BASIN SUMMARIES FOR BENTHOS

Prepared for

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1.0 INTRODUCTION AND METHODS

The present basin summaries for benthos are based on results from the Maryland Long-term Benthic Monitoring and Assessment Component of the Chesapeake Bay Water Quality Monitoring Program. The Program uses the Benthic Index of Biotic Integrity (B-IBI) to characterize benthic community condition.

The B-IBI is calculated by scoring each of several attributes of benthic community structure and function according to thresholds established from reference data distributions. The scores are then averaged across attributes (see Weisberg et al., 1997). Sites with index values of 3 or more (on a 1 to 5 scale) are considered to have good benthic condition indicative of good habitat quality. Weisberg et al. (1997) validated the B-IBI by calculating classification efficiencies of sites of known sediment quality using independent datasets. Overall, the index correctly distinguished degraded sites from reference sites 93% of the time.

Recently, a series of statistical and simulation studies were conducted to evaluate and optimize the B-IBI (Alden et al., 2002). New sets of metric/ threshold combinations for the tidal freshwater and oligohaline habitats were also developed in these studies with a larger dataset than was available to Weisberg et al. (1997) for these two habitats. The results of Alden et al. (2002) indicated that the B-IBI is sensitive, stable, robust, and statistically sound.

Data used for the 2004 basin summary update were from single benthic grab samples (440 cm^2 surface area, 0.5-mm screen) collected 1999-2003 from randomly selected sites within the Maryland portion of the Chesapeake Bay. Results from trend analyses of samples collected 1985-2003 at 22 long-term monitoring stations (three replicate samples per station) are also reported. Samples were sorted, enumerated, and identified to the lowest possible taxon. Ash-free dry weight biomass was determined for each taxon. The B-IBI was calculated for each sample and benthic community condition was classified in two ways.

For probabilistic segment-wide assessments, benthic community condition was classified as either degraded, non-degraded, or of intermediate/indeterminate quality, as recommended by Alden et al. (2002). Using the original index development datasets of Weisberg et al. (1997), bootstrap simulations were used to determine 90% confidence intervals for the B-IBI. This was done separately for reference and degraded samples for each of the seven habitat types defined by the benthic monitoring program. These confidence intervals defined three categories: "non-degraded", for samples with B-IBI values falling above the lower confidence limit of the reference dataset but above the upper confidence limit of the degraded dataset; "degraded", for samples with B-IBI values falling below the upper confidence limit of the degraded dataset and below the lower confidence limit of the reference dataset; and "indeterminate" for samples with B-IBI values falling within the range of overlap of the confidence intervals of the two datasets. Where there was no overlap, index values falling between the confidence limits of the two datasets were defined as of "intermediate" quality. This approach was taken because it produces more reliable assessments of degradation with fewer Type I errors (false alarms).

For fixed-site trend analyses, benthic community condition was classified into the four condition levels currently used by the benthic monitoring program: “meets goal” (non-degraded benthic communities with B-IBI $\geq$ 3.0), marginal (B-IBI = 2.7-2.9), degraded (B-IBI = 2.1-2.6), and severely degraded (B-IBI $\leq$ 2.0).

Probability estimates for any one segment were obtained by multiplying by 100 the proportions of samples falling within each of the three condition categories (“non-degraded,” “degraded” and “intermediate/indeterminate”) discussed above. Probability estimates and 90% confidence intervals were adjusted for segments with $\geq$ 5 samples as recommended by Agresti and Caffo (2000). Adjusted confidence intervals tend to perform better than standard confidence intervals, and cover the true proportion close to the intended α level. For segments with < 5 samples, adjusted probabilities were calculated but exact confidence intervals were used. Probability estimates and confidence intervals are for the binomial distribution. Therefore, these should be viewed as distinguishing between the condition category and “otherwise” (i.e, degraded vs. otherwise; non-degraded vs. otherwise; intermediate/indeterminate vs. otherwise). Consequently, probabilities do not add to 100%. It should be kept in mind that low sample size results in wide confidence intervals and low confidence in the estimates.

