Findings and Recommendations
From the Self-Evaluation of the
VADEQ Biological Monitoring Program

Virginia Department of Environmental Quality

Water Division

Office of Water Monitoring and Assessment

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A self assessment of the Biological Monitoring program was conducted by VADEQ Biologists in 2008 to gain a better understanding of what the program needs to move forward in the future. This document was created to provide focus and direction to biological monitoring in Virginia for the next several years.

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VADEQ Central Office and Regional Office staff met from February 2008 through March 2009, to identify needed guidance and data management tools related to the Biological Monitoring Program.

1. Develop Genus-Level Identification and a Biological Condition Gradient (BCG) for VA streams, and determine how this can be advantageous to all streams.

Issue

Genus-Level ID will provide the foundation for establishment of a Biological Condition Gradient (BCG) in Virginia. A BCG will enable VADEQ to better interpret biomonitoring data and develop a tiered aquatic life use (TALU). As a result, a TALU will help prevent degradation of high quality Virginia streams and set interim restoration goals to improve moderately to severely impaired streams. These tools will also enable VADEQ to measure step-wise improvements in water quality in impaired streams consistent with the proposal by EPA Region 3 for national consideration and VA House Bill (HB) 1150.

Background

The Biological Condition Gradient (BCG) concept is a tested method used to describe the biological response of benthic macroinvertebrates to levels of stress. Genus-Level data, which result in more accurate assessments of water quality, are used in combination with the BCG to assist with stressor identification. The BCG scientific model describes how ten ecological attributes of natural aquatic systems respond to varying levels of stress. These attributes then aid in the development of six stressor gradient tiers ranging from Tier 1 being natural or unaltered to Tier 6 being severely altered (EPA, 2005). The BCG can be calibrated to any regional scale and can be used to more precisely evaluate the current and potential biological conditions of state waters. Many states are adopting the use of the BCG in their programs. Maine and Ohio were the first to adopt biologically-based tiered aquatic life uses in their Water Quality Standards (WQS) in order to: 1) incorporate ecologically relevant endpoints into decisions; 2) inform water quality management decisions; 3) quantify water quality improvements; and 4) merge the design and practice of monitoring and assessment with the development and implementation of their water quality standards. EPA has used their experiences to compile a template that States and Tribes may use to develop biologically-based tiered uses (EPA, 2005).

This document will explain how developing a BCG will better enable Virginia to improve impaired streams and aid in preventing non-impaired streams from becoming impaired. BCG is greatly enhanced by using Genus-Level identification of macroinvertebrates. A Family-Level ID based BCG would provide for fewer tiers, be less rigorous and defensible, and provide fewer exceptional waters.

Additional Justification for Genus-Level ID

Virginia is the only state in EPA Region III not already identifying benthic macro-invertebrates to Genus-Level (DEQ goes only to family level), and has also been preceded in genus level implementation by two local Virginia governments (Chesterfield and Fairfax Counties). Biomonitoring programs of other states, local governments, academics, environmental groups, and other stakeholders are reviewed by regional EPA staff using a draft EPA policy “Critical Technical Elements of A Bioassessment Program” (Yoder and Barbour, 2006) that rates bioassessment programs based on 13 key elements, one of which is taxonomic resolution (genus - level vs. family). This policy categorizes biomonitoring programs into four levels with points assigned within each level for each of the 13 elements. VADEQ currently rates a 70%, or Level 2, with low

scores in four of the 13 elements prohibiting an increase to a Level 3. Of the four critical elements in which VADEQ scores low, two involve Genus-Level ID, one involves a BCG, and one involves data management (not all physical-chemical and biological data are connected). Within five to ten years of implementing BCG and other recommendations in this self-assessment, it is estimated VADEQ could score an 85-91%, or Level 3.

Genus-Level data result in increased assessment accuracy and precision. According to Lenat and Resh (2001), a North Carolina (NC) family-level biotic index was compared to a genus/species-level index on a subset of data from two NC ecoregions. The family-level index missed approximately 28% of sites that should have been scored as poor and placed on the 303(d) list. It also missed approximately 40% of sites that should have been scored as excellent (these were not necessarily mistakenly rated as poor and placed on the 303(d) list). Pennsylvania Department of Environmental Protection (PADEP) calculated statistics on Family versus Genus-Level data for an EPT Index and found that a large window of resolution was lost by Family-Level ID. When comparing the Hilsenhoff Biotic Index (HBI) for Family versus Genus-Level data it was noted that on a scale of 1-10 a Family-Level HBI of 5 had a corresponding Genus-Level HBI ranging from 3.6 to 5.8. This was a large difference considering the scale (Rodney Kime, PADEP, personal communication).

King and Richardson (2001) stated that Genus-Level data were superior to Family-Level data in their ability to detect impairment. Lenat and Resh (2001) also stated that "the success of antidegradation policies also may be difficult to evaluate with family-level taxonomy because small declines in water quality might go undetected." The same may be expected for small improvements in water quality, thus it is important to implement Genus-Level ID in tracking TMDL IP successes. The ability of Genus-Level data to detect small changes in water quality is the reason Genus-Level ID is suggested for use in a BCG. However, according to Lenat and Resh (2001), identifying only the first 100 organisms in a sample essentially eliminates most rare taxa. VADEQ could have more accurate bioassessments by requiring VADEQ biologists to identify additional macroinvertebrates, increasing from the current 100 to 300 organisms. There are several other reasons to increase subsample size. A minimum of 350 organisms is required to run RIVPACS-type predictive models (Ostermiller and Hawkins, 2004). All national surveys use Genus-Level ID, so VADEQ would be moving towards the national standard; however identifying 300 organisms per sample is the minimum requirement a state program needs to meet in order for their data to be used directly as a part of the National Survey (Larry Willis, VADEQ, personal communication,2008). A study by King and Richardson (2001) suggested identifying a minimum of 200 organisms for wetlands, which could also apply to low-gradient Coastal Plains streams assessed using the CPMI.

