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Do changes in seaweed biodiversity influence associated invertebrate epifauna?

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Abstract

Most investigations of biogenic habitat provision consider the promotion of local biodiversity by single species, yet habitatforming species are often themselves components of diverse assemblages. Increased prevalence of anthropogenic changes to assemblages of habitat-forming species prompts questions about the importance of facilitator biodiversity to associated organisms. We used observational and short-term (30 days) manipulative studies of an intertidal seaweed system to test for the implications of changes in four components of biodiversity (seaweed species richness, functional group richness, species composition, and functional group composition) on associated small mobile invertebrate epifauna. We found that invertebrate epifauna richness and abundance were not influenced by changes in seaweed biodiversity. Invertebrate assemblage structure was in most cases not influenced by changes in seaweed biodiversity; only when algal assemblages were composed of monocultures of species with 'foliose' morphologies did we observe a difference in invertebrate assemblage structure. Correlations between algal functional composition and invertebrate assemblage structure were observed, but there was no correlation between algal species composition and invertebrate assemblage structure. These results suggest that changes in seaweed biodiversity are likely to have implications for invertebrate epifauna only under specific scenarios of algal change.

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1. Introduction

Local biodiversity is often positively influenced by the presence of habitat forming or habitat modifying organisms (Thompson et al., 1996; Stachowicz, 2001). The importance of biogenic habitat provision and of positive interactions in general is increasingly acknowledged, particularly in marine systems (Bertness et al., 1999; Bruno and Bertness, 2000; Stachowicz, 2001; Bruno et al., 2003). Biogenic habitat provision is most often investigated as the creation or modification of habitat by one species for a group of other species (Castilla et al., 2004; Wonham et al., 2005). However, many situations exist where habitat-forming species are components of assemblages of taxa that can collectively act as habitat (Bruno and Bertness, 2000; Stachowicz, 2001; Bruno et al., 2003). Investigations into assemblage-level influence on biogenic habitat provision are much less frequent and, where available, have yielded mixed results, showing positive, negative, and neutral

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relationships between facilitator diversity and diversity of associated organisms (Bruno and Bertness, 2000).

These mixed results concerning habitat provision by multi-species communities may stem from problems of defining facilitator diversity, because various components of diversity (e.g., richness, composition) can affect processes differentially (Diaz and Cabido, 2001; Naeem, 2002) and it can be difficult to separate the effects of different components of diversity (Naeem and Wright, 2003). Biodiversity, as it relates to ecosystem functioning, can be defined in a variety of different ways, incorporating the number of species (Magurran, 1988; Petchey, 2000), the functional roles of the species (Tilman et al., 1997; Diaz and Cabido, 2001; Petchey and Gaston, 2002), and the identity of the species or the functional groups that compose the assemblage.

While much work in biodiversity research has focused on species richness as the independent variable, there is debate about the relative importance of species richness, functional richness and species or functional group identity (Tilman et al., 1997; Bruno et al., 2005). Here, we describe our efforts to address these concepts in an intertidal study system, where we test how variation in four seaweed assemblage-level parameters (i.e. seaweed species richness, functional group richness, species composition, and functional group composition) influences associated small mobile epifauna. Understanding the relative influence of these different components of biodiversity on biogenic habitat provision is becoming increasingly important as human activities continue to alter composition of biological communities and reduce diversity (Coleman and Williams, 2002). Habitat loss has been pinpointed as the major cause of declining biodiversity (Tilman et al., 1994), and the implications are compounded if habitat forming species are lost.

Anthropogenic changes in seaweed diversity have been observed in nearshore marine environments from many regions throughout the world, most notably in Europe (Schramm and Nienhuis, 1996) and in eastern Canada (Lotze and Milewski, 2004; Bates et al., 2005). Anthropogenic stressors that result in changes in seaweed assemblages include eutrophication, silt deposition, trampling, habitat alienation, and harvest of predators or herbivores. These stressors act by compromising the basic requirements of marine algae, which include substrate to attach to, light and nutrients for photosynthesis, and potential for successful dispersal and recruitment. As a result, stressed algal assemblages often shift from mosaics of longer-lived, perennial algae to assemblages dominated by ephemeral, fast growing, nutrient scavenging annuals (Lotze et al., 1999), often

referred to as 'green-tides'. These observed changes involve different components of biodiversity, including the number and identity of seaweed species and functional groups. Because seaweeds are vital biogenic habitat providers for small mobile invertebrates, an understanding of the relationships between different components of seaweed diversity and invertebrate diversity is important for predicting the implications of marine floristic change.

