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Research article

FEEDING ECOLOGY OF *ASTERINA SARASINI* IN REEF COMMUNITIES OF ANDAMAN AND NICOBAR ISLANDS.

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ABSTRACT: The feeding ecology of the *Asterina sarasini* was examined to Rutland and Hutbay Island. 1258 observation of sea stars were made. It consumes a wide range of prey, including molluscs and crustaceans, and can be regarded as generalist predator. A total of 14 species were reported as prey items of *Asterina sarasini* during our survey. The gastropod *Trivia oryza* (Pielou's eveness index, p=0.41) was the most dominant prey of this sea star. The second and third most important prey were the crustacean *Paguru comptus* (n=37, 28.0%) and the bivalves *Mytilus edulis plantensis* (n= 14, 10.6%) respectively. The proportion of sea stars feeding on sessile prey increases with sea star size. A significant positive correlation was found between the size of the sea star and the size of the most frequent prey. The diet was fairy constant throughout the year, but the diet composition differed between sites and sea-star size.

Key words: Ecology, *Asterina sarasini*, Andaman and Nicobar islands

INTRODUCTION

The feeding ecology of several sea stars, especially boreal species, has been widely studied [8, 14, 19]. The majority of sea stars is carnivorous, and can be regarded as major predators in their habitats [29, 16, 15, 13]. Predation is an essential factor in the regulation of species abundance and composition in Marine benthic communities [29, 21]. Several works (Paine 1994) have indicated the significance of intertidal sea star to intertidal ecology, and note that it may play an important role in the maintenance of the zonation patterns and the community stability and diversity. Ecological studies on the echinoderm species from India are scarce [23, 27, 18]. The genus *Asterina* includes several species of wide distribution in India [28, 2, 24, 3]. Sea stars are often important community structuring processes [22, 4, 13], mainly in intertidal regions in temperate latitudes [16,]. *Asterina sarasini* is an oral brooding and the most abundant intertidal sea star in Andaman and Nicobar Islands [30]. It is widely distributed along the Andaman coast, including the Gulf of Mannar [25, 28]. Although *Asterina sarasini* is a common predator and prominent member of intertidal and shallow sublittoral communities, its significance in regulating the community structure is uncertain since quantitative data on diet composition and foraging behavior are lacking. The purpose of this study was to analyze the diet of *Asterina sarasini* in tide pool habitats and relationship between sea-star body size and prey size.

MATERIALS AND METHODS

Study Area:

This study was conducted from December' 2009 to April' 2011 on the exposed area of the Rutland Island: 11˚29'17.28" and E92˚40'8.46" and Hutbay Island: N 10^{0}32.58.5" and E 92^{0}32'39.06" (Fig.1).

Rutland Island: Rutland is one of the largest islands in South Andaman Archipelago enriched with highly diversed corals and its associated biological diversity in comparison with other islands of this group. This Island is located across the Macpherson Strait from South Andaman. The island spans an area of approximately 109.3 km², and has a coastline measuring some 60 Km. It is rich in marine life with the shallow waters near the islands having a good representation of coral reefs. This site was located at the south coast of Andaman Island and consists of hard bedrocks platforms with extensive and numerous tide pools and rocks that provides shelter for sea stars during low tides.