Further evidence to support the use of Genus-Level ID in bioassessments comes from Bailey et al (2001), who suggested that in taxonomically rich areas such as Virginia, genus or species identification is necessary for bioassessments. Tolerance values VADEQ currently uses for each family are mostly averages of the tolerances of genera in that family, though a wide range may exist. For example, net-spinning caddisfly (Hydropsychidae) genera range in tolerance values from 0 (lowest tolerance to pollution) to 7.8 on a scale of 1-10 (David Penrose, personal communication), yet VADEQ uses a Tolerance Value of 6 for the Family Hydropsychidae, which can result in an inaccurate bioassessment in cases where the more sensitive genera within Hydropsychidae have been collected. In addition, in a West Virginia court case "Ohio Valley Environmental

Coalition v. USACOE" (case 3:05-cv-00784 Document 277, 2007) a judge was critical of only using family level identification.

Virginia streams are generally categorized as belonging to Mountain or Piedmont bioregions, whose limits are naturally defined by topographic and biological features; however VSCI scores did not statistically separate Mountain and Piedmont streams (VADEQ 2006). The SCI was developed based on Family-Level biological data collected from reference sites throughout Virginia, excluding the coastal plain (VADEQ 2003). According to Hawkins et al. (2000), Family-Level data are not as effective as Genus-Level data for characterizing reference conditions. This could explain the current lack of statistical separation in Mountain and Piedmont streams.

The Coastal Plains Macroinvertebrate Index (CPMI) multimetric assessment tool was designed to work with Genus-Level benthic data (Maxted et al. 2000); however VADEQ uses Family-Level data and could be incorrectly assessing these low-gradient Coastal Plain streams. Additional research has also shown that most indices are underestimated when taxa are identified to family rather than Genus-Level (Guerold 2000), which would affect VADEQ's VSCI and CPMI scores and consequently water quality assessments.

In addition to providing more accurate and precise assessments of water quality, Genus-Level data can assist with stressor identification, as evidenced by West Virginia and Ohio. West Virginia developed the concept of "dirty reference" streams, which gives a percentage to the likelihood that a particular impairment is caused by a particular stressor. Ohio developed Biological Response Signatures and uses them to assign "causes and sources of impact for 305(b) reports and in supporting enforcement and litigation. It has been used to link effects with specific discharges, especially those involving the Complex Toxic impact type, and to pinpoint the discharge rather than poor habitat or other factors as the likely cause of impairment." (http://www.epa.gov/waterscience/biocriteria/casestudies/detectionohio.html).

Braccia and Voshell (2006) demonstrated how genus-level data could be used to "identify primary stressors in streams where there are multiple potential stressors to the benthic macroinvertebrate fauna." They wrote that "considering the presence or absence of individual taxa in conjunction with taxon-specific natural history provides a great deal of useful information about the ecological condition of water bodies and probable causes of impairment." By noting a lack of taxa that require clean streambeds, they concluded that the major stressor to the benthic community was excessive sedimentation.

Results from the 2006 EPA publication "Estimation and Application of Macroinvertebrate Tolerance Values" suggested that "taxonomic identification to genus level provides indicators that are more closely associated with observed stressor levels."

Proposed Implementation of a Genus-Level BCG in Virginia

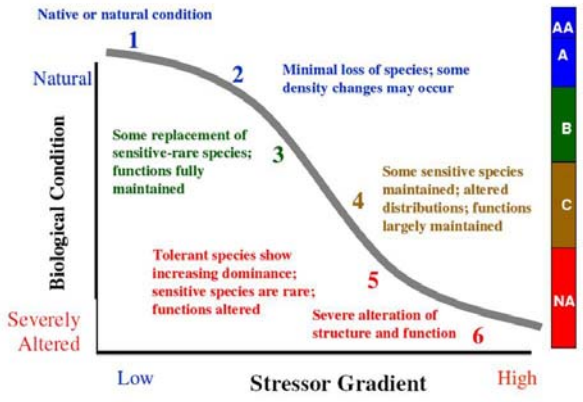
Developing Virginia's BCG will begin with a stream classification process modeled after Pennsylvania's methods and assisted by EPA. After review of existing BCG programs, Virginias BCG program should be based on the BCG programs classification schemes and overall BCG programs of Maine, and/or Pennsylvania. Ohio's BCG program was considered, however, it was developed based upon Ohio's natural resources and the

anthropogenic effects on Ohio's waters. Virginia's natural resources and anthropogenic effects are more comparable to Maine's and Pennsylvania's natural resources therefore Ohio's BCG would not be considered as an example for a BCG program in Virginia.

Specifically, VADEQ Regional Biologists found Pennsylvania's stream classification process to be most practical and thorough and comparable to Virginia streams. Virginia's stream classification process should be similar and could use ecoregion, watershed size, chemical, habitat and benthic macroinvertebrate taxa list (Genus-Level) data. A workshop setting should be used where Biologists from across the state meet and classify streams with assistance from EPA biologists.

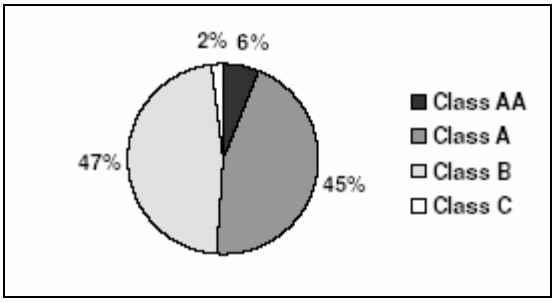
In the case of modeling VADEQ's BCG program to have an end result similar to Maine's goal-based management program, the following characteristics are important. Maine's BCG consists of six tiers ranging from Tier 1 being natural or unaltered to Tier 6 being severely altered. The BCG was used to develop TALU (or "is the basis for TALU"), in which Maine categorizes streams into five classes (AA, A, B, C, NA) based on the six tiers of the BCG as illustrated in **Figure 1**. When a stream is initially classified the only category considered impaired is NA (not attaining); however, when a stream degrades a class it is listed as impaired regardless of which class it is in, which is how Maine applies its anti-degradation policy. In Virginia, the initial classification setting could be open to public comment after a biologist work group and/or AAC classifies the stream. Maine suggests rigorous protocol to move a stream from class to class and includes a public comment period. In the case of a stream degrading and being listed as impaired, restoring the stream to the higher class is used as a restoration goal. For example, class C could be used as the interim restoration goal for class NA streams (the most impaired streams). Susan Davies (Water Quality Standards Coordinator, Maine DEP) emphasizes that Maine maintains pressure to move stream miles up the WQ ladder to higher tiers. The biggest benefit of Tiered Aquatic Life Use (TALU) WQ standards to Maine is the effective protection of higher quality streams as Maine has only a small percentage of their streams in the lowest two tiers (see **Figure 2**) (S. Davies, MDEP, Personal Communication,2008).

