Benthic Macroinvertebrate Sampling

Norton Basin, Little Bay, Grass Hassock Channel, and the Raunt

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ACRONYMS USED IN THIS REPORT

ANOVA - Analysis of Variance

DMMP - Dredged Material Management Plan

LPIL - lowest practical identification level

mcy - million cubic yards

MLW - mean low water

NPS-GNRA - National Park Service Gateway National Recreation Area

NYC - New York City

SNK - Student-Newman-Keuls

USACE-NYD - U.S. Army Corps of Engineers, New York District

USAE-WES - U.S. Army Engineer Waterways Experiment Station

1.0 INTRODUCTION

The U.S. Army Corps of Engineers, New York District (USACE-NYD) has developed a Dredged Material Management Plan (DMMP) for the Port of New York/New Jersey. The beneficial use of dredged materials is a significant component of the DMMP, which presents a variety of placement alternatives to be considered as potential solutions to the ongoing dredging crisis in the Port. One such alternative is bathymetric recontouring of artificially deepened habitats (navigation channels, sub-aqueous borrow pits). This alternative has particular application to borrow pits located within dead-end basins, as these areas are often severely degraded due to hydrodynamic isolation, resulting in poor water quality and accumulation of contaminants.

The goal of the Norton Basin/Little Bay Project is to demonstrate the feasibility of habitat restoration via bathymetric recontouring of the Norton Basin/Little Bay complex, located in Jamaica Bay, Far Rockaway, NY. This would be accomplished by filling several borrow pits (55-65 ft. deep) located within Norton Basin/Little Bay using dredged material derived from navigation improvement projects within the Port.

Preliminary fisheries hydro-acoustic surveys conducted by the U.S. Army Engineers Waterways Experiment Station (USAE-WES) indicated limited utilization of the Norton Basin/Little Bay borrow pits by fishes. The fishes detected in preliminary hydro-acoustic surveys were presumably small schooling forage species [e.g. bay anchovies (*Anchoa mitchilli*) or Atlantic silversides (*Menidia menidia*)] which do not rely on the structure of the pits as essential habitat.

In September 2000, a pilot study was conducted in Norton Basin, Little Bay, and two reference areas located in Jamaica Bay (The Raunt and Grass Hassock Channel). This study included sediment characterization, water quality profiles, and a preliminary survey of living resources (fish, macrocrustaceans) using gill nets and otter trawls. These data were intended to provide information on the biological and physico-chemical attributes of Norton Basin/Little Bay with comparison to both shallow and deep reference locations, and to guide the data collection efforts to be conducted during Phase I (Baseline Environmental Studies) of the Norton Basin/Little Bay project.

The Phase I Baseline Environmental Study of the Norton Basin/Little Bay project was initiated in 2001. Data are being gathered to further characterize biotic and abiotic conditions within the study and reference areas identified in the pilot study. This study includes water quality monitoring, hydrodynamic monitoring, characterization of benthic invertebrate communities, SPI surveys, and fish surveys (hydro-acoustics, gill nets, trawl surveys). We report here on benthic macroinvertebrate communities surveyed during June and October of 2002, the second year of the Phase I study.

Figure 2.1 Locations of study areas (Norton Basin and Little Bay) and reference areas (Grass Hassock Channel and the Raunt).

2.0 STUDY AREA

2.1 Norton Basin

Norton Basin is located east of the Edgemere Landfill. The three 45 to 50 ft deep (MLW) borrow pits have soft, mud substrates, while shallower areas of the basin are characterized by sandy substrates. Side-scan sonar surveys conducted in 2000 have revealed at least two 30 - 40 ft wrecks and extensive debris (i.e. tires, pilings, other structures) on the floor of the basin. There are several small submerged structures along the eastern shore of the basin, which are thought to be smaller boats or automobiles (CR Environmental, Inc. 2001).

2.2 Little Bay

Little Bay is located southeast of the Edgemere Landfill. The three 60 to 65 ft deep (MLW) borrow pits have soft, mud substrates, while shallower areas of the inlet tend to have sandy substrates. Side-scan sonar surveys detected several 30 - 40 ft wrecks and extensive debris (i.e. tires, pilings, other structures) on the floor of the basin (CR Environmental, Inc. 2001).

2.3 Reference Areas

Two reference areas (the Raunt and Grass Hassock Channel) located within the National Park Service Gateway National Recreation Area (NPS-GNRA) were selected for comparison to Norton Basin/Little Bay. These reference areas were intended to provide information on biotic and physico-chemical conditions from both shallow and deep estuarine habitats within Jamaica Bay.

2.3.1 The Raunt

The Raunt is a shallow (7 – 25 ft. deep) tidal gut, which originates at the confluence of Runway Channel and Beach Channel, northeast of Rockaway Inlet. The Raunt passes in a northeasterly direction through Little Egg Marsh, Big Egg Marsh, and Yellow Bar Hassock and terminates at Goose Pond Marsh, in the community of Broad Channel, Queens, NY. Bottom sediments in the Raunt are predominantly sands and silts, with seasonally dense mats of sea lettuce (*Ulva lactuca*) and extensive beds of tube-dwelling amphipods (*Ampelisca sp.*) in the upper reaches. The *Ampelisca* mats gradually diminish and the substrate becomes hard sand bottom in the lower reaches of the Raunt (CR Environmental, Inc. 2001).

2.3.2 Grass Hassock Channel

Grass Hassock Channel is a wide, 20 – 50 ft. deep tidal channel, which originates at the confluence of Winhole Channel and Beach Channel, northeast of the Cross Bay Boulevard Bridge, and terminates at the Jo-Co Marsh Pit, east of Runway 4L at JFK Airport. The Channel is bounded by Jo-Co Marsh and Silver Hole Marsh to the west and by Conchs Hole Point, the Edgemere Landfill, Norton Basin, and Motts Point to the east. The substrate of Grass Hassock Channel is very patchy, and includes sand/silt, shell/gravel, extensive *Ampelisca* mats, and dense sponge colonies (CR Environmental, Inc. 2001).

3.0 METHODS

3.1 Benthic Grab Sampling

A total of 90 samples (three samples from each station) were collected at 30 stations within the study and reference areas using a 0.04m^2 Ted Young modified Van Veen grab in June of 2002 and again in October of 2002 (**Fig. 3.1, Table 3.1**). Three sampling sites were located in the Grass Hassock reference area (GH1, GH2, and GH3), three in the Raunt reference area (R1, R2, and R3), nine in the Little Bay study area (LB1 through LB9), eleven in the Norton Basin study area (NB1 through NB11), and four in the entrance to Norton Basin (NB12 through NB15). Samples were sieved through a 0.5-mm mesh screen and preserved with a 10% buffered formalin/Rose Bengal solution in the field. Benthic samples were shipped to BVA's taxonomic laboratory in Mobile, Alabama for analysis.

