Alpha and Functional Diversities of Fishes from a Seagrass Bed in Pitogo, Zamboanga City

Ephrime B. Metillo[1] and Oliver D. Tito[2]

Abstract

We studied the alpha (∝) and functional (trophic) diversity of fishes that thrive in a seagrass bed in Pitogo, Zamboanga City. Replicate fish samples were collected using a 20-m long gill net set for 30 min. The Shannon diversity index for fishes (identified up to the Genus level) was comparable within the habitat. Fish stomach contents were analyzed following the numerical method. The Shannon diversity indices for the dietary items indicate that **Choerodon** *and* **Pseudobalistes** *are highly carnivorous, the* **Rhinecanthus** *is herbivorous and the rest of the genera (***Apogon**, **Balistes**, **Chaetodon**, **Cheilinus**, **Gerres**, **Halichoeres**, **Lethrinus**, **Lutjanus**, **Rypticus** *and* **Scarus***) are omnivorous. Overlap in diet is apparent among these genera, but partitioning is achieved by differences in the relative intensity of consumption of certain dietary items.*

Key Words: functional diversity, alpha diversity, seagrass, feeding ecology

Introduction

Fifty (50) species of seagrasses are found distributed around the world (Fortes, 1990). Interestingly, seagrasses are the only group of submerged flowering plants in the marine environment. They possess leafy shoots and creeping stems called rhizomes. In tropical areas they exist in enormous quantities and form large dense meadows that can perform a wide spectrum of biological and physical functions. Seagrass beds have so far been valued for their role as fish nursery areas and as a source of food and shelter for fish, invertebrates, turtles and dugong (Fortes, 1990). They reduce sediment transport to coral reefs and trap sediments from mangroves. They also reduce wave energy and regulating water flow. In the Philippines, 16 species of seagrasses have been identified, making it the second richest in the world (the richest is Australia) in terms of identified number of seagrass species (Fortes, 1990). Seagrass beds support approximately 481 species of plants and animals. It is also reported that in terms of fish fauna, it is 50% similar to coral reefs and 10% similar to mangroves (National Biodiversity Research Agenda for the Philippines, 1997).

Among the diverse plant and animals associated with the Philippine seagrasses, many are commercially important. Recent studies have identified epiphyte, epibenthos, in-fauna,

This study is partially funded from a grant by the Commission on Higher Education (CHED)

[1]Department of Biological Sciences, College of Science & Mathematics, Mindanao State University-Iligan Institute of Technology

[2]Department of Marine Biology, Zamboanga State College of Marine Sciences and Technology, Fort Pilar, Zamboanga City

birds, reptiles and mammals as components of the seagrass ecosystem (Fortes, 1990). Fish and shrimps are probably the most important among the associated fauna. The generalized relationship among the major components identified from seagrass systems in the Philippines are food and energy pathways or trophic levels of common species (Fortes, 1990).

Hammond et al. (1994) identified at least 30 species of tropical fishes of which the Scaridae are considered the most important as seagrass direct consumers. Evidences of grazing "halos" also indicate use of reefs as sheltering sites (Randall as cited by Hammond et al., 1994). The enormous density exhibited by fishes in their morphology and biology is reflected in their wide range of food preferences were some are specialized or highly adapted to feed on such items as zooplankton, snails, corals, animals and some plants (Nelson, 1994). With this complexity, resource overlap analysis has been examined among species comprising the fish and shrimp guilds within an eelgrass bed in Victoria, Australia (Bird, 1991). Dietary overlap was found to be low between species. In the few cases where dietary similarities between species were relatively high, the potential competition is reduced by spatial separation of foraging zones (Howard, 1984 as cited by Nelson, 1994). Since our understanding on seagrass ecology, diversity and the relationship of the associated flora and fauna is mostly based on qualitative data, trophic level and structure studies are less commonly pursued. Thus, these areas of the seagrass bed ecology remain vague, unidentified and largely unknown. The present study is broadly aimed at contributing to the knowledge on the interactions in a seagrass ecosystem. In particular, the study is expected to provide information on the alpha and functional diversities of seagrass bed fishes.