Figure 1



Maine TALUs in relation to the BCG Tiers (EPA, 2005)

Figure 2



Percent of linear miles of all rivers and streams in each of Maine's designated use classes (year 2000) (EPA, 2005).

Additionally, classification information will allow us to better discriminate between communities expected in the mountains and those expected in the piedmont and thus improve assessments. Due to the aforementioned BCG classification data, we shall be better able to determine a relationship between biological condition and stressors.

Furthermore, a BCG is an enhanced tool for implementing antidegradation. Currently Virginia's assessment process focuses on impaired segments of streams and rivers. Once these streams are listed as impaired they only receive attention until they reach the level of "meeting" water quality standards. VADEQ could use a BCG to implement a TALU to discontinue managing streams and rivers toward a lowest acceptable condition. The use of a TALU will strengthen Virginia's ability to improve impaired streams and prevent non-impaired streams from becoming impaired. Therefore, with a TALU in Virginia streams will be managed better by both protecting high quality waters and improving impaired waters through the use of interim restoration goals.

The resulting classification of streams and improved assessment and stressor relationship with stream quality will enable the TMDL program to:

- define and defend a scientific prioritization of streams for TMDL implementation
- establish realistic interim restoration goals for impaired streams
- track improvements due to implementation plan projects.

In terms of realistic interim restoration goals, a TALU should be used to "establish a consistent approach for identifying attainable, incremental restoration goals that are grounded in the concept of biological integrity (EPA, 2005)." Interim restoration goals will enable a methodical improvement of a class C to a class A (see **Figure 1**). This will be particularly useful in urban and agricultural watersheds where current technology and resources limit achievement of the standard and where opportunities may arise later to further improve water quality. Moreover, using TALU in a fashion that aids in identifying interim restoration goals and tracks implementation plan projects' improvements will help attain the goals set forth by VA HB 1150. HB 1150 requires the Virginia Secretary of Natural Resources to draft a clean up plan for the Chesapeake Bay and Virginia Waters that must include: "*Measurable and attainable objectives for cleaning up the Chesapeake Bay and other impaired Virginia waters* (HB 1150 section 62.1-44.117.B.2)." From a Regional standpoint, a TALU will give Virginia the tool to achieve EPA Region III's "Healthy Waters Priority"goals of:

- "achieve greater and faster advances in preventing waters from becoming polluted…,

- and improve those waters that are polluted." (EPA, 2008)

In summary, a TALU will give VADEQ a scale on which to set goals and track improvements of water quality.

A TALU cannot be used to "de-list" an impaired stream after it has attained a "realistic goal." An impaired stream is required to remain on the 303(d) list until such time it meets water quality standards. During the interim restoration goals period, efforts should be made to revisit and revise the interim goal and further restore the stream's water quality when resources and technologies become available.

In addition, the classification process will require Virginia to turn attention toward non-impaired streams yielding greater in-depth data on higher quality streams in the Commonwealth and improve VADEQ's ability to determine if a stream is degrading. The identification of degradation enables the agency to address the stressor and maintain high quality waters. This information will be helpful in the communication of stream quality to VPDES and VWP permit writers. The ability to communicate this information to the public will be helpful whether it be in an assessment report or a public meeting.

Opportunities/Risks of development and implementation

Opportunities of implementation

1. Genus-Level ID/BCG gives VADEQ the ability to identify high quality streams and better identify Virginia's aquatic resources.
2. It is consistent with other states in Region III, allowing us to compare data within Chesapeake Bay states
3. A properly developed BCG/TALU would help us to :
    a. Prevent a stream from being designated as "irreparable."
    b. Provide a means for anti-degradation by consistent designation of high quality waters
    c. Help make our statewide assessments more robust and avoid incorrectly assessing streams.
    d. Aid the TMDL and Assessment programs in defining realistic interim goals
    e. Provide a scientifically defensible method of prioritizing streams for TMDL Implemention funds
    f. Enhance the use of biological data in the permitting process
        i. BCG/TALU stream classification will offer VPDES and VWP permit writers a better understanding of the potentially affected water body upon receiving a permit application.
        ii. Communicate clearly to the public both the existing and potential uses of a waterbody
4. The BCG would be most effective if the agency transitions to Genus-Level identification of benthic macroinverterbrates in the Biomonitoring Program.
5. Genus-Level data should result in:
    a. Increased accuracy and precision in assessments and may prevent unnecessary and costly TMDLs on incorrectly assessed streams, specifically those near the current VSCI impairment threshold.
    b. Increased accuracy and precision in relationships between biological condition and stressor identification

c. Increased legal defensibility of the VADEQ biomonitoring program.
d. Stream classification should allow biologists to better discriminate between benthic communities at Genus-Level expected in Mountain versus Piedmont versus Coastal Plain streams, yielding improved assessments
e. Provide more accurate bioassessments by requiring VADEQ biologists to identify additional macroinvertebrates, increasing from the current 100 to 300 organisms
f. Virginia Stream Condition Index (VSCI) and Coastal Plain Macroinvertebrate Index (CPMI) can be tailored "in-house" for use with Genus-Level data and would not require the assistance of a consultant such as TetraTech.
g. The diversity of aquatic life will be better characterized and documented.

