



Blue Carbon Creation by Nippon Steel Corp.

Dec. 11, 2023

Nippon Steel Corp., Research & Development

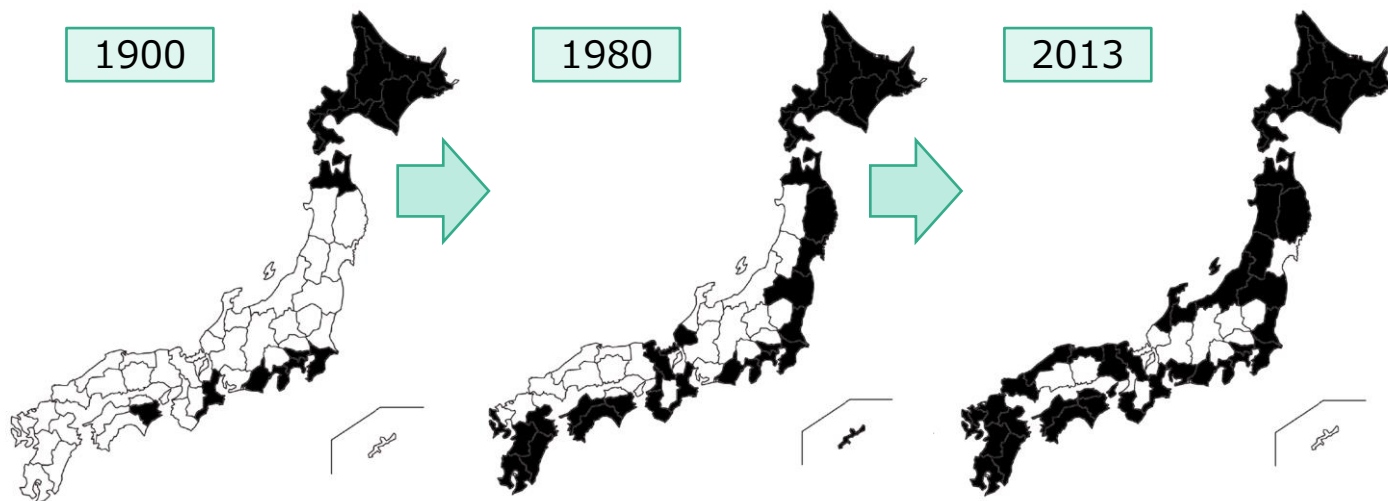
Chika Kosugi

*Seaweed beds are communities consisting of one to several species and are places for primary production in coastal area.

Current Status of Seaweed Beds* in Japan

■ Expanding of sea desertification, declining seaweed beds, around Japan

- ✓ The sea desertification was first recognized in 1885 and has been enlarging in 21st century.
- ✓ Decline of coastal fisheries due to the sea desertification.



Trends in prefectures with declining seaweed beds
(Black; declining seaweed beds, modified from Fujita, 2006)

Seaweed (kelp) beds



Barren ground



Mashike-cho, Hokkaido

Since 2004, we had been thinking of the solution that the steel company could offer...

One of the Sea Desertification Mechanisms, Iron Starvation Around Coastal Area

■ The coastal iron hypothesis (Matsunaga et al., 1994)

