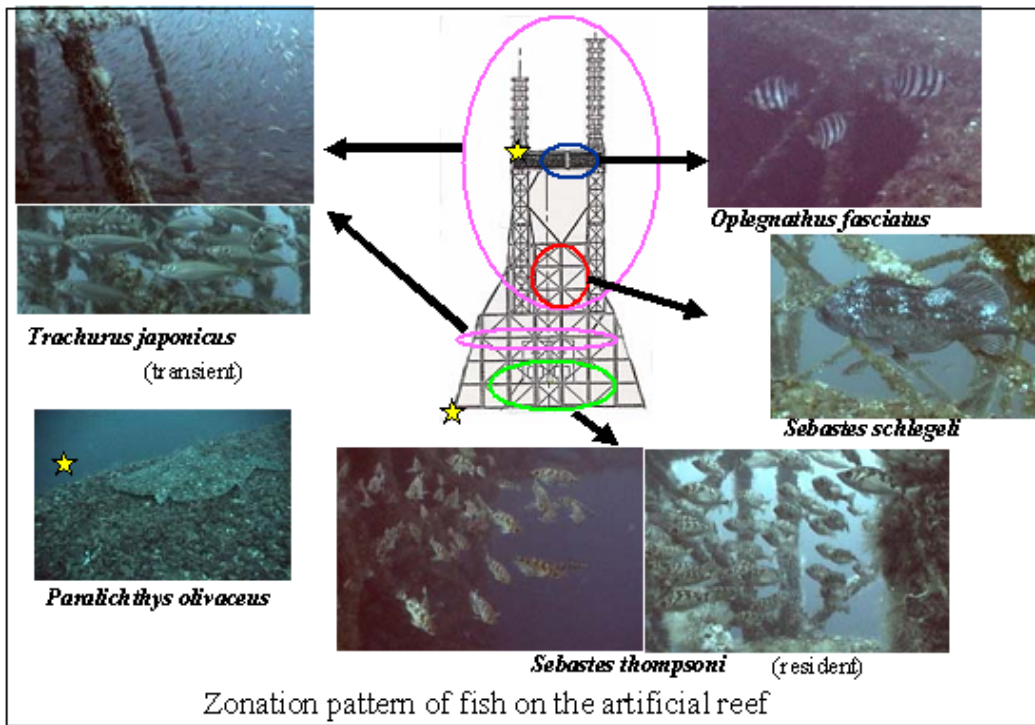
Case study 2 - Artificial reef in deeper waters (~50m)

High-rise artificial reef projects have also implemented at several locations in Japan (e.g. Yamagata pref., Ishikawa pref.)



