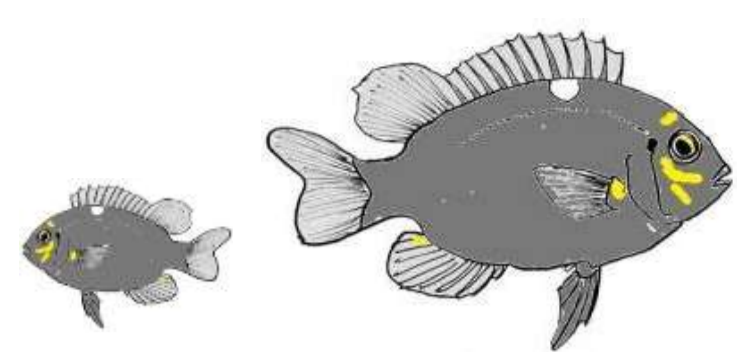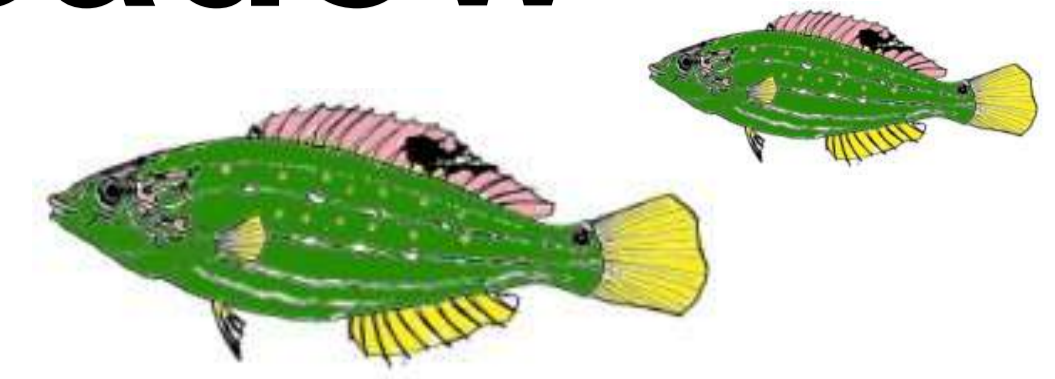# *La grande bouffe*: unraveling trophic relations of a fish assemblage in a tropical seagrass meadow

[1]Pogoreutz, C., Kneer, D., Litaay, M., Asmus, H., Ahnelt, H.

Science for the Protection of Indonesian Coastal Ecosystems II (SPICE II-project, BMBF funded)

Seagrass meadows are productive ecosystems supporting high biomass and diversity, and occuping large proportions of shallow shelf areas all over the world. As they are structurally complex, seagrass meadows provide shelter from predation, as well as valuable feeding grounds. Therefore, they are considered nursery areas for juvenile reef fauna, but also attract large herbivores, such as dugongs or green turtles, as well as reef-dwelling predators, including houndfish, barracuda, or sharks.