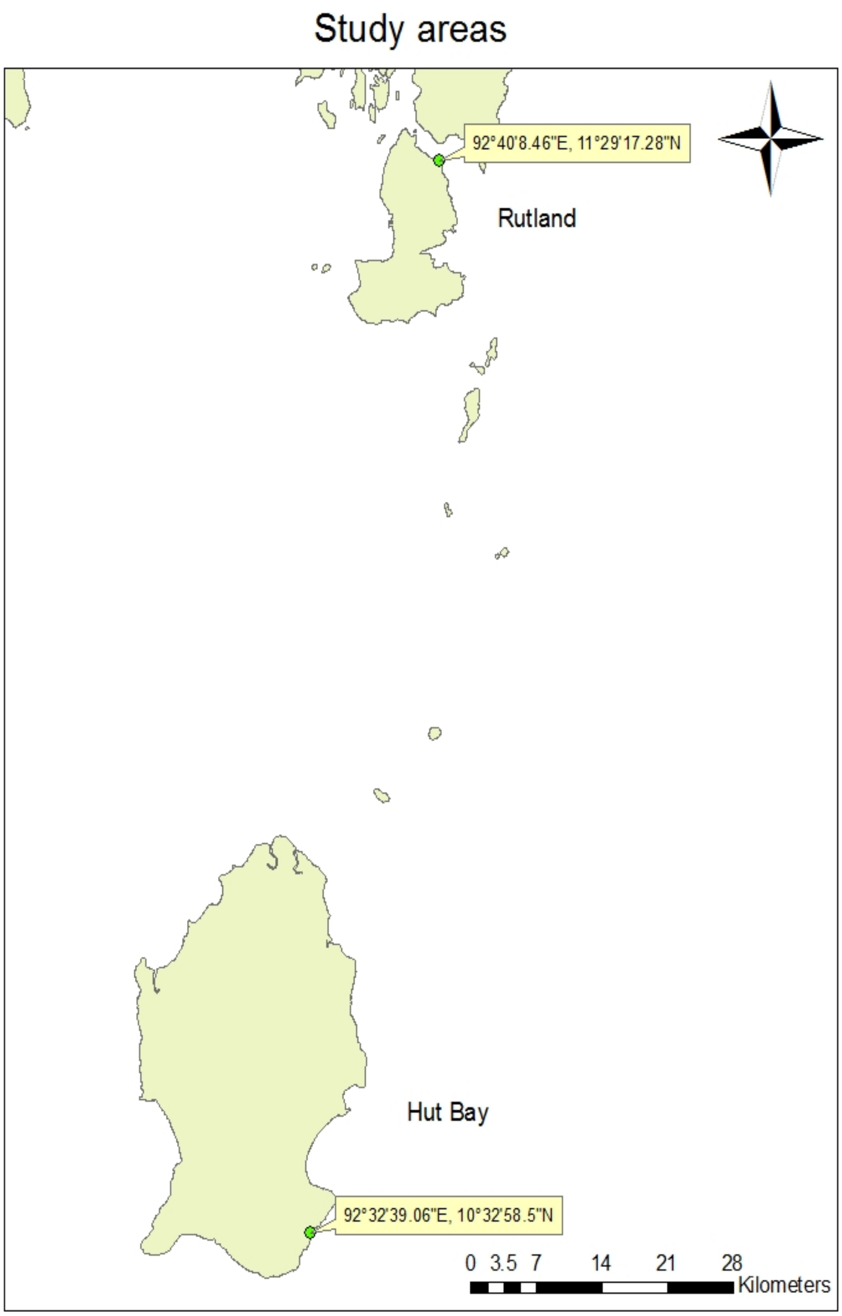

Fig.1 Study sites with co-ordinates

Hutbay Island*:* The sea shore area of the Hutbay Island is narrow about 3m about with many fallen trees. The rocky shore at this island mainly composed of basaltic hard substrata. The intertidal region extends for about 50 m which is sandy with plenty of shingle. Herein holothurians are common. The narrow shallow area which is about 30 m wide and 3m - 5m deep. Thereafter the sea is very deep. In the shallows, corals are common. With low tide, water is seen steadily percolating from the land into the sea.

Field Survey and Data analysis:

Surveys of sea-star activity were carried out in two months interval at both sites. The observations were made during low tide at daylight hours because of the difficulty of observing animals during high tide on the exposed rocky shore (due to high wave action). Prey measurements taken were: (1) anterior-posterior length for mussels, chitons, (2) columellar length for spiraled shells gastropods. To estimate the availability of prey in the environment, all potential prey within 20 randomly placed quadrates ($0.25m^2$) on the underside of rocks were cleared at all sites ad shore levels. A subsequent t-test was used to evaluate differences between sea-star sizes at the two sites. Correlation analysis was used to study predator-prey size relationships by means of the Pearson product-moment (r) correlation coefficient. The diet composition was assessed through a canonical correspondence analysis (CCA) [32, 33, 34, 35].