2.0 SUMMARIES

2.1 UPPER WESTERN SHORE BASIN TRIBUTARIES

Benthic communities in upper western shore basin tributaries were only moderately degraded for the period 1999-2003. Probabilities of observing degraded benthos in these tributaries ranged from 38 to 41% (Table 1). The Middle River had the least number of degraded sites among the three tributaries. Good benthic community condition in the Middle River is consistent with observations of good water quality status for this river. The Gunpowder showed patterns of degradation over a large area. In contrast, the Bush River showed degradation in the upper reaches of the estuary. Degraded sites in the Bush River were numerically dominated by pollution tolerant organisms, mostly tubificid oligochaetes. This is consistent with excess algal growth and reduced water clarity in this region of the river.

2.2 LOWER WESTERN SHORE BASIN TRIBUTARIES

Benthic community condition in lower western shore basin tributaries for the period 1999-2003 was best in the Severn River and worst in the South and Magothy Rivers (Table 2). The Magothy River exhibited degradation in the upper two thirds of the estuary. Patterns of degradation appeared to respond to a mixture of over-enrichment and hypoxia. This is consistent with excess algal abundance and observations of low dissolved oxygen concentrations at the shallow, upstream water quality monitoring station.

The Severn River had surprisingly few degraded sites during the 1999-2003 period. This is in contrast with the previous 1995-2000 assessment where the probability of observing degraded benthos was > 50%. In the previous assessment, benthic community degradation in the Severn River was limited to the upper portion of the estuary, above the long term water quality station. Sites in this region of the river had few organisms or were azoic, which was consistent with severe hypoxia or anoxia problems. Data collected since 1999 shows predominately good benthic community condition, but the area of degradation has shifted to the middle portion of the estuary. A mid-river fixed monitoring station shows a degrading trend in the B-IBI (Table 3), which is consistent with a trend in declining bottom dissolved oxygen concentrations at the water quality monitoring station. The South, Rhode, and West Rivers exhibited patterns of degradation predominately due to excess abundance indicative of over-enrichment, consistent with excess algal abundance and reduced water clarity in these three tributaries. Probabilities of degradation were relatively large for the Rhode and West Rivers, but the confidence of the estimates was low (i.e., the confidence intervals were broad, Table 2).

2.3 UPPER EASTERN SHORE BASIN TRIBUTARIES

During the period 1999-2003, the Northeast River, Bohemia River, Sassafras River, and Eastern Bay were in worst condition, with a > 50% probability of observing degraded benthos (Table 4). Benthic community condition in the Elk River was largely indeterminate, but not particularly degraded. Confidence intervals for these estimates were generally broad (Table 4).

The Chester River oligohaline condition was largely indeterminate, and for the tidal freshwater region there were insufficient samples to produce any reliable estimate. The Chester River mesohaline region showed a relatively high probability of degraded benthos (48%, Table 4). Most of the sites with failing B-IBI were concentrated in the lower portion of the river, around Eastern Neck Island. Poor benthic community condition in this region could not be attributed to stress from low dissolved oxygen. Fifty percent of the sites in this region exhibited excess abundance of organisms, indicative of enriched conditions consistent with degrading trends in algal abundance and water clarity. A fixed long-term monitoring station located mid-river above the region where a majority of the probability sites failed, had good benthic community status and no significant trend in the B-IBI (Table 5).

The fixed station in the Elk River exhibited a significant positive trend in the B-IBI, but marginally degraded benthic community in 2003 (Table 5). The improving trend was associated with a decrease in the abundance of oligochaete worms and an overall increase in the density of bivalves. Improving trends in the Elk River are reported for algal abundance and the status of most water quality parameters is good. Benthic community dynamics in the Elk River are probably influenced by over-enrichment resulting from algal growth, but also by patterns in river flow and the associated salinity fluctuations.

2.4 CHOPTANK RIVER BASIN

Overall, the Choptank River had good benthic community condition during the 1999-2003 period. However, some degradation was noted in the mesohaline portion of the estuary. About 50% of the sites sampled in the mesohaline region failed to meet the benthic community restoration goals (B-IBI < 3.0). Half of these samples were only mildly degraded, resulting in a relatively low probability of observing degraded benthos (Table 6). A long-term monitoring station in the lower mesohaline Choptank River indicated good benthic community condition and no significant trend in the B-IBI (Table 7). Degraded sites in the upper mesohaline portion of the river were located around the Cabin Creek area. Some of these sites exhibited excess abundance of organisms, which is usually associated with over-enrichment. This is consistent with observations of poor water quality and degrading trends in nitrogen and algal concentrations in this region of the river. Dissolved oxygen conditions at the time of the benthic sampling were good throughout the river. A long-term monitoring station in the upper oligohaline Choptank River indicated marginally degraded benthos with no significant trend in the B-IBI (Table 7).