Risks of not developing/implementing Genus-Level ID/BCG

1. Inability to more accurately identify high quality streams and describe aquatic resources
2. Inability to more accurately assess streams and identify stressors in TMDLs when methods are available
   a. Costly TMDLs developed based on less than optimal data
   b. Inability to determine better relationships between biological conditions and stressors
   c. Inability to better discriminate between mountain and piedmont communities resulting in less than optimal assessments.
3. Lack of more accurate data for permit writers
4. Inability to demonstrate effort and improvement of impaired streams in the TMDL IP process (VA HB 1150)

Risks of developing/implementing Genus-Level ID/BCG

1. May result in more benthic tmdls due to greater accuracy of the data
2. Development will require time and funding. No nationwide template for developing and implementing a BCG exists due to the uniqueness of each state's natural resources.
3. Genus-Level ID could increase misidentifications due to the increased difficulty in identifying to genus-level rather than family, which could skew assessments.
4. Reduction in the number of sites that could be monitored in the first few years of Genus-Level ID due to increased time to identify 300 organisms to genus-level. Efficiency will improve with experience.

Resource Needs

1. Approximately 5 years of data collection, including each region conducting biomonitoring of five additional reference sites per year (typically reference sites identified in previous years) at Genus-Level needed to begin development of a BCG.
2. Taxonomy training for biologists.

3. Rework SCI and metrics. Includes meetings with committee of biologists and AAC, statistical work performed by Jason Hill, EPA review, potential changes according to AAC and EPA comments, report writing and review.
4. BCG development will begin dependent upon data collection effort at the genus level.
    a. Approximately 4-5 years after genus-level collection begins, development of Genus-Level index will begin.
    b. Policy development and AAC process with final development of BCG policy and implementation in Virginia will require 2 years.
5. Time and cost required to provide Genus-Level training to biologists
    a. Cost of VCU 3-day EPT class (mayflies, stoneflies, and caddisflies) and certification for all biologists is $15,000. This class would cover over half of the genera that biologists would need to learn to identify.
    b. Cost of VADEQ 3 day EPT class (mayflies, stoneflies, and caddisflies) and certification for all biologists is $13,000.
    c. Cost of VCU 3-day Fly larvae and Water Beetle identification class and certification for all biologists is $10,000
    d. Cost of having Greg Pond and/or Maggie Passmore of EPA conduct training for all other insect orders at Cacapon or annual biologist meeting is approximately $2,200
    e. Would need recertifications every five years, this can be done in-house
6. Time to recalculate VSCI: estimated 900 staff hours
7. Total time and cost of creating each regional reference collection: $107 + employee time
    a. Consists of approximately 200 organisms per region, $225 for alcohol and $550 for vials for entire state

Prioritized sampling and with GIS landcover/water quality biological condition model could fill potentially large data gaps.

Suggested Solutions

1. Begin phased BCG development process in fall 2009-2017
    a. Phase 1: 2009-2010 biologists attending Genus-Level training and beginning to identify macroinvertebrate samples to Genus-Level
    b. Phase 2: 2012 Develop BCG implementation timeline with EPA Region 3
    c. Phase 3: 2013 Initiate BCG timeline while monitoring ongoing BCG work within other states
2. Genus-Level training will begin in 2009-2010.
3. Continue to test and refine benthic multimetric indices (Genus-Level benthic data would allow VADEQ to define six tiers).
4. Biologist Genus-Level identification recertification will be performed every five years at the annual biologist meeting or at regional offices during audits. The Biological Monitoring Coordinator will proctor.
5. When new biologists are hired, Genus level certification will be required within one year of hiring. Certifications will be proctored by the Biological Monitoring Coordinator at a DEQ office if necessary.

Continue long term goal of creating fish and algae IBI's. Additional biological information helps better define BCG.

Task and Task Assignments

2009

- Biologists should begin compiling genus-level reference collections in 2009. The Biological Monitoring Coordinator will check these for accuracy. Three to five organisms per genus-level required **–Biologists and Biological Monitoring Coordinator (BMC)**
- VADEQ will schedule genus-level training for biologists with VCU in August 2009 - **BMC**
- Have biologists identify 300 count macroinvertebrate samples to Genus-Level at all 2009 ProbMon sites **– Biologists and BMC**

2010

- Biologists will identify all macroinvertebrate samples to genus-level beginning 2010 **- Biologists and BMC**
- VCU certification by August 2010 - **BMC**
- Once Genus-Level ID training has begun, have biologists choose five different reference sites per year, to be monitored both spring and fall beginning 2010-2014 in support of Genus-Level VSCI development **–Biologists and BMC**

2012

- Develop BCG implementation timeline with EPA Region 3 in 2012**- Workgroup and BMC**

2013

- Initiate BCG timeline in 2013 **–Biologists and BMC**

2014

- Assemble a workgroup of experts from academic and professional community to review and assist in developing Macroinvertebrate Genus-Level IBI June 2014 - 2016 **- BMC**
- Begin analysis of data in 2014-2015 and prepare draft of IBI March 2016 **– Biologists and BMC**

2017

- Continue analysis of data and do validation of IBI in 2017 **–Biologists and BMC**

Ongoing

- Continue to monitor other states' ongoing BCG work **–Workgroup and BMC**

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2. Fish Community Collections and Index of Biotic Integrity (IBI) Development

Issue

The VADEQ currently uses one biological indicator, macroinvertebrates, in the Water Quality Monitoring and Assessment monitoring plans. The development and application of a fish IBI would add an important and relevant biological assessment tool to Virginia's monitoring program. The fish IBI would complement and augment the macroinvertebrate VSCI, since fish respond to stressors that may not affect macroinvertebrate communities. Fish community data are expected to be particularly useful for the assessment of larger, non-wadeable streams and rivers, for which there are currently no macroinvertebrate assessment tools available. The fish IBI would provide an enhanced assessment of the Aquatic Life Use standard.

Background

VADEQ conducts its Freshwater Probabilistic Monitoring (ProbMon) using a sampling network based on an annual series of randomly chosen stations. ProbMon's goal is to make statistically valid reports on the biological, chemical, and physical condition of Virginia's streams and rivers. ProbMon was initiated by VADEQ in 2001 and until 2006 focused on using aquatic macroinvertebrate assessment for reporting on biological conditions. An aquatic vertebrate monitoring program, developed and currently conducted by Virginia Commonwealth University (VCU) using EMAP fish collection techniques, will create a complementary, synoptic, and geospatial database for fish community composition, health, and abundance throughout the Commonwealth.

