

Summary

Taxonomic reinvestigation of marine macroalgal species with special reference to morphologically similar species complexes

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Marine macroscopic algae, normally called seaweeds, are photosynthetic organisms generally living in rocky coastal areas. They include the members of three distinct lineages, Ulvophyceae, Rhodophyta, and Phaeophyceae. Because of their morphological simplicity and plasticity, accurate identification at species rank is often difficult. As DNA sequence data emerged, the species-level taxonomy previously defined mainly by morphological data has been faced to revision. In particular, there have been many reports that a morphologically defined single species contains several genetic entities, suggesting that there is a lot of species diversity having been overlooked due to their morphological similarity.

This thesis reports three examples of taxonomic studies of macroalgal, morphologically similar species complexes found in Kanto region. These studies dealt with the morphologically defined species bearing high genetic diversity and probably including two or more species: *Ulva 'conglobata'* Kjellman (Ulvales, Ulvophyceae), *Chondrus 'verrucosus'* Mikami (Gigartinales, Rhodophyta), and the species of *Petalonia* Derbès et Solier (Ectocarpales, Phaeophyceae). These were detected by year-round floristic survey using DNA sequence data around Hayama, Kanagawa Prefecture, at first. Then, the three species complexes were further studied with additional sampling, by phylogenetic analysis, by morphological and ecological comparison, and by the investigation of the type specimen.

All the studies above showed that two or more genetically distinct and sympatric species existed within the species complex, and that the detected genetic species were subsequently identified by morphological and ecological characteristics. In addition, most of the newly detected species were either identified to the previously described species, or distinguished from them. As a result, the studies revised the species delineations and recognized three new species. Summaries for each of the three studies are as follows:

Chapter 1 dealt with the green algal specimens similar to *Ulva conglobata* (Ulvales, Ulvophyceae). The analyses of plastid *rbcL* and nuclear ITS sequences and the morphological observation indicated that *U. conglobata* included at least five species distantly related to each other: *U. fasciata* Delile, *U. pertusa* Kjellman, *U. tanneri* Hayden et Waaland, *Ulva* sp. 1, and *Ulva* sp. 2. Morphological observation of the authentic specimens of *U. conglobata* distinguished the species without denticulation, *U. pertusa*, *U. tanneri*, and *Ulva* sp. 2, from *U. conglobata*. *Ulva* sp. 2 showed secondary rhizoids as a unique and stable morphological character, and hence was described as *U. adhaerens* Matsumoto et Shimada sp. nov. During this study, the ORF-containing group II intron was found in *rbcL* of *U. adhaerens*. The amino acid sequence of the ORF was grouped with some of those of green plants in phylogenetic analysis, suggesting its vertical inheritance.

Chapter 2 reported *Chondrus 'verrucosus'* (Gigartinales, Rhodophyta). The analyses of plastid *rbcL* and nuclear EF2 sequences revealed that this species had included two genetically distinct sister species sympatric in some areas. They showed differences in the thallus size, in the cell shape around the carposporangia, and in the distributional pattern. The study of the type specimen and the samples from the type locality showed that one of the species corresponded to *C. verrucosus*, and hence the other was described as *C. retortus* Matsumoto et Shimada sp. nov.

Chapter 3 concerned with the *Petalonia* (Ectocarpales, Phaeophyceae) species in Kanto region. Only two species, *P. binghamiae* (J. Agardh) Vinogradova and *P. fascia* (O. F. Müller) Kuntze had been reported in this region. However, the analyses of plastid *rbcL* and nuclear ITS sequences resulted in three genetically distinct sister species sympatric at some coasts. These three species showed differences in medullary structure, thallus thickness, habitat, and seasonality. Mainly based on their medullary structures, the two of the three species were identified as the previously reported species. The remaining one did not correspond to the species reported so far, and was described as *P. tenuis* Matsumoto et Shimada sp. nov.