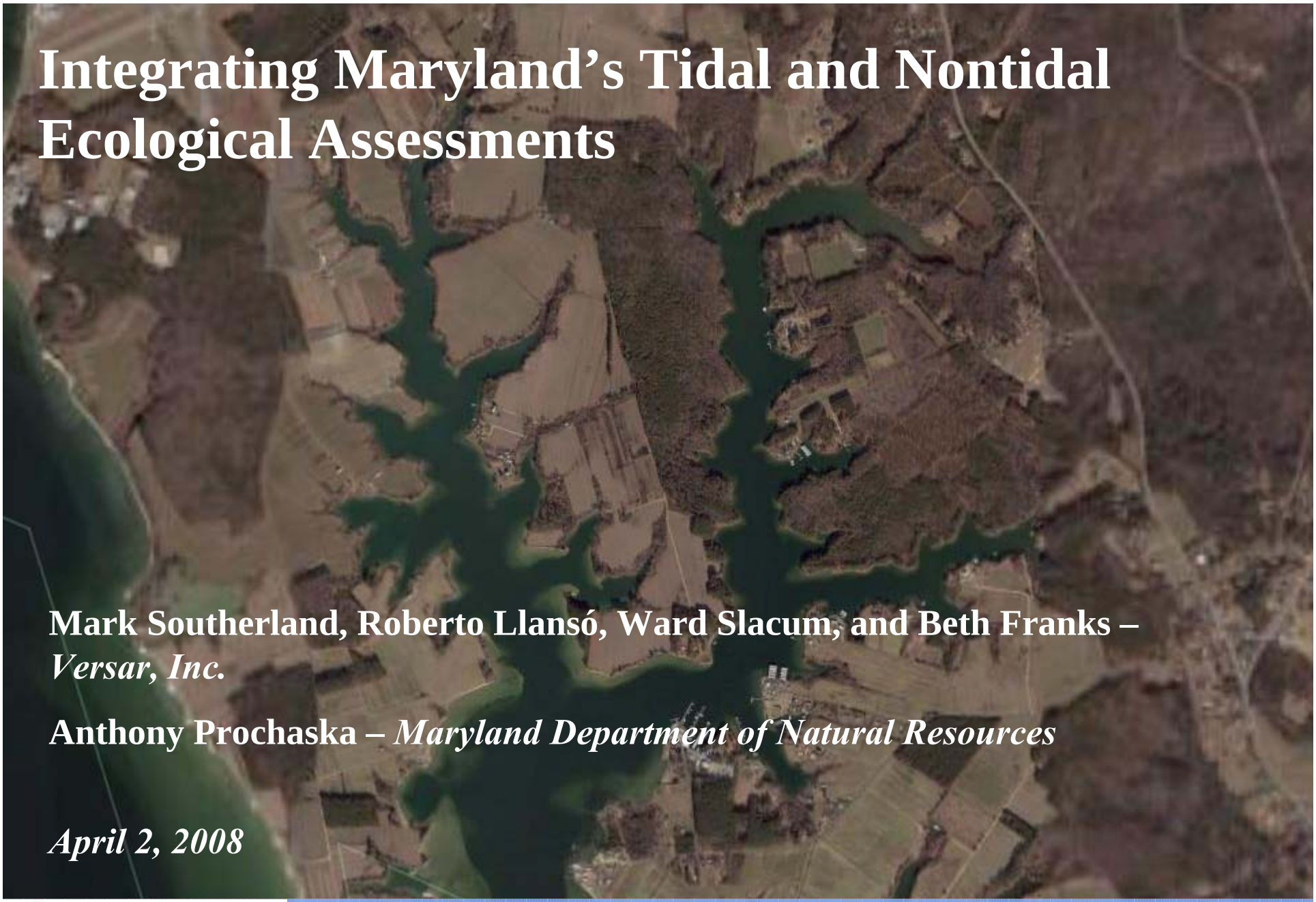
# Integrating Maryland's Tidal and Nontidal Ecological Assessments



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MARYLAND DEPARTMENT OF NATURAL RESOURCES

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# Outline

- Need for integrated assessments
- MBSS and LTB as long-term monitoring programs
- Comparability of current assessments
- Gaps in assessing Maryland's waters
- Future of integrated assessments

# Need for Integrated Assessments

- Clean Water Act requires assessment of all waters
- Chesapeake Bay restoration is based on Tributary Strategies
- Water resource managers must look upstream
- Setting priorities requires comparable assessments

# MBSS and LTB

- Maryland Biological Stream Survey
  - Nontidal stream sampling since 1994
  - Probability-based with 84 watershed primary sampling units (PSUs)
  - 300 sites per year in 3- and 5-year snapshots
  - Reference-based indicators for fish, benthic macroinvertebrates, stream salamanders
    - Good
    - Fair
    - Poor
    - Very Poor

# MBSS and LTB

- Maryland Biological Stream Survey
  - Synoptic reports every 5 years at scale of
    - 8-digit watersheds (average of 90 $mi^2$)
    - Trib basins
    - Counties
  - 305b biennial reports with pass-fail (10% of reference) by watershed
  - 303d listings of impaired waters using watershed means and confidence limits (proposed use of probability that number of stream miles degraded > 10% given confidence limit)

# MBSS and LTB

- Long-Term Benthic Monitoring Program
  - Tidal sampling since 1994
  - Probability-based with 6 strata
  - 150 sites per year within a moving average
  - Reference-based indicators for infaunal invertebrates
    - Meets goal
    - Marginally degraded
    - Degraded
    - Severely degraded

