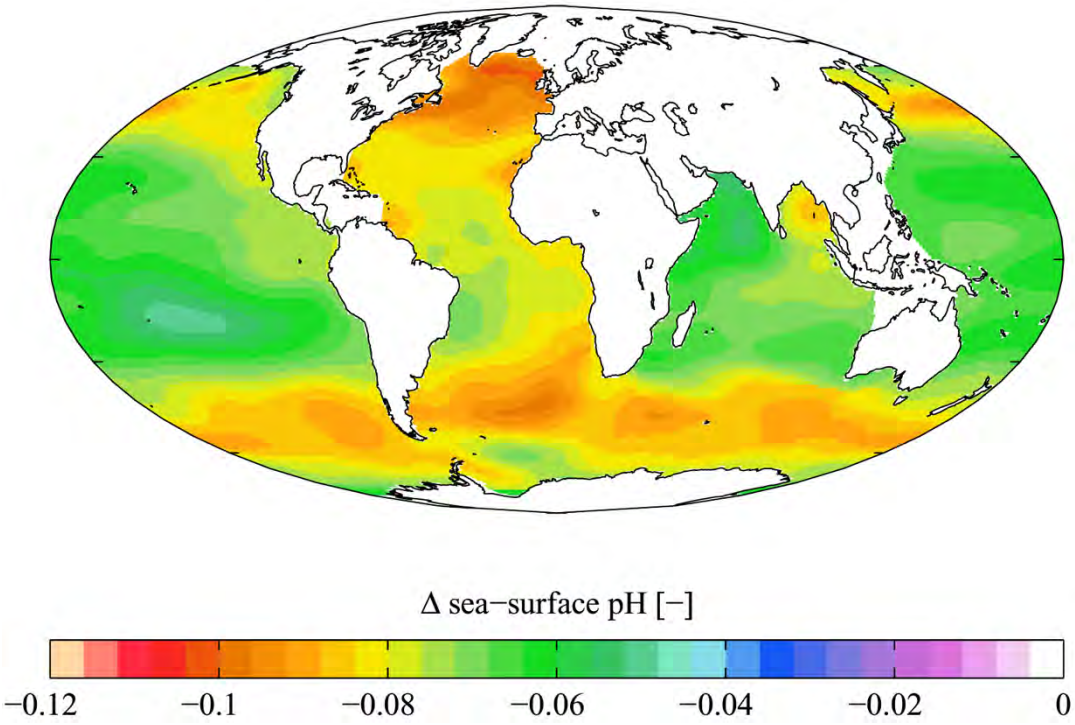
The effects of ocean acidification on the early life history of the olive flounder (*Paralichthys olivaceus*)

