APPENDIX F

Nearshore Habitat Assessment Data Report
Grette Associates, LLC

RICH PASSAGE PASSENGER ONLY FAST FERRY STUDY

DRAFT NEARSHORE HABITAT ASSESSMENT DATA REPORT

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1 INTRODUCTION

Initial trials of a low-wake, foil-supported catamaran began within Rich Passage, east of Bremerton, Washington in early February 2005. The aim of these field trials is to study wake generation by this type of low-wake, high speed vessel and to identify potential shore response. Effects of vessel wake and run-up on the biological community in the intertidal and shallow subtidal zone [Mean Higher High Water (MHHW; approximately +11.5 based on Clam Bay) to –8.0 ft Mean Lower Low Water (MLLW)] were last investigated in 2001 (WSDOT 2001), and included natural resource investigations such as intertidal habitat surveys, benthic infaunal studies and aquatic vegetation (kelp, macro-algae and eelgrass) surveys. A biological survey of sites within Rich Passage was conducted in January, 2005 before the high-speed vessel trials began. The purpose of the current survey was to obtain winter baseline information on the existing biological community and nearshore habitat in Rich Passage for comparison with future surveys during and after the vessel trials.

2 BACKGROUND

Passenger-only ferry service was first implemented between Seattle and Bremerton by Washington State Ferries (WSF) in 1985. Shortly after service began, waterfront property owners along Rich Passage reported changes to the shoreline from ferry wakes including erosion of sand and gravel beaches, damage to bulkheads and property, and loss of clam beds, kelp beds, and crabs. WSF responded by restricting passenger-only ferry speeds in Rich Passage to 12 knots (kt).

In 1998, the Chinook-class passenger-only ferry was introduced on the Seattle – Bremerton route. This boat, with a catamaran-style hull and water-jet engines, was designed to travel at speeds 34-37 kt and meet wake criteria limiting maximum wave height and energy. However, Rich Passage property owners filed a lawsuit alleging bulkhead damage, beach erosion, and biological damage caused by ferry wakes, and speeds were again reduced to a maximum of 12 kt through Rich Passage. Passenger-only ferry service was suspended in February 2003 due to budget shortfalls, but private operation of a passenger-only ferry resumed in August, 2004. That ferry also slows through Rich Passage. Car ferries and naval vessels have continued to operate at normal speeds in Rich Passage throughout this time period.

3 SURVEY METHODS

3.1 Types

In order to assess the biological community and nearshore habitat, a number of parameters were surveyed at each of six study sites. The physical composition of substrate at the surface and approximately 1-2 inches below the armoring layer was assessed, both quantitatively and qualitatively. The biological community composition was evaluated in terms of macroalgae and macroinvertebrate presence and percent cover. Invertebrates living within the substrate (infauna) were also quantified. Due to seasonal die-back, eelgrass and kelp beds were not delineated during the current survey.

At each study site, a transect line was established from MHHW to -5 ft MLLW using a 300-ft fiberglass measuring tape. The tape was anchored at the onshore location established using GPS

coordinates provided by Pacific International Engineering (Table 1). The tape was then stretched out from shore to a depth of approximately -8 ft MLLW.

Surface substrate composition was observed within a 0.25 m^2 quadrat placed every 15 feet along the transect tape from the onshore edge to -5 ft MLLW. The quadrat was placed with the bottom edge at the specified survey distance, and always on the right side of the tape facing away from shore. Within these quadrats, algae were identified to genus and percent cover estimated. Surface invertebrates were identified and enumerated; barnacle abundance was estimated as percent cover.

Four sediment cores were taken at three locations along each transect, within the uppermost, lowermost, and midpoint quadrats of the transect. The core sampler was 4 inches in diameter and 6 inches deep. Where the substrate was composed of 100% bedrock within the quadrat, cores were not taken. One core from each location was set aside for grain size analysis. This core was taken after removing the uppermost armoring layer of substrate, approximately 1-2 inches deep. These samples were stored on ice or frozen until delivery to AmTest labs for analysis. Grain size analysis was performed following standard ASTM D-422 protocols. The remaining three cores from each site were sieved using a 0.5 mm mesh sieve. Infauna was removed from the sample and preserved in 5% formalin with rose bengal stain.

Appendix C contains the grain size analysis results, quality control summary, methodology report, and hydrometer plots.