2.5 LOWER EASTERN SHORE BASIN TRIBUTARIES

During the period 1999-2003, lower eastern shore basin tributaries exhibited good overall benthic community condition. Condition was best in Fishing Bay, the mesohaline portion of the Nanticoke River, the Manokin River, and the Big Annemessex River. Probabilities of observing good benthos in these systems were greater than 50%, with the lower bound of the confidence interval above 25% (Table 8). Benthic community condition was worse in the Pocomoke River. In Tangier Sound and Pocomoke Sound condition was of intermediate quality. Forty-four percent of all sites in these two systems failed the restoration goals (B-IBI < 3), but many of the failing sites were only marginally degraded. This is reflected in the relatively high probabilities of observing benthos of intermediate quality in these two systems (Table 8).

Low biomass relative to reference conditions is a problem affecting lower eastern shore basin tributaries. Fifty percent or more of the sites in the Wicomico River, Manokin River, Big Annemessex River, Tangier Sound, and Pocomoke Sound exhibited low biomass during the period 1999-2003. A fixed long-term monitoring station in the Nanticoke River exhibited a degrading trend in the B-IBI, and significant degrading trends in biomass and species diversity (Table 9). The major problem affecting water quality in the lower eastern shore basin is high sediment loads, which may reduce the amount of food that is available from the water column to the benthos. High river flows in 2003 may have exacerbated the high sediment load problem.

2.6 PATAPSCO/BACK RIVER BASIN

Benthic community condition in the Patapsco River estuary for the period 1999-2003 was mostly degraded. The probability of observing degraded benthos was 62% with good confidence (Table 10). Severely degraded condition occurred in the upper portion of the estuary, above the Francis Scott Key Bridge and at sites in Curtis Creek, Stony Creek, and along the deep channel south of Sparrows Point. These areas are affected by very low dissolved oxygen concentrations and toxic contamination. Excess abundance indicating eutrophic conditions was common in the lower portion of the estuary in areas that are not typically affected by hypoxia. In a study conducted by Ranasinghe et al. (1994) benthic community degradation in the Patapsco River was inversely correlated with trace metal concentrations, and in laboratory bioassays sediments from Bear Creek were significantly toxic to the amphipod *Leptocheirus plumulosus* (Scott et al. 1991).

The Back River estuary showed moderately degraded benthic condition with total densities of organisms that were either within the good range or in excess of reference conditions, in agreement with pollution related to excess algal growth and high particulate organic deposition. In contrast to the Patapsco River, dissolved oxygen conditions in the Back River are usually good.

Fixed long-term monitoring stations in the Patapsco/Back River basin indicated degraded to severely degraded benthic community condition (Table 11), except for Station 23, which showed improvements in the last three years. No significant trends in the B-IBI were detected in 2003.

2.7 PATUXENT RIVER BASIN

During the period 1999-2003, benthic community condition in the Patuxent River was best in the oligohaline portion of the river, and worst in the tidal fresh and mesohaline regions (Table 12). Benthic degradation in the Patuxent River is mainly related to adverse effects from low dissolved oxygen. The intensity of summer hypoxic events varies annually, and this variability is reflected in the B-IBI. In the mesohaline Patuxent River, and over the 1995-2003 time series, there was a positive relationship between the percentage of samples failing the restoration goals (B-IBI < 3) and the frequency of low dissolved oxygen observations below 2 mg/L (Figure 1). Degradation was due primarily to low abundance, biomass, and species diversity, and to low biomass of species sensitive to pollution, which are typically representative of mature communities in the absence of low dissolved oxygen stress. One factor linked to hypoxia is the amount of decaying organic matter from algal blooms. Large algal concentrations are likely to result in more extensive hypoxia and increased benthic degradation. Consistent with poor water clarity and high algal concentrations, the lower Patuxent River shows a positive relationship between the percentage of samples with severely degraded benthic condition and average chlorophyll concentrations below the pycnocline (Llansó et al. 2004).

