The combined effects of elevated carbon dioxide concentration and temperature on the early development stage of olive flounder *Paralichthys olivaceus*

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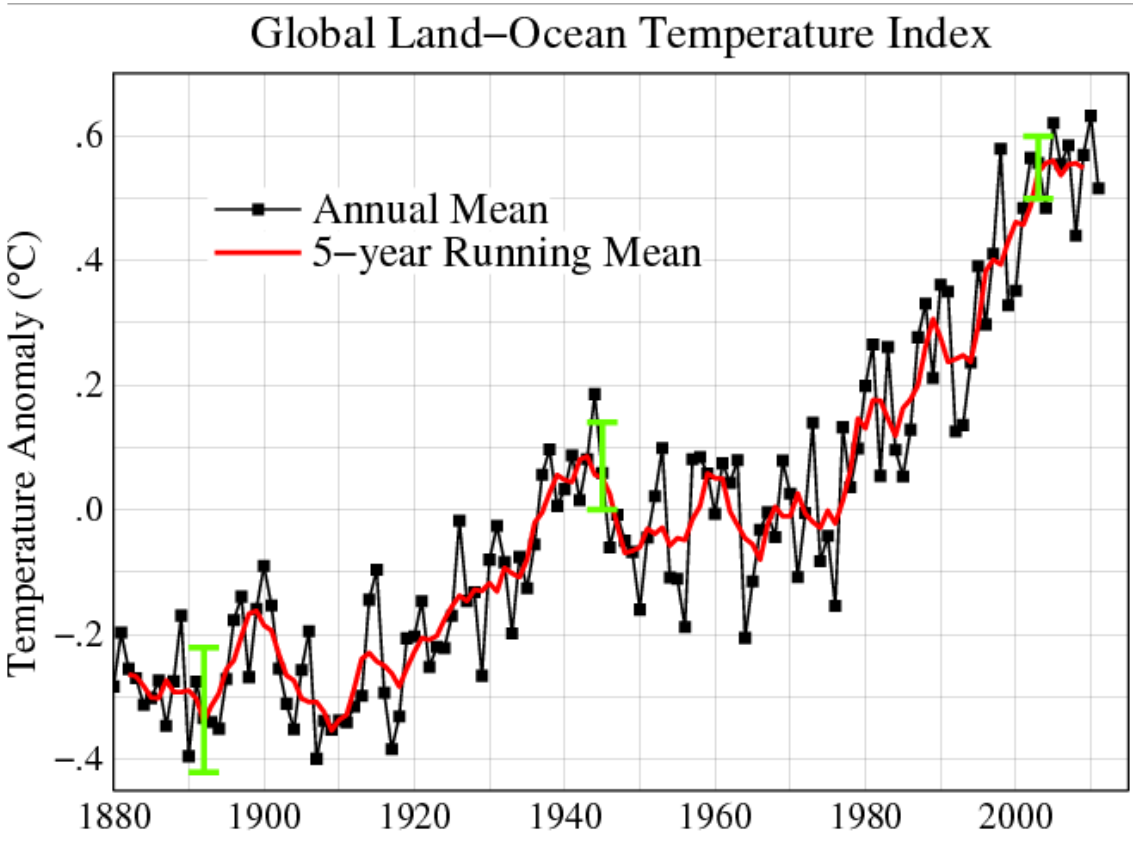
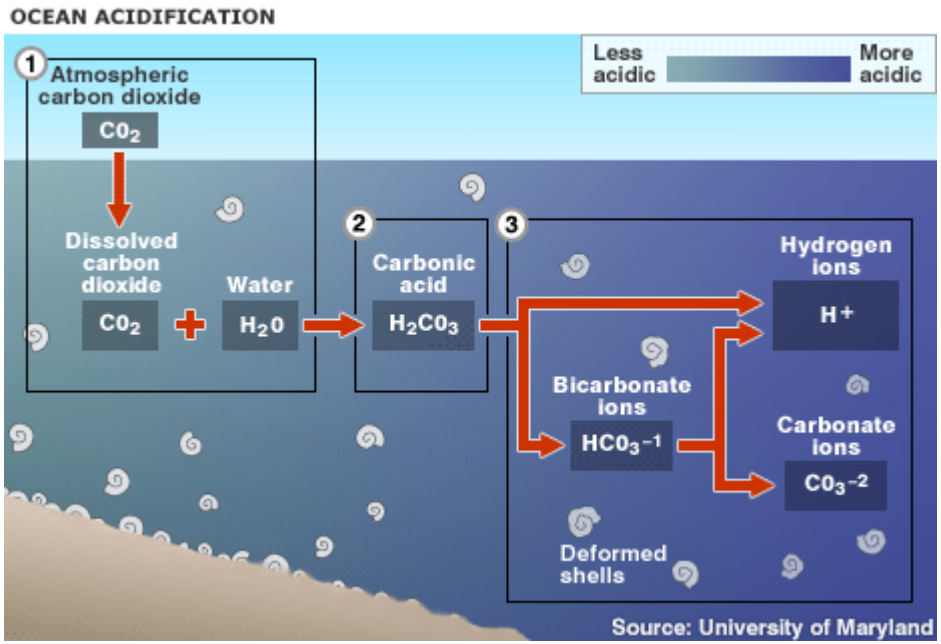
Global warming



