Regional patterns of macrofaunal diversity and abundance determined by antagonistic ecosystem engineers in soft-sediment intertidal habitats

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Organisms as ecosystem engineers

Jones et al. 1994

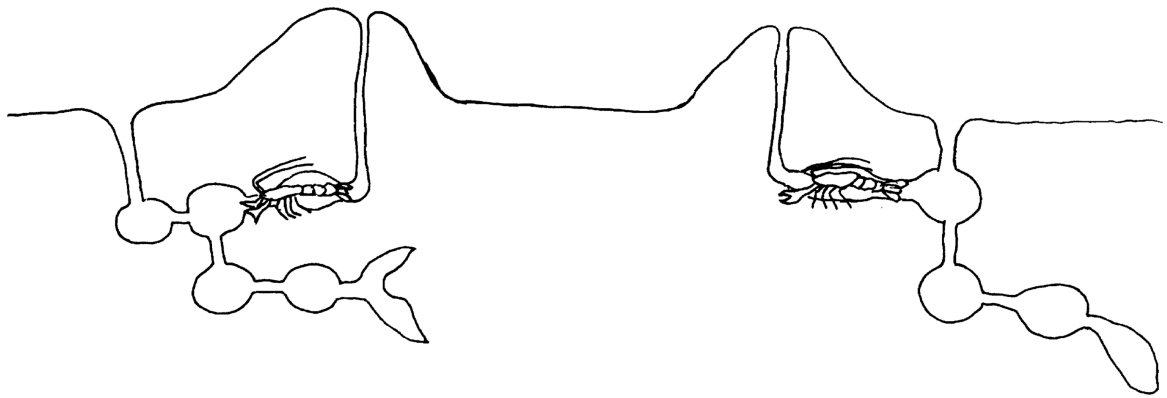
- Physical processes that are not directly trophic or competitive.
- Modification, maintenance and / or creation of habitats.
- Profound impact on the availability of resources.
- Autogenic engineers: through their own physical structures.
- Allogenic engineers: through their behaviour and activity.

Intertidal ecosystem engineers

Burrowing shrimps

- Burrow construction & maintenance
- Deposit - feeding
- Bioturbation & sediment disturbance

→ Reduced abundance and diversity of associated fauna



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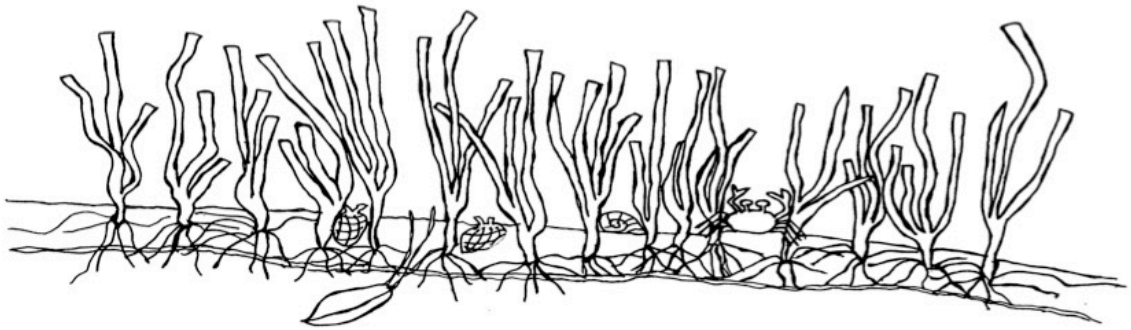
Intertidal ecosystem engineers

Seagrasses

- Production of shoots, leaves, roots
- Above-ground habitat
- Buffering of flow & sediment stabilisation

