YOUNGS BAY
BENTHIC INVERTEBRATE STUDY
2023

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Introduction

Clatsop County Fisheries (CCF) operates three net pen sites located in Youngs Bay west of Astoria, Oregon: Tide Point, Bornstein, and Yacht Club (Figure 1). The sites, in operation since 1987, rear and release juvenile salmon annually. These efforts are in accordance with the Select Area Fisheries Project and aim to maximize the return of hatchery produced fish. To meet the monitoring and reporting protocols of the National Pollutant Discharge Elimination System (NPDES) permit #101767 issued by the Oregon Department of Environmental Quality, Clatsop County submits the following biennial report.

To record any environmental impacts of the Youngs Bay net pen sites, sampling occurs at designated outfall, perimeter, and reference stations. The three outfall stations are located under each of the three fish pen sites; Tidepoint, Bornstein, and Yacht Club. The perimeter stations occur at points on the perimeter of the allotted mixing zone of each station (Figures 2 and 3). The data collected from both the outfall and perimeter stations are then compared with reference stations. The reference stations establish normal biological parameters for Youngs Bay. Due to the close proximity of the Tidepoint and Bornstein sites, they share reference and perimeter stations. In addition to these efforts, CCF staff also conducts additional sampling to ensure permit requirements are satisfied. Sampling occurred throughout the month of July 2023.

Methods

To document any anoxic conditions on the benthic surface layer, a core sample was taken under each individual net pen. The core sampler, designed by CCF staff, consists of a weighted 3.8 cm aluminum core with an attached flap valve at the apex of the frame (Figure 4). The tool was lowered to the bottom and upon retrieval the flap valve creates suction removing a portion of the uppermost layer of sediment. The sample was then examined for the presence of H_2S odor, a black surface layer, the presence/absence of living organisms, and the depth of the oxidized layer (Tables 1-3). Each sediment grab was deposited back into the water after the observations were completed.

To monitor any accumulation of organic matter from the net pens, sampling for grain size, and total organic carbon (TOC) occurred at designated outfall, perimeter, and reference stations (Figures 2 and 3). Utilizing the core sampler described above, samples for grain size composition and TOC were taken at the designated stations by removing approximately 4 cm of benthic sediment. The samples were stored in small plastic containers and refrigerated. The analytical lab of the School of Environmental and Forest Science at the University of Washington analyzed sediment samples for grain size distribution and TOC.

To study benthic invertebrate population characteristics of the outfall, perimeter, and reference stations, CCF staff engineered a larger weighted sampler made of aluminum and high-density polyethylene (HDPE) (Figure 5.). The tool utilizing a similar core and valve design, was lowered to the bottom at which time the rope was pulled up and down several times. This action utilized lead weights to drive the 7.6 cm aluminum core into the sediment. Upon retrieval, a ball valve located within the HDPE upper portion of the sampler created suction and in turn removed a portion of the benthic layer. Once on the deck, a ring attached to the ball was pulled, releasing pressure, and the aluminum portion of the sampler

was disconnected by loosening the attached hose clamps. Staff then pushed the sediment out with a small plunger, removing 5 cm of sediment from the uppermost portion of the sample.

Samples were kept in plastic buckets until all replicates for that station were collected. The samples were then rinsed with a 2-gallon hand pump sprayer through a 0.5 mm sieve. To preserve the invertebrates, the remaining matter was stored in small plastic jars containing a buffered formalin solution. After one week, each replicate was rinsed and preserved in ethanol until analyzed. The benthic invertebrates from each replicate were sorted and identified to the lowest possible taxonomic classification: generally, species.

In 2019, due to additional permit requirements, a log that includes water temperature, pH and the presence/absence of Beggiatoa spp. was established (Table 14). At each of the designated stations, the presence/absence of Beggiatoa spp., an anoxic bacterial mat, was observed by lowering an underwater HD camera probe to the bottom. The upper benthic layer was then visually inspected for Beggiatoa spp. on a handheld HD screen. At this time, both water temperature and pH readings were taken. Water temperature was recorded by lowering a thermometer 1 m below the surface and pH was taken with a digital pH meter. (table 14). Additional water quality monitoring included six 250 ml water samples taken – 1 upstream and 1 down stream of each site: Tidepoint, Bornstein, and the Yacht Club. Samples were refrigerated and promptly mailed to Alexin Analytical Laboratories Inc. for total dissolved solid analysis (Table 13).

Results

Tables 1-3 – Tide Point, Bornstein, and Yacht Club Sedimentation Logs

- Each individual net pen sediment sample at Tidepoint, Bornstein, and Yacht Club showed no H_2S odor or black surface layer. All samples contained living organisms.

Table 4 – Yacht Club Percent Grain Size Distribution, Total Organic Carbon, and Dominant Species

- Sand dominated the grain size distribution at the Yacht Club stations with the highest percentage of 81.25 percent at outfall 001 and the lowest at reference station SUBC 003 with 70.75 percent. The highest percent of silt/clay was found at reference station SUBC 003 at 29.25 percent, while the lowest occurred at outfall 001 with 18.75 percent. Gravel was found at two reference stations, SUBC 001 at 6.34 percent and SUBC 002 at 2.95 percent.
- The total organic carbon (TOC) had a range of 9.72 mg/L at perimeter station SUBC 004 to 15.58 mg/L at perimeter station SUBC 005.
- Americorophium spp. was the dominant benthic invertebrate species in four out of the six stations at the Yacht Club site, with the largest concentration being 80,601 per square meter located at reference station SUBC 001. This is also the largest concentration of the species over the entire sampled area. Potamopyrgus antipodarum was the most dominant species found in outfall 001 and perimeter station SUBC 005.

Table 5 – Tide Point/Bornstein Percent Grain Size Distribution, Total Organic Carbon, and Dominant Species

- Sediment grain was predominantly sand at the Tide Point and Bornstein sites, with all stations above 64.41 percent (perimeter SUBC 010). Overall, the highest sand percentage was 74.05 percent at reference SUBC 007.
- The TOC was found to be the highest at perimeter station 010 at 26.84 mg/L, while the lowest was at reference station SUBC 007 at 7.03 mg/L.
- Americorophium spp. was the dominant benthic invertebrate species in four out of the seven stations (1 outfall, 1 perimeter, and 2 reference). The highest concentration occurred at the perimeter station SUBC 010 with Americorophium spp. at 64,000 per square meter and the lowest at Outfall 003 with 11,729 per square meter.

Table 6 – Average Densities of Youngs Bay Dominant Species per Outfall, Reference, and Perimeter Stations

- It was found that Americorophium spp. held the highest average densities throughout the reference and the perimeter stations with 30,616 per square meter in the reference stations, and 38,631 per square meter over the perimeter stations. Potamopyrgus antipodarum was the dominant species found at the outfall stations, with 27,248 per square meter vs 16,912 at reference stations and 32,767 at perimeter stations.

Table 7 – Youngs Bay Total Organic Carbon Measurements (mg/L.), 2005-2023

- Total organic carbon readings for all stations, with the exception of reference stations SUBC 001, SUBC 002, and perimeter station SUBC 010, were under their biennial averages from 2005-2023.

Table 8- Yacht Club Benthic Invertebrate Densities and Diversities

- Perimeter station SUBC 005 had the highest invertebrate densities with 163,067 per square meter, was the most diverse with ten species, and the top three species comprised the lowest percentage of the overall population (86.4 percent). All other stations were within similar ranges containing six or seven species per station and the top three of those species comprising anywhere from 90.5 to 98.1 percent of the overall density.

Table 9- Tide Point / Bornstein Benthic Invertebrate Densities and Diversities

- Perimeter station SUBC 010 had the highest invertebrate densities at 105,263 per square meter. The top two of the six species found, Potamopyrgus antipodarum, and Americorophium spp. made up 97.4% of the total invertebrate density for SUBC 010. All other stations were within similar ranges containing between six and nine species with the top three of those species comprising anywhere from 82.7 percent to 98.2 percent of the overall population.

Table 10- Youngs Bay Benthic Invertebrate Densities, 2009-2023

- Listed are the densities of the six most common benthic invertebrates over the last eight biennial sampling periods; Potamopyrgus antipodarum, Americorophium spp., Oligochaeta, Eogammarus confervicolus, Hobsonia florida, and Nereis limnicola. The top two benthic invertebrate species since sampling began in 2005 have been Potamopyrgus antipodarum and Americorophium spp.

Table 11 – Yacht Club Most Dominant Benthic Invertebrate Species Per Station, 2017-2023

- In the four sampling periods occurring between 2017 – 2023, each perimeter, reference, and outfall station were dominated by either Potamopyrgus antipodarum or Americorophium spp. Data for SUBC 005 was not collected during 2017 or 2019.

Table 12 – Tide Point/Bornstein Most Dominant Benthic Invertebrate Species Per Station, 2017-2023

- In the four sampling periods occurring between 2017 – 2023, each perimeter, reference, and outfall station were dominated by either Potamopyrgus antipodarum, Americorophium spp., or Oligochaeta. Data for Outfall 002 was not collected during 2017 sampling.

Table 13 – Total Dissolved Solids Measurements of Each Net Pen Site in Youngs Bay, 2023

Table 14 – Young's Bay Beggiatoa spp., Water Temperature, pH- 2023

- Beggiatoa spp. was not present at any of the designated stations. Water temperature and pH were found to be within acceptable ranges.

Table 15 – Outfall 001/ Reference Condition Comparisons (Wilcoxon Test)

- There was significant difference between the dominant species percent of sample between outfall 001 and the reference stations SUBC 001, SUBC 002, and SUBC 003. Among animals per sample (abundance), number of species per sample (taxa richness), and comparisons of individual species per sample, there was no significant difference between outfall station 001 and the reference stations.

Table 16 – SUBC 004 / Reference Condition Comparisons (Wilcoxon Test)

- For perimeter station SUBC 004 there was statistical difference in the dominant species percent of sample when compared to reference stations SUBC 001, SUBC 002, and SUBC 003. There was no major difference in animals per sample and number of species per sample. When comparing individual species, there was significant difference between the reference stations and perimeter SUBC 004 with Eogammarus confervicolus.

Table 17 – SUBC 005 / Reference Condition Comparisons (Wilcoxon Test)

- Perimeter station SUBC 005 had a statistical difference in the number of species per sample and the dominant species percent of sample. When comparing individual species per sample Hobsonia florida, Eogammarus confervicolus, Nematoda, and Saduria entomon were found to have a notable difference between the perimeter and reference stations.

Table 18 – Outfall 003 / Reference Condition Comparisons (Wilcoxon Test)

- There was a statistical difference in the animals per sample (taxa richness) and the dominant species percent of sample. There were also notable differences in Americorophium spp. per

sample. No Eogammarus confervicolus were found at the outfall station but a few were present at the reference stations. Higher numbers of Cumacea were at the outfall in comparison to the reference stations.

Table 19 – SUBC 009 / Reference Condition Comparisons (Wilcoxon Test)

- Perimeter station SUBC 009 contained no Eogammarus confervicolus, while the reference stations had higher numbers, with SUBC 006 having the most at 28. The other species comparisons for this station were found to have no significant differences.

Table 20 – SUBC 010 / Reference Condition Comparisons (Wilcoxon Test)

- SUBC 010 and the reference stations were very similar in comparison with the exception of Potamopyrgus antipodarum and Americorophium spp. The two species were found in higher abundance at perimeter station SUBC 010.

Table 21 – Outfall 002 / Reference Condition Comparisons (Wilcoxon Test)

- There were no significant differences found between Outfall 002 and the reference stations SUBC 006, 007, and 008.

Discussion

The environmental monitoring of net pen salmon rearing is to ensure that the water body is suitable for fish rearing and that the accumulation of organic matter due to fish rearing is not creating a systemic impact on Youngs Bay. The fish in Youngs Bay are released as smolts, and only kept for part of the year. This allows the benthic environment time to recover. In addition to this, much of the rearing occurs during times of abundant rainfall and high flows, adding to the cleansing capability of an already turbulent, tidally influenced location. Furthermore, when considering the environmental impact of net pen rearing, researchers should also be cognizant of other anthropogenic influences in Youngs Bay; a bridge, fishing boats, a public boat ramp, an abandoned cannery, public usage of the net pen pier, and invasive species.