3.2 Locations

Six sites were chosen as survey locations, including Manette Beach (#1), Point White (#3) and (#5), Point Glover (#9) and (#10), along with a reference site, Crystal Springs (#12) (Figure XX). Site numbers are consistent with beach monitoring sites established by the WSF Rich Passage Wave Action Study Team (RPWAST) during previous studies conducted in Rich Passage (RPWAST 2001). Site 1 is an east-facing beach north of Bremerton on the Kitsap Peninsula. Site 3 and Site 5 are located on the south shore of Bainbridge Island, facing south east. Site 9 and Site 10 are located across Rich Passage from Sites 3 and 5 on the south shore, facing north and north west. Finally, Site 12 is located on the west shore of Bainbridge Island, facing west. This site is not subjected to frequent wakes from ferries but is subject to tidal and wind driven forcing mechanisms and was therefore used as the reference site. These six sites were last surveyed in May of 2000 and 2001 (RPWAST 2001). Sites 1, 3, 9, and 12 were also surveyed in October and November 1999 (WSDOT 2000), and Sites 3, 5, and 9 were qualitatively observed by BioAquatics in March and April of 1999.

Table 1. Transect End Point Coordinates (NAD 83).

Transect, Point	Easting	Northing
Study site #1, start point	1203476.71	214336.51
Study site #1, end point	1203748.99	214043.48
Study site #3, start point	1212997.81	220564.98
Study site #3, end point	1213255.11	220258.72
Study site #5, start point	1214319.81	221951.53
Study site #5, end point	1214681.18	221780.03
Study site #9, start point	1216385.24	219726.84

Study site #9, end point	1216555.12	220088.97
Study site #10, start point	1213792.87	218872.23
Study site #10, end point	1213560.12	219197.54
Reference site #12, start point	1210690.96	226212.96
Reference site #12, end point	1210291.35	226230.66

3.3 Schedule

These six sites were surveyed over two days in January 2005. Sites 1, 3, and 12 were surveyed between 10:00 am and 4:00 pm on January 25; Sites 5, 9, and 10 were surveyed between 9:00 am and 1:00 pm on January 28.

4 SURVEY RESULTS

Several species of macroalgae and invertebrates were observed at the six sites in Rich Passage (Table 2). The distribution of these species at each site is discussed below, along with surface substrate observations and results of grain size and benthic infauna analyses.

Table 2. Macroalgae and invertebrates observed within intertidal quadrats in Rich Passage, January 2005.

Common Name	Scientific Name
Ulvaria	*Ulvaria fusca*
Ulva	*Ulva fenestrata*
Bleached brunette	*Cryptosiphonia woodii*
Iridea	*Mazzaella splendens*
Turkish towel	*Gigartina exasperata*
Sargassum	*Sargassum sp.*
Colander kelp	*Agarum fimbriatum*
Prionitis	*Prionitis spp.*
Rockweed	*Fucus distichus*
Nudibranch	*Nudibranchia*
Limpet	*Lottidae*
Chiton	*Mopalia sp.*
Snail	*Trochidae*
Moon snail	*Polinices lewisii*
Scallop	*Pectinidae* *Limidae*
Lyre crab	*Hyas lyratus*
Dungeness crab	*Cancer magister*
Hermit crab	*Pagurus sp.*
Decorator crab	*Oregonia gracilis*
Anemone	*Metridium senile*
Sea star	*Pisaster ochraceus*
Barnacle	*Chthamalus sp.* *Balanus sp.*
Tube worm	*Sabellidae* *Serpulidae*

4.1 Site 1

4.1.1 *Substrate Composition*

The transect at Site 1 extended 180 ft from +16 ft to -5 ft MLLW (Figure 1a). The substrate on the upper beach was composed primarily of gravel. Between 75 and 105 feet along the transect (+4 to +1 ft MLLW), the substrate was dominated by sand with some gravel or cobble. Beyond 120 ft on the transect (below 0 ft MLLW), substrate was again dominated by gravel, with some sand intermixed. WSDOT characterized the beach material at this site as fine gravel in 2000 and 2001 (WSDOT 2001).

4.1.2 *Vegetation Cover*

The upper beach was devoid of aquatic vegetation. Few species were observed along the transect in general, but those present included *Ulvaria*, bleached brunette (*Cryptosiphonia woodii*), *Mazzaella*, and *Sargassum*. Vegetation cover did not exceed 10 percent in any quadrat.