Here, we ask (1) Is seaweed species richness positively correlated with invertebrate species richness and abundance? (2) Is seaweed functional richness positively correlated with invertebrate species richness and abundance? (3) Does species composition of host seaweed assemblages correlate with invertebrate assemblage structure? and (4) Does functional composition of host seaweed assemblages correlate with invertebrate assemblage structure?

2. Materials and methods

We initiated this study with observational collections to determine natural levels of seaweed diversity and structure of associated mobile epifauna. We then performed manipulative experiments over 2 years to determine the implications of varied combinations of seaweed species richness, functional richness, and species and functional composition on structure of associated mobile epifaunal assemblages. This study was done in June to August over 2 years (2003-2004) at Nudibranch Pt. (48°48.871'N, 125°10.338'W), in southern Barkley Sound, British Columbia, Canada. Nudibranch Pt. is a relatively pristine site with gently sloping, semi waveexposed rocky reefs. Site preparation took place in April and May 2003 and observational and manipulative quadrats measured 16×47 cm, oriented perpendicular to the water line. This quadrat size was chosen as a manageable area to sample, and made efficient use of transplant materials. A list of seaweed species used in observational and manipulative studies is given in Table 1. Current taxonomic authorities can be found by consulting AlgaeBase (www.algaebase.org).

2.1. Defining seaweed functional groups

To assign seaweed species into functional groups (Table 1), we used functional form groupings following Steneck and Dethier (1994). Owing to transplant method limitation (described below), we employed only four of a possible seven seaweed functional groups (Table 1): foliose, corticated foliose, leathery, and corticated terete (i.e. rounded in cross section). As asserted by Farina

Table 1

List of algal species included in this study, with functional group assignment and whether they were encountered in the observational study (O), used in the manipulative study (M) or both (B)

Taxon	Functional group	Inclusior	
Ahnfeltiopsis leptophyllum	Leathery	0	
Analipus japonicus	Corticated terete	В	
Callithamnion pikeanum	Filamentous	0	
Ceramium pacificum	Filamentous	0	
Ceramium sp.	Filamentous	0	
Chondracanthus exasperatus	Leathery	М	
Fucus gardneri	Leathery	В	
Gastroclonium subarticulatum	Corticated terete	М	
Halosaccion glandiforme	Foliose	В	
Mastocarpus jardinii	Leathery	М	
Mastocarpus papillatus	Leathery	В	
Mazzaella affinis	Corticated foliose	В	
Mazzaella splendens	Corticated foliose	В	
Microcladia borealis	Corticated terete	0	
Microcladia coulteri	Corticated terete	0	
Neorhodomela larix	Corticated terete	М	
Odonthalia flocossa	Corticated terete	В	
Osmundea spectabilis	Leathery	0	
Porphyra sp.	Foliose	В	
Prionitis lanceolata	Corticated terete	В	
Sargassum muticum	Corticated terete	М	
Ulva fenestrata	Foliose	В	
Ulva intestinalis	Foliose	М	
Ulva linza	Foliose	В	
Ulva stenophylla	Foliose	В	

et al. (2003), the functional/morphological approach in marine algae has had variable support for a *gradient* of functional performance across groups, but the *endpoints* are well established with fast growing opportunistic 'simple' forms (i.e. the foliose group) at one end, and slower-growing, typically later successional species with 'complex' thalli (i.e. corticated terete) at the other end. Our discussion of seaweed functional composition concentrates on the differences between these endpoints.

2.2. Observational study

The purpose of the observational study was two-fold: to determine natural levels of seaweed species richness, functional richness, and total seaweed biomass to aid in the creation of realistic 'controls' for transplanted seaweed communities; and to obtain baseline descriptions of the relationships between seaweed community parameters and invertebrate diversity. Observational quadrats were sampled in May 2003 by harvesting a patch located 50 cm to the right of ten randomly selected manipulative quadrats (described below). Within each observational quadrat, each seaweed species present, along with associated invertebrates, was collected and immediately placed into separate zippered collection bags. Samples were then frozen for a minimum of 24 h to euthanize epifauna before processing.