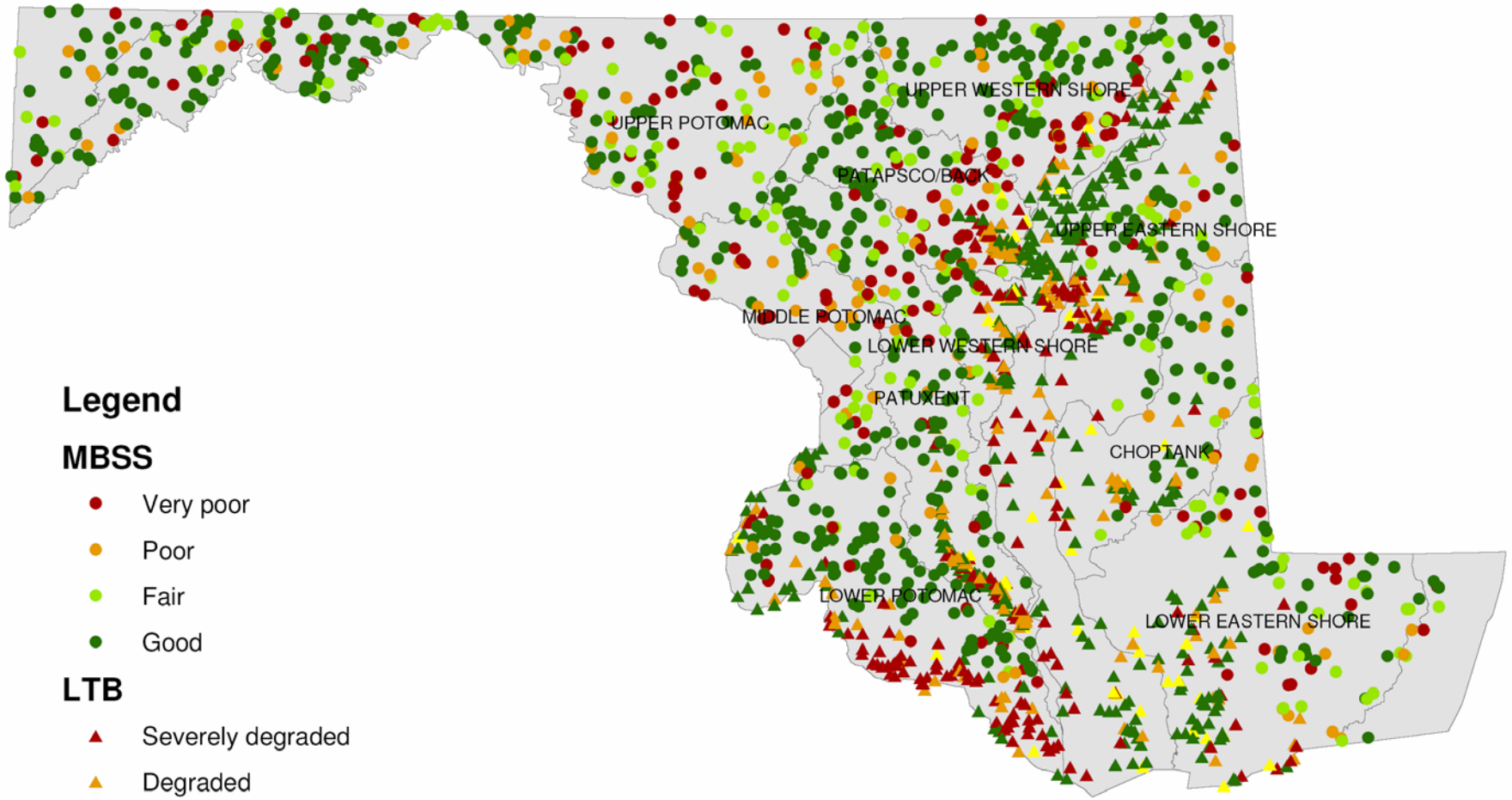
# MBSS and LTB

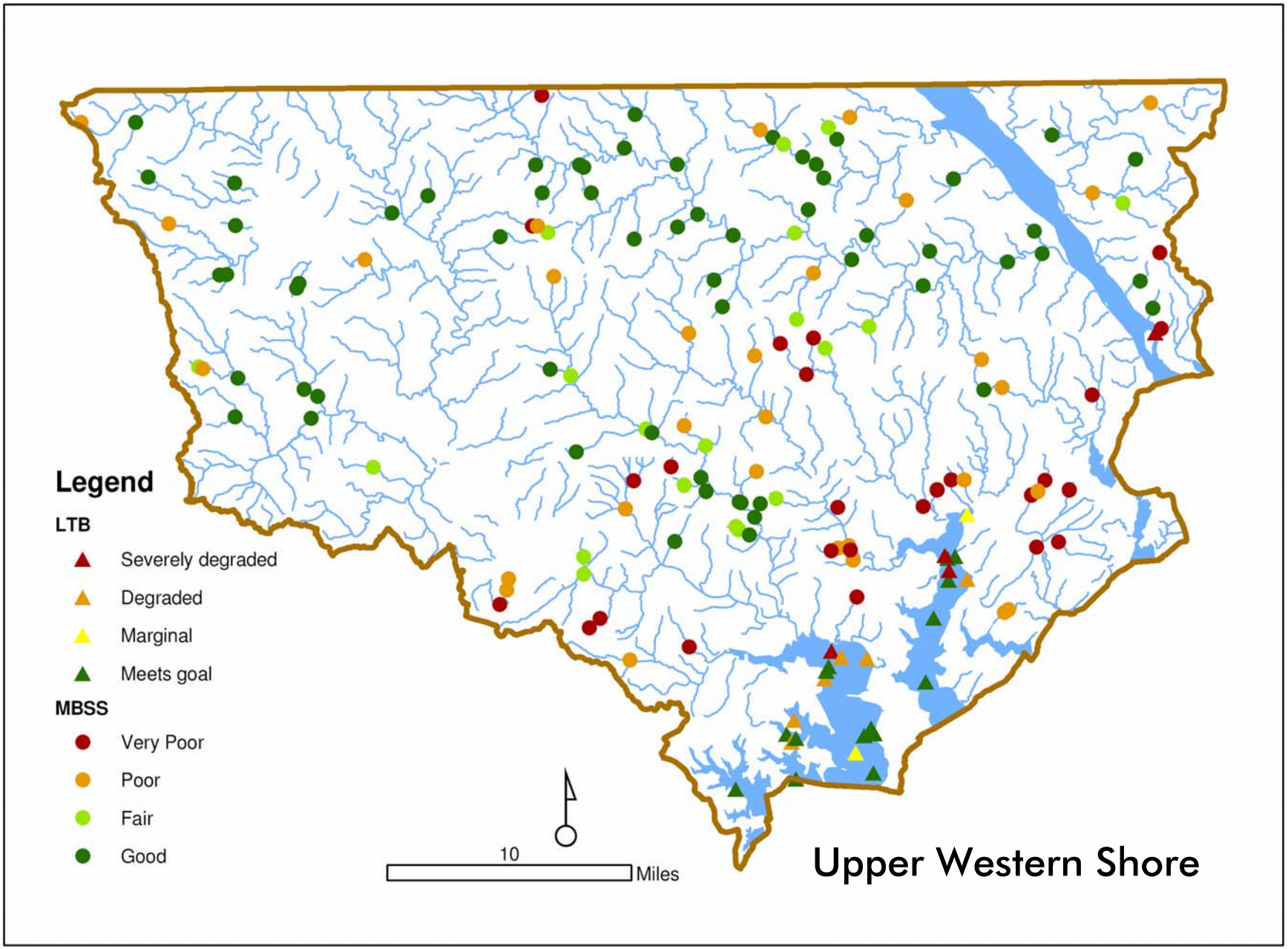
- Long-Term Benthic Monitoring Program
  - Annual report
  - State of Bay using 1 year of data with % pass-fail by 10 Trib Basins
  - 305b biennial report post-stratified by segment (MD half of 85) for % passing (failing ≤ 5% reference)
  - 303d listing uses a statistical test considering uncertainty that compares the % of area degraded with % expected in reference conditions

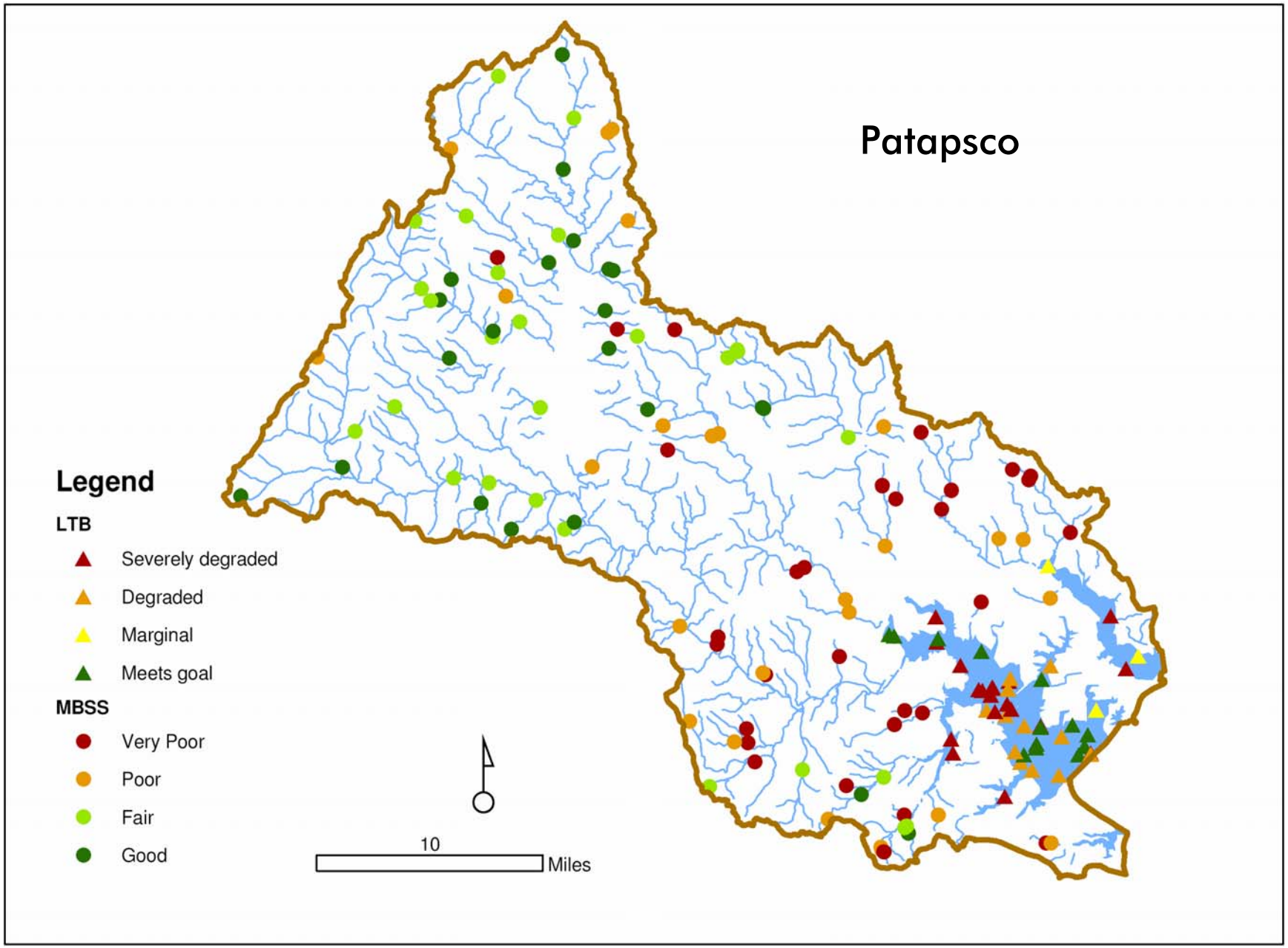
# Other Programs

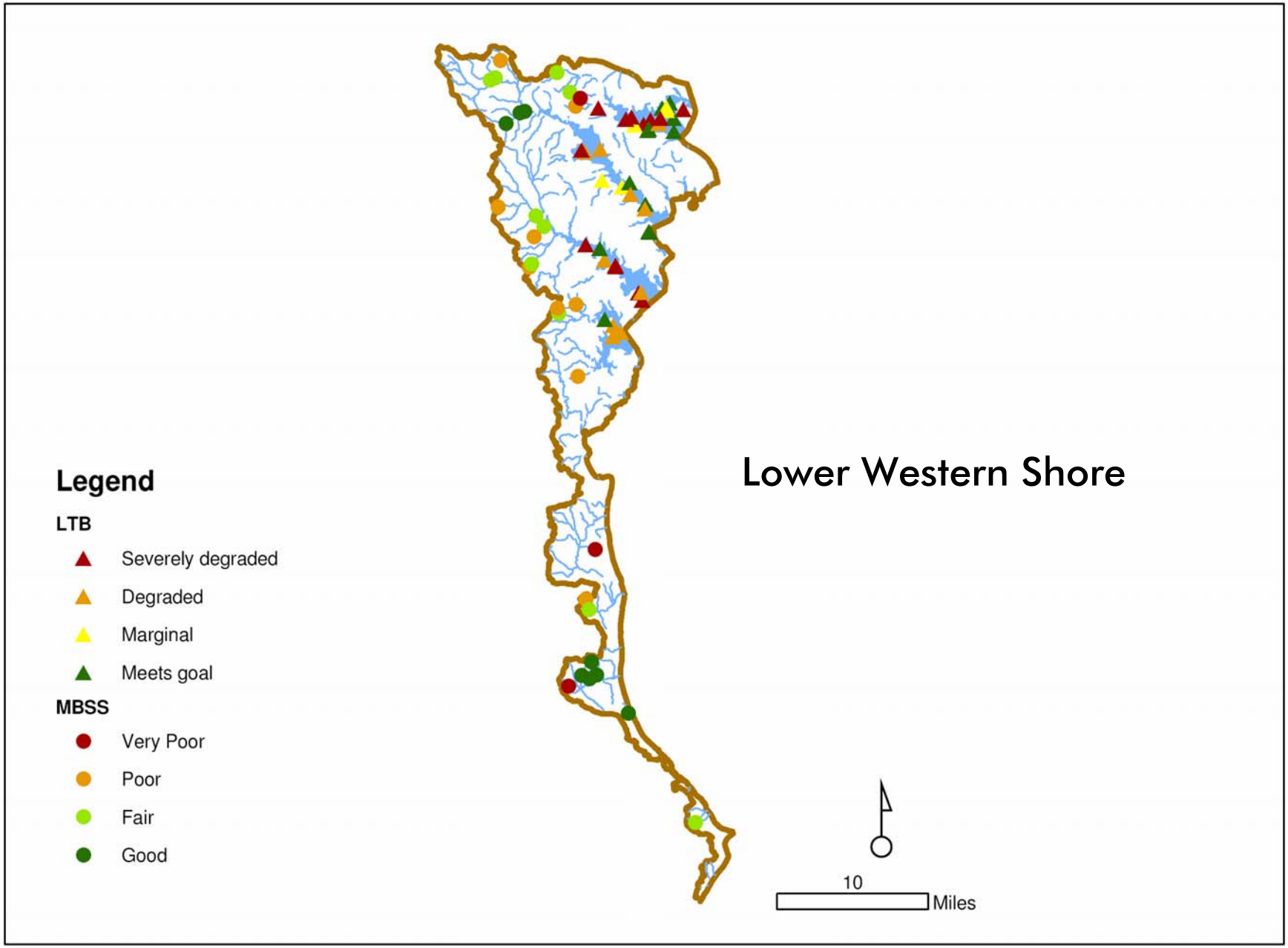
- Maryland Coastal Bays
  - 1990s synoptic assessment
  - 2000-2006 fixed site sampling with limited random sites
- Maryland's Eyes on the Bay
  - Fixed station monthly monitoring data
  - Continuous monitoring data
  - Water quality mapping data
- UMCES Integration & Application (IAN) Network
- NOAA integrated health assessment
- VA INSTAR and PA nontidal monitoring programs

