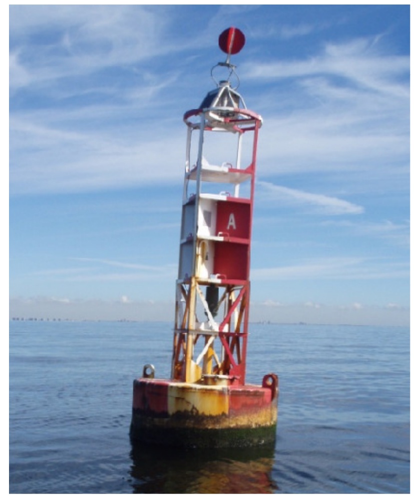
Ambrose Obstruction Biological Sampling Report



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1.0 INTRODUCTION

The United States Army Corps of Engineers (USACE) – New York District (NYD) is investigating the need for Federal Action to remove a reported navigation obstruction located at the entrance to Ambrose Channel in the Lower Bay of NY/NJ Harbor. The obstruction, identified as High Spot C, is located at the apex of the New York Bight in a critical approach area for deep draft commercial vessel traffic. Although much of the Ambrose Channel is naturally deep, a channeled passage through an area of shoals located between Sandy Hook, New Jersey and Rockaway Point, New York has been dredged since the early 1910s (USACE 2009).

High Spot C is centered on 40° 27’ 50.4” N by 73° 50’ 7.5” W and is located just north of the mid-channel Whistle Buoy RW “A” (Figure 1). The obstruction measures approximately 700 feet north to south, and 1,300 feet east to west. Water depth at the obstruction is approximately 53 feet at mean low water while nearby water depths range from 72 to 80 feet. A remote sensing survey of High Spot C indicated a uniform rocky bottom with no articulated vessel structure or debris piles (USACE 2009). The obstruction is composed primarily of gravel to boulder size material with a surrounding habitat of flat sandy areas.

A field sampling program was conducted from 21 – 23 September 2009 to determine the biological communities utilizing the obstruction and surrounding areas. The sampling program and gear types were chosen based upon a review and recommendations made by the National Marine Fisheries Service (NMFS) to target species associated with structure and likely to utilize the obstruction for shelter or foraging activities. The benthic community was sampled using a 0.1-m^2 Smith-McIntyre Grab and the fish and macro-invertebrate communities were sampled with baited lobster pots, crab traps, and fish traps set overnight both on the obstruction and in the near field area up to approximately 250 meters from the center of High Spot C. A bottom trawl sampling program was also completed during the fall of 2008 but focused primarily in the area of two other obstructions (High Spot A and High Spot B) that were later determined not to require Federal Action. Because the bottom trawls were conducted well beyond the area of High Spot C, as much as eight miles away, the data from that survey was not included in this report.

2.0 METHODS

2.1 Benthic Invertebrate Survey

2.1.1 Sampling

Benthic grab samples were collected on 21 September 2009 using a 0.1-m^2 Smith-McIntyre Grab deployed from the USACE vessel *Hudson* using an on-board winch. Figure 1 shows the approximate boundary of the obstruction and the benthic sampling locations. Locations were determined in the field based on observed water depth and sediment characteristics. Because of the gravel and rock substrate, benthic samples could not be collected directly on the obstruction. However, five benthic grab samples were collected within 150 meters of the obstruction boundary ("on obstruction") and five samples were collected beyond the obstruction boundary in the near field area where water depths and sediments were consistent with the surrounding "off obstruction" habitat. One obstruction sample, B-A-E, was taken slightly beyond the marked 150 meter boundary due to bottom substrate which restricted the use of the grab sampler.

At each sampling location, one benthic sample was collected and washed onboard the sampling vessel using a 500-µ mesh sieve. Organisms, sediment and debris retained within the sieve were then placed into a labeled sample bottle and preserved with a 10% buffered Formalin solution containing Rose Bengal stain for later analysis in the laboratory. For each grab sample, the date, time, station location, weather/oceanographic conditions, water depth, sediment color/odor, approximate volume collected, sediment texture and presence of epibenthic fauna/flora were recorded.

2.1.2 Sorting/ID

In the laboratory, each benthic grab sample was analyzed for species composition and abundance. Organisms were sorted from the remaining debris, identified by taxonomists and enumerated. Identifications were made to the lowest practical taxon when not to the species level. Quality control procedures consisting of a Continuous Sampling Plan were followed to assure an Average Outgoing Quality Limit of 0.10 (90% accuracy). Samples containing excessive sand and detritus, or organisms in significant number, were split in the laboratory using a Caton Macroinvertebrate Sub-sampler. This sub-sampler consists of a rectangular screen (~380-µ mesh) and has sets of grid coordinates, which allow for as many as thirty 6x6-cm subsamples. The sub-sampling sort followed the Rapid Bioassessment Protocol III (Barbour *et. al.* 1999) procedure and the process of selecting and sorting sub-samples continued until the total number of organisms removed and sorted reached the 100-organism target, or the entire sample had been sorted. The selected square in which the 100-organism count was reached was sorted entirely, even though the total count for all squares may have exceeded 100.

2.1.3 Analysis

Benthic density (organisms/m^2) was calculated for each taxa in each sample collected based on the total grab area sampled and the applicable split fraction if the sample was sub-sampled in the laboratory as described above in Section 2.1.2. Benthic community biodiversity was measured via taxa richness, the Shannon-Wiener Diversity Index, and evenness (or equitability) from the benthic grab data. Each biodiversity index was calculated for each sample collected.

Taxa richness is a measure of the total number of taxa collected in a sample. In counting the number of distinct taxa present, general taxonomic designations at the generic, familial, and higher taxonomic levels were dropped if there was one valid lower-level designation for that group. For example, if *Leitoscoloplos sp.*, *Leitoscoloplos fragilis*, and *Leitoscoloplos robustus* were all identified in one sample, then *Leitoscoloplos sp.* would *not* be counted and the number of distinct taxa recorded in this example would be two.

The Shannon-Wiener Diversity Index (*H'*) is a widely used species diversity index. It provides more information about the benthic community structure than taxa richness because it takes into account the relative abundance of each taxa as well as taxa richness (Morin 1999). The diversity index H' can range between values of 0 and 4. Low values of H' indicate low taxa richness and an uneven distribution of abundance among species while high values indicate high taxa richness and an even distribution of abundance among taxa. The index is computed as follows:

$$H' = -\sum_{i=1}^{s} (p_i \ln p_i)$$

where S is the total number of species per sample (i.e., taxa richness) and p_i is the proportion of total individuals in the i^{th} species. Mathematically, p_i is defined as n_i/N where n_i is the number of individuals of a taxa in a sample and N is the total number of individuals of all taxa in the sample.

Evenness (E or equitability) measures the distribution among species within the community by scaling one of the diversity measures relative to its maximal possible value. Evenness can range from 0 (uneven distribution) to 1 (even distribution). It is computed as follows:

$$E = \frac{H'}{H'_{max}}$$

where H' is the observed diversity (as cited above) and H'_{max} is the natural logarithm of the total number of taxa (S) in the sample ($H'_{max} = \ln S$).

2.1.4 Water Quality

Dissolved oxygen (DO), temperature, conductivity, and salinity were measured at each grab location using a calibrated YSI Model 85 Handheld Oxygen, Conductivity, Salinity and Temperature System meter. Measurements were recorded from the bottom strata of the water column at approximately one foot (0.3 m) above the substrate. Field instruments were calibrated each day both prior to and after sampling. At least once per sampling day, the accuracy of the YSI Model 85 instrument was verified using an ASTM certified thermometer, a water sample analyzed in the laboratory using a calibrated conductivity/salinity meter, and three water samples collected and preserved for dissolved oxygen in the field and analyzed in the laboratory for DO using the Winkler titration method.

2.2 Fish, Crab and Lobster Pot Survey

2.2.1 Sampling Locations

The fish, crab, and lobster pot survey was conducted from the USACE vessel *Hudson*. Figure 1 displays the positions of the fish, crab, and lobster pots deployed during this survey. A total of six fish traps, one crab pot, and five lobster pots were deployed on the obstruction for approximately 24 hours per set. All of the traps were deployed twice over two consecutive nights on 21 and 22 September 2009. Two sample locations were set near the center of the obstruction, F-C-W to the West and F-C-E to the east. F-C-W had one fish trap and one lobster pot, while F-C-E had one fish trap and one crab pot. Two fish traps and two lobster pots were located approximately 50 meters from the center point, one of each to the north (F-A-N) and one of each to the south (F-A-S). The last two obstruction fish traps and lobster pots were set approximately 100 meters from the center point, one of each to the east (F-A-E) and one of each to the west (F-A-W).

An equal number of traps (six fish traps, one crab pot, and five lobster pots) were deployed in areas immediately off the obstruction for the same two consecutive overnight periods (approximately 24 hours per set). Water depths and sediments in these areas were consistent with surrounding habitat beyond the obstruction. Four fish traps and four lobster pots were set approximately 150 meters from the edge of the obstruction, one set in each cardinal direction. Each set contained one fish trap and one lobster pot (F-B-N, F-B-S, F-B-E, and F-B-W). F-B-S was moved to the northwest to maintain the required distance (1,000 feet) from the channel marker for navigation. One fish trap and one lobster pot were set 250 meters northwest of the edge of the obstruction (F-B-NW), and one fish trap and one crab trap were set 250 meters to the southeast (F-B-SE).

2.2.2 Fish traps

Fish traps were rectangular, measuring 24 inches x 24 inches x 22 inches (height), weighed approximately 20 pounds, and consisted of ¼-inch wire mesh with a one-inch wide and two-inch high opening (Figure 2). The single fyke trap (one funnel leading to the opening into the trap) was baited with approximately ¼ liter of clam belly chum held in ¼-inch mesh chum bag. A

GPS location was recorded at each sample location and each trap was rigged with a float line, buoy and flag.