In the laboratory, macroinvertebrates were identified to the lowest practical identification level (LPIL), which in most cases was to species unless the specimen was unidentifiable (a juvenile, damaged, or unknown). The number of individuals of each taxon, excluding fragments, was recorded. A voucher collection was prepared, composed of representative individuals of each species not previously encountered in samples from this region.

Macroinvertebrate density and biomass was calculated per unit area for each station. Species diversity and community "evenness" was also determined and compared among sampling locations. Data from similar sampling stations were grouped together for the purpose of statistical analyses. The seven data groups represent the Raunt (n=9) and the Grass Hassock Channel (n=9) reference areas, the deep areas of Little Bay (over 40 ft. deep, n=18), the intermediate depth areas of Little Bay (approx. 30 ft. deep, n=9), the deep areas of Norton Basin (over 40 ft. deep, n=9), the intermediate depth areas of Norton Basin (20 ft. to 35 ft. deep, n=24), and the entrance to Norton Basin (10 ft. to 20 ft. deep, n=12). The data were graphically and statistically analyzed to identify differences in macroinvertebrate density among the study and reference areas. Data were log(y+1) transformed to meet normality assumptions. Transformed abundance data were

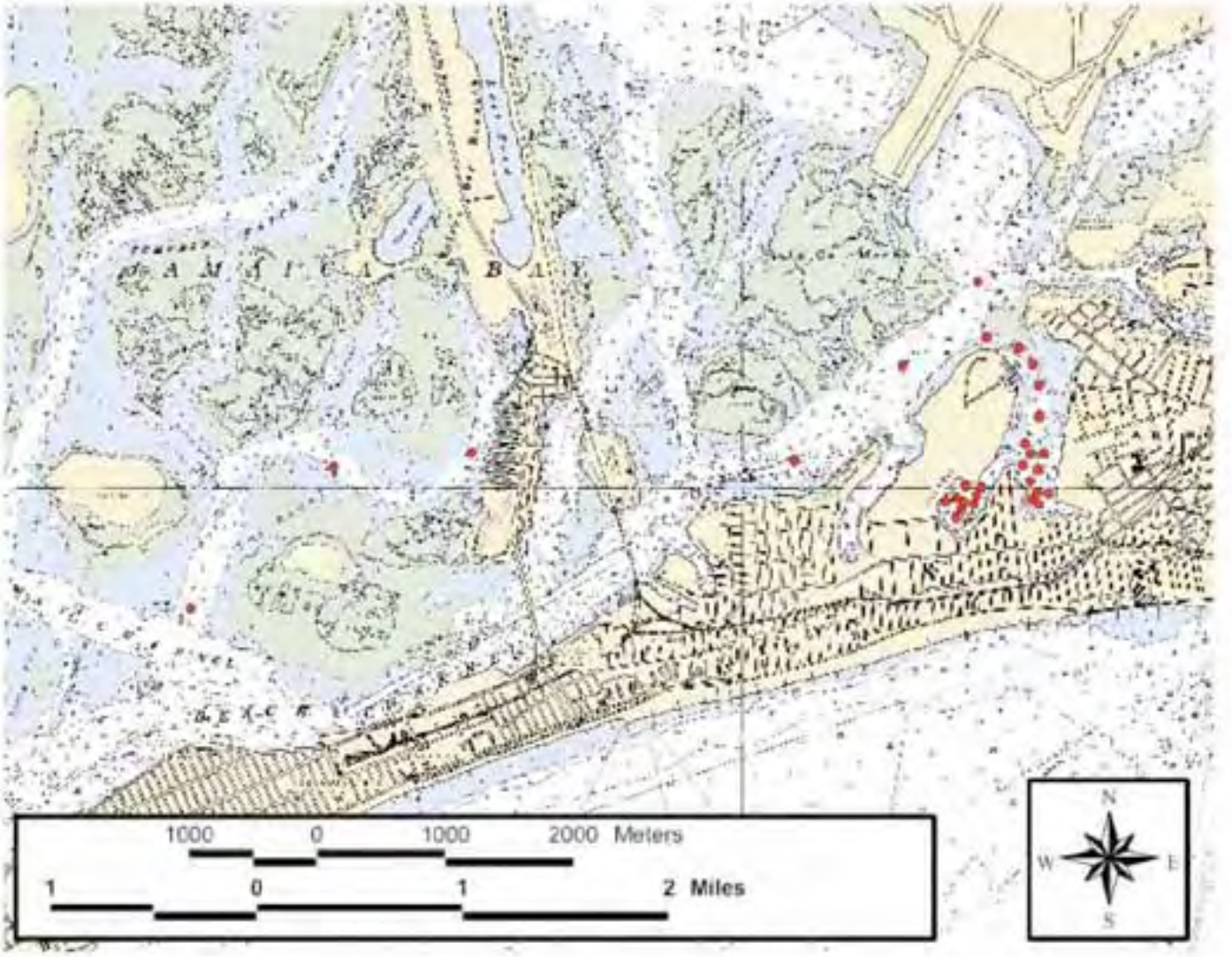


Figure 3.1 Locations of benthic grab sampling stations at Norton Basin study and reference areas, June and October 2002.

Table 3.1 Benthic sampling station locations (latitude and longitude) and depth data, Norton Basin study and reference areas, June and October 2002.

Site	Latitude	Longitude	Depth (ft.)
LB-1	40˚ 35.8926 '	73˚ 46.8135 '	32
LB-2	40˚ 35.9400 '	73˚ 46.8740 '	40
LB-3	40˚ 35.9320 '	73˚ 46.7860 '	50
LB-4	40˚ 35.9816 '	73˚ 46.8133 '	44
LB-5	40˚ 35.9560 '	73˚ 46.8155 '	64
LB-6	40˚ 35.9391 '	73˚ 46.7453 '	50
LB-7	40˚ 36.0019 '	73˚ 46.7572 '	30
LB-8	40˚ 35.9617 '	73˚ 46.6744 '	50
LB-9	40˚ 36.0333 '	73˚ 46.6470 '	31
NB-1	40˚ 35.9182 '	73˚ 46.3504 '	26
NB-2	40˚ 35.9630 '	73˚ 46.4163 '	29
NB-3	40˚ 35.9853 '	73˚ 46.3327 '	30
NB-4	40˚ 36.0086 '	73˚ 46.3939 '	45
NB-5	40˚ 36.0484 '	73˚ 46.4341 '	29
NB-6	40˚ 36.0879 '	73˚ 46.3894 '	32
NB-7	40˚ 36.1460 '	73˚ 46.4565 '	29
NB-8	40˚ 36.1677 '	73˚ 46.4035 '	45
NB-9	40˚ 36.2315 '	73˚ 46.3423 '	20
NB-10	40˚ 36.2723 '	73˚ 46.4115 '	23
NB-11	40˚ 36.4266 '	73˚ 46.3524 '	43
NB-12	40˚ 36.4778 '	73˚ 46.3577 '	18
NB-13	40˚ 36.5357 '	73˚ 46.3947 '	15
NB-14	40˚ 36.5851 '	73˚ 46.4528 '	13
NB-15	40˚ 36.6096 '	73˚ 46.5612 '	10
GH-1	40˚ 36.2638 '	73˚ 47.6327 '	23
GH-2	40˚ 36.7156 '	73˚ 46.8842 '	49
GH-3	40˚ 36.2022 '	73˚ 46.6634 '	26
R-1	40˚ 35.6329 '	73˚ 51.0451 '	12
R-2	40˚ 36.0881 '	73˚ 50.2277 '	9
R-3	40˚ 36.2022 '	73˚ 49.4790 '	10