Core soil samples taken by Clatsop County Staff ensured that organic materials from fish rearing is not accumulating under each individual net pen (Tables 1-3). The accumulation of organic material would result in the absence of live animals, H_2S odor, and the disappearance of the oxidized layer. The visual inspection of each sample supports the notion that either the organic material from fish rearing is being absorbed at the rate of which it is produced, or the biproducts are being flushed away at a rate that does not allow accumulation to occur. The evidence of this is additionally supported by the absence of Beggiatoa spp. (Table 14). The lack of organic accumulation from continued fish rearing and acquired water quality data would suggest the Youngs Bay system is suitable for fish rearing (Table 13-14).

Increases of organic matter under both the net pens and within the perimeter of the allotted mixing zone could result in increases of total organic carbon (TOC). With the exception of perimeter station SUBC 009, outfall and perimeter stations were lower in TOC when compared to both their 2021 levels and the biennial averages from 2005 to 2023. Reference stations at both locations, Tidepoint/Bornstein and the

Yacht Club showed more variance with four of six stations increasing from 2021 levels and four of six registering lower than their biennial averages (Table 7).

Sediment grain size distribution was predominantly sand at all designated stations in Youngs Bay. The sediment at the Tide Point/Bornstein sites contained more gravel and woody debris (Tables 4-5). The bottom here is harder and is likely exposed to more currents. The Yacht Club site is partially protected from pilings upstream and a bridge downstream. This could aid in reducing current velocity and in turn, scour.

The Youngs Bay stations have been dominated by the amphipods, Americorophium spp. (predominately Americorophium salmonis) and by the invasive species the New Zealand mud snail, Potamopyrgus antipodarum. For several years, these benthic dwellers have competed for the role as the most prolific species in Youngs Bay (Table 10). Per net pen site, the dominance of the top two species at the Yacht Club site holds true for four of six stations (Table 11). Both perimeter station SUBC 005 and Outfall 001 are most densely populated by Potamopyrgus antipodarum. Oligochaeta are found further upstream at the Tide Point/Bornstein sites (Table 12). The presence of Oligochaeta upstream could be due to a number of environmental factors; habitat, water quality, nutrients etc. The past several years there has been a rotation amongst these three species in reference, perimeter, and outfall sites as the most prolific species per station (Table 12).

An increase in organic matter from fish rearing in Youngs Bay could result in a decrease in the number of species present. If one species were to benefit from organic waste at the pens, the species could outcompete other species occupying the same benthic habitat. This could result in a decrease in species diversity. At the Yacht Club site, the top three species comprise 86.4 to 98.1 percent of the population per station and average six to ten different species per station. At the Tidepoint/Bornstein location, the top three species account for anywhere from 82.7 to 94.9 percent of the population per station and contained an average of six to nine species per station (Tables 8-9). When comparing reference stations to perimeter and outfall stations the Wilcoxon test for statistical analysis equates to no significant differences in the number of species per sample, with the exception of perimeter station SUBC 005 (Tables 15-21). The perimeter station held a higher number of species per sample than the reference stations. This would suggest that the slight variation in species per sample is due to changing ecological conditions and not influences by any additional dynamics from the net pen sites. Further breakdown of taxonomic classification, may help solidify this principle. When comparing the outfall and perimeter to the reference stations, the majority of stations show no significant difference in specific species per sample, but there are some with statistically significant differences (Tables 15-21). Continued monitoring of species density and species per sample, will ensure species degradation doesn't occur as a result of the net pens.

Figures

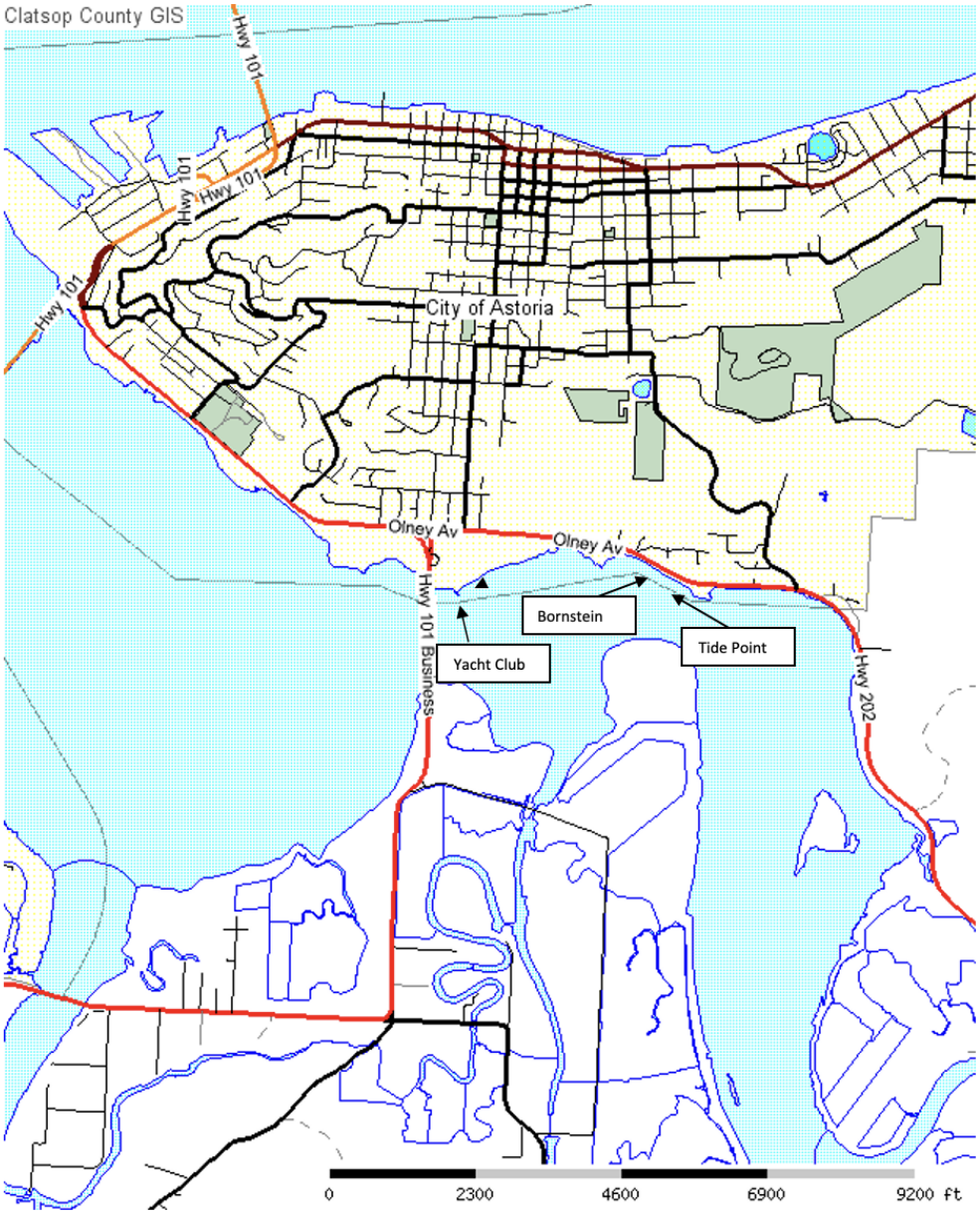


Figure 1. Youngs Bay Net Pen Sites

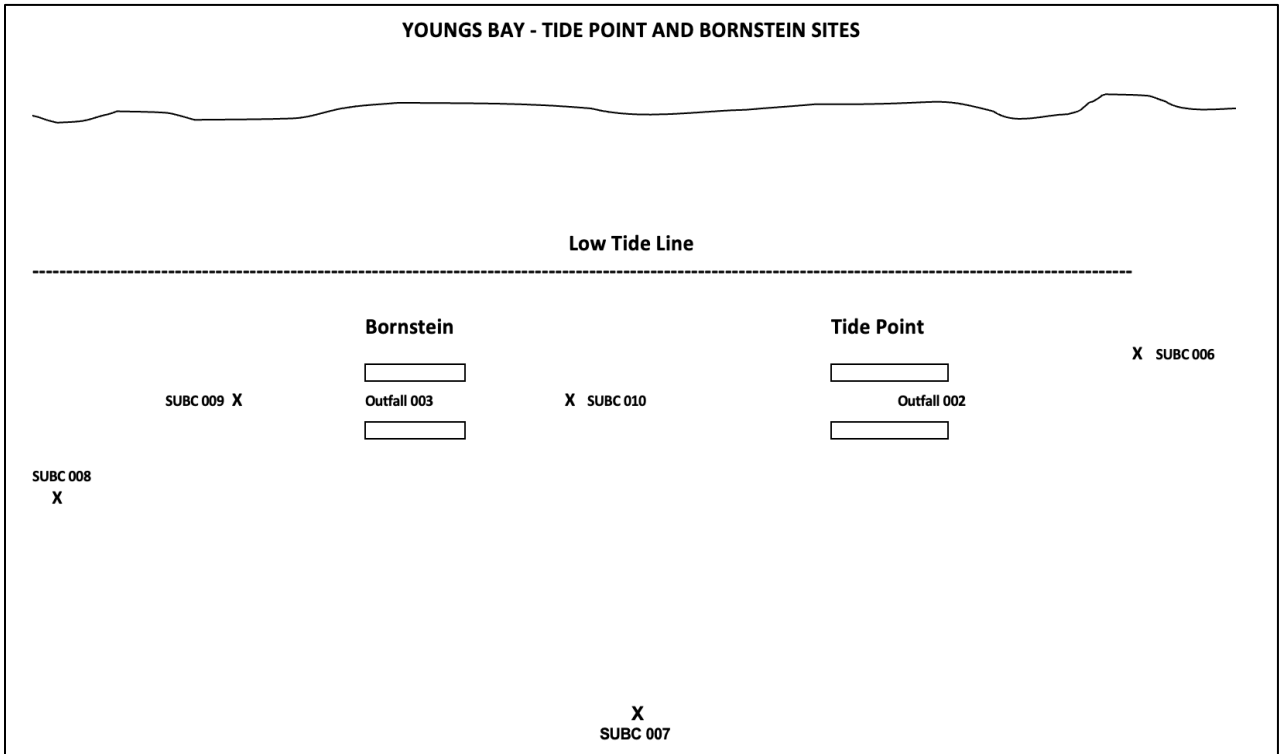


Figure 2. Tide Point/Bornstein Site Stations.