Most known fish species are carnivores or omnivores. In contrast to animal protein, seagrass, being plant matter, is hard to digest and of little nutritional value. Seagrass and epiphytic algae are a readily available food source in seagrass meadows, but few studies have focused on the diet of fish in seagrass beds. Most of these studies were conducted in the Caribbean, while trophic relationships of fishes in highly diverse South-East Asian seagrass meadows are poorly known. Accordingly, we examined the dietary composition of a tropical seagrass bed ichthyofauna in the Spermonde Archipelago, South Sulawesi, Indonesia. To unravel fish trophic relations, fish were collected with gill nets and beach seines, and subjected to gut-content (GCA) and stable isotope analysis (SIA). Trophic levels (TL) were calculated based on $TL_i = [(\delta^{15}N_i - \delta^{15}N_{PC}/3.4] + 2$; where TL_i is the average trophic level of species i, $\delta^{15}N_i$ the average $\delta^{15}N$ of species i, $\delta^{15}N_{PC}$ the average $\delta^{15}N$ of primary consumers, and 3.4 the mean $\delta^{15}N$ trophic enrichment occurring from primary consumers up. Further, we aimed to identify whether seagrasses or algae are the primary producer at the base of the food web.
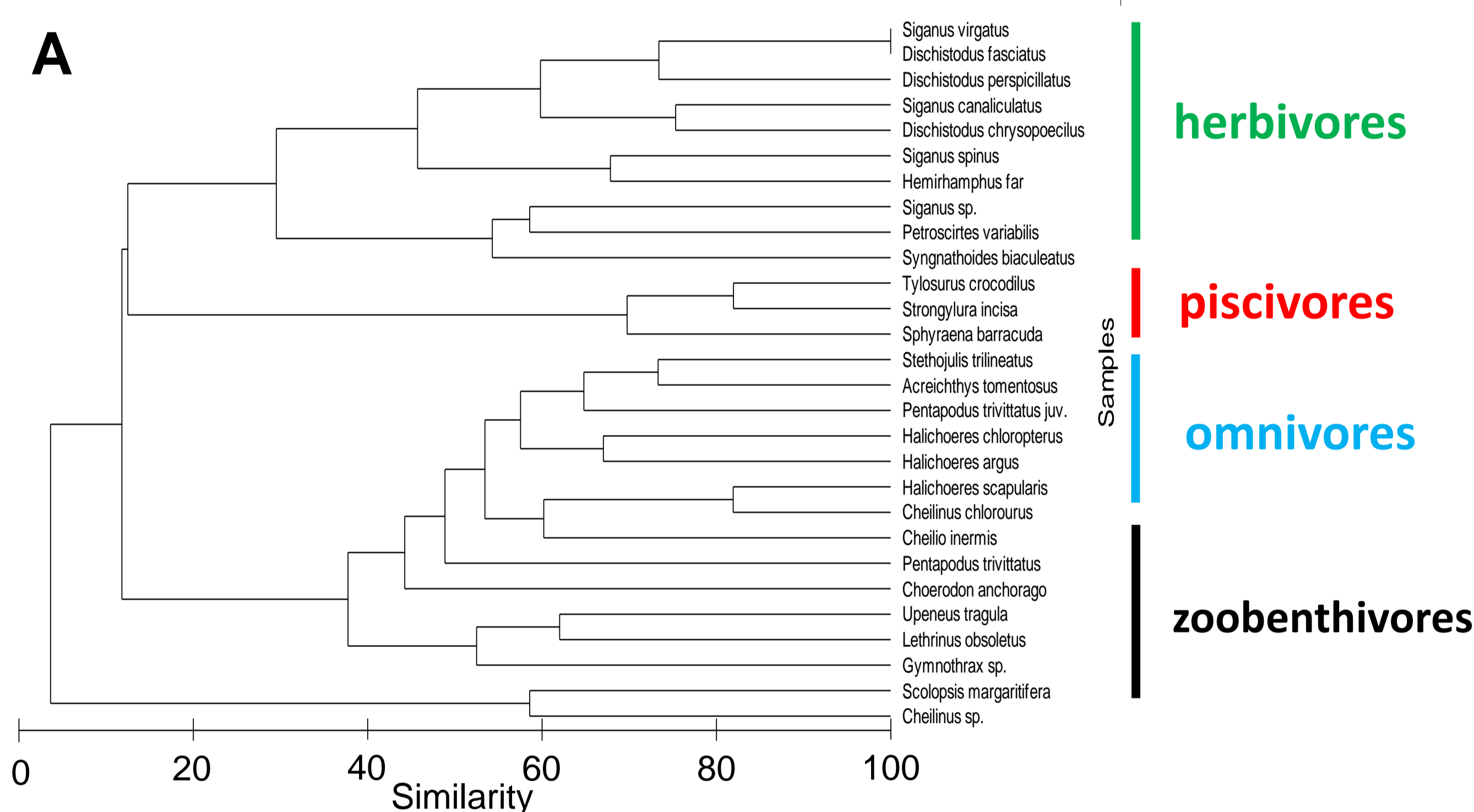

Collection site in the Spermonde Archipelago, Indonesia.

*Tropical off-shore mixed-species seagrass bed*

Common primary consumers vs. top predators: the herbivorous halfbeak Hemirhamphus far *(left) and the piscivorous houndfish* Tylosurus crocodilus *(right).*