→ Increased abundance and diversity of associated fauna



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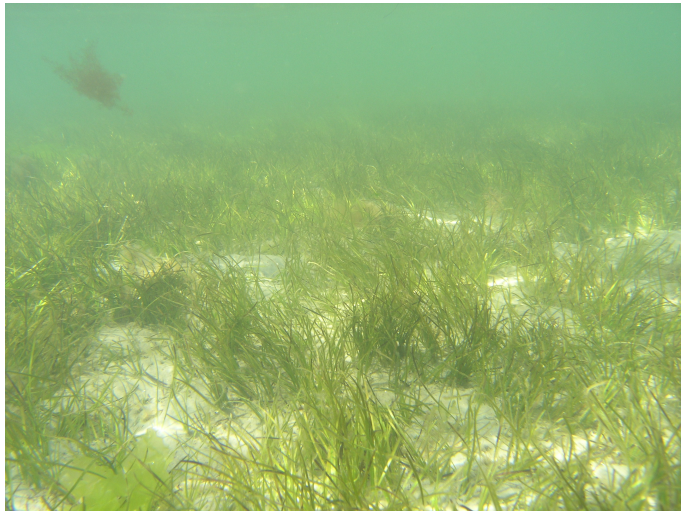
Antagonistic ecosystem engineers

Burrowing shrimps

- Allogenic ecosystem engineers > impacts via their behaviour and activity

Seagrasses

- Autogenic ecosystem engineers > impacts via own physical structures



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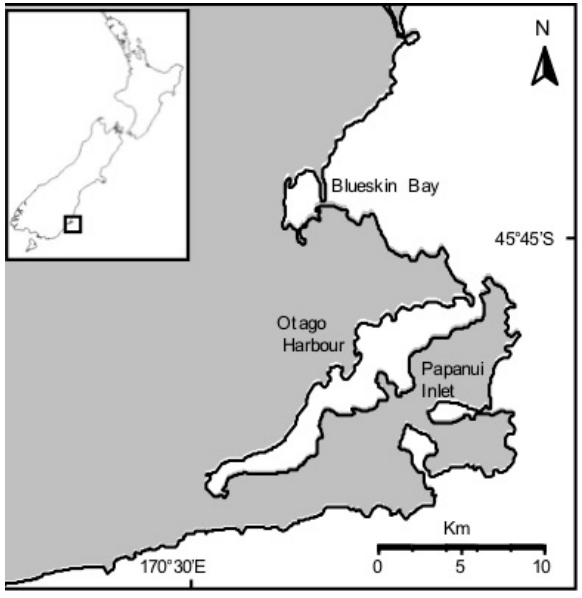
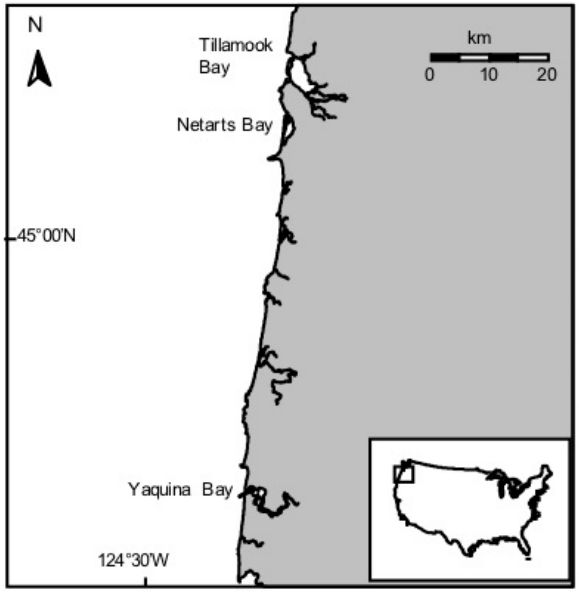
Burrowing shrimps vs seagrasses



Southeastern NZ

- Papanui Inlet
- Blueskin Bay
- Otago Harbour



Pacific Northwest

- Netarts Bay
- Yaquina Bay
- Tillamook Bay

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Burrowing shrimps vs seagrasses

NZ & USA

Shrimp vs seagrass

Biffarius filholi $\leftrightarrow$ *Zostera muelleri*
Neotrypaea californiensis $\leftrightarrow$ *Zostera japonica*

Within each inlet in each region

High shrimp Hs: $>$40 mounds per m^2.
Low shrimp Ls: $<$20 mounds per m^2.
High seagrass Hz: 8000 shoots per m^2.
Low seagrass Lz: 2000 shoots per m^2.
Mixed shrimp / seagrass Sz: 10–20 mounds & 4000 shoots per m^2.