The fish community data collected from ProbMon sites will allow VADEQ and VCU to develop a Fish Index of Biotic Integrity (IBI). This new tool would strengthen VADEQ assessments of the biological integrity in streams which is presently based only on a benthic macroinvertebrate index.

Fish IBIs can provide data complimentary to benthic macroinvertebrate analysis, because fish communities react differently to certain environmental stressors. The magnitude of these responses may also differ. For example, fish are more sensitive than macroinvertebrates to ammonia (Miller, 1990). Due to their mobility, fish can migrate from streams with localized deleterious conditions such as low dissolved oxygen (DO), toxic contamination, or temperature extremes, whereas benthic macroinvertebrates must endure these conditions in place, which is reflected in the assemblage. These differences can provide additional insight into watershed problems. Fish kills in the Shenandoah Valley have recently demonstrated that benthic macroinvertebrate metrics can indicate reference level conditions, while fish communities are obviously stressed as indicated by lesions and mortalities (personal communication of preliminary data; Voshell, 2007).

EPA strongly recommends the use of two or more biological indices to assess aquatic life use. Fish are the easiest biological community to identify in-house, and were the first to be used in a multimetric IBI to assess water resources (Karr, J.R., 1981). In addition, the public relates well to fish indices, since many people fish recreationally and are familiar with game and non-game species. Public concern with stream health is frequently centered on the health and abundance of game fish species. When

discussing macroinvertebrate assessment with the public, the question that is frequently asked of the biologists is “what does this mean for the fish?”

Ohio, Kentucky, Maryland and North Carolina already use fish community data to make aquatic life use decisions. In EPA’s “Stressor Identification Guidance Document” (USEPA. 2000), an example is given of Ohio using fish data in the development of a TMDL. West Virginia and Pennsylvania are currently working to validate a fish IBI. The VADEQ is currently three years into a five year pilot phase of fish community assessment that will provide much of the data required to create a fish IBI.

Opportunities/Risks

Opportunities

- Provide an assessment tool for larger, non-wadeable streams
- Fish IBIs can provide data complimentary to benthic macroinvertebrate analysis, because fish communities react differently to some environmental stressors than macroinvertebrates. The magnitude of these responses may also differ.
- Fish IBI metrics detect effects of water quality on the organism level, such as fin rot, gill abnormalities, deformities etc. that can not be detected with algal or benthic macroinvertebrate IBIs
- For those streams already on the 303 (d) list, fish community work would provide additional information for stressor identification.
- A probabilistic application of a fish IBI program could provide data to correlate land use, water quality, and habitat parameters to fish health/community structure and impacts. These correlations could be translated into improved strategies for protecting watersheds against future impacts.
- Establish baseline data against which to compare future impacts, such as those now occurring in the Shenandoah and Upper James River watersheds.
- May be able to obtain specialized training and equipment necessary for fish collection and identification through National Assessment Survey using little state general funds.
- May receive assistance and expertise from Virginia DGIF fisheries biologists.

Risks (with implementation)

- Biologist time devoted to fish community work will reduce the time available to perform benthic macroinvertebrate surveys, resulting in fewer sites assessed.
- Fish are mobile through their habitat; fluctuations of fish numbers and species over time within a given stream reach due to migration, may change enough to result in significantly different IBIs, depending on when the fish are collected.
- Learning to design and become efficient at developing TMDLs to address fish community effects.
- Non-anthropogenic factors (drought, disease) can result in communities that appear to be impaired in spite of good water quality conditions.

Risks (without implementation)

- Macroinvertebrate communities may not react to all present stressors, when in fact the fish community is impacted, as indicated by Va Tech results (Voshell, 2007).
- VADEQ could incur public mistrust if we fail to identify and address impacts to fish communities. A significant fraction of Virginia citizens are recreational anglers who are greatly concerned with fisheries health.

Resource Needs

- Funding could be provided through the EPA 106 Grant funds for monitoring and supplemental funding for special monitoring studies.
- Based on approximately 60 sites per year, Fish IBI sampling and analysis would cost approximately 150 man-hours/ year. This assumes 2 crews of 3 persons/crew performing collections at 25 sites per crew. Travel would be concurrent with ongoing ProbMon sampling expeditions and would therefore not incur additional travel expenses. Supplies statewide include formaldehyde, ethanol, containers, field equipment estimated to cost $1,000/yr.
- Backpack shockers w/ electrodes and batteries and nets will be approximately $4,500 each region.
- After contract with VCU expires in 2011, VADEQ would need to develop the expertise and acquire the equipment necessary to collect and ID fish species
- If VADEQ's current fish tissue sampling crew is to assist with Fish IBI sampling, protocols of that program will need to be adjusted for the sampling requirements of the fish IBI.
- Need guidance for developing a fish IBI, and require training in electroshocking and fish identification (See opportunities above)

Suggested Solutions

- Use data from fish collections performed in conjunction with ProbMon sampling from 2006 - 2009 to perform a preliminary analysis of fish community data in 2010-2011
- 2012 there will be an initial draft of Fish IBI to cover Piedmont, Coastal, and Mountainous regions (approximately 80 to 90%) of Virginia's perennial stream miles; further iterations of IBI will be required to increase coverage.
- Obtain equipment, funding and training from EPA, DGIF, VCU, and other sources as available. EPA can provide guidance and recommendations in development of fish IBI.
- Provide additional fish training to other biologists as training resources allow to expand pool of available biologists to assist in sampling.
- Invite the DEQ Fish Tissue Quality Coordinator into Fish IBI workgroup to provide guidance for assembling fish collection equipment, and to discuss the potential for the fish tissue monitoring staff to assist with IBI data collection.
- Stagger fish collection dates from benthic collection to space out work through the year.
- Inquire about borrowing equipment and assistance with electroshocking from DGIF, solicit advice about what equipment we need and what are maintenance requirements.