Benthic community status at Patuxent River fixed monitoring stations showed degraded conditions at Lyons Creek and Broomes Island in 2003, and good condition at Holland Cliff and Chalk Point (Table 13). At Holland Cliff, the magnitude of a degrading trend in the B-IBI continued to diminish with the 2003 data, giving signals of recovery at this station. In addition, a previous degrading trend through 2001 at Broomes Island was no longer significant in 2002 and 2003. Variable annual low dissolved oxygen events are likely to influence trend direction at this station. Station 74 is under the thermal influence of the Chalk Point power plant. However, no significant impacts on benthos from the thermal discharge have been documented to date. Likewise, an oil spill in Swanson Creek in April 2000 did not show impacts at the Chalk Point fixed station.

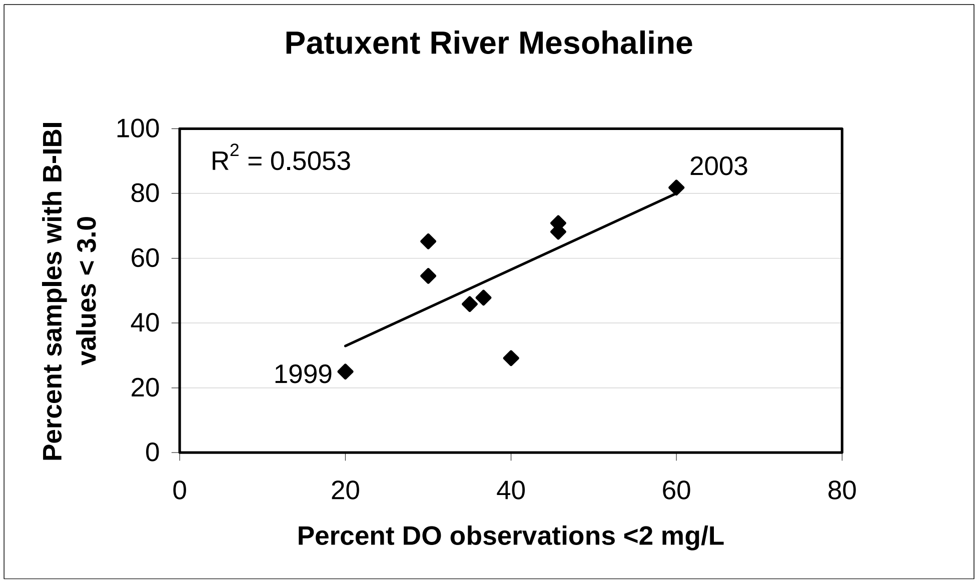

Figure 1. Relationship of benthic index of biotic integrity to percent dissolved oxygen observations below 2 mg/L (June-September) in the mesohaline Patuxent River. Each point represents a different year, 1995-2003. Dissolved oxygen data are fortnight near-bottom observations from Chesapeake Bay Water Quality Monitoring program stations RET1.1, and LE1.1 through LE1.4.

2.8 POTOMAC RIVER BASIN

For the period 1999-2003, benthic community condition was poor throughout the Potomac River estuary, but more so in the lower mesohaline than in the upper regions (Table 14). The probability of observing degraded benthos in the mesohaline region was 71% with good confidence. In the oligohaline and tidal fresh portions of the river, probabilities were 36 and 47%, although for a majority of samples benthic condition was classified as indeterminate (Table 14).

The Potomac River has one of the highest areas with degraded benthic community in the Chesapeake Bay. Much of the problem in the Potomac River is severe oxygen depletion in the lower deep mainstem. In 2003, the Potomac River had the highest percentage of sites among strata failing the restoration goals because of insufficient abundance or biomass. Unlike with the Patuxent River, no significant relationship is observed when the percent samples failing the restoration goals is plotted against the frequency of low dissolved oxygen observations below 2 mg/L. This is because hypoxia in the Potomac River is a perennial problem that affects waters below the pycnocline, with little inter-annual variability. Relationships between the B-IBI and dissolved oxygen in the Potomac River are best explored as a function of depth. The frequency of low dissolved oxygen events in the Potomac River is strongly associated with water depth, and so is the probability of observing severely degraded benthos (Llansó et al. 2004).

