First report on the annual gametogenesis of high-latitude corals *Alveopora japonica* (Eguchi, 1968) and *Oulastrea crispata* (Lamarck, 1816) on Jeju Island, Korea

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Introduction & Objective

- Global warming -> SST (Surface Sea temperature) has been increased
  - 0.41°C for the past 30yrs / 1.29°C increase since 1968 in Korea

- Several coral species have migrated towards higher-latitude (Yamano et al. 2011)

- Increased **subtropical species** in marine ecosystem of Jeju Island

< Seaweed based >

< Coral based >

- In this study, **annual reproductive cycle and reproductive strategy of two Scleractinian corals, Alveopora japonica and Oulastrea crispata, were analyzed**
Introduction & Objective

- In shallow rocky foreshores, usually nested among algae and soft corals
- Hemispherical shape, small and less than 40 mm in diameter
- A hermaphroditic brooding coral with oocytes and spermaryes developing on separate mesenteries of the polyp (Harii et al., 2001)

**Alveopora japonica**

- Kingdom: Animalia
- Phylum: Cnidaria
- Class: Anthozoa
- Order: Scleractinia
- Family: Acroporidae
- Genus: *Alveopora*
In murky water and at low tide, colonies size about 10-15cm

A hermaphroditic coral with oocytes and spermaries developing on same mesenteries of the polyp (Lam, 2000)

A broadcast spawner and planula brooder (Lam, 2000)
Material and method

- Sampling period: January ~ December in 2015
- Location: North (Geumneung) and South (Bomok), 5-10m depth
- Target species: *Alveopora japonica* & *Oulastrea crispata*
- Sampling frequency: Over than 5 colonies for each specie Monthly
Material and method

- **Standard Histological work for coral research**

  - **Sample collection**
    - Directly fixation with 10% formalin solution
  - **Decalcification**
    - 10% HCl, 20% citric acid with 50% formic acid solution
  - **Embedding paraffin blocks**
    - Tissue processor machine and then heated paraffin embedding machine
  - **Sectioning & Staining**
    - Tissue was Sectioned in 6~7µm and stained followed by H&E staining method
  - **Observation**
    - Identifying organisms of corals and sexual gonads, image analysis
Material and method

- Image analysis by “Image J”

1. Maximum diameter, (um)
2. Perpendicular diameter, (um)
3. Surface area (um²)
Material and method

- **Planulae observation**

  - **Light**
  - **Water tank**
  - **Collecting larvae (with 200µm mesh)**
  - **2% glutaraldehyde**
  - **50, 70, 90, 95, 100% Ethanol for dehydration**
  - **30, 50, 70, 100% Isoamyl acetate for substitution**
  - **Vacuum dry, coating**

  - **ZEISS Supra 55VP, Korea Basic Science Institute**

- **<Flow-out aquarium>**
- **<SEM picture process>**
**Result** (SST of sampling sites)

- SST (Surface Sea Temperature): 13 ~ 25.02°C
- North: 24.01 °C
- South: 25.02 °C

- SST(Surface Sea Temperature): 13 ~ 25.02°C
Result \textit{(A. japonica \& O. crispata} Oogenesis\textit{)}

\textbf{Alveopora japonica}\hfill\textbf{Oulastrea crispata}

- (A) \textbf{Stage 1} (Empty stage) in mesoglea (Scale bar=50µm). (B) \textbf{Stage 2}, early development of oocyte (Scale bar=50µm). (C) \textbf{Stage 3}, developing oocyte (Scale bar=100µm). (D) \textbf{Stage 4}, mature oocyte (Scale bar=100µm).

- (E) \textbf{Stage 1} (Empty stage) in mesoglea in January (Scale bar=50µm). (F) \textbf{Stage 2}, early development of oocyte (Scale bar=50µm). (G) \textbf{Stage 3}, late development of oocyte (Scale bar=50µm). (H) \textbf{Stage 4}, Mature oocyte (Scale bar=100µm). \textit{N}: nucleus, \textit{O}: oocyte.
Result (A. japonica & O. crispata Spermatogenesis)

- **Stage 1** (Empty stage) (Scale bar=100µm)
- **Stage 2**, Primordial spermary (Scale bar=50µm)
- **Stage 3**, Developing spermary (Scale bar=50µm)
- **Stage 4**, Mature spermary (Scale bar=50µm)

- **Stage 1** in mesoglea (Scale bar=100µm)
- **Stage 2**, Primordial spermary (Scale bar=100µm)
- **Stage 3**, Developing spermary (Scale bar=50µm)
- **Stage 4**, Mature spermary (Scale bar=200µm)

mf: mesenterial filament, S: spermary
**Result**

- Frequency of reproductive stages of *A. japonica* from North, (A) Oocyte, (B) Spermary
Frequency of reproductive stages of *A. japonica* from South, (A) Oocyte, (B) Spermary
Frequency of reproductive stages of *O. crispata* from South, (A) Oocyte, (B) Spermary
Result (North, GMD & SA of A. japonica)

Spawning period

GMD (um)

Surface area (um^2)

Spawning period
Result (South, GMD & SA of *A. japonica*)

- **Surface area (um^2)**
- **GMD (um)**

**Spawning period**
Result (South, GMD & SA of *O. crispata*)

- **GMD (um)**
- **Surface area (um^2)**

*Spawning period*
### Result

- **Planulae of *A. japonica* (South)**

  - From July and Aug *A. japonica* samples
  - Size: About 600~700µm for each
  - Ability to mobile (Swimming)
  - *Symbiodininiums* which facilitate photosynthesis were found at endotherm

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**<A>,<B>** Pictures by digital optical microscope, (Scale bar= 100µm, 200µm),

**<C>,<D>** SEM picture of Planulae, (Scale bar= 20µm, 10µm)
Summary

- Slightly difference in maturation period between *A. japonica* from North and South

- **<In the North>** Oocytes: March ~ August
  Spermaries: May ~ July

- **<In the South>** Oocytes: April ~ August
  Spermaries: May ~ August, September

- Planulae of *A. japonica* were collected from July to August (at South site)
- The average size - 600µm, possessed motility

- **<For O. crispata>** Oocytes: May ~ September
  Spermaries: May ~ October
A. japonica and O. crispata are a hermaphroditic brooding coral with oocytes and spermares developing on separate mesenteries of the polyps.

Seasonal patterns of gametogenesis were shown from those species.

Gonial mitosis occurring in late January.

The major spawning of those two species appeared to followed a period of rising the water temperature in September in Jeju Island.

More research on physiology and ecology of those species are required in various area.

Long-term environmental monitoring is also necessary to prepare for climate changes.
Thank you
ありがとうございます。
谢谢您。
Merci.
شكرًا
Благодарю вас
La ringrazio!
감사합니다

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