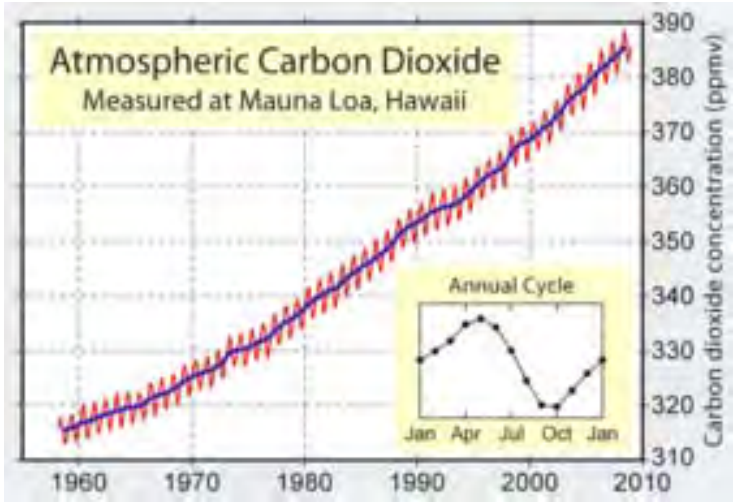
Pukyung National University
Kyungsu Kim

Contents

Introduction

Introduction



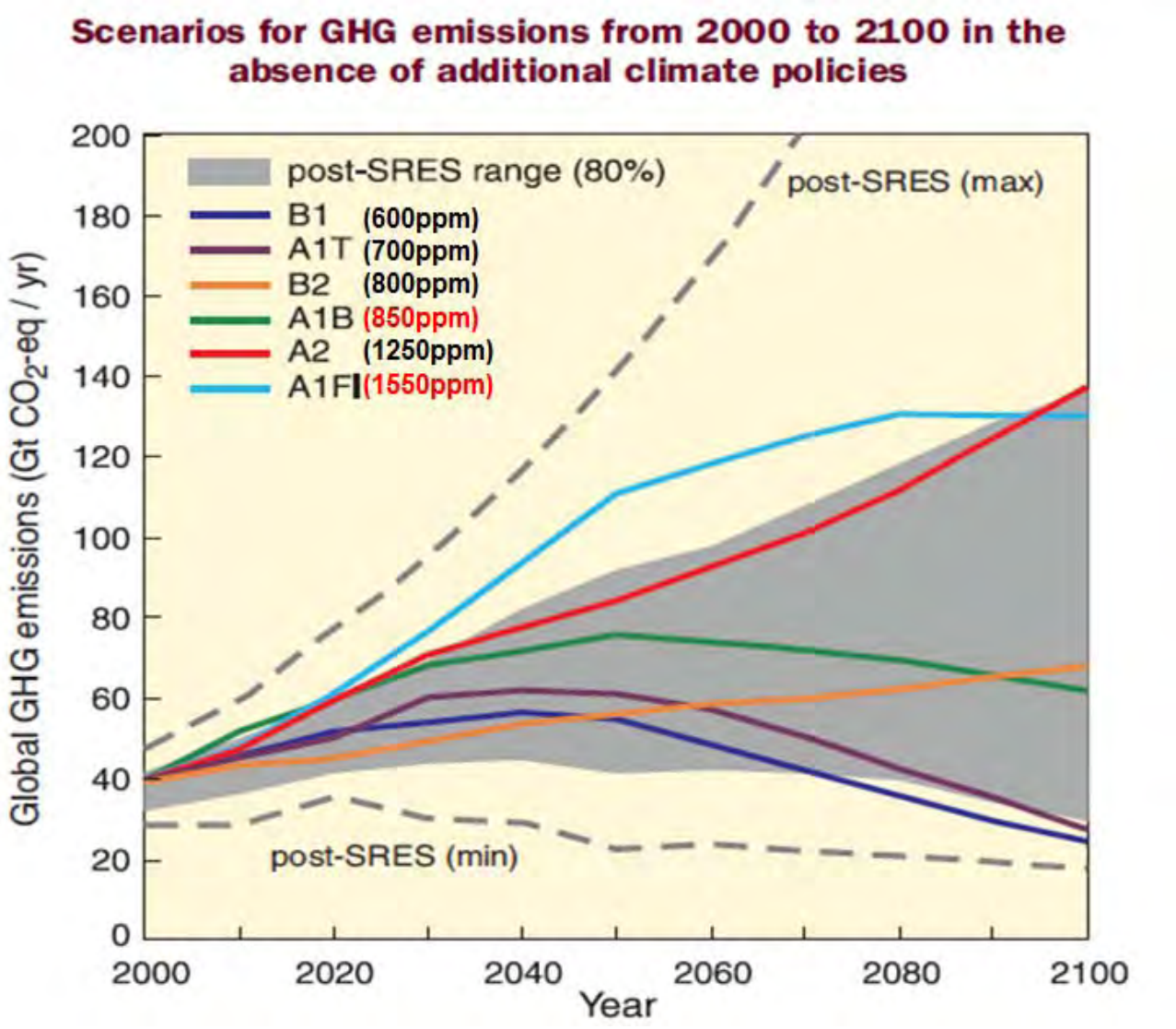


Keeling Curve

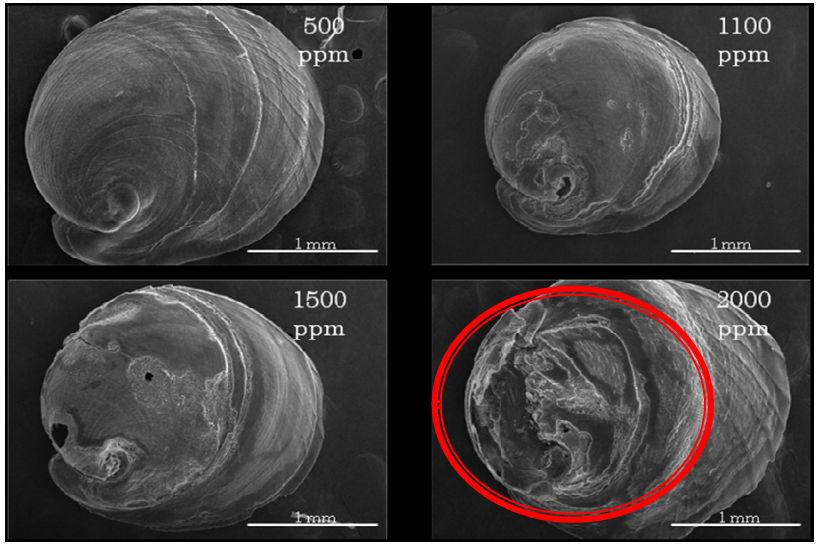
Estimated change in annual mean sea surface pH between the pre-industrial period (1700s) and the present day (1990s). Δ pH here is in standard pH unit.