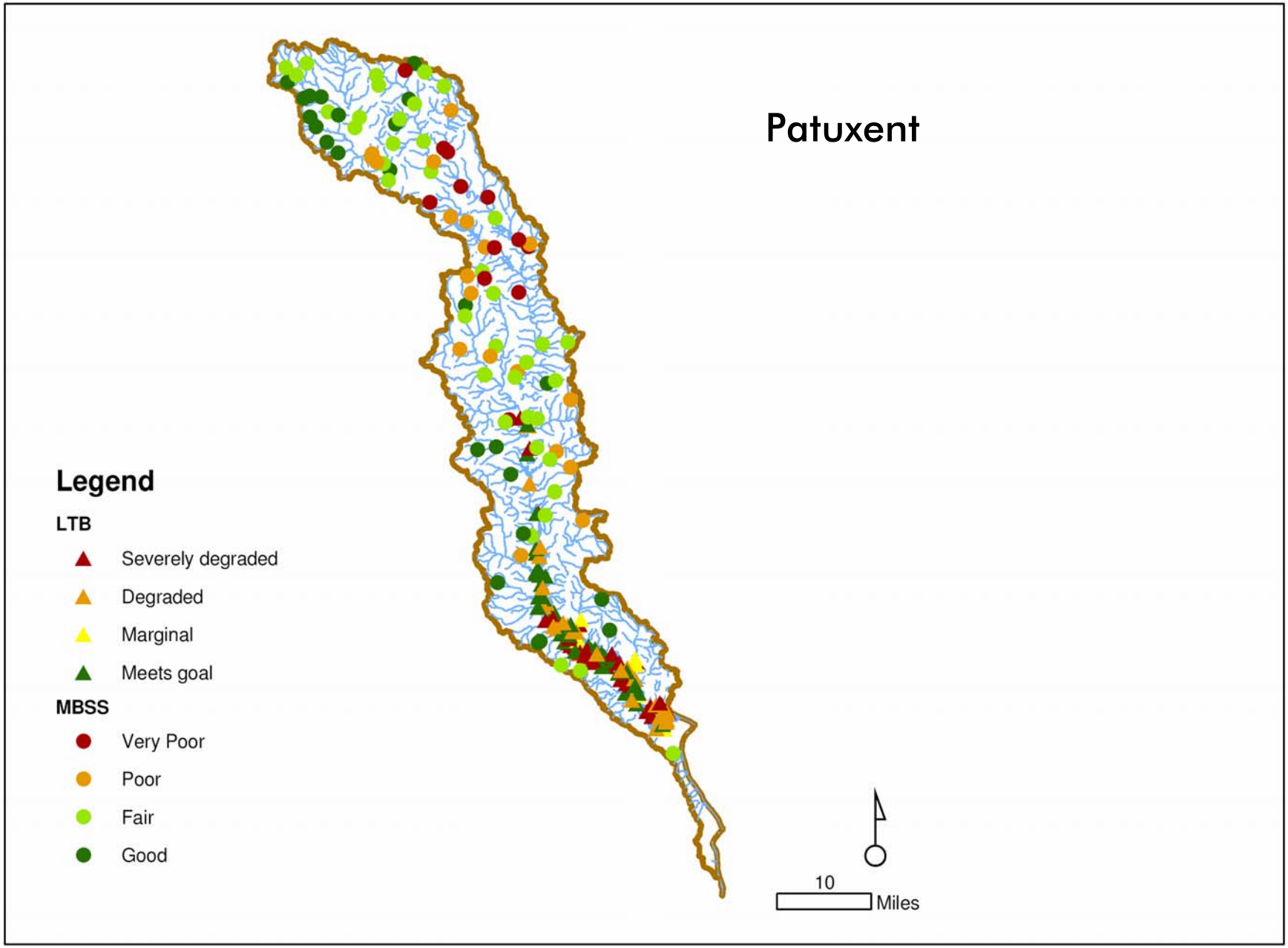
# 2000-2004

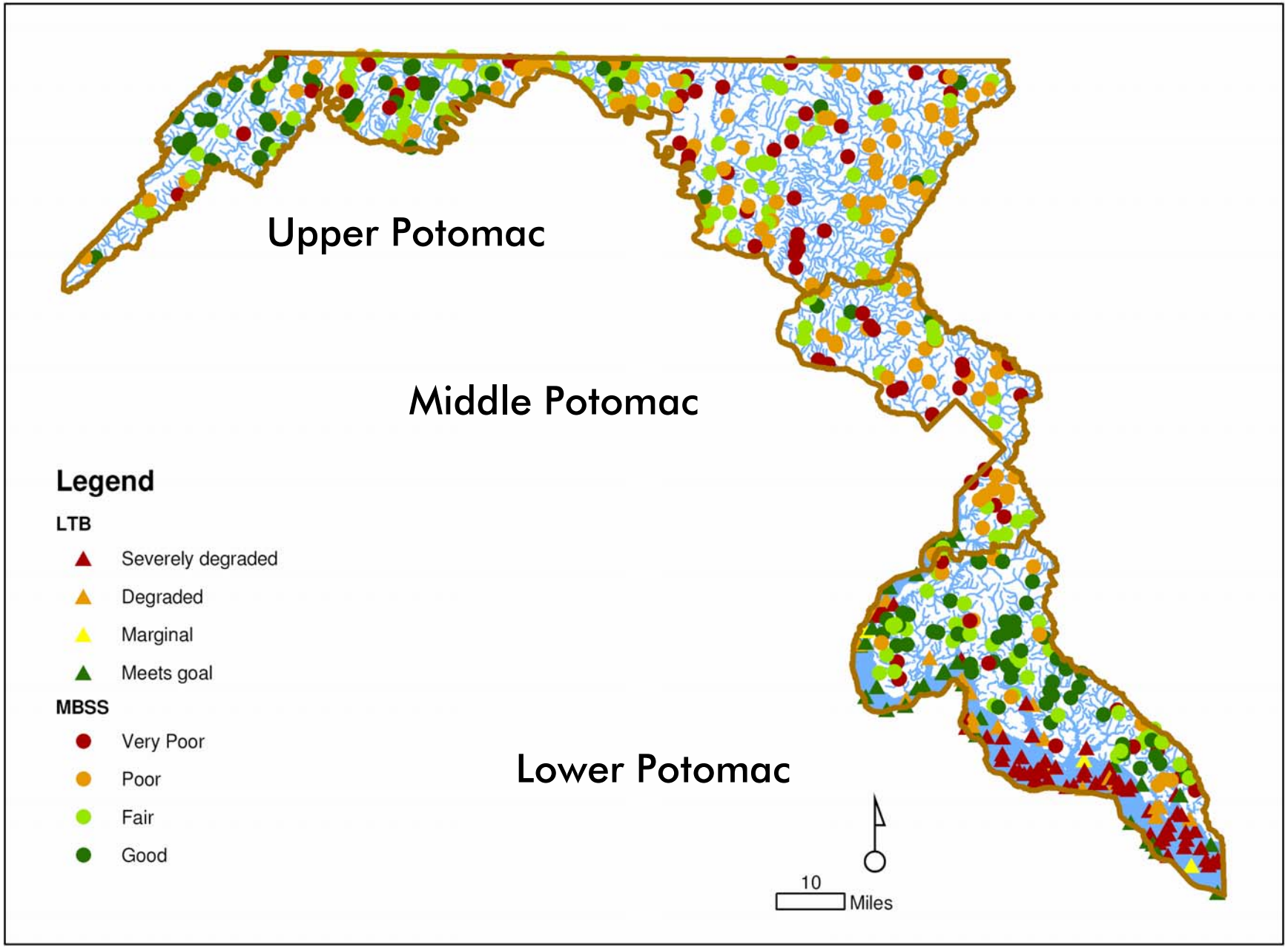

UPPER WESTERN SHORE
UPPER POTOMAC
PATAPSCO/BACK
UPPER EASTERN SHORE
MIDDLE POTOMAC
LOWER WESTERN SHORE
PATUXENT
CHOPTANK
LOWER POTOMAC
LOWER EASTERN SHORE
Legend
MBSS
Very poor
Poor
Fair
Good
LTB
Severely degraded
Degraded
Marginal
Meets goal


Legend
LTB
Severely degraded
Degraded
Marginal
Meets goal
MBSS
Very Poor
Poor
Fair
Good
10
Miles
Upper Western Shore

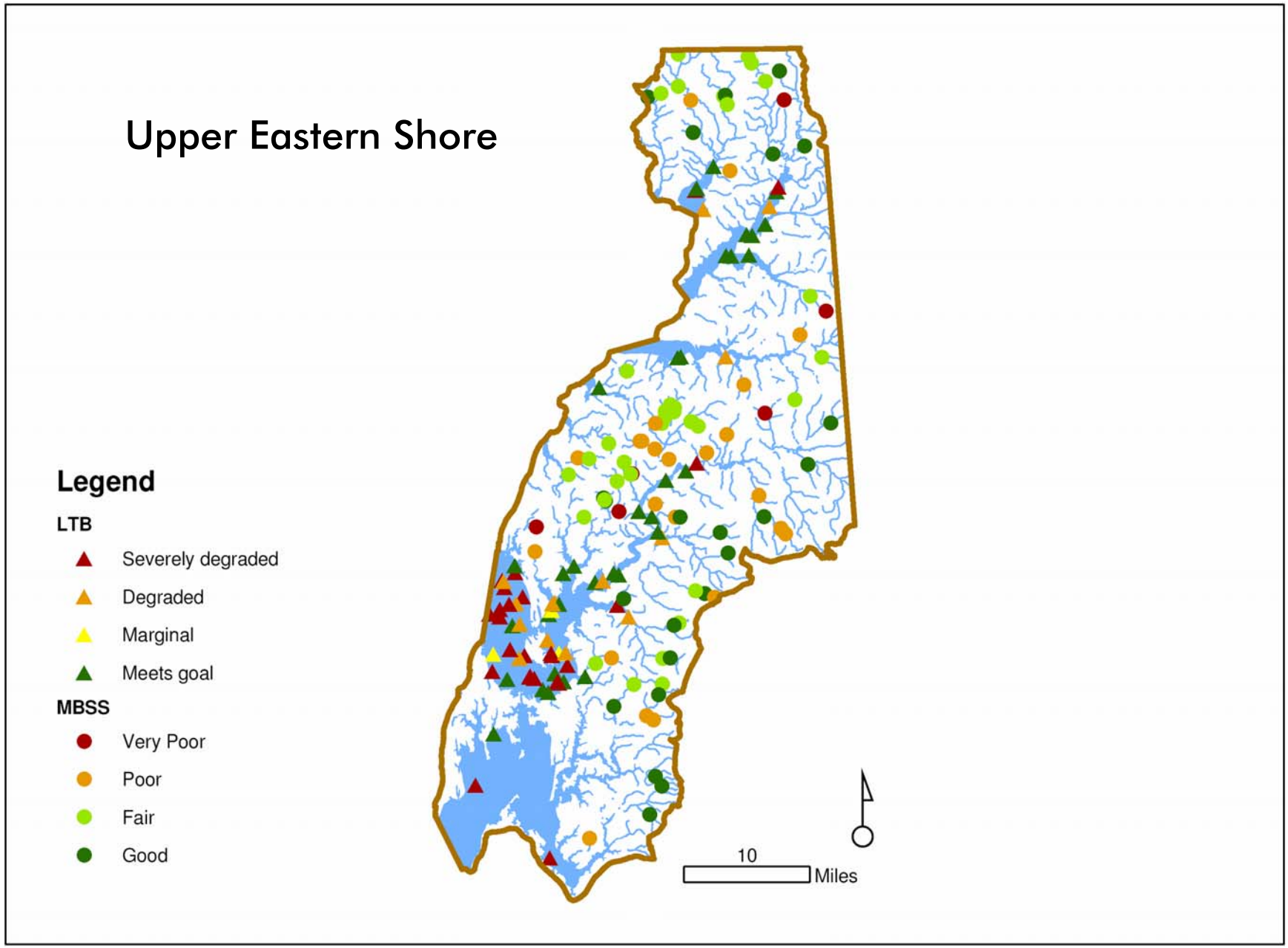

Patapsco
Legend
LTB
Severely degraded
Degraded
Marginal
Meets goal
MBSS
Very Poor
Poor
Fair
Good
10
Miles


