Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

BBG021-08 Room:301A Time:May 26 16:30-16:45

Establishment and breakdown of symbiosis between corals and zooxanthellae

Kazuhiko Koike[1*], Hiroshi Yamashita[1]

[1]Graduate School of Biosphere Science

Enormous numbers of symbiotic dinoflagellates (zooxanthella or genus Symbiodinium) are engaged in scleractinian corals in tropical seas. They are seemingly mutualistic; Corals rely on the organic materials from the symbionts, and the symbionts do on the inorganic nutrients and carbonates from the corals. This close relationship has been passed down unbroken from Triassic and been firmly grounded on their evolutions. However, they might be rather independent.

Coral harbors symbiont intracellularly. Most of the coral species acquire symbionts not maternally but from environments. In this case, they must at least select the symbionts from other suspending particles in seawater, and keep them in their cells. How? Lively discussions have been done on this topic so far, and as yet not been brought to a conclusion. We consider this event is involved in some chemical recognition by a lectin, a carbohydrate-recognizing protein. Lectins from corals bind to the free-swimming zooxanthellae, and other non-symbiotic microalgae, but then, reverse reactions occurred; soon the zooxanthella deformed into spherical form and lost mobility as it were arrested, but still maintained active growth. On the other hand, non-symbiotic algae bust or aggregated and non-growthable anymore. Recently, Dr. M. Jimbo, Kitasato University, found that artificially removal of surface carbohydrate structure on the zooxanthella significantly retarded the establishment of symbiosis with corals. In this connection we may add that zooxanthellae in free-swimming form possess flagella and a well-developed eye-spot. But after symbiosis with animals, they lose these organella. Of course they may not need foot and eye in animals, that would be, but it seems host-directed mechanisms might control the failure of these formations in the symbionts, and if it is, this should be another arresting mechanism by corals.

Another particular interest to the symbiont acquisition by corals would be a presence of the symbiont-sources in the environment. According to our previous analysis by using quantitative PCR, at maximum several hundred thousand cells were existing in 1 L of seawater at a coral reef. Subsequent analyzes of environmental DNA clones and culture strains isolated from ambient waters or sands revealed; zooxanthellae never engaging to the animal-bearing lineage were in the environment, and contrarily those exactly much to the subsidiary engagement to animals were also. We still do not know the symbiotic implication of the former group (it should be very interesting when considering the symbiont evolution), but can suspect the latter group might be derived from ambient corals. Then, these biomass can be interpreted as both sink from corals and source to corals.

Next we performed an experiment to know whether corals actually release symbionts to the water. Healthy corals in an aquarium indeed discharged the symbionts at accurate periodicity. Corals in field also discharge them to a bottle attached to the branch. Based on the qPCR quantifications, ca. 6000 cells/h were released from just 1 cm2 surface of the coral, and interestingly, a certain type of genetic clade (clade C) was alternatively discharged ahead of another clade (clade D) which is recognized as thermally tough clade. This phenomenon might be interpreted as a survival strategy of corals suffering to rapid environmental changes, such as global warming.

Symbionts may thus be arrested by corals and eventually dismissed for corals' reason. Their relationship is mutualistic as a result, but corals are somehow selfish.

Keywords: Symbiodinium, coral, zzooxanthella