Environmental effects on growth performance of Pacific oyster *Crassostrea gigas* cultured in the Seto Inland Sea, Japan, from 1990 to 2021

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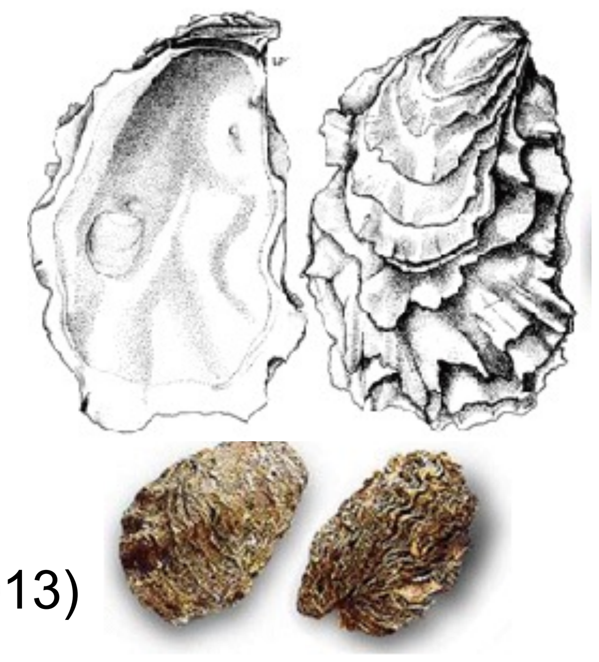
Introduction

- ❑ The Pacific Oyster *Crassostrea gigas*
- ❑ Commercial aquacultural species in over 70 countries (FAO, 2022)
- ❑ Marine model organism of short-term acidification laboratory experiment (Kurihara, 2007; Hettinger et al., 2013)



❖ The long-term effects of various environmental factors (water temperature, salinity, pH, and food availability) on *C. gigas* growth in the natural ocean environment remain unknown.

❖ To effectively manage oyster production under future climate challenges, this study applied the long-term cultured *C. gigas* in the Seto Inland Sea, western Japan, to investigate the long-term changes of *C. gigas* growth and its associated environmental factors.

Materials & Methods

❖ Sampling
- 4 rafts from June 1990 to January 1991, total 2071 oysters sampled
- 3 rafts during May-February per each fiscal year total 25 rafts and 5980 oysters sampled from 2015 to 2021

❖ Environmental data

Water temperature (WT), Salinity, Chlorophyll-a (Chl-a)

❖ Biological traits data
- ❑ Dorso-ventral height (DVH)
- ❑ Total weight (TW)
- ❑ Wet meat weight (MW)

❖ Statistics analysis
- Length-weight relationship $W = aL^b$ between DVH and TW/MW
- GAM analysis between environmental and biological data