analyzed using a one-way Analysis of Variance (ANOVA), and post-hoc comparisons were conducted using the Student-Newman-Keuls (SNK) test. Statistical analyses were conducted using the SuperANOVA General Linear Modeling Program for the Macintosh PC (Version 1.11).

4.0 RESULTS

4.1 Benthic Macroinvertebrates

4.1.1 June 2002 Community Composition

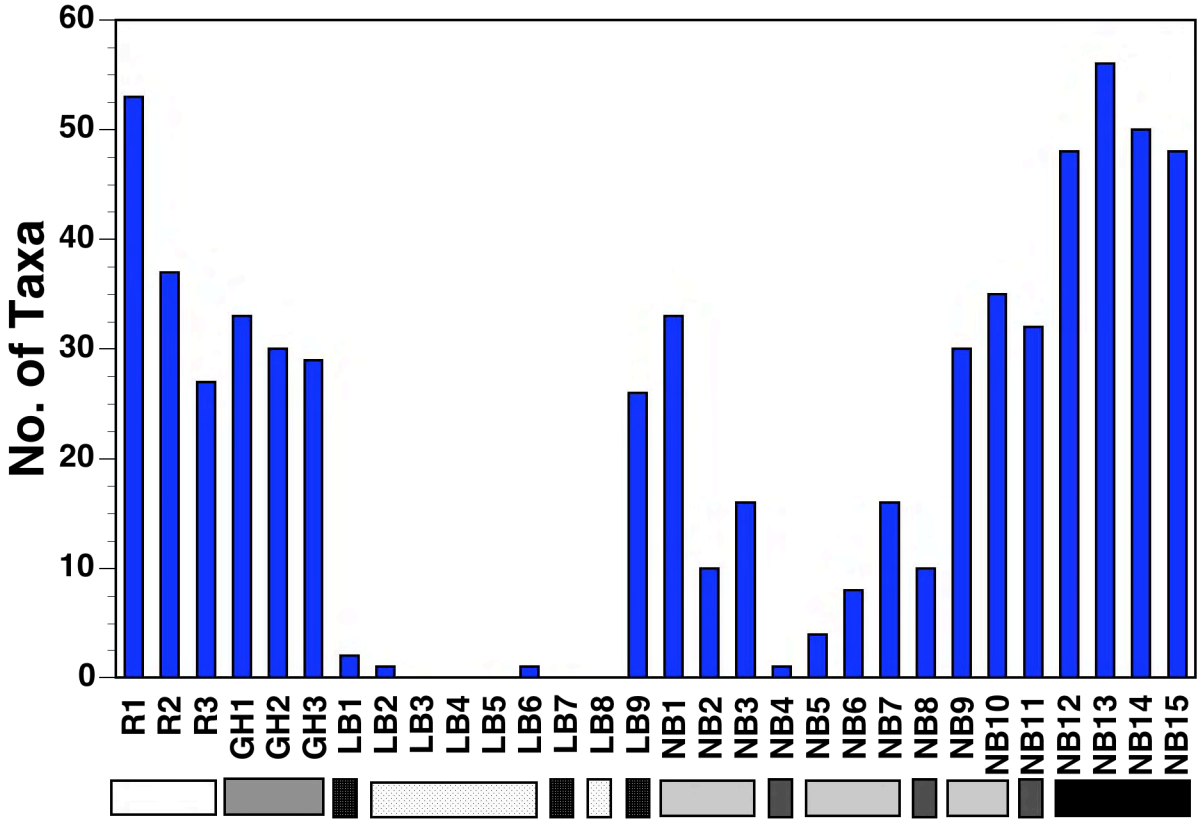
A total of 80,934 individuals, representing 127 taxa, were identified from the 90 grab samples collected at 30 stations within the Norton Basin/Little Bay study areas and reference areas in June of 2002. Arthropods (insects, and crustaceans) were the most abundant taxa, representing 49.4% of the total assemblage. Annelids (marine worms) represented 48.3% of the total organisms. A list of all taxa is provided in **Appendix I-A.**

Polychaetes dominated the annelid community. The ubiquitous estuarine spionid polychaete *Streblospio benedicti* was well-represented among samples, as was *Polydora cornuta, Mediomastis* sp., *Sabellaria vulgaris*, and *Capitella capitata*. Tubificid oligochaetes represented two percent of the annelid community.

The arthropod community was dominated by amphipods, primarily *Ampelisca vadorum*, which accounted for nearly one-third of the total benthic macroinvertebrate community in June. Other amphipods present included *Monocorophium tuberculatum*, *Microdeutopus gryllotalpa*, and *Unciola serrata*. Mud crabs (*Xanthidae*) and the ostracod *Parasterope pollex* were collected but represented only a minor component of the arthropod community.

Molluscs were a very minor component of the benthic community (< 2 %). The mollusc community included various bivalves and gastropods, most notably the mud snail *Ilyanassa obsoleta*. Proboscis worms, flatworms, peanut worms, tunicates, bryozoans, and brachiopods were present in some samples but accounted for < 0.5 % of the total benthic community. The total number of macroinvertebrate taxa ranged from 0 at LB3, LB4, LB5, LB7, and LB8 to 56 at NB13 (**Fig. 4.1.1.1; Fig. 4.1.1.2; Appendix I-B**). The total number of individuals per station (composite of 3 grabs) ranged from 0 (LB3, LB4, LB5, LB7, and LB8) to 10,937 (NB14) (**Table 4.1.1.1**).

In the deep areas of Norton Basin (over 40 ft. deep), arthropods represented 70.8 % of the total assemblage, annelids represented 27.6 %, molluscs represented 1.6 %, and flatworms and brachiopods represented < 1 % (**Fig. 4.1.1.3**). The dominant species was *A. vadorum*, representing 45.1 % of the total assemblage. In the intermediate depth areas



The Raunt.....R1 - R3
Grass Hassock Channel.....GH1 - GH3
Intermediate depth stations (approx. 30 ft.) in Little Bay..... LB1, LB7, LB9
Deep stations (over 40 ft.) in Little Bay.....LB2 - LB6, LB8
Intermediate depth stations (20 ft. to 35 ft.) in Norton Basin..... NB1 - NB3, NB5 - NB7, NB9, NB10
Deep stations (over 40 ft.) in Norton Basin.....NB4, NB8, NB11
Norton Basin entrance channel.....NB12 - NB15

Figure 4.1.1.1 Total number of benthic macroinvertebrate taxa, June 2002.