Tasks and Task Assignments

2009

- Create fish forms/queries/metrics in EDAS (biological monitoring database) June 2009 **- Workgroup and BMC**
- Continue assisting/performing fish collection for IBI in the 2009-2010 ProbMon season and Phase 3 (2011-2015) probmon for validation. - **Biologists and BMC**
- Assemble a workgroup of fish experts from academic and professional community to review fish community data and assist in developing draft fish IBI June 2009- June 2011 **– Workgroup and BMC**

2010

- Perform literature review of fish IBI use in stressor identification by February 2010. **– Workgroup and Biological Monitoring Coordinator (BMC)**

2011

- Begin analysis of current ProbMon fish data January 2011 **–Workgroup and BMC**

On going

- Identify fish ID and electroshocking training opportunities, Fish and Tissue Sediment team could lead some training- **Biologists and BMC**
- Fish IBI team will work with Fish Sediment team to collect data at target and stress sites to validate fish IBI, with wage employee participating with both programs.

References

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3. Validation of Coastal Plain Macroinvertebrate Index (CPMI)

Issues

The CPMI was originally developed for use in coastal/swampy streams. However, it does not discriminate well between unimpaired and impaired coastal/swampy streams without defined channel/banks. Compounding the difficulty is that the Virginia Stream Condition Index (VSCI) is not appropriate for these types of waters. Virginia is using a simplified family-level version of the original genus-level index of the CPMI. The CPMI needs to be recalibrated at Genus Level to determine if appropriate for assessment purposes of coastal streams and there is a yet to be a defined technique for swampy streams.

Background

From the period 2001 – 2006 there were over 5,800 stream miles in the lower piedmont and coastal plain which VADEQ was unable to assess due to lack of confidence in the Coastal Plain Macroinvertebrate Index (per Freshwater Probabilistic Monitoring Coordinator, Jason Hill). Unlike the VSCI, which was developed specifically for Virginia and independently validated, the CPMI was developed for use by several states in a range of stream types; accuracy of the CPMI in Virginia waters has never been tested in an independent study. For the past decade VADEQ biologists have been basing their assessments of coastal plain waters (including swamps) on a combination of the CPMI and best professional judgment.

VADEQ conducts biological assessments across a wide range of lotic systems. These include low gradient streams with a clearly defined main channel and banks, as well as swampy streams with braided channels and poorly defined banks (or “swamps”). Not all low gradient habitat metrics conform to natural expectations. There is particular concern that scoring categories for bank stability, channel flow, vegetative protection, sinuosity and possibly others are inappropriate. If VADEQ’s habitat assessment methods do not characterize these systems, more appropriate methods should be explored.

Assessments in Low Gradient Streams with Defined Channels

The method which VADEQ uses for assessing coastal plain low gradient streams (the Coastal Plain Macroinvertebrate Index or CPMI) was developed by the Mid-Atlantic Coastal Streams (MACS) Workgroup in the 1990’s for broad use in streams from as far north as New Jersey down to South Carolina. The CPMI was originally calibrated at genus level using only a few reference streams in Virginia. Findings of the MACS study indicated that variability in the reference sites was affecting the discriminatory ability of the CPMI in Virginia’s coastal plain. This variability was likely due to the abundance of naturally acidic waters in the southern coastal plain and seasonal variability in pH (USEPA, 1998). As a result, 4 of the 7 Virginia reference sites chosen by the study were considered impaired by the final index. As a step towards improving the discriminatory ability of the index in the Virginia coastal plain, the MACS study recommended research, focused on reducing the variability of the benthic assemblage at reference sites (USEPA, 1998). A validation study by VADEQ would be aimed at reducing this variability of reference sites, to improve the discriminatory ability of the index as recommended by USEPA.

Assessments in Swamps

The CPMI was designed for wadable streams of the Middle Atlantic Coastal Plain. As stated in the original report, these methods "are best suited for perennial streams with a confined channel" (USEPA, 1997). Swamps are often characterized by non-detectable flow within braided or poorly defined channels; they are also naturally low in dissolved oxygen (e.g., 4 ppm or lower) and are often quite acidic. It is reasonable to assume that even the most pristine swamps host macroinvertebrate communities that would be considered stressed or impaired according to the CPMI. North Carolina utilizes a complex suite of pH-dependent multimetric indices to assess waters in their six swamp regions, no other coastal plain state to date has developed a benthic macroinvertebrate protocol specific to swamps (Delaware assesses some swamps, but restricts sampling to main channel. Maryland is working on a method to address Blackwater Rivers, which can be swampy in nature, but does not currently employ a sampling method unique to swamps.) Research has found that it is inappropriate to use family-level taxonomy in assessing swampy habitats (King, 2001). Because of this uncertainty, a swamp genus-level index, in the probable event that a separate index for swamps is required, will need to be produced.

A CPMI validation effort

This effort would:

1) quantify how well existing CPMI metrics discriminate at genus level between impaired and unimpaired streams in Virginia's coastal plain.
2) determine the best suite of metrics for assessing these streams.
3) establish whether or not we need a separate suite of metrics for swamps.

The results of this work will enable us to increase the number of stream miles which we can confidently assess. This will also help guarantee that further stream monitoring in the coastal plains will generate appropriate data that can be used in strengthening VADEQ's assessments in all habitats.

Opportunities/ Risks

Opportunities

- CPMI validation would give support to assessment decisions of low gradient coastal streams.
- Increase the number of stream miles which we can confidently assess.
- Validate the best assessment tools for swamps for the Commonwealth of Virginia.
- Prevent some waters from being listed as impaired and being subjected to the costly TMDL process, when not appropriate. Saving the agency money.

Risks of not implementing CPMI Validation

- Failure to validate the CPMI will result in questionable assessments of low gradient coastal plain streams*.