Of the seven fixed monitoring stations in the Potomac River, only two showed significant trends in the B-IBI in 2003 (Table 15). Station 44 at Morgantown exhibited a degrading trend, and Station 51 in shallow water near St. Clements Island exhibited an improving trend. Degrading trends in abundance, biomass, and diversity contributed to the observed B-IBI trend at Station 44. This station is on the slope of the deep channel of the Potomac River and may be affected by tilts of the pycnocline bringing episodic fluctuations in dissolved oxygen and salinity, which are likely to exert stress on the benthic community during the reproductive season. The improving trend at Station 51 is due to significant increases in diversity and the abundance of carnivore and omnivores and species sensitive to pollution. These changes may be indicative of improving water quality conditions in the shallow flanks of the lower Potomac River.

3.0 REFERENCES

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TABLES*

**For all tables: Probabilities adjusted according to Agresti and Caffo (2000). Confidence limits adjusted for segments with ≥ 5 sites. Exact confidence limits used for segments with < 5 sites.*

Table 1. Total number of sites, degraded sites, and probabilities (90% confidence limits) of observing degraded benthos, non-degraded benthos, or benthos of indeterminate condition for Upper Western Shore Basin tributaries, 1999-2003.

Segment	Tributary	Total No. Sites	No. Deg. Sites	P Deg.	P Non-deg.	P Indeter.
MIDOH	Middle	4	1	37.5 (1.3–75.1)	37.5 (1.3–75.1)	50.0 (9.8–90.2)
GUNOH	Gunpowder	13	5	41.2 (21.5–60.9)	17.6 (2.4–32.9)	52.9 (33.0–72.9)
BSHOH	Bush	9	3	38.5 (16.2–60.7)	15.4 (0–31.9)	61.5 (39.3–83.8)

Table 2. Total number of sites, degraded sites, and probabilities (90% confidence limits) of observing degraded benthos, non-degraded benthos, or benthos of intermediate condition for Lower Western Shore Basin tributaries, 1999-2003.

Segment	Tributary	Total No. Sites	No. Deg. Sites	P Deg.	P Non-deg.	P Interm.
MAGMH	Magothy	18	9	50.0 (32.4–67.6)	31.8 (15.4–48.2)	27.3 (11.6–42.9)
SEVMH	Severn	12	2	25.0 (7.1–42.9)	62.5 (42.5–82.5)	25.0 (7.1–42.9)
SOUMH	South	9	6	61.5 (39.3–83.8)	30.8 (9.6–51.9)	23.1 (3.8–42.4)
RHDMH	Rhode	4	2	50.0 (9.8–90.2)	37.5 (1.3–75.1)	37.5 (1.3–75.1)
WSTMH	West	3	1	42.9 (1.7–86.5)	57.1 (13.5–98.3)	28.6 (0–63.2)

Table 3. Trend in benthic community condition for the Severn River fixed station, 1985-2003. Trends were identified using the van Belle and Hughes (1984) procedure. Current mean B-IBI and condition based on 2001-2003 values. Initial mean B-IBI and condition based on 1995-1997 values.

Station[1]	Trend Significance	Median Slope (B-IBI units/yr)	Current Condition (2001-2003)	Initial Condition (1995-1997)
204, Severn River	p <0.05	–0.17	2.59 (Degraded)	3.67 (Meets Goal)

[1]Sta. 204, high mesohaline mud habitat, 39.006778 lat., 76.504683 long.

Table 4. Total number of sites, degraded sites, and probabilities (90% confidence limits) of observing degraded benthos, non-degraded benthos, or benthos of intermediate condition (indeterminate for low salinity habitats) for Maryland Upper Eastern Shore Basin tributaries, 1999-2003.