Legend
LTB
Severely degraded
Degraded
Marginal
Meets goal
MBSS
Very Poor
Poor
Fair
Good
Lower Western Shore
10
Miles

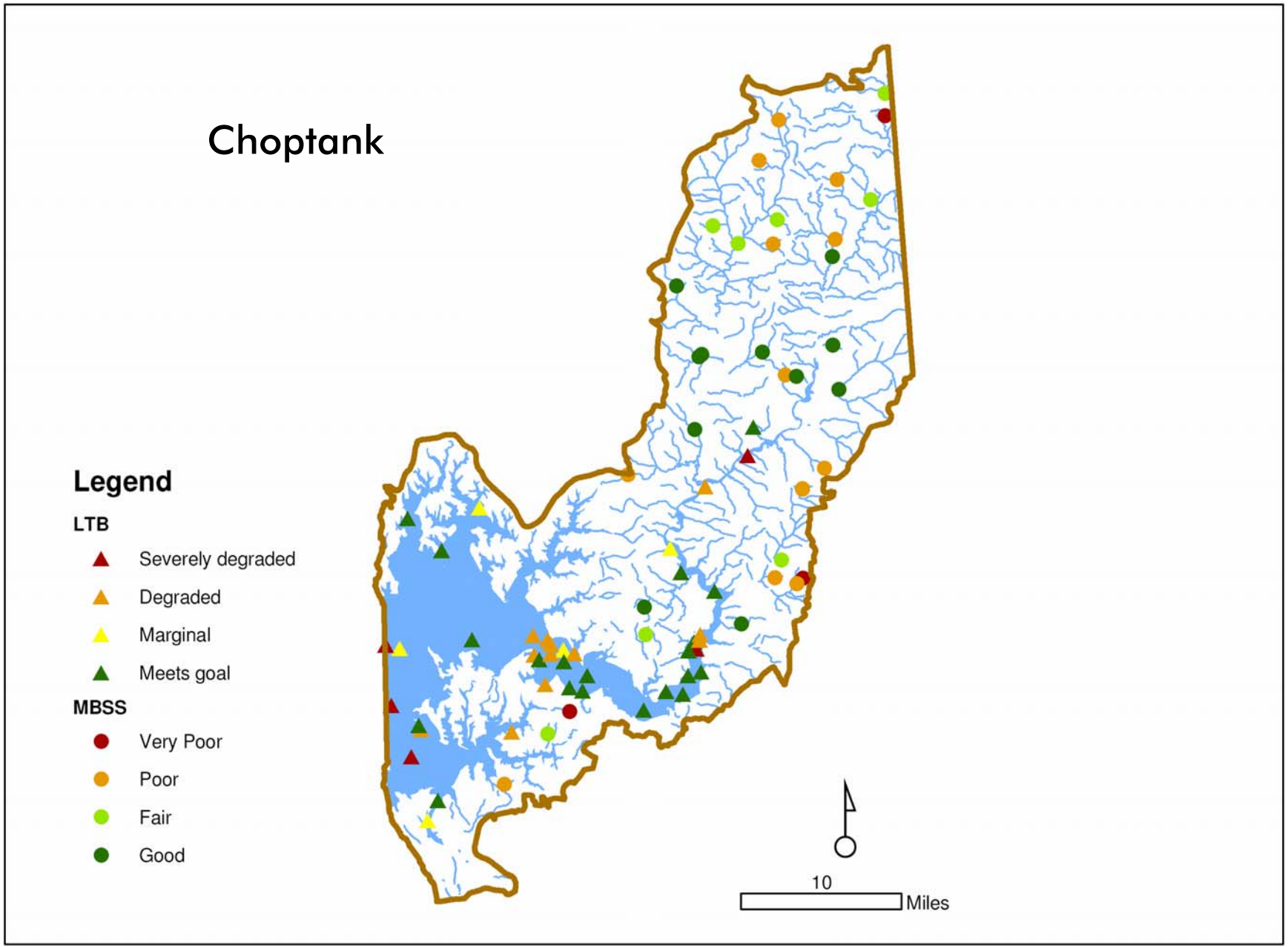

Patuxent
Legend
LTB
Severely degraded
Degraded
Marginal
Meets goal
MBSS
Very Poor
Poor
Fair
Good
10
Miles


Upper Potomac
Middle Potomac
Lower Potomac
Legend
LTB
Severely degraded
Degraded
Marginal
Meets goal
MBSS
Very Poor
Poor
Fair
Good
10
Miles