Materials and Methods

Fish were collected from the littoral area of Pitogo (Coordinates 6° 56.15'N; 121° 59.38'E) on 21 July 1997. This site is located on the West coast of Zamboanga City with an approximate distance of eight (8) kilometers from the city proper. The seagrass *Syringodium isoetifolium* dominates in the site, but a few *Cymodocea rotundata* are also present. In decreasing order of abundance, macroalgae present in the sites were *Gracillaria, Hypnea, Ulva, Halimeda, Dictyota, and Laurencia.* Two sampling sites were established, and after noting the compass bearing, dive spot, current, tide reference points, depth and area of the seagrass bed, replicate transect lines were laid followed by the setting of a gill net. The gill net has a one-inch eye and measuring 20 m in length and 1.5 m in depth. Two casts were made on each site to sample ebb and flood water. After an interval of 30 minutes, the net was then retrieved with the fish samples. Fishes caught in the gill net were hand-picked and segregated according to Genus, and their lengths (in mm) and weights (in g) measured. Genera of fishes were confirmed using taxonomic guides by Rau and Rau (1980) and Nelson (1994). Samples were placed in resealable plastic bags and fixed in 10% formalin in seawater.

In the laboratory, the stomach of individual fish was dissected out and the stomach contents analyzed following the numerical method. Food ingested was segregated into several types, specifically seagrass, seaweeds, gastropods, echinoderms, crustaceans and fishes. Unidentifiable contents were assigned amorphous materials. The volume of each type of food item ingested per individual fish were quantified and expressed in percentage based on the total items of food ingested (Windell and Bowen, 1978).

Alpha and fish diet diversities were computed using the Shannon diversity index (Magurran, 1986).

Results and Discussion

General diversity of fish

Thirteen (13) genera of teleost species were identified from a total of 116 individuals sampled (Table 1). These are *Apogon, Balistes, Chaetodon, Cheilinus, Choerodon, Gerres, Halichoeres, Lethrinus, Lutjanus, Pseudobalistes, Rhinecanthus, Rypticus, and Scarus.* These genera are commonly found in seagrass beds (Steffe et al. 1989; Rau and Rau, 1980). Among the genera that are found to be common on both sites are *Cheilinus* and *Scarus* which are also found to be the most abundant while *Rhinecanthus* the least abundant. As regards the average length and weight of the fish samples, *Scarus* showed the highest in length and weight with *Apogon* having the least length and weight (Table 1). The general diversity of fishes in site 1 is 1.418 while that of site 2 is 1.583. The computed evenness is 0.7914 and 0.7205 for sites 1 and 2, respectively. There was no significant differences between alpha (a) diversity of the two sites (t-test, $p > 0.05$). Most tropical ecosystems tend to be similar within habitat (alpha) diversity, but between habitat or beta (β) diversity is often contrasting and show greater values (National Biodiversity Research Agenda for the Philippines, 1997).

Diet composition and diversity

Stomach content analysis of the samples reveal that fish caught in the seagrass ecosystem feed on seaweed, seagrass, crustaceans, gastropods, echinoderms and small fish. Table 2 shows the diet composition as well as the diversity in diet of all fish genera. Diet diversities for all genera are graphically presented in Figure 1. Our results show that *Choerodon* and

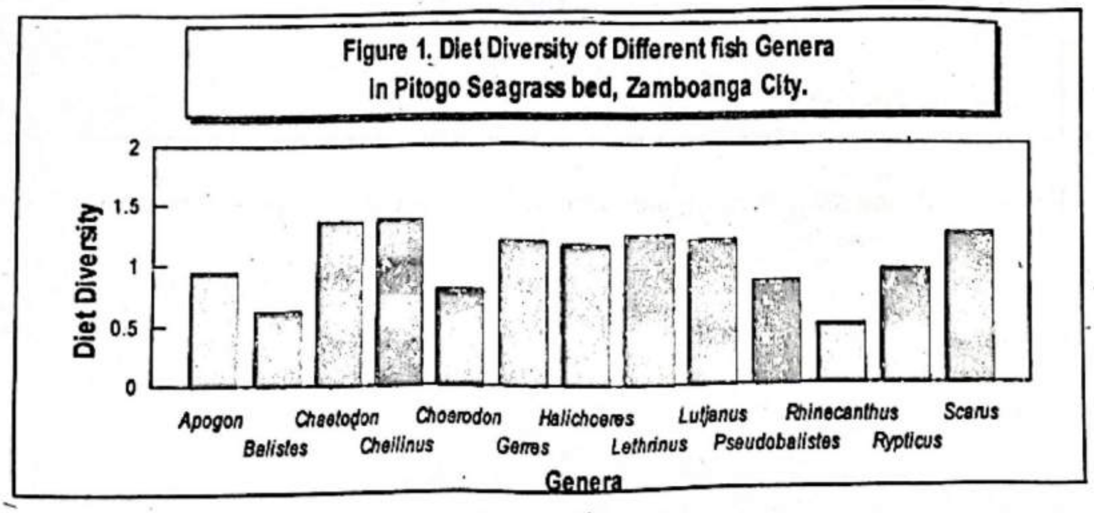

Figure 1. Diet diversity of different fish genera in Pitogo seagrass bed, Zamboanga City

