

Effects of Spatial and Temporal Variability of the Kelp Canopy on Community Structure

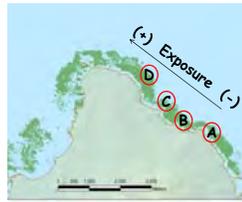


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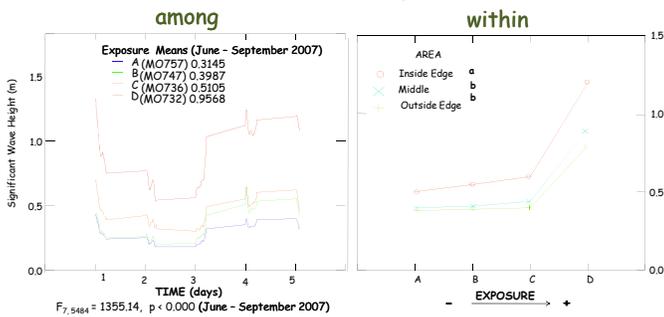


Introduction

Spatial and temporal variation in the structure of ecological communities is often associated with environmental gradients across multiple spatial and temporal scales. These patterns of community structure depend on a complex interplay between environmental gradients and the relative importance of species interactions that occur across environmental stress gradients. Along the Monterey Peninsula two environmental gradients of exposure from oceanic swell exists: among forests along a gradient of exposure to ocean swell, and within forests along a gradient of exposure from the outer section to the more protected inshore sections.



The Oceanic Swell Exposure Gradient



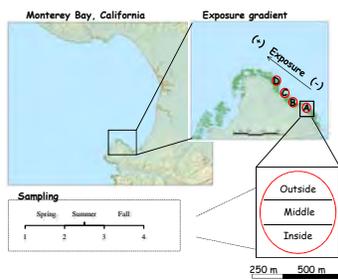
Questions

- how does the structure of the canopy habitat vary along an environmental gradient of swell exposure?
- what is the contribution of the exposure regime to variability in the invertebrate community?
- are total abundance of invertebrates, evenness and species richness correlated with habitat structure?
- is a positive interaction provided by *Membranipora* spp. contributing disproportionately more to the variation in invertebrate community than the habitat structure?

Methods

Four 60m³ transects within 3 locations (outside, middle & inside) for kelp forest along the exposure gradient over three seasons (Spring, Summer & Fall)

Observations- Habitat Structure, Invertebrate Community and Positive Interactions



Habitat Structure

Observations- density of *Macrocystis* sporophytes, number of fronds/ sporophytes and blade concentration

Invertebrate Community

Observations- collection of canopy associated invertebrates collected in 250µ mesh net (8 replicates /location)

Positive Interactions

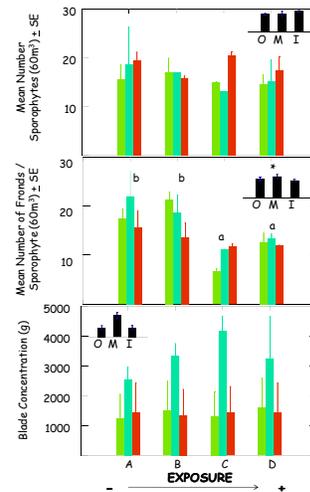
Observations- density of *Membranipora* (dry wet weight in g) on blades

Experimental Manipulation- invertebrate community (H', S, N and J) are from caged experimental manipulations of kelp habitat with and without *Membranipora*, where the environmental gradients does not influences the community composition

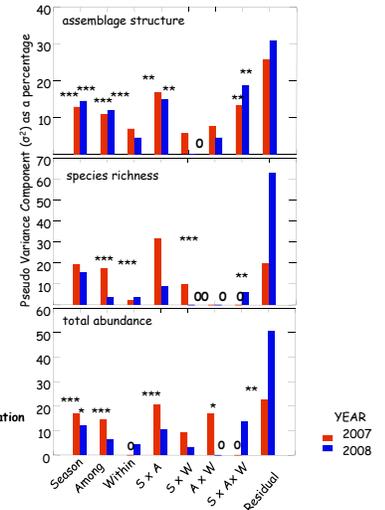


Results

Habitat Structure



Invertebrate Community



Sizes of pseudo multivariate variance components (σ^2 as %) for multivariate measures calculated from estimated mean squares. Scales of significant variation from the permutational multivariate analysis of variance (PERMANOVA) and ANOVA analyses: * p<0.05; ** p<0.01; *** p<0.001. (0) denotes a negative variance component.

Positive Interactions

Observations

Stepwise multiple regression (forward)

Dependent Variable	Steps	Independent Variable	Std. Coeff.	Tolerance	Partial r ²	Total r ²	P
Species Richness	1	Membranipora	0.450	1.0000	0.5515	0.0000	
	2	Fronds / Sporophyte	0.091	0.9965	0.016	0.5675	0.0389
Total Number of Individuals	1	Membranipora	0.298	1.0000	0.3106	0.0000	
	2	Sporophyte #	-0.017	0.9838	0.0686	0.3792	0.003
Evenness	1	Membranipora	0.145	1.0000	0.421	0.0000	
	2	Fronds / Sporophyte	0.0381	0.9965	0.1357	0.0000	
	3	Sporophyte #	-0.01	0.9744	0.111	0.5678	0.0857

Experimental Manipulations

Two sample t- test for measures of invertebrate community and presence of *Membranipora*. Mean for each variable represented with the (standard deviation).

Variable	Membranipora	No Membranipora	P
Membranipora (g)	0.9024 (0.11)	0.1134 (0.16)	0.0000
H'	1.66 (21)	1.14 (14)	0.0027
S	15.8 (1.3)	8.4286 (1.27)	0.0000
N	2395 (935.62)	878.4286 (434.38)	0.0184
J	0.6037 (0.08)	0.3568 (0.13)	0.0029

Conclusions

- strong differences in physical structure of the canopy habitat and invertebrate communities among forests along the gradient of oceanic swell but not within forests.
- kelp forests that are most exposed to swell supported the greatest total abundance, species richness, and markedly different invertebrate communities in comparison to kelp forests more protected from oceanic swell.
- effects of increased physical stress along the gradient of oceanic swell were ameliorated by the increasing abundance of an epiphytic bryozoan (*Membranipora* spp.).
- this association occurs disproportionately more in the kelp forests with the greatest exposure to oceanic waves. In turn, in absence of oceanic swell, presence of *Membranipora* significantly increase total abundance, species richness, species evenness and diversity of invertebrates.

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