Multilateral Evolutionary Transitions in Individuality (ETIs)

Talk with us: https://tcnj.zoom.us/j/93937611089?pwd=NWEwV2JGN3hBb1FBT1ZsSTdlaVNVQT09

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Research Topic

Evolutionary transitions in individuality (ETIs) occur when a group of individual units become integrated such that the level natural selection acts on shifts to the group as a single entity

- **Egalitarian transition:** Group is formed by distinct units that come together to form a new higher level organism[1]
- **Fraternal transition:** Group is formed by similar units that combine to form a new higher level organism[1]
- These two transitions are not mutually exclusive and can co-occur in some cases, creating the need to define a new category: **multilateral transitions**
- We applied a consolidated list of individuality criteria to two proposed multilateral transitions, *Ulva* and corals, to determine if they represent an ETI.

Individuality Criteria[2]

- ***Indivisibility***: An individual cannot be divided into smaller units that still maintain the properties of the whole
- ***High Cooperation, Low Conflict:*** Independent individuals form cooperative groups that have the potential to evolve into a higher-level individual.
- ***Division of Labor:*** Group members split fitness-related functions among each other.
- ***Discreteness:*** An individual acts as a single entity that is distinct from other individuals and its environment.
- ***Group-level Adaptations:*** Conspicuous outcomes of natural selection at the higher-level.
- ***Multilevel Selection 2 (MLS2):*** Selection acts at the group-level and the fitness of lower-level units and the group must both be accounted for

Ulva (Sea Lettuce)

- *Ulva mutabilis* (sea lettuce) has drawn particular interest as a model system for studying morphogenesis and evolutionary transitions (Fig. 1).
- Fraternal transition in *Ulva* is discussed in the context of its transition to multicellularity.
- Egalitarian transition refers to the symbiotic relationship that the bacteria and *Ulva* share: *U.mutabilis-Roseovarius-maribacter* tripartite community[3] (Fig. 2).

Scleractinia (Corals)

- Scleractinia is one of the most well studied orders of corals (Fig. 3).
- Its defining reef building property serves as a framework for polyps transitioning to colonies.
- Fraternal transitions in Scleractinia are the traits that are at the 'polyps to colonies' level.
- Egalitarian transitions are traits that are associated with the endosymbiotic dinoflagellates becoming integrated into corals (Fig. 3)

Conclusion

- Selection in *Ulva* seems to be working on both the cellular and multicellular level.
- The criteria were met for Scleractinia with a variety of examples.
- A higher-level entity emerges from integration of lower-level individuals; transitions in individuality is a spectrum.
- Next steps: Apply multilateral transitions ideas to the origin of life.

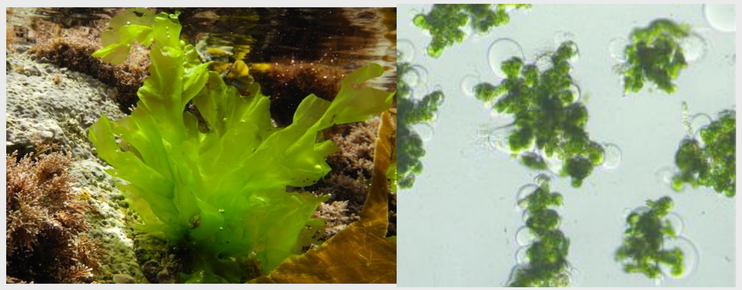

Figure 1. *U. mutabilis* in a marine environment in the midst of a diverse ecosystem[4] (left) and axenic culture of developing *Ulva*[5].

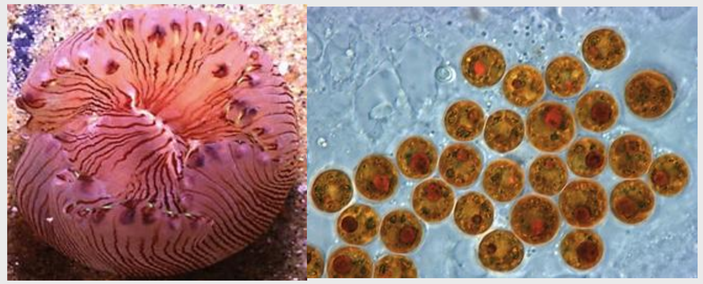

Figure 3. Photographs depicting Scleractinia[6] and microscopic dinoflagellates (*Symbiodinium*)[7].

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