On the art of stealing chloroplasts

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It is a common perception that animal cells do not have chloroplasts, the organelles responsible for photosynthesis. Yet, a small number of sea slugs from the order Sacoglossa are able to perform photosynthesis using chloroplasts sequestered from the macroalgae they feed upon, which are integrated in their cells (hence termed kleptoplasts). These photosynthetic sea slugs have been frequently termed 'crawling leaves' or 'solar-powered' sea slugs (Cruz et al. 2013). We have shown that photosynthesis plays an important role in sea slug survival and fitness over periods of food scarcity (Cartaxana et al. 2017) and that these animals possess photoprotective mechanisms that can mitigate oxidative stress resulting from the uptake of algal chloroplasts (Cruz et al. 2015, Cartaxana et al. 2019). Advanced lipidomic tools have allowed us to infer the relevance of lipids in long-term functional kleptoplasty (Rey et al. 2020), while state-of-the-art imaging techniques demonstrated translocation of photosynthates from kleptoplasts in the sea slug's digestive gland to other tissues in its body (Cruz et al. 2020). Recently, the European Research Council funded in 2.25 million euros the project KleptoSlug, developed to continue the studies on this remarkable association between a metazoan and an algal-derived organelle. This project will enable us to unravel the cellular mechanisms supporting the sequestration and maintenance of functional chloroplasts inside animal cells, as well as to comprehend the role(s) of photosynthesis in sea slugs.

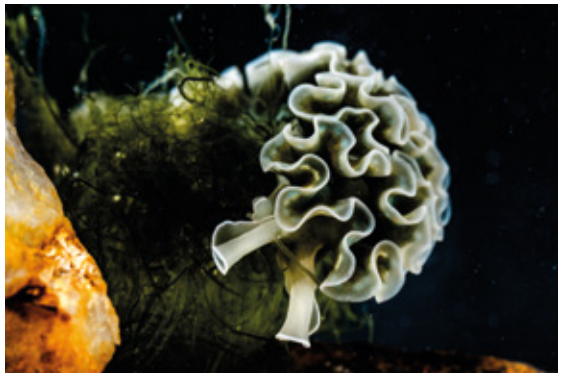

FIGURE 1
Photosynthetic Sacoglossa sea slugs:
Elysia viridis;
Elysia crispata.