Segment	**Tributary**	**Total No. Sites**	**No. Deg. Sites**	**P Deg.**	**P Non-deg.**	**P Interm.**
NORTF	Northeast	4	3	62.5 (24.9–98.7)	25.0 (0–52.7)	37.5 (1.3–75.1)
ELKOH	Elk	6	1	30.0 (6.1–53.9)	30.0 (6.1–53.9)	60.0 (34.4–85.6)
BOHOH	Bohemia	2	2	66.7 (22.4–100)	33.3 (0–77.6)	33.3 (0–77.6)
SASOH	Sassafras	3	2	57.1 (13.5–98.3)	28.6 (0–63.2)	42.9 (1.7–86.5)
CHSTF	Chester tf.	1	1	60.0 (5–100)	40.0 (0–95)	40.0 (0–95)
CHSOH	Chester olg.	5	1	33.3 (7.4–59.3)	33.3 (7.4–59.3)	55.6 (28.2–82.9)
CHSMH	Chester mes.	38	18	47.6 (34.9–60.3)	38.1 (25.7–50.5)	19.0 (9.1–29.0)
EASMH	Eastern Bay	5	4	66.7 (40.7–92.6)	33.3 (7.4–59.3)	22.2 (0–45.1)

Table 5. Trends in benthic community condition for Maryland Upper Eastern Shore Basin fixed stations, 1985-2003. Trends were identified using the van Belle and Hughes (1984) procedure. Current mean B-IBI and condition based on 2001-2003 values. Initial mean B-IBI and condition based on 1985-1987 values. NS: not significant.

Station[1]	**Trend Significance**	**Median Slope (B-IBI units/yr)**	**Current Condition (2001-2003)**	**Initial Condition (1985-1987)**
29, Elk River	$p < 0.05$	0.02	2.68 (Marginal)	2.38 (Degraded)
68, Chester River	NS	0.00	3.40 (Meets Goal)	3.51 (Meets Goal)

[1]Sta. 29, oligohaline habitat, 39.479615 lat., 75.944499 long.
Sta. 68, low mesohaline habitat, 39.132941 lat., 76.078679 long.

Table 6. Total number of sites, degraded sites, and probabilities (90% confidence limits) of observing degraded benthos, non-degraded benthos, or benthos of intermediate condition (indeterminate for low salinity habitats) for the Choptank River Basin, 1999-2003.

Segment	Tributary	Total No. Sites	No. Deg. Sites	P Deg.	P Non-deg.	P Interm.
CHOOH	Choptank olg.	5	1	33.3 (7.4–59.3)	44.4 (17.1–71.8)	44.4 (17.1–71.8)
CHOMH2	Choptank mes.	17	6	38.1 (20.6–55.6)	42.9 (25.0–60.7)	28.6 (12.3–44.8)
CHOMH1	Choptank mes.	9	3	38.5 (16.2–60.7)	46.2 (23.3–69.0)	30.8 (9.6–51.9)

Table 7. Trends in benthic community condition for Choptank River Basin fixed stations, 1985-2003. Trends were identified using the van Belle and Hughes (1984) procedure. Current mean B-IBI and condition are based on 2001-2003 values. Initial mean B-IBI and condition are based on 1985-1987 values. NS: not significant.

Station[1]	Trend Significance	Median Slope (B-IBI units/yr)	Current Condition (2001-2003)	Initial Condition (1985-1987)
66, Upper Choptank	NS	0.00	2.73 (Marginal)	2.60 (Degraded)
64, Lower Choptank	NS	0.00	3.04 (Meets Goal)	2.78 (Marginal)

[1]Sta. 66, oligohaline habitat, 38.801447 lat., 75.921825 long.
Sta. 64, high mesohaline mud habitat, 38.590464 lat., 76.069340 long.

Table 8. Total number of sites, degraded sites, and probabilities (90% confidence limits) of observing degraded benthos, non-degraded benthos, or benthos of intermediate condition (indeterminate for low salinity habitats) for Maryland Lower Eastern Shore Basin tributaries, 1999-2003.