(http://en.wikipedia.org/wiki/Ocean_acidification)

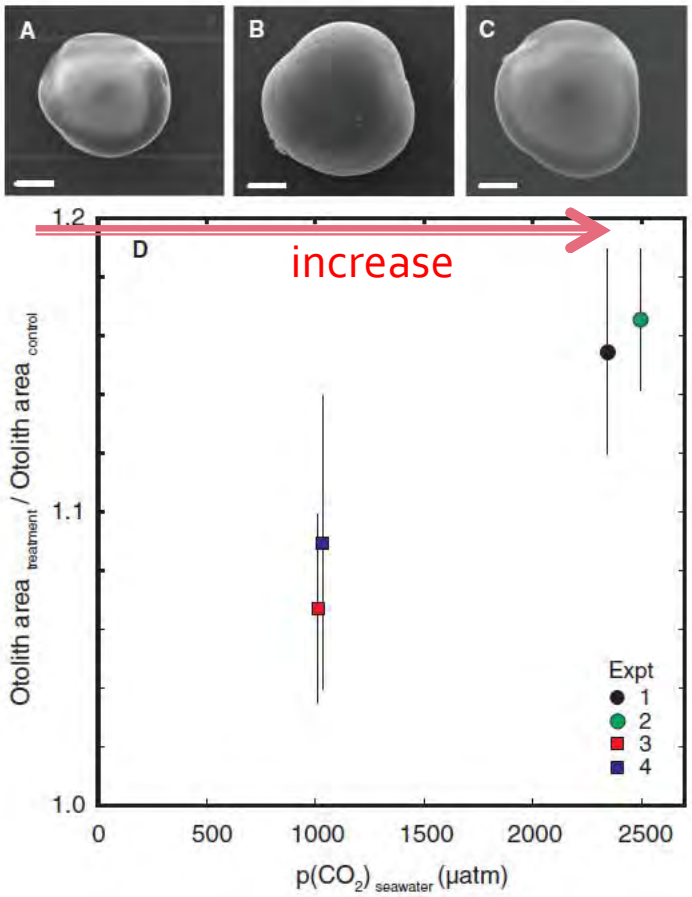
Introduction



Introduction



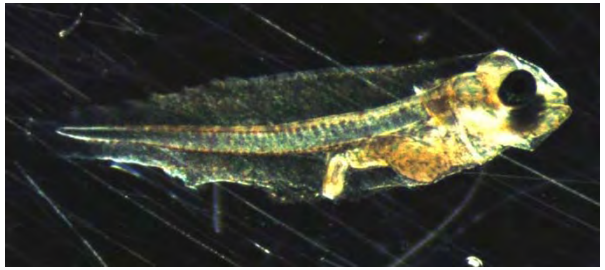
Post-larval Ezo abalone *Haliotis discus hannai* were reared under different pCO2 concentrations for 30 days from just after metamorphosis.
(Takami et al., 2010)

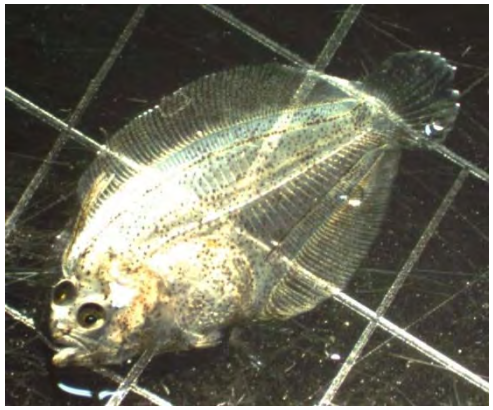


Dorsal view of sagittal otoliths of 7-day-old white sea bass grown. (Checkley et al., 2009)

Introduction

- Olive flounder(*Paralichthys olivaceus*) is one of the most important commercial species in Korea.