Ocean acidification



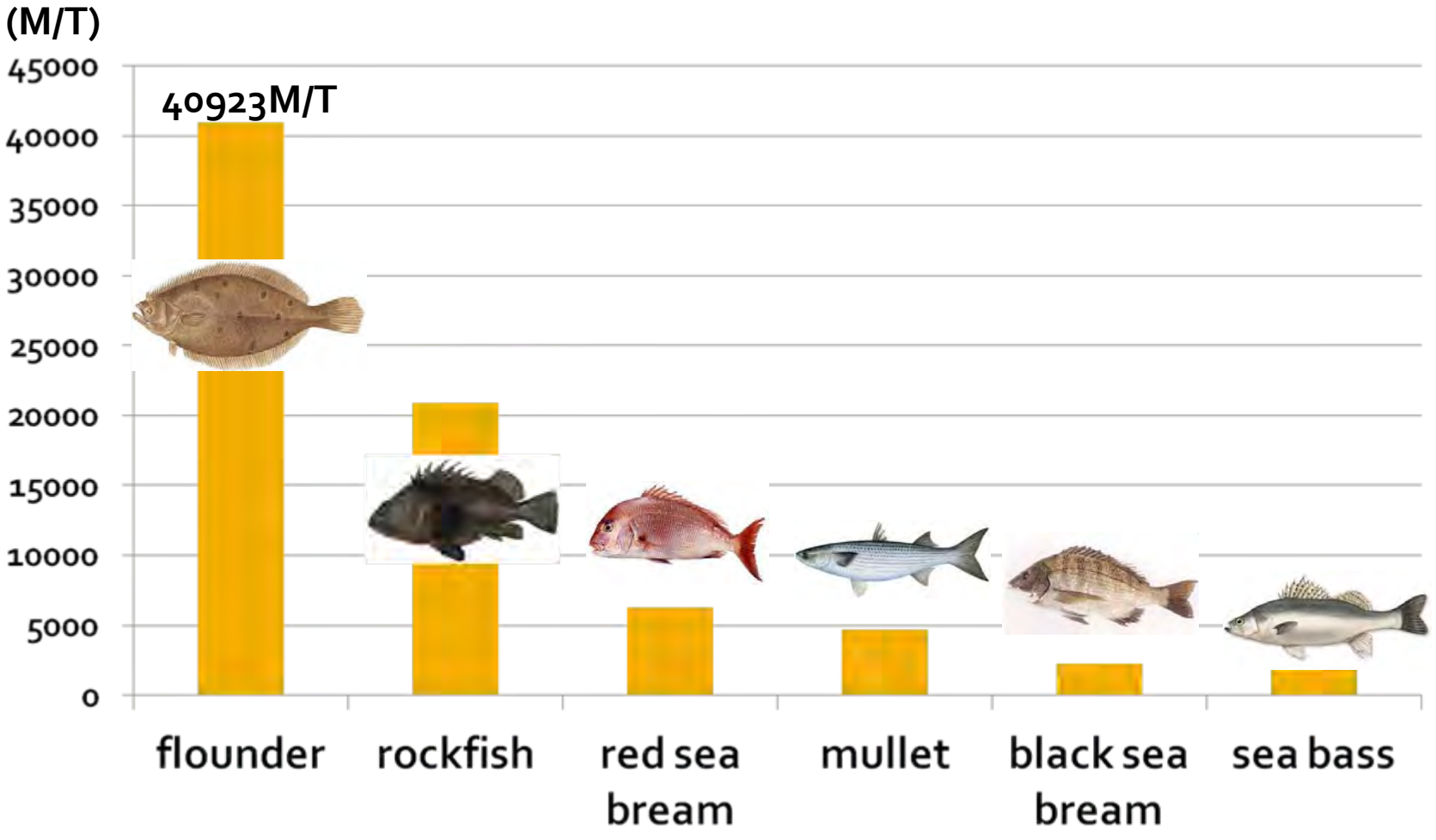
Olive flounder

- Important commercial species in Korea
  (main aquaculture species)

- their growth and survival during the early life history will response to a new environment : seawater warming and ocean acidification