Pseudobalistes are highly carnivorous, the *Rhinecanthus* is herbivorous and the other genera are omnivorous, namely: *Apogon, Balistes, Chaetodon, Cheilinus, Gerres, Halichoeres, Lethrinus, Lutjanus, Rypticus and Scarus.*

With regard to the diversity of the diet, the Shannon diversity indices suggest that the diet of the fish samples were broad (omnivorous) except for *Rhinecanthus* which is herbivorous and *Choerodon* and *Pseudobalistes* which are carnivorous as evidenced by the predominance of animal remains in their guts. Dietary source overlap is observed to be high among the thirteen (13) different genera (Figure 2) where crustacean food item was shared by eleven genera of fish with hauge of consumption from 13% to 80%. Fish overlapped with algae food item at a range of 5-80%, with seagrass at 5-50%, and gastropod at 10-70%. Diet studies of seagrass bed fishes have strong selection for prey size and sometimes for prey types (Bird 1991). For example *Acantholuteres spilomelanurus* (Acanthuridae) preys solely on gastropods.

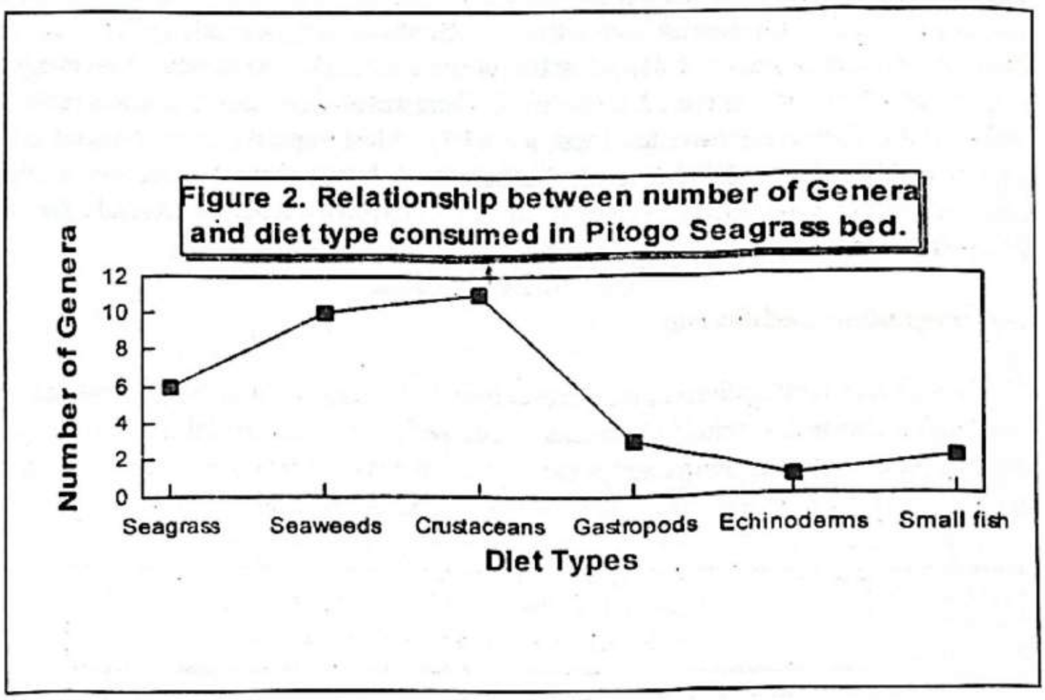

Figure 2. Relationship between number of fish genera and diet type consumed in Pitogo seagrass bed.

Table 1. Average length and weight of the different genera of fishes in Pitogo seagrass bed. Zamboanga City

GENUS	# OF INDIVIDUALS	AVE. LENGTH (mm)	AVE. WEIGHT (g)
Site 1			
Lethrinus	16	131	35
Cheilinus	13	85	30
Gerres	2	122	25
Scarus	7	169	65
Chaetodon	2	117	20
Rhinecanthus	1	117	50
Site 2			
Halichoeres	3	137	25
Chaetodon	3	145	60
Scarus	40	161	55
Balistes	2	110	25
Pseudobalistes	3	120	15
Cheilinus	6	124	40
Apogon	2	100	10
Lutjanus	5	139	35
Rypticus	11	164	30

Table 2. Fish Diet composition and diversity of the different genera in Pitogo seagrass bed. Zamboanga City.