RESULTS AND DISCUSSION

Individuals of *Asterina sarasini* was found on the undersides of rocks in tide pools, under different sized flat rocks (0.08-2 m^2) of the littoral fringe and midshore zone (usually associated with very shallow tide pools). Small sea stars ($r<20$mm) were also found inhabitating spaces undernaeath *Mytilus edulis plantensis* mussel stacks. All animals at tide pools were usually hidden during surveys. Mean sea star densities on the undersides of rocks in tide pools were $103.1 ind.m^{-2}$ (S.E.: 69.84, n=10) at Rutland Islands (RT) and 123.22 ind. m^{-2} (S.E.: 44.45, n=20) at Hut Bay Island (HT). 716 sea star were observed from Rutland Island and 542 from Hut Bay Island (Table1).

Table 1. Total and Relative Frequency of prey items of *Asterina sarasini* at Rutland Island (RT) and Hutbay Island (HT).

Prey Animals	RT		HT	
MOLLUSCA	f	%	f	%
Polyplacophora				
Plaxiphora tricolor	12	3.7	0	0
Tunisia pectioides	4	1.2	0	0
Gastropoda				
Neritia (Theliostyla) patula	1	0.6	1	0.6
Naticarius onca	1	0.6	4	2.7
Trivia oryza	25	16.2	7	3.4
Purpura persica	1	0.6	8	3.9
Turbonilla felicita	1	0.6	0	0
Turbo crassus	0	0	4	1.9
Bivalvia				
Asaphis violascens	6	3.9	9	4.3
Mytilus edulis plantensis	0	0	15	7.2
ARTHROPODA				
Crustacea				
Balanus glandula	1	0.6	1	0.5
Paguru comptus	0	0	1	0.5
POLYCHAETA				
Notophyllum splendens	0	0	1	0.5
Observed Sea Star	**716**		**542**	
Observed feeding	**36**		**22**	
% Feeding	**5.03%**		**4.05%**	

Only 4.54% of the animals observed were feeding (n=48). *Asterina* captures bivalves, gastropods, chitons, arthropod, crustacean, polycheta, using the tube feet and arms and assumes a humped feeding position to digest the prey extraorally. A total of 14 items were recorded as a prey of *Asterina sarasini*. In terms of prey groups, Mollusca represented the dominant component of the diet with 11 prey items (Table 1). The diet of *Asterina sarasini* at the studied site was dominated by a single species, the gastropod *Trivia oryza* (p=0.41, Table 2). It occurred in 41.6% of the feeding sea star. The second and third most important prey were the crustacean *Paguru comptus* (n=37, 28.0%) and the bivalves *Mytilus edulis plantensis* (n= 14, 10.6%) respectively. Next were the *Balanus glandula* (n=10, 7.5%), *Tonicia pectioides* (n=7, 5.3%) *Asaphis violascens* (n=5, 3.7%), *Plaxiphora tricolor* (n=4, 3.0%) respectively. Other prey items such as gastropods *Neritia (Theliostyla) patula, Naticarius onca, Purpura persica, Turbonilla felicita, Turbo crassus, Notophyllum splendens* were relatively uncommon and less distributed. Only one prey was consumed at a time. All mussels captured were already detached from the substrate and oriented by the sea star with their hinge downward. *Asterina sarasini* is also able to pull the chiton and limpets from the rock with their tube feet (General observation during field study). Feeding on *Barnacles* was accomplished by extrusions of the stomach through the aperture without damaging the outer shell and leaving the barnacle shells attached to the substrate. It is important to recognize these different prey have different mobilities. Mussels and Burnacles are sessile; chitons and gastropods are slow moving; while crabs are highly mobile. A significant positive correlation was found between the size of *Asterina sarasini* and the size of *Trivia oryza, Paguru comptus, Mytilus edulis plantensis* (Fig. 2). However, we found no significant correlation between sea-star size and the size of *Balanus glandula, Tonicia pectioides, Asaphis violascens, Plaxiphora tricolor*.