2.3. Manipulative experiment

To separate the influence of seaweed species richness, functional richness, and functional composition on associated invertebrate epifauna, we created seaweed communities that varied each of these parameters while holding the other variables constant. We use the approach of 'synthetic removal experiments' as described by Schmid et al. (2002), where the experimental design includes intact communities and then omits certain species or groups of species to determine the effects. Prior to each transplant experiment, plots were scraped clear of existing biota. We then composed five sets of experimental communities (n=4 per treatment), each with a set of four transplanted 'control' plots. The control plots were based on the communities described in the observational study, and each was composed of eight seaweed species randomly selected across four functional groups.

2.4. Experimental treatments

Three variables were considered when determining composition of seaweed treatment plots: Seaweed species richness (S), seaweed functional richness, (F), and seaweed functional composition (FC). A fourth parameter, seaweed species composition, was incorporated by randomly selecting species within functional groups according to the guidelines described below. To describe the functional composition of seaweed plots, we classified assemblages as simple (only 'foliose' forms present), complex (only 'corticated terete' forms present), or mixed (all four functional groups present). The treatments described below are summarized in Table 2.

- Treatment 1 (T1) S=4, F=4, FC=mixed. Four seaweed species were included in each plot. One species was randomly selected from each seaweed functional group, ensuring all functional groups were represented. This treatment tested for the consequences of reduced species richness without the loss of functional richness. This treatment is referred to as a 'mixed polyculture'.
- Treatment 2 (T2) S=1, F=1, FC= foliose. Monocultures of species randomly selected from the 'foliose' functional group. We refer to this treatment as the 'simple monoculture'. This treatment is comparable to the 'green tide' phenomenon, where seaweed assemblages are composed of fast growing, opportunistic

Table 2 Description of algal assemblage parameters used to compose control and experimental plots

Treatment identity	Species richness (S)	Functional richness (F)	Functional composition (FC)	Year
C: Control	8	4	Mixed	2003 and 2004
T1: Mixed Polyculture	4	4	Mixed	2003
T2: Simple Monoculture	1	1	Foliose	2003
T3: Simple Polyculture	6	1	Foliose	2004
T4: Complex Monoculture	1	1	Corticated terete	2004
T5: Complex Polyculture	6	1	Corticated terete	2004

N=4 for each treatment; each treatment had four associated control plots.

algae typically from the Chlorophyte order Ulvales (Middelboe and Sand-Jensen, 2000).

- Treatment 3 (T3) S=6, F=1, FC=foliose. Polycultures of six species selected from the 'foliose' morphotype. We refer to this treatment as the 'simple polyculture'. This treatment tests for the influence of a low functional richness but high species richness.
- Treatment 4 (T4) S=1, F=1, FC=corticated terete. Monocultures of species selected from the 'corticated terete' functional group. This treatment is comparable to a late-successional seaweed assemblage, where a slower-growing, competitively dominant, robust morphotype is found, such as the *Chondracanthus canaliculatus* monocultures described by Dean and Connell (1987). We refer to this treatment as the 'complex monoculture'.
- Treatment 5 (T5) S=6, F=1, FC=corticated terete. Polycultures of six species selected from the 'corticated terete' morphotype. We refer to this treatment as the 'complex polyculture'.

Treatments 1 and 2 were run in 2003 and treatments 3 to 5 were run in 2004. In each year, all treatment plots had an associated control plot, resulting in 8 control plots in 2003 and 12 control plots in 2004.

2.5. Seaweed transplants

We employed the transplant approach of Shaughnessy and DeWreede (2001) to create composite communities. To prepare for transplants, plots were first cleared of the existing flora and fauna, five holes were drilled into the rocky substratum, and masonry anchors were embedded. The anchors provided a means of attaching malleable wire grids to the intertidal. Seaweed thalli selected for transplant were collected from within the study site and defaunated by dipping in fresh water and shaking, followed by visual inspection and picking of remaining epifauna (Kelaher, 2002). Holdfasts of algae were woven into three-twist PVC rope, and then attached to the wire grids with nylon zip ties. Mean biomass of all transplanted plots was approximately equal (dry biomass=10.25 g± 0.94 g) and was equivalent to the seaweed biomass of the observational plots (12.84 g±2.00 g). Algal percent cover was greater than 95% in all plots.

Plots were established over 3 days and left in the field for 30 days. Plots were then harvested by collecting the total biomass of each species from each plot into separate zippered collection bags. Samples were frozen for a minimum of 24 h to euthanize epifauna before processing.