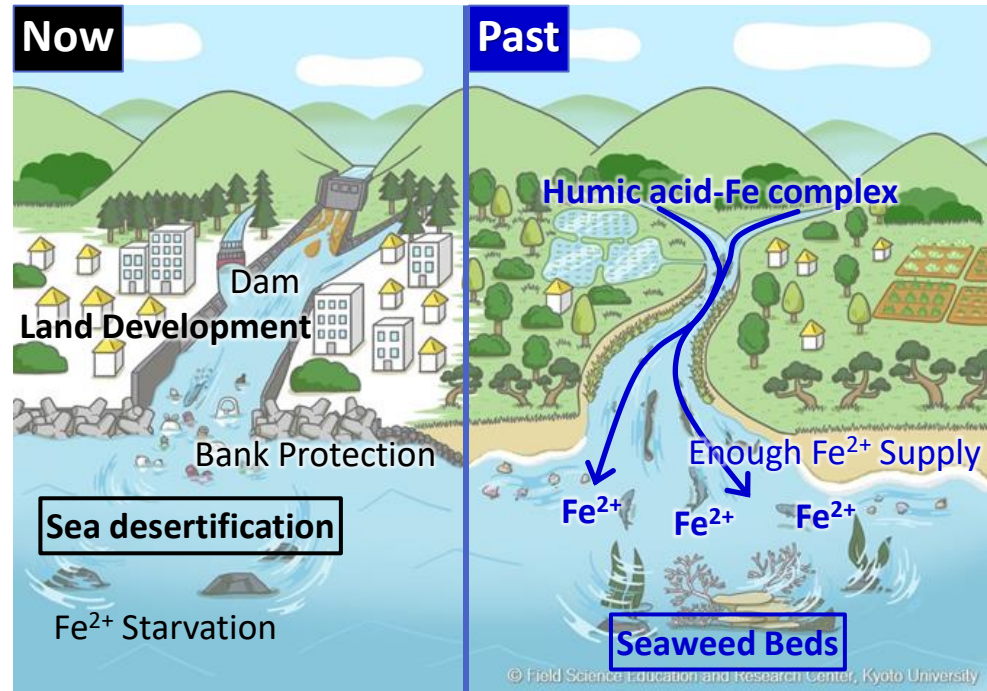
Originally, iron in soil was supplied to coastal areas through rivers.



Iron supply has been decreasing due to land development such as bank protection work and dam construction.



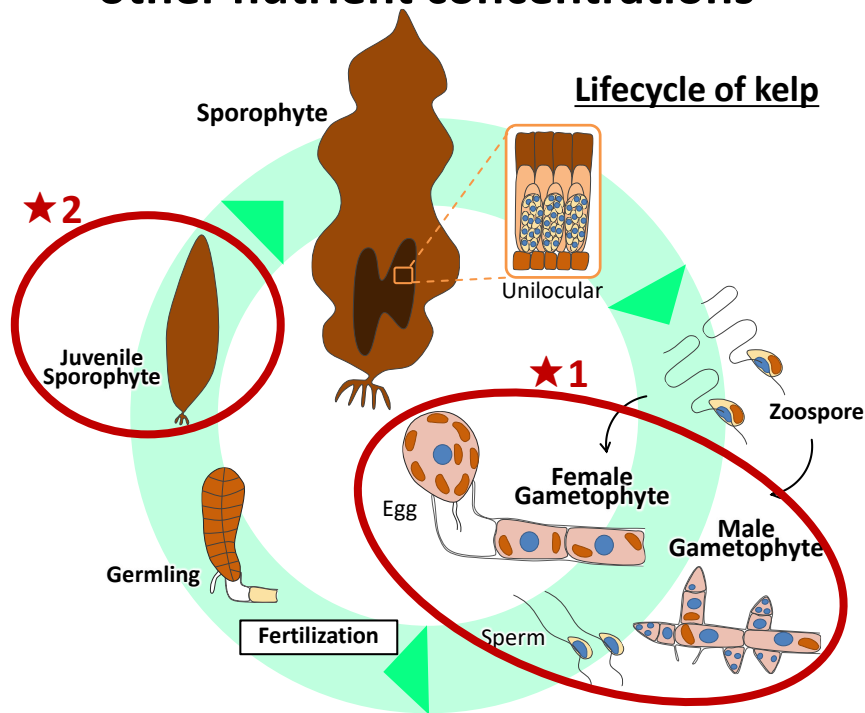
Iron starvation occurred in coastal area, and the sea desertification has been expanding.