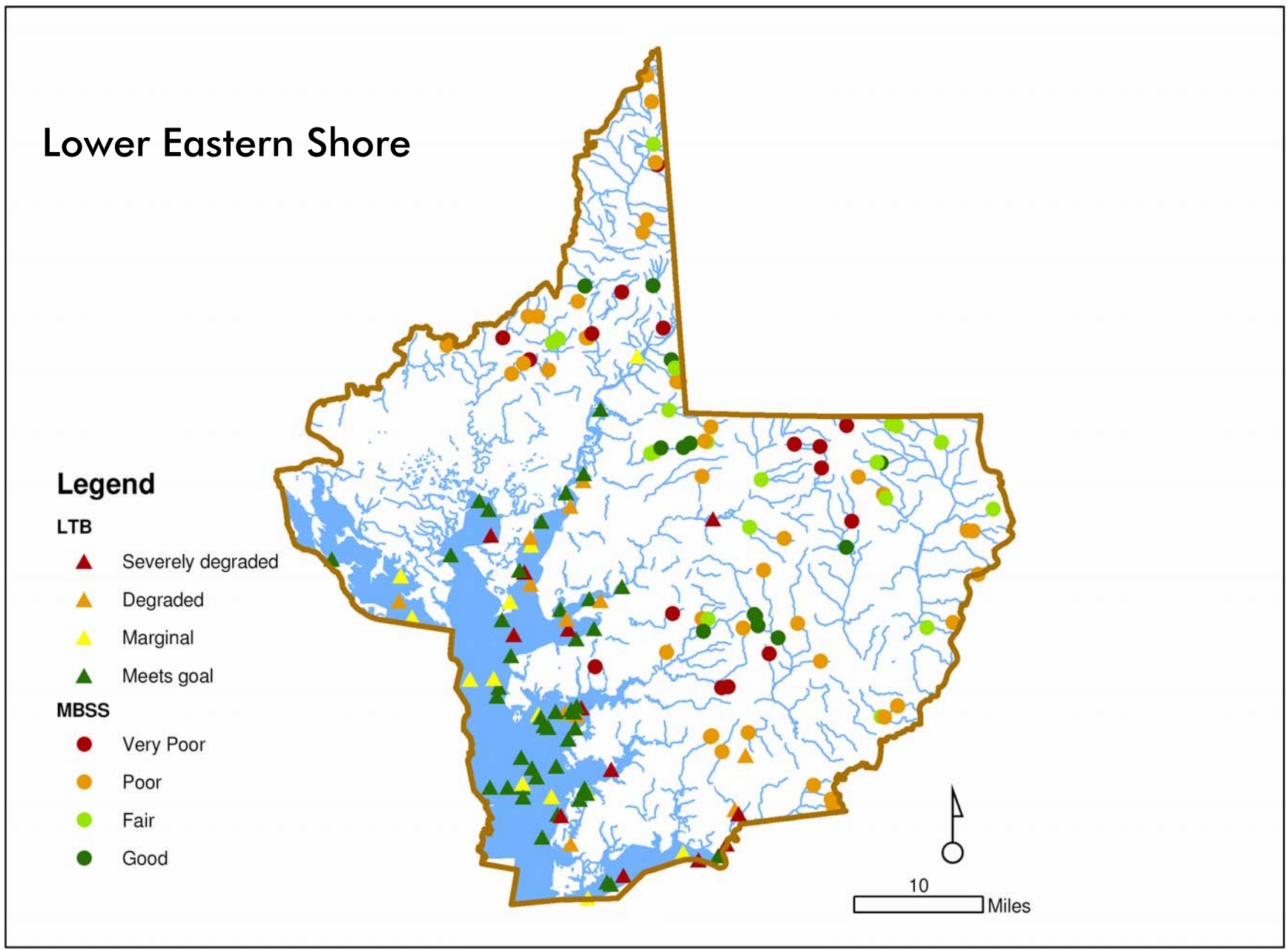
# Upper Eastern Shore

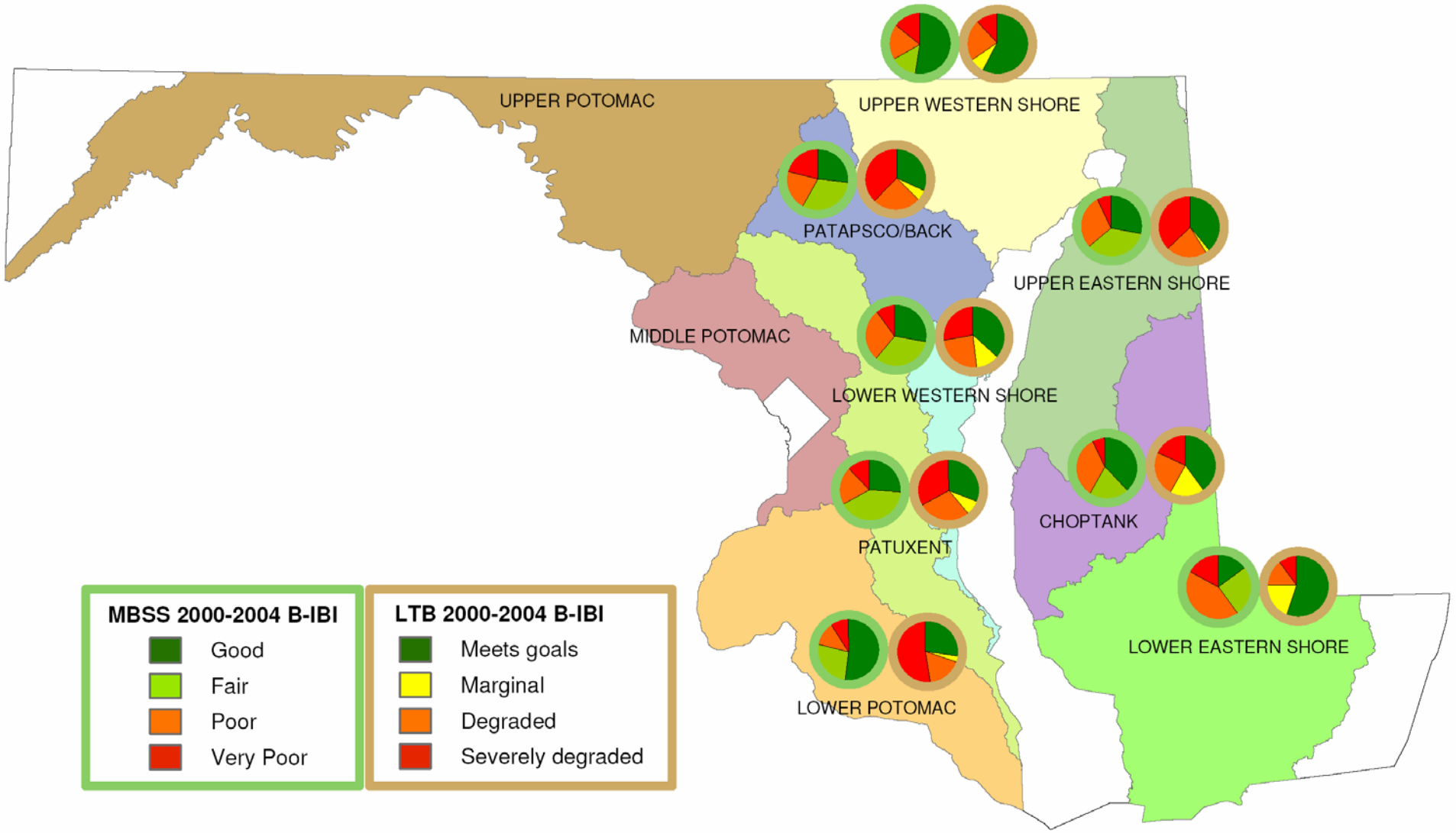


# Choptank


Legend
LTB
Severely degraded
Degraded
Marginal
Meets goal
MBSS
Very Poor
Poor
Fair
Good
10
Miles

# Lower Eastern Shore




UPPER POTOMAC
UPPER WESTERN SHORE
PATAPSCO/BACK
UPPER EASTERN SHORE
MIDDLE POTOMAC
LOWER WESTERN SHORE
CHOPTANK
PATUXENT
LOWER EASTERN SHORE
LOWER POTOMAC
MBSS 2000-2004 B-IBI
Good
Fair
Poor
Very Poor
LTB 2000-2004 B-IBI
Meets goals
Marginal
Degraded
Severely degraded

# Comparability of Assessments

**Percent Degraded 2000-2004**

| Tributary Strategy Basin | MBSS | LTB | Difference |
|---|---|---|---|
| CHOPTANK RIVER | 42% | 60% | -18% |
| LOWER EASTERN SHORE | 60% | 45% | 15% |
| LOWER POTOMAC RIVER | 21% | 72% | -51% |
| LOWER WESTERN SHORE | 39% | 63% | -24% |
| MIDDLE POTOMAC* | | | |
| OCEAN COASTAL** | | | |
| PATAPSCO/BACK | 42% | 69% | -27% |
| PATUXENT RIVER | 33% | 69% | -36% |
| UPPER EASTERN SHORE | 36% | 61% | -25% |
| UPPER POTOMAC* | | | |
| UPPER WESTERN SHORE | 33% | 43% | -10% |
| YOUGHIOGHENY RIVER** | | | |

*Partially included in LTB Lower Potomac
**Basins not sampled by LTB

# Reasons Assessments May Differ

- The assessment methods are not the same
  - Degradation threshold
  - Time period (2000-2004 in this analysis)
  - Spatial scale (Trib basin in this analysis)
- Gaps in waters are not sampled
- Unique situations in each watershed, such as
  - Extensive development in coastal zone
  - Well-protected coastal zone
  - Heavy upstream loading
  - Unique natural conditions (e.g., deep waters)

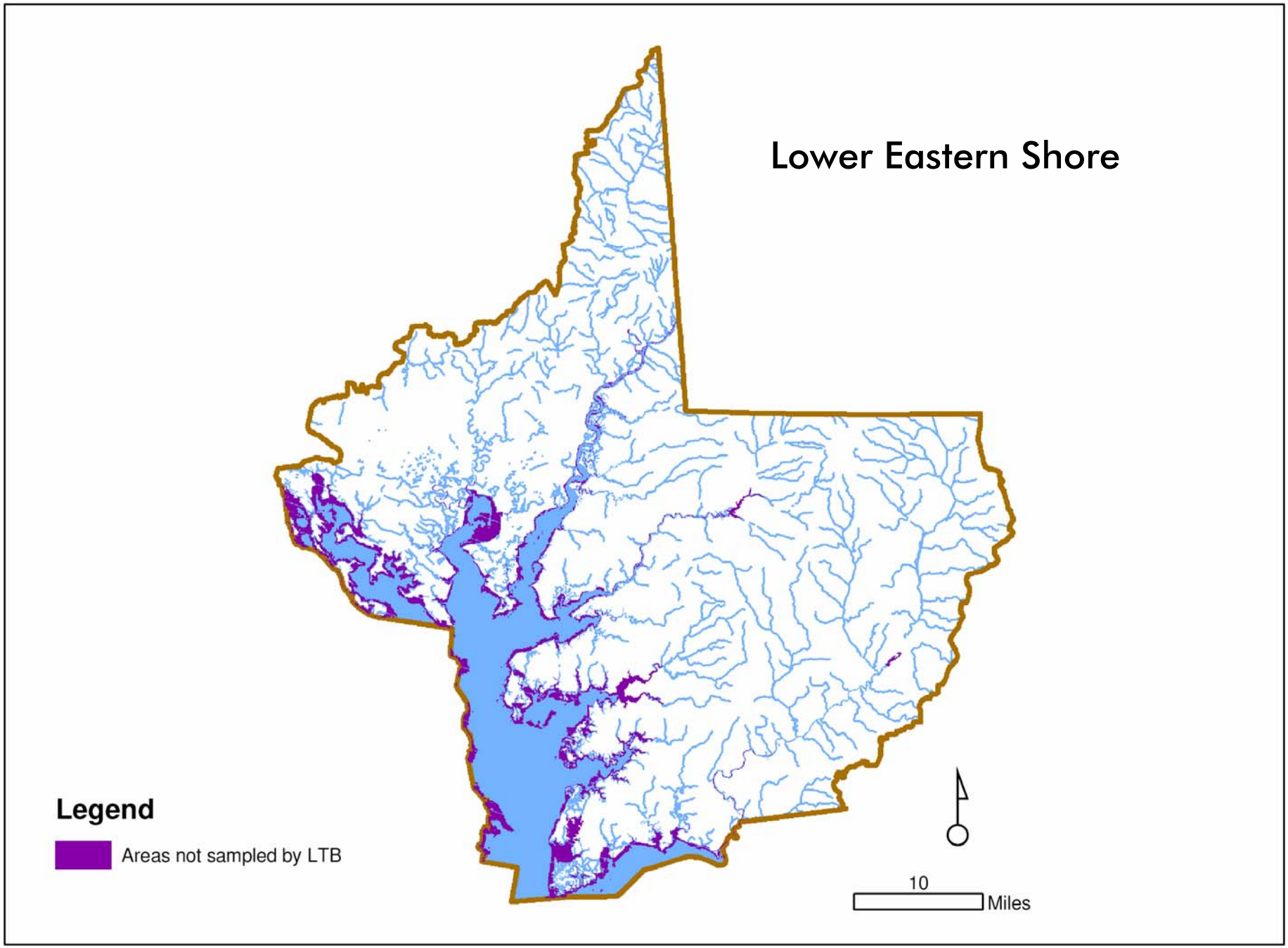
# Comparable Methods

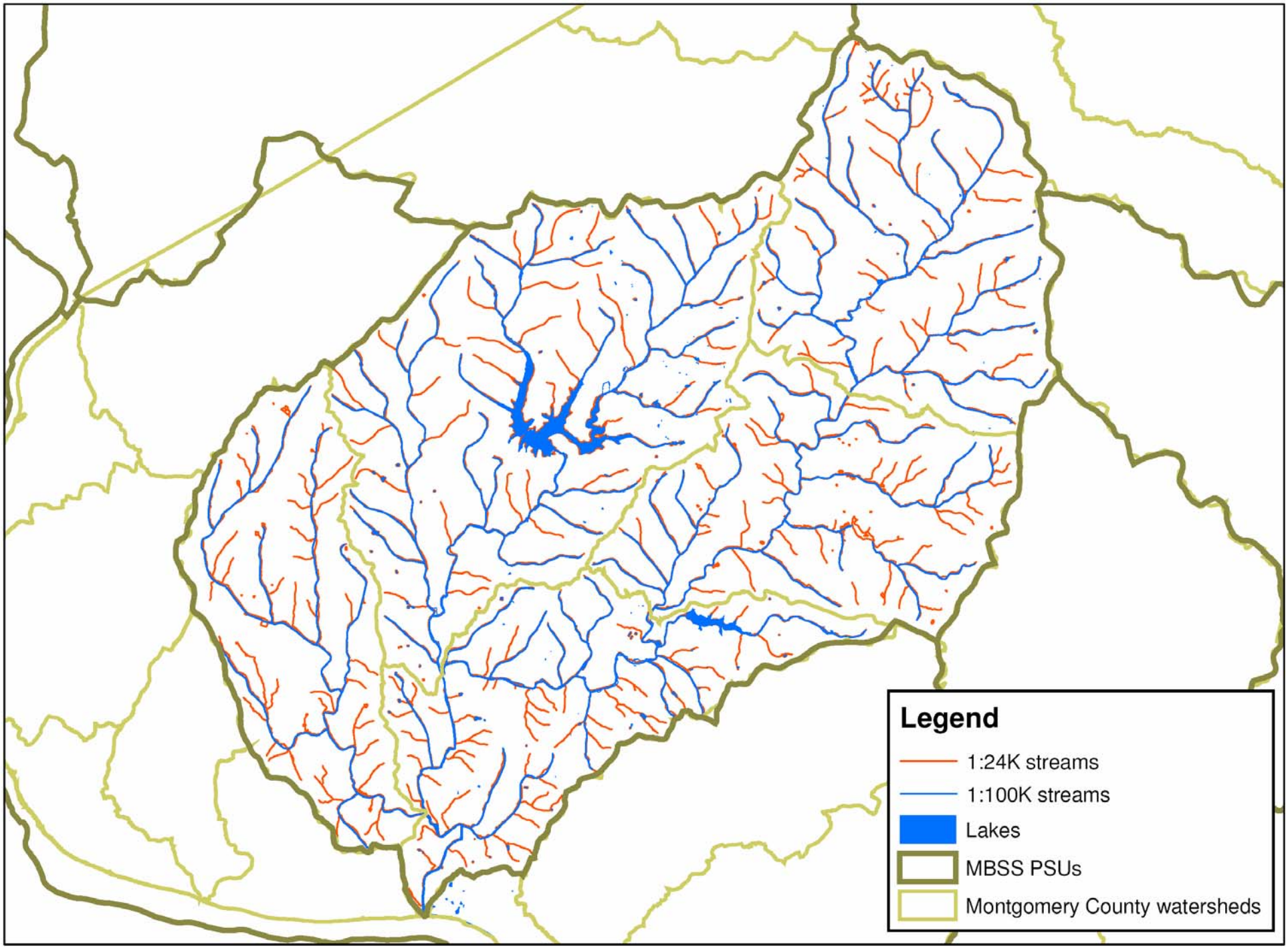
- Both MBSS and LTB use invertebrate reference-based indicators of condition
- Thresholds of degradation are reference based, so that different condition classes that can be standardized