Olive flounder

Aquaculture production of commercial species in 2010

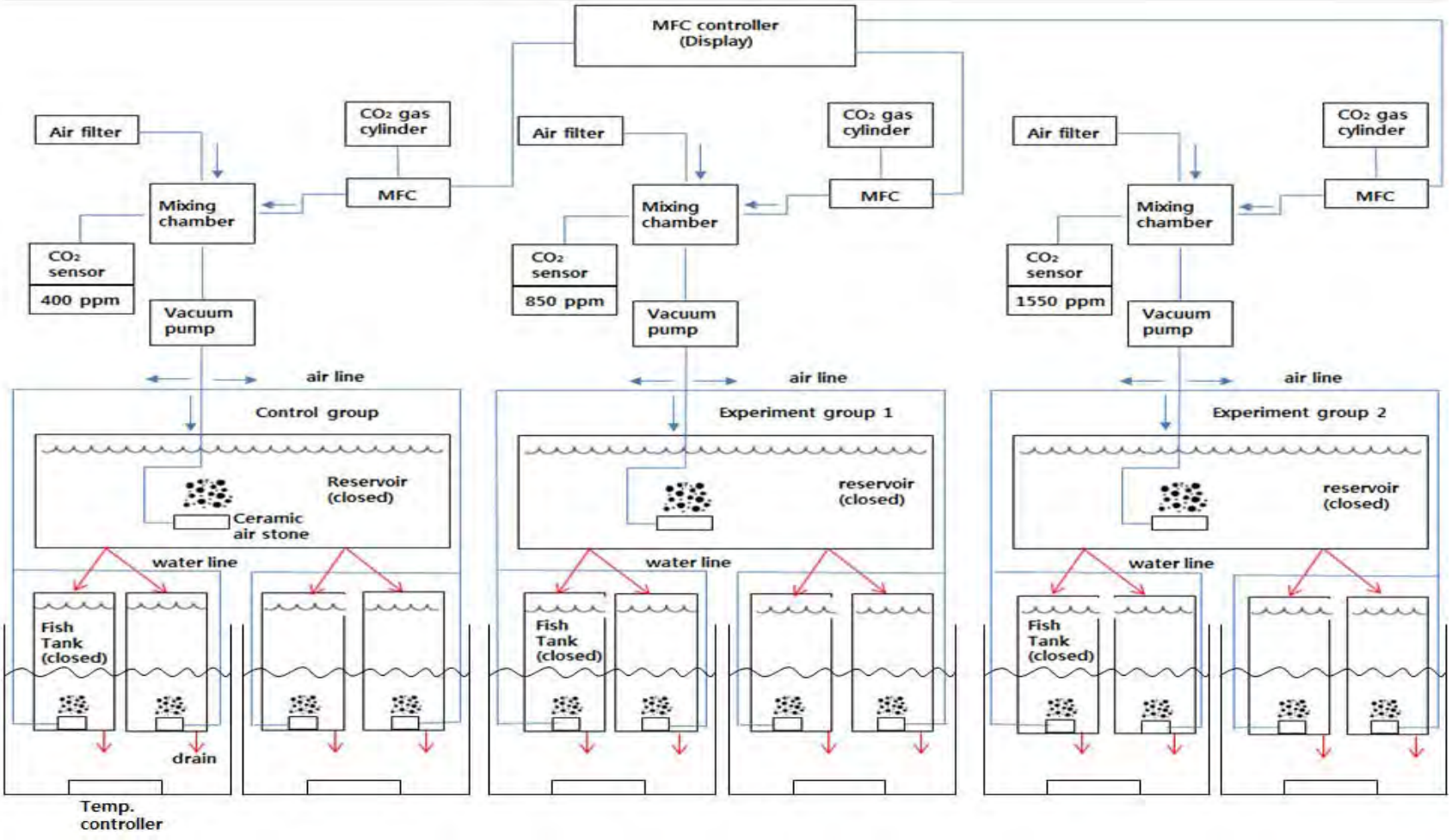


Purpose of this study

To evaluate the combined effects of ocean acidification and global warming on early development stage of olive flounder.

Experimental setting

- Artificial condition



Experimental setting

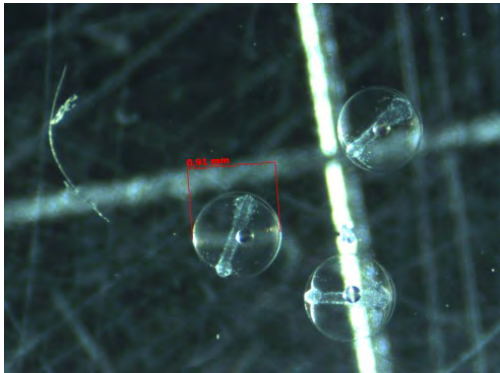
- 3 different CO_2 concentrations
  -400 ppm-current day
  - 850 ppm-mild emission (2100)
  - 1550 ppm-strong emission (2100)

- 2 different temperatures
  -18℃-mean temp. of southern coast area in Korea
  -22℃-forecast temp. of southern coast area in Korea at 2100(KORDI, 2004)

Rearing and feeding

- Rearing : from fertilized eggs to metamorphosis (approximately 28 days)

- Feeding : from hatching to 14 days : fed rotifer & chlorella
  - 14 ~ 21 days : rotifer and artemia
  - 21 ~ 28 days : artemia only



Sampling and measurement

- Sampling : 10 ind/tank every 3~5days (measuring length)
- At 28th day : All live fishes were preserved in alcohol after measuring length and weight
- Otolith length measurement (sample length range: 10.5~11mm 5 ind./tank)