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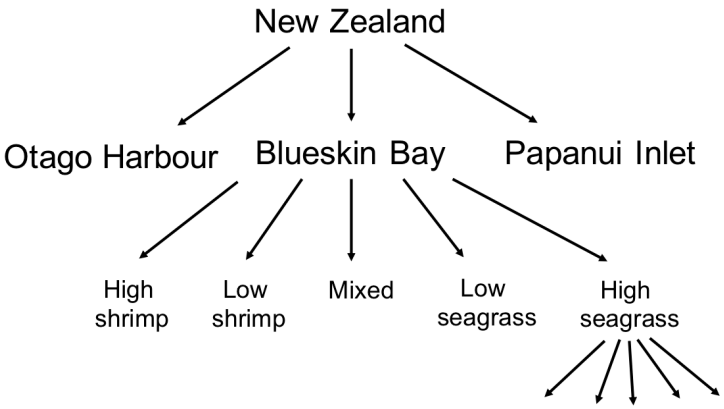
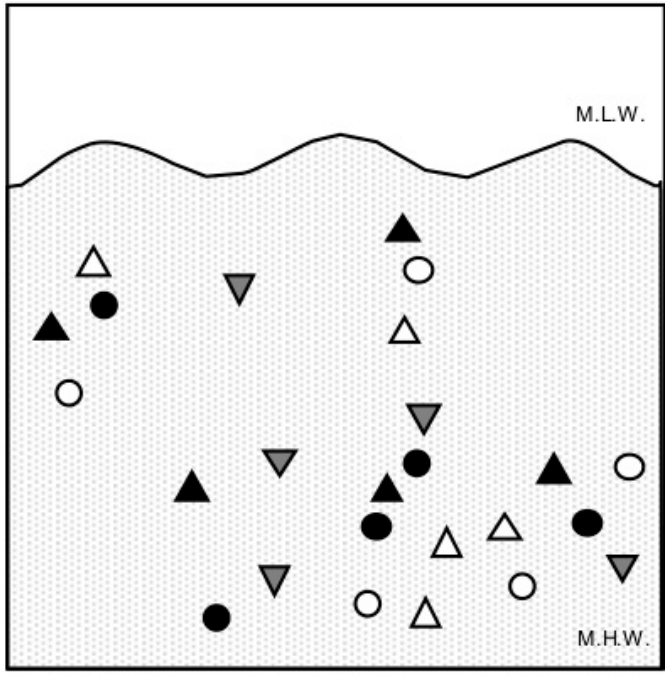
Intertidal sampling

Set up





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Intertidal sampling

Summer & winter

Macrofaunal assemblage (>500 micron)

Habitat variables:

- Seagrass biomass (above- and below-ground: shoots, leaves, dry weight)
- Shrimp (mound density, bioturbation rate)
- Sediment (chlorophyll *a*, grain size, organic content, CHN)

Multivariate analysis (Berkenbusch & Rowden 2007).
Univariate analysis (current study).

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Multivariate analysis**

Macrofaunal assemblages:

- distinctly different between shrimp & seagrass sites.
- distinctly different between shrimp & mixed sites.
- similar between seagrass & mixed sites.

Consistent differences in each region.
Consistent differences in summer and winter.