4.1.3 *Macroinvertebrates*

Few macroinvertebrates were observed at Site 1. All invertebrates were seen beyond 75 ft on the transect tape. Anemones were present in the middle of the transect. Eight individuals each were counted in the quadrats located at 75 and 90 ft, covering less than 5% of the quadrat area. Barnacles were present at 90 and 135 ft, covering 1-2% of the area at the lower station. Mobile invertebrates were observed at the lower extent of the transect, and included lyre crabs (*Hyas lyratus*), limpets, sea stars, and a Dungeness crab (*Cancer magister*).

4.1.4 *Grain Size Analysis*

Grain size analysis at this site revealed that substrate at the upper station was composed of 97.6% gravel, 1.5% silt, 0.8% silt, and 0.1% sand. The middle station was composed of 68.9% sand, 27.3% gravel, 3.1% clay, and 0.6% silt. Results from the lower station showed 50.8% sand, 42.1% gravel, 4.3% silt, and 2.8% clay.

4.1.5 *Benthic Infauna*

Benthic infauna analysis is ongoing and taxanomic results are forthcoming.

4.2 Site 3

4.2.1 *Substrate Composition*

The beach at Point White was almost non-existent at high tide. The shore sloped steeply away from an onshore elevation of +14 ft, leaving a transect length of only 105 ft before reaching -5 ft MLLW. The substrate on the upper beach was composed of gravel, transitioning to a combination of cobble and gravel in the mid-reaches (+6 to +1 ft MLLW), and was composed increasingly of sand at the end of the transect (below 0 ft MLLW). The substrate at this site had been previously characterized as coarse and medium sand in 2000 and 2001, respectively (WSDOT 2001).

4.2.2 *Vegetation Cover*

Vegetation was lacking in the upper intertidal zone. Beyond 75 ft on the transect, *Ulva*, bleached brunette, *Mazzaella*, *Sargassum*, Turkish towel (*Gigartina exasperata*), and an unidentified red

alga were observed. The percent cover increased with depth: at 75 ft, vegetation cover was no more than 1%, increasing to 25% at 90 ft, and finally reaching 45% at the end of the transect. No kelp bed was observed from the transect.

4.2.3 *Macroinvertebrates*

Few macroinvertebrates were observed at this site. All were seen beyond 45 ft. Barnacles were seen in the middle of the transect, covering approximately 5% of the quadrat area. Hermit crabs, snails, and a chiton were also noted.

4.2.4 *Grain Size Analysis*

Grain size analysis at this site revealed that substrate at the upper station was composed of 55.7% gravel, 41.2% sand, 1.6% clay and 1.4% silt. The middle station was composed of 86.3% gravel, 10.7% sand, 1.5% clay, and 1.4% silt. Results from the lower station showed 82.0% gravel, 15.1% sand, 2.1% clay, and 0.7% silt.

4.2.5 *Benthic Infauna*

Benthic infauna analysis is ongoing and taxanomic results are forthcoming.

4.3 Site 5

4.3.1 *Substrate Composition*

The beach at Site 5 was similar to that at Point White, composed of primarily gravel throughout the transect, with some cobble in the mid-reaches (+1 to -1 ft MLLW). The total transect length was 120 ft from +15 ft to -5 ft MLLW. The substrate at this site had been previously characterized as fine gravel in 2000 and 2001 (WSDOT 2001).

4.3.2 *Vegetation Cover*

Although no vegetation was seen above 60 ft on the transect, beyond this distance vegetation included *Ulva*, *Mazzaella*, *Prionitis*, Turkish towel, an unidentified red filamentous alga, and a kelp identified as *Agarum fimbriatum*. Vegetation cover was minimal, however, until the last quadrat, which had roughly 30% cover.

4.3.3 *Macroinvertebrates*

Macroinvertebrates observed in the lower reaches of the transect included barnacles, chiton, snails, hermit crabs, decorator crabs, sea stars, tube worms, scallops, nudibranchs, and a limpet. The highest invertebrate density along the transect was observed beyond 90 ft.

4.3.4 *Grain Size Analysis*

Grain size analysis at this site revealed that substrate at the upper station was composed of 98.0% gravel, 1.0% silt and 0.9% clay. The middle station was composed of 95.3% gravel, 2.5% sand, 1.7% clay, and 0.6% silt. Results from the lower station showed 73.3% gravel, 23.1% sand, 1.8% clay, and 1.8% silt.

4.3.5 *Benthic Infauna*

Benthic infauna analysis is ongoing and taxanomic results are forthcoming.