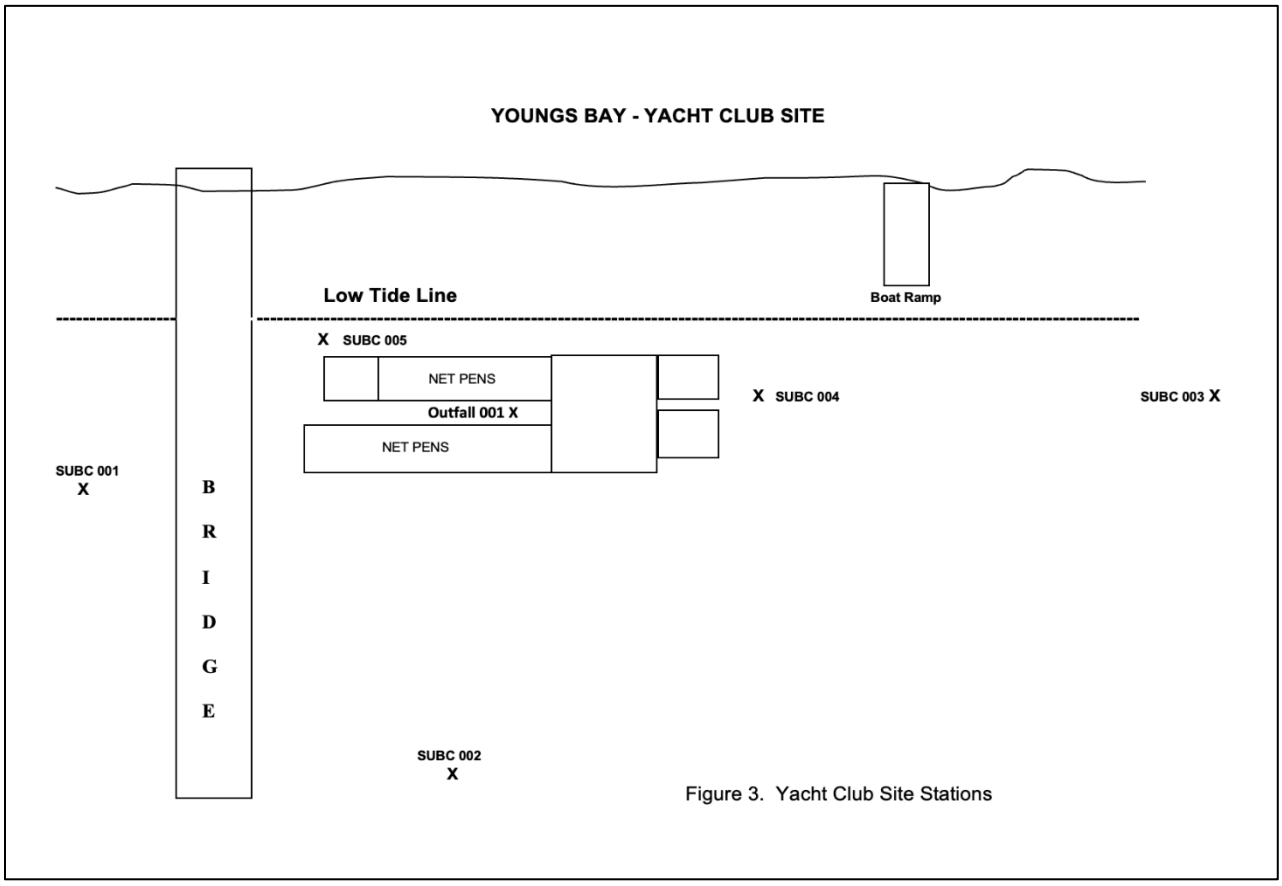


Figure 3. Yacht Club Site Stations

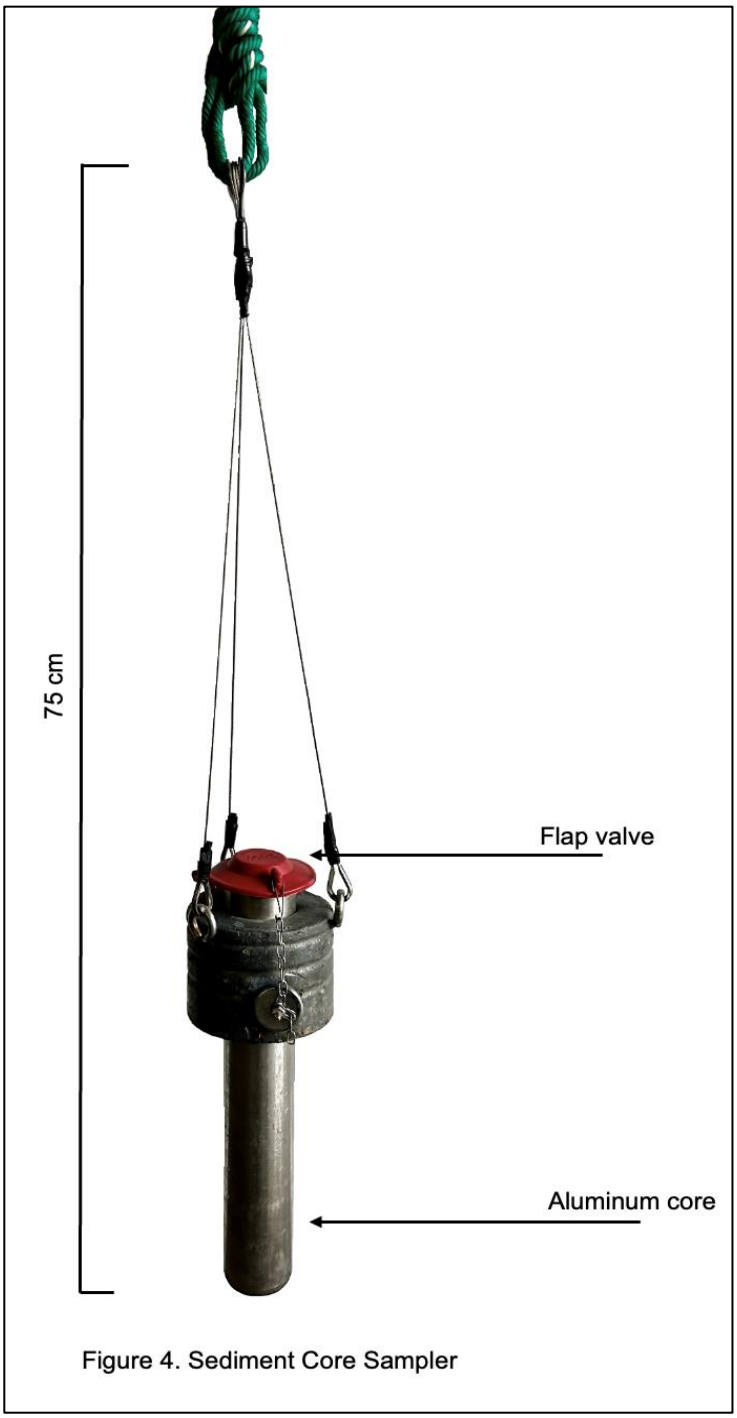


Figure 4. Sediment Core Sampler

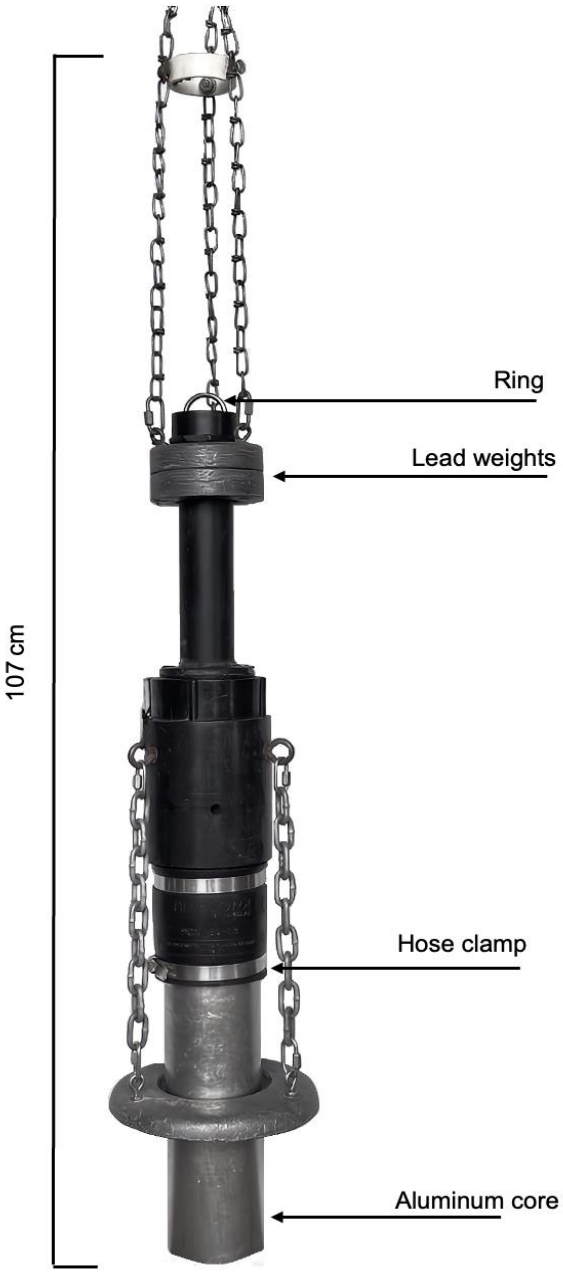
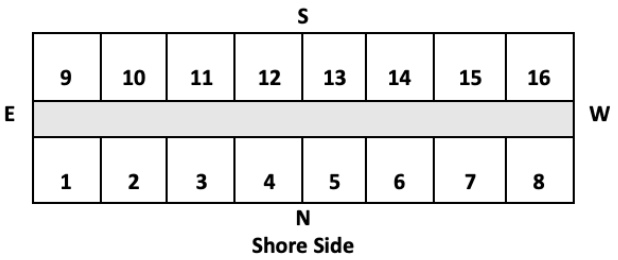


Figure 5. Benthic Invertebrate Sampler

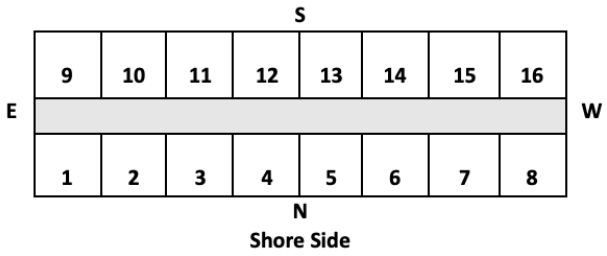
Tables

Table 1. Tide Point Sedimentation Log 2023.



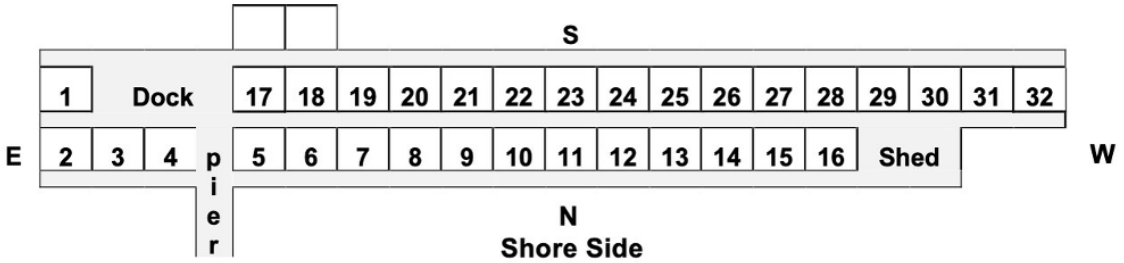
Pen #	H_2S odor	Black Surface Layer	Living Organisms Present	Depth of Oxidized Layer	Sample Size	Comments
1	No	No	Yes	1.0 cm	5.0 cm	Light brown top w/ clam shells, chunks of wood, sand and silt bottom
2	No	No	Yes	1.5 cm	8.0 cm	Light brown top, soft and sandy, woody debris, little clay on bottom
3	No	No	Yes	2.0 cm	9.5 cm	Light brown top, mostly silt, dark grey clay with some clam shells
4	No	No	Yes	1.5 cm	7.0 cm	Light brown top, silty, wood chunks, Cordylophora, dark grey clay
5	No	No	Yes	1.0 cm	6.0 cm	Light brown very soft top, fine woody debris, very hard bottom
6	No	No	Yes	1.5 cm	7.5 cm	Light brown top with some gravel, woody debris, dark grey clay bottom
7	No	No	Yes	1.0 cm	6.0 cm	Light brown top, detritus, wood chunks, dark grey clay bottom
8	No	No	Yes	1.0 cm	8.0 cm	Light brown top, sandy silt, fine woody debris, some clay on bottom
9	No	No	Yes	2.0 cm	8.0 cm	Light brown top, broken shells, wood chunk, dark grey clay with brown
10	No	No	Yes	1.5 cm	8.0 cm	Light brown sandy top, black silt clay mixture with detritus
11	No	No	Yes	1.0 cm	6.0 cm	Very hard dark crumbly surface, mixture of sand, silt and clay.
12	No	No	Yes	0.5 cm	5.0 cm	Hard top layer, some wood chunks, dark clay bottom
13	No	No	Yes	1.0 cm	9.0 cm	Light brown top, Cordylophora, fine woody debris, dark clay bottom
14	No	No	Yes	1.5 cm	6.5 cm	Light brown top, Cordylophora, plant debris, dark grey clay bottom
15	No	No	Yes	1.0 cm	6.0 cm	Light brown top, smashed shells, tiny rocks, dark grey clay bottom
16	No	No	Yes	2.0 cm	8.0 cm	Light brown top, gravel with sandy silt, dark grey clay bottom w/ brown

Table 2. Bornstein Sedimentation Log 2023.