*Here is a partial list of VADEQ sites which have been rated as impaired by the CPMI and for which there is insufficient chemical or other corollary data to support that rating (a data review would identify all such stations):

Blackwater River (Isle of Wight, VADEQ Station ID 5ABLW038.69)
Buckhorn Swamp (Southampton County, VADEQ Station ID 5ABKH005.16)
Round Hill Swamp (Southampton County, VADEQ Station ID 5ARHS000.39)
Seacock Swamp (Southampton County, VADEQ Station ID 5ASCK003.84)
Somerton Creek (Suffolk City, VADEQ Station ID 5ASTN002.43)
X-Trib to Bland Creek (Gloucester County, VADEQ Station ID 8-XEA000.12)

- 5800+ stream miles in lower piedmont and coastal plain will remain unassessed due to uncertainty in methods (14% of stream miles for which biological monitoring data has been collected).
- Application of weak or inappropriate tools to swamps and other low gradient streams will likely result in some non-impaired waters being identified as impaired (and vice versa). One TMDL can cost the agency in excess of $20,000 in consultant fees alone.

Risks of implementing CPMI Validation

- Completion of a CPMI validation may not guarantee a product which can be used to assess swamps easily or with a high degree of accuracy.
- Contractor costs for identifying problematic taxa (e.g., Chironomidae) to genus level could exceed $300 per sample

Resource Needs

CPMI Validation

- Project would require data from a minimum of 100 stations (50 impaired, 50 non-impaired).
- Independent water chemistry filters required for assigning test sites to “Reference” and “Stressed” categories. Lab costs for these analyses would be approximately $100 per site or less based on current DCLS prices (exact number of stations to be determined during data review).
- Additional staff time would be required to analyze data, test metrics (approximately 30 man hours) and develop a multimetric index. Index could be developed in-house without the costly need for consultants.

Suggested Solutions

- Review VCU benthic database (INSTAR) for useful information to augment data from EDAS.
- Follow USEPA National Wetlands Survey scheduled for field implementation in 2011 which may provide VADEQ with additional direction in developing a swamp index.

Tasks and Task Assignments

2009

- Spring/Fall 2009 and 2010 **PRO, NRO, and TRO biologists** begin sorting 200 organisms from all coastal low gradient/swampy sites for genus level identification; begin collecting chemical samples at all sites

2010

- Meet with Freshwater Probabilistic Monitoring Coordinator (FPMC), Jason Hill in January 2010 and begin data review for CPMI validation; determine number of additional sites from which data will need to be collected - **Workgroup and Biological Monitoring Coordinator (BMC)**

2011

- January 2011 – Determine if enough sites and data for CPMI validation
- Summer 2011 - Participate with VADEQ Wetlands Program in National Wetlands Survey to evaluate survey and index methods.
- In December 2011 begin testing metrics and metric ranges for the CPMI, selecting best working metrics that discriminate between impaired and non-impaired coastal streams; combine into new coastal plain macroinvertebrate index- **FPMC**, **Workgroup and BMC**

2012

- By December 2012 modify current habitat assessment protocol for coastal low gradient streams, according to National Wetland Survey, so that it can be used to assess swamps; determine if there is sufficient information on swamps in EDAS to test metrics. If so, select best metrics for swamps. If not, begin building the database required to do so (identify sites, sample, evaluate, etc.) - **FPMC**, **Workgroup and BMC**

Citations

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4. Develop a Biologist TMDL workgroup

Issue

The importance of precision regarding stressor identification is critical due to the amount of resources required to monitor and restore benthic impaired stream segments. Currently, Regional Biologists, TMDL Staff and TMDL contractors are not always in agreement regarding stressor identification. Collaboration between Regional Biologists and TMDL staff must be conducted as needed during benthic TMDL development in order to improve the accuracy of stressor analysis.

Background

Regional Biologist involvement in the development of benthic TMDLs varies widely among DEQ regions. Given the complexity of Benthic TMDL stressor analysis, good communication between the Biologist and TMDL staff is imperative. In some regions, Biologists are not involved beyond the assessment of biological monitoring stations. In other regions, Biologists attend public meetings and review TMDL documents related to pollutant(s) of concern to the benthic macroinvertebrate community. A proposed solution is to form a workgroup. Biologist/TMDL workgroup members would include Regional Biologists and TMDL staff. This workgroup would collaborate to gain a better understanding of data needs, when data should be collected, and how the data best describes the biological community in an impaired watershed. Benthic TMDLs are especially challenging because the specific causes of the impairment is not always clear, despite the detectable benthic community response to pollution or environmental stress. Stressor analysis is currently conducted by contractors. Occasionally, Regional Biologists, TMDL Coordinators, and Contractors will disagree with the resultant stressor identification. Due to contract timelines, there is not always sufficient time to collect additional benthic samples necessary to accurately identify the stressor and contracts are sometimes awarded before the need for additional chemical data collection and type is assessed. Better communication between Biologist and TMDL staff throughout Benthic TMDL development could help avoid these costly planning deficiencies.

Probabilistic Monitoring data shows that 44% of streams are moderately or severely stressed based on the VSCI and CPMI (VADEQ, 2008). Consequently, benthic impairments are increasing with each assessment cycle and subsequently will mean more benthic TMDLs will be required.

Opportunities/Risks

Opportunities from forming a Biologist/TMDL Workgroup

- Opening better lines of communication between Biologists, TMDL staff, and contractors in order to obtain the best information possible regarding stressor analyses, parametric coverage, sampling frequency, and defining relationships among the data and biological communities.
- Increase opportunities to de-list impaired stream segments through better communication, data review, and investigation prior to TMDL contracts.
- Create a more robust stressor analysis process and identify defensible stressor(s) by involving Regional Biologists (i.e. the regional experts on benthic macroinvertebrates) in the Benthic TMDL process

    - The workgroup would provide materials to help TMDL Coordinators plan their projects thus allowing enough time in advance to collect the appropriate parameters.
    - Workgroup members would share knowledge and literature reviews about benthic community responses to stressors (i.e. how specific contaminants affect benthics, sediment, habitat etc).
- Increased accuracy in identifying specific stressors for benthic TMDLs will result in more efficient resource allocations (time and money).
- Provide guidance on water quality, physical habitat, and biological data collection for TMDL development
    - Provide input on timing (relative to the contractor hiring).
    - Sample frequency (parameter dependant).
    - Recommend water analyte parameters to TMDL coordinators.
    - Provide guidance for chemical parameter selection for other programs such as PREP.
- Provide stressor guidance (information about screening values for various stressors)
    - Provide statewide percentiles of water quality parameters.
    - Provide screening values that help TMDL coordinators place water quality data into low, medium, high stressor risk (based on DEQ data collection and literature).
- Provide a forum to explore the potential of in-house stressor identification.
- Provide agency-wide evaluation of new tools like CADDIS (Causal Analysis/Diagnosis Decision Information System) which could be used to highlight data gaps or to support our hypotheses regarding stressor identification.
- Provide a forum to review other states' approaches to benthic TMDLs.
- Refine process of awarding TMDL contracts.
- Monitoring requests by TMDL staff will be more focused; thus, eliminating the cost of unnecessary monitoring.