At the end of the first overnight sampling period, the traps were retrieved, the catch removed and placed in an on-board holding tank. The trap was then re-baited and reset. The catch from each trap was analyzed including species, number collected, and length measurements. From each sample, up to 25 individuals of each fish species were measured for total length (TL) to the nearest millimeter. Collections of invertebrates, such as shrimp, mud crabs or tube worms, were also noted on the fish trap field data sheet.

2.2.3 Crab/Lobster Pots

Each lobster pot was rectangular and measured 36 inches x 18 inches x 12 inches (height), weighed approximately 40-60 pounds and was constructed of coated wire mesh with two fykes and closed escape ports (Figure 2). Each square crab pot measured 24 inches x 24 inches x 24 inches, weighed approximately 20-40 pounds and was constructed of coated wire mesh with two fykes and closed escape ports (Figure 2). The pots were baited with frozen adult Atlantic menhaden cut into three sections (head, middle, tail). A GPS location was recorded at each sample location and each trap was rigged with a float line, buoy, and flag.

At the end of the first overnight sampling period, the pots were retrieved, the catch removed and placed in an onboard holding tank. The trap was then re-baited and reset. The catch from each pot was analyzed including species, number collected, and measurements. From each sample, up to 25 individuals of each species were measured; carapace lengths for lobster and carapace width for crab were recorded to the nearest millimeter. Fish collected in pots were also identified, measured and recorded on the field data sheet.

2.2.4 Water Quality

Bottom water quality was analyzed at each sampling location before and after each 24-hour set. Sampling methods were consistent with those conducted during the benthic invertebrate survey and are described earlier in Section 2.1.4.

3.0 RESULTS

3.1 Benthic Invertebrate Survey

3.1.1 Taxa Richness

A total of 46 distinct taxa were represented in the 10 samples collected during September 2009 (Table 1). Taxa collected during the sampling effort were distributed among annelids (20), arthropods (20), mollusks (3) and other taxa (3), which included two echinoderms and one nematode (Table 2). The five samples collected within 150 meters of the obstruction ("on obstruction" samples) consisted of a total of 39 taxa, while samples collected further than 150 meters from the obstruction within the "near field" area consisted of 31 taxa (Table 3). Overall, average taxa richness was slightly higher within 150 meters of the obstruction than it was further from the obstruction (14 compared to 13).

High taxa richness (more than 30% of all taxa collected) occurred at three locations collected over 150 meters from the obstruction including B-B-W (approximately 250 meters west of the obstruction) with 20 taxa represented followed by B-B-E (16) and B-B-NW (15). High taxa richness occurred at two locations within 150 meters of the obstruction at B-A-E with 18 taxa followed by B-A-N with 16. Low taxa richness, less than 20% of all taxa collected, occurred at one location within 150 meters of the obstruction at B-A-SW with a richness of 9 and at two locations further from the obstruction at B-B-S with a richness of 8 and at B-B-N with 9 taxa represented (Figure 3).

3.1.2 Density

The Annelid *Polygordius* sp., was the taxon collected at the highest densities during the sampling effort, averaging 6,734 organisms/m^2 across all sites (Table 1). Furthermore, it was also the only organism collected at every location sampled. *Polydora ligni*, Nematoda and Opheliidae were the next most commonly collected taxa with average densities of 2,393, 1,040 and 931 organisms/m^2, respectively (Table 1). The distribution and abundance of individuals across the three primary phyla collected (annelids, arthropods, and mollusks) and others (primarily nematodes) are shown in Table 2. Annelids comprised 79.8% of the total density collected, 12.8% were arthropods, 6.8% were other taxa, and only 0.7% were mollusks.

The average benthic organism density across the 10 samples collected during September 2009 was 15,376 organisms/m^2 (Table 3). In general, samples collected further than 150 meters from the obstruction had a higher average total density (17,053 organisms/m^2) compared to those samples collected within 150 meters of the obstruction (13,698 organisms/m^2). Densities ranged from 2,074 to 31,818 organisms/m^2 within approximately 150 meters of the obstruction compared to 7,830 to 28,829 organisms/m^2 collected outside by approximately 150 to 250 meters of the obstruction (Table 3 and Figure 4).

Densities within approximately 150 meters of the obstruction

Within approximately 150 meters of the obstruction, the highest total density of 31,818 organisms/m^2 was collected at location B-A-SE and was mostly due to a large collection of *Polygordius* sp., which had a density of 28,939 organisms/m^2 and was the highest density of any taxa collected during the sampling effort (Table 1). High total densities were also found at locations B-A-N and B-A-SW of 14,710 and 14,274 organisms/m^2 , respectively and was mostly due to a high density of *Polydora ligni* at B-A-N and both *Polygordius* sp. and *Polydora ligni* at B-A-SW. The least dense sample, B-A-E, was also collected within 150 meters of the obstruction and had a total density of 2,074 organisms/m^2 (Table 1).

Annelids comprised 73.8% of the total density collected within 150 meters of the obstruction, 21.0% were arthropods, 3.6% were other taxa, and only 1.6% were mollusks (Table 2). Annelids and arthropods were collected at all five locations, mollusks were present at 4 locations (B-A-E, B-A-N, B-A-SE, and B-A-SW), nematodes were present at three locations (B-A-E, B-A-N, and B-A-SE), the few echinoderms collected were found at (B-A-SW and B-A-W).

Densities outside approximately 150 meters of the obstruction

Beyond approximately 150 meters of the obstruction, the highest total sample densities occurred at locations B-B-NW and B-B-S with densities of 28,829 organisms/m^2 and 23,724 organisms/m^2, respectively (Table 1). *Polydora ligni* (6,907 organisms/m^2 at B-B-NW) and

Polygordius sp. (9,760 organisms/m^2 at B-B-S) were again the single highest contributors to the high total densities at these two locations.

Annelids comprised 77.6% of the total density in samples collected beyond 150 meters of the obstruction, 13.8% were arthropods, 8.7% were nematodes, and only 0.2% were mollusks (Table 2). Annelids, arthropods, and nematodes were collected at all five locations, mollusks were only present at location B-B-W, and no echinoderms were collected outside 150 meters of the obstruction.

Comparison of observed densities within and outside approximately 150 meters of the obstruction

Comparisons of observed densities within and outside approximately 150 meters of the obstruction showed a slightly higher percent composition of arthropods within approximately 150 meters of the obstruction compared to outside 150 meters which had a slightly higher percent composition of annelids (Table 2). The percent composition of mollusks was higher near the obstruction while the percent composition of nematodes was higher further from the obstruction.

3.1.3 Diversity (H') and Evenness (E)

The benthic community diversity among the ten samples collected ranged from a low of 0.49 at B-A-SE to a high of 2.61 at B-A-E; both locations were within 150 meters of the obstruction (Table 3). Only three samples were found to have diversity values over 2.0; one location within 150 meters of the obstruction B-A-E (2.61) and two further than 150 meters of the obstruction including B-B-W (2.46) and B-B-NW (2.31). The theoretical maximum value for diversity is 4.00; thus, the majority of the locations sampled had relatively low diversity (Figure 5). The average diversity was slightly lower for samples collected within 150 meters of the obstruction than for those collected beyond the 150 meter boundary (1.43 compared to 1.73, respectively).

Evenness is calculated as observed diversity divided by the theoretical maximum diversity calculated from the measured taxa richness; the theoretical maximum value for evenness is 1.00. As would be expected, the values for evenness followed a similar trend to those described for diversity (Table 3 and Figure 6). The evenness of the ten samples collected ranged from a low of 0.20 at B-A-SE to a high of 0.90 at B-A-E; both locations were within 150 meters of the obstruction. The maximum evenness for locations collected beyond the 150 meters of the obstruction occurred at location B-B-NW (0.85) and the minimum occurred at location B-B-N (0.30). Evenness averaged 0.56 for the five locations within 150 meters of the obstruction and 0.66 for the five locations further than 150 meters from the obstruction (Table 3). These values are slightly more than half of the theoretical maximum suggesting a moderately even distribution among species at most locations within and outside 150 meters of the obstruction.

3.1.4 Sediment and Water Quality

Sample depths at the ten benthic collection locations ranged from 61 feet (B-A-W) to 79 feet (B-B-N and B-B-W). Based on field observations, sediment collected during the benthic invertebrate survey ranged from sand with an admixture of pebbles, shells, and brick fragments, to sand with an admixture of fine sand and clay (Table 4). In all of the samples, sediment color was brown or brown/gray.

Bottom water characteristics were similar between benthic sampling locations (Table 5). Bottom water temperature ranged from 17.3 to 19.8°C. Conductivity (SPC@25°C) ranged from 47,830 to 49,420 and salinity ranged from 31.2 to 32.4 ppt. Dissolved oxygen ranged from 5.1 to 6.4 mg/L.

3.2 Fish, Crab and Lobster Pot Survey

3.2.1 Species and Abundance

A total of 448 organisms consisting of seven species of fish and crustaceans were collected during the two 24-hour sampling events conducted in September 2009. A majority (52%) of the organisms collected during the fish, crab and lobster trap survey were Atlantic rock crab (*Cancer irroratus*), followed by cunner (*Tautogolabrus adspersus*) (29%), conger eel (*Conger oceanicus*) (11%), black sea bass (*Centropristis striata*) (6%), and American lobster (*Homarus americanus*) (1%). One portly spider crab (*Libinia emarginata*) and one little skate (*Leucoraja erinacea*) were also collected. Of these organisms, 242 (171 fish and 71 crustaceans) were collected on the obstruction while 206 (37 fish and 169 crustaceans) were collected within the near field area up to approximately 250 meters from the obstruction (Table 6). Figure 7 displays the distribution amongst sample locations of the total number of fish collected during the survey.