Table 2. Prey Size and Correlation between *Asterina sarasini* arm length and prey size (mm) of the most important prey items.

Prey	N	r (95% CI)	p-Value	Predator Size Mean (±SE)	prey size		
					Mean (± SE)	Max	Min
Trivia oryza	55	0.41 (0.31-0.52)	<0.0001	29.14 (12.5)	18.63 (5.2)	33	6
Paguru comptus	37	0.4 (0.15-0.65)	0.007	27.35 (11.6)	17.14 (4.9)	22.3	6
Mytilus edulis plantensis	14	0.49 (0.13-0.83)	0.027	22.08 (12.3)	12.43 (4.9)	22	5.5
Balanus glandula	10	0.12 (-0.37-0.60)	0.598	34.01 (8.0)	32.55 (7.1)	50	22.5
Tonicia pectioides	7	0.13 (-0.51-0.77)	0.656	39.22 (16.2)	31.02 (9.7)	48	13
Asaphis violascens	5	0.42 (0-0.85)	0.17	29.47 (4.8)	23.60 (4.8)	31	16
Plaxiphora tricolor	4	0.87 (0.74-1)	0.002	21.61 (6.8)	13.86 (6.3)	22	6

This study described the feeding habits of *Asterina sarasini*, a dominant brooding sea star in the intertidal and shallow subtidal system Rutland and Hutbay Island. Although its diet is dominated by the gastropod *Trivia oryza,* it consumes a wide range of prey, including molluscs and crustaceans and can be regarded as a generalist or opportunistic predator. The sea star adopts the characteristics humped-up pose when feeding on mussels, suggesting that pulling is often used to open this prey. The insertion of a portion of the stomach through a small opening or natural gap as described by Feder (1955) for *Pisaster ochraceus* may also apply to some extent to *Asterina sarasini*. We observed a few case (<3%) where the stomach was inserted at the byssus opening when feeding over *Asaphis violascens*. The co existence of *Asterina sarasini* and prey underneath rock during low tides may also explain the capture of motile prey such as small crustacean, snails. All mussels captured by *Asterina sarasini* were detached from the substrate. This could support the idea the star removed the mussels prior to digestion or could suggest feeding on self detached or washed out animals that are accumulated underneath rocks. Changes on the diet of sea stars with size were reported for many species [11, 7, 14, 17, 31, 1, 12. If we compare the diet of *Asterina sarasini* as a function of sea star size, *Trivia oryza* is the major prey species but there is a slight shift in diet composition between juveniles (<20mm , arm length) and medium /large sea stars (≥20mm, arm length) (Fig.3).