2.6. Sample processing

To remove the epifauna from the host alga, each frozen seaweed thallus was removed from its bag and soaked in a dish with 500 mL of seawater to thaw. Most epifauna sank to the bottom of the dish, but each sample was also rubbed and visually inspected to remove remaining epifauna. Thalli with dense branching or folding were processed with additional attention. This approach was highly effective, and visual inspection with a dissecting microscope revealed few, if any, epifauna remaining on the thalli. Because sessile invertebrate individuals were relatively scarce (typically bryozoans or barnacles) and difficult to quantify as number of individuals (in the case of the colonial bryozoans), our analyses are limited to mobile epifauna. Samples were sieved through a 0.2 mm screen to retain epifauna, and then preserved in a 1.5 mL Eppendorf tube containing 95% ethanol. Invertebrates were then enumerated as morphospecies (Oliver and Beattie, 1996) and then later keyed to the highest taxonomic resolution possible. Host thalli were dried at 80 °C for 24 h, and then weighed to the nearest 0.01 g to quantify host biomass.

2.7. Statistical analysis

Tests for the influence of seaweed species and functional richness were performed using ordinary least squares regression for the observational study, and one-way ANOVAs for the manipulative study, in both cases using invertebrate taxon richness and abundance as response variables. We found that groups of control plots were not different within year (P>0.25)



Fig. 1. nMDS plots of Bray–Curtis Similarity based on: A) seaweed taxonomic composition, B) seaweed functional composition, and C) associated mobile invertebrate epifauna, from 2003 and 2004. C: Control, T1: mixed polyculture, T2: simple monoculture, T3: simple polyculture, T4: complex monoculture, T5: complex polyculture. (See Table 2 and text for detailed descriptions of treatments). Dashed line indicates that treatment group is different than control group (ANOSIM p < 0.05; Table 4).

so controls were pooled across treatments within each year (Underwood, 1997). Treatments were compared to control plots from the same year in which the treatment was done. To account for increased likelihood of Type 1 statistical errors, we used Bonferroni corrected critical alpha values in cases where multiple comparisons were performed (Zar, 1999). For parametric tests, data were tested for normality (Anderson–Darling test) and homogeneity of variance using Cochran's C (Underwood, 1997). If data did not conform, appropriate transformations were applied (Zar, 1999). Parametric tests were carried out using JMP 4.0.4 (SAS Institute Inc.). Non-parametric multivariate approaches (Clarke, 1993) were used to test for the influence of seaweed taxonomic and functional composition on invertebrate composition. Similarity in species composition of invertebrate samples and seaweed transplant plots was calculated on fourth-root transformed (invertebrates) and root-transformed (seaweed) abundances using Bray and Curtis (1957) similarities and visualized using non-metric multidimensional scaling (nMDS). To calculate seaweed functional composition, total per-plot biomass of each seaweed species was summed into the appropriate functional group before applying root

Table 3

ANOSIM results for manipulative experiment: comparisons of specific treatments to control plots for algal taxonomic composition (A), algal functional composition (B), and composition of associated mobile invertebrate epifauna (C)

Treatment compared to control	A: algal species composition		B: algal functional composition		C: invertebrate species composition	
	Clarke's <i>R</i>	P value	Clarke's <i>R</i>	P value	Clarke's <i>R</i>	P value
T1	-0.012	0.476	-0.071	0.605	0.250	0.071
T2	0.865	0.005	0.317	0.043	0.520	0.001
Т3	0.954	0.001	0.271	0.009	0.282	0.042
T4	0.896	0.001	0.733	0.002	0.213	0.149
T5	0.903	0.001	0.491	0.002	-0.055	0.573

transformation and calculating Bray–Curtis similarity. Two techniques were used to assess the implications of the different treatments for invertebrate composition: a) for the manipulative experiment, direct comparisons between treatments and controls were made using Analysis of Similarities (ANOSIM; Clarke, 1993), and b) for both the observational and manipulative components, assessments of overall congruence in multivariate similarity patterns between seaweed functional and species composition versus invertebrate species composition were made using Mantel tests (Zar, 1999); here we calculate Spearman rank correlation (Zar, 1999) between similarity matrices.

Where significant differences between treatment and controls were indicated by the ANOSIM tests, biota responsible for differences between groups were identified using Similarity Percentages (SIMPER; Clarke, 1993). Multivariate analyses were carried out using PRIMER software (Version 5.2, Primer-E, www.primer-e.org).