Figure 4.1.1.2 Total number of benthic macroinvertebrate taxa, June 2002.

Table 4.1.1.1 Community Parameters**,** Norton Basin study and reference area benthic stations, June 2002.

Station	Date (m/d/y)	Total No. Taxa	Total No. Individuals	Mean Density (No. m^{-2})	Density (Std Err)	H' Shannon (log e)	J' Pielou Evenness
R1	6/1/02	53	5023	41858.3	11206.6	2.20	0.56
R2	6/1/02	37	2659	22158.3	12038.3	1.72	0.48
R3	6/1/02	27	2499	20825.0	17206.7	1.62	0.49
GH1	6/1/02	33	8842	73683.3	36224.9	1.01	0.29
GH2	6/1/02	30	8386	69883.3	12596.6	1.25	0.37
GH3	6/1/02	29	2901	24175.0	8941.2	1.86	0.55
LB1	6/1/02	2	7	58.3	22.0	0.68	0.99
LB2	6/1/02	1	1	8.3	8.3	0.00	0.00
LB3	6/1/02	0	0	0.0	0.0	0.00	0.00
LB4	6/1/02	0	0	0.0	0.0	0.00	0.00
LB5	6/1/02	0	0	0.0	0.0	0.00	0.00
LB6	6/1/02	1	1	8.3	8.3	0.00	0.00
LB7	6/1/02	0	0	0.0	0.0	0.00	0.00
LB8	6/1/02	0	0	0.0	0.0	0.00	0.00
LB9	6/1/02	26	573	4775.0	3632.3	1.65	0.51
NB1	6/1/02	33	3945	32875.0	17147.3	2.01	0.58
NB2	6/1/02	10	923	7691.7	2273.5	0.34	0.15
NB3	6/1/02	16	1782	14850.0	4824.0	1.04	0.37
NB4	6/1/02	1	1	8.3	8.3	0.00	0.00
NB5	6/1/02	4	531	4425.0	398.7	0.45	0.32
NB6	6/1/02	8	1148	9566.7	1558.5	1.27	0.61
NB7	6/1/02	16	1751	14591.7	5306.2	1.34	0.48
NB8	6/1/02	10	380	3166.7	1665.2	1.31	0.57
NB9	6/1/02	30	2928	24400.0	10726.8	1.78	0.52
NB10	6/1/02	35	9264	77200.0	47495.9	1.57	0.44
NB11	6/1/02	32	2400	20000.0	11441.0	1.70	0.49
NB12	6/1/02	48	7496	62466.7	23463.3	1.97	0.51
NB13	6/1/02	56	3433	28608.3	9512.9	2.72	0.68
NB14	6/1/02	50	10937	91141.7	31473.5	2.62	0.67
NB15	6/1/02	48	3123	26025.0	12122.1	2.56	0.66

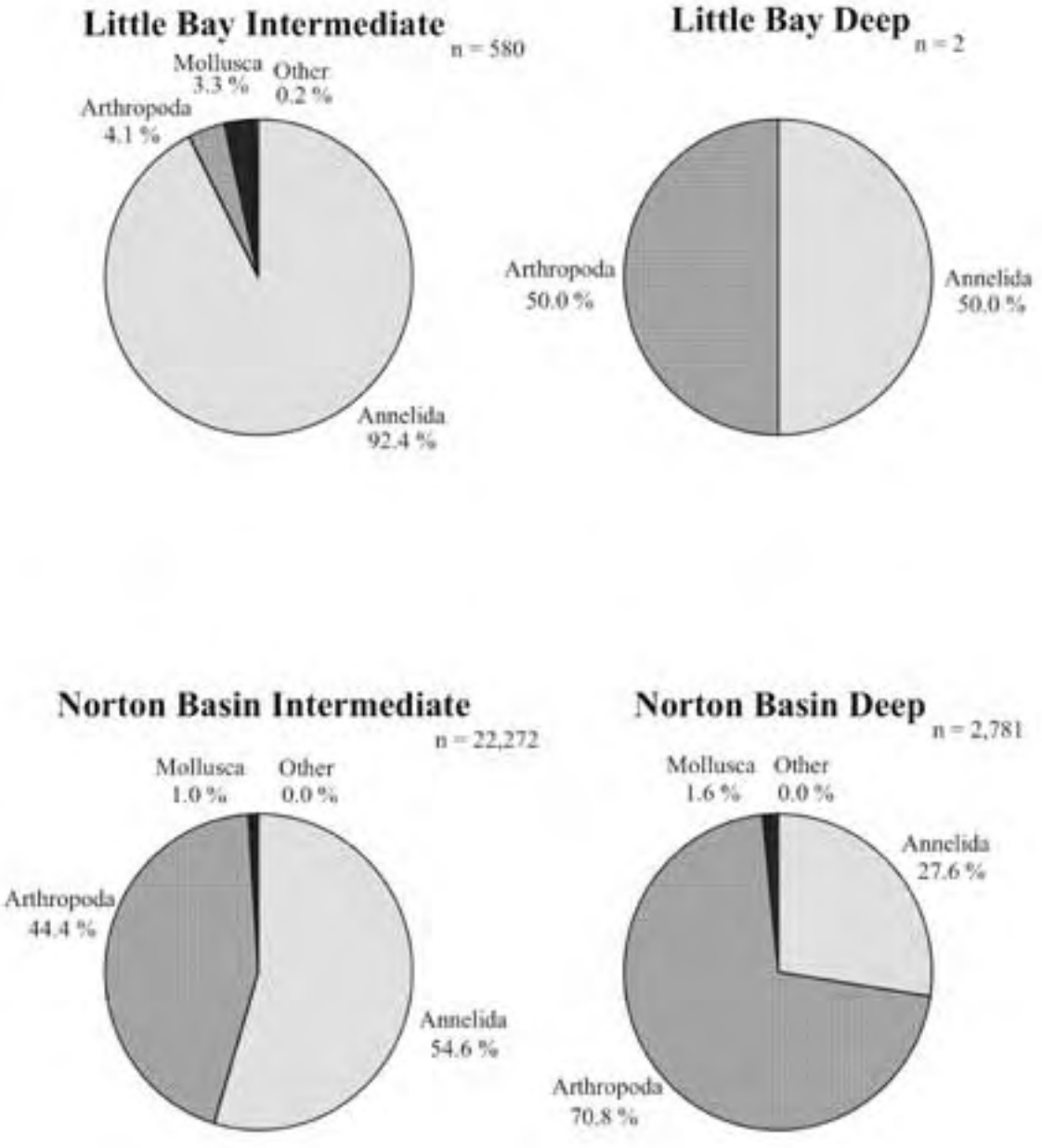


Figure 4.1.1.3 Benthic community composition, Norton Basin and Little Bay deep water and intermediate depth study areas, June 2002.

of Norton Basin (20 ft. to 35 ft. deep), annelids represented 54.6 % of the total assemblage, arthropods represented 44.4 %, molluscs represented 1.0 %, and proboscis worms and bryozoans represented < 1 % (**Fig. 4.1.1.3**). The dominant species again was *A. vadorum*, representing 32.5 % of the total assemblage.