GENUS	DIET TYPES (%)						
	algae	*crustaceans*	*amorph. seagrass*	*small fish*	*gastropods*	*echinoderms*	*Diversity Index*
Apogon	10	40	50				0.944
Balistes	5	80	15				0.614
Chaetodon	30	20	25	25			1.371
Cheilinus	23	47	10	10		10	1.383
Choerodon		10	20			70	0.802
Gerres	25	15	10	50			1.206
Halichoeres	10	30	10			50	1.168
Lethrinus	25	45	10	20			1.258
Lutjanus		40	20	5	35		1.206
Pseudobalistes		50	5			45	0.856
Rhinecanthus	80		20				0.501
Rypticus	40		50		10		0.944
Scarus	27	13	15	45			1.263

Diet analysis indicate that the fish species sampled can be classified as either carnivorous, herbivorous or omnivorous. The diversity in the diet of fish is explained by the fish ability to change and/or shift from one diet to another depending on the availability of the resource (Steffe et al. 1989; Glova and Swales, 1992; Bird, 1991). Fish also have tendencies to become a specialist for a particular food or a generalist feeder on a broad type of food (Bird, 1990). According to Kotischal and Thompson (1986 as cited in Magurran, 1988), the feeding niche of fish may be categorized into three: (1) specialist when the diet is composed of one particular kind of food (plants of animals); (2) low diversity feeders when the diet is made up of small quantity of either types of food; and (3) high diversity or generalist when it has wide feeding niches. The apparent overlap in the diet of the majority of fish genera examined indicates competition between them but coexistence is facilitated by the fact that their relative consumption to specific dietary item vary in intensity. We speculate that this is a way in which these fishes partition their food resource thereby alleviating competition (Schoener, 1974).

Summary and Conclusion

The alpha (a) diversity of fishes caught in a seagrass bed in Pitogo, Zamboanga City shows a general patterns of no difference, but the functional (trophic) diversity was variable. The results show that *Choerodon* and *Pseudobalistes* are highly carnivorous while the Rhinecanthus is found to be herbivorous. Omnivorous behavior was observed on several fish genera. Although a number of fish genera exhibits a generalist character in terms of feeding, there are some that are specialists, which feed purely on seaweeds or invertebrates. Diet overlap is apparent among the different genera investigated, however, food partitioning is achieved by the differences in the relative intensity of consumption of certain dietary items.

References Cited

Brewer, R. 1994. The science of ecology. 2nd ed., Saunders Publishing.

Bird, F.L. 1991. Comparative diets and prey selection of seagrass-associated fish found in Swan Bay and Port Philip Bay, Victoria. In Australian Society for Fish Biology Newsletter. Vol 21.

English, S. 1994. Survey manual for tropical marine resources. Australian Institute of Marine Sciences, Townsville, Queensland, Australia.

Fortes, M.D. 1990. Seagrasses: a resource unknown in the Asian region. ICLARM - Education series 5.

Glova, G.J. and Swales, S. 1992. Diet and spatial overlap between stream populations of a native and two introduced fish species in New Zealand. Australian Journal of Marine and Freshwater Research. 42(4).

Hammond, L.S. Synnot, R.N. and Norman, R. 1994. Marine Biology-Australia.Longman-Cheshire Publishers.

Kusabs, I.A. and Swales, S. 1991. Diet and food resource partitioning in koaro (*Galaxias brevipennis*) and juvenile rainbow trout (Oncorhyncus mykiss) in two Taupo streams. New Zealand. New Zealand Journal of Marine and Freshwater Research. 25.

Magurran, A.E. 1986. Ecological diversity and its measurements. Princeton University Press. N.J.

Nelson, J. C. 1994. Fishes of the world.. 3rd ed., John Wiley and Sons, N.Y.

National Biodiversity Research Agenda for the Philippines.1997. RAWOO, SEARCA Convention, Philippines.

Rau, N. and Rau, A. 1980. Commercial marine fishes of the central Philippines (bony fishes). German Agency for Technical Cooperation. Germany.

Schoener, T.W. 1974. Resource partitioning in ecological communities. Science. 185.

Steffe, A.S., Westboy, M. and Bell, J.D. 1989. Habitat selection and diet in two pipefishes associated with seagrasses. Marine Ecology Progress Series. 55.

Windell, J.T. and Bowen, S.H. 1978. Methods for study of fish diets based on analysis of stomach contents. In Bagenal, T. (ed)1978. Methods for assessment for fish production in freshwater. 3rd ed. Blackwell Scientific Publications Ltd., Oxford.