- **MBSS**
  - PASS = (≥ 10% of reference)
    - » Good (4.0-5.0)
    - » Fair (3.0-3.9)
  - FAIL =
    - » Poor (2.0-2.9)
    - » Very poor (1.0-1.9)
- **LTB**:
  - PASS = Meets goal (≥ 5% of reference)
  - FAIL =
    - » Marginally degraded (2.7-2.9)
    - » Degraded (2.1-2.6)
    - » Severely degraded (1.0-2.0)

# Gaps in Maryland's Waters

- LTB does not sample
  - Above head of tide (MLLW)
  - Shallows < 1 m depth
  - Mainstem deep trough > 12 m depth (but assumed to be azoic)
- MBSS does not sample
  - Below head of tide
  - Large rivers > 4$^{th}$ order
  - Small streams < 1$^{st}$ order (on 1:100,000-scale map)


Lower Eastern Shore
Legend
Areas not sampled by LTB
10
Miles


Legend
1:24K streams
1:100K streams
Lakes
MBSS PSUs
Montgomery County watersheds

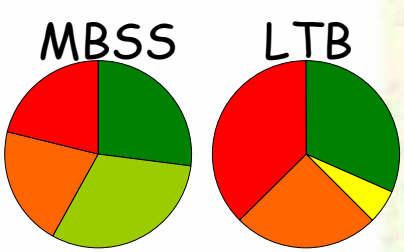
# Gaps in Maryland's Waters

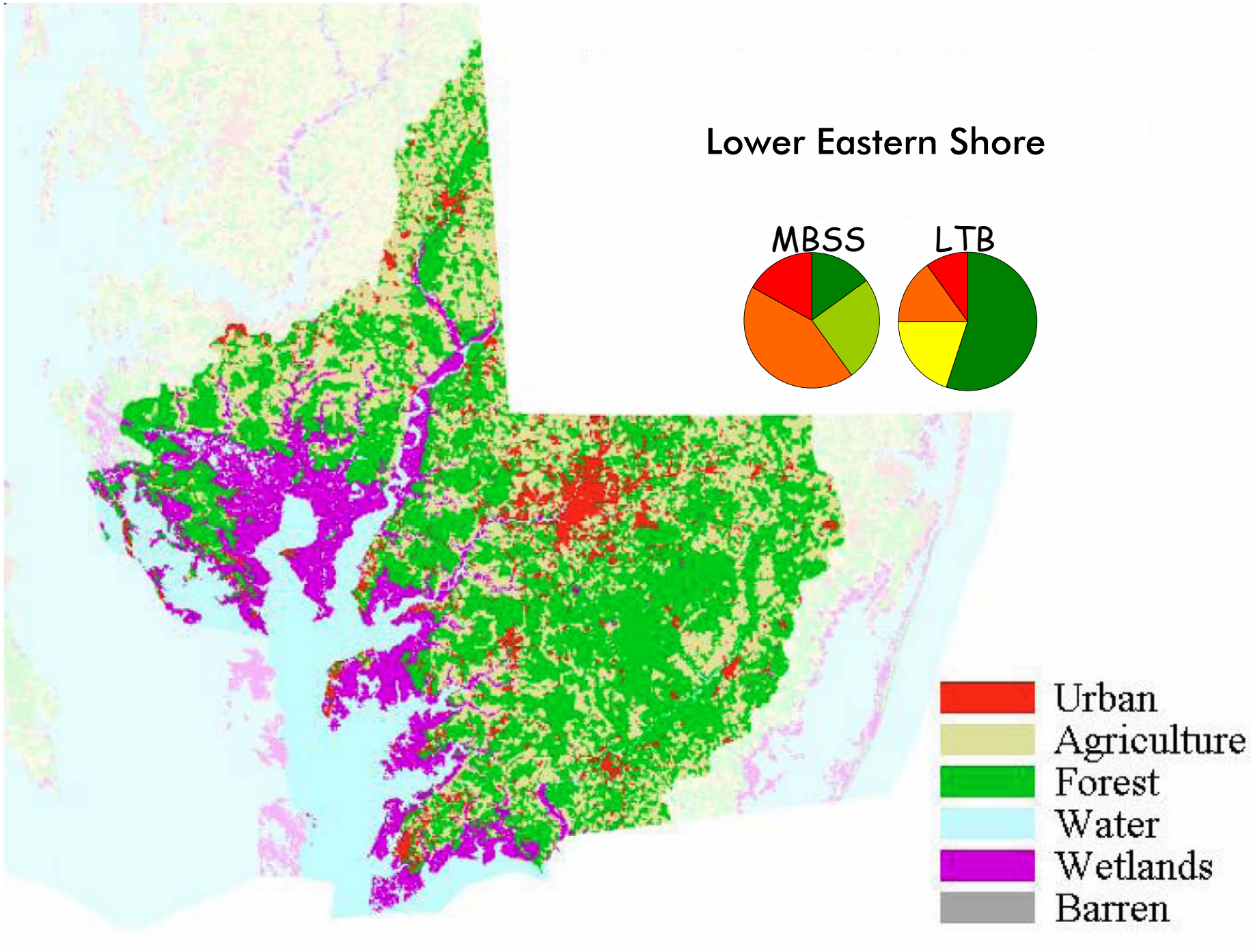
- Tidal waters are assessed by LTB (including Deep Trough)
  - Gap of up to 15% not assessed are nearshore shallows (based on NOAA data)
- Nontidal streams covered by MBSS
  - Gap of 6.8% are freshwater tidal
  - Gap of 1.5% are large rivers
  - Gap of up to 40% of miles missed are smallest streams (based on 1:24,000-scale map overlay in Montgomery County)

# Unique Watersheds

- Extensive development in coastal zone
- Well-protected coastal zone
- Heavy upstream loading
- Unique natural conditions (e.g., deep waters)

Patapsco




Lower Eastern Shore
MBSS
LTB
Urban
Agriculture
Forest
Water
Wetlands
Barren

# What Do We Want From Integration?

1. Integrated reporting (with consistent condition classes)
   - Eyes on the Bay
   - Chesapeake Bay EcoCheck
2. Monitoring and assessment of gaps
   - Nearshore shallows
   - Freshwater tidal
   - Small streams
   - Large rivers
3. Better understanding of upstream influences
4. Incorporation of trends information

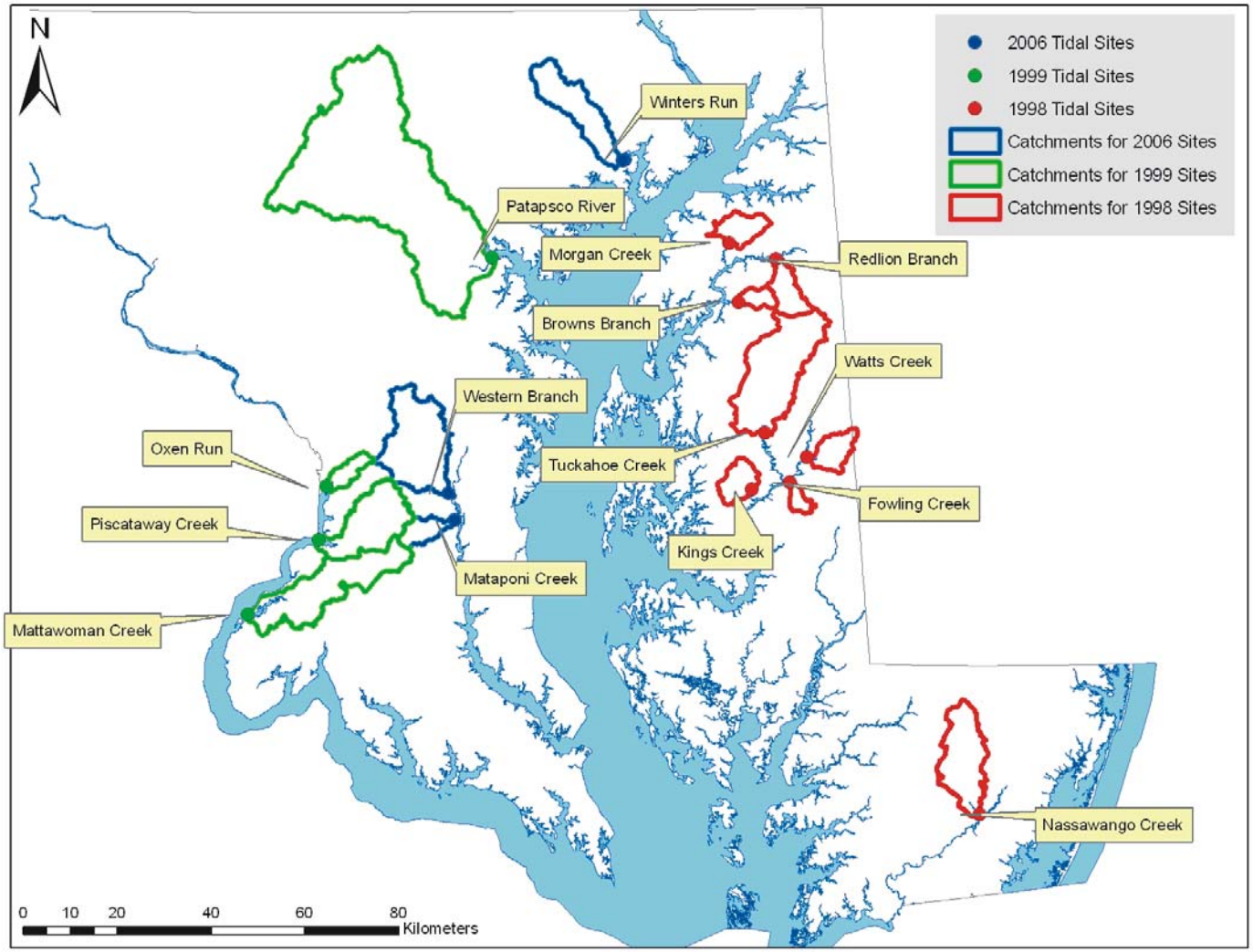
# Monitoring and Assessment of Gaps

- Feasibility of monitoring the gaps
  - Need appropriate fish and invertebrate sampling methods for tidal freshwaters (demonstrated in 1998 MBSS study)
- Who should monitor these gaps?
  - EPA national survey
  - MBSS (1999 survey design for tidal freshwaters)
  - Counties
  - Other organizations