**Berkenbusch & Rowden (2007). Aquatic Ecology 41:129–147.

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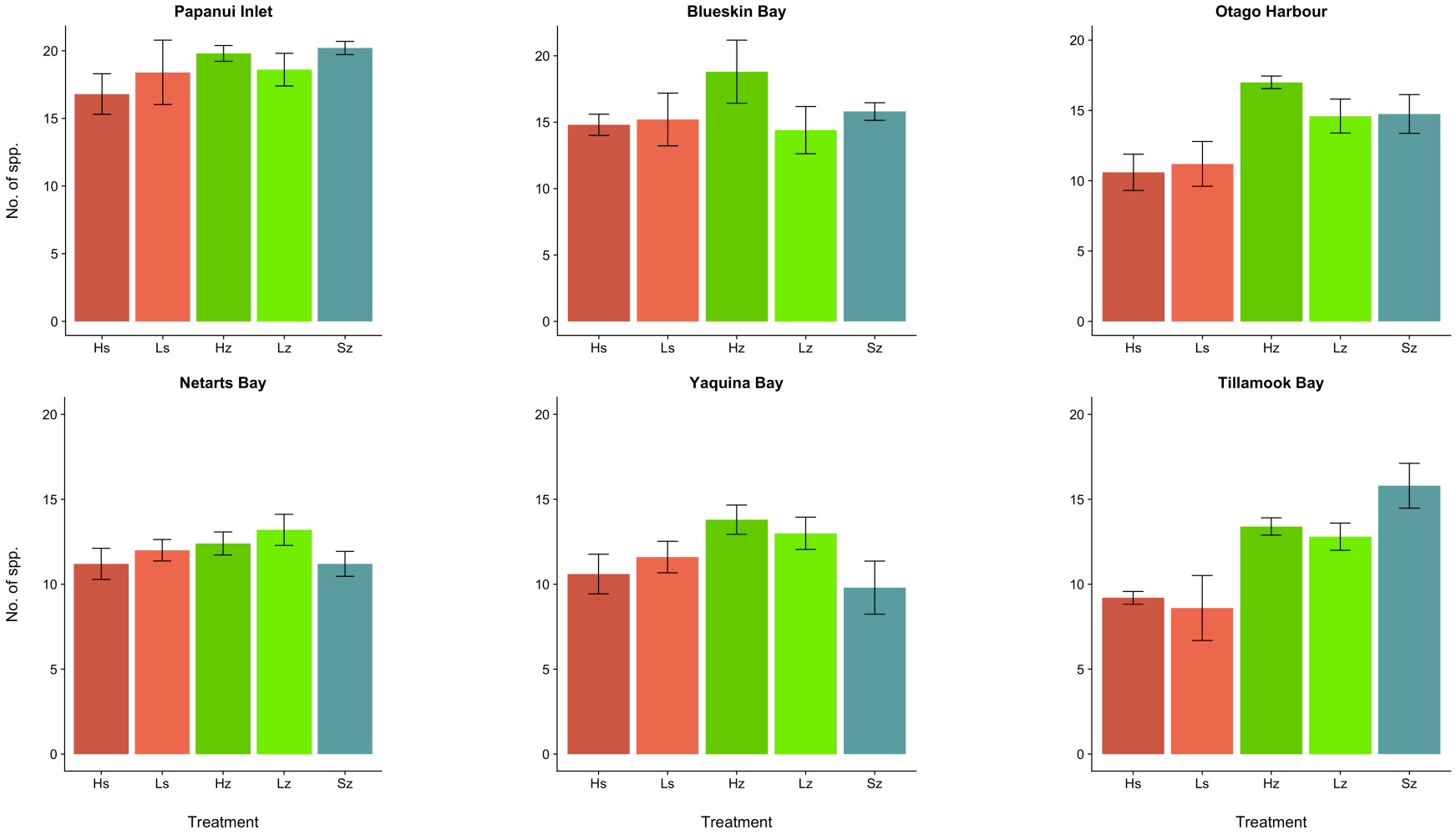
No. of species