A total of two individuals were collected from the deep areas of Little Bay (over 40 ft. deep). One individual was an amphipod (*Gammarus mucronatus*), while the other was an annelid (*Enchytraeidae* spp.). In the intermediate depth areas of Little Bay (approx. 30 ft. deep), annelids represented 92.4 % of the total assemblage, arthropods represented 4.1 %, molluscs represented 3.3 %, and bryozoans represented < 1 % (**Fig. 4.1.1.3**). The dominant species was *S. benedicti*, representing 57.9 % of the total assemblage.

At the Norton Basin entrance channel, annelids represented 76.2 % of the total assemblage, arthropods represented 20.3 %, and molluscs represented 3.3 %. Proboscis worms and tunicates represented < 1 % (**Fig. 4.1.1.4**). The dominant species again was *S. benedicti*, representing 18.7 % of the total assemblage.

At the Grass Hassock Channel reference area, arthropods represented 87.4 % of the total assemblage, while annelids represented 11.8 %. Molluscs, proboscis worms, and peanut worms represented < 1 % of the total assemblage (**Fig. 4.1.1.4**). The dominant species was *A. vadorum*, representing 67.1 % of the total assemblage.

At the Raunt reference area, arthropods represented 53.5 % of the total assemblage, annelids represented 41.4 %, molluscs represented 3.3 %, and proboscis worms represented 1.8 % of the total assemblage (**Fig. 4.1.1.4**). The dominant species was *A. vadorum*, representing 29.2 % of the total assemblage.

4.1.2 October 2002 Community Composition

A total of 40,095 individuals, representing 109 taxa, were identified from the 90 grab samples collected at 30 stations within the Norton Basin/Little Bay study areas and reference areas in October of 2002. Annelids (marine worms) were the most abundant taxa, representing 69.7 % of the total assemblage. Arthropods (insects and crustaceans) represented 27.9 % of total organisms. A list of all taxa is provided in **Appendix II-A.**

Polychaetes dominated the annelid community. The ubiquitous estuarine spionid polychaete *S. benedicti* was well-represented among samples, as was *Mediomastis* sp., *S. vulgaris*, and *C. capitata*. Tubificid oligochaetes represented 4.4 % percent of the annelid community.

The arthropod community was dominated by amphipods, primarily *A. vadorum*, which accounted for nearly a quarter of the total benthic macroinvertebrate community in October. Other amphipods present included *Lysianopsis alba*, *Melita nitida*, and *M.*

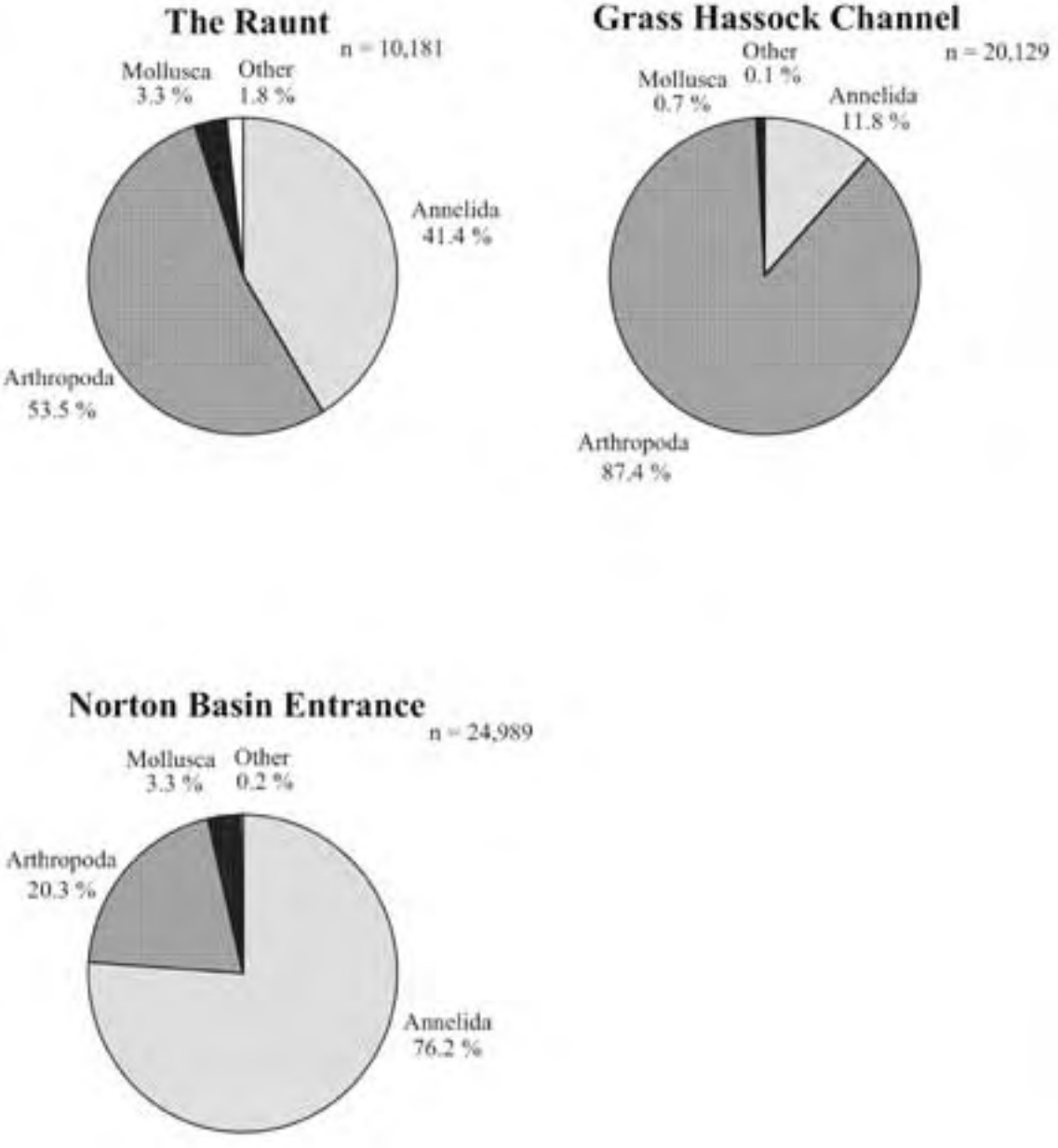


Figure 4.1.1.4 Benthic community composition, Norton Basin entrance channel, Grass Hassock Channel, and the Raunt reference areas, June 2002.