The majority of the fish collected, 82%, were collected in traps placed on the obstruction. Cunner, the most abundant fish collected (n=128), was only collected on the obstruction. By contrast, the majority (70%) of the crustaceans were collected in traps set within the near field area adjacent to the obstruction (Figure 8). The crustaceans collected in the near field traps were comprised almost entirely of Atlantic rock crab (99% of the total) while five out of the six American lobster collected were found on the obstruction (Table 6).

3.2.2 Length

Table 7 displays the minimum, maximum and average total length measurements of the fish and crustaceans collected from traps located both on and adjacent to the obstruction. Of the fish species, black sea bass ranged from 49 mm to 329 mm, conger eel ranged from 485 mm to 1240 mm, cunner ranged from 98 mm to 176 mm, and the little skate measured 480 mm. Average total length for black sea bass was higher on the obstruction than adjacent to the obstruction (216 mm compared to 187 mm), while the average length for conger eel was higher in collections adjacent to the obstruction (859 mm compared to 714 mm).

Of the crustaceans, Atlantic rock crab ranged from 19 mm and 135 mm in carapace width and American lobster ranged from 77 mm to 83 mm in carapace length; while the portly spider crab measured 62 mm in carapace width. The average total length for Atlantic rock crab was slightly lower on the obstruction than adjacent to the obstruction (89 mm compared to 92 mm), while the average length for American lobster was higher in collections on the obstruction (79 mm compared to the 77 mm lobster collected adjacent to the obstruction).

3.2.3 Water Quality

Very little variation in water quality parameters occurred both between sample locations and between 24-hour sets during the fall 2009 fish, lobster and crab survey (Table 8). Temperature ranged between 17.4 and 18.0°C while dissolved oxygen readings ranged between 5.1 and 5.5

mg/L. Conductivity ranged between 48,710 and 49,420 (SPC@25°C) and salinity ranged between 31.9 and 32.4 ppt.

4.0 DISCUSSION

Although the reported obstruction known as High Spot C is located beyond the project boundary for the current Harbor Deepening Project, NYD is investigating if a Federal Action is required to remove the obstruction which is located in a critical approach area where three navigation lanes converge at the apex to the New York Bight. A channeled passage through an area of shoals located between Sandy Hook, New Jersey and Rockaway Point, New York was first dredged in the early 1910s and recent remote sensing surveys of the area surrounding the entrance to Ambrose Channel have identified numerous debris fields including the High Spot C obstruction (USACE 2009).

The results of the field sampling program provides an overview of the biological community utilizing High Spot C and the adjacent habitat (within 250 meters of the obstruction) during the late summer/early fall (September) and can be used in the assessment of potential impacts of any Federal Action. The common species (cunner, black sea bass, conger eel, American lobster and Atlantic rock crab) collected during the sampling effort are likely regular/year-round inhabitants of the obstruction. The composition of the fish and macroinvertebrate communities on and adjacent to the obstruction are likely to change seasonally as species move into and out of the area.

Benthic Community

Within the Lower Bay complex, benthic community structure follows a broad north-south pattern that corresponds to large-scale differences in sediment and hydrodynamic conditions (Cerrato 2006). The southern half of the complex (Sandy Hook Bay to Raritan Bay) is dominated by muddy sediments while the northern half (Lower Bay) is predominantly sandy. The distribution and abundance of benthic fauna living on or within the bottom are in turn closely associated with these broadscale patterns in different habitats. Moreover, the community is influenced by seasonal fluctuations in abundance with the benthic fauna in fine grained sediments tending to be more abundant and seasonally variable than in sandy areas (Cerrato 2006).

The benthic community that was sampled in the area of the obstruction during the late summer/early fall 2009 was generally typical of the coastal Mid-Atlantic region. Similar to previous investigations summarized by Cerrato (2006), collections were dominated by the annelids *Polygordius* sp. and *Polydora ligni* as well as to a lesser extent nematodes and the arthropods *Unciola* sp. and *Ampelisca abdita* (Table 1). Blue mussel (*Mytilus edulis*) and two gastropod species were also identified from the samples collected nearest to the obstruction. Community indices, such as diversity and evenness, indicated a slightly more diverse community inhabiting the area further from the obstruction (beyond 150 meters), although overall, average taxa richness and average density were similar between sites (Figure 9).

Annelids including *Polygordius* sp. are an important prey for many marine fish and shellfish and comprised nearly 80% of the organisms collected during the benthic invertebrate sampling program. Annelids have been found to be among the common prey items of marine fish, including several EFH species (Collette and MacPhee 2002, NMFS 1999a, NMFS 1999b, NMFS 1999c, and NMFS 2007); suggesting the area around the obstruction provides foraging habitat for a variety of fish and macroinvertebrates. Arthropods were also common in collections and are important prey of black sea bass, cunner, and to a lesser extent conger eel and lobster, while mollusks are eaten by cunner and rock crab (Auster 1989, Drohan *et. al.* 2007, Levy *et. al.* 1988, and Rebach and Ristvey 1999).

Fish and Crustacean Communities

The benthic survey suggests the surrounding substrates may provide habitat for a benthic community that is likely utilized as a forage base for some fish and crustacean species, including those species inhabiting the obstruction. Based on the biological sampling conducted during September 2009, the obstruction and adjacent habitat provides potential prey and the obstruction provides shelter habitat for structure oriented species collected during the survey, such as black sea bass and cunner (Steimle and Zetlin 2000). The latter species likely utilize the obstruction year–round. Since passive collection methods were used, the diurnal movements of fishes (moving from the obstruction to forage and back for cover and protection) could not necessarily be discerned. However, structure oriented species such as black sea bass are likely to be present in the surrounding sand flats as a result of the obstruction providing structural habitat in the area while they forage in nearby habitats; other species such as cunner appear to be more closely associated with structure regardless of diurnal period.

The food habits of black sea bass, conger eel, cunner, lobster and rock crab are summarized below and are in part a primary reason why these species utilize the obstruction. Cunner are perennial inhabitants and forage on benthic and epibenthic invertebrates including mussels, barnacles, clams, isopods, amphipods, shrimp, and small crab and lobster (Auster 1989). Black sea bass forage on benthic and epibenthic invertebrates including crustaceans (primarily rock crab and sand shrimp), isopods, amphipods, shrimp, and small crab, lobster, and fish (Drohan *et. al.* 2007). Conger eel feed primarily on decapod crustaceans and fish; with smaller eels (<80 cm TL) feeding most heavily on decapod crustaceans and larger eels (>80 cm) consuming more fish (Levy *et. al.* 1988). Atlantic rock crab are opportunistic feeders on an assortment of items including algae, polychaetes, mussels, gastropods, and various crustaceans (Rebach and Ristvey 1999).

Fish, crab, and lobster pots placed both on and adjacent to the obstruction indicated differences in the aquatic community between habitats. The majority of the fish collected during this survey, 82%, were collected in traps placed on the obstruction. All of the fish collected on the obstruction (cunner, conger eel and black sea bass) were species typically associated with reef or structured habitat (Able and Fahay 1998 and Collette and MacPhee 2002). Furthermore, five out of six American lobster, a crustacean also associated with reef habitat, were collected in traps placed on the obstruction. Within inshore areas such as the Lower Bay, lobsters frequent areas of sand with overlying boulders and distribution is related to water temperature with spawning migrations into shallow water typically occurring in the spring and summer (USACE 1999).

Along with little skate, an EFH species which is typically associated with sand, gravel and mud flats (Collette and MacPhee 2002), black sea bass and conger eel were also collected in traps set adjacent to the obstruction. Black sea bass regularly use sand or mud flat areas surrounding wrecks and reefs as foraging areas for food (Steimle and Figley 1996). Thus collections of black sea bass beyond the bounds of the obstruction are not unexpected. Conger eel have also been demonstrated to use non-reef areas, in particular, they are known to use burrows in sand/mud substrates (Able *et. al.* 1982).

Despite its name, Atlantic rock crab, the species most frequently collected in near field samples, typically utilizes sand/mud substrates in areas south of Cape Cod (Bigford 1979). Atlantic rock crab utilizing habitat adjacent to the obstruction may be an important part of the diet of black sea bass as Steimle and Figley (1996) found Atlantic rock crab comprise 84% to 95% (percent of frequency of occurrence) of the diet of black sea bass collected off of the coast of New Jersey. Similarly, Atlantic rock crab was found to be an important part of the diet of American lobster inhabiting the Lower Bay which feed primarily on small and juvenile decapods such as Atlantic rock crabs, sand shrimp, hermit crabs, lady crabs, and mud crabs (NMFS 2000).

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6.0 TABLES

Table 1. Benthos density (organisms/m^2) collected during the Ambrose Obstruction Biological Sampling, September 2009.