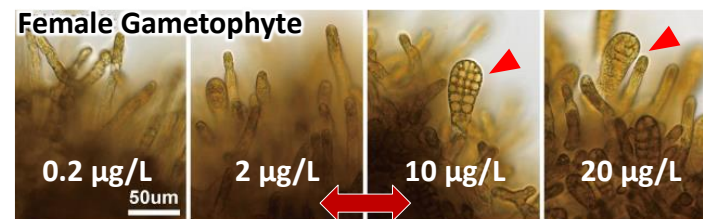
Field Science Education and Research Center, Kyoto University

Effects of Iron on Kelp Lifecycle (*Saccharina japonica*)

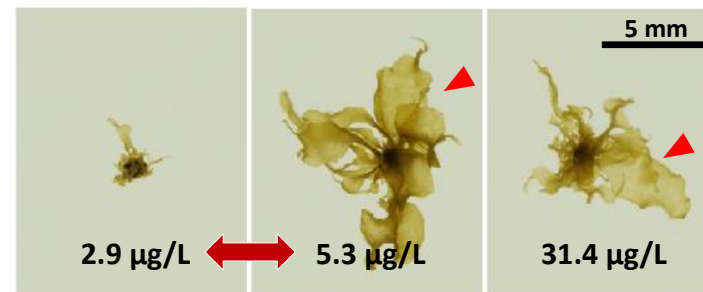
- Culture test of kelp in different dissolved iron concentrations while controlling other nutrient concentrations



★1 Iron is necessary for gametophyte maturation



★2 Iron is necessary for sporophyte growth

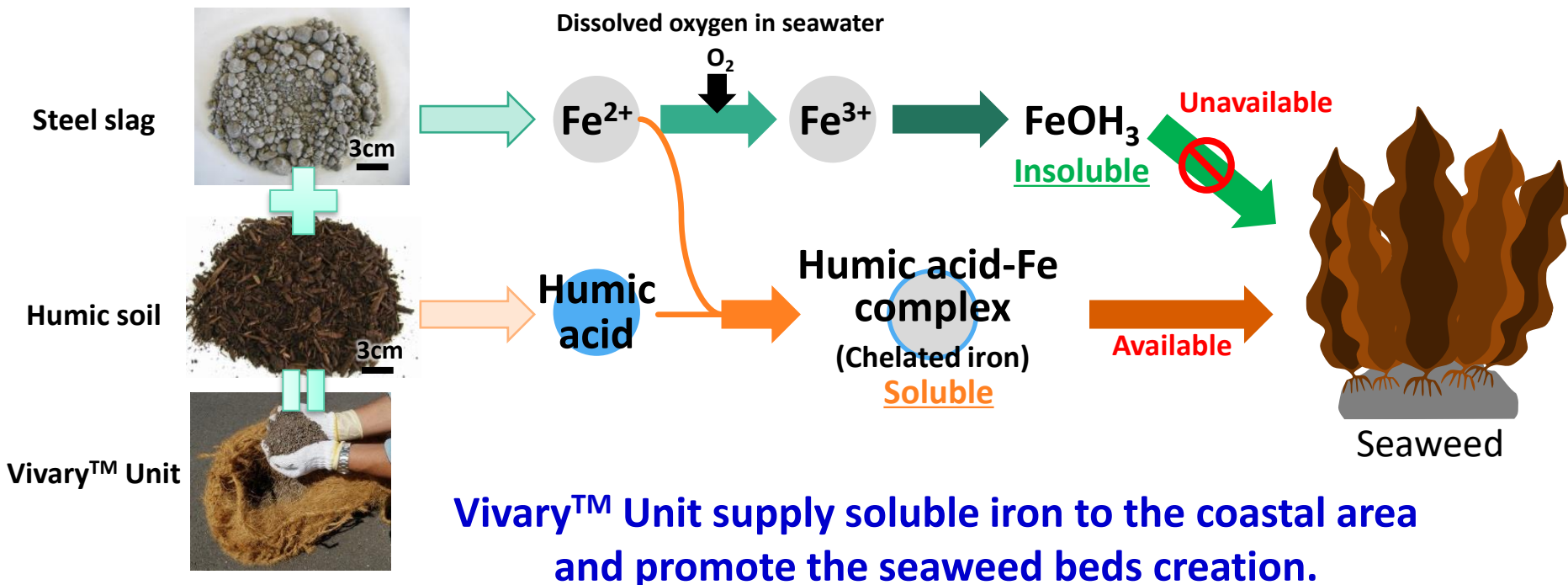


From collaborative research with Prof. Motomura / Hokkaido Univ.