Pen #	H_2S Odor	Black Surface Layer	Living Organisms Present	Depth of Oxidized Layer	Sample Size	Comments
1	No	No	Yes	1.0 cm	10.0 cm	Light brown top, lots of woody debris and detritus, hard clay
2	No	No	Yes	1.5 cm	3.5 cm	Light brown top, hard clay, some wood on bottom
3	No	No	Yes	0.5 cm	8.0 cm	Large chunks of rotten wood on top with barnacles, some clay
4	No	No	Yes	2.0 cm	10.5 cm	Light brown top with coarse sand, fine woody debris, clay/silt
5	No	No	Yes	1.5 cm	7.5 cm	Silt top, some sand with fine woody debris, dark clay bottom
6	No	No	Yes	3.0 cm	3.5 cm	Light brown top, coarse sand, wood, hard brown clay on bottom
7	No	No	Yes	1.0 cm	5.0 cm	Very soft silty top, some woody debris, some clay on bottom
8	No	No	Yes	5.0 cm	13.0 cm	Light brown top, mostly silt, tiny bit of clay on bottom
9	No	No	Yes	0.5 cm	3.0 cm	Light brown top, some rocks, hard clay w/ sand and silt below
10	No	No	Yes	1.0 cm	3.0 cm	Large chunks of wood, hard clay with wood and sand on bottom
11	No	No	Yes	3.0 cm	8.0 cm	Mostly coarse sand on top, silt with some hard clay and detritus
12	No	No	Yes	0.5 cm	8.0 cm	Hard compacted coarse sand, large wood chunks, brown clay bottom
13	No	No	Yes	1.0 cm	6.5 cm	Course sandy top, clay with sandstone and pebbles on bottom
14	No	No	Yes	1.5 cm	1.5 cm	Light brown top, clam shell on top, sand and hard clay bottom
15	No	No	Yes	1.5 cm	10.0 cm	Light brown top, coarse sand, fine woody debris, dark clay bottom
16	No	No	Yes	2.0 cm	7.0 cm	Light brown top, more silt than sand, dark grey clay bottom

Table 3. Yacht Club Sedimentation Log Sheet 2023.



Pen #	H_2S Odor	Black Surface Layer	Living Organisms Present	Depth of Oxidized Layer	Sample Size	Comments
1	No	No	Yes	2.0 cm	6.0 cm	Light brown top, shell fragments, sandy clay bottom
2	No	No	Yes	1.0 cm	4.5 cm	Light brown top, detritus, black clay and sand throughout
3	No	No	Yes	2.0 cm	9.0 cm	Light brown top, coarse sandy silt, large wood chunks
4	No	No	Yes	0.5 cm	6.5 cm	Light brown top, sticks, sticky clay and silt, lots of organisms
5	No	No	Yes	3.0 cm	10 cm	Light brown top, plant matter, more sand than silt, woody bits
6	No	No	Yes	0.5 cm	6.5 cm	Light brown top, silt and clay mixture, woody debris
7	No	No	Yes	2.0 cm	11.5 cm	Light brown top, silty with detritus and dark clay bottom
8	No	No	Yes	2.5 cm	6.0 cm	Light brown top, large woody debris, plant matter, clay bottom
9	No	No	Yes	1.0 cm	4.0 cm	Light brown top layer, sticks, clay and silt
10	No	No	Yes	1.5 cm	8.5 cm	Light brown top layer, large wood chunk, sand and silt, no clay
11	No	No	Yes	1.0 cm	4.0 cm	Light brown top, small gravel, some plant matter, mostly silt
12	No	No	Yes	1.0 cm	10.0 cm	Light brown top, mostly clay, some sand, wood chunks
13	No	No	Yes	1.5 cm	4.5 cm	Light brown top, silt, clay, plant matter
14	No	No	Yes	1.5 cm	6.0 cm	Light brown top, metal pieces, detritus, clay and silt
15	No	No	Yes	2.0 cm	9.0 cm	Light brown top, detritus, sticks, very silty
16	No	No	Yes	1.0 cm	4.0 cm	Light brown top, detritus, clay with silt
17	No	No	Yes	0.5 cm	5.5 cm	Detritus throughout, woody debris, silty bottom with clay
18	No	No	Yes	1.0 cm	5.0 cm	Light brown top layer, lots of sticks, large wood chunks, clay
19	No	No	Yes	2.0 cm	7.5 cm	Light brown top, silt with sand, woody debris, clay bottom
20	No	No	Yes	1.5 cm	5.0 cm	Light brown top, plant matter, sand and silt, little clay
21	No	No	Yes	2.0 cm	7.5cm	Light brown top, large wood debris, sand & silt, dark clay btm
22	No	No	Yes	0.5 cm	3.5 cm	Light brown top, sand & silt, detritus, some clay at bottom
23	No	No	Yes	1.5 cm	4.5 cm	Light brown top, light plant matter, dark clay bottom
24	No	No	Yes	2.0 cm	8.0 cm	Light brown top, sandy, sticks, detritus, dark grey clay bottom
25	No	No	Yes	1.5 cm	12.0 cm	Light brown top, sand and silt, woody debris, clay btm w/ detritus
26	No	No	Yes	1.0 cm	7.0 cm	Light brown top, plant matter, sticks, small gravel, dk clay btm
27	No	No	Yes	0.5 cm	8.0 cm	Light brown top, sandy, sticks, detritus, dark clay bottom
28	No	No	Yes	1.0 cm	6.5 cm	Light brown top, plant matter, dark clay bottom w/ detritus
29	No	No	Yes	2.0 cm	10.0 cm	Light brown top, fine woody debris, dark grey clay w/ plants
30	No	No	Yes	1.5 cm	8.5 cm	Light brown top with plant matter, dark grey clay bottom
31	No	No	Yes	1.0 cm	4.5 cm	Light brown top, dark grey clay bottom with detritus
32	No	No	Yes	2.0 cm	6.0 cm	Light brown top, woody debris, more sand than silt, clay btm

Table 4. 2023 Yacht Club Percent Grain Size Distribution, Total Organic Carbon, and Dominant Species.

				TOC		Density
STATION	%Gravel	%Sand	%Silt/Clay	mg/L	Most Dominant Species	#/sq.meter
Outfall 001	0.00	81.25	18.75	12.26	Potamopyrgus antipodarum	48,361
SUBC 001 (Reference)	6.34	72.39	21.27	13.20	Americorophium spp.	80,601
SUBC 002 (Reference)	2.95	74.44	22.61	13.28	Americorophium spp.	28,451
SUBC 003 (Reference)	0.00	70.75	29.25	12.23	Americorophium spp.	32,120
SUBC 004 (Perimeter)	0.00	75.50	24.50	9.72	Americorophium spp.	27,669
SUBC 005 (Perimeter)	0.00	72.13	27.88	15.58	Potamopyrgus antipodarum	63,579

Table 5. 2023 Tide Point/Bornstein Percent Grain Size Distribution, Total Organic Carbon, and Dominant Species

				TOC		Density
STATION	%Gravel	%Sand	%Silt/Clay	mg/L	Most Dominant Species	#/sq.meter
Outfall 002	10.77	70.56	18.67	18.00	Americorophium spp.	27,248
SUBC 008 (Reference)	0.00	67.43	32.58	14.37	Oligochaeta	17,865
SUBC 009 (Perimeter)	0.00	68.51	31.49	20.29	Potamopyrgus antipodarum	12,511
Outfall 003	18.49	67.77	13.74	14.02	Potamopyrgus antipodarum	11,729
SUBC 006 (Reference)	0.00	72.89	27.11	15.29	Americorophium spp.	25,443
SUBC 007 (Reference)	0.70	74.05	25.25	7.03	Americorophium spp.	12,090
SUBC 010 (Perimeter)	18.54	64.41	17.06	26.84	Americorophium spp.	64,000

Table 6. 2023 Average Densities of Youngs Bay Dominant Species.

SPECIES	OUTFALL	REFERENCE	PERIMETER	OVERALL
Potamopygrus antipodarum	27,248	16,912	32,767	24,176
Americorophium spp.	18,506	30,616	38,631	30,288
Oligochaeta	10,326	7,308	10,271	8,916
Eogammarus confervicolus	3,308	1,664	4,707	2,980
Nereis limnicola	882	1,504	1,068	1,226
Average Total/Sq.m	60,270	58,005	87,443	67,585
1st Species % of Population	45.21	52.78	44.18	44.81

Table 7. 2005-2023 Youngs Bay Total Organic Carbon Measurements (mg/L).

STATION	2005	2007	2009	2011	2013	2015	2017	2019	2021	2023	AVERAGE
Outfall 001	11.00	23.70	20.40	24.00	17.50	18.20	23.00	18.30	20.51	12.26	18.89
SUBC 001 (Reference)	11.50	13.70	10.60	14.60	18.20	10.00	9.70	2.00	12.90	13.20	11.64
SUBC 002 (Reference)	9.10	12.10	16.60	12.90	14.00	9.00	13.90	12.00	6.27	13.28	11.92
SUBC 003 (Reference)	16.90	12.10	12.80	14.70	14.80	12.30	12.00	25.40	11.20	12.23	14.44
SUBC 004 (Perimeter)	13.70	12.60	13.60	13.10	22.70	14.70	14.80	11.90	12.90	9.72	13.97
SUBC 005 (Perimeter)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	18.80	15.58	17.19
Outfall 002	24.70	20.20	21.60	67.50	N/A	N/A	N/A	18.90	25.60	18.00	28.07
SUBC 006 (Reference)	18.60	18.10	19.10	17.90	22.40	18.20	17.90	15.70	15.90	15.29	17.91
SUBC 007 (Reference)	14.80	8.30	10.70	7.40	10.30	8.70	9.20	7.30	6.02	7.03	8.98
SUBC 008 (Reference)	11.40	16.30	19.00	17.80	27.60	14.60	15.60	15.30	18.40	14.37	17.04
SUBC 009 (Perimeter)	18.20	16.20	14.90	16.60	16.40	15.40	17.10	19.60	16.00	20.29	17.07
SUBC 010 (Perimeter)	12.90	10.10	9.30	53.10	18.60	21.30	53.20	120.90	35.00	26.84	36.12
Outfall 003	31.10	19.50	44.50	44.90	21.30	27.70	14.50	56.80	28.70	14.02	30.30

Table 8. 2023 Yacht Club Benthic Invertebrate Denstities and Diversities.

	Outfall 001	SUBC 001	SUBC 002	SUBC003	SUBC 004	SUBC 005
TAXON	**#/Sq.M**	**#/Sq.M**	**#/Sq.M**	**#/Sq.M**	**#/Sq.M**	**#/Sq.M**
Potamopyrgus antipodarum	48,361	51,308	7,940	7,519	16,481	63,579
Hobsonia florida	782	782	60	60	1,263	1,444
Oligochaeta	25,263	19,549	120	361	6,556	22,677
Americorophium spp.	26,346	80,601	28,451	32,120	27,669	54,676
Eogammarus confervicolus	8,421	4,511	602	2,406	60	17,865
Nereis limnicola	1,323	2,105	481	722	1,624	1,083
Canuella canadensis	0	0	0	0	0	0
Corbicula fluminea	0	0	60	0	0	0
Gnorimosphaeroma insulare	0	180	0	0	0	782
Macoma balthica	0	0	0	0	0	0
Nematoda	0	0	0	0	0	421
Cumacea	0	0	0	0	60	60
Saduria entomon	0	0	0	0	0	481
Total/Sq.M	**110,496**	**159,037**	**37,714**	**43,188**	**53,714**	**163,067**
Number of Species	**6**	**7**	**7**	**6**	**7**	**10**
1st Species % of Population	**43.8**	**50.7**	**75.4**	**74.4**	**51.5**	**39.0**
1st + 2nd % of Population	**67.6**	**82.9**	**96.5**	**91.8**	**82.2**	**72.5**
1st+ 2nd + 3rd % of Population	**90.5**	**95.2**	**98.1**	**97.4**	**94.4**	**86.4**

Table 9. 2023 Tide Point/Bornstein Benthic Invertebrate Densities and Diversities.

	Outfall 003	SUBC 006	SUBC 007	SUBC 008	SUBC 009	SUBC 010	Outfall 002
TAXON	**#/Sq.M**	**#/Sq.M**	**#/Sq.M**	**#/Sq.M**	**#/Sq.M**	**#/Sq.M**	**#/Sq.M**
Potamopyrgus antipodarum	11,729	17,624	8,241	8,842	12,511	38,496	21,654
Hobsonia florida	481	602	301	1,504	1,203	481	902
Oligochaeta	962	1,323	4,632	17,865	11,188	662	4,752
Americorophium spp.	1,925	25,443	12,090	4,992	8,180	64,000	27,248
Eogammarus confervicolus	0	1,684	180	602	0	902	1,504
Nereis limnicola	180	301	4,571	842	842	722	1,143
Canuella canadensis	0	0	0	0	0	0	0
Corbicula fluminea	0	0	0	0	0	0	120
Gnorimosphaeroma insulare	0	60	0	120	0	0	0
Macoma balthica	0	0	0	0	60	0	0
Nematoda	0	60	0	241	241	0	0
Cumacea	421	60	180	0	361	0	0
Saduria entomon	0	0	0	0	0	0	0
Total/Sq.M	**15,699**	**47,158**	**30,195**	**35,007**	**34,586**	**105,263**	**57,323**
Number of Species	**6**	**9**	**7**	**8**	**8**	**6**	**7**
1st Species % of Population	**74.7**	**54.0**	**40.0**	**51.0**	**36.2**	**60.8**	**47.5**
1st + 2nd % of Population	**87.0**	**91.3**	**67.3**	**76.3**	**68.5**	**97.4**	**85.3**
1st+ 2nd + 3rd % of Population	**93.1**	**94.9**	**82.7**	**90.5**	**92.2**	**98.2**	**93.6**

Table 10. Youngs Bay Benthic Invertebrate Densities, 2009-2023.