Chemical examination

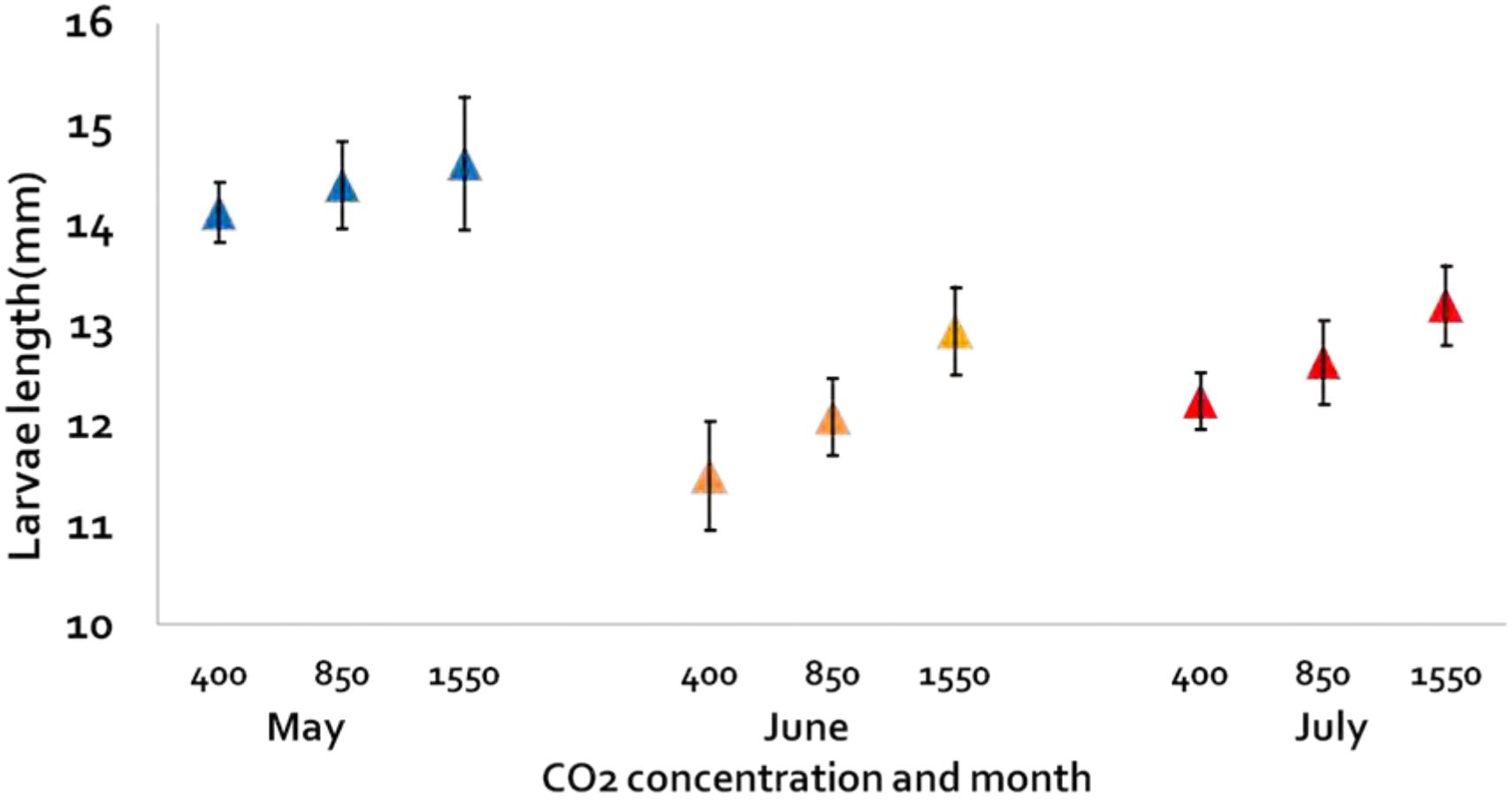
- Fish samples : using ICP(chemical elements concentration of body tissue) and SEM(skeleton structure of vertebrae)

Statistic analysis

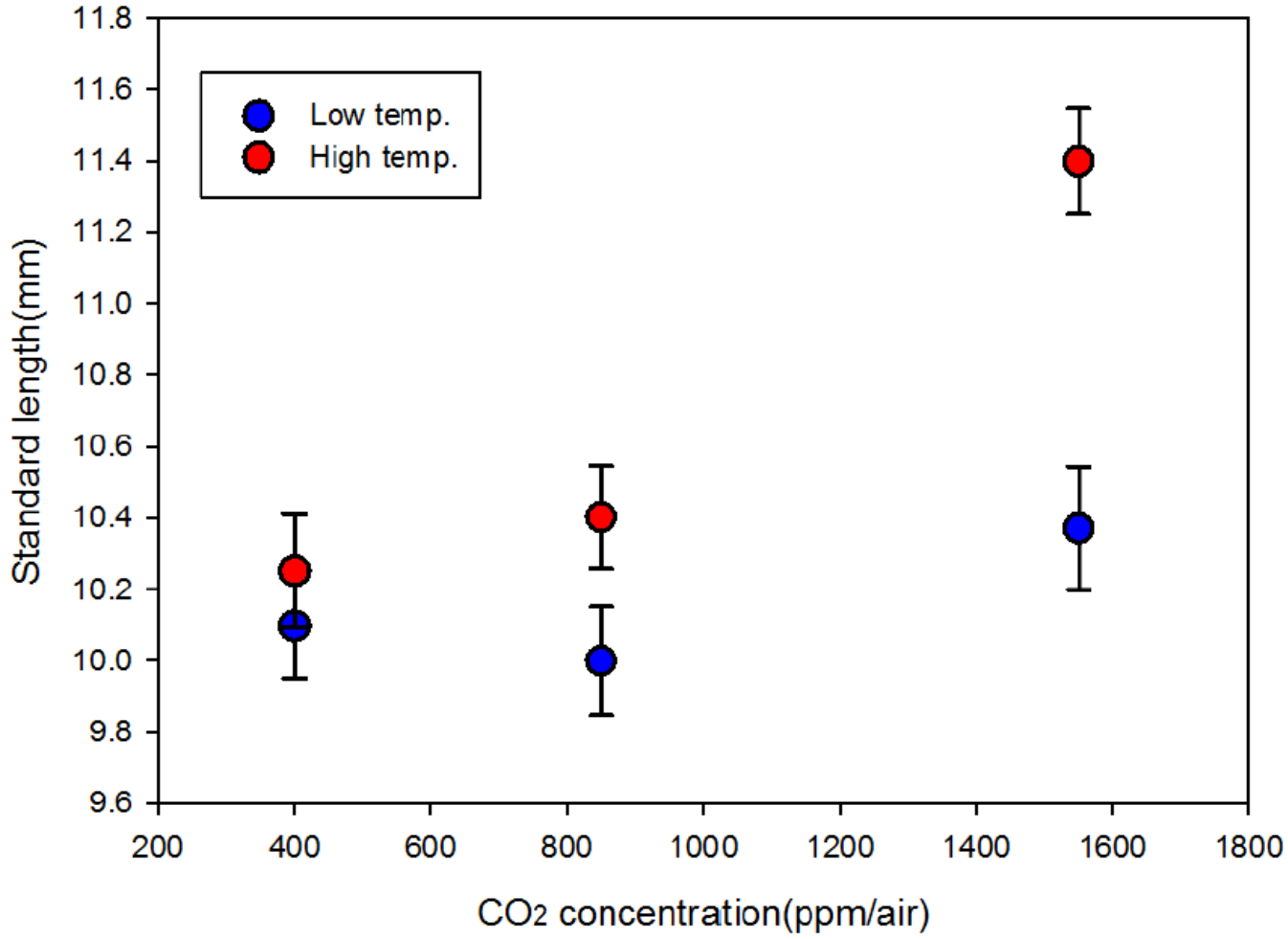
- all sample date – test of normality.