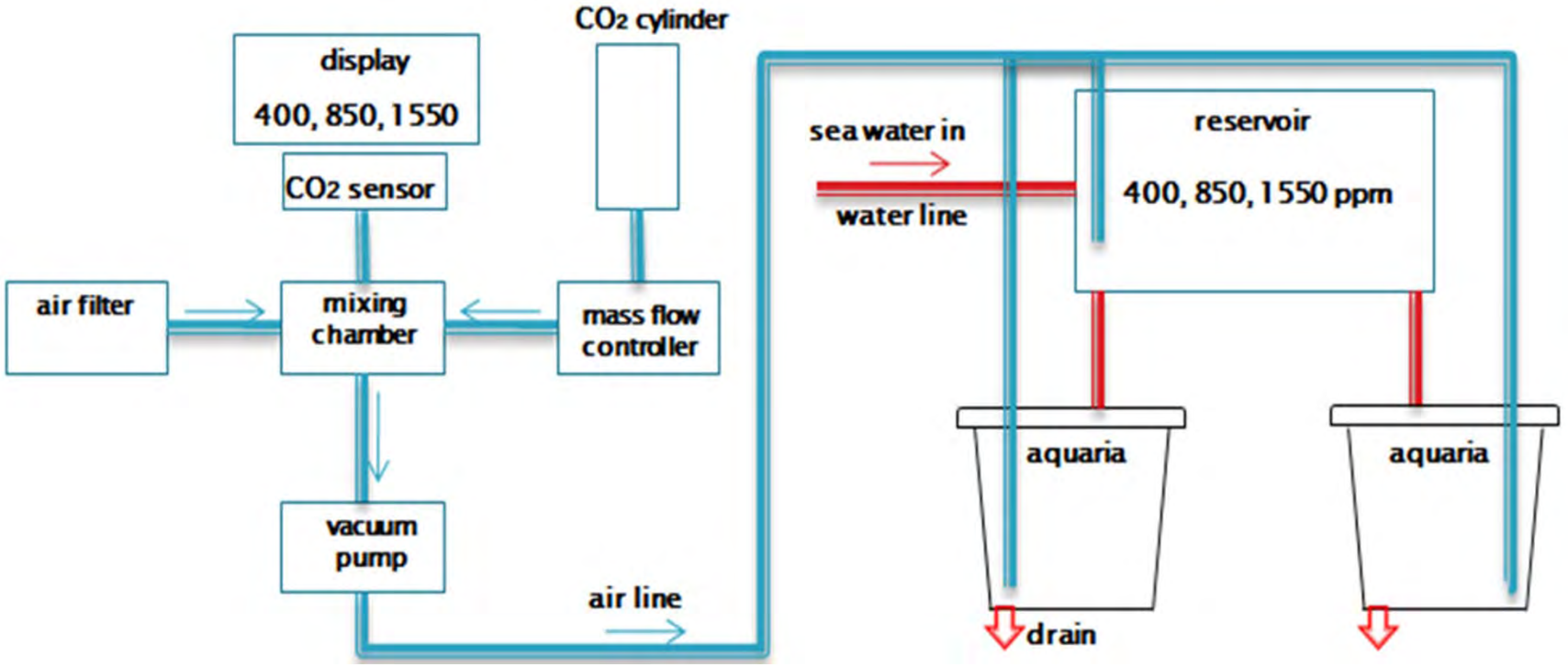




- This experiment was designed to investigate how the ocean acidification affects early development.

Materials and Methods

Materials and Methods



Schematic illustration of the laboratory experimental system used to simulate future ocean acidification environments for rearing larval fishes.

Materials and Methods

- The artificially fertilized eggs of olive flounder, *Paralichthys olivaceus* were collected from hatchery, and larvae were raised in different conditions for 4 weeks.

- Experiments were repeated 3 times during May-July, 2011.

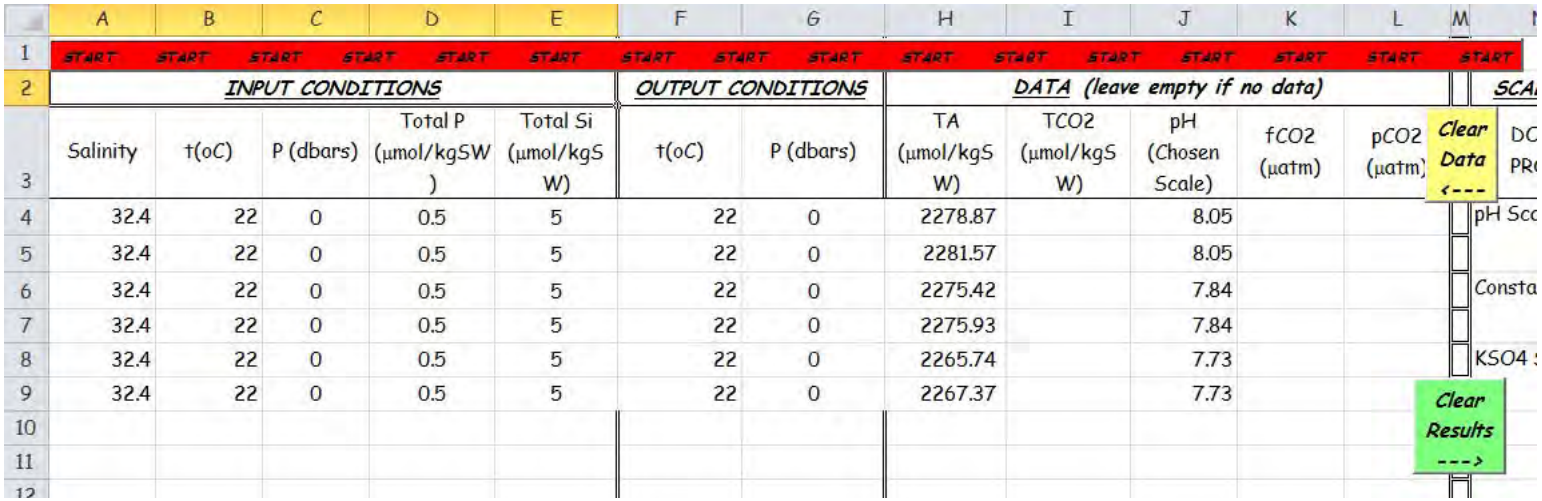
Materials and Methods

- At the end of experiment, fish larvae were sampled for measuring length and weight.