A. Hierarchical Bray-Curtis Cluster Analysis of fish diet based on gravimetric fish gut content data. Fish are grouped into four distinct trophic guilds: herbivores, piscivores, omnivores, and (macro)zoobenthivores.
B. Isotope signatures of ichthyofauna in relation to primary producers and organic matter in an Indonesian seagrass meadow.
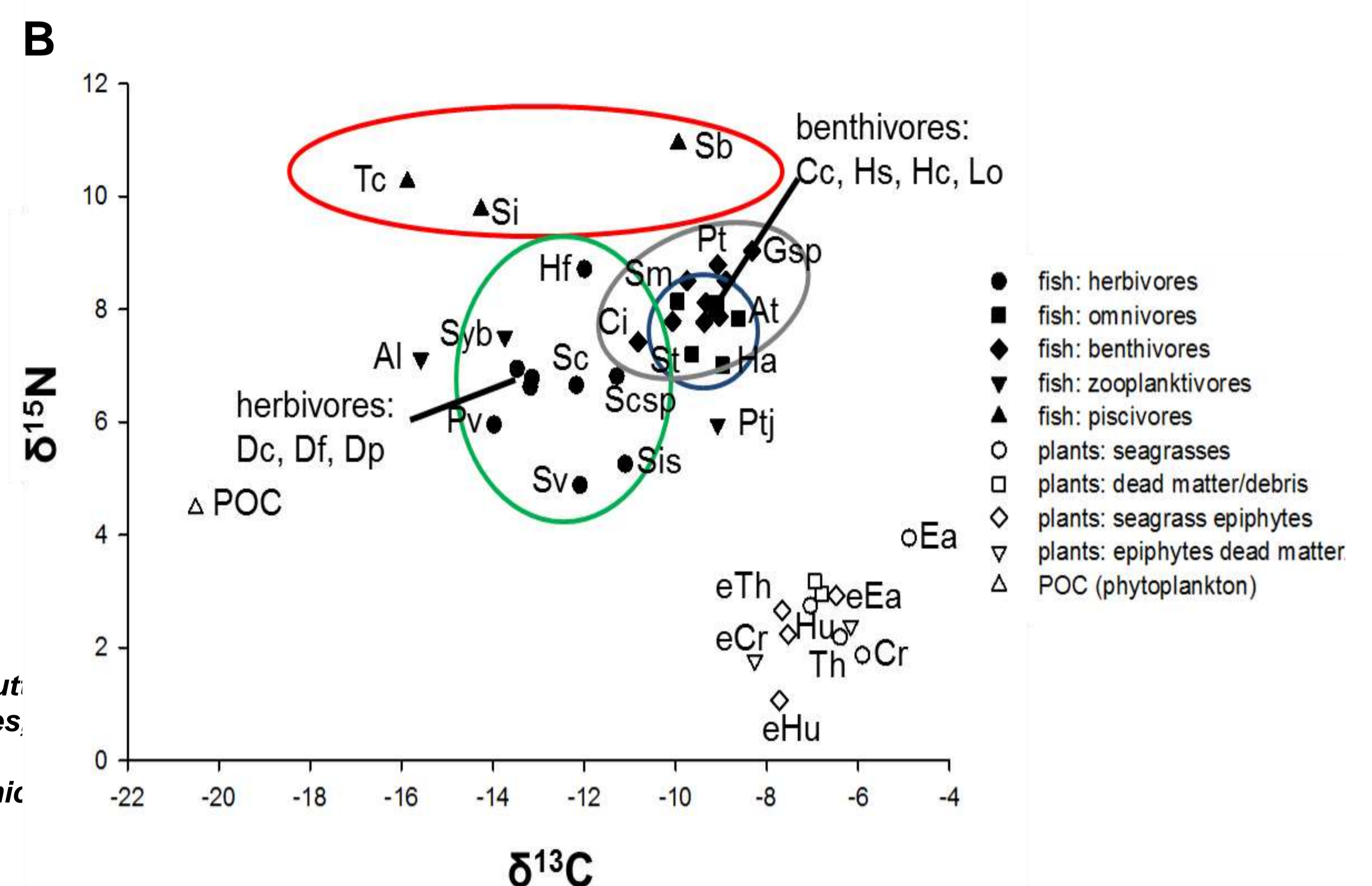
Gut feeling: revelations of GCA and SIA

In total, 182 specimens from 26 species were subjected to GCA, and 66 specimens from 18 species were subjected to SIA. GCA revealed four trophic levels, which cluster into distinct groups: herbivores (10 spp.), piscivores (3 spp.), omnivores (4 spp.), and zoobenthivores (9 spp.). Allover, 4436 prey items from 23 major prey categories were identified. Crustaceans in general were the food item most commonly ingested (found in 58 % of all guts), followed by gastropods (26.5 %) and plant material (24.5 %), the latter often too strongly macerated to allow for a separation into seagrass or algae. Crustaceans and gastropods in different size classes are major food-web components in many marine habitats, linking different trophic levels. Obviously, plants are a plentiful resource in seagrass beds as well. However, while seagrasses may seem the obvious diet of choice, due to their bountiful supply, they are rarely used directly as a food source by fish. This is due to their low digestibility and nutrient content. Algae, on the other hand, are used by a number of fish and invertebrates that can be found in seagrass beds.

Highest δN^{15} values and TLs were found in the piscivores *Sphyraena barracuda (*10.94‰; TL 3.69) and *Tylosurus crocodilus* (10.28 ‰; TL 3.44), lowest δN^{15} values and TL were found in the herbivore *Siganus virgatus* (4.88 ‰; TL 1.91). Benthivores and omnivores exhibited intermediate isotopic signatures and TLs. The SIA results reflect the findings from GCA, as top predators commonly exhibit higher δN^{15} values and TLs than lower-level consumers, while primary producers (PPs) exhibit the lowest levels of all. Significant statistical differences between $\delta^{13}C$ values of primary producers may allow identification of the base of a food web; unfortunately, despite finding such a significant difference in the present study, it is not possiible to clearly identify the base of the food web. All fish are more depleted in $\delta^{13}C$ relative to primary producers. The reason behind this remains unclear. As SI signatures of white fish abdominal muscle might reflect long-term energy flow, reaching up to several months back in time, it might be possible that a recent shift in primary producer $\delta^{13}C$ towards less depleted signatures might be masked. Another reason might be contamination of samples with inorganic carbon; since samples were treated with hydrochloric acid before being subjected to SI analyisis, this scenario is not very likely, though. Even though $\delta^{13}C$ of seagrasses and algae cluster closely together in the plot, despite being statistically significantly different, signatures of epiphytic algae are closer to that of fish, which makes these primary producers a more likely base of food web. This coincides with most previous studies. As a conclusion, seagrasses can be expected to be more crucial as shelter from predation and substrate for epiphytes, than for dietary requirements.

[1]Contact: c.pogoreutz@gmail.com