- One way ANOVA and Two way ANOVA. (Tool : minitab 16)

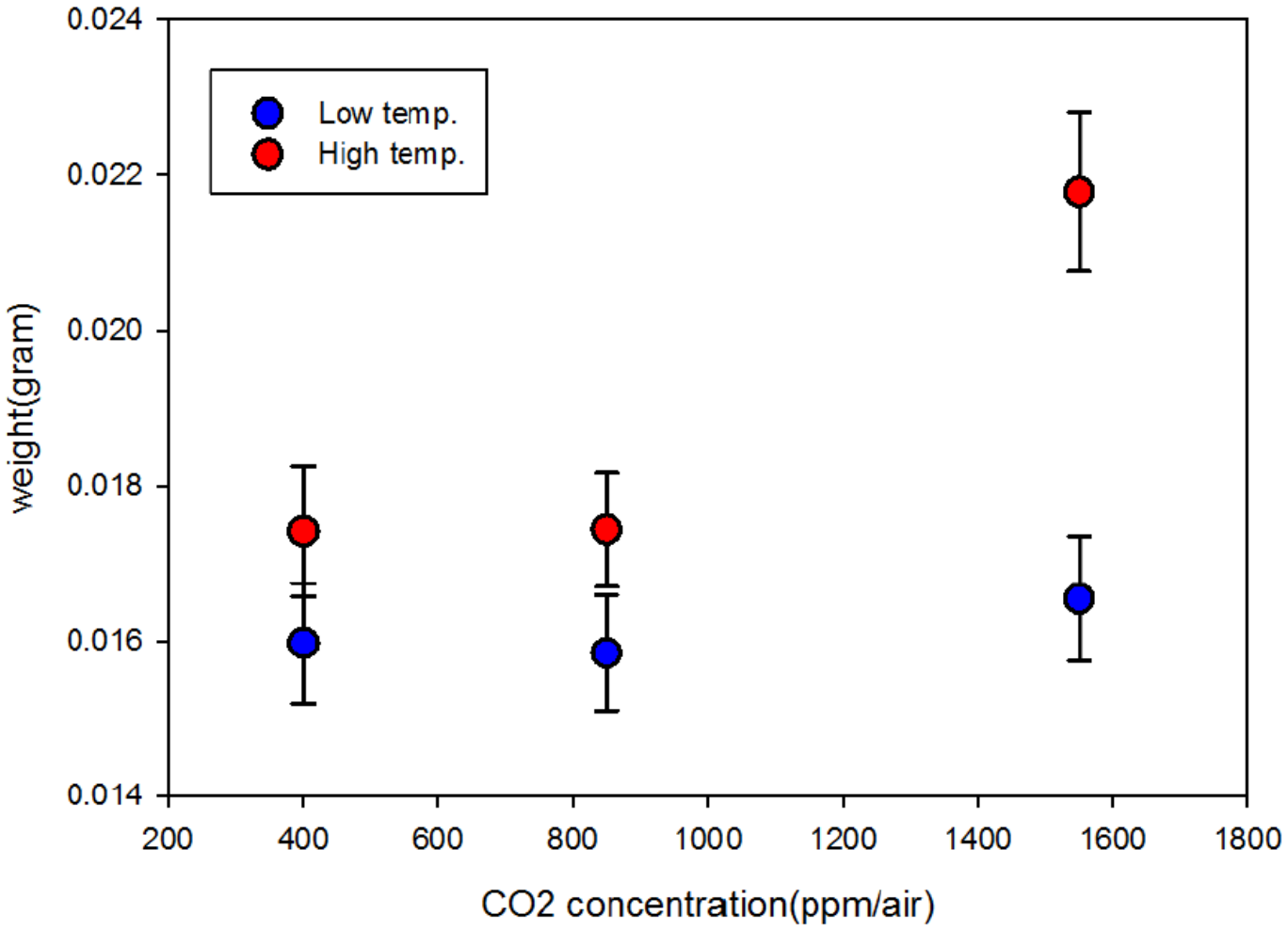
Result of previous study-length



