HERBIVORY BY FISHES ON CORAL REEFS;

THE CURRENT STATE OF PLAY

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Coral reefs covering 600,000 km ^{2} represent only a small area (0.17%) of the planet's surface but support a disproportionately high component of the world's shallow water fish fauna. The 3,000 species of fishes that occur in the Indo-West-Pacific, a region that includes approximately 73% of the world's coral reefs constitutes 12% of the worlds fish species and 22% of marine fish species (Helfman *et al* 1997). These fishes are dominated by a single order the Perciformes which includes the majority of the marine herbivorous fishes. Coral reefs are biogenic structures that occur in shallow waters, subject to intense tropical light regimes and characterised by complex structural features. Reefs also exhibit high levels of primary productivity (1500 to 5000 g C/m^2

/yr). The dominant primary producers are assemblages of algal turfs that occur in complex mixture of green, red and brown algae and subject to rapid turnover with 20-90% of turf algal production being consumed daily (Hatcher 1997). A variety of experimental investigations have identified perciform fishes as important consumers of reef algal turfs (Hatcher & Larkum 1983).

Herbivory through grazing fishes is a defining feature of coral reefs, especially in the Indo-Pacific (Steneck 1988). The high local diversity of this fish fauna, with up to 40 species of vertebrates co-occurring within small areas makes this a unique herbivore assemblage. Analysis of the patterns of carbon flow in reef systems supports the view that herbivorous grazing fishes are a key part of the reef ecosystem processes. Coral reefs constitute oases of high primary productivity in tropical oceans (Hatcher 1997). It is assumed that the low standing crops of nutritious plant assemblages are rapidly consumed, assimilated and incorporated into food webs that underwrite the high levels of secondary production of coral reefs. A closer examination of coral reefs as the exemplar of marine fish herbivory reveals a lack of critical information relating to the process itself. For example, herbivory in terrestrial systems is understood in functional terms, the ability to derive energy from the fibrous portions of plants through fermentation by symbiotic microbes. This approach provides a link between the structure of plant foods, the nature of the resources accessed by herbivores and the internal processes by which materials are processed, assimilated and incorporated into food chains. In marine systems herbivores are defined as animals that remove plant material, a definition that is inadequate for understanding food processing and energy flow in marine ecosystems. The problem becomes more acute when one considers the wide variety of nominally herbivorous species on coral reefs and the varied composition of the algal materials that must serve as substrates for fish digestion (Kloareg & Quatrano 1988).

Compared to terrestrial system we are ignorant of important functional aspects of herbivory on coral reefs. This review will address some of the consequences of this and suggest a bipartite approach to future investigations of herbivory. Firstly we need better information on the nature of the food resources harvested by the different taxa and diversity of food processing modes that occur. Secondly we require information on the digestive physiology of the herbivores themselves. Our approach includes a survey of the taxa of nominally herbivorous fishes, surgeonfishes (Acanthuridae), parrotfishes (Scaridae) and drummers (Kyphosidae). Microbial fermentation is a key digestive process in terrestrial herbivores. We commenced our study with a comparative survey of short chain fatty acids in the alimentary tracts of nominally herbivorous fish species. This survey suggests a wide variety of food-processing modes confirmed by studies of diet and alimentary tract turnover times. An important finding of the survey was the dominance of fishes consuming detrital materials. An analysis of detrital material itself has revealed that detritus has twice the total hydrolysable amino acids of algae. Our conclusions are; i) there is a wide variety of food processing modes amongst many of the nominal herbivores on coral reefs; ii) many herbivores are in fact detritivores; iii) detritus itself has a surprisingly high higher nutritional profile; iv) although we can identify dietary items and feeding modes we lack information on the digestive physiology of the fishes concerned. In order to understand herbivory in marine and terrestrial ecosystems we need to initiate a program of study into the digestive physiology of the major groups of nominal herbivores in marine systems.

References

Hatcher, B.G. and A.W.D. Larkum. (1983) An experimental analysis of the factors controlling the standing crop of the epilithic algal community on a coral reef. J.Exp. Mar. Biol. Ecol 69: 61-84

Hatcher, B.G.(1997) Organic production and decomposition. In: life and death of coral reefs. C.Birkeland (ed). Chapman and Hall New York, pp 140-174

Helfman, G.S. Collette, B.D. and D.E.Facey (1997) The diversity of fishes. Blackwell Science, Massachusetts

Kloareg, B. and R.S. Quatrano. (1988) Structure of the cell walls of marine algae and ecophysiological functions of the matrix polysaccharides. Oceanogr. Mar.Biol. Annu. Rev. 26: 259-313

Steneck, R.S. (1988) Herbivory on coral reefs: a synthesis. In Proc 6th Int. Coral Reef Symp., Townsville J.H.Choat (ed). 1: 37-49