Species	2009	2011	2013	2015	2017	2019	2021	2023
Potamopyrgus antipodarum	20,601	15,699	11,325	21,223	8,186	21,214	25,434	24,176
Americorophium spp.	22,115	8,692	18,723	35,873	5,020	17,839	17,839	30,288
Oligochaeta	10,471	4,426	9,662	4,969	1,039	2,260	12,131	8,916
Eogammarus confervicolus	907	767	60	1,704	421	1,213	1,772	2,980
Hobsonia florida	907	767	87	2,142	421	360	1,596	759
Nereis limnicola	416	1,117	661	1,897	355	1,072	990	1,226

Table 11. Yacht Club Most Dominant Benthic Invertebrate Species Per Station, 2017-2023.

	2017		2019		2021		2023	
Station	Species	Density	Species	Density	Species	Density	Species	Density
Outfall 001	P. antipodarum	16,180	P. antipodarum	43,970	Americorophium spp.	85,293	P. antipodarum	48,361
SUBC 001 (reference)	Americorophium spp.	12,271	P. antipodarum	11,007	Americorophium spp.	74,706	Americorophium spp.	80,601
SUBC 002 (reference)	P. antipodarum	962	Americorophium spp.	7,759	Americorophium spp.	7,759	Americorophium spp.	28,451
SUBC 003 (reference)	P. antipodarum	8,000	P. antipodarum	22,195	Americorophium spp.	25,022	Americorophium spp.	32,120
SUBC 004 (perimeter)	Americorophium spp.	13,594	P. antipodarum	42,827	Americorophium spp.	16,601	Americorophium spp.	27,669
SUBC 005 (perimeter)	N/A	N/A	N/A	N/A	P. antipodarum	54,857	P. antipodarum	63,579

Table 12. Tide Point/Bornstein Most Dominant Benthic Invertebrate Species Per Station, 2017-2023.

	2017		2019		2021		2023	
Station	Species	Density	Species	Density	Species	Density	Species	Density
Outfall 002	N/A	N/A	Americorophium spp.	37,293	Oligochaeta	24,120	Americorophium spp.	27,248
Outfall 003	P. antipodarum	10,226	Americorophium spp.	31,338	Americorophium spp.	58,466	P. antipodarum	11,729
SUBC 006 (reference)	P. antipodarum	6,015	Americorophium spp.	35,970	Americorophium spp.	47,759	Americorophium spp.	25,443
SUBC 007 (reference)	P. antipodarum	3,970	Oligochaeta	5,053	Oligochaeta	9,444	Americorophium spp.	12,090
SUBC 008 (reference)	P. antipodarum	3,609	P. antipodarum	12,692	Oligochaeta	19,308	Oligochaeta	17,865
SUBC 009 (perimeter)	P. antipodarum	6,316	P. antipodarum	21,714	Oligochaeta	13,474	P. antipodarum	12,511
SUBC 010 (perimeter)	P. antipodarum	13,474	P. antipodarum	37,534	Americorophium spp.	86,075	Americorophium spp.	64,000

Table 13. Total Dissolved Solids Measurements Of Each Net Pen Site in Youngs Bay, 2023.

Net Pen Site	Upstream (mg/L)	Downstream (mg/L)
Tide Point	4,925	4,925
Bornstein	4,975	5,300
Yacht Club	5,050	5,425

Table 14. Young's Bay *Beggiatoa* spp., Water Temperature, pH- 2023.

Station	Beggiatoa spp. Present	Water Temp C.	pH
Outfall 001	No	18	7.3
SUBC 001	No	18	7.3
SUBC 002	No	18	7.3
SUBC 003	No	18	7.3
SUBC 004	No	18	7.3
SUBC 005	No	18	7.3
Outfall 002	No	18	7.3
SUBC 006	No	18	7.3
SUBC 007	No	18	7.3
SUBC 008	No	18	7.3
SUBC 009	No	18	7.3
SUBC 010	No	18	7.3
Outfall 003	No	18	7.3

Table 15 Outfall 001 / Reference Condition Comparisons

Null Hypothesis: There is no difference between the Reference Stations and Outfall 001 in the Number of Animals/Sample

Station Designation	SUBC 001			SUBC 002			SUBC003			Outfall 001					
Number of Animals/Sample	1556	543	545	231	150	246	180	292	246	328	762	747	" =	0.05	
Excel Rank	12	8	9	3	1	4	2	6	4	7	11	10	$	8	Tabular Value
Matches	1	1	1	1	1	2	1	1	2	1	1	1	T=	28	
Wilcoxon Rank	12	8	9	3	1	4.5	2	6	4.5	7	11	10	T'=	11	
				T=	50					T=	28				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 001 in the Number of Species/Sample

Station Designation	SUBC 001			SUBC 002			SUBC003			Outfall 001					
Number of Species/Sample	7	5	6	5	5	6	5	6	4	6	6	6	" =	0.05	
Excel Rank	12	2	6	2	2	6	2	6	1	6	6	6	$	8	Tabular Value
Matches	1	4	6	4	4	6	4	6	1	6	6	6	T=	25.5	
Wilcoxon Rank	12	3.5	8.5	3.5	3.5	8.5	3.5	8.5	1	8.5	8.5	8.5	T'=	13.5	
				T=	52.5					T=	25.5				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 001 in the Dominant Species % of Sample

Station Designation	SUBC 001			SUBC 002			SUBC003			Outfall 001					
Dominant Species % of Sample	61.89	54.88	67.89	78.35	76.67	71.95	71.11	73.97	77.24	50.3	40.29	44.44	" =	0.05	
Excel Rank	5	4	6	12	10	8	7	9	11	3	1	2	$	8	Tabular Value
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T=	6	
Wilcoxon Rank	5	4	6	12	10	8	7	9	11	3	1	2	T'=	33	
				T=	72					T=	6				**Reject Null Hypothesis**
					N=9						N=3				

The dominant species may not be the same for every station

Null Hypothesis: There is no difference between the Reference Stations and Outfall 001 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC003			Outfall 001					
Potamopyrgus antipodarum	512	216	125	45	29	58	27	52	46	165	307	332	" =	0.05	
Excel Rank	12	9	7	3	2	6	1	5	4	8	10	11	$	8	Tabular Value
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T=	29	
Wilcoxon Rank	12	9	7	3	2	6	1	5	4	8	10	11	T'=	10	
				T=	49					T=	29				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 001 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC003			Outfall 001					
Hobsonia florida	1	12	0	1	0	0	0	1	0	6	4	3	" =	0.05	
Excel Rank	6	12	1	6	1	1	1	6	1	11	10	9	$	8	Tabular Value
Matches	3	1	5	3	5	5	5	3	5	1	1	1	T=	30	
Wilcoxon Rank	7	12	3	7	3	3	3	7	3	11	10	9	T'=	9	
				T=	48					T=	30				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 001 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC003			Outfall 001					
Oligochaeta	23	298	4	0	1	1	4	2	0	3	289	128	" =	0.05	
Excel Rank	9	12	7	1	3	3	7	5	1	6	11	10	$	8	Tabular Value
Matches	1	1	2	2	2	2	2	1	2	1	1	1	T=	27	
Wilcoxon Rank	9	12	7.5	1.5	3.5	3.5	7.5	5	1.5	6	11	10	T'=	12	
				T=	51					T=	27				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 001 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC003			Outfall 001					
Americorophium spp.	963	7	370	181	115	177	128	216	190	133	110	195	" =	0.05	
Excel Rank	12	1	11	7	3	6	4	10	8	5	2	9	$	8	Tabular Value
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T=	16	
Wilcoxon Rank	12	1	11	7	3	6	4	10	8	5	2	9	T'=	23	
				T=	62					T=	16				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 001 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC003			Outfall 001					
Eogammarus confervicolus	49	0	26	2	2	6	19	12	9	18	37	85	" =	0.05	
Excel Rank	11	1	9	2	2	4	8	6	5	7	10	12	$	8	Tabular Value
Matches	1	1	1	2	2	1	1	1	1	1	1	1	T=	29	
Wilcoxon Rank	11	1	9	2.5	2.5	4	8	6	5	7	10	12	T'=	10	
				T=	49					T=	29				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 001 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC003			Outfall 001					
Nereis limnicola	6	10	19	2	3	3	2	9	1	3	15	4	" =	0.05	
Excel Rank	8	10	12	2	4	4	2	9	1	4	11	7	$	8	Tabular Value
Matches	1	1	1	2	3	3	2	1	1	3	1	1	T=	23	
Wilcoxon Rank	8	10	12	2.5	5	5	2.5	9	1	5	11	7	T'=	16	
				T=	55					T=	23				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 001 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC003			Outfall 001					
Corbicula fluminea	0	0	0	0	0	1	0	0	0	0	0	0	" =	0.05	
Excel Rank	1	1	1	1	1	12	1	1	1	1	1	1	$	8	Tabular Value
Matches	11	11	11	11	11	1	11	11	11	11	11	11	T=	18	
Wilcoxon Rank	6	6	6	6	6	12	6	6	6	6	6	6	T'=	21	
				T=	60					T=	18				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 001 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC003			Outfall 001					
Gnorimosphaeroma insulare	2	0	1	0	0	0	0	0	0	0	0	0	" =	0.05	
Excel Rank	12	1	11	1	1	1	1	1	1	1	1	1	$	8	Tabular Value
Matches	1	10	1	10	10	10	10	10	10	10	10	10	T=	16.5	
Wilcoxon Rank	12	5.5	11	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	T'=	22.5	
				T=	61.5					T=	16.5				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Table 16 SUBC 004 / Reference Condition Comparisons

Null Hypothesis: There is no difference between the Reference Stations and SUBC 004 in the Number of Animals/Sample

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 004				
Number of Animals/Sample	1556	543	545	231	150	246	180	292	246	227	326	340	" = 0.05	
Excel Rank	12	10	11	4	1	5	2	7	5	3	8	9	$ 8	Tabular Value
Matches	1	1	1	1	1	2	1	1	2	1	1	1	T= 20	
Wilcoxon Rank	12	10	11	4	1	5.5	2	7	5.5	3	8	9	T'= 19	
				T=	58					T=	20			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 004 in the Number of Species/Sample

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 004				
Number of Species/Sample	7	5	6	5	5	6	5	6	4	5	7	5	" = 0.05	
Excel Rank	11	2	8	2	2	8	2	8	1	2	11	2	$ 8	Tabular Value
Matches	2	6	3	6	6	3	6	3	1	6	2	6	T= 20.5	
Wilcoxon Rank	11.5	4.5	9	4.5	4.5	9	4.5	9	1	4.5	11.5	4.5	T'= 18.5	
				T=	57.5					T=	20.5			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 004 in the Dominant Species % of Sample

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 004				
Dominant Species % of Sample	61.89	54.88	67.89	78.35	76.67	71.95	71.11	73.97	77.24	50.66	46.01	57.35	" = 0.05	
Excel Rank	5	3	6	12	10	8	7	9	11	2	1	4	$ 8	Tabular Value
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 7	
Wilcoxon Rank	5	3	6	12	10	8	7	9	11	2	1	4	T'= 32	
				T=	71					T=	7			**Reject Null Hypothesis**
					N=9						N=3			