4.4 Site 9

4.4.1 *Substrate Composition*

At this site the beach sloped away moderately from +18 to -5 ft MLLW, and gave a total transect length of 210 ft. The upper beach was composed entirely of sand, followed by a band of gravel and cobble (+18 to +11 ft MLLW), which quickly transitioned to primarily gravel and sand (+8 to +6 ft MLLW), then sand and gravel (below +3 ft MLLW). Shell hash was present from the middle of the transect out. The substrate at this site had been previously characterized as medium sand on the upper beach and fine gravel on the mid beach (WSDOT 2001).

4.4.2 *Vegetation Cover*

No vegetation was observed in the upper reaches of this transect. At 90 ft, *Ulva* was encountered. Bleached brunette, Turkish towel, and *Agarum* were present in the lower quadrats, although cover was dominated by eelgrass, as much as 80% of the quadrat area.

4.4.3 *Macroinvertebrates*

Snails were the most commonly observed invertebrate along this transect. Chitons, anemones, and a nudibranch were also observed near the middle of the transect.

4.4.4 *Grain Size Analysis*

Grain size analysis at this site revealed that substrate at the upper station was composed of 64.8% sand, 32.5% gravel, 1.6% clay and 1.0% silt. The middle station was composed of 60.1% sand, 32.8% gravel, 4.5% silt, and 2.7% clay. Results from the lower station showed 62.0% sand, 32.2% gravel, 3.9% silt, and 1.8% clay.

4.4.5 *Benthic Infauna*

Benthic infauna analysis is ongoing and taxonomic results are forthcoming.

4.5 Site 10

4.5.1 *Substrate Composition*

The total transect length at this site was 150 ft, from +14 to -5 ft MLLW. The substrate was composed of sand at the top of the transect, quickly transitioning to a combination of gravel, sand, and shell, which then gave way to bedrock in the middle of the transect (+5 to +3 ft). The lower portions of the transect were bedrock with pockets of sand and shell. A single small ridge approximately 2 inches high, similar to that described at Pt. Glover (Site 9) by BioAquatics (1999), was observed at this site at 25 ft along the transect tape. The substrate at this site has been previously characterized as medium sand (WSDOT 2001).

4.5.2 *Vegetation Cover*

There was no vegetation on the upper beach. In the area composed of bedrock, vegetation included *Fucus*, *Ulva*, *Prionitis*, *Mazzaella*, an unidentified red filamentous alga, *Sargassum*, Turkish towel, and *Agarum*. Generally vegetation cover was sparse. Exceptions include *Sargassum*, covering 35% of the quadrat at 120 ft, Turkish towel providing 40% cover at 135 ft, and *Agarum* covering 35% of the quadrat at 150 ft.

4.5.3 *Macroinvertebrates*

The only invertebrates observed at this site were barnacles on the bedrock at 60 and 75 ft on the transect tape. The barnacles were not abundant, covering approximately 5% of the quadrat area.

4.5.4 *Grain Size Analysis*

Grain size analysis at this site revealed that substrate at the upper station was composed of 96.1% sand, 2.3% silt, 1.2% clay, and 0.5% gravel. No sample was taken from the middle station. Results from the lower station showed 91.1% sand, 3.7% gravel, 3.2% clay, and 2.1% silt.

4.5.5 *Benthic Infauna*

Benthic infauna analysis is ongoing and taxonomic results are forthcoming.

4.6 Site 12

4.6.1 *Substrate Composition*

The transect at this site was 180 ft in total length, from +17 ft to -5 ft MLLW. The substrate was primarily gravel in the upper portion of the transect (above +10 ft MLLW). Cobble was mixed with the gravel between 30 and 120 ft on the tape (+10 to 0 ft MLLW). At 120 ft and beyond (below 0 ft MLLW), sand began to dominate the substrate composition.

4.6.2 *Vegetation Cover*

No vegetation was observed landward of 90 ft on the transect. Below this, macroalgae species included *Ulva*, *Mazzaella*, and bleached brunette. The maximum cover provided by these species combined was 20% of the quadrat area.

4.6.3 *Macroinvertebrates*

Barnacles were observed in the mid reaches of the transect, covering as much as 40% of the quadrat area. Hermit crabs, limpets, snails, and chitons were found beyond 90 ft, while tube worms were the only invertebrates seen at 165 and 180 ft.