Phylum	Class	Order	Family	Genus species	B-A-E	B-A-N	B-A-SE	B-A-SW	B-A-W	B-B-E	B-B-N	B-B-NW	B-B-S	B-B-W	All Stations Average
Annelida	Oligochaeta	---	---	---					60	150				226	**44**
	Polychaeta	---	---	---	338									526	**86**
		Archiannelida	Polygordiidae	*Polygordius sp.*	225	500	28939	7808	3253	2553	8900	4204	9760	1203	**6734**
		Ariciida	Opheliidae	---									9309		**931**
		Capitellida	Capitellidae	---							100			75	**18**
			Maldanidae	---		200						300		75	**58**
		Cirratulida	Cirratulidae	*Cirriformia sp.*								2402			**240**
		Eucinida	Lumbrinereidae	*Lumbrineris sp.*	19	500				1351		2102	300	376	**465**
		Magelonida	Magelonidae	*Magelona sp.*					120						**12**
		Phyllodocida	Glyceridae	*Glycera sp.*	131	100	152		120		400	300	150	75	**143**
			Nephtyidae	*Nephtys sp.*						150	200				**35**
			Nereidae	*Nereis sp.*	19										**2**
			Phyllodocidae	---	19	200				450		300		376	**135**
			Polynoidae	---	131									301	**43**
			---	*Harmothoe sp.*								1201			**120**
			Syllidae	---			152					300			**45**
		Sabellida	Sabellidae	---	19										**2**
		Spionida	Paraonidae	---						5405					**541**
			Sabellariidae	*Sabellaria vulgaris*	38									150	**19**
			Spionidae	*Polydora ligni*		8900	758	5105		150		6907		2105	**2393**
				Scolecolepides		200						1201		226	**163**
		Terebellida	Ampharetidae	---	75					150				150	**38**
Arthropoda	Crustacea	Amphipoda	---	---	38				120		100				**26**
			Ampeliscidae	*Ampelisca abdita*	94	200				300		2402		75	**307**
			Aoridae	*Pseudounciola*					723						**72**
				Unciola sp.	131	1600	606	450		2102		2703	450	376	**842**
				Ampharete sp.			152								**15**
			Caprellidae	---		100									**10**
			Phoxocephalidae	*Harpinia sp.*	375	200	152	300		751		901	450	226	**335**
			Stenothoidae	*Parametopella*	19										**2**
			Haustoriidae	*Acanthohaustorius*					301						**30**
			Lysianassidae	---					602						**60**
			Pleustidae	*Stenopleustes*	75					150					**23**
		Cumacea	Bodotriidae	*Cyclaspis varians*					181	150					**33**
			Diastylidae	*Diastylis quadrispinosa*						150					**15**
		Decapoda	Cancridae	*Cancer irroratus*		10				10				10	**3**
			Paguridae	*Pagurus longicarps*				150							**15**
		Isopoda	Anthuridae	*Cyathura polita*		100					100				**20**
			Chaetiliidae	*Chiridotea sp.*					120				150		**27**
		Mysidacea	Mysidae	*Heteromysis formosa*										75	**8**
		Veneroida	Astartidae	*Astarte sp.*	48						10				**6**
			Cardiidae	---	113										**11**
				Clinocardium sp.			152								**15**
				Tellina sp.				150			300	300		150	**90**
Echinodermata	Echinoidea	Clypeasteroida	Echinarachnidae	*Echinarachnius*					10						**1**
	Asteroidea	Forcipulatida	Asteriidae	*Asterias forbesi*				10							**1**
Mollusca	Bivalvia	---	---	---		200		150							**35**
		Mytioida	Mytilidae	*Mytilus edulis*			152								**15**
	Gastropoda	---	---	---										75	**8**
		Mesogastropoda	Calyptraeidae	*Crepidula fornicata*	56	100	152								**31**
		Neogastropoda	Nassariidae	*Ilyanassa trivittata*				150							**15**
Nematoda	---	---	---	---	113	1600	455			601	200	3303	3153	977	**1040**
Taxa Richness					**18**	**16**	**11**	**9**	**10**	**16**	**9**	**15**	**8**	**20**	**46**
Total Benthos Density (organisms/m^2)					**2,074**	**14,710**	**31,818**	**14,274**	**5,612**	**14,575**	**10,310**	**28,829**	**23,724**	**7,830**	**15,376**

Table 2. Taxa occurrence and total density (organisms/m^2) from each sample collected during the Ambrose Obstruction Biological Sampling, September 2009.

Station	Taxa Occurrence								Total Density (organisms/m^2) Occurrence							
	Annelida		Arthropoda		Molluska		Other		Annelida		Arthropoda		Molluska		Other	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
B-A-E	9	50.0%	7	38.9%	1	5.6%	1	5.6%	1,013	48.9%	892	43.0%	56	2.7%	113	5.4%
B-A-N	7	43.8%	6	37.5%	2	12.5%	1	6.3%	10,600	72.1%	2,210	15.0%	300	2.0%	1,600	10.9%
B-A-SE	4	36.4%	4	36.4%	2	18.2%	1	9.1%	30,000	94.3%	1,061	3.3%	303	1.0%	455	1.4%
B-A-SW	2	22.2%	4	44.4%	2	22.2%	1	11.1%	12,913	90.5%	1,051	7.4%	300	2.1%	10	0.1%
B-A-W	4	40.0%	5	50.0%	0	0.0%	1	10.0%	3,554	63.3%	2,048	36.5%	0	0.0%	10	0.2%
B-B-E	8	50.0%	7	43.8%	0	0.0%	1	6.3%	10,360	71.1%	3,614	24.8%	0	0.0%	601	4.1%
B-B-N	4	44.4%	4	44.4%	0	0.0%	1	11.1%	9,600	93.1%	510	4.9%	0	0.0%	200	1.9%
B-B-NW	10	66.7%	4	26.7%	0	0.0%	1	6.7%	19,219	66.7%	6,306	21.9%	0	0.0%	3,303	11.5%
B-B-S	4	50.0%	3	37.5%	0	0.0%	1	12.5%	19,520	82.3%	1,051	4.4%	0	0.0%	3,153	13.3%
B-B-W	12	60.0%	6	30.0%	1	5.0%	1	5.0%	5,865	74.9%	912	11.7%	75	1.0%	977	12.5%
Obstruction Average	**5**	**38.5%**	**5**	**41.4%**	**1**	**11.7%**	**1**	**8.4%**	**11616**	**73.8%**	**1452**	**21.0%**	**192**	**1.6%**	**437**	**3.6%**
Near Field Average	**8**	**54.2%**	**5**	**36.5%**	**0**	**1.0%**	**1**	**8.3%**	**12913**	**77.6%**	**2479**	**13.5%**	**15**	**0.2%**	**1647**	**8.7%**
All Stations Total	**20**	**43.5%**	**20**	**43.5%**	**3**	**6.5%**	**3**	**6.5%**	**122644**	**79.8%**	**19655**	**12.8%**	**1035**	**0.7%**	**10422**	**6.8%**

Table 3. Benthic community taxa richness, density (organisms/m^2), Diversity (H'), and Evenness (E) from each sample collected during Ambrose Obstruction Biological Sampling, September 2009.

Station	Taxa Richness	Density (organisms/m^2)	Diversity (H')	Evenness (E)
B-A-E	18	2,074	2.61	0.90
B-A-N	16	14,710	1.51	0.54
B-A-SE	11	31,818	0.49	0.20
B-A-SW	9	14,274	1.08	0.49
B-A-W	10	5,612	1.48	0.64
Obstruction Average	**13**	**13,698**	**1.43**	**0.56**
Obstruction Total Taxa Richness	**39**	**---**	**---**	**---**
B-B-E	16	14,575	1.98	0.71
B-B-N	9	10,310	0.65	0.30
B-B-NW	15	28,829	2.31	0.85
B-B-S	8	23,724	1.27	0.61
B-B-W	20	7,830	2.46	0.82
Near Field Average	**14**	**17,053**	**1.73**	**0.66**
Near Field Total Taxa Richness	**31**	**---**	**---**	**---**
All Station Average	**13**	**15,376**	**1.58**	**0.61**

Table 4. Sediment characteristics and depth to bottom at each sampling location from the Ambrose Obstruction Biological Sampling, September 2009.

Station	Sediment Texture	Sediment Color	Sediment Odor	Bot Water Depth (ft)
B-A-N	SAND,GRAVEL,PEBBLE	BROWN,GRAY	NONE	66
B-A-E	ROCKY	BROWN	NONE	67
B-A-SE	SAND, GRAVEL, GLASS	BROWN	NONE	62
B-A-SW	CLAY, SAND, GRAVEL	GRAY, BROWN	SLIGHT PETROLEUM	62
B-A-W	SANDY	BROWN	NONE	61
B-B-NW	SAND, GRAVEL, ROCK	GRAY, BROWN	NONE	70
B-B-N	SAND, SHELL HASH, ROCK DEBRIS	BROWN, GRAY	NONE	79
B-B-E	FINE SAND, ROCKS	BROWN	NONE	72
B-B-S	SAND,SHELLS,GRAVEL, BRICK FRAGS.	BROWN	NONE	69
B-B-W	SAND, GRAVEL, ROCK	BROWN, GRAY	NONE	79

Table 5. Water quality parameters measured During Ambrose Obstruction Biological Sampling, September 2009.

Station Code	Bottom Water Temperature (deg C)	Bottom Water Conductivity (SPC@25°C)	Bottom Water Dissolved Oxygen (mg/l)	Bottom Water Salinity (ppt)
B-A-SW	17.5	49,180	5.6	32.1
B-A-SE	19.3	48,780	6.2	32.0
B-A-N	17.9	49,090	5.6	32.1
B-A-W	18.0	48,990	6.3	32.2
B-A-E	18.0	49,240	5.9	32.2
B-B-E	17.3	49,420	5.1	32.4
B-B-N	18.4	47,950	5.9	31.2
B-B-NW	19.0	48,310	6.0	31.7
B-B-SW	19.8	48,160	6.4	31.4
B-B-S	19.7	47,830	6.2	31.2

Table 6. Species collected in fish, crab, and lobster pots during the Ambrose Obstruction Biological Sampling, September 2009.