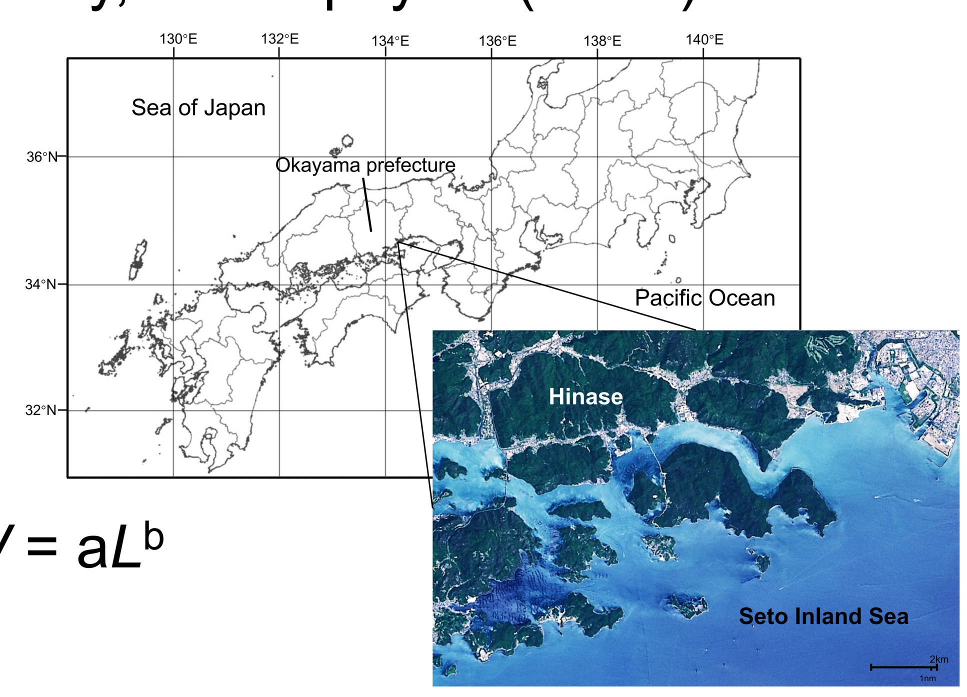


Fig.1 Sampling location

Results and Discussion

1. Monthly change of environmental conditions between 1990 and 2015-2021

✓ **NO significant change in water temperature (WT)** during oyster culture period.

✓ **Great decline of salinity** in July and August of 2015-2021

✓ **Apparently high and fluctuating Chl-a in 1990,** while **low and stable in 2015-2021.**