- After measurement, fish larvae was dried, and the concentration of calcium and trace elements were analysed using the ICP(inductively coupled plasma)-AES.

Materials and Methods

- Rearing seawater was collected in each tank during experiment period.
- Measured-pH, salinity, temperature, total alkalinity(TA).
- To use CO2 sys program – pCO2 calculation

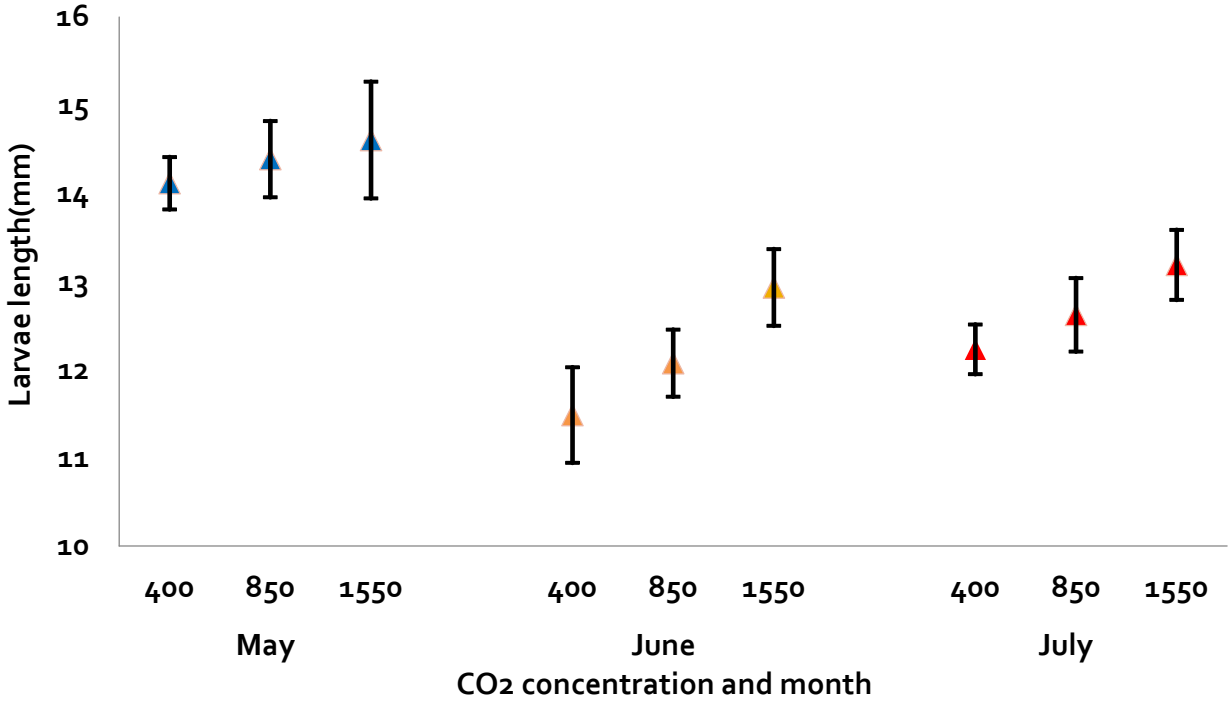


	A	B	C	D	E	F	G	H	I	J	K	L	M
1	START	START	START	START	START	START	START	START	START	START	START	START	START
2	INPUT CONDITIONS					OUTPUT CONDITIONS		DATA (leave empty if no data)					SCA
3	Salinity	t(oC)	P (dbars)	Total P (µmol/kgSW)	Total Si (µmol/kgSW)	t(oC)	P (dbars)	TA (µmol/kgSW)	TCO2 (µmol/kgSW)	pH (Chosen Scale)	fCO2 (µatm)	pCO2 (µatm)	Clear Data <---
4	32.4	22	0	0.5	5	22	0	2278.87		8.05			
5	32.4	22	0	0.5	5	22	0	2281.57		8.05			
6	32.4	22	0	0.5	5	22	0	2275.42		7.84			
7	32.4	22	0	0.5	5	22	0	2275.93		7.84			
8	32.4	22	0	0.5	5	22	0	2265.74		7.73			
9	32.4	22	0	0.5	5	22	0	2267.37		7.73			Clear Results --->
10													
11													
12													