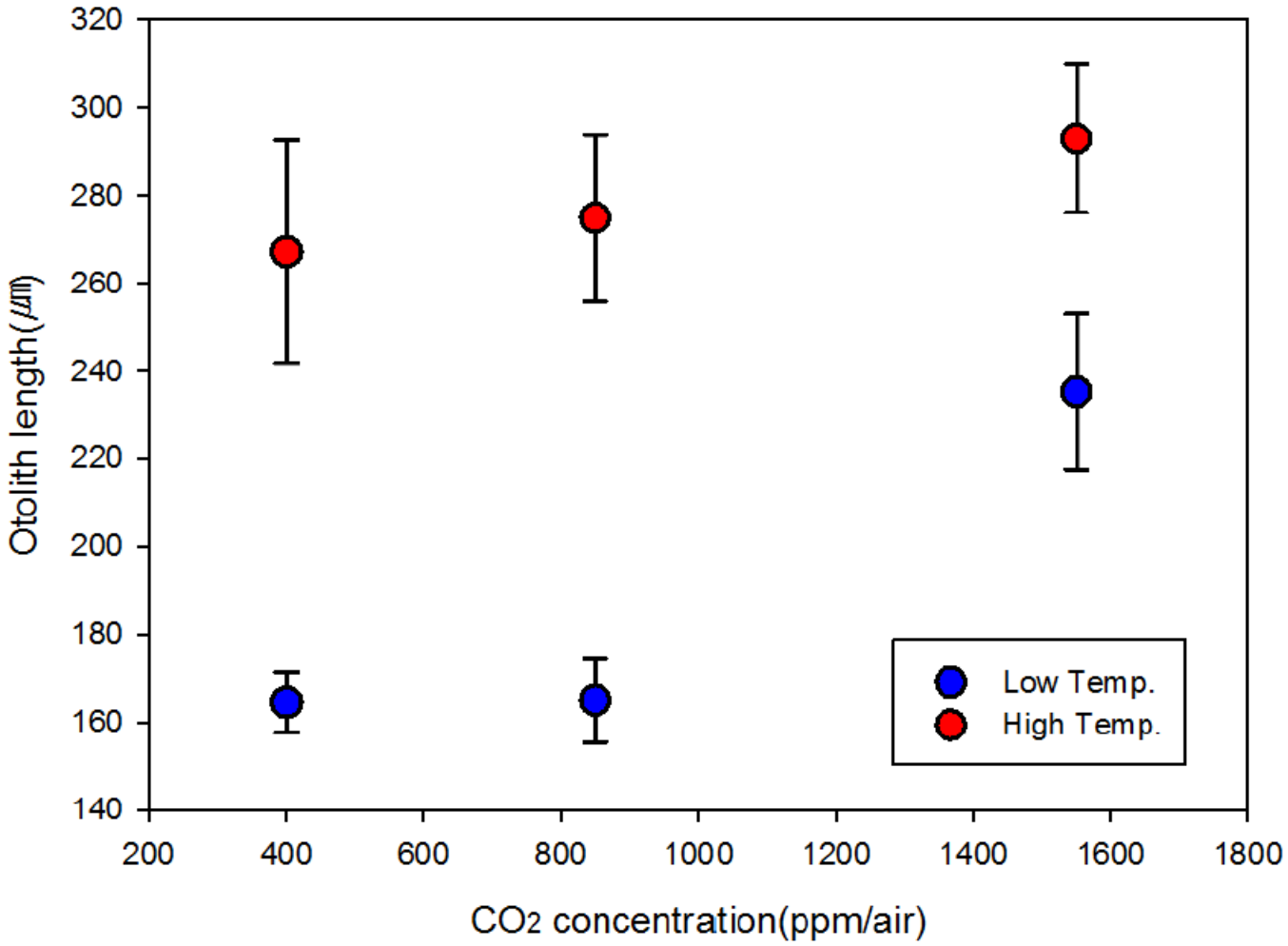
Results - length



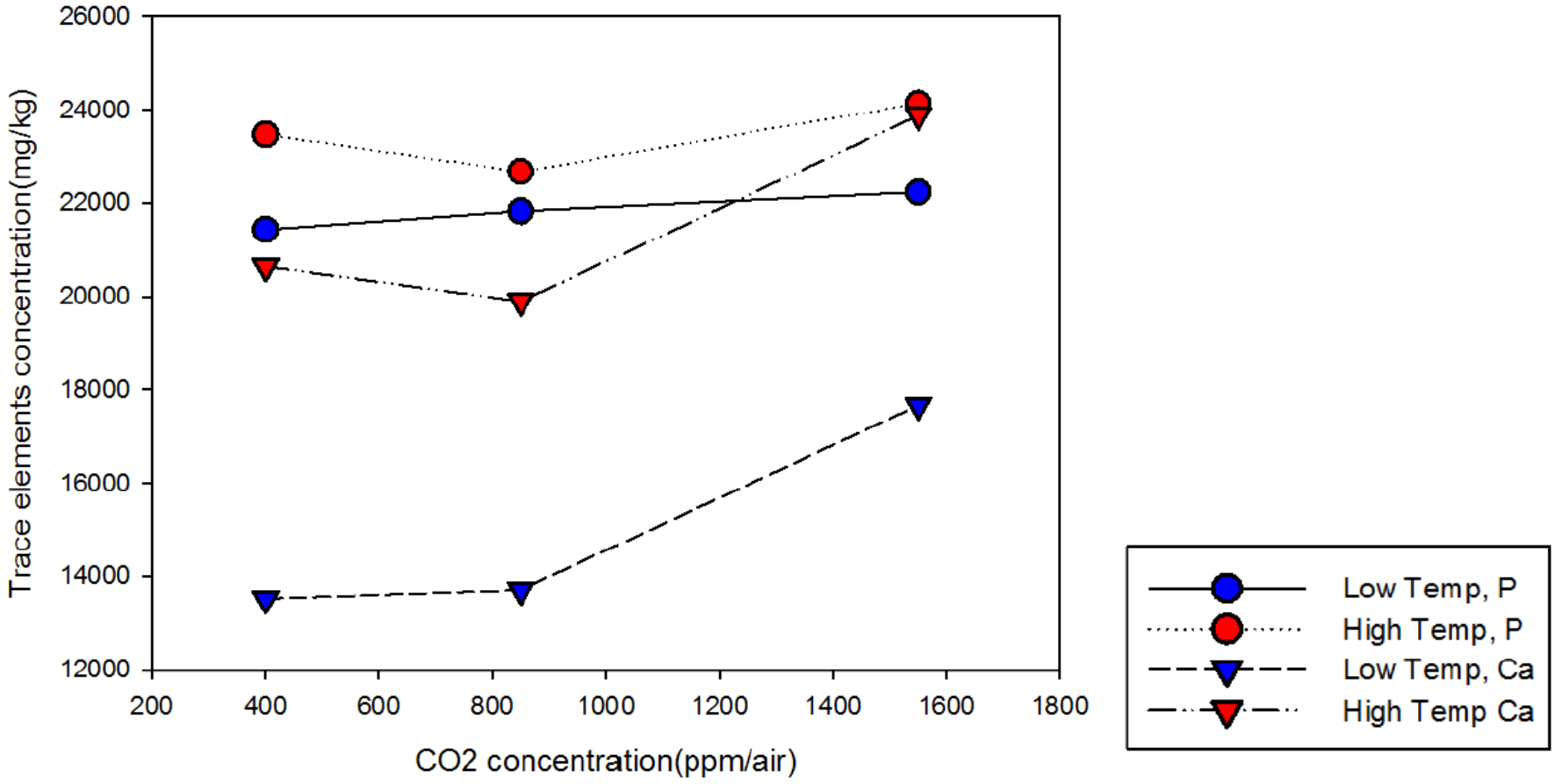