The dominant species may not be the same for every station

Null Hypothesis: There is no difference between the Reference Stations and SUBC 004 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 004				
Potamopyrgus antipodarum	512	216	125	45	29	58	27	52	46	72	106	96	" = 0.05	
Excel Rank	12	11	10	3	2	6	1	5	4	7	9	8	$ 8	Tabular Value
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 24	
Wilcoxon Rank	12	11	10	3	2	6	1	5	4	7	9	8	T'= 15	
				T=	54					T=	24			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 004 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 004				
Hobsonia florida	1	12	0	1	0	0	0	1	0	4	9	8	" = 0.05	
Excel Rank	6	12	1	6	1	1	1	6	1	9	11	10	$ 8	Tabular Value
Matches	3	1	5	3	5	5	5	3	5	1	1	1	T= 30	
Wilcoxon Rank	7	12	3	7	3	3	3	7	3	9	11	10	T'= 9	
				T=	48					T=	30			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 004 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 004				
Oligochaeta	23	298	4	0	1	1	4	2	0	32	46	31	" = 0.05	
Excel Rank	8	12	6	1	3	3	6	5	1	10	11	9	$ 8	Tabular Value
Matches	1	1	2	2	2	2	2	1	2	1	1	1	T= 30	
Wilcoxon Rank	8	12	6.5	1.5	3.5	3.5	6.5	5	1.5	10	11	9	T'= 9	
				T=	48					T=	30			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 004 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 004				
Americorophium spp.	963	7	370	181	115	177	128	216	190	115	150	195	" = 0.05	
Excel Rank	12	1	11	7	2	6	4	10	8	2	5	9	$ 8	Tabular Value
Matches	1	1	1	1	2	1	1	1	1	2	1	1	T= 16.5	
Wilcoxon Rank	12	1	11	7	2.5	6	4	10	8	2.5	5	9	T'= 22.5	
				T=	61.5					T=	16.5			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 004 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 004				
Eogammarus confervicolus	49	0	26	2	2	6	19	12	9	0	1	0	" = 0.05	
Excel Rank	12	1	11	5	5	7	10	9	8	1	4	1	$ 8	Tabular Value
Matches	1	3	1	2	2	1	1	1	1	3	1	3	T= 8	
Wilcoxon Rank	12	2	11	5.5	5.5	7	10	9	8	2	4	2	T'= 31	
				T=	70					T=	8			**Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 004 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 004				
Nereis limnicola	6	10	19	2	3	3	2	9	1	4	13	10	" = 0.05	
Excel Rank	7	9	12	2	4	4	2	8	1	6	11	9	$ 8	Tabular Value
Matches	1	2	1	2	2	2	2	1	1	1	1	2	T= 26.5	
Wilcoxon Rank	7	9.5	12	2.5	4.5	4.5	2.5	8	1	6	11	9.5	T'= 12.5	
				T=	51.5					T=	26.5			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 004 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 004				
Corbicula fluminea	0	0	0	0	0	1	0	0	0	0	0	0	" = 0.05	
Excel Rank	1	1	1	1	1	12	1	1	1	1	1	1	$ 8	Tabular Value
Matches	11	11	11	11	11	1	11	11	11	11	11	11	T= 18	
Wilcoxon Rank	6	6	6	6	6	12	6	6	6	6	6	6	T'= 21	
				T=	60					T=	18			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 004 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 004				
Gnorimosphaeroma insulare	2	0	1	0	0	0	0	0	0	0	0	0	" = 0.05	
Excel Rank	12	1	11	1	1	1	1	1	1	1	1	1	$ 8	Tabular Value
Matches	1	10	1	10	10	10	10	10	10	10	10	10	T= 16.5	
Wilcoxon Rank	12	5.5	11	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	T'= 22.5	
				T=	61.5					T=	16.5			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 004 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 004				
Cumacea	0	0	0	0	0	0	0	0	0	0	1	0	" = 0.05	
Excel Rank	1	1	1	1	1	1	1	1	1	1	12	1	$ 8	Tabular Value
Matches	11	11	11	11	11	11	11	11	11	11	1	11	T= 24	
Wilcoxon Rank	6	6	6	6	6	6	6	6	6	6	12	6	T'= 15	
				T=	54					T=	24			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Table 17 SUBC 005 / Reference Condition Comparisons

Null Hypothesis: There is no difference between the Reference Stations and SUBC 005 in the Number of Animals/Sample

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 005				
Number of Animals/Sample	1556	543	545	231	150	246	180	292	246	1414	582	715	" = 0.05	
Excel Rank	12	7	8	3	1	4	2	6	4	11	9	10	$ 8	Tabular Value
Matches	1	1	1	1	1	2	1	1	2	1	1	1	T= 30	
Wilcoxon Rank	12	7	8	3	1	4.5	2	6	4.5	11	9	10	T'= 9	
				T=	48					T=	30			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 005 in the Number of Species/Sample

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 005				
Number of Species/Sample	7	5	6	5	5	6	5	6	4	9	8	10	" = 0.05	
Excel Rank	9	2	6	2	2	6	2	6	1	11	10	12	$ 8	Tabular Value
Matches	1	4	3	4	4	3	4	3	1	1	1	1	T= 33	
Wilcoxon Rank	9	3.5	7	3.5	3.5	7	3.5	7	1	11	10	12	T'= 6	
				T=	45					T=	33			**Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 005 in the Dominant Species % of Sample

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 005				
Dominant Species % of Sample	61.89	54.88	67.89	78.35	76.67	71.95	71.11	73.97	77.24	45.69	39.52	31.33	" = 0.05	
Excel Rank	5	4	6	12	10	8	7	9	11	3	2	1	$ 8	Tabular Value
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 6	
Wilcoxon Rank	5	4	6	12	10	8	7	9	11	3	2	1	T'= 33	
				T=	72					T=	6			**Reject Null Hypothesis**
					N=9						N=3			

The dominant species may not be the same for every station

Null Hypothesis: There is no difference between the Reference Stations and SUBC 005 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 005				
Potamopyrgus antipodarum	512	216	125	45	29	58	27	52	46	646	193	218	" = 0.05	
Excel Rank	11	9	7	3	2	6	1	5	4	12	8	10	$ 8	Tabular Value
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 30	
Wilcoxon Rank	11	9	7	3	2	6	1	5	4	12	8	10	T'= 9	
				T=	48					T=	30			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 005 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 005				
Hobsonia florida	1	12	0	1	0	0	0	1	0	14	4	6	" = 0.05	
Excel Rank	6	11	1	6	1	1	1	6	1	12	9	10	$ 8	Tabular Value
Matches	3	1	5	3	5	5	5	3	5	1	1	1	T= 31	
Wilcoxon Rank	7	11	3	7	3	3	3	7	3	12	9	10	T'= 8	
				T=	47					T=	31			**Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 005 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 005				
Oligochaeta	23	298	4	0	1	1	4	2	0	134	94	149	" = 0.05	
Excel Rank	8	12	6	1	3	3	6	5	1	10	9	11	$ 8	Tabular Value
Matches	1	1	2	2	2	2	2	1	2	1	1	1	T= 30	
Wilcoxon Rank	8	12	6.5	1.5	3.5	3.5	6.5	5	1.5	10	9	11	T'= 9	
				T=	48					T=	30			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 005 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 005				
Americorophium spp.	963	7	370	181	115	177	128	216	190	455	230	224	" = 0.05	
Excel Rank	12	1	10	5	2	4	3	7	6	11	9	8	$ 8	Tabular Value
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 28	
Wilcoxon Rank	12	1	10	5	2	4	3	7	6	11	9	8	T'= 11	
				T=	50					T=	28			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 005 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 005				
Eogammarus confervicolus	49	0	26	2	2	6	19	12	9	139	54	104	" = 0.05	
Excel Rank	9	1	8	2	2	4	7	6	5	12	10	11	$ 8	Tabular Value
Matches	1	1	1	2	2	1	1	1	1	1	1	1	T= 33	
Wilcoxon Rank	9	1	8	2.5	2.5	4	7	6	5	12	10	11	T'= 6	
				T=	45					T=	33			**Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 005 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 005				
Nereis limnicola	6	10	19	2	3	3	2	9	1	8	4	6	" = 0.05	
Excel Rank	7	11	12	2	4	4	2	10	1	9	6	7	$ 8	Tabular Value
Matches	2	1	1	2	2	2	2	1	1	1	1	2	T= 22.5	
Wilcoxon Rank	7.5	11	12	2.5	4.5	4.5	2.5	10	1	9	6	7.5	T'= 16.5	
				T=	55.5					T=	22.5			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 005 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 005				
Corbicula fluminea	0	0	0	0	0	1	0	0	0	0	0	0	" = 0.05	
Excel Rank	1	1	1	1	1	12	1	1	1	1	1	1	$ 8	Tabular Value
Matches	11	11	11	11	11	1	11	11	11	11	11	11	T= 18	
Wilcoxon Rank	6	6	6	6	6	12	6	6	6	6	6	6	T'= 21	
				T=	60					T=	18			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 005 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 005				
Gnorimosphaeroma insulare	2	0	1	0	0	0	0	0	0	12	0	1	" = 0.05	
Excel Rank	11	1	9	1	1	1	1	1	1	12	1	9	$ 8	Tabular Value
Matches	1	8	2	8	8	8	8	8	8	1	8	2	T= 26	
Wilcoxon Rank	11	4.5	9.5	4.5	4.5	4.5	4.5	4.5	4.5	12	4.5	9.5	T'= 13	
				T=	52					T=	26			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 005 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 005				
Nematoda	0	0	0	0	0	0	0	0	0	4	1	2	" = 0.05	
Excel Rank	1	1	1	1	1	1	1	1	1	12	10	11	$ 8	Tabular Value
Matches	9	9	9	9	9	9	9	9	9	1	1	1	T= 33	
Wilcoxon Rank	5	5	5	5	5	5	5	5	5	12	10	11	T'= 6	
				T=	45					T=	33			**Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 005 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 005				
Cumacea	0	0	0	0	0	0	0	0	0	0	0	1	" = 0.05	
Excel Rank	1	1	1	1	1	1	1	1	1	1	1	12	$ 8	Tabular Value
Matches	11	11	11	11	11	11	11	11	11	11	11	1	T= 24	
Wilcoxon Rank	6	6	6	6	6	6	6	6	6	6	6	12	T'= 15	
				T=	54					T=	24			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 005 in the Species indicated

Station Designation	SUBC 001			SUBC 002			SUBC 003			SUBC 005				
Saduria entomon	0	0	0	0	0	0	0	0	0	2	2	4	" = 0.05	
Excel Rank	1	1	1	1	1	1	1	1	1	10	10	12	$ 8	Tabular Value
Matches	9	9	9	9	9	9	9	9	9	2	2	1	T= 33	
Wilcoxon Rank	5	5	5	5	5	5	5	5	5	10.5	10.5	12	T'= 6	
				T=	45					T=	33			**Reject Null Hypothesis**
					N=9						N=3			

Table 18 Outfall 003 / Reference Condition Comparisons

Null Hypothesis: There is no difference between the Reference Stations and Outfall 003 in the Number of Animals/Sample

Station Designation	SUBC 006				SUBC 007			SUBC 008			Outfall 003				
Number of Animals/Sample	590	114	80	140	174	188	172	259	151	85	77	99	" = 0.05		
Excel Rank	12	5	2	6	9	10	8	11	7	3	1	4	$ 8	Tabular Value	
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 8		
Wilcoxon Rank	12	5	2	6	9	10	8	11	7	3	1	4	T'= 31		
				T=	70					T=	8			**Reject Null Hypothesis**	
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 003 in the Number of Species/Sample

Station Designation	SUBC 006				SUBC 007			SUBC 008			Outfall 003				
Number of Species/Sample	8	5	3	6	7	6	7	8	6	6	6	5	" = 0.05		
Excel Rank	11	2	1	4	9	4	9	11	4	4	4	2	$ 8	Tabular Value	
Matches	2	2	1	5	2	5	2	2	5	5	5	2	T= 14.5		
Wilcoxon Rank	11.5	2.5	1	6	9.5	6	9.5	11.5	6	6	6	2.5	T'= 24.5		
				T=	63.5					T=	14.5			**Do Not Reject Null Hypothesis**	
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 003 in the Dominant Species % of Sample

Station Designation	SUBC 006				SUBC 007			SUBC 008			Outfall 003				
Dominant Species % of Sample	53.73	63.16	50	34.29	49.43	38.3	41.86	78.76	47.68	70.59	85.71	69.7	" = 0.05		
Excel Rank	7	8	6	1	5	2	3	11	4	10	12	9	$ 8	Tabular Value	
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 31		
Wilcoxon Rank	7	8	6	1	5	2	3	11	4	10	12	9	T'= 8		
				T=	47					T=	31			**Reject Null Hypothesis**	
					N=9						N=3				

The dominant species may not be the same for every station

Null Hypothesis: There is no difference between the Reference Stations and Outfall 003 in the Species indicated