Summer



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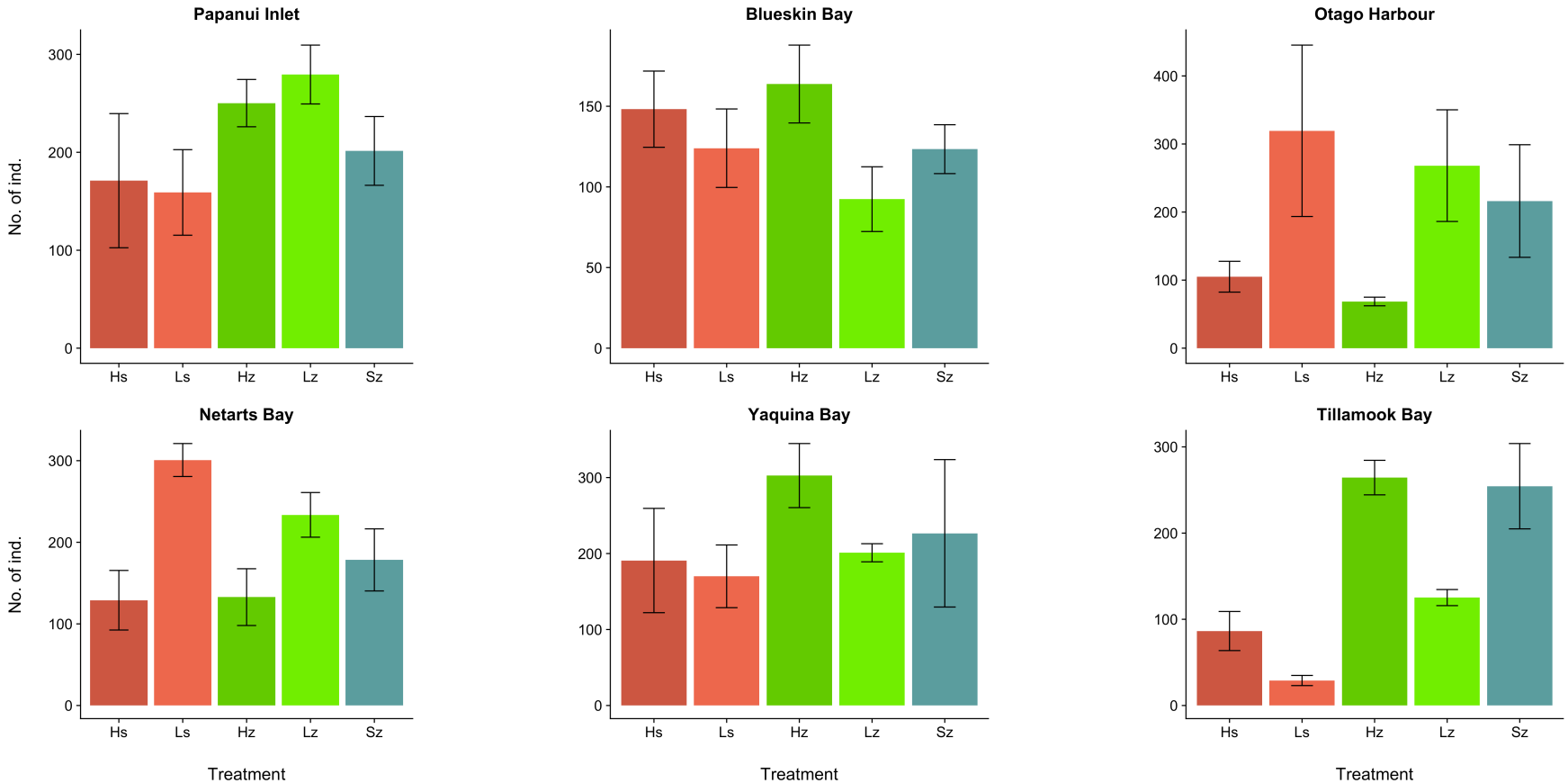
No. of indviduals