3. Results

3.1. Observational study

For the observational collections, no significant correlations were observed between any of the measured variables, however no low-diversity seaweed plots were encountered; average seaweed species richness was $6.1 (\pm 0.49)$ and average seaweed functional richness was 2.90 (± 0.23). There was no correlation between seaweed species richness versus invertebrate species richness $(P=0.64, r^2=0.17)$ or invertebrate abundance $(P=0.65, r^2=0.17)$ $r^2 = 0.02$), or between seaweed functional richness versus invertebrate richness (P=0.73, $r^2=0.03$) and invertebrate abundance (P=0.57, $r^2=0.04$). Further, no correlation was observed between invertebrate assemblage structure and either seaweed assemblage structure (Spearman rank correlation $(r_s)=0.111$, P=0.232) or seaweed functional structure ($r_s = 0.019$, P = 0.469). An average of 301.7 (± 63.5 SE) invertebrates were found per plot, with 3017 epifauna individuals across 61 invertebrate taxa enumerated in total.

3.2. Manipulative experiment

None of the five seaweed treatments resulted in differences in invertebrate richness or invertebrate abundance compared to control plots (ANOVA, $P_{2003} > 0.025$, $P_{2004} > 0.017$). Across all treatment plots, a total of 9593 invertebrate individuals were encountered across 66 taxa. Mean per-plot invertebrate taxon richness ranged from 15 to 25, and mean per-plot abundance ranged from 110 to 338 individuals.

Invertebrate composition in most of the treatments varied independently of seaweed composition. Invertebrate assemblages from mixed polycultures (T1) were not significantly different from the 2003 controls (ANOSIM P>0.025), and simple polycultures (T3), complex monocultures (T4), and complex polycultures (T5) were not significantly different from the 2004 controls (ANOSIM P>0.017; Fig. 1C and Table 3C). In only one treatment (simple monocultures, T2) did composition of invertebrate assemblages depend on the identity of the seaweed treatment (ANOSIM, R=0.520, P<0.001; Fig. 1C and Table 3C). SIMPER analysis indicated that differences in the abundance of amphipods accounted for 42% of the observed assemblage

Table 4

Summary of differences in abundance of major invertebrate taxa found on control plots versus monocultures of foliose seaweed (Group T2)

Order	Control average abundance	Group T2 average abundance	Average dissimilarity	Dissimilarity/SD	% contribution to overall dissimilarity
Amphipoda	198.17	118.25	19.83	1.38	42.15
Harpacticoida	39.50	19.25	7.41	1.44	15.75
Gastropoda	41.17	23.50	4.68	1.19	9.95
Patellogastropoda	13.50	2.50	2.21	1.60	4.71
Acarida	14.00	8.25	2.19	2.22	4.65
Polychaeta	9.50	6.75	1.93	2.60	4.10

Table 5

Seaweed functional similarity

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	Observation	Observational collections		Manipulative experiment			
Epifauna similarity versus:	rs	Р	r _{s (T1-T2)}	$P_{(T1-T2)}$	<i>r</i> _{s(T3-T5)}	P _(T3-T5)	
Seaweed taxonomic similarity	0.111	0.232	0.111	0.239	0.103	0.139	

0.275

0.469

Spearman rank correlation values for tests of congruence between two seaweed assemblage descriptors versus assemblage structure of associated invertebrate epifauna

dissimilarity between T2 and the control plots (Table 4), followed by harpacticoid copepods ($\sim 16\%$), snails ($\sim 10\%$) and limpets, mites, and polychaetes which each accounted for less than 5% of the differences.

0.19

Overall similarity relationships between seaweed taxonomic composition and invertebrate taxonomic composition (Fig. 1, Table 5) were not correlated in 2003 (r_s =0.111, P=0.239) or in 2004 (r_s =0.103, P= 0.139). However, overall patterns of seaweed functional composition were correlated with patterns of invertebrate taxonomic composition in both 2003 (r_s =0.275, P=0.013) and 2004 (r_s =0.196, P=0.017).

4. Discussion

We found that many of the tested components of seaweed diversity had no observable influence on diversity of associated invertebrate epifauna. In all cases, invertebrate richness and abundance varied independently of the manipulated qualities of host algal assemblages. Invertebrate assemblage structure was different between control plots and algal assemblages composed with simple monocultures, but under none of the other test scenarios. Congruence was detected between algal functional structure and invertebrate assemblages, but not between algal taxonomic structure and invertebrate assemblages.

