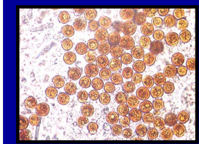
ZOOXANTHELLAE ULTRASTRUCTURE AFFECTED IN BLEACHED CORALS

Ophélie LADRIERE[1], Nicole DECLOUX[2], Philippe COMPERE[2] and Mathieu POULICEK[1]

[1] Laboratory of Animal Ecology and Ecotoxicology, Unit of Marine Ecology, [2] Laboratory of Evolutive and Functional Morphology, Unit of Ultrastructural Morphology, University of Liège, Bat. B6C, Allée du 6 août, 15, B-4000 Liège (Sart Tilman), BELGIUM

Introduction

www.earthdive.com



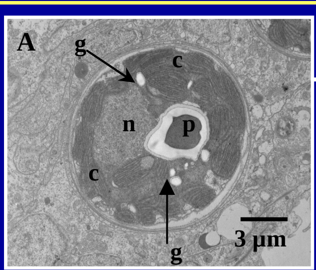
www.hawaii.edu

Most reef-building corals are **hermatypic** : they harbour endosymbiotic dinoflagellates, (**zooxanthellae**, unicellular algae), within gastroderm cells. **Bleaching**, loss of colour due to loss of these symbiotic algae and/or their photosynthetic pigments, on a large scale, appears to increase by intensity and geographic extent, certainly related to increasing sea temperatures. A lot of tools are still needed to study the mechanisms of this phenomenon.

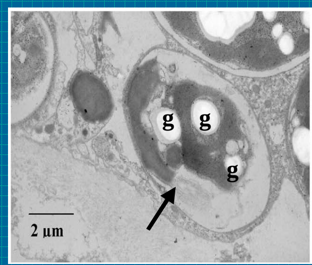
Materials & Methods

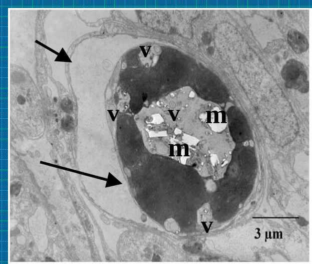
To observe what are **morphological changes appearing in zooxanthellae during bleaching**, we sampled three coral species from environment and one coral heat-shocked in experimental aquarium. For each species, healthy and bleached fragments were cut and fixed in 2.5% glutaraldehyde. Coral skeletons were dissolved in 0.2 M EDTA. Samples were further fixed in 2.5% glutaraldehyde solution and post-fixed in 1% OsO_4, before embedding in epoxy resin according to a routine procedure (ethanol/epoxypropane dehydratation). Ultra-thin sections (~70 nm thick) were performed with a diamond knife on an ultra-microtome, contrasted with uranyl acetate and lead citrate, and observed on a Jeol JEM 100-SX transmission electron microscope (TEM) at 80 kV of accelerating voltage.

Results & Discussion

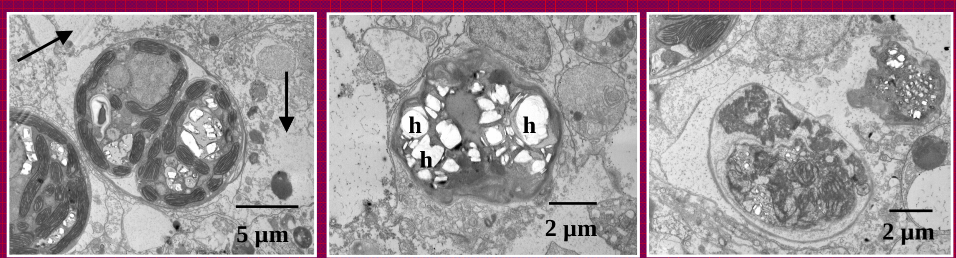


Zooxanthella of **healthy** coral. Well-structured and visible organelles: p, pyrenoid (chloroplast extension surrounded by a starch sheath), c, peripheric chloroplast, n, nucleus (with condensed chromosomes), g, reserve material globules.





Zooxanthellae of **naturally bleached** corals. Vacuolization (v), increasing space between membranes (arrows, down), more reserve globules (g), mineral crystals holes (m), rupture of organelles membranes or cell membrane (arrow, up). **-> accumulation of reserve material due to metabolic dysfunction or after signal preparing to expulsion; membranes disruption and disorganization show cell necrosis.**



Zooxanthellae of **experimentally bleached** coral. More zooxanthellae in division, vacuolization, increasing space between organelles, holes (h) left by mineral crystals (lost during cutting), rupture of organelles membranes and lysis, lysis of host cell (arrows). **->Alterations are more important** in these coral because a real **shock (acute thermal stress)** is applied in this case whereas a **gradual stress** appear in the **natural** environment. The **division of algae** (higher mitotic index) can be induced by the host to **compensate** the **loss** of algae due to bleaching (try to recovery) or, by the zooxanthellae, to induce their **expulsion** by increasing their density.

Conclusion

These observations show that zooxanthellae are **morphologically affected** by environmental stress that causes bleaching and that natural and experimental bleaching have **different effects** on symbionts. Indeed, **heat-shocked** corals seem **more heavily damaged** than in nature. Ultrastructure of bleaching effects is an interesting **complementary tool** for the study of the mechanisms of this phenomenon that affect more and more coral reefs and threat global marine biodiversity.