tuberculatum. Mud crabs (*Xanthidae*) were collected but represented only a minor component of the arthropod community. Molluscs were a minor component of the benthic community (< 4 %). The mollusc community included various bivalves and gastropods, most notably the mud snail *I. obsoleta*. Proboscis worms, flatworms, hydrozoans, tunicates, horseshoe worms, and sponges were present in some samples but accounted for <0.5% of the total benthic community. The total number of macroinvertebrate taxa ranged from 0 at LB6, LB7, LB8, and NB3 to 52 at NB14 (**Fig. 4.1.2.1; Fig. 4.1.2.2; Appendix II-B**). The total number of individuals per station (composite of 3 grabs) ranged from 0 (LB6, LB7, LB8, and NB3) to 5,549 (GH2) (**Table 4.1.2.1**).

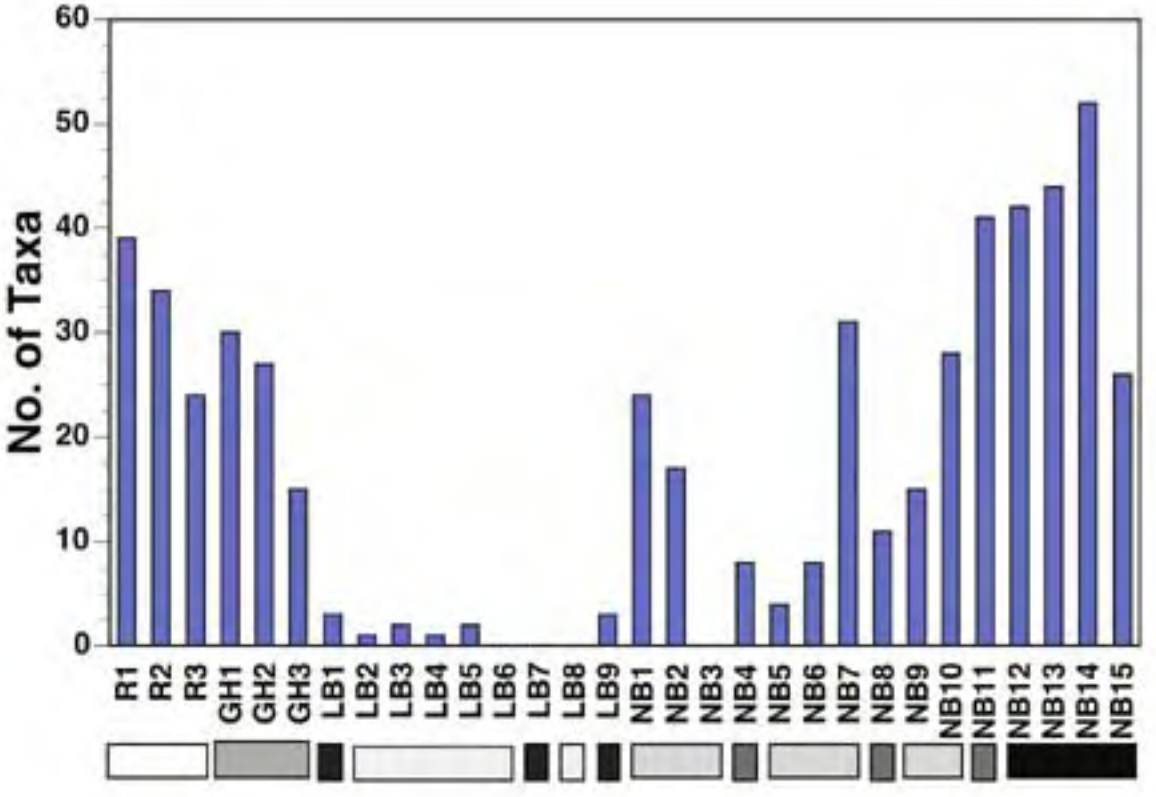
In the deep areas of Norton Basin (over 40 ft. deep), annelids represented 91.1 % of the total assemblage, molluscs represented 7.9 %, and arthropods represented 1.0 % (**Fig. 4.1.2.3**). The dominant species was *S. benedicti*, representing 47.8 % of the total assemblage. In the intermediate depth areas of Norton Basin (20 ft. to 35 ft. deep), annelids represented 93.7 % of the total assemblage, molluscs represented 5.0 %, arthropods represented 1.3 %, and flatworms represented < 1 % (**Fig. 4.1.2.3**). The dominant species again was *S. benedicti*, representing 62.8 % of the total assemblage.

A total of six individuals were collected from the deep areas of Little Bay (over 40 ft. deep). Three were molluscs (gastropods), two were annelids (polychaetes), and one was an arthropod (*Ampelisca* spp.) (**Fig. 4.1.2.3**). In the intermediate depth areas of Little Bay (approx. 30 ft. deep), annelids represented 87.0 % of the total assemblage, molluscs represented 8.7 %, and arthropods represented 4.3 % (**Fig. 4.1.2.3**). The dominant species was *C. capitata*, representing 78.3 % of the total assemblage.

At the Norton Basin entrance channel, annelids represented 90.2 % of the total assemblage, arthropods represented 6.0 %, and molluscs represented 3.7 %. Hydrozoans, flatworms, sponges, and tunicates represented < 1 % (**Fig. 4.1.2.4**). The dominant species was *S. benedicti*, representing 37.8 % of the total assemblage.

At the Grass Hassock Channel reference area, arthropods represented 62.3 % of the total assemblage, annelids represented 36.1 %, and molluscs represented 1.5 %. Proboscis worms and flatworms represented < 1 % of the total assemblage (**Fig. 4.1.2.4)**. The dominant species was *A. vadorum*, representing 60.8 % of the total assemblage.

At the Raunt reference area, annelids represented 90.5 % of the total assemblage, arthropods represented 5.7 %, and molluscs represented 3.7 %. Proboscis worms and horseshoe worms represented < 1 % of the total assemblage (**Fig. 4.1.2.4**). The dominant species was *S. benedicti*, representing 67.3 % of the total assemblage.



The Raunt.....R1 - R3
Grass Hassock Channel.....GH1 - GH3
Intermediate depth stations (approx. 30 ft.) in Little Bay..... LB1, LB7, LB9
Deep stations (over 40 ft.) in Little Bay.....LB2 - LB6, LB8
Intermediate depth stations (20 ft. to 35 ft.) in Norton Basin..... NB1 - NB3, NB5 - NB7, NB9, NB10
Deep stations (over 40 ft.) in Norton Basin.....NB4, NB8, NB11
Norton Basin entrance channel.....NB12 - NB15

Figure 4.1.2.1 Total number of benthic macroinvertebrate taxa, October 2002.