When compared alone, species of algae vary in quality of habitat provision for epifauna, with complexly branching algal species typically having a greater diversity of associated invertebrate epifauna as compared to algae with simple morphologies (Gee and Warwick, 1994; Chemello and Milazzo, 2002). In our study we examined invertebrates associated with various types of seaweed communities. All seaweed plots composed with greater than one species had associated invertebrate epifauna assemblages that were not different than control plots that contained eight seaweed species. When seaweed plots were composed with only one species, results of epifauna comparisons depended on the functional identity of the seaweed monoculture. This latter result is consistent with previous investigations that link invertebrate diversity to seaweed host identity (Gee and Warwick, 1994; Chemello and Milazzo, 2002). Our results are similar to Parker et al. (2001) who showed that within a subtidal Northeast Atlantic estuarine seagrass/drift seaweed community, plant composition was a strong predictor of invertebrate community structure, while plant richness showed only a weak positive correlation with diversity of invertebrate epifauna. Our results contrast with similar studies undertaken in terrestrial habitats. Haddad et al. (2001) reported that insect species richness was positively correlated with plant species and functional richness in grassland ecosystems, and Perner et al. (2003) reported that after the cessation of pollution, herbivore richness was positively influenced by subsequent increases in plant species and functional richness.

0.196

0.017

0.013

Given that stronger relationships have been observed between diversity of plants and invertebrates in terrestrial systems, it is logical to ask why marine algal diversity and associated epifauna are not more tightly linked. Terrestrial insects are often specialized to their host (Janz et al., 2001), whereas marine invertebrates tend to be much more generalized in their host usage (Arrontes, 1999), although examples of marine host specialization do exist (Sotka, 2005). In the absence of widespread host-specialization, marine epifauna are likely more amenable than insects to switch to a new host if host composition or richness were to change.

Why did invertebrates associated with simple monocultures differ compared to the controls? The majority of studies relating host architectural complexity to epifauna diversity conclude that host plants that are better at providing predator-free space will have the highest associated invertebrate diversity (Duffy and Hay, 1991; Arrontes, 1999). The species included in the foliose functional group tend to be of low structural complexity, with many species lacking branches or specialized structures. This lack of complexity may provide fewer spaces for epifauna to hide from predators, which could explain the different composition of amphipods, harpacticoid copepods, gastropods, limpets, mites, and polychaete worms observed in simple monocultures (Table 4) compared to controls. However, structural complexity can be difficult to define in a straightforward manner, and other characteristics besides branching may influence an algal host's ability to provide predator-free space. Several of the foliose seaweed species (e.g. Porphyra spp., Ulva fenestrata) exhibit highly folded morphologies, which can also provide effective shelter for invertebrate epifauna. Fig. 1C shows that several of the simple monoculture plots had associated invertebrate epifauna assemblages that group closely with those from the control plots. This suggests that functional groupings may not be the most reliable method of predicting a seaweed species performance as a host for invertebrate epifauna. Evidence exists to suggest that host species identity is particularly important when abiotic conditions are stressful. For example, Lilley and Schiel (2006) found that on New Zealand shores exposed to thermal stress, removal of a dominant canopy forming species, Hormosira banksii (Turner) Decaisne, had significant influence on assemblage structure of nearby and associated organisms.

4.1. Observational versus manipulative results

Results from our manipulative study suggest that only under particular scenarios of algal change will composition of associated epifauna be influenced. Therefore, it is not surprising that our observational study did not reveal any linkages between algal biodiversity and epifaunal diversity, because no lowdiversity seaweed assemblages were encountered in observational plots.

4.2. The implications for invertebrates of changes in seaweed biodiversity

Under most scenarios, it appears that invertebrate epifauna assemblages are robust to changes in seaweed biodiversity. However, it is interesting to note that the type of seaweed assemblage that we demonstrate to have an influence on invertebrate diversity is similar to the increasingly field-observed 'green tide' phenomenon. This suggests that if green tides continue to become more widespread, there is potential for changes in seaweed biodiversity to influence invertebrate assemblages. It is also worth noting that even though host-specificity does not appear strong in this system, seaweeds do provide habitat for myriad invertebrates and if seaweed cover were to be entirely lost, this could be detrimental to associated invertebrate epifauna (Walker and Kendrick, 1998), and to larger invertebrates and fish that feed on seaweed-associated epifauna.

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