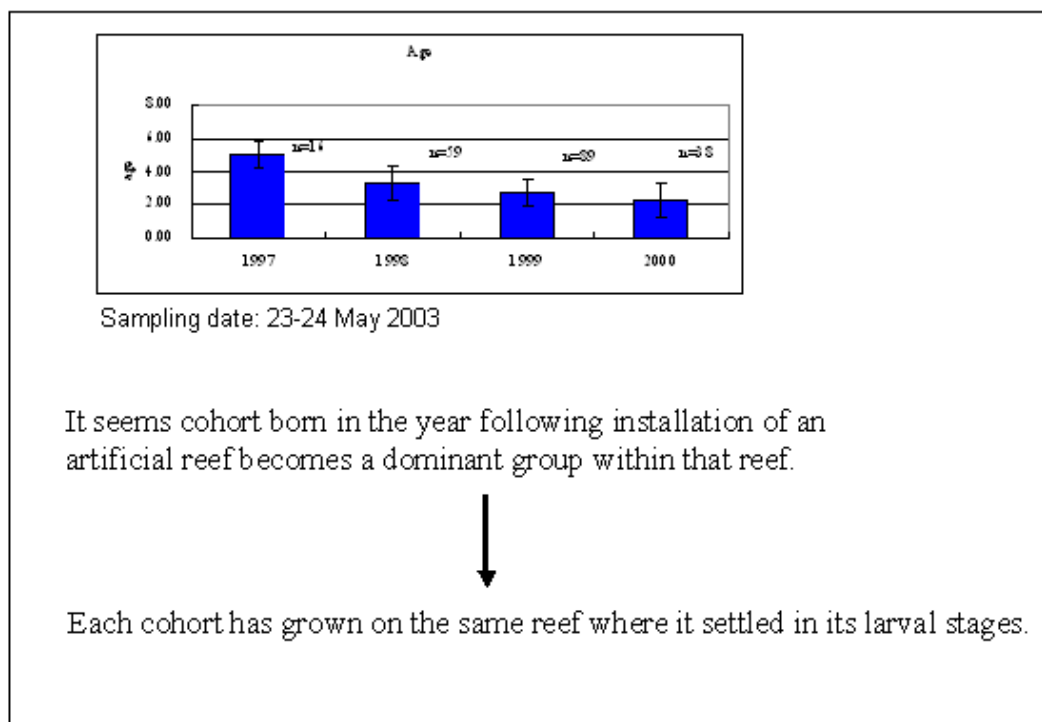
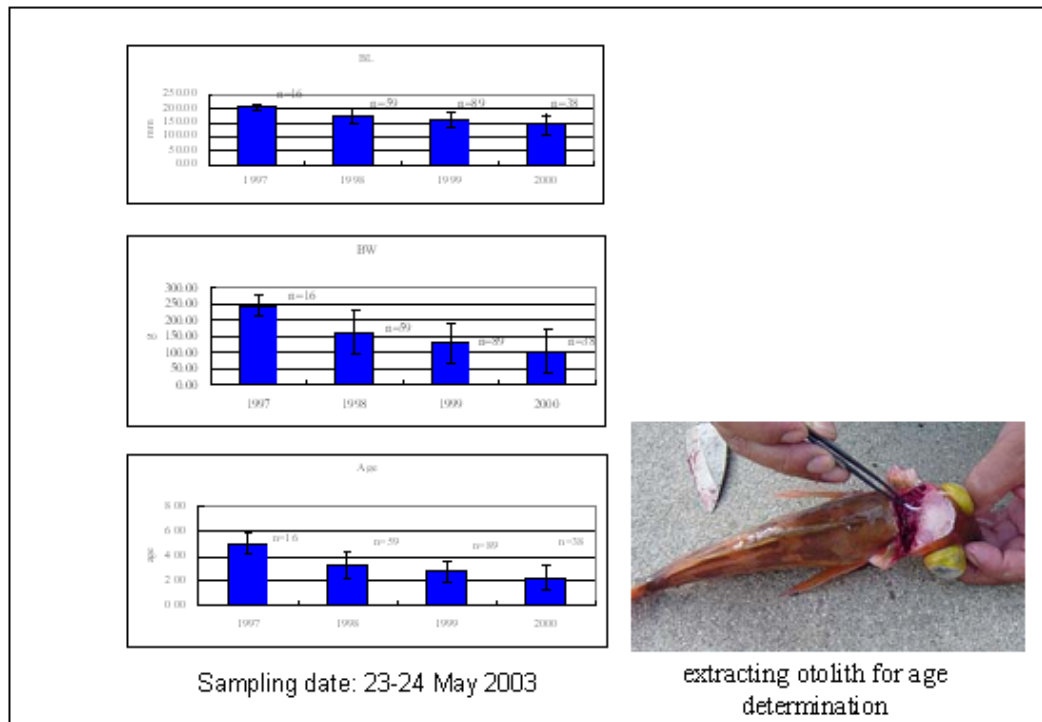
Map of study site (Sea of Japan)

Schematic illustration of deployed artificial reefs around Tayusho reef



Sebastes thompsoni

- This species found on the artificial reef structure, although not observed in the adjacent natural reef
- Seems to settle in artificial reef over the years and increase in body size over time (U/W observations)



Conclusion

- High-rise artificial reefs offer topographic complexities that accommodate pelagic and demersal fish assemblages.
- Fish assemblages on the artificial reefs consist of both resident and migrant species.
- *Sebastes thompsoni* seems to grow from larval to adults stages on the artificial reefs and reside permanently on the same reefs.
- Artificial reefs are effective in creating productive hard bottom habitat where there are none (highseas 50 to 100m depth), hence enhancing fish production.
- Further studies using Tag and recapture method needed to confirm our data.

Overall Conclusion

The role of artificial reefs is to serve as tool for proper management of marine fisheries.

There is a need to collect more biological as well as ecological data to understand the proper functioning of artificial reefs so that we can manage them in more sustainable manner.