4.6.4 *Grain Size Analysis*

Grain size analysis at this site revealed that substrate at the middle station was composed of 48.8% gravel, 47.7% sand, 2.3% clay, and 1.2% silt. Results from the lower station showed 78.3% sand, 12.5% gravel, 6.0% silt, and 3.0% clay. A sample was not taken from the upper station due to the presence of a large rock.

4.6.5 *Benthic Infauna*

Benthic infauna analysis is ongoing and taxonomic results are forthcoming.

5 SUMMARY AND CONCLUSIONS

Surface substrate characteristics differ slightly at each of the sites, although gravel dominated the upper transects in the east and south facing sites, while sand was more prevalent on the upper beaches at the north facing sites and in the lower elevation of sites in Port Glover In general, surface substrate composition was not qualitatively different from observations in 2000 and 2001.

The biological community differed by site as well, although the general species composition was similar between all sites. It is expected that as spring and summer approach, algal cover will increase, and likewise the number of mobile invertebrates which use the habitat provided by the algal species will also increase.

Substrate grain size below the armoring layer was similar to surface substrate observations described above. The percentage of fines (silt and clay) in the substrate generally increased with depth across all sites. When the grain size analysis differed from visual observations, in the mid-reaches of the transects there was usually more gravel in the analysis, with more sand in the analysis than observed at the deep stations.

The purpose of this survey was to determine baseline substrate and community characteristics for comparison with similar surveys both during and after passenger-only fast ferry sea trials. To the extent possible, future comparative analyses will consider both human-induced and natural variation in changes in community characteristics.

6 REFERENCES

BioAquatics 1999. Biological and Shoreline Survey, Rich Passage, WA.

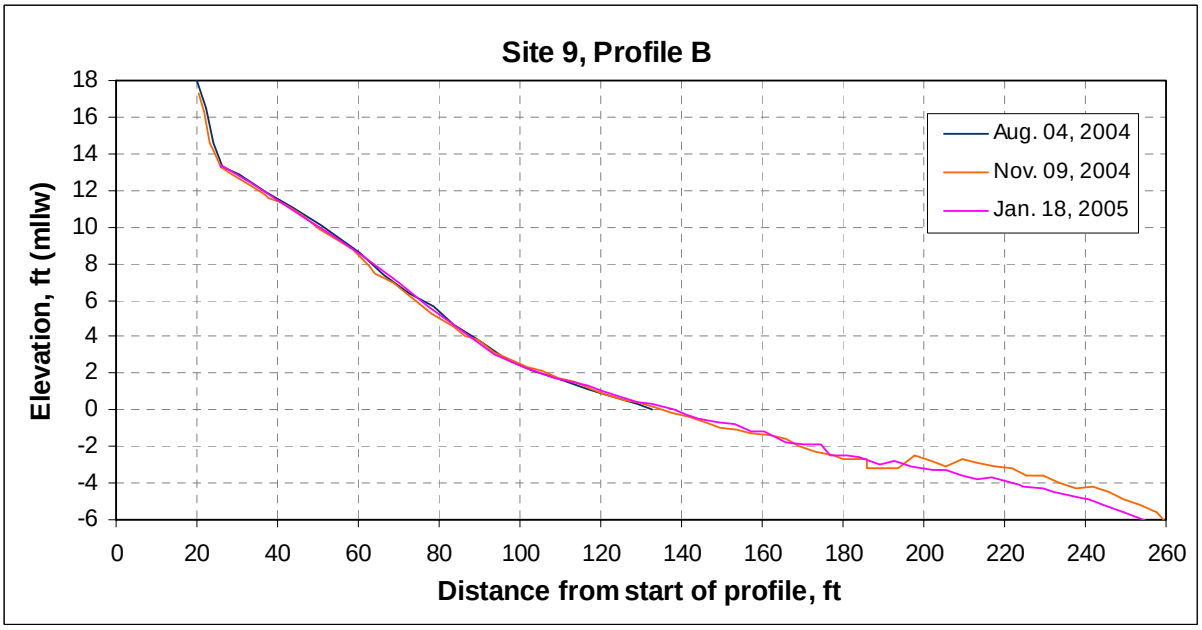
WSDOT 2000. Phase I Final biological and habitat survey data report.

Rich Passage Wave Action Study Team (RPWAST). Operation of the POFF Service between Seattle and Bremerton. MDNS, SEPA expanded checklist, Rich Passage Wave Action Study Final Report.