Iron is essential for kelp to complete its lifecycle.

Technology to Reproduce the Iron Supply (Vivary™ Unit)

■ Development of the fertilizer using steel slag



Research and Development to Use Steel Slag in Coastal Area

■ Steel slag, a byproduct in steelmaking

- ✓ Occurs when melting iron ore
- ✓ Contains about 20% iron



Juvenile kelp

1 cm

■ Verification of effectiveness and safety of the fertilizer

- ✓ Clarification through seaweeds culture tests (kelp and laver) in lab., and aquaria facilities.
- ✓ Safety was confirmed through toxicity tests, etc.



Fish
(red sea bream)



Abalone



Prawn

Aquaria facilities



Test tanks;

W1,000*L5,000*D1,600mm



Laver mesh
with fertilizer

10 cm



Laver mesh
without fertilizer

10 cm

72/96 h
acute toxicity test



Seaweed (laver)



Phytoplankton

Mashike-cho,
Hokkaido

Restoration of Seaweed Beds using Vivary™ Unit at Hokkaido

■ Collaboration with fisheries cooperative association (2014~)

- ✓ Transporting steel slag and humic soil to Mashike fishing port
- ✓ Mixed and packed in the degradable bags of 20 kg each

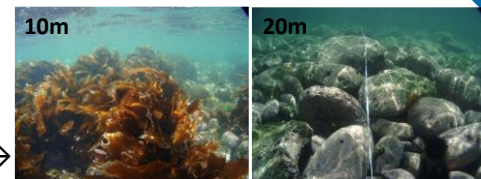


- ✓ Digging a 1 m trench on the coastline
- ✓ Finally, backfilling with surrounding sand

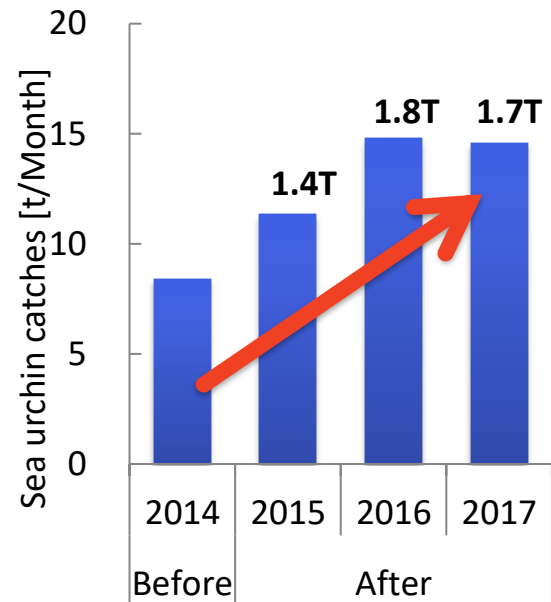
Expansion of Seaweed Beds and Increasing Sea Urchin Catches