Figure 4.1.2.2 Total number of benthic macroinvertebrate taxa, October 2002.

Table 4.1.2.1 Community Parameters**,** Norton Basin study and reference area benthic stations, October 2002.

Station	Date (m/d/y)	Total No. Taxa	Total No. Individuals	Mean Density (No. m^{-2})	Density (Std Err)	H' Shannon (log e)	J' Pielou Evenness
R1	10/10/02	39	2601	21675.0	1925.9	1.20	0.33
R2	10/10/02	34	3877	32308.3	12080.2	1.27	0.36
R3	10/10/02	24	2223	18525.0	2224.9	1.20	0.38
GH1	10/10/02	30	4692	39100.0	6445.4	1.46	0.43
GH2	10/10/02	27	5549	46241.7	6432.3	1.26	0.38
GH3	10/10/02	15	3460	28833.3	1257.4	0.67	0.25
LB1	10/10/02	3	3	25.0	0.0	1.10	1.00
LB2	10/10/02	1	1	8.3	8.3	0.00	0.00
LB3	10/10/02	2	2	16.7	16.7	0.69	1.00
LB4	10/10/02	1	1	8.3	8.3	0.00	0.00
LB5	10/10/02	2	2	16.7	8.3	0.69	1.00
LB6	10/10/02	0	0	0.0	0.0	0.00	0.00
LB7	10/10/02	0	0	0.0	0.0	0.00	0.00
LB8	10/10/02	0	0	0.0	0.0	0.00	0.00
LB9	10/10/02	3	20	166.7	96.1	0.39	0.36
NB1	10/10/02	24	1091	9091.7	2904.4	1.46	0.46
NB2	10/10/02	17	402	3350.0	3250.0	1.35	0.48
NB3	10/10/02	0	0	0	0.0	0.00	0.00
NB4	10/10/02	8	21	175.0	104.1	1.76	0.84
NB5	10/10/02	4	20	166.7	58.3	1.24	0.89
NB6	10/10/02	8	16	133.3	84.6	1.84	0.88
NB7	10/10/02	31	2843	23691.7	11286.4	1.14	0.33
NB8	10/10/02	11	159	1325.0	215.5	1.53	0.64
NB9	10/10/02	15	188	1566.7	423.9	1.69	0.62
NB10	10/10/02	28	633	5275.0	1081.2	1.73	0.52
NB11	10/10/02	41	1556	12966.7	1419.4	1.97	0.53
NB12	10/10/02	42	1673	13941.7	1879.2	1.93	0.52
NB13	10/10/02	44	2037	16975.0	1650.3	1.77	0.47
NB14	10/10/02	52	4795	39958.3	16035.9	2.76	0.70
NB15	10/10/02	26	2230	18583.3	8526.9	1.26	0.39

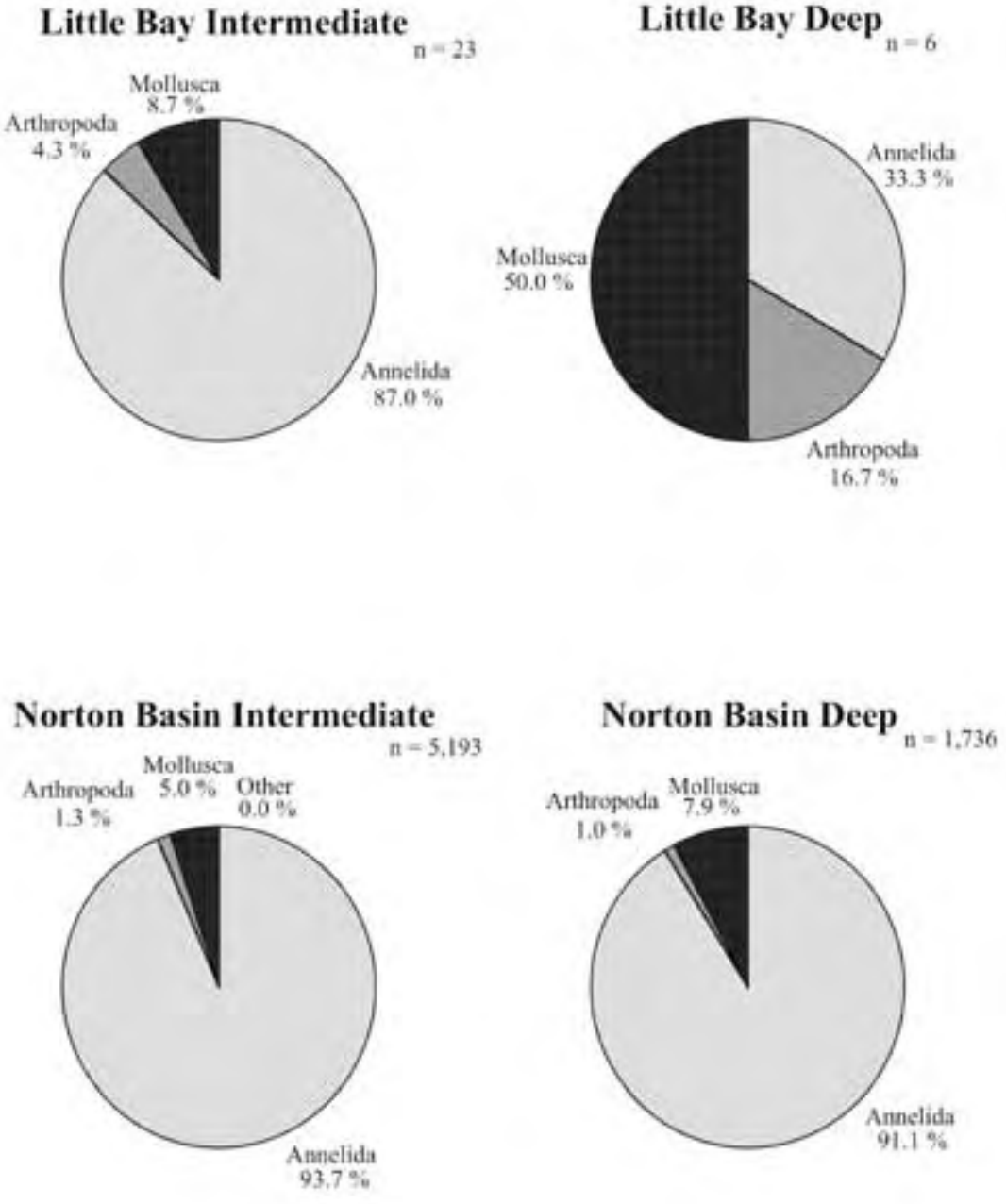


Figure 4.1.2.3 Benthic community composition, Norton Basin and Little Bay deep water and intermediate depth study areas, October 2002.