Results

Results- Body length

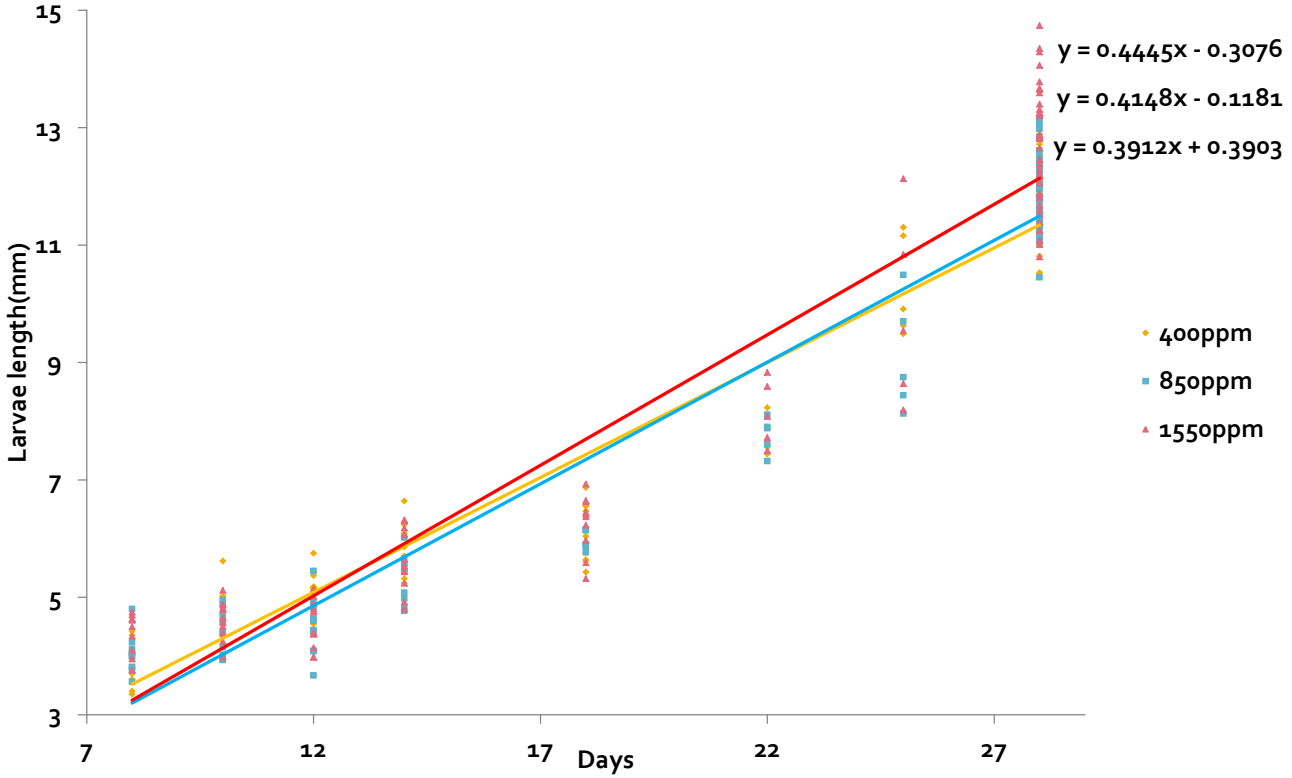
- The growth of olive flounder was to promote with the increasing concentration of carbon dioxide in seawater($p<0.05$, June and July).



