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Elliott Bay Seawall Habitat Features -- Initial Monitoring Results for Nearshore Ecosystem

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Elliott Bay Seawall Innovative Habitat Design: Initial Results of Monitoring the Nearshore Ecosystem

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OVERVIEW

The Elliott Bay Seawall protects the downtown Seattle urban waterfront from storm and seismic forces. The Seattle Department of Transportation completed the 6-year replacement of the southern half of the seawall in 2019.

The Seattle urban waterfront is the migratory corridor for the majority of salmon from the Green/Duwamish River system to the south, including Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*O. mykiss*) listed as threatened species under the Endangered Species Act.

As part of the seawall replacement, several innovative habitat features were installed to improve the urbanized marine nearshore ecosystem: 1) light-penetrating sidewalks; 2) a textured seawall face with shelves; and 3) an intertidal habitat bench and beach.

The objectives of the habitat features are to:

1. Create an effective intertidal migratory corridor for juvenile salmon
2. Increase the marine nearshore ecosystem quality and function

This poster provides the initial results of monitoring in 2018 for Objective 2—algal and invertebrate colonization under the sidewalk and on the textured seawall. The University of Washington is providing results of monitoring for Objective 1 in a separate paper. Monitoring was conducted per the requirements identified in the *EBSP Post Construction Monitoring and Adaptive Management Plan* (Tetra Tech 2013) and the *EBSP Post Construction Monitoring and Adaptive Management Plan Update* (SDOT 2017).

Uncovered Aquarium Seawall Shelf Samling in August 2018

Covered Aquarium Shelf Sampling in August 2018

1. METHODS

Invertebrate and Algal Attachment on the Textured Seawall

Sampling was conducted using quadrat sampling following the methods described in Goff (2010). Sampling occurred at two monitoring sites (Aquarium and Pier 55) in uncovered areas and behind piers at four elevations relative to MLLW.

All algae and invertebrates within quadrats were identified to species or family, and percent cover of the quadrat was recorded. Sampling occurred in April, June, and August 2018 during low tides.

Macroalgae Growth Under the Light Penetrating Sidewalks

Sampling was similarly conducted following the methods described in Goff (2010), but only documenting macroalgae species/families. Sampling occurred at the same two monitoring sites (Aquarium and Pier 55) in uncovered areas and behind piers, but on the intertidal bench. Sampling was conducted in August 2018.

Seawall Face Sampling Transects in Uncovered Area at Pier 55

Habitat Bench Sampling Transect in Uncovered Area at Pier 55

2. RESULTS

Invertebrate and Algal Attachment on the Textured Seawall

A total of 20 species or families of algae or invertebrates were recorded in 2018 (Table 1). Average percent cover ranged from less than 20% to over 75%, with cover increasing from April to August. More species were typically observed in uncovered areas (particularly algae) than in covered areas during all months of sampling. Prior to installation of light-penetrating sidewalks and textures on the seawall, no algae and few invertebrates were observed in covered areas. The species diversity is lower than that observed by Goff (2010) on test panels in open areas during 2008 and 2009. Monitoring will continue in 2020 and 2022 to provide statistical comparisons and results in meeting predicted targets.

Acorn barnacle (*Balanus glandula*) and thatched barnacle (*Semibalanus cariosus*) were the most common species observed, in both covered and uncovered areas. Limpet presence was low during April surveys and increased during June and August monitoring. Mussel presence also increased between April, June, and August. Green string lettuce (*Ulva linza*), sea lettuce (*Ulva* sp.), black tar (*Mastocarpus papillatus*), and biofilm were frequently observed, whereas red algae (*Porphyra* sp. 1 and *Porphyra* sp. 2) and rockweed (*Fucus disticus*) were observed less frequently.

Macroalgae Growth Under the Light Penetrating Sidewalks

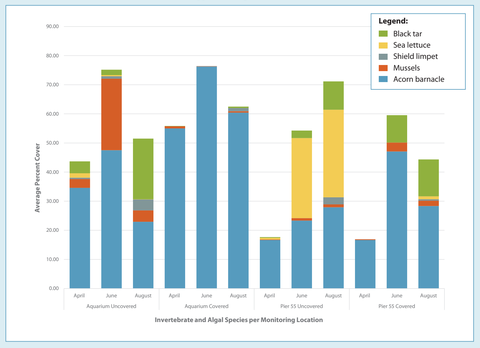
A total of nine species of macroalgae were recorded in 2018 on the intertidal bench (Table 1). At the uncovered bench locations at the Aquarium and the Pier 55 sites, sea lettuce was the most common species observed during the August 2018 monitoring and average percent cover was approximately 75%. Turkish washcloth (*Mastocarpus papillatus*) was also observed at the benches of both sites. Iridescent weed (*Mazaella splendens*) and red hair (*Bangia* sp.) were observed at the Pier 55 site. Green string lettuce was observed on the expanded bench of the Aquarium north site. Two species were observed at the covered bench areas of the Aquarium and Pier 55 sites with less than 10% average cover.