Summer



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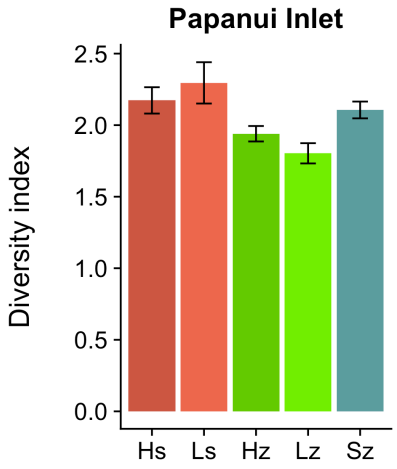
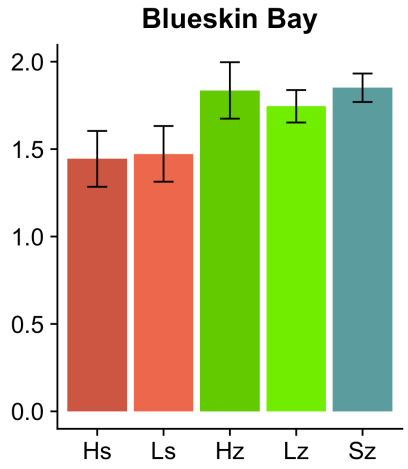
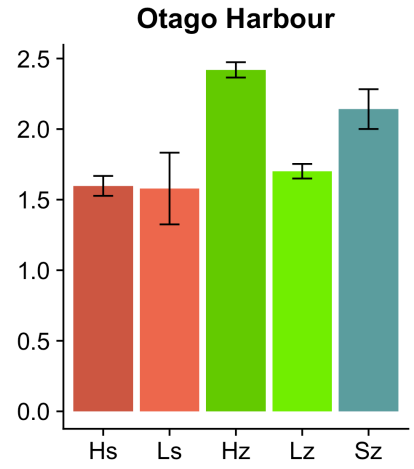
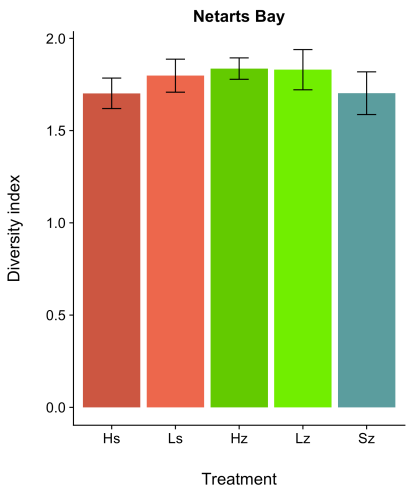
Diversity

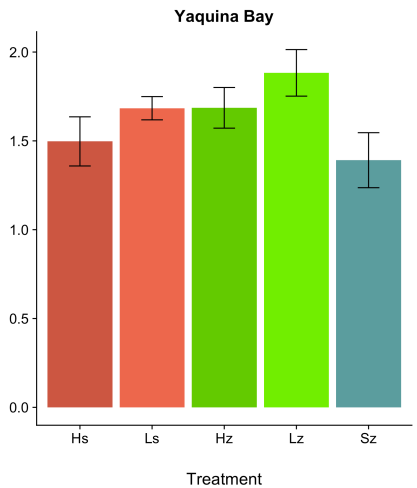
Summer

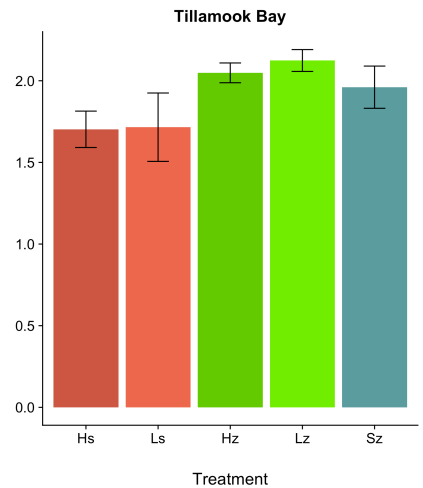












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Summary

Preliminary assessment of patterns in univariate indices.

- Some differences between burrowing shrimp and seagrass sites.
- No universal pattern across sites and treatments (at least not in summer).

Acknowledgments

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