Results- Growth rates

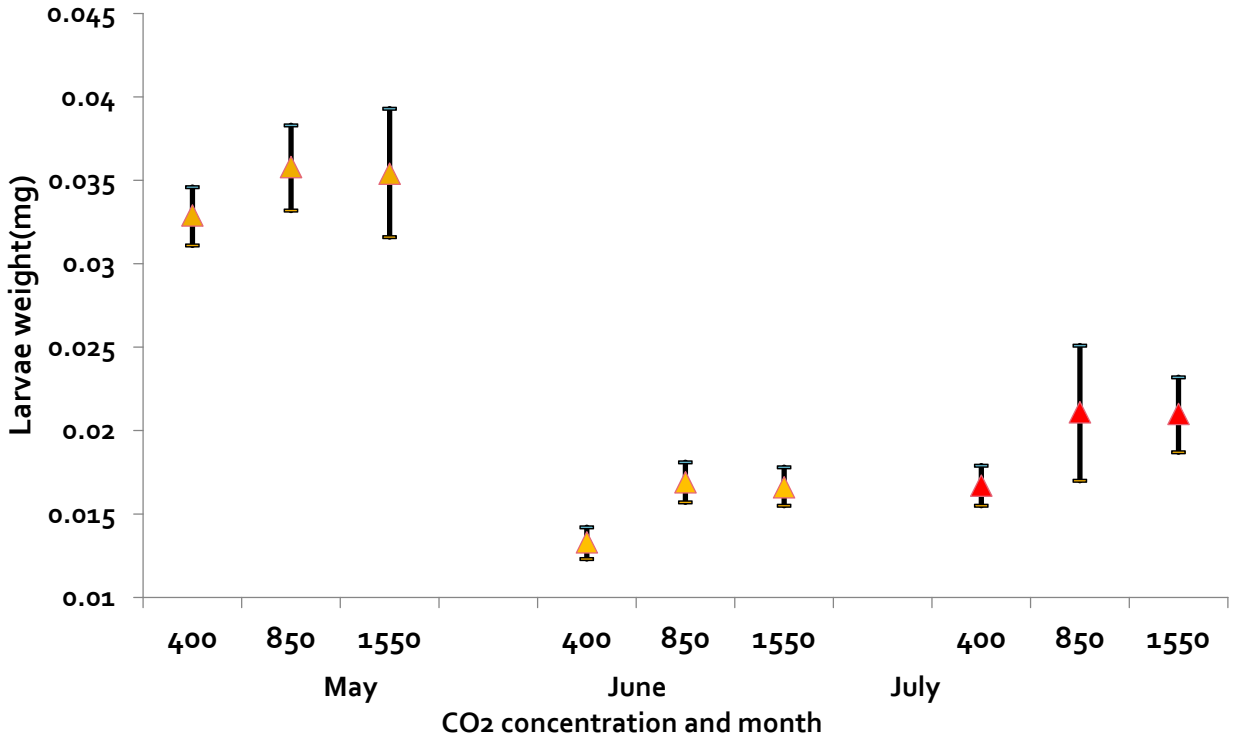
- Growth rate was significantly increased with increasing CO_2 concentration.

(ANCOVA : F=2.10, df=1, 14, *P*<0.05)