Results - weight



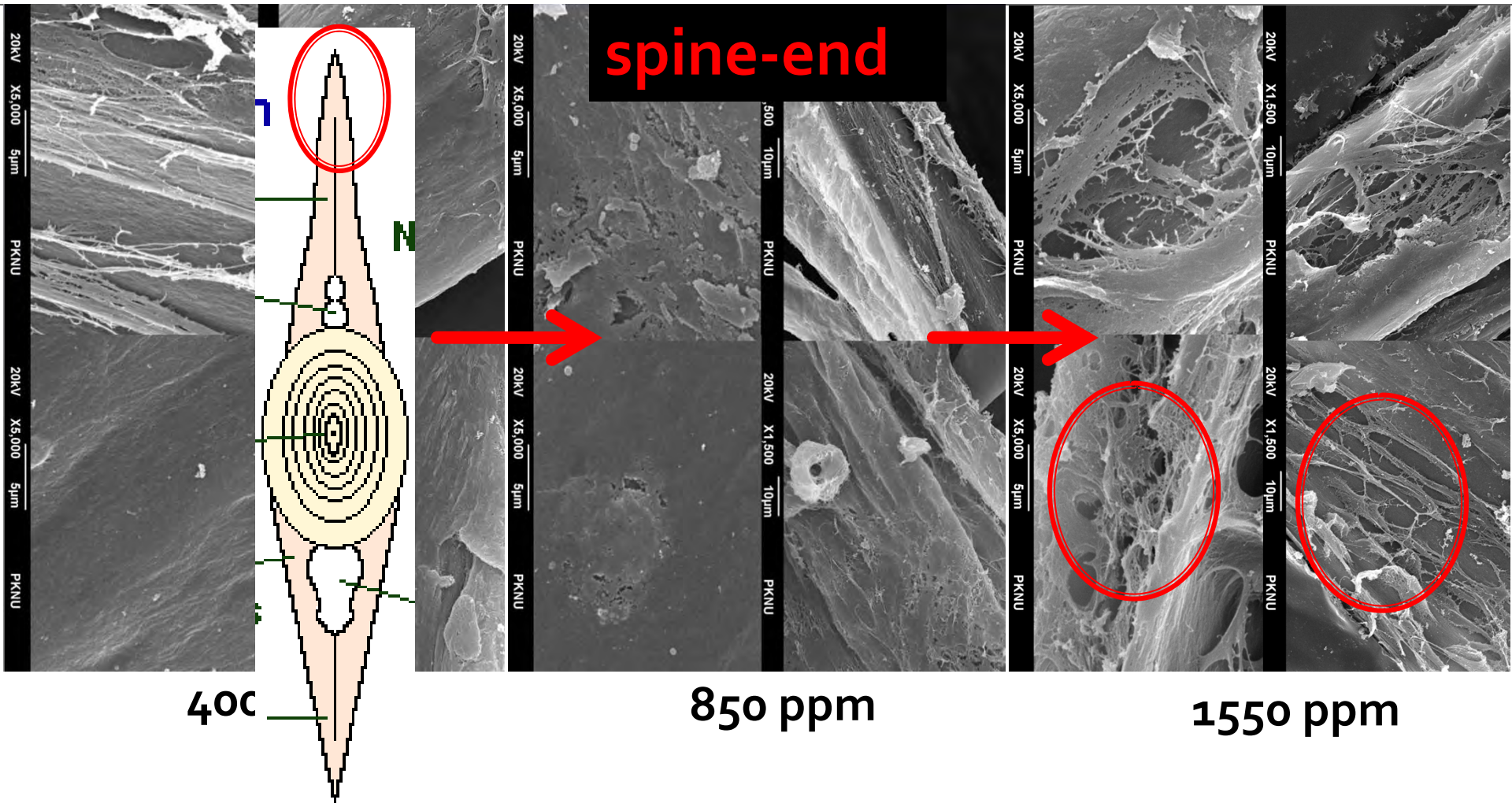
Results – otolith length



Results – chemical elements(Ca, P)