Segment	Tributary	Total No. Sites	No. Deg. Sites	P Deg.	P Non-deg.	P Interm.
NANTF	Nanticoke tf.	0	-	- -	- -	- -
NANOH	Nanticoke olg.	4	1	37.5 (1.3–75.1)	50.0 (9.8–90.2)	37.5 (1.3–75.1)
NANMH	Nanticoke mes.	11	3	33.3 (13.3–53.4)	53.3 (32.1–74.6)	26.7 (7.8–45.5)
FSBMH	Fishing Bay	5	2	44.4 (17.1–71.8)	55.6 (28.2–82.9)	22.2 (0–45.1)
WICMH	Wicomico	10	3	35.7 (14.6–56.8)	42.9 (21.0–64.7)	35.7 (14.6–56.8)
MANMH	Manokin	10	1	21.4 (3.3–39.5)	50.0 (28.0–72.0)	42.9 (21.0–64.7)
BIGMH	Big Annemessex	8	1	25.0 (4.4–45.6)	50.0 (26.2–73.8)	41.7 (18.2–65.1)
POCOH	Pocomoke	6	4	60.0 (34.4–85.6)	20.0 (0–40.9)	40.0 (14.4–65.6)
POCMH	Pocomoke Sound	10	2	28.6 (8.6–48.5)	28.6 (8.6–48.5)	57.1 (35.3–79.0)
TANMH	Tangier Sound	42	6	17.4 (8.2–26.6)	37.0 (25.2–48.7)	50.0 (37.8–62.2)

Table 9. Trend in benthic community condition for Nanticoke River Station 62, 1985-2003. Trends were identified using the van Belle and Hughes (1984) procedure. Current mean B-IBI and condition based on 2001-2003 values. Initial mean B-IBI and condition based on 1985-1987 values.

Station[1]	Trend Significance	Median Slope (B-IBI units/yr)	Current Condition (2001-2003)	Initial Condition (1985-1987)
62, Nanticoke River	$p < 0.05$	–0.03	3.00 (Meets Goal)	3.42 (Meets Goal)

[1]Sta. 62, low mesohaline habitat, 38.383952 lat., 75849988 long.

Table 10. Total number of sites, degraded sites, and probabilities (90% confidence limits) of observing degraded benthos, non-degraded benthos, or benthos of intermediate condition (indeterminate for low salinity habitats) for the Patapsco/Back River Basin, 1999-2003.

Segment	Tributary	Total No. Sites	No. Deg. Sites	P Deg.	P Non-deg.	P Interm.
PATMH	Patapsco	48	30	61.5 (50.4–72.7)	15.4 (7.1–23.6)	26.9 (16.8–37.1)
BACOH	Back	5	3	55.6 (28.2–82.9)	22.2 (0–45.1)	44.4 (17.1–71.8)

Table 11. Trends in benthic community condition for Patapsco and Back River fixed stations, 1985-2003. Trends were identified using the van Belle and Hughes (1984) procedure. Current mean B-IBI and condition based on 2001-2003 values. Initial mean B-IBI and condition based on 1985-1987 values for Sta. 22 and 23, 1989-1991 values for Sta. 201 and 202, and 1995-1997 values for Sta. 203. NS: not significant.

Station[1]	Trend Significance	Median Slope (B-IBI units/yr)	Current Condition (2001-2003)	Initial Condition (See heading)
22, Middle Branch	NS	0.00	1.76 (Severely Degr.)	2.08 (Degraded)
23, Patapsco River	NS	0.00	3.00 (Meets Goal)	2.49 (Degraded)
201, Bear Creek	NS	0.00	1.49 (Severely Degr.)	1.10 (Severely Degr.)
202, Curtis Bay	NS	0.00	1.89 (Severely Degr.)	1.40 (Severely Degr.)
203, Back River	NS	0.02	2.07 (Degraded)	2.08 (Degraded)

[1]Sta. 22, low mesohaline habitat, 39.254940 lat., 76.587354 long.
Sta. 23, low mesohaline habitat, 39.208275 lat., 76.523352 long.
Sta. 201, low mesohaline habitat, 39.234275 lat., 76.497184 long.
Sta. 202, low mesohaline habitat, 39.217940 lat., 76.563853 long.
Sta. 203, oligohaline habitat, 39.275107 lat., 76.446015 long.

Table 12. Total number of sites, degraded sites, and probabilities (90% confidence limits) of observing degraded benthos, non-degraded benthos, or benthos of intermediate condition (indeterminate for low salinity habitats) for the Patuxent River Basin, 1999-2003.