Common Name	Scientific Name	Station														All Station Total
		Obstruction							Near Field							
		F-A-E	F-A-N	F-A-S	F-A-W	F-C-E	F-C-W	Total	F-B-E	F-B-N	F-B-NW	F-B-S	F-B-SE	F-B-W	Total	
		Fish Species														
Black sea bass	*Centropristis striata*	2	3	2	8	3	4	**22**	3	0	1	2	1	0	**7**	**29**
Conger eel	*Conger oceanicus*	1	1	4	0	12	3	**21**	2	5	9	3	8	2	**29**	**50**
Cunner	*Tautogolabrus adspersus*	19	26	24	4	35	20	**128**	0	0	0	0	0	0	**0**	**128**
Little skate	*Leucoraja erinacea*	0	0	0	0	0	0	**0**	0	1	0	0	0	0	**1**	**1**
		Crustaceans														
American lobster	*Homarus americanus*	2	1	0	0	2	0	**5**	1	0	0	0	0	0	**1**	**6**
Atlantic rock crab	*Cancer irroratus*	6	10	11	12	8	19	**66**	16	43	6	22	74	6	**167**	**233**
Portly spider crab	*Libinia emarginata*	0	0	0	0	0	0	**0**	0	1	0	0	0	0	**1**	**1**
Total		**30**	**41**	**41**	**24**	**60**	**46**	**242**	**22**	**50**	**16**	**27**	**83**	**8**	**206**	**448**

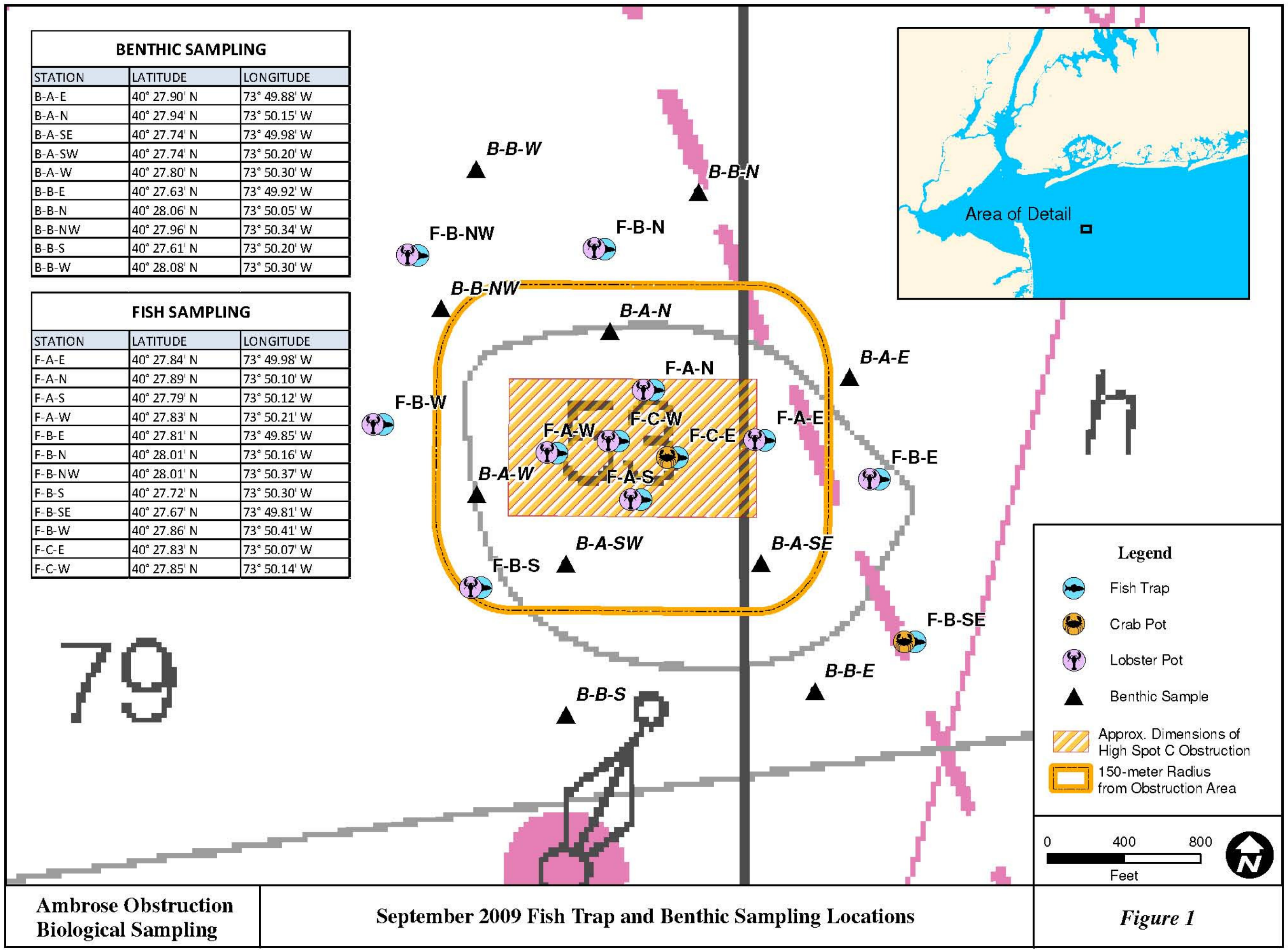
Table 7. Minimum, maximum and average lengths of species collected during Ambrose Obstruction Biological Sampling, September 2009.

Common Name	Scientific Name	Obstruction				Near Field				All Individuals			
		Number Measured	Minimum (mm)	Maximum (mm)	Average (mm)	Number Measured	Minimum (mm)	Maximum (mm)	Average (mm)	Number Measured	Minimum (mm)	Maximum (mm)	Average (mm)
Fish Species													
Black sea bass	*Centropristis striata*	22	50	328	216	7	49	329	187	29	49	329	209
Conger eel	*Conger oceanicus*	21	485	910	714	29	525	1240	859	50	485	1240	799
Cunner	*Tautogolabrus adspersus*	114	98	176	138	0	0	0	0	114	98	176	138
Little skate	*Leucoraja erinacea*	0	0	0	0	1	480	480	480	1	480	480	480
Crustacean Species													
American lobster	*Homarus americanus*	5	77	83	79	1	77	77	77	6	77	83	79
Atlantic rock crab	*Cancer irroratus*	63	42	127	89	124	19	135	92	187	19	135	91
Portly spider crab	*Libinia emarginata*	0	0	0	0	1	62	62	62	1	62	62	62

Table 8. Water quality parameters measured during Ambrose Obstruction BiologicalSampling, September 2009.

Station	Date	Temperature (deg C)		Conductivity (SPC@25°C)		Dissolved Oxygen (mg/l)		Salinity (ppt)	
		Set	Retreive	Set	Retreive	Set	Retreive	Set	Retreive
F-A-S	21-Sep-09	17.4	17.9	48,710	48,900	5.4	5.3	31.9	32.1
F-A-S	22-Sep-09	17.9	18.0	48,900	49,120	5.3	5.3	32.1	32.2
F-A-E	21-Sep-09	17.4	17.9	48,710	48,900	5.4	5.3	31.9	32.1
F-A-E	22-Sep-09	17.9	18.0	48,900	49,120	5.3	5.3	32.1	32.2
F-A-W	21-Sep-09	17.4	17.9	48,710	48,900	5.4	5.3	31.9	32.1
F-A-W	22-Sep-09	17.9	17.6	48,900	49,420	5.3	5.1	32.1	32.4
F-A-N	21-Sep-09	17.4	17.9	48,710	48,900	5.4	5.3	31.9	32.1
F-A-N	22-Sep-09	17.9	17.6	48,900	49,420	5.3	5.4	32.1	32.4
F-C-W	21-Sep-09	17.4	17.9	48,710	48,900	5.4	5.3	31.9	32.1
F-C-W	22-Sep-09	17.9	17.6	48,900	49,420	5.3	5.1	32.1	32.4
F-C-E	21-Sep-09	17.4	17.8	48,710	49,320	5.4	5.5	31.9	32.3
F-C-E	22-Sep-09	17.8	18.0	49,320	49,120	5.5	5.3	32.3	32.2
F-B-SE	21-Sep-09	17.4	17.8	48,710	49,320	5.4	5.5	31.9	32.3
F-B-SE	22-Sep-09	17.8	18.0	49,320	49,120	5.5	5.3	32.3	32.2
F-B-NW	21-Sep-09	17.4	17.8	48,710	49,320	5.4	5.5	31.9	32.3
F-B-NW	22-Sep-09	17.8	18.0	49,320	49,120	5.5	5.3	32.3	32.2
F-B-N	21-Sep-09	17.4	17.9	48,710	48,900	5.4	5.3	31.9	32.1
F-B-N	22-Sep-09	17.9	18.0	48,900	49,120	5.3	5.3	32.1	32.2
F-B-E	21-Sep-09	17.4	17.8	48,710	49,320	5.4	5.5	31.9	32.3
F-B-E	22-Sep-09	17.8	18.0	49,320	49,120	5.5	5.3	32.3	32.2
F-B-S	21-Sep-09	17.4	17.8	48,710	49,320	5.4	5.5	31.9	32.3
F-B-S	22-Sep-09	17.8	18.0	49,320	49,120	5.5	5.3	32.3	32.2
F-B-W	21-Sep-09	17.4	17.8	48,710	49,320	5.4	5.5	31.9	32.3
F-B-W	22-Sep-09	17.8	17.6	49,320	49,420	5.5	5.1	32.3	32.4

7.0 FIGURES



BENTHIC SAMPLING

STATION	LATITUDE	LONGITUDE
B-A-E	40° 27.90' N	73° 49.88' W
B-A-N	40° 27.94' N	73° 50.15' W
B-A-SE	40° 27.74' N	73° 49.98' W
B-A-SW	40° 27.74' N	73° 50.20' W
B-A-W	40° 27.80' N	73° 50.30' W
B-B-E	40° 27.63' N	73° 49.92' W
B-B-N	40° 28.06' N	73° 50.05' W
B-B-NW	40° 27.96' N	73° 50.34' W
B-B-S	40° 27.61' N	73° 50.20' W
B-B-W	40° 28.08' N	73° 50.30' W

