GÖTEBORGS UNIVERSITET

What Makes *Elysia viridis* Tick?
Fitness Consequences of Diet Selection and Kleptoplasty

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ABSTRACT
Understanding the mechanisms involved in resource use by an organism is pivotal to understanding its ecology. A conspecific population that as a whole demonstrates a generalist pattern of resource use may in fact consist of relatively specialized individuals. *Elysia viridis*, a sacoglossan opisthobranch mollusc, tends to demonstrate this type of sympatric variation in diet, although to differing extents depending on the ontogenetic stage. However, the mechanisms underlying this inter-individual variation are poorly understood. Utilizing the basic framework of optimal diet theory, this thesis investigated the prevalence of individual specialization and its effects on energy assimilation in *E. viridis* on different algal diets and the mechanisms that underpin or constrain diet selection. This was assessed through a combination of laboratory experiments addressing how *E. viridis*' original algal host affected algal diet choice, handling efficiency, growth, and the retention of functional chloroplasts (kleptoplasty) in the lab and relating conclusions from these experiments to observations of abundance and size of the sea slug in the study area.
Assessments of abundance and size distributions of *E. viridis* on different algal hosts demonstrated that the sea slug commonly colonized the co-occuring algal species *Codium fragile*, *Cladophora rupestris*, and *Cladophora sericea* in the field. Abundance was generally highest on *Cladophora* hosts compared to *C. fragile* hosts, and *C. rupestris* tended to accommodate larger individuals compared to the other hosts (**paper I**). In the lab *E. viridis* tended to select algal diets that had a similar morphology (filamentous septate vs. planar siphonaceous) to their original host, which related to increased handling efficiency through previous experience of feeding techniques required for different algal morphologies. This indicated that short-term diet selection was influenced by differences in feeding efficiency, suggesting *E. viridis* were specialised to feed on particular diets. However, diet selection did not correlate to the long-term fitness value of a diet, indicating that factors other than nutrition are important for host/diet selection in *E. viridis*. However, positive growth by *E. viridis* on all algal diets irrespective of their original algal host indicated that slugs were capable of effectively switching to non-host algae (**paper II**). Furthermore, *E. viridis* derived functional kleptoplasts from three different genera of algae (*Chaetomorpha*, *Codium*, and *Cladophora*), refuting claims that members of Cladophorales were unsuitable sources of functional kleptoplasts to *E. viridis* (**paper III**). However, kleptoplast functionality varied within the genus *Cladophora*. Finally we provided evidence that *E. viridis* receives a substantial fitness benefit under satiation by retaining functional kleptoplasts through increased growth efficiency via phototrophy (**paper IV**).
Overall this thesis contributes substantially to understanding the fitness trade-offs *E. viridis* faces through diet selection. Furthermore, it emphasizes that assessing energy assimilation in polyphagous sacoglossans requires not only an understanding of the fitness contributions of nutritional and morphological traits of different algal diets but also their role as a source of functional kleptoplasts to the slug. However, many conclusions reached in the lab did not concur with field patterns, indicating a need for further study on biotic (e.g. predation) and abiotic (e.g. wave force) pressures on *E. viridis* populations and assessment of the roles algal hosts play in circumventing these pressures.
Keywords: *Elysia viridis*, sacoglossan, herbivore, macroalgae, seaweed, optimal diet theory, individual specialisation, diet selection, kleptoplasty, phototrophy