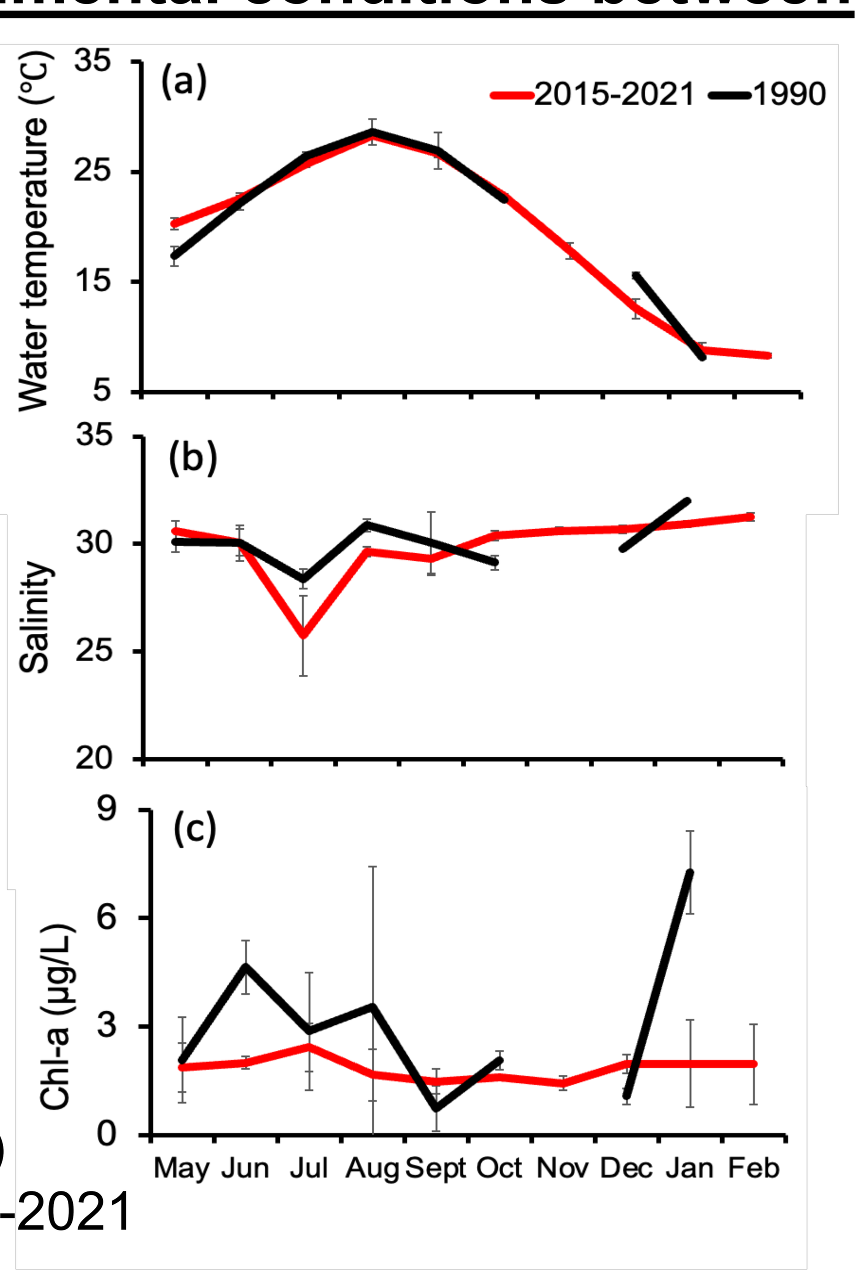


Fig.2 Monthly change of (a) WT, (b) Salinity, (c) Chl-a in 1990 and 2015-2021

2. Monthly change of *C. gigas* biological traits between 1990 and 2015-2021

✓ DVH, TW and MW in July:

1990 > 2015-2021

implying **greater growth in July of 1990** than 2015-2021

✓ DVH, TW and MW at harvesting (Oct-Jan):