# Better Understanding of Upstream Influences

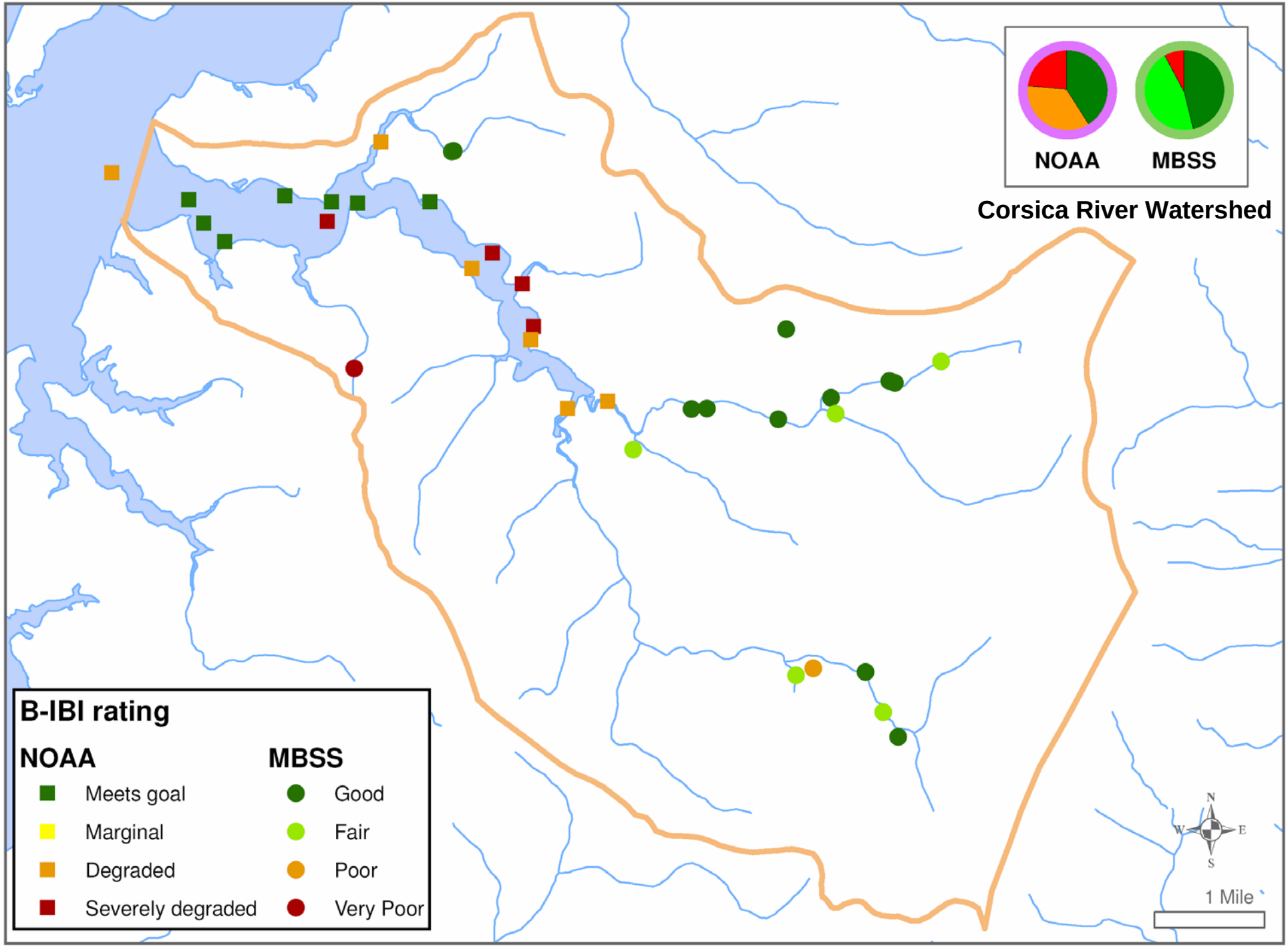
- Potential for learning from assessment mismatches
- Partition MBSS-LTB data by land use (as a predictor of coastal development influence)
- Link assessment to SPARROW model results
- Smaller scale studies to better understand downstream effects
  - MBSS 1998-1999 and 2006 fish study
  - NOAA 2007 benthic study