Risks of forming Biologist/TMDL Workgroup

- Resource expenditures i.e. potentially utilizing approximately 3 weeks/member of time annually performing workgroup duties which would take away from other job duties.
- Potential for an increase in monitoring costs as data needs are identified to cover lab analyses for chemical sampling, salaries for additional time, and travel costs associated with collecting the samples.

Risks of not forming Biologist/TMDL Workgroup

- Inconsistency of Benthic TMDL development across regions.
- Insufficient data available for proper stressor identification
    - Weak stressor identification can lead to poor resource allocation

Resource Needs

- Formation of a biologist TMDL workgroup will require staff time and minimal funds for travel only.

- During the developmental phase or first year, Biologist/TMDL Workgroup members would have quarterly meetings to produce the following report – *Benthic TMDLs: Data Collection and Stressor Thresholds*
    - Approximately eight DEQ staff members would meet in Charlottesville, for the initial meeting and the final meeting.
    - The group would convene as needed via teleconference.
- Additionally, as issues arise meetings could take place as an agenda item at the annual biologist meetings.
- Electronic and hard copies of the technical document. Eight hard copies at approximately $40.00 each would equal $320.00. Fifty CDs will cost approximately $30.00.

Suggested Solutions

- Improve the process of Benthic TMDL development and the accuracy of stressor identification by developing and utilizing the report.
- Increase communication by a standing workgroup meeting as needed to address benthic TMDLs.
- Establish workgroup goal of strengthening the development of Benthic TMDLs including more precise stressor identification through improved communication between Biologists, TMDL Coordinators and Contractors.

Task and Task Assignments

2009

- Create a list of Biologists, TMDL Coordinators, and other staff willing to commit to the development of the reports and to serve on the standing Benthic/TMDL Workgroup March 2009 **– Workgroup and Biological Monitoring Coordinator (BMC)**
- Schedule and conduct quarterly meetings to develop the document, first meeting June 2009 **– BMC**
- Review existing guidance and Stressor Analysis documents such as CADDIS and make recommendations on how to incorporate some of these tools into TMDL development December 2009**–Workgroup and BMC.**

2011

- Compile draft of report; *Benthic TMDLs: Data Collection and Stressor Thresholds* and solicit peer review June 2011 **– Workgroup and BMC.**
- Distribute the draft; invite DEQ staff and TMDL contractors to a presentation of the document; solicit comments December 2011 - **BMC.**

2012

- Revise draft of report and distribute final copies on CD, post on Dent and Dew's website February 2012 **–Workgroup and BMC.**
- Establish goals of the Standing workgroup to reconvene on an as-needed basis to make recommendations and exchange expertise pertaining to benthic TMDLs August 2012 - **Workgroup and BMC.**

5. Algal Index of Biotic Integrity (IBI)

Issue

An index of biotic integrity for algae (diatoms) should be developed as a means to accurately and more cost effectively monitor streams and rivers for nutrient impairments, sedimentation, acidity, and metals.

Background

Nutrients are one of the leading causes of water quality impairments in Virginia waters. Within rivers and streams, chronic symptoms of nutrient over-enrichment include low dissolved oxygen, fish kills, nuisance algal growth, and species and abundance shifts of flora and fauna.

Along with physicochemical parameters such as pH and dissolved oxygen, impairment to the aquatic life use is based on impairments to the benthic macroinvertebrate community which are determined using the Virginia Stream Condition Index (VSCI) and the Coastal Plain Macroinvertebrate Index (CPMI). However, stressor analyses must be conducted to determine if nutrient enrichment is indeed the cause of impairment. Algae community data provides valuable information about nutrient enrichment, as well as other impacts including sedimentation, acidity, and metals. It is actually the algal biomass which is being considered as a surrogate for nutrient over-enrichment stressor analyses.

Epiphyte communities, especially those dominated by diatoms, are sensitive indicators to changes in water quality in streams and rivers. Epiphytes are primary producers and therefore respond directly to changes in water nutrient concentrations (Barbour et al. 1999). Algae generally have rapid reproduction rates and very short life cycles, making them valuable for short term impacts (Barbour et al. 1999). Algal assemblages are sensitive to some pollutants which may not visibly affect macroinvertebrates or fish, or may only affect other organisms at higher concentrations (Barbour et al. 1999). Studies have shown that indices based on diatom assemblage attributes are good indicators of detecting impairment caused by human disturbance (Hill et al. 2000, Wang and Stevenson 2005).

The periphyton (attached algae) community structure is not currently used to assess aquatic life use by the VA DEQ. Several other states including CO, DE, FL, ID, KY, MA, ME, MT, NM, SD, and UT have developed or are in the process of developing indices for periphyton/diatom assemblage structure (algal IBI). An index of biotic integrity for algae (such as the VSCI for macroinvertebrates) should be developed. Diatoms, which make up part of the periphyton community, will be used for the development of the index since they are ubiquitous and at least a few can be found under almost any environmental condition. In addition, most diatoms can be identified to species and tolerances or sensitivities to specific changes in environmental conditions are known for many species. Finally, EPA strongly recommends having two or more biological indices to assess aquatic life designated use.

Opportunities/Risks

Opportunities

VA DEQ already has algae samples identified from approximately 150 Probabilistic Monitoring (ProbMon) sites across the state, reducing the costs and time needed to develop an algal index. The collection and identification of 100+ additional algae samples is already planned through the ProbMon program.

An algal