Invertebrate and Algal Species/Families Documented in 2018

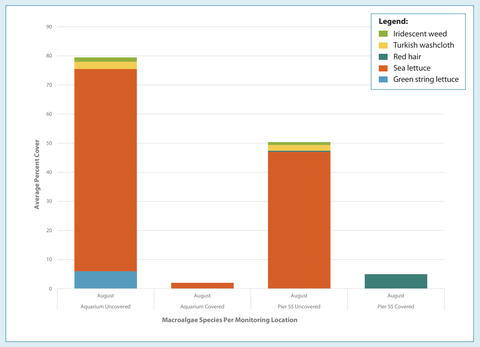
Scientific Name	Common Name	Aquarium Site		Aquarium Bench		Pier 55 Site		Pier 55 Bench	
		Covered	Uncovered	Covered	Uncovered	Covered	Uncovered	Covered	Uncovered
Sessile Invertebrates									
Balanus crenatus	Crenulated barnacle	X				X	X		
Balanus glandula	Acorn barnacle	X	X			X	X		
Chthamalus dalii	Little brown barnacle					X	X		
Semibalanus cariosus	Thatched barnacle	X	X			X	X		
Ascidiacea	Ascidian/Sea squirt		X			X	X		
Bryozoan	Bryozoan	X				X	X		
Mytilus sp.	Mussels	X	X			X	X		
Tube worms[a]	Tube worms					X			
Mobile Invertebrates									
Lottia pelta	Shield limpet	X	X			X	X		
Tectura scutum	Plate limpet		X			X	X		
Littorins sp.	Snails/Periwinkles		X			X			
Mopalia muscosa	Mossy chiton					X			
Foliose Algae									
Porphyra sp. 1	Red algae						X		
Porphyra sp. 2	Red algae		X				X		
Ulva linza	Green string lettuce	X	X			X	X		
Ulva sp.	Sea lettuce		X	X	X	X	X		X
Filamentous Algae									
Bangia sp.	Red hair		X				X	X	X
Corticated Macrophytes									
Mastocarpus papillatus	Black tar	X	X		X	X	X		
Mazaella splendens	Iridescent weed							X	X
Leathery Macrophytes									
Fucus disticus	Rockweed		X				X		
Microalgae									
Biofilm[b]	Diatoms, bacteria		X			X	X		
TOTALS		**8**	**14**	**1**[c]	**2**[c]	**16**	**17**	**2**[c]	**3**[c]

Notes:
a. Tube worm observations were empty casings.
b. Biofilm covers bare areas and species.
c. Only macroalgae species were documented on benches. Expanded bench at Aquarium not documented here, but four species of macroalgae observed in uncovered areas.

Average Percent Cover of Five Most Common Invertebrate and Algal Species



Average Percent Cover of Five Most Common Macroalgae Species



3. DISCUSSION

While a vertical seawall and a narrow intertidal habitat bench do not restore natural Puget Sound beach and bluff conditions, these features can improve marine nearshore ecosystem productivity and functions for invertebrates and fish species. In highly urbanized areas, providing increased productivity and a more suitable migratory corridor can improve rearing and feeding and reduce mortality of ESA-listed salmonids and other species in an otherwise inhospitable landscape.

The marine nearshore of Puget Sound, including Elliott Bay, supports a rich and diverse assemblage of submerged aquatic vegetation, including seaweeds (such as green, brown, and red macroalgae) and seagrass. Light requirements of submerged aquatic vegetation is a complex topic and has been researched in Puget Sound (Simenstad et al. 1997; Thom et al. 2008). The light requirements of submerged aquatic vegetation are often described as a percentage of light available at the water surface (Shafer 2002). The minimum light requirements for most marine macroalgae is on the order of 0.1% to 1% of the irradiance at the water surface (Zimmerman 2007). As measured by the University of Washington, the light-penetrating sidewalks have increased light behind the large pier structures along the waterfront by 0.5% to 2.4% of ambient photosynthetically active radiation. This level of light should support macroalgal colonization and growth—monitoring demonstrates macroalgae colonization.

The textured seawall panels and intertidal habitat bench provide suitable surfaces for colonization by a diverse assemblage of algae and invertebrate species. Test panels monitored by Goff (2010) in 2008 and 2009 in open areas showed an increase in species diversity and cover over two to three years, so it is likely that continued monitoring will show increased diversity and cover of macroalgae and invertebrates.

REFERENCES

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