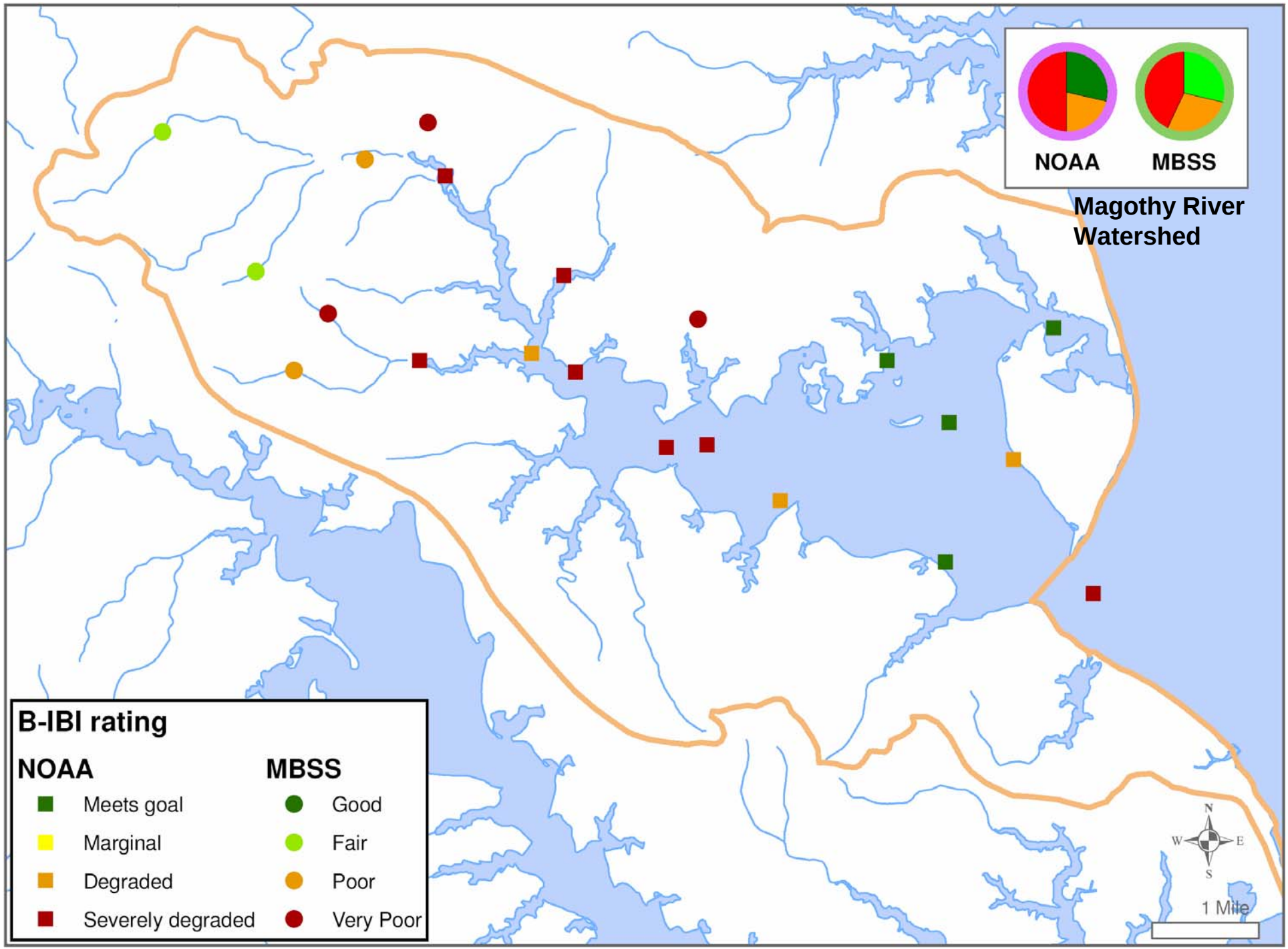
# 2006 MBSS Fish Study

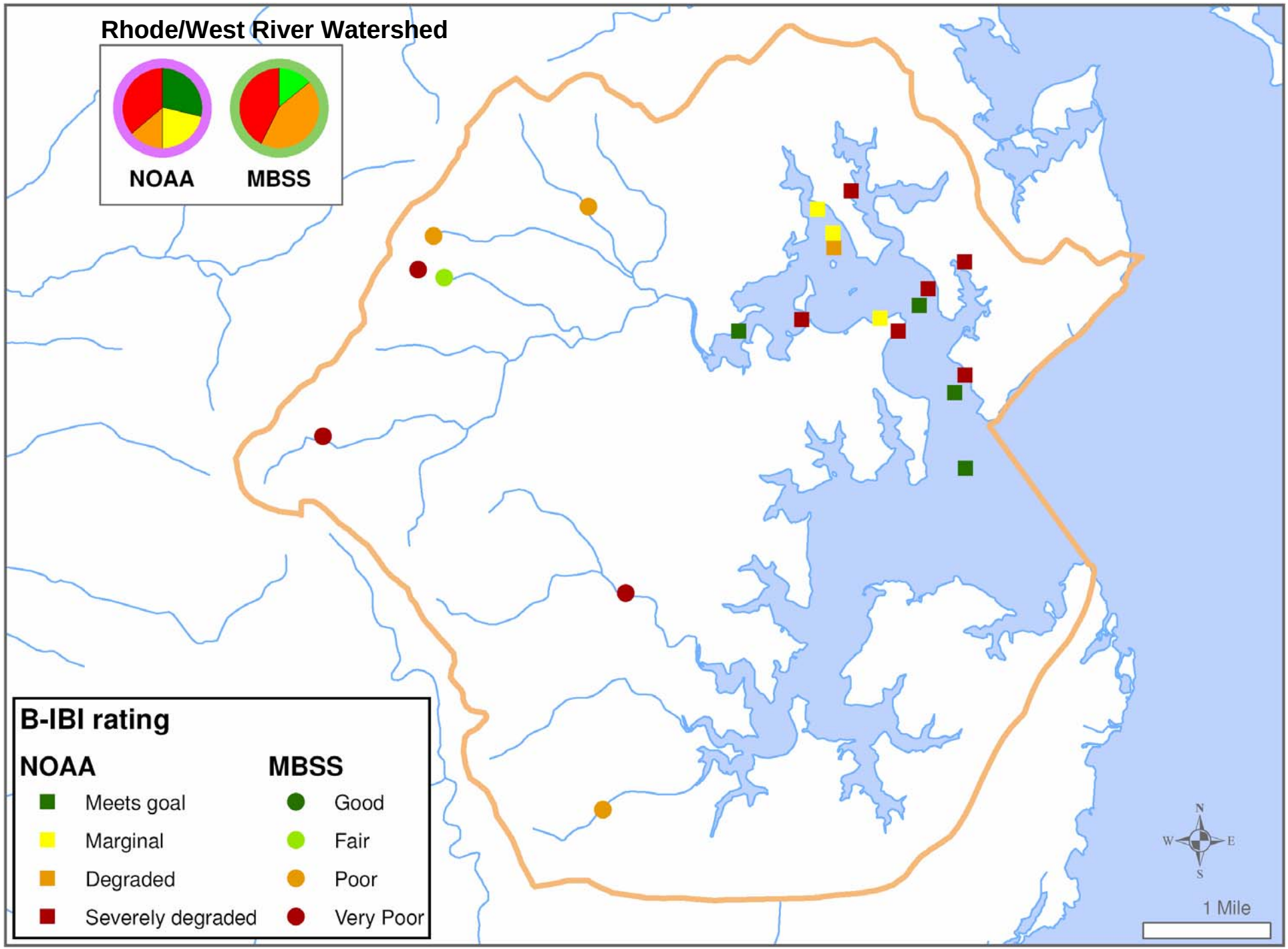


# 2007 NOAA Benthic Study

- Corsica River Watershed
- Magothy River Watershed
- Rhode/West River Watershed

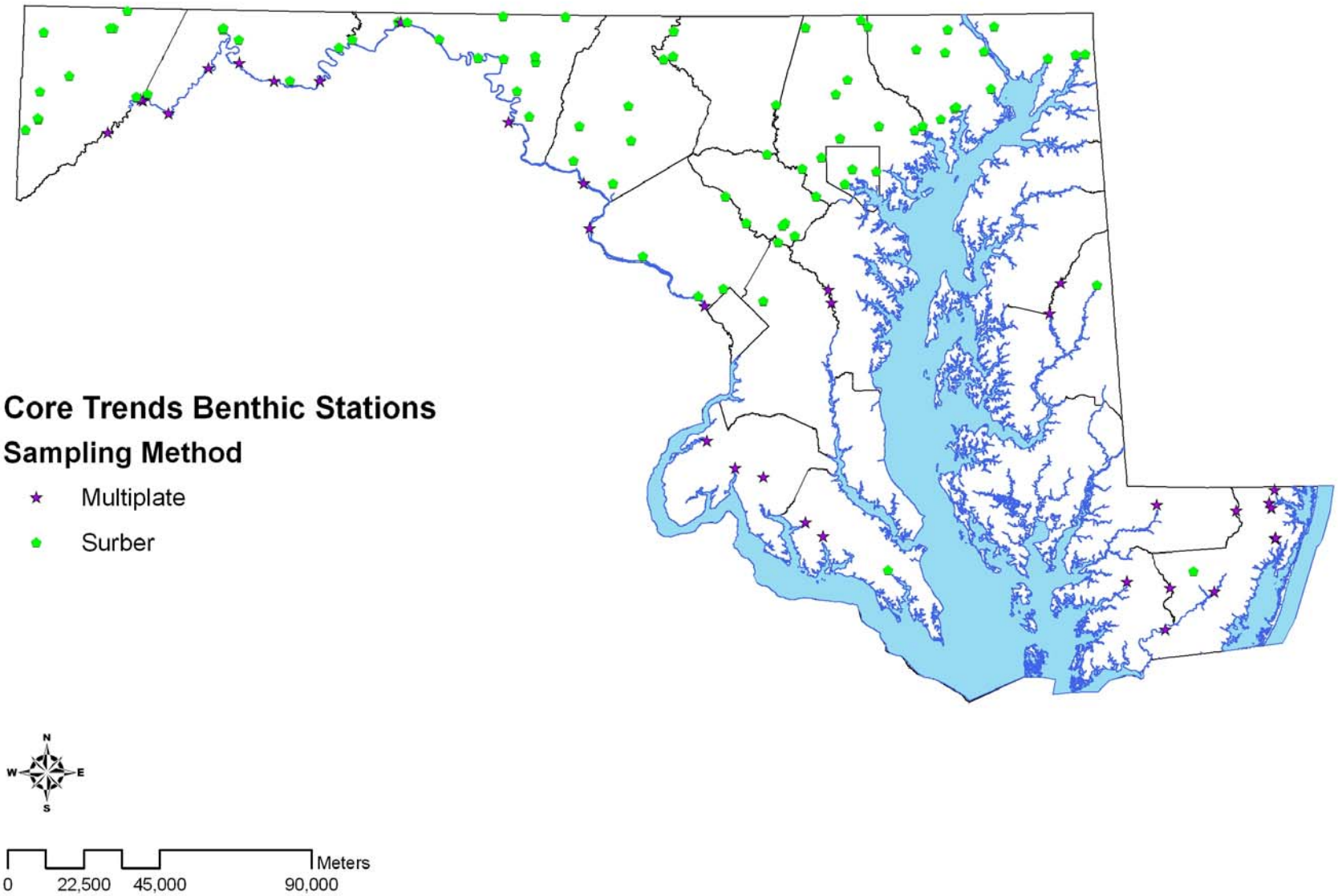

NOAA
MBSS
Corsica River Watershed
B-IBI rating
NOAA
Meets goal
Marginal
Degraded
Severely degraded
MBSS
Good
Fair
Poor
Very Poor
N
W
E
S
1 Mile

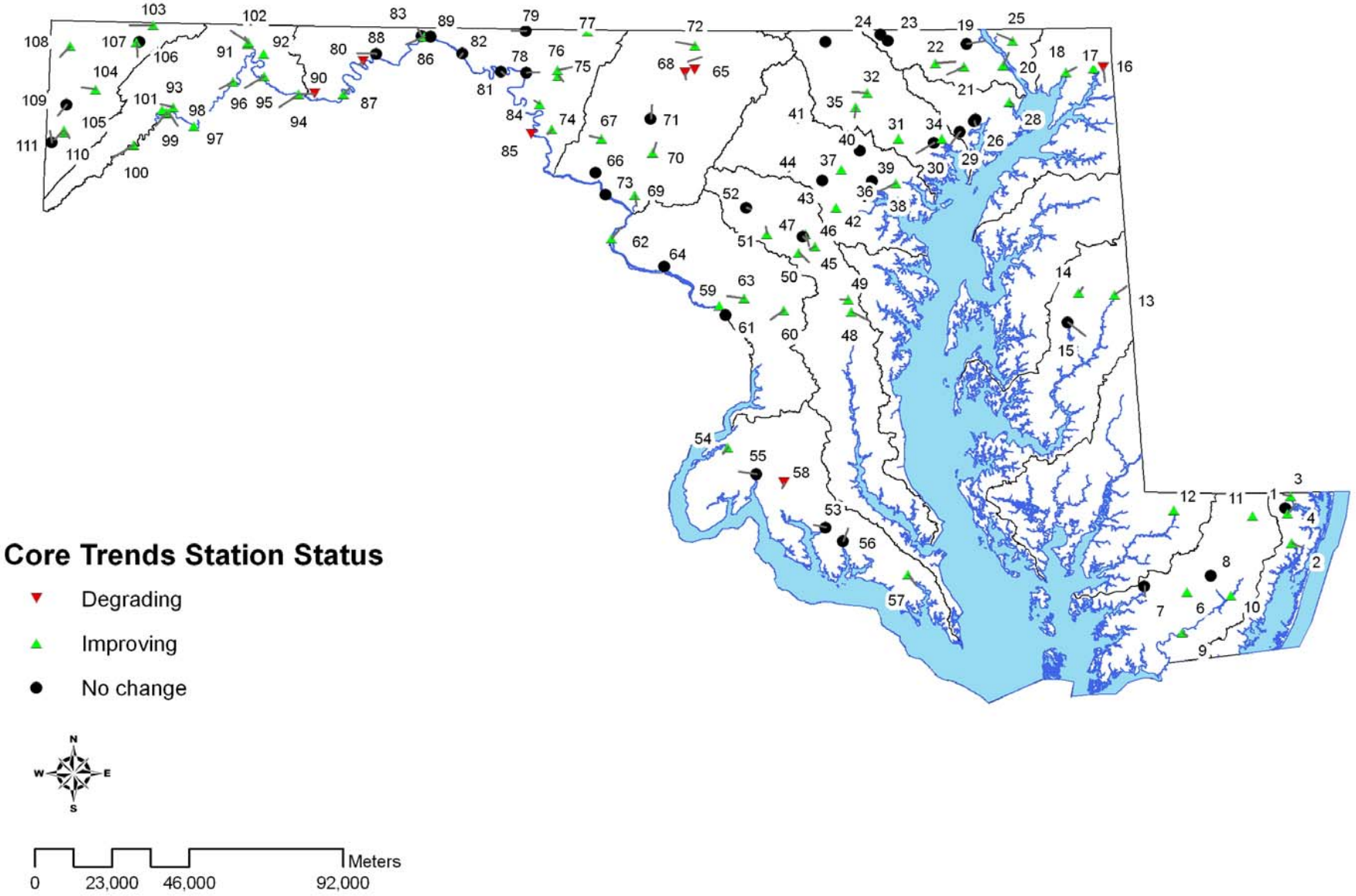

NOAA
MBSS
Magothy River Watershed
B-IBI rating
NOAA
Meets goal
Marginal
Degraded
Severely degraded
MBSS
Good
Fair
Poor
Very Poor
N
W
E
S
1 Mile


Rhode/West River Watershed
NOAA
MBSS
B-IBI rating
NOAA
Meets goal
Marginal
Degraded
Severely degraded
MBSS
Good
Fair
Poor
Very Poor
N
W
E
S
1 Mile

# Incorporating Trends Information

- 10-year MBSS and LTB trends analysis
- Maryland DNR CORE/TREND program
  - 111 sites, 84 TREND and 27 CORE
  - First sites sampled in 1976
  - Current sampling at annual to 5-year intervals
  - Surber in riffles and modified Hester-Dendy
  - EPT and other metrics of stream health
  - Could be tied to areawide assessments to extrapolate trends and possible downstream time lags


Core Trends Benthic Stations
Sampling Method
Multiplate
Surber
N
W
E
S
Meters
0
22,500
45,000
90,000


Core Trends Station Status
Degrading
Improving
No change
N
W
E
S
0
23,000
46,000
92,000
Meters

# Future of Integrated Assessments

1. *Integrated reporting* (with consistent condition classes) is feasible
2. *Monitoring and assessment of gaps* requires some method development and funding
3. *Better understanding of upstream influences* can be obtained from studies at smaller scales
4. *Potential for incorporation of trends information* from fixed site programs