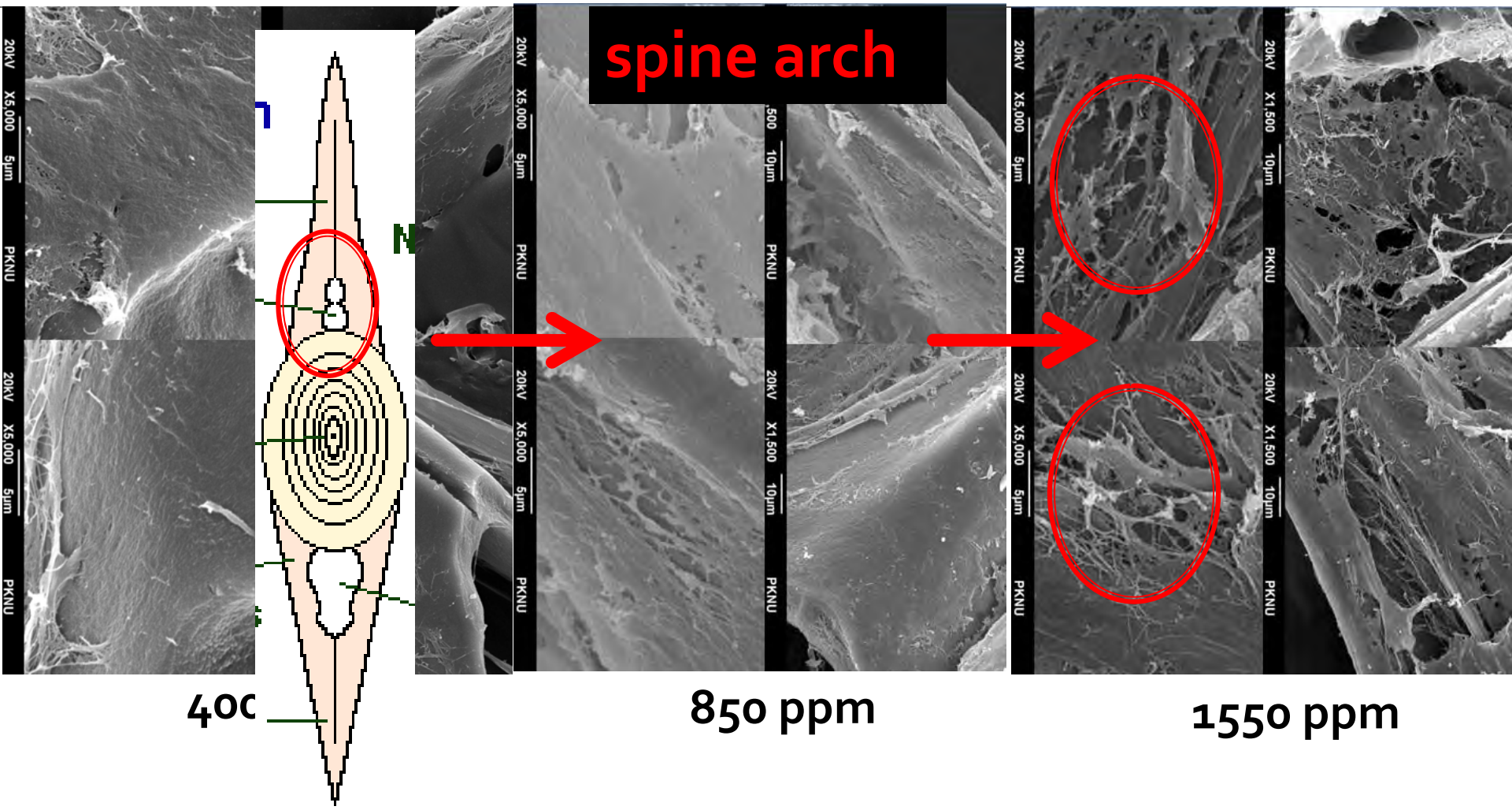


Results – SEM photography



Decreasing density by increasing CO_2

Results – SEM photography



Decreasing density by increasing CO_2

Discussion

- The results of our experiment agree with

  - Morgan et al. (2001) and Munday et al. (2009) in that length and weight of larvae increased by promoted appetite and feeding activity in acidified water.

  - Martens *et al.* (2005) in that skeleton formation was triggerd off and bone mineral contents were significantly enhanced by increasing CO_2.

  - Checkley et al. (2009) in that otolith size was increased in increased CO_2 concentration.

Discussion

- However, our results disagree with
  - Andrea et al. (2012) in that severe tissue damage in Atlantic cod larvae showed under increasing ocean acidification.

  - Hannes et al. (2012) in that reduced early life growth and survival in a fish showed in increased carbon dioxide.

Summary

- We examined the difference in larval growth of olive flounder reared under different CO_2 concentration and temperature.
- Larval growth seems to be similar for both 400 and 850 ppm CO_2 in seawater temperature range of 18~22℃
- However, growth was enhanced in 1550 ppm CO_2 in both temperature.

Summary

- Also, calcium component in larval bone was significantly increased in 1550 ppm CO_2 water, while potassium concentration weak increased in 1550 ppm CO_2.

- SEM photos showed visible difference among experiment groups.

Thank you for your attention.