FISH SAMPLING

STATION	LATITUDE	LONGITUDE
F-A-E	40° 27.84' N	73° 49.98' W
F-A-N	40° 27.89' N	73° 50.10' W
F-A-S	40° 27.79' N	73° 50.12' W
F-A-W	40° 27.83' N	73° 50.21' W
F-B-E	40° 27.81' N	73° 49.85' W
F-B-N	40° 28.01' N	73° 50.16' W
F-B-NW	40° 28.01' N	73° 50.37' W
F-B-S	40° 27.72' N	73° 50.30' W
F-B-SE	40° 27.67' N	73° 49.81' W
F-B-W	40° 27.86' N	73° 50.41' W
F-C-E	40° 27.83' N	73° 50.07' W
F-C-W	40° 27.85' N	73° 50.14' W

Figure 1. **Fish/crustacean and benthic sampling locations during the Ambrose Obstruction Biological Sampling, September 2009.**

Figure 2. Sampling gear deployed during the Ambrose Obstruction Biological Sampling including the single fyke fish trap with ¼-inch wire mesh (left), the double fyke 24-inch x 24-inch x 24-inch crab pot (center), and the double fyke 36-inch x 18-inch x 12-inch lobster pot (right), September 2009.

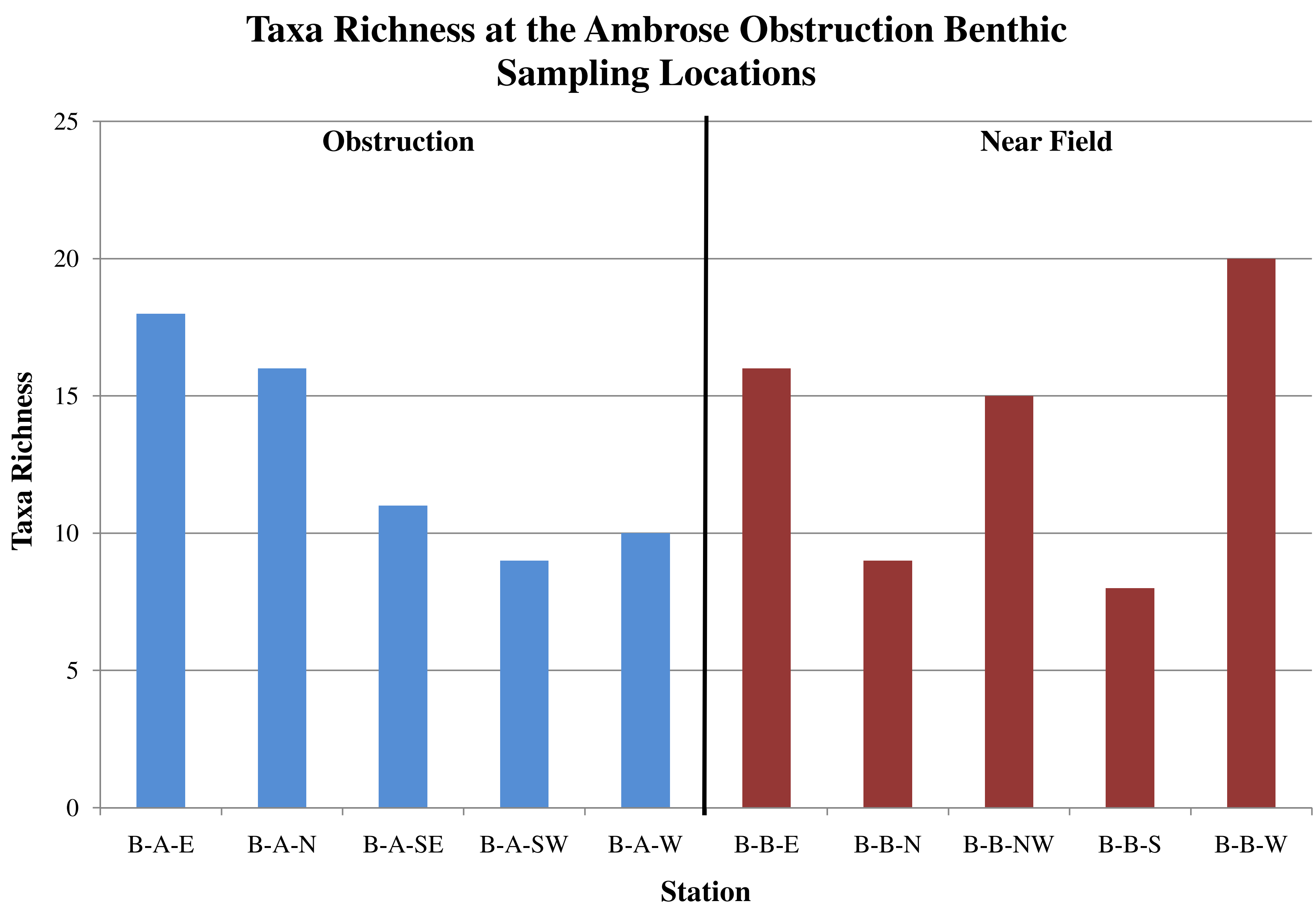


Figure 3. Benthic invertebrate taxa richness on and near field of the Ambrose Obstruction.

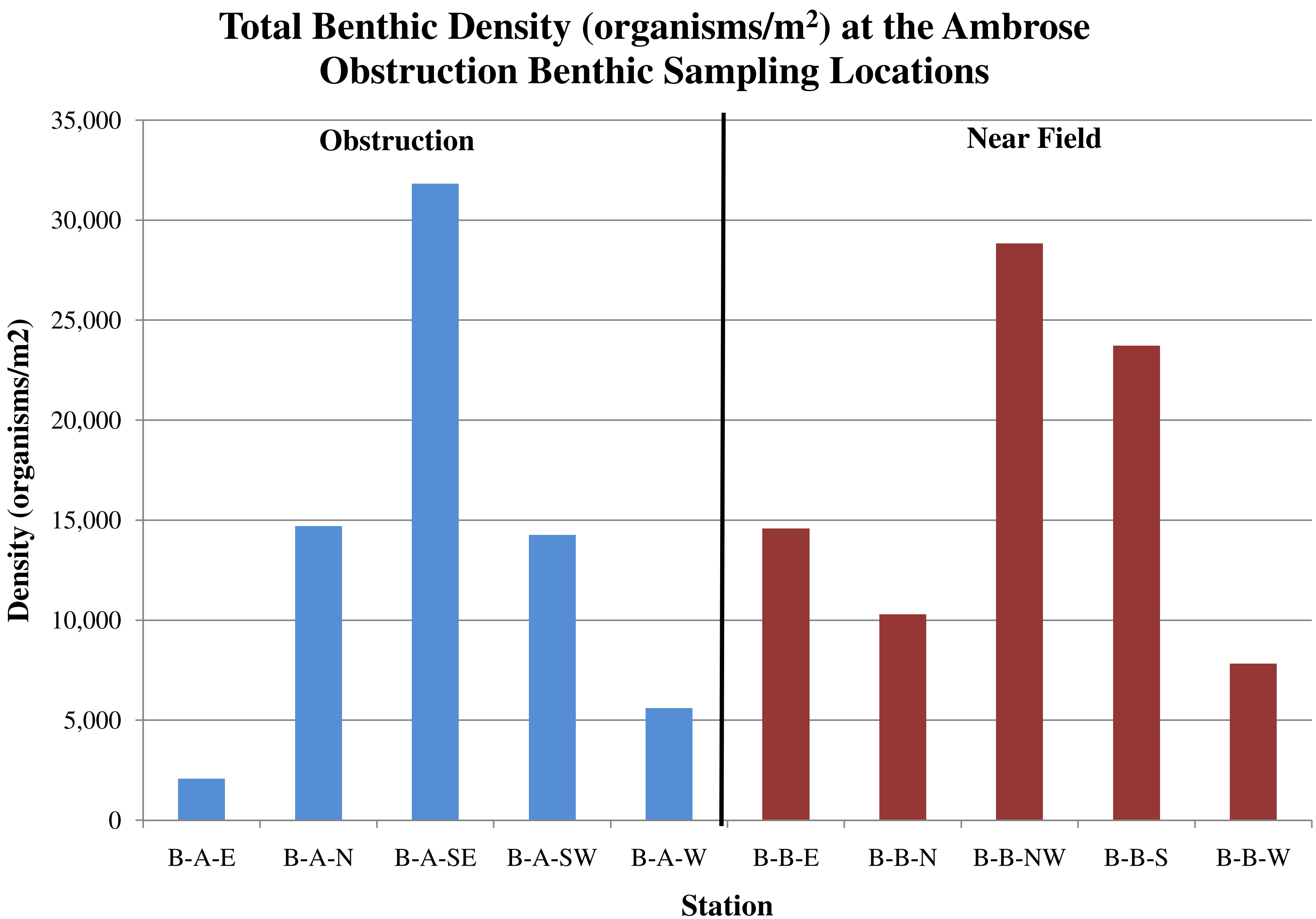


Figure 4. Benthic invertebrate density on and near field of the Ambrose Obstruction.