Station Designation	SUBC 006				SUBC 007			SUBC 008			Outfall 003				
Potamopyrgus antipodarum	223	30	40	36	29	72	72	28	47	60	66	69	" = 0.05		
Excel Rank	12	3	5	4	2	10	10	1	6	7	8	9	$ 8	Tabular Value	
Matches	1	1	1	1	1	2	2	1	1	1	1	1	T= 24		
Wilcoxon Rank	12	3	5	4	2	10.5	10.5	1	6	7	8	9	T'= 15		
				T=	54					T=	24			**Do Not Reject Null Hypothesis**	
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 003 in the Species indicated

Station Designation	SUBC 006				SUBC 007			SUBC 008			Outfall 003				
Hobsonia florida	10	0	0	2	2	1	11	10	4	1	1	6	" = 0.05		
Excel Rank	10	1	1	6	6	3	12	10	8	3	3	9	$ 8	Tabular Value	
Matches	2	2	2	2	2	3	1	2	1	3	3	1	T= 17		
Wilcoxon Rank	10.5	1.5	1.5	6.5	6.5	4	12	10.5	8	4	4	9	T'= 22		
				T=	61					T=	17			**Do Not Reject Null Hypothesis**	
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 003 in the Species indicated

Station Designation	SUBC 006				SUBC 007			SUBC 008			Outfall 003				
Oligochaeta	22	0	0	26	32	19	21	204	72	1	5	10	" = 0.05		
Excel Rank	8	1	1	9	10	6	7	12	11	3	4	5	$ 8	Tabular Value	
Matches	1	2	2	1	1	1	1	1	1	1	1	1	T= 12		
Wilcoxon Rank	8	1.5	1.5	9	10	6	7	12	11	3	4	5	T'= 27		
				T=	66					T=	12			**Do Not Reject Null Hypothesis**	
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 003 in the Species indicated

Station Designation	SUBC 006				SUBC 007			SUBC 008			Outfall 003				
Americorophium spp.	317	72	34	48	86	67	49	9	25	19	1	12	" = 0.05		
Excel Rank	12	10	6	7	11	9	8	2	5	4	1	3	$ 8	Tabular Value	
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 8		
Wilcoxon Rank	12	10	6	7	11	9	8	2	5	4	1	3	T'= 31		
				T=	70					T=	8			**Reject Null Hypothesis**	
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 003 in the Species indicated

Station Designation	SUBC 006				SUBC 007			SUBC 008			Outfall 003				
Eogammarus confervicolus	12	10	6	1	2	0	8	1	1	0	0	0	" = 0.05		
Excel Rank	12	11	9	5	8	1	10	5	5	1	1	1	$ 8	Tabular Value	
Matches	1	1	1	3	1	4	1	3	3	4	4	4	T= 7.5		
Wilcoxon Rank	12	11	9	6	8	2.5	10	6	6	2.5	2.5	2.5	T'= 31.5		
				T=	70.5					T=	7.5			**Reject Null Hypothesis**	
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 003 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 003					
Nereis limnicola	4	1	0	27	21	28	8	4	2	1	2	0	" =	0.05	
Excel Rank	7	3	1	11	10	12	9	7	5	3	5	1	$	8	Tabular Value
Matches	2	2	2	1	1	1	1	2	2	2	2	2	T=	10.5	
Wilcoxon Rank	7.5	3.5	1.5	11	10	12	9	7.5	5.5	3.5	5.5	1.5	T'=	28.5	
				T=	67.5					T=	10.5				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 003 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 003					
Gnorimosphaeroma insulare	1	0	0	0	0	0	0	2	0	0	0	0	" =	0.05	
Excel Rank	11	1	1	1	1	1	1	12	1	1	1	1	$	8	Tabular Value
Matches	1	10	10	10	10	10	10	1	10	10	10	10	T=	16.5	
Wilcoxon Rank	11	5.5	5.5	5.5	5.5	5.5	5.5	12	5.5	5.5	5.5	5.5	T'=	22.5	
				T=	61.5					T=	16.5				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 003 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 003					
Nematoda	0	1	0	0	0	0	3	1	0	0	0	0	" =	0.05	
Excel Rank	1	10	1	1	1	1	12	10	1	1	1	1	$	8	Tabular Value
Matches	9	2	9	9	9	9	1	2	9	9	9	9	T=	15	
Wilcoxon Rank	5	10.5	5	5	5	5	12	10.5	5	5	5	5	T'=	24	
				T=	63					T=	15				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and Outfall 003 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 003					
Cumacea	1	0	0	0	2	1	0	0	0	3	2	2	" =	0.05	
Excel Rank	7	1	1	1	9	7	1	1	1	12	9	9	$	8	Tabular Value
Matches	2	6	6	6	3	2	6	6	6	1	3	3	T=	32	
Wilcoxon Rank	7.5	3.5	3.5	3.5	10	7.5	3.5	3.5	3.5	12	10	10	T'=	7	
				T=	46					T=	32				**Reject Null Hypothesis**
					N=9						N=3				

Table 19 SUBC 009 / Reference Condition Comparisons

Null Hypothesis: There is no difference between the Reference Stations and SUBC 009 in the Number of Animals/Sample

Station Designation	SUBC 006				SUBC 007			SUBC 008			SUBC 009				
Number of Animals/Sample	590	114	80	140	174	188	172	259	151	100	180	295	" = 0.05		
Excel Rank	12	3	1	4	7	9	6	10	5	2	8	11	$ 8	Tabular Value	
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 21		
Wilcoxon Rank	12	3	1	4	7	9	6	10	5	2	8	11	T'= 18		
				T=	57					T=	21			**Do Not Reject Null Hypothesis**	
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and SUBC 009 in the Number of Species/Sample

Station Designation	SUBC 006				SUBC 007			SUBC 008			SUBC 009				
Number of Species/Sample	8	5	3	6	7	6	7	8	6	7	7	7	" = 0.05		
Excel Rank	11	2	1	3	6	3	6	11	3	6	6	6	$ 8	Tabular Value	
Matches	2	1	1	3	5	3	5	2	3	5	5	5	T= 24		
Wilcoxon Rank	11.5	2	1	4	8	4	8	11.5	4	8	8	8	T'= 15		
				T=	54					T=	24			**Do Not Reject Null Hypothesis**	
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and SUBC 009 in the Species indicated

Station Designation	SUBC 006				SUBC 007			SUBC 008			SUBC 009				
Dominant Species % of Sample	53.73	63.16	50	34.29	49.43	38.3	41.86	78.76	47.68	36	31.67	39.66	" = 0.05		
Excel Rank	10	11	9	2	8	4	6	12	7	3	1	5	$ 8	Tabular Value	
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 9		
Wilcoxon Rank	10	11	9	2	8	4	6	12	7	3	1	5	T'= 30		
				T=	69					T=	9			**Do Not Reject Null Hypothesis**	
					N=9						N=3				

The dominant species may not be the same for every station

Null Hypothesis: There is no difference between the Reference Stations and SUBC 009 in the Species indicated

Station Designation	SUBC 006				SUBC 007			SUBC 008			SUBC 009				
Potamopyrgus antipodarum	223	30	40	36	29	72	72	28	47	36	55	117	" = 0.05		
Excel Rank	12	3	6	4	2	9	9	1	7	4	8	11	$ 8	Tabular Value	
Matches	1	1	1	2	1	2	2	1	1	2	1	1	T= 23.5		
Wilcoxon Rank	12	3	6	4.5	2	9.5	9.5	1	7	4.5	8	11	T'= 15.5		
				T=	54.5					T=	23.5			**Do Not Reject Null Hypothesis**	
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and SUBC 009 in the Species indicated

Station Designation	SUBC 006				SUBC 007			SUBC 008			SUBC 009				
Hobsonia florida	10	0	0	2	2	1	11	10	4	1	7	12	" = 0.05		
Excel Rank	9	1	1	5	5	3	11	9	7	3	8	12	$ 8	Tabular Value	
Matches	2	2	2	2	2	2	1	2	1	2	1	1	T= 23.5		
Wilcoxon Rank	9.5	1.5	1.5	5.5	5.5	3.5	11	9.5	7	3.5	8	12	T'= 15.5		
				T=	54.5					T=	23.5			**Do Not Reject Null Hypothesis**	
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and SUBC 009 in the Species indicated

Station Designation	SUBC 006				SUBC 007			SUBC 008			SUBC 009				
Oligochaeta	22	0	0	26	32	19	21	204	72	36	57	93	" = 0.05		
Excel Rank	5	1	1	6	7	3	4	12	10	8	9	11	$ 8	Tabular Value	
Matches	1	2	2	1	1	1	1	1	1	1	1	1	T= 28		
Wilcoxon Rank	5	1.5	1.5	6	7	3	4	12	10	8	9	11	T'= 11		
				T=	50					T=	28			**Do Not Reject Null Hypothesis**	
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and SUBC 009 in the Species indicated

Station Designation	SUBC 006				SUBC 007			SUBC 008			SUBC 009				
Americorophium spp.	317	72	34	48	86	67	49	9	25	21	49	66	" = 0.05		
Excel Rank	12	10	4	5	11	9	6	1	3	2	6	8	$ 8	Tabular Value	
Matches	1	1	1	1	1	1	2	1	1	1	2	1	T= 16.5		
Wilcoxon Rank	12	10	4	5	11	9	6.5	1	3	2	6.5	8	T'= 22.5		
				T=	61.5					T=	16.5			**Do Not Reject Null Hypothesis**	
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and SUBC 009 in the Species indicated

Station Designation	SUBC 006				SUBC 007			SUBC 008			SUBC 009				
Eogammarus confervicolus	12	10	6	1	2	0	8	1	1	0	0	0	" = 0.05		
Excel Rank	12	11	9	5	8	1	10	5	5	1	1	1	$ 8	Tabular Value	
Matches	1	1	1	3	1	4	1	3	3	4	4	4	T= 7.5		
Wilcoxon Rank	12	11	9	6	8	2.5	10	6	6	2.5	2.5	2.5	T'= 31.5		
				T=	70.5					T=	7.5			**Reject Null Hypothesis**	
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and SUBC 009 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 009					
Nereis limnicola	4	1	0	27	21	28	8	4	2	4	5	5	" =	0.05	
Excel Rank	4	2	1	11	10	12	9	4	3	4	7	7	$	8	Tabular Value
Matches	3	1	1	1	1	1	1	3	1	3	2	2	T=	20	
Wilcoxon Rank	5	2	1	11	10	12	9	5	3	5	7.5	7.5	T'=	19	
				T=	58					T=	20				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and SUBC 009 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 009					
Gnorimosphaeroma insulare	1	0	0	0	0	0	0	2	0	0	0	0	" =	0.05	
Excel Rank	11	1	1	1	1	1	1	12	1	1	1	1	$	8	Tabular Value
Matches	1	10	10	10	10	10	10	1	10	10	10	10	T=	16.5	
Wilcoxon Rank	11	5.5	5.5	5.5	5.5	5.5	5.5	12	5.5	5.5	5.5	5.5	T'=	22.5	
				T=	61.5					T=	16.5				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and SUBC 009 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 009					
Macoma balthica	0	0	0	0	0	0	0	0	0	1	0	0	" =	0.05	
Excel Rank	1	1	1	1	1	1	1	1	1	12	1	1	$	8	Tabular Value
Matches	11	11	11	11	11	11	11	11	11	1	11	11	T=	24	
Wilcoxon Rank	6	6	6	6	6	6	6	6	6	12	6	6	T'=	15	
				T=	54					T=	24				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and SUBC 009 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 009					
Nematoda	0	1	0	0	0	0	3	1	0	0	3	1	" =	0.05	
Excel Rank	1	8	1	1	1	1	11	8	1	1	11	8	$	8	Tabular Value
Matches	7	3	7	7	7	7	2	3	7	7	2	3	T=	24.5	
Wilcoxon Rank	4	9	4	4	4	4	11.5	9	4	4	11.5	9	T'=	14.5	
				T=	53.5					T=	24.5				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Null Hypothesis: There is no difference between the Reference Stations and SUBC 009 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 009					
Cumacea	1	0	0	0	2	1	0	0	0	1	4	1	" =	0.05	
Excel Rank	7	1	1	1	11	7	1	1	1	7	12	7	$	8	Tabular Value
Matches	4	6	6	6	1	4	6	6	6	4	1	4	T=	29	
Wilcoxon Rank	8.5	3.5	3.5	3.5	11	8.5	3.5	3.5	3.5	8.5	12	8.5	T'=	10	
				T=	49					T=	29				**Do Not Reject Null Hypothesis**
					N=9						N=3				

Table 20 SUBC 010 / Reference Condition Comparisons

Null Hypothesis: There is no difference between the Reference Stations and SUBC 010 in the Number of Animals/Sample