■ Monitoring of changes in seaweed beds and sea urchin catches

Undersea condition (Jul. 2015)→

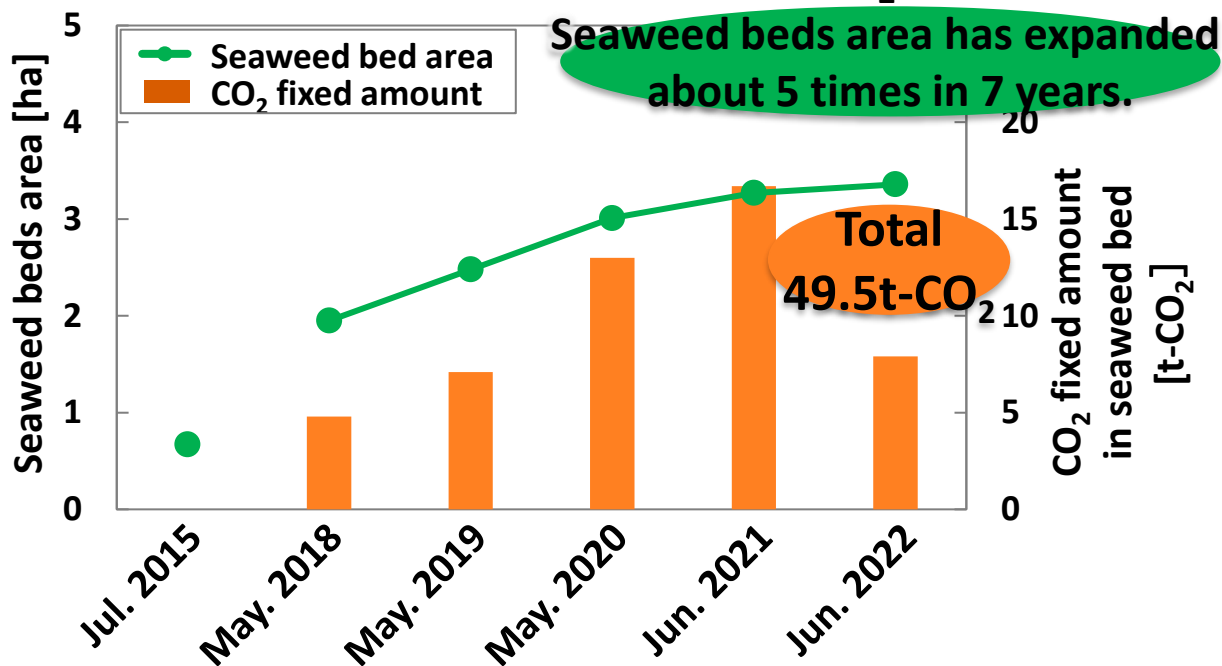


- ✓ In 2015, seaweeds only grew to about 10 m offshore, and almost no seaweed grew anywhere else.
- ✓ Seaweed beds (black area in photos) gradually expanded offshore and towards the coastline.
- ✓ Sea urchin catches improved with the expansion of seaweed beds (2015~2017).



Evaluation of Seaweed Beds as Blue Carbon

- Obtained the J Blue™ credit certification for CO₂ fixed amount in 5 years

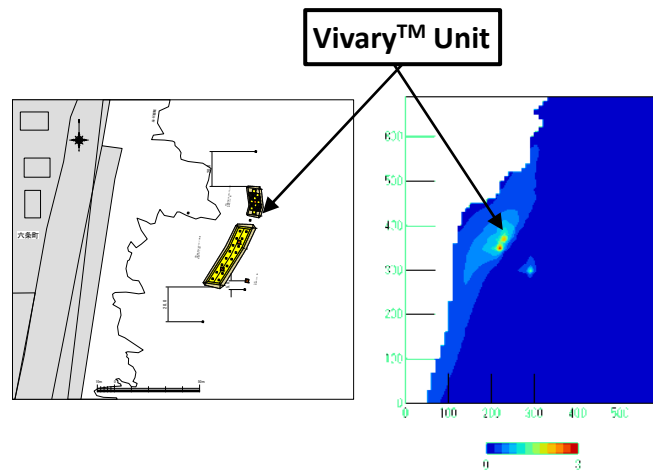


A blue carbon credit certification system that can visualize results is necessary for private companies to sustain their activities.

Nationwide Expansion Based on Established Technologies

■ Improving reliability in the creation of blue carbon with fertilization

- ✓ Elucidation of the environmental conditions for stably supplying iron
 - ➔ **Laboratory and aquaria facilities**
- ✓ Improving certainty through data collection and model analysis/construction regarding the creation of various seaweed beds



An example of iron diffusion simulation in the coastal area

Contribution to the Community and Nurturing Young People

- On-site classes held at primary and junior high schools (5 classes in 2023).



Summary:

Our Concept for a Sustainable Blue Carbon Creation

Science & Technology



- ✓ Local government
- ✓ Fisheries cooperative association

Community

Education



Sustainable activities are necessary to create Blue Carbon, and for this purpose, a link between the Science & Technology, Community, and Education is important.