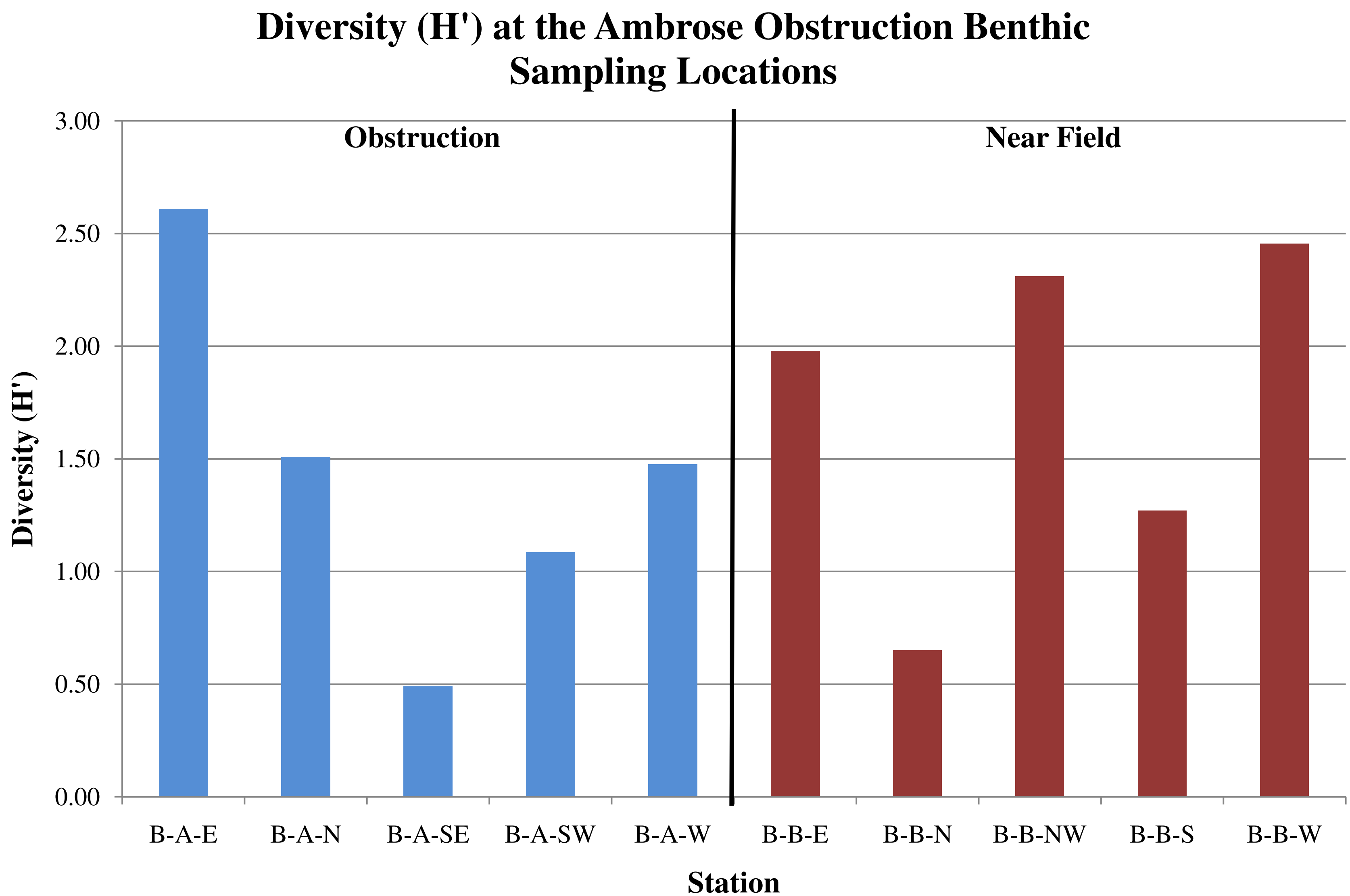


Figure 5. **Benthic invertebrate diversity on and near field of the Ambrose Obstruction.**

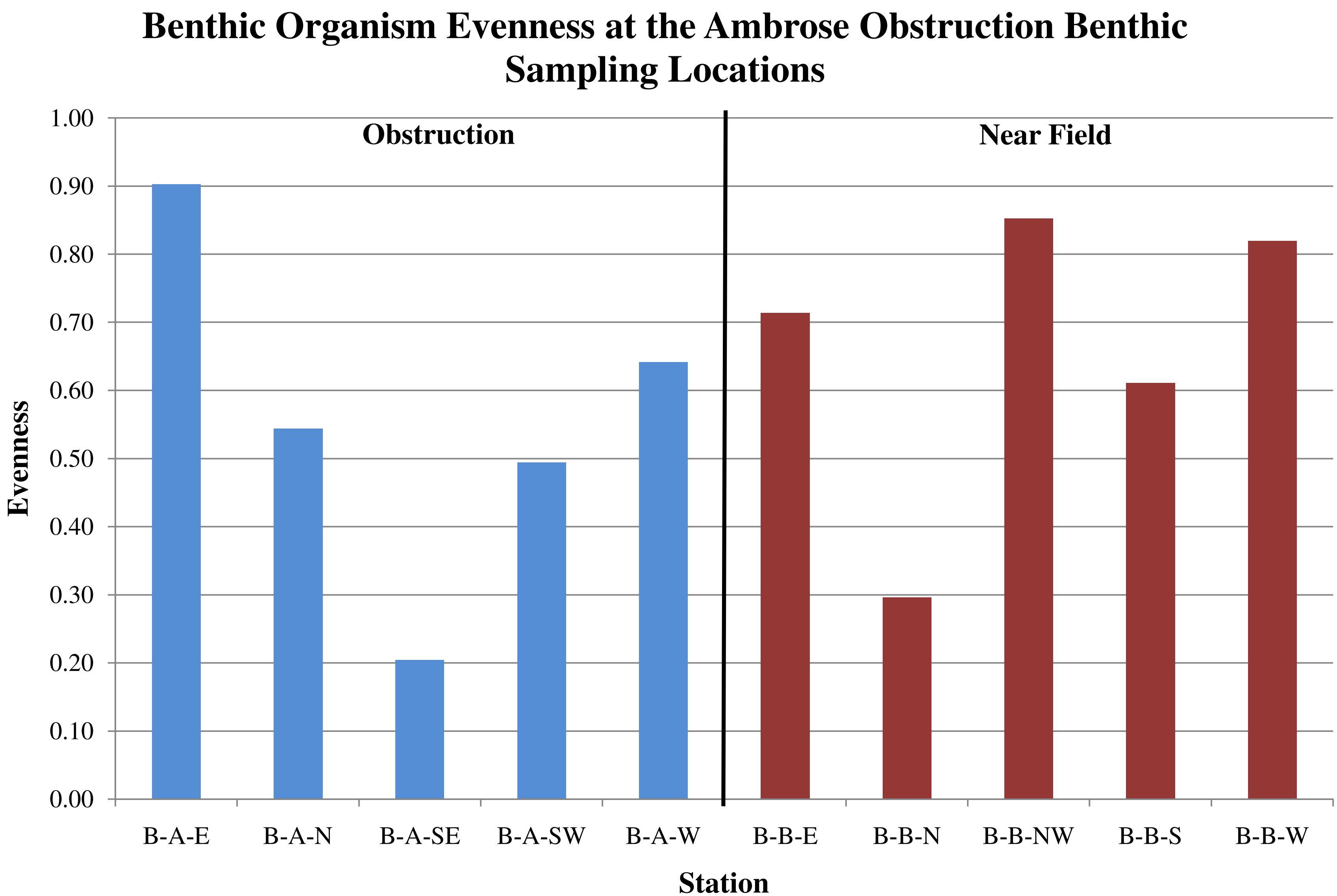


Figure 6. Benthic invertebrate evenness on and near field of the Ambrose Obstruction.