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 010				
Number of Animals/Sample	590	114	80	140	174	188	172	259	151	254	340	1156	" = 0.05	
Excel Rank	11	2	1	3	6	7	5	9	4	8	10	12	$ 8	Tabular Value
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 30	
Wilcoxon Rank	11	2	1	3	6	7	5	9	4	8	10	12	T'= 9	
				T=	48					T=	30			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 010 in the Number of Species/Sample

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 010				
Number of Species/Sample	8	5	3	6	7	6	7	8	6	6	6	6	" = 0.05	
Excel Rank	11	2	1	3	9	3	9	11	3	3	3	3	$ 8	Tabular Value
Matches	2	1	1	6	2	6	2	2	6	6	6	6	T= 16.5	
Wilcoxon Rank	11.5	2	1	5.5	9.5	5.5	9.5	11.5	5.5	5.5	5.5	5.5	T'= 22.5	
				T=	61.5					T=	16.5			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 010 in the Dominant Species % of Sample

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 010				
Dominant Species % of Sample	53.73	63.16	50	34.29	49.43	38.3	41.86	78.76	47.68	56.69	49.71	66.52	" = 0.05	
Excel Rank	8	10	7	1	5	2	3	12	4	9	6	11	$ 8	Tabular Value
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 26	
Wilcoxon Rank	8	10	7	1	5	2	3	12	4	9	6	11	T'= 13	
				T=	52					T=	26			**Do Not Reject Null Hypothesis**
					N=9						N=3			

The dominant species may not be the same for every station

Null Hypothesis: There is no difference between the Reference Stations and SUBC 010 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 010				
Potamopyrgus antipodarum	223	30	40	36	29	72	72	28	47	97	169	374	" = 0.05	
Excel Rank	11	3	5	4	2	7	7	1	6	9	10	12	$ 8	Tabular Value
Matches	1	1	1	1	1	2	2	1	1	1	1	1	T= 31	
Wilcoxon Rank	11	3	5	4	2	7.5	7.5	1	6	9	10	12	T'= 8	
				T=	47					T=	31			**Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 010 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 010				
Hobsonia florida	10	0	0	2	2	1	11	10	4	1	2	5	" = 0.05	
Excel Rank	10	1	1	5	5	3	12	10	8	3	5	9	$ 8	Tabular Value
Matches	2	2	2	3	3	2	1	2	1	2	3	1	T= 18.5	
Wilcoxon Rank	10.5	1.5	1.5	6	6	3.5	12	10.5	8	3.5	6	9	T'= 20.5	
				T=	59.5					T=	18.5			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 010 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 010				
Oligochaeta	22	0	0	26	32	19	21	204	72	2	8	1	" = 0.05	
Excel Rank	8	1	1	9	10	6	7	12	11	4	5	3	$ 8	Tabular Value
Matches	1	2	2	1	1	1	1	1	1	1	1	1	T= 12	
Wilcoxon Rank	8	1.5	1.5	9	10	6	7	12	11	4	5	3	T'= 27	
				T=	66					T=	12			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 010 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 010				
Americorophium spp.	317	72	34	48	86	67	49	9	25	144	151	769	" = 0.05	
Excel Rank	11	7	3	4	8	6	5	1	2	9	10	12	$ 8	Tabular Value
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 31	
Wilcoxon Rank	11	7	3	4	8	6	5	1	2	9	10	12	T'= 8	
				T=	47					T=	31			**Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 010 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 010				
Eogammarus confervicolus	12	10	6	1	2	0	8	1	1	7	4	4	" = 0.05	
Excel Rank	12	11	8	2	5	1	10	2	2	9	6	6	$ 8	Tabular Value
Matches	1	1	1	3	1	1	1	3	3	1	2	2	T= 22	
Wilcoxon Rank	12	11	8	3	5	1	10	3	3	9	6.5	6.5	T'= 17	
				T=	56					T=	22			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 010 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 010				
Nereis limnicola	4	1	0	27	21	28	8	4	2	3	6	3	" = 0.05	
Excel Rank	6	2	1	11	10	12	9	6	3	4	8	4	$ 8	Tabular Value
Matches	2	1	1	1	1	1	1	2	1	2	1	2	T= 17	
Wilcoxon Rank	6.5	2	1	11	10	12	9	6.5	3	4.5	8	4.5	T'= 22	
				T=	61					T=	17			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 010 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 010				
Gnorimosphaeroma insulare	1	0	0	0	0	0	0	2	0	0	0	0	" = 0.05	
Excel Rank	11	1	1	1	1	1	1	12	1	1	1	1	$ 8	Tabular Value
Matches	1	10	10	10	10	10	10	1	10	10	10	10	T= 16.5	
Wilcoxon Rank	11	5.5	5.5	5.5	5.5	5.5	5.5	12	5.5	5.5	5.5	5.5	T'= 22.5	
				T=	61.5					T=	16.5			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 010 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 010				
Nematoda	0	1	0	0	0	0	3	1	0	0	0	0	" = 0.05	
Excel Rank	1	10	1	1	1	1	12	10	1	1	1	1	$ 8	Tabular Value
Matches	9	2	9	9	9	9	1	2	9	9	9	9	T= 15	
Wilcoxon Rank	5	10.5	5	5	5	5	12	10.5	5	5	5	5	T'= 24	
				T=	63					T=	15			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and SUBC 010 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			SUBC 010				
Cumacea	1	0	0	0	2	1	0	0	0	0	0	0	" = 0.05	
Excel Rank	10	1	1	1	12	10	1	1	1	1	1	1	$ 8	Tabular Value
Matches	2	9	9	9	1	2	9	9	9	9	9	9	T= 15	
Wilcoxon Rank	10.5	5	5	5	12	10.5	5	5	5	5	5	5	T'= 24	
				T=	63					T=	15			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Table 21 Outfall 002 / Reference Condition Comparisons

Null Hypothesis: There is no difference between the Reference Stations and Outfall 002 in the Number of Animals/Sample

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 002				
Number of Animals/Sample	590	114	80	140	174	188	172	259	151	365	249	339	" = 0.05	
Excel Rank	12	2	1	3	6	7	5	9	4	11	8	10	$ 8	Tabular Value
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 29	
Wilcoxon Rank	12	2	1	3	6	7	5	9	4	11	8	10	T'= 10	
				T=	49					T=	29			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and Outfall 002 in the Number of Species/Sample

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 002				
Number of Species/Sample	8	5	3	6	7	6	7	8	6	7	6	6	" = 0.05	
Excel Rank	11	2	1	3	8	3	8	11	3	8	3	3	$ 8	Tabular Value
Matches	2	1	1	5	3	5	3	2	5	3	5	5	T= 19	
Wilcoxon Rank	11.5	2	1	5	9	5	9	11.5	5	9	5	5	T'= 20	
				T=	59					T=	19			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and Outfall 002 in the Dominant Species % of Sample

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 002				
Dominant Species % of Sample	53.73	63.16	50	34.29	49.43	38.3	41.86	78.76	47.68	49.04	49.8	67.55	" = 0.05	
Excel Rank	9	10	8	1	6	2	3	12	4	5	7	11	$ 8	Tabular Value
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 23	
Wilcoxon Rank	9	10	8	1	6	2	3	12	4	5	7	11	T'= 16	
				T=	55					T=	23			**Do Not Reject Null Hypothesis**
					N=9						N=3			

The dominant species may not be the same for every station

Null Hypothesis: There is no difference between the Reference Stations and Outfall 002 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 002				
Potamopyrgus antipodarum	223	30	40	36	29	72	72	28	47	179	90	91	" = 0.05	
Excel Rank	12	3	5	4	2	7	7	1	6	11	9	10	$ 8	Tabular Value
Matches	1	1	1	1	1	2	2	1	1	1	1	1	T= 30	
Wilcoxon Rank	12	3	5	4	2	7.5	7.5	1	6	11	9	10	T'= 9	
				T=	48					T=	30			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and Outfall 002 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 002				
Hobsonia florida	10	0	0	2	2	1	11	10	4	5	4	6	" = 0.05	
Excel Rank	10	1	1	4	4	3	12	10	6	8	6	9	$ 8	Tabular Value
Matches	2	2	2	2	2	1	1	2	2	1	2	1	T= 23.5	
Wilcoxon Rank	10.5	1.5	1.5	4.5	4.5	3	12	10.5	6.5	8	6.5	9	T'= 15.5	
				T=	54.5					T=	23.5			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and Outfall 002 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 002				
Oligochaeta	22	0	0	26	32	19	21	204	72	55	16	8	" = 0.05	
Excel Rank	7	1	1	8	9	5	6	12	11	10	4	3	$ 8	Tabular Value
Matches	1	2	2	1	1	1	1	1	1	1	1	1	T= 17	
Wilcoxon Rank	7	1.5	1.5	8	9	5	6	12	11	10	4	3	T'= 22	
				T=	61					T=	17			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and Outfall 002 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 002				
Americorophium spp.	317	72	34	48	86	67	49	9	25	100	124	229	" = 0.05	
Excel Rank	12	7	3	4	8	6	5	1	2	9	10	11	$ 8	Tabular Value
Matches	1	1	1	1	1	1	1	1	1	1	1	1	T= 30	
Wilcoxon Rank	12	7	3	4	8	6	5	1	2	9	10	11	T'= 9	
				T=	48					T=	30			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and Outfall 002 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 002				
Eogammarus confervicolus	12	10	6	1	2	0	8	1	1	18	5	2	" = 0.05	
Excel Rank	11	10	8	2	5	1	9	2	2	12	7	5	$ 8	Tabular Value
Matches	1	1	1	3	2	1	1	3	3	1	1	2	T= 24.5	
Wilcoxon Rank	11	10	8	3	5.5	1	9	3	3	12	7	5.5	T'= 14.5	
				T=	53.5					T=	24.5			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and Outfall 002 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 002				
Nereis limnicola	4	1	0	27	21	28	8	4	2	6	10	3	" = 0.05	
Excel Rank	5	2	1	11	10	12	8	5	3	7	9	4	$ 8	Tabular Value
Matches	2	1	1	1	1	1	1	2	1	1	1	1	T= 20	
Wilcoxon Rank	5.5	2	1	11	10	12	8	5.5	3	7	9	4	T'= 19	
				T=	58					T=	20			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and Outfall 002 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 002				
Corbicula fluminea	0	0	0	0	0	0	0	0	0	2	0	0	" = 0.05	
Excel Rank	1	1	1	1	1	1	1	1	1	12	1	1	$ 8	Tabular Value
Matches	11	11	11	11	11	11	11	11	11	1	11	11	T= 24	
Wilcoxon Rank	6	6	6	6	6	6	6	6	6	12	6	6	T'= 15	
				T=	54					T=	24			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and Outfall 002 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 002				
Gnorimosphaeroma insulare	1	0	0	0	0	0	0	2	0	0	0	0	" = 0.05	
Excel Rank	11	1	1	1	1	1	1	12	1	1	1	1	$ 8	Tabular Value
Matches	1	10	10	10	10	10	10	1	10	10	10	10	T= 16.5	
Wilcoxon Rank	11	5.5	5.5	5.5	5.5	5.5	5.5	12	5.5	5.5	5.5	5.5	T'= 22.5	
				T=	61.5					T=	16.5			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and Outfall 002 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 002				
Nematoda	0	1	0	0	0	0	3	1	0	0	0	0	" = 0.05	
Excel Rank	1	10	1	1	1	1	12	10	1	1	1	1	$ 8	Tabular Value
Matches	9	2	9	9	9	9	1	2	9	9	9	9	T= 15	
Wilcoxon Rank	5	10.5	5	5	5	5	12	10.5	5	5	5	5	T'= 24	
				T=	63					T=	15			**Do Not Reject Null Hypothesis**
					N=9						N=3			

Null Hypothesis: There is no difference between the Reference Stations and Outfall 002 in the Species indicated

Station Designation	SUBC 006			SUBC 007			SUBC 008			Outfall 002				
Cumacea	1	0	0	0	2	1	0	0	0	0	0	0	" = 0.05	
Excel Rank	10	1	1	1	12	10	1	1	1	1	1	1	$ 8	Tabular Value
Matches	2	9	9	9	1	2	9	9	9	9	9	9	T= 15	
Wilcoxon Rank	10.5	5	5	5	12	10.5	5	5	5	5	5	5	T'= 24	
				T=	63					T=	15			**Do Not Reject Null Hypothesis**
					N=9						N=3			