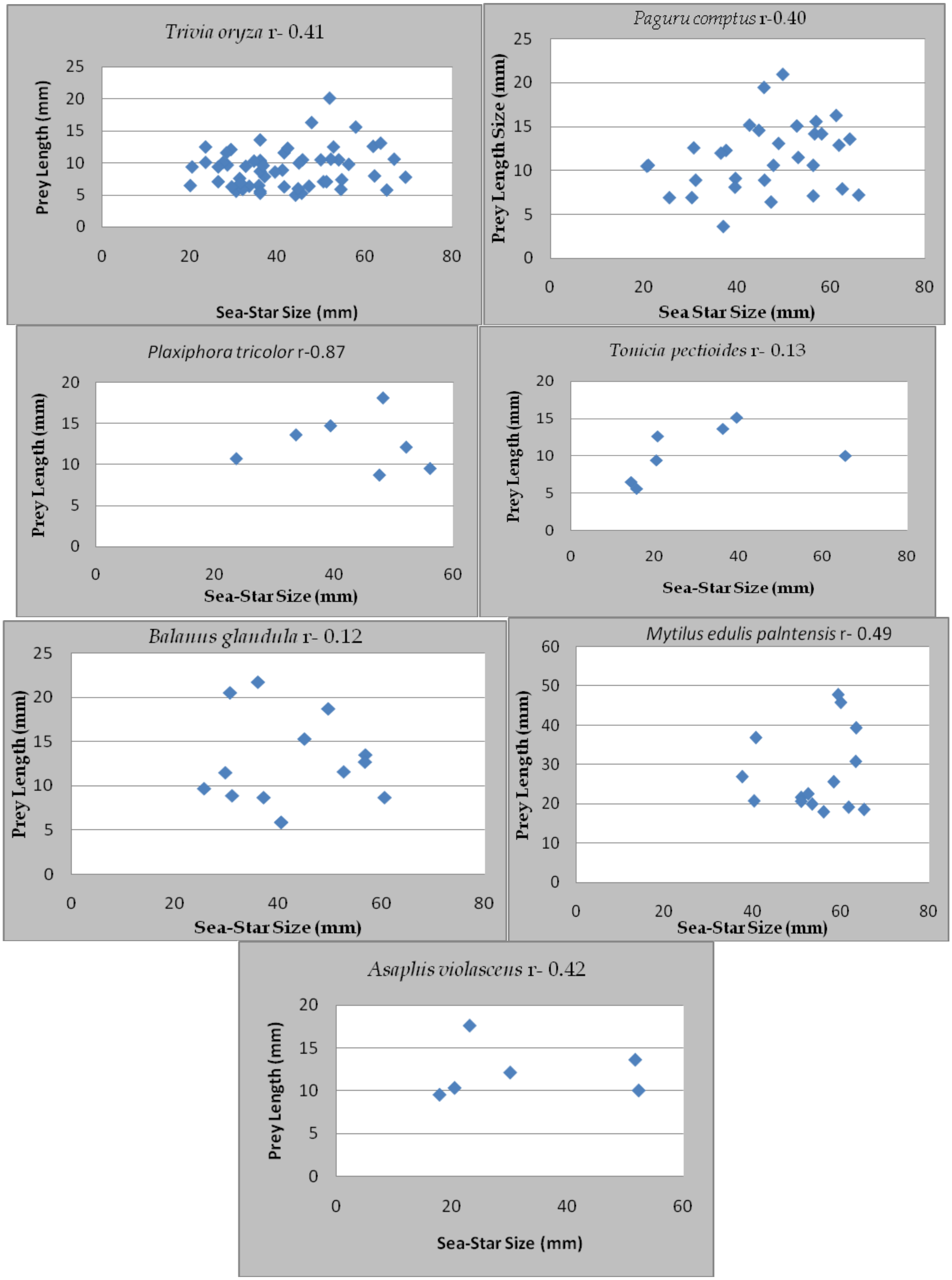

Fig.2 The relationship between *Asterina Sarasin* size and prey length (mm).

