**Does turbidity or genetics account for morphological differences in eelgrass (Zostera marina) at two sites near Liberty Bay?**

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**STUDY GOALS**

The rooted marine plant Zostera marina (eelgrass) shows a high degree of phenotypic plasticity in response to environmental conditions. Our goal was to explore whether light limitation and/or genetics could account for morphological differences between two populations of Z. marina growing near Liberty Bay.

**BACKGROUND**

Eelgrass is important to many ecosystems because it provides habitat; it modifies physical and sedimentary processes; it alters sediment geochemistry; and it is a significant dietary carbon source. Because eelgrass is sensitive to water column turbidity, nutrient loading, and sea-level oxygen, it is considered an indicator of coastal water quality.

A site assessment of biological resources in and around Liberty Bay in April 2006 showed that, despite the presence of suitable beaches, there was no eelgrass growing inside Liberty Bay north of Hoyt and Lemno. There was a small friable bed of Z. marina on the western shore of Point Bolin (PB) and an extensive Z. marina meadow on Agate Passage near Sandy Hook (SH) (Fig. 1). Z. marina plants at PB were unusually small (Fig. 2) and were limited to a very narrow depth range, 1–1.5 m (MLLW). At low tide boat wakes impinged on the shore and resuspended bottom sediment, increasing turbidity over the PB eelgrass bed. Z. marina plants at SH were large (Fig. 2) and extended to depths of 4–5 m (MLLW). Tissue movement was vigorous at SH due to strong tidal currents in Agate Passage.

**HYPOTHESES (Fig. 3)**

1. Small plant size and narrow depth range of Z. marina at PB reflect a sub-optimal light environment. 2. Wakes from Liberty Bay boat traffic created higher turbidity levels at PB compared to SH.

**METHODS**

Field measurements were made in and around Liberty Bay. To measure morphological differences, leaves were collected at 2 m intervals along a 100-m alongshore transect. Genetic diversity, degree of clonality, and edaphic richness of eelgrass beds were determined by comparing the polymorphism of ten DNA microsatellite loci characteristic of Z. marina (Reusch et al., 1996).

**RESULTS**

- **Bed sediment grain size**: Bed sediment under the PB SLOB had a slightly larger mean grain size (σSB = 0.48) and was less well sorted than bed sediment under the SH SLOB (σSB = 2.00) (Fig. 4). The beach elevation at the PB SLOB was about 0.2 m higher than that of the SH SLOB (Table 1).
- **Boat wakes**: Boat wakes were apparent in the pressure (water depth) record as an increase in variance lasting several minutes (Fig. 7). The pressure record was ground-truthed by documenting boat wake events during a 2-hour window on May 16. Some boat wakes were followed by higher turbidity, but there was more variability in the SSC records than could be accounted for entirely by boat wakes (e.g., Fig. 8).
- **Genetics**: The eelgrass bed at PB was genetically richer than the bed at SH. There were 30 different genotypes at PB compared to only 12 genotypes at SH. Small plants at PB were less effective in attenuating currents and waves. Individual plants at PB were also more genetically diverse than those at SH. Eelgrass at SH primarily reproduced clonally via rhizome branching while PB eelgrass appeared to reproduce primarily by flowering and seeding establishment. Small plants at PB could have been an annual population; an annual life cycle is in growth strategy in disturbed environments (Phillips et al., 1983).

**SIGNIFICANCE**

- Lower light levels could have accounted for smaller leaf sizes at PB.
- Boat wakes were not the only cause of higher turbidity at PB.
- **Possible explanation**: Turbidity increased with depth (PB sensor was 14 cm closer to the bed than SH sensor). Small leaves at PB were less effective in attenuating currents and waves. PB experienced more southerly winds than SH.
- **Advection of sediment**: Sediment plumes from mouth of creek are reflected into PB.
- Pressure/OBS sensors were an effective way to monitor boat wake impingement on the shore.
- **Conclusion**: Higher genotypic richness in the PB eelgrass bed, indicative of generative (flowering) rather than vegetative (clonal) reproduction, suggests a population subject to greater physical disturbance than at SH.  