1990 ≅ 2015-2021

might due to the **great variation among rafts**

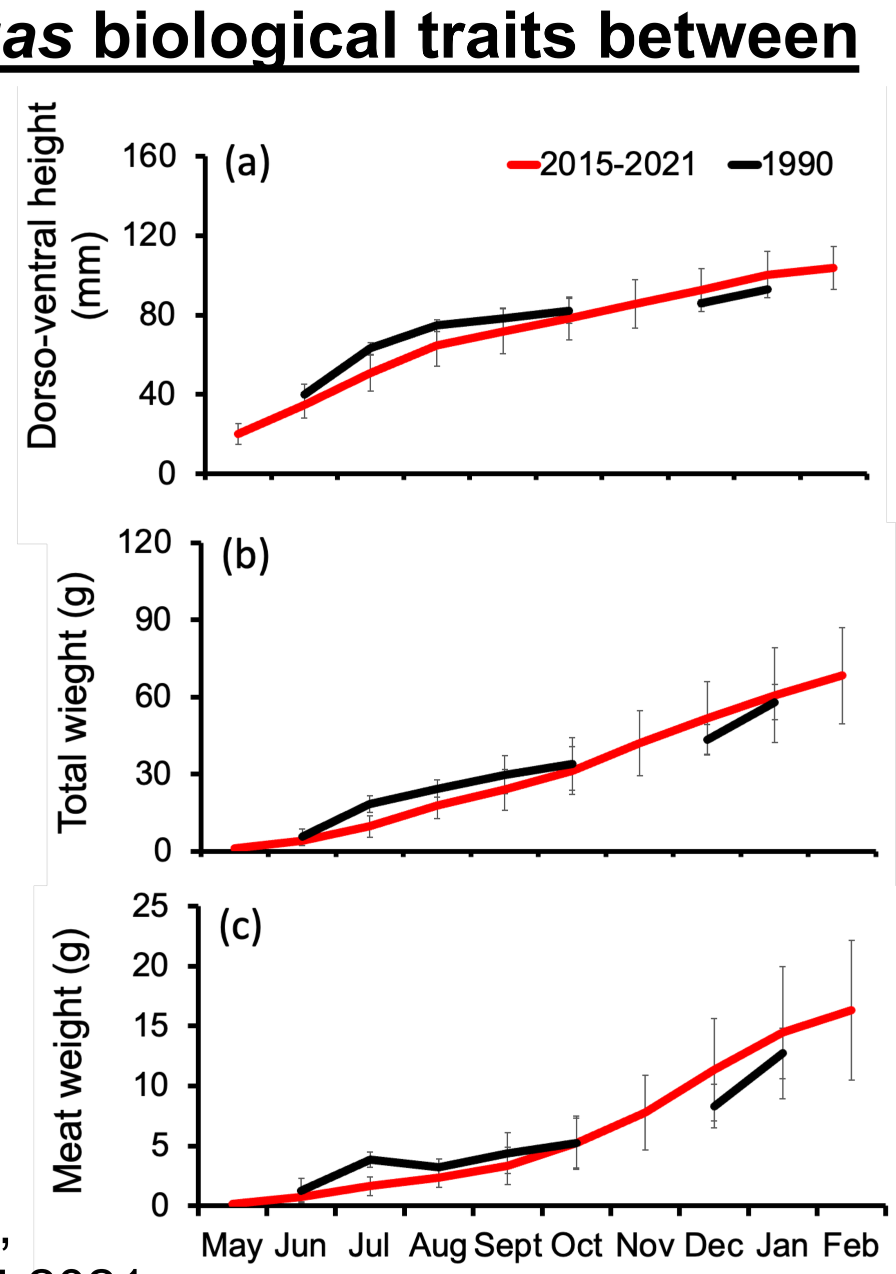


Fig.3 Monthly change of (a) DVH, (b) TW, (c) MW in 1990 and 2015-2021

3. Change of Length-Weight relationships between 1990 and 2015-2021

✓ Parameter b in TW-DVH:

1990 ≅ 2015-2021

✓ Parameter b in MW-DVH:

1990 < 2015-2021

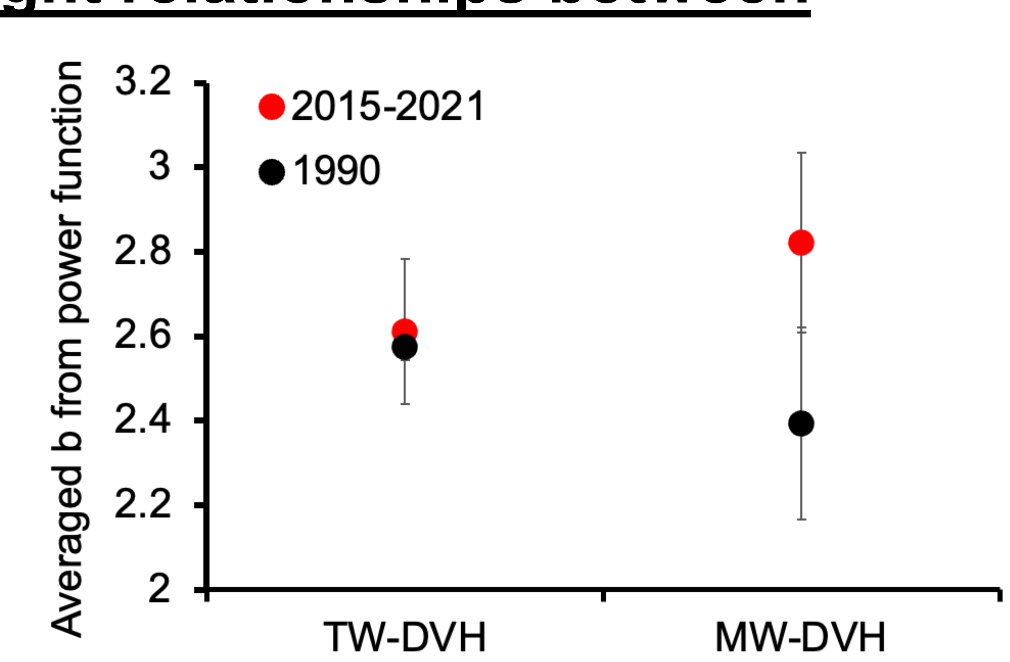


Fig.4 Mean values of parameter b constant from length-weight power functions, in 1990 and 2015-2021

➢ **Recovered eelgrass ecosystem** in 2015-2021 might provide better **food conditions** for oysters to attain **enhanced meat production**.

4. Environmental impacts on *C. gigas* biological traits

Table 1. GAMs results for environmental impacts on oyster biological traits in July

	Year	Location	WT	Salinity	Chl-a	R^2	DE	GCV
DVH	*					0.561	57.2%	0.024
TW	***	*		+**		0.609	61.9%	0.168
MW	*					0.676	68.4%	0.193

(n=532)

✓ No significant environmental influence on DVH or MW, while a **strong and positive impact of salinity** found on TW in July.

➢ **Heavy rainfalls in summer of 2015-2021** might lead to the low salinity in July, which had a negative impact on oysters TW.

Conclusion

➢ From 1990 to 2021, heavy rainfalls caused low salinity in summer and negatively influenced *C. gigas* TW, potentially shell weight; while recovered eelgrass ecosystem may have contributed a higher meat weight of *C. gigas* through improved food conditions.

➢ **Oyster shell characters** should be further investigated to have a holistic view of *C. gigas* long-term changes.