


【Grant-in-Aid for Transformative Research Areas (B) 】

Creation of holobiont molecular sciences by integrating biosphere and molecular informatics (holobiont molecular sciences)

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	Research Area Information	Number of Research Area : 23B206 Project Period (FY) : 2023-2025 Keywords : Holobiont, Molecule, Ecology, behavior of living, Informatics

Purpose and Background of the Research

●Outline of the Research

Primary metabolites like amino acids and lipids are essential for all living beings, whereas secondary metabolism is specific to certain species. These secondary metabolites, diverse in structure, can exhibit significant biological activity. An example is penicillin, a medicine derived from blue mold. Although the biosynthesis of these complex structures has been disclosed, the purpose and evolution of secondary metabolism remain enigmatic. Researchers have long pondered how organisms acquired and retained their biosynthetic capacities, involving specific genes and enzymes. Observing ecosystems, it's clear that chemical substances influence every living organism's behavior and physiology. As organisms evolved, they developed specific substances and receptors, modifying them over time, underlining chemicals' role in adaptive strategies. The lingering question is the actual behavior of these substances in ecological environments. To answer this, interdisciplinary efforts extending beyond material science are required.

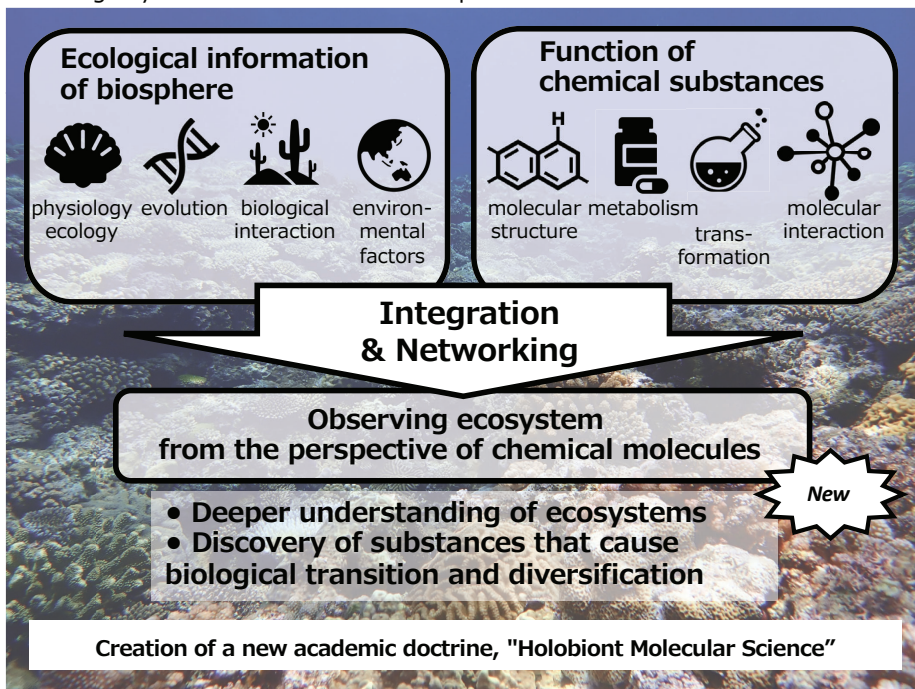


Figure 1. Outline of this research

This research group seeks to merge understandings of individual organism paradigms with the roles of compounds in ecosystems, aiming for a profound comprehension of biospheric phenomena and organism diversifications influenced by these chemical substances. We are going to focus on holobionts, capturing diverse life patterns and vital data on compound dynamics within them. By integrating and networking data from various ecological sources, we aim to devise a groundbreaking methodology that offers a holistic view of ecosystems through compound interconnections.

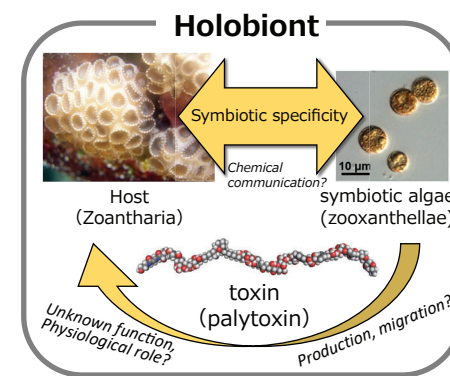


Figure 2. An example of a holobiont (corals and symbiotic algae)

Expected Research Achievements

Group A01 (Prof. James D. Reimer)

Environmental, ecological, and genetic observations of coral reef Symbiodiniaceae-host holobiont symbioses

1. What are the environmental, ecological, and genetic factors that lead to generation of azooxanthellate species from zooxanthellate species?
2. What are differences in gene expression between zooxanthellate and azooxanthellate species?
3. Can we predict how symbioses change the ecology, genetics, and chemistry of symbiotic and asymbiotic species? (with A02 and A03)
4. Can the genus Palythoa make a good model system for evaluating ecological and evolutionary implications of Symbiodiniaceae symbioses? (with A02 and A03)

Group A02 (Dr. Hiroshi Yamashita)

Elucidation of the role of chemical substances, which specifically works in symbiosis.

- Identifying the specific genes in holobiont environment by comparative genome analysis.
- Seeking the substances that contribute to symbiotic lifestyles.
- Establishment of an indoor assay system to evaluate the activity of the substances.

Group A03 (Dr. Yuta Tsunematsu)

Symbiotic entities' chemical diversity and elucidation of novel functionalities within ecosystems.

- Profiling the metabolome of holobiont
- Acquisition of a key molecule that regulates relationship of holobiont.
- Networking the information of chemical substances, metabolism and physiological function.

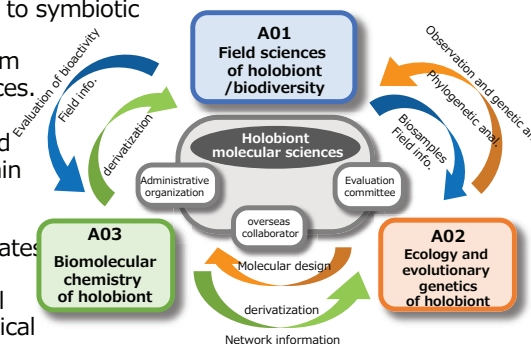


Figure 3. Collaboration structure of this study

Through the collaborative research, we foster a comprehensive understanding of the ongoing global degradation of coral reef ecosystems and pave the way for the establishment of next-generation environmental conservation.

Homepage Address, etc.

<https://sites.google.com/view/holobiont>
YT's HP: <https://sites.google.com/view/yutatsunematsu/>