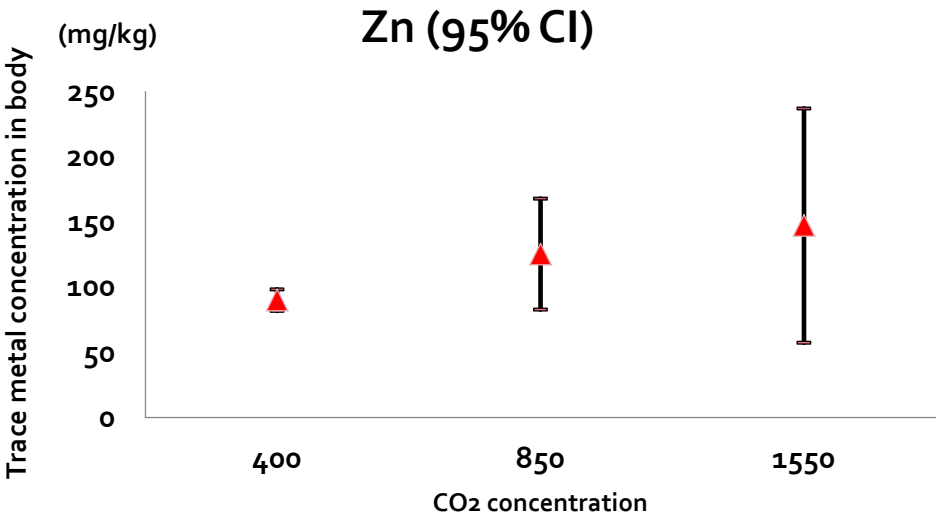


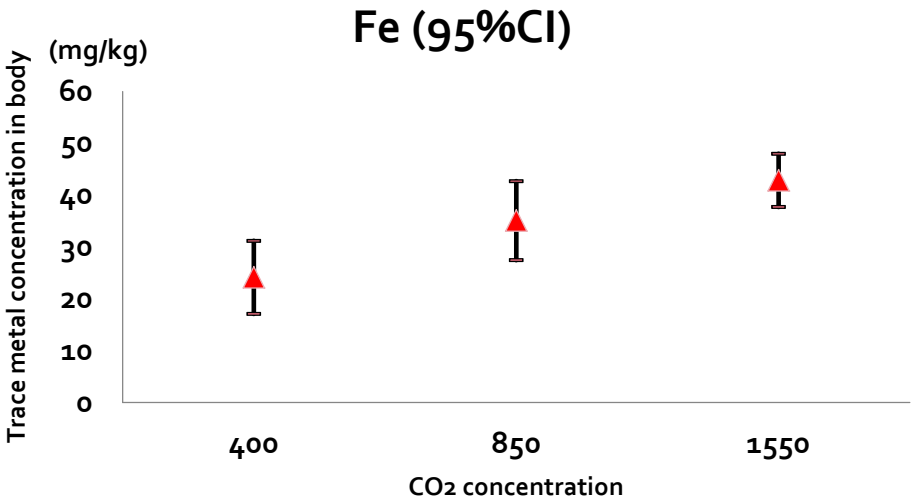
Results- Body weight

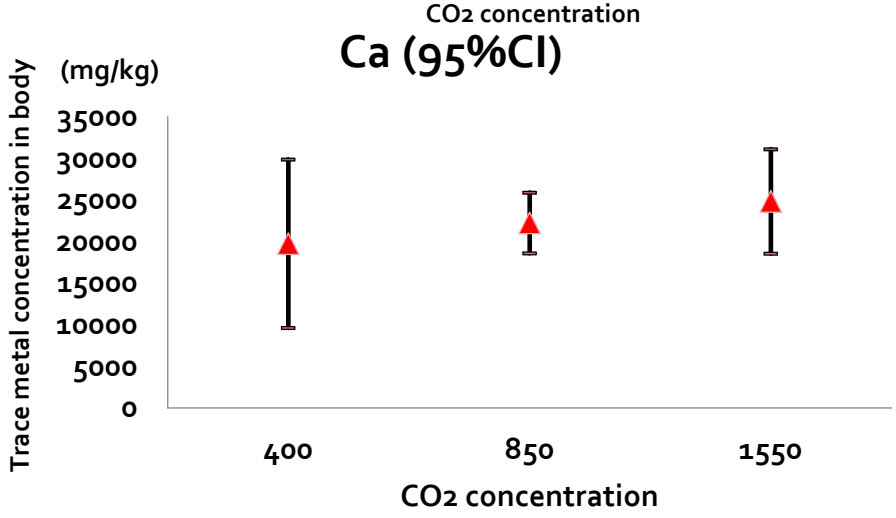
- The weight of olive flounder was to promote with the increasing concentration of carbon dioxide in seawater($p<0.05$, June and July).

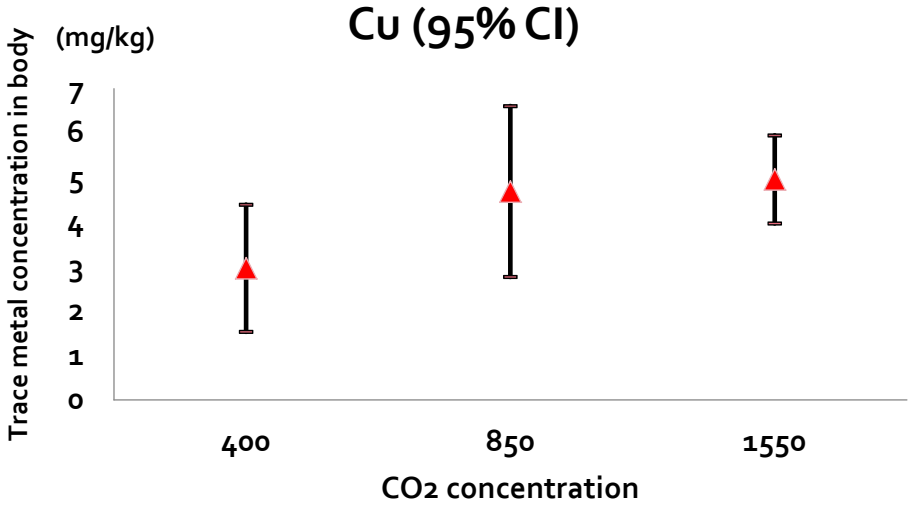


Results-Trace elements









Flounder in the body and rearing seawater trace elements concentration were different.

Results- Seawater chemical analysis

- *p*CO2 of each seawater were different.

CO_2(ppm)	pH	Temp.	TA	Sal.	pCO_2
400	8.05	22.0	2278.9	32.4	573.6
850	7.84	22.0	2275.4	32.4	987.9
1550	7.73	22.0	2267.4	32.4	1296.7

Difference concentration

Discussion

Discussion

- Our results share the similar conclusions from previous studies on otolith growth in fish larvae (Checkley *et al*., 2009), growth and calcification in the cephalopod under elevated seawater pCO_2(Gutowska *et al.,* 2008).

- To need the physiological study about the enhanced fish larvae growth.

Discussion

- Result of seawater analysis, pCO_2 was different between target pCO_2 and real pCO_2.
  ⇒ caused by gas exchange

- To maintain CO_2 concentration of seawater is important ⇒ to increase accuracy of experiment

Discussion

- Calcium and trace elements appeared the increased accumulation in the body depending on raising concentration of carbon dioxide.
  It seems that the marine organisms forced to adapt in order to survive.
- The resulting enrichment of Ca^{2+} in the gut fluid leads to the precipitation of calcium carbonates. The bicarbonate required for this process is secreted by the intestine, thereby leading to an acidification of the blood plasma(Cooper et al. 2010).

Future study

- To combine effects of pH and temperature

⇒ to observe synergetic effects

- To study about the effects of several marine organism by ocean acidification and global warming.

Thank you for your attention.