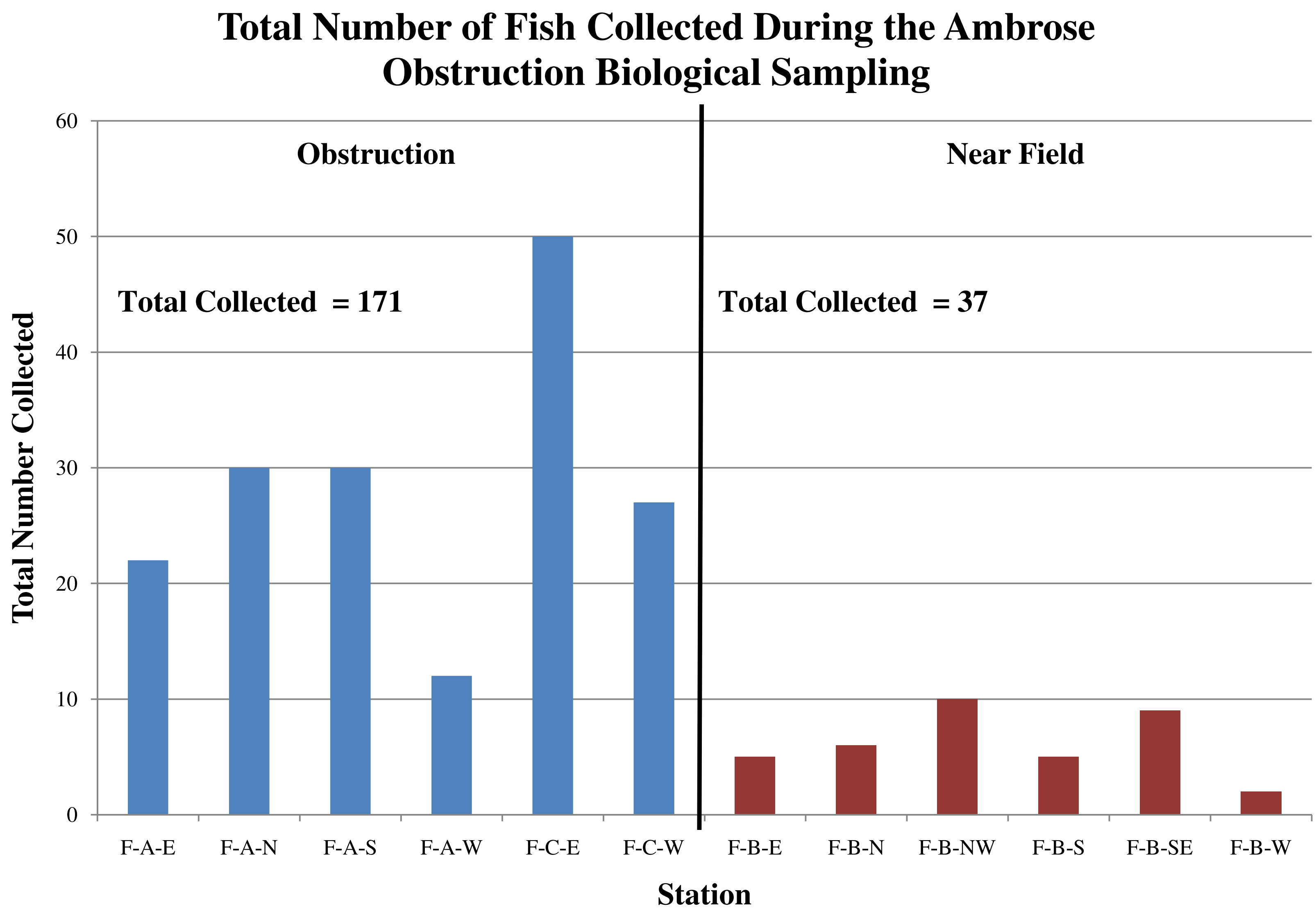


Figure 7. Total number of fish collected on and near field of the Ambrose Obstruction.

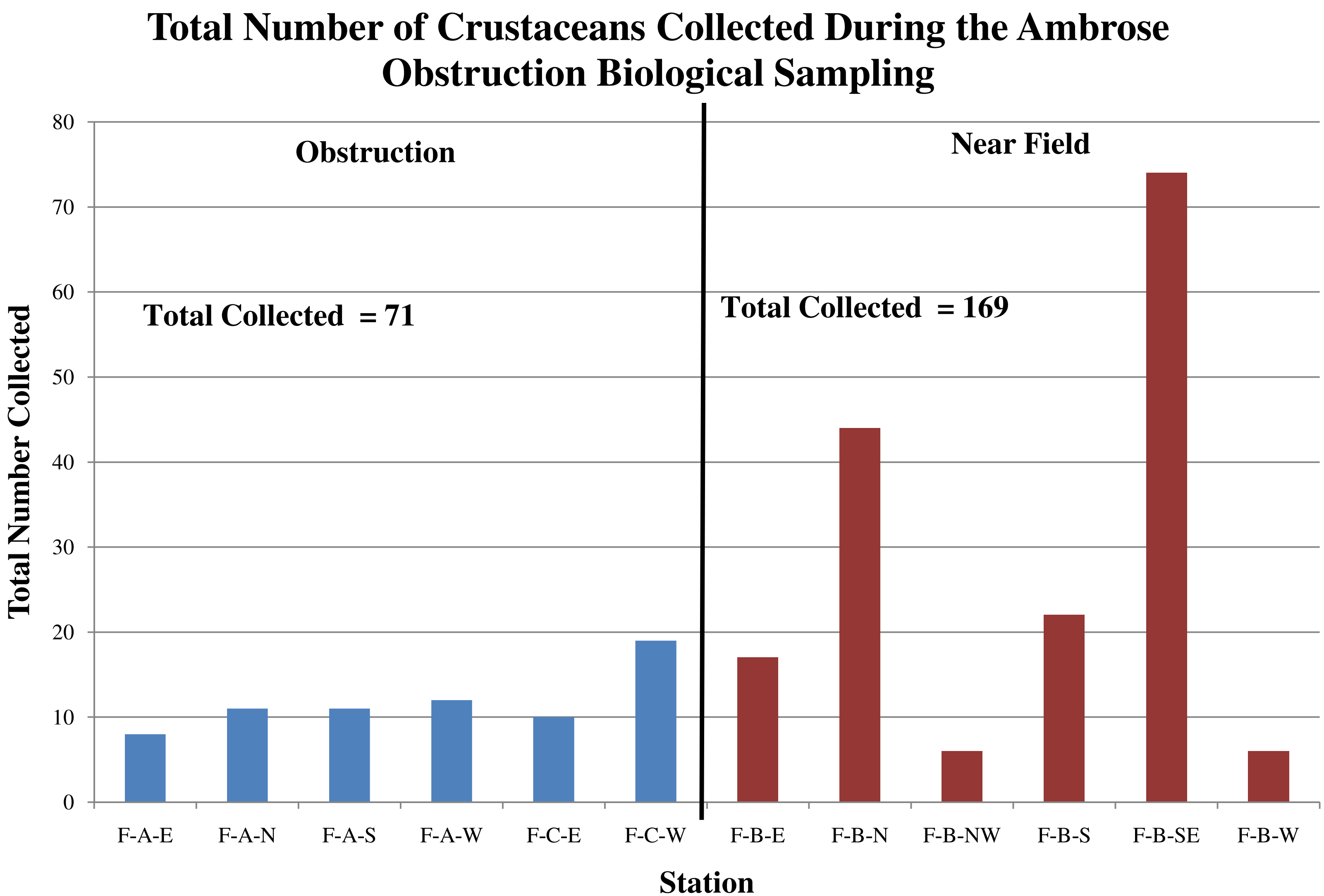


Figure 8. **Number of crustaceans collected on and near field of the Ambrose Obstruction.**

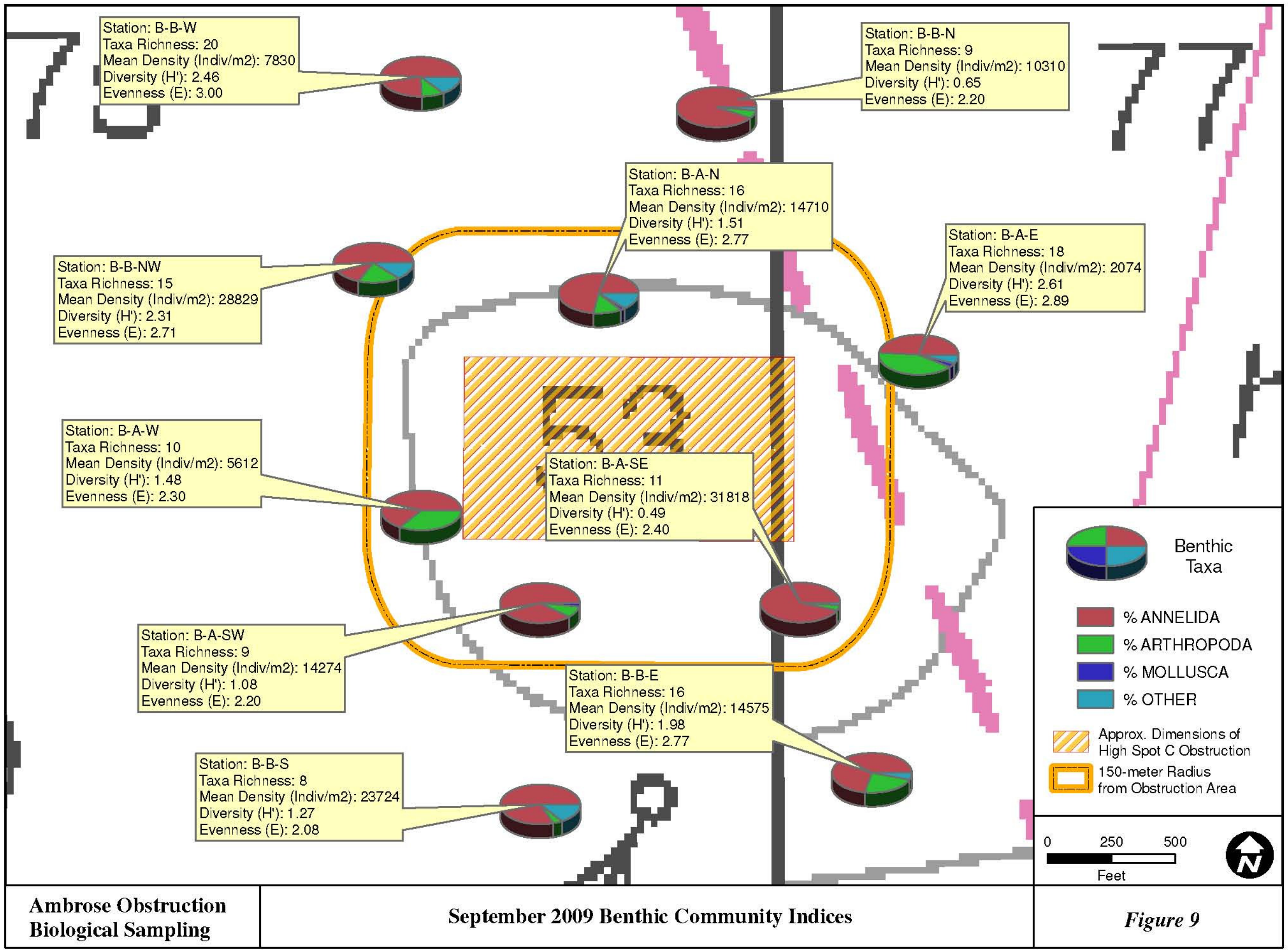


Figure 9. **Summary of benthic community indices for the Ambrose Obstruction Biological Sampling, September 2009.**