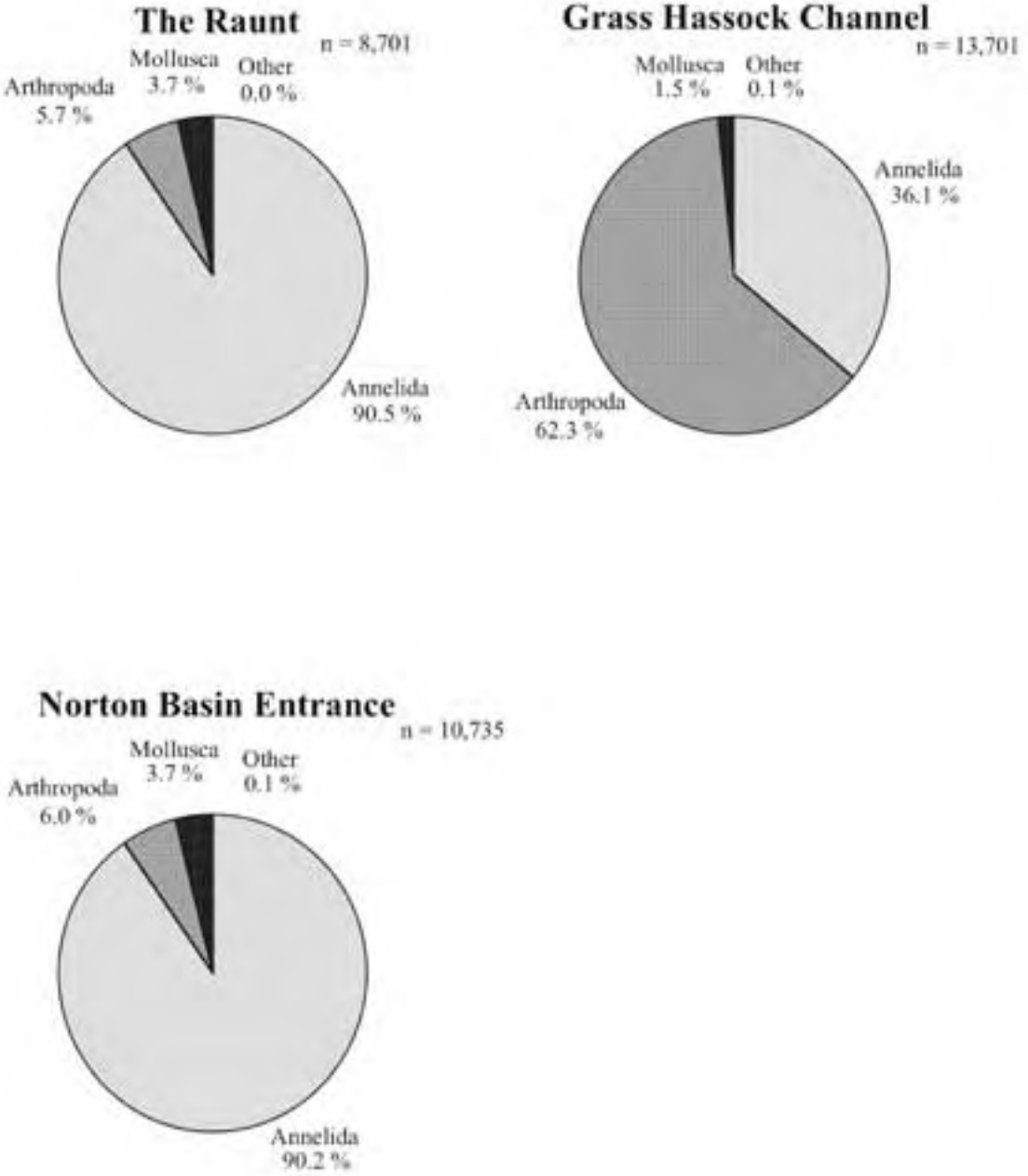


Figure 4.1.2.4 Benthic community composition, Norton Basin entrance channel, Grass Hassock Channel, and the Raunt reference areas, October 2002.

4.1.3 Abundance and Distribution

4.1.3.1 Total Macroinvertebrates

In June 2002, mean density of total macroinvertebrates ranged from 0.0 ind./m^2 at LB3-5, LB7, and LB8 to 91,141.7 ind./m^2 at NB14. In October 2002, mean density of total macroinvertebrates ranged from 0.0 ind./m^2 at LB6-8, and NB3 to 46,241.7 ind./m^2 at GH2. Total macroinvertebrate density at the deep water stations within Little Bay was significantly less than all other stations sampled in June; total macroinvertebrate density at the intermediate depth stations within Little Bay was significantly less than all other stations sampled in June with the exception of the Little Bay deep stations. Total macroinvertebrate density at the deep water stations within Norton Basin was significantly less than all other stations sampled in June with the exception of those located in Little Bay (ANOVA, p = 0.0001) (**Fig. 4.1.3.1.1; Fig. 4.1.3.1.2**). All remaining stations showed no significant differences in total macroinvertebrate densities for the month of June. Although not significantly different from each other, total macroinvertebrate densities at the Little Bay deep water and intermediate depth stations were significantly less than all other stations sampled in October. Similarly, total macroinvertebrate densities at the Norton Basin deep water and intermediate depth stations were significantly less than all other stations sampled in October with the exception of the Little Bay stations (ANOVA, p = 0.0001) (**Fig. 4.1.3.1.1; Fig. 4.1.3.1.3**). All remaining stations showed no significant differences in total macroinvertebrate densities for the month of October.

4.1.3.2 Annelids

In June 2002, mean density of annelids ranged from 0.0 ind./m^2 at LB2-5, LB7, and LB8 to 22,538.9 ind./m^2 at NB14. In October 2002, mean density of annelids ranged from 0.0 ind./m^2 at LB1, LB2, LB5-8, and NB3 to 10,963.9 ind./m^2 at NB14. Annelid density at the deep water stations within Little Bay was significantly less than all other stations sampled in June; annelid density at the intermediate depth stations within Little Bay was significantly less than all other stations sampled in June with the exception of the Little Bay deep stations. Annelid density at the deep water stations within Norton Basin was significantly less than all other stations sampled in June with the exception of those located in Little Bay. Annelid density at stations located in the Norton Basin entrance channel was significantly greater than all other stations sampled in June (ANOVA, p = 0.0001) (**Fig. 4.1.3.2.1**). All remaining stations showed no significant differences in annelid densities during June. Although not significantly different from each other, annelid densities at the Little Bay deep water and intermediate depth stations were significantly less than all other stations sampled in October. Similarly, annelid densities at the Norton Basin deep water and intermediate depth stations were significantly less than all other stations sampled in October with the exception of the Little Bay stations (ANOVA, p = 0.0001) (**Fig. 4.1.3.2.1**). All remaining stations showed no significant differences in