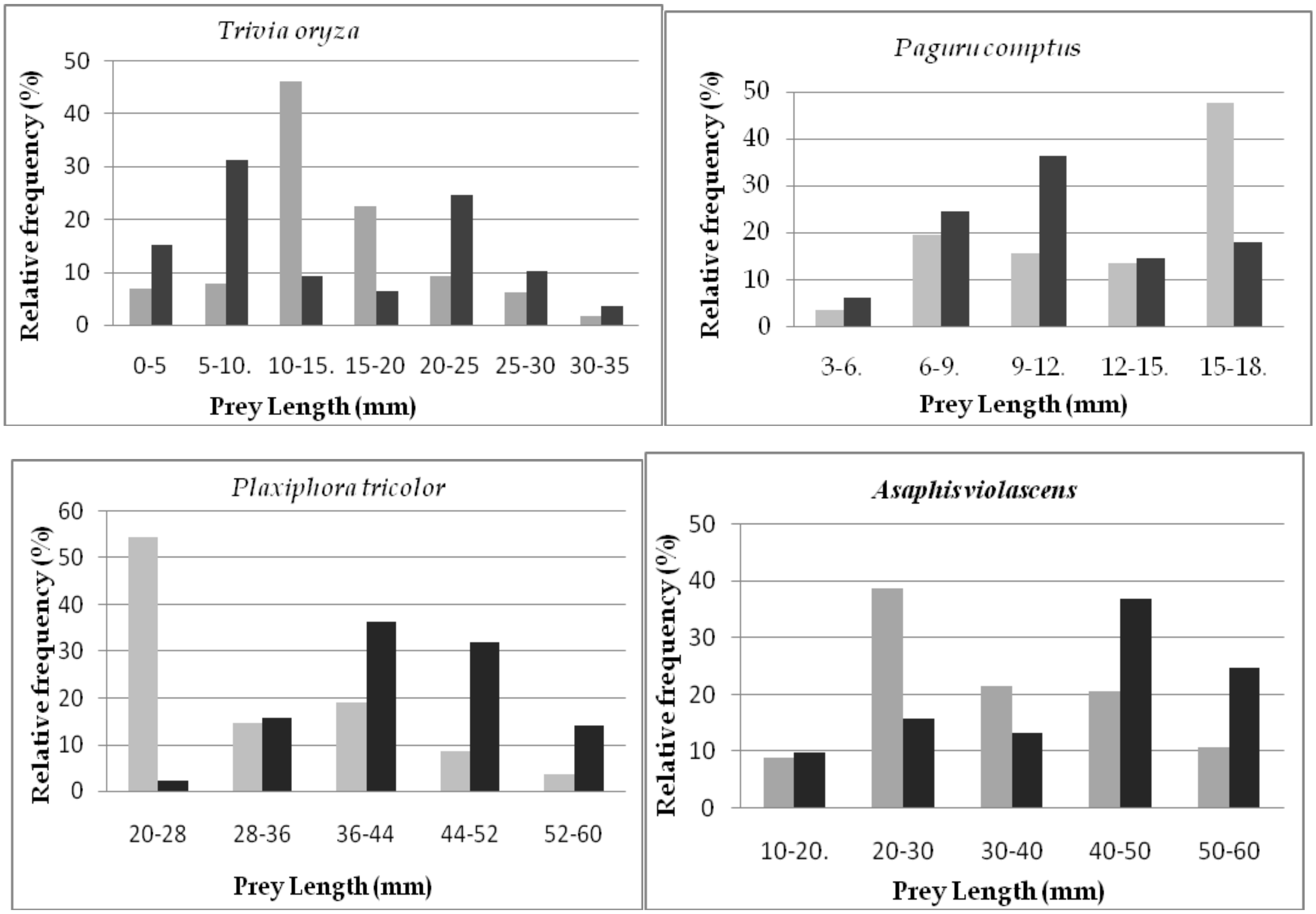

Fig. 3: Relative frequency (%) of various sizes of prey eaten by *Asterina sarasini* (light gery bar) and the expected relative frequency in the field, based on their availability under rocks at tide pools (dark grey bar).

Juveniles were found to prey more often on small crustacean, gastropods while large sea stars preyed upon large bivalves (*Asaphis violascens* and *Mytilus edulis plantensis*). Differences in the diet of Asterina sarasini may be due to variation in the size range of their prey. Consequently, small sea stars may feed on a narrow size range of prey, while large sea stars may feed on a broader size range, reaching more nutritionally valuable prey that are not available for small sea stars. This suggests that grain from feeding on small crustacean, molluscs decreases with increasing body size and consequently, there is a change in dietary preferences from large prey. This result is supported by the fact that large sea star mostly feed on sessile prey.

The observed difference in diet between study sites can be attributable to the differences in prey availability resulting from the opportunistic feeding strategy. The Bivalve *Mytilus edulis plantensis* is absent in Rutland Island but it is eaten at Hutbay where it occurs in a high densities. The Polyplacophora *Plaxiphora tricolor* and the gastropod *Trivia oryza* are more abundant in Rutland Island and are therefore used by the sea star as food. The availability of prey to predators depends not only on their population density, but also on exposure, activity and escape or defense responses [8, 19]. *Asterina sarasini* does not eat prey in proportion to their abundance on undersides of rocks in both sites at the infralittoral fringe. Generally it consumed *Trivia oryza* and the mussels *Mytilus edulis plantensis* more than other prey, even when they were not the most abundant prey species.

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