Segment	Tributary	Total No. Sites	No. Deg. Sites	P Deg.	P Non-deg.	P Interm.
PAXTF	Patuxent tf.	5	3	55.6 (28.2–85.9)	22.2 (0–45.1)	44.4 (17.1–71.8)
PAXOH	Patuxent olg.	13	3	29.4 (11.2–47.6)	47.1 (27.1–67.0)	35.3 (16.2–54.4)
PAXMH	Patuxent mes.	107	51	47.7 (39.9–55.6)	35.1 (27.7–42.6)	18.9 (12.8–25.1)

Table 13. Trends in benthic community condition for Patuxent River Basin fixed stations, 1985-2003. Trends were identified using the van Belle and Hughes (1984) procedure. Current mean B-IBI and condition based on 2001-2003 values. Initial mean B-IBI and condition based on 1985-1987 values. NS: not significant.

Station[1]	Trend Significance	Median Slope (B-IBI units/yr)	Current Condition (2001-2003)	Initial Condition (1985-1987)
79, Lyons Creek	NS	0.00	2.39 (Degraded)	2.75 (Marginal)
77, Holland Cliff	$p < 0.1$	–0.07	3.40 (Meets Goal)	3.76 (Meets Goal)
74, Chalk Point	NS	0.00	3.44 (Meets Goal)	3.78 (Meets Goal)
71, Broomes Island	NS	0.00	2.33 (Degraded)	2.59 (Degraded)

[1]Sta. 79, tidal freshwater, 38.750448 lat., 76.689020 long.
Sta. 77, low mesohaline, 38.604452 lat., 76.675017 long.
Sta. 74, low mesohaline, 38.547288 lat., 76.674851 long.
Sta. 71, high mesohaline mud, 38.395124 lat., 76.548844 long.

Table 14. Total number of sites, degraded sites, and probabilities (90% confidence limits) of observing degraded benthos, non-degraded benthos, or benthos of intermediate condition (indeterminate for low salinity habitats) for the Potomac River Basin, 1999-2003.

Segment	Tributary	Total No. Sites	No. Deg. Sites	P Deg.	P Non-deg.	P Interm.
POTTF	Potomac tf.	11	5	46.7 (25.4–67.9)	13.3 (0–27.8)	53.3 (32.1–74.6)
POTOH	Potomac olg.	21	7	36.0 (20.2–51.8)	32.0 (16.6–47.4)	40.0 (23.8–56.2)
POTMH	Potomac mes.	92	66	70.8 (63.2–78.5)	15.6 (9.5–21.7)	15.6 (9.5–21.7)

Table 15. Trends in benthic community condition for Potomac River Basin fixed stations, 1985-2003. Trends were identified using the van Belle and Hughes (1984) procedure. Current mean B-IBI and condition based on 1991-2003 values. Initial mean B-IBI and condition are based on 1985-1987 values. NS: not significant.

Station[1]	Trend Significance	Median Slope (B-IBI units/yr)	Current Condition (2001-2003)	Initial Condition (1985-1987)
36, Rosier Bluff	NS	0.07	2.17 (Degraded)	3.20 (Meets Goal)
40, Maryland Point	NS	0.00	2.79 (Marginal)	2.80 (Marginal)
43, Morgantown	NS	0.00	3.67 (Meets Goal)	3.76 (Meets Goal)
44, Morgantown	$p < 0.05$	–0.04	1.84 (Severely Degr.)	2.80 (Marginal)
47, Morgantown	NS	0.00	3.53 (Meets Goal)	3.89 (Meets Goal)
51, St. Clements Isl.	$p < 0.001$	0.04	2.96 (Marginal)	2.43 (Degraded)
52, St. Clements Isl.	NS	0.00	1.22 (Severely Degr.)	1.37 (Severely Degr.)

[1]Sta. 36, tidal freshwater, 38.769781 lat., 77.037531 long.
Sta. 40, oligohaline, 38.357458 lat., 77.230534 long.
Sta. 43, low mesohaline, 38.384125 lat., 76.989028 long.
Sta. 44, low mesohaline, 38.385625 lat., 76.984695 long.
Sta. 47, low mesohaline, 38.365125 lat., 76.984695 long.
Sta. 51, high mesohaline sand, 38.205462 lat., 76.738020 long.
Sta. 52, high mesohaline mud, 38.192297 lat., 76.747687 long.