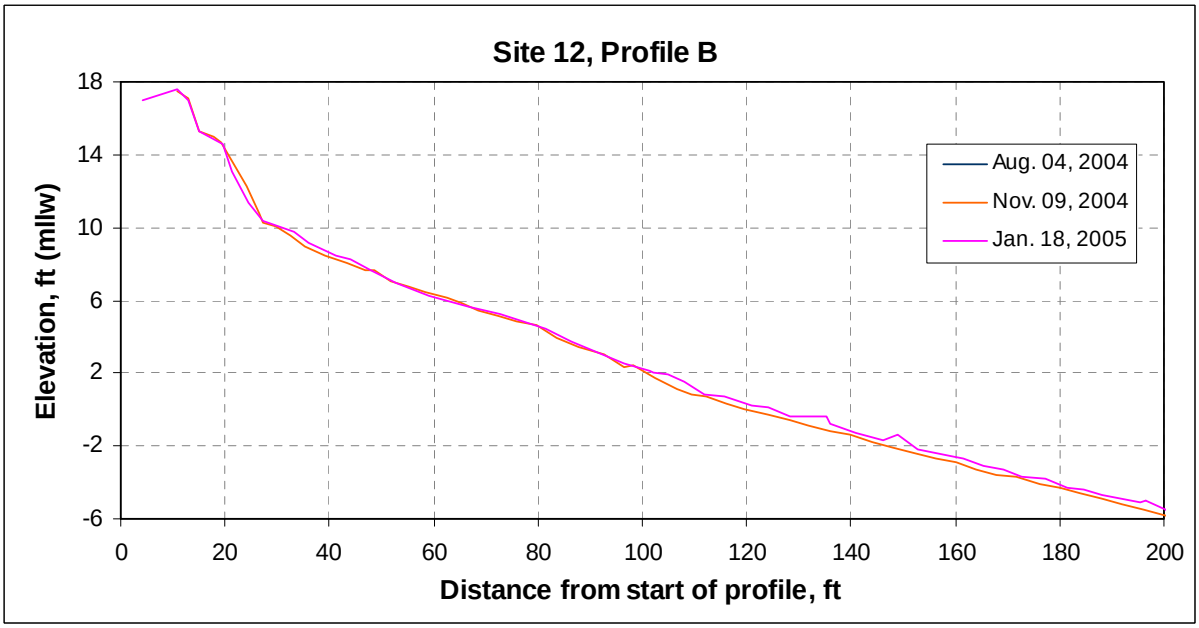
APPENDIX A. BEACH PROFILES

Profiles at survey transects for biological monitoring. Profile survey measurements provided by Pacific International Engineering, PLLC)


Site 5, Profile B
Elevation, ft (mllw)
Distance from start of profile, ft
Aug. 04, 2004
Nov. 09, 2004
Jan. 18, 2005
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
0
10
20
30
40
50
60
70
80
90
100
110
120


Site 9, Profile B
Elevation, ft (mllw)
Distance from start of profile, ft
Aug. 04, 2004
Nov. 09, 2004
Jan. 18, 2005
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
0
20
40
60
80
100
120
140
160
180
200
220
240
260


Site 10, Profile B
Elevation, ft (mllw)
18
14
10
6
2
-2
-6
0
20
40
60
80
100
120
140
160
180
200
Distance from start of profile, ft
Aug. 04, 2004
Nov. 09, 2004
Jan. 18, 2005


Site 12, Profile B
Elevation, ft (mllw)
18
14
10
6
2
-2
-6
0
20
40
60
80
100
120
140
160
180
200
Distance from start of profile, ft
Aug. 04, 2004
Nov. 09, 2004
Jan. 18, 2005

APPENDIX B.
HABITAT AND COMMUNITY CHARACTERISTICS IN RICH PASSAGE, JANUARY 2005.

