# 4.0 SUMMARY

## 4.1 CHARACTERIZATION OF OYSTER BEDS

Continuous water quality monitoring on oyster beds off Kelly Island provided an overview of the seasonal patterns for water temperature, specific conductivity, salinity, dissolved oxygen, pH, turbidity, and chlorophyll. Water temperature increased from 17ºC in May to a high of 26ºC in August, and decreased thereafter to 12ºC in November. Specific conductivity increased uniformly over the monitoring period from 23-mS/cm in May to 33-mS/cm in November. Likewise, salinity increased over the same interval from 14 to 21-ppt. Dissolved oxygen, correlating negatively with temperature, decreased from 7.5-mg/L in May to a low of 5-mg/L in August and increased thereafter to 9-mg/L in November. Measures of pH were relatively stable over the monitoring period averaging about 7.7. Turbidity was also consistent at about 100-NTU. Chlorophyll was highest in May averaging about 50-µg/L, and declined thereafter to about 10-µg/L by November. Periodic monitoring of total suspended solids indicated variability over the monitoring period but most measures ranged less than 100-mg/L. Sediment accumulation rates averaged about 250-g/cm$^2$/year over the monitoring period. Spat settlement rates generally ranged less than 0.1-spat/100-cm$^2$/day over the settlement period from July to September, but ranged as high as 0.4-spat/100-cm$^2$/day. The temporal pattern of settlement suggested that oysters spawning might be attuned to a lunar cycle. Seasonal dredge surveys of oyster beds indicated that oysters were relatively abundant on the seedbeds, however, most were small or below market size. In contrast, oysters were infrequent to absent on most lease beds. Oyster mortality, as indicated by empty box shells, appeared to be reflective of the overall population throughout. Predation by oyster drills appeared to affect more of the smaller sizes oysters.

## 4.2 CHARACTERIZATION OF FISHERIES

Thirty-one species of fish were collected by trawl and seine during seasonal sampling along Kelly Island and in the Mahon River; all species were typical for the nearshore estuarine habitats. In spring, the most abundant fish were spotted hake, striped cusk-eel, and hogchoker. In summer, Kelly Island appeared to offer important nursery habitat for weakfish. Juvenile fish were abundant in the Mahon River and were collected at all sampling locations along the nearshore of Kelly Island. In fall, juvenile Atlantic croaker was the most abundant species with more than 1,000 fish collected at each sampling location. Although to a lesser degree, croaker was most abundant during winter. Also at this time, the abundances of white perch and striped bass peaked, most likely because of the presence of the juvenile croakers on which they prey. Horseshoe crabs were most abundant during spring and were collected incidentally as they attempted to spawn and nest along the shoreline of Kelly Island. Blue crabs were most abundant during fall and for the most part comprised juveniles. Diamondback terrapins were only occasionally collected during spring sampling, but were commonly observed in nearshore waters. Most likely, terrapins nest on Kelly Island during late spring and early summer.

A survey of spawning adult horseshoe crabs suggested that, relative to Port Mahon Beach, Kelly Island might offer less suitable spawning habitat. However, in comparison with a bay-wide survey run by the USGS, both Kelly Island and Port Mahon may be among the most important beach spawning sites along the Delaware shoreline of Delaware Bay. More data needs to be collected for the Kelly Island and Port Mahon beaches using USGS survey methods before their relative importance can be gauged. A survey of juvenile horseshoe crabs in late summer indicated low abundance throughout the study range.

## 4.3 CHARACTERIZATION OF SEDIMENTS

### 4.3.1 Sediment Profile Imagery

- Sediments were predominantly silty-clays. Fine- to medium- sands were the second most predominant sediment type. There was little variation in sediments between July and October with 46 of 50 stations having the same sediment type.

- An oyster bed, whole shell and coarse shell hash, occurred at one station (KM-10) in both July and October.

- Thin flocculent layers of sediments from recent resuspension events occurred at 10 stations. Thicker layers of uniformly colored lighter sediments indicative of major resuspension/deposition events occurred at 13 stations.

- Sediment grain-size layering occurred at 11 stations. Layers were primarily sandy over silty sediments (seven stations), and likely represent lens of coarser sediments transported over finer during storm events. Stations with sandy layer over silt-clay layer may be located near sediment transition areas. At four stations silty overlaid clayey sediments.

- Processes structuring surface sediments appeared to be physical at all stations in October and all but five in July. At these five stations (KM-07, KS-06, RS-08, RS-09, and RS-10) biological process were dominant in structuring surfical sediment fabric.

- Overall, community succession appeared to be primarily pioneering Stage I with evidence of intermediate Stage II fauna at five stations. (See section 3.3.1.4 for Stage I and Stage II definitions)

### 4.3.2 Characterization of Benthos

Benthic organisms identified from sediment samples collected offshore Kelly Island were typical for the nearshore estuarine habitats. Overall, the most abundant organisms comprised the oligochaete worms. For the most part, indices of species diversity were similar throughout the study area including mean number of taxa, Shannon-Wiener Index, and Simpson's Diversity

Index. Total abundance and total biomass were variable over the study area, but did not appear to be spatially dependent. An invasive species of isopod was found to be pervasive in the study area. Sediment characterization of benthic samples indicated bottom sediments of mostly silt-mud and less than 12% total organic carbon.

## 4.4 HYDROACOUSTIC SURVEY

Extensive oyster habitat (identified by the presence of exposed shell and related epi-fauna is present in the region associated with oyster seed beds. Because of generally poor visibility it was difficult to determine quantities of live oysters in these beds. Oyster lease areas to the south did exhibit limited regions of shell bottom, but were generally dominated by non-shell surface habitat. Excluding oyster shell habitat, three other principal habitat types were found in the survey region. Two of these were composed of sand - silt substrate being segregated by the presence or absence of shell bits or pieces in the matrix. The final bottom type was defined by biogenic component although the bottom character did appear different from the sand-shell types. This bottom type was dominated by epi-fauna/flora, presumably tubeworms.

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