Transect:
- 1 Manette Beach
- 3 Point White (West)
- 5 Point White (East)
- 9 Point Glover (East)
- 10 Point Glover (West)
- 12 Crystal Springs

Depth Bin:
- 1, >+5 ft MLLW
- 2, +5 to +2.5 ft MLLW
- 3, +2.5 to 0 ft MLLW
- 4, 0 to -2.5 ft MLLW
- 5, -2.5 to -5.0 ft MLLW

Substrate (qualitative):
- ro, rock
- co, cobble
- gr, gravel
- sa, sand
- sh, shell hash

Macroalgae Taxa:
- ag, *Agarum fimbriatum*
- cr, *Cryptosiphonia woodii*
- fu, *Fucus distichus*
- gi, *Gigartina* spp.
- ma, *Mazzaella* spp.
- pr, *Prionitis* sp.
- red, unidentified red filamentous
- sa, *Sargassum* sp.
- ul, *Ulva* spp.
- zo, *Zostera marina*

Invertebrate Taxa
- an, anemone
- ba, barnacle
- ch, chiton
- de, decorator crab
- du, Dungeness crab
- hc, hermit crab
- li, limpet
- ly, lyre crab
- nu, nudibranch
- sc, scallop
- sn, snails
- st, sea star
- wo, tube worm

Year	Transect	Distance (ft)	Depth Bin	Substrate	Macro taxa	Invert taxa
2005	1	0	1	gr		
2005	1	15	1	gr		
2005	1	30	1	gr		
2005	1	45	1	gr		
2005	1	60	1	gr		
2005	1	75	2	sa/gr		an
2005	1	90	3	sa/co	ul	an,ba
2005	1	105	3	sa/co		
2005	1	120	4	gr/sa	cr	
2005	1	135	4	gr/co	ma	ba
2005	1	150	4	gr/sa	cr	
2005	1	165	5	gr/sa	cr	ly,li

Year	Transect	Distance (ft)	Depth Bin	Substrate	Macro taxa	Invert taxa
2005	1	180	5	gr/sa	sa	ly,du,st
2005	3	0	1	gr		
2005	3	15	1	gr		
2005	3	30	1	gr		
2005	3	45	1	co		ba
2005	3	60	2	co/gr		ba
2005	3	75	3	co/gr/sa	ul	
2005	3	90	4	co/sa	sa,ul,cr,red	ch,sn,hc
2005	3	105	5	sa/co	gi,ma	hc
2005	5	0	1	gr		
2005	5	15	1	gr		
2005	5	30	1	gr		ba
2005	5	45	2	gr		ba,ch
2005	5	60	3	gr	ul	ch,ba
2005	5	75	4	co	red	sn,ba
2005	5	90	5	co	ul,red	ch,ba,hc,de,st
2005	5	105	5	gr	ul,gi,ma	wo
2005	5	120	5	co	gi,ul,ma,pr	sc,li
2005	9	0	1	sa		
2005	9	15	1	gr/sh		
2005	9	30	1	gr		
2005	9	45	1	co		
2005	9	60	1	gr/sa		
2005	9	75	1	sa		
2005	9	90	2	sa/gr	ul	
2005	9	105	3	sa/gr	ul	
2005	9	120	3	sa/gr		ch,an
2005	9	135	4	sa/gr/sh	cr,ul	sn
2005	9	150	4	sa/gr/sh	zo,cr	
2005	9	165	4	sa/gr/sh	zo	nu
2005	9	180	5	sa/gr/sh	zo,gi	
2005	9	195	5	sa/gr/sh	zo	sn
2005	9	210	5	sa/gr	zo,gi,ag,cr	sn
2005	10	0	1	sa		
2005	10	15	1	sh/sa/gr		
2005	10	30	1	sh/sa		
2005	10	45	1	sh/gr		
2005	10	60	1	ro	fu,ul	ba
2005	10	75	2	ro	fu,ul	ba
2005	10	90	2	ro	fu,red,ul	
2005	10	105	2	ro	red,fu,pr	
2005	10	120	3	ro/sh/sa	sa,gi,ma	
2005	10	135	4	ro/sh/sa	gi,pr,ma	

Year	Transect	Distance (ft)	Depth Bin	Substrate	Macro taxa	Invert taxa
2005	10	150	5	sa/sh/ro	ag,ma,gi	
2005	12	0	1	ro		
2005	12	15	1	gr		
2005	12	30	1	co		
2005	12	45	1	gr/co/sh/sa		ba
2005	12	60	1	gr		ba
2005	12	75	2	gr/co		ba
2005	12	90	2	gr/co	ul	ba,hc,li
2005	12	105	3	gr/co	ul	hc
2005	12	120	4	gr/sa/co	ul,ma	
2005	12	135	4	sa/gr	cr,ul	ch,hc
2005	12	150	4	sa/gr	cr,ul	ch,wo
2005	12	165	5	sa/gr	cr,ul	wo
2005	12	180	5	sa/gr	cr,ul	wo

APPENDIX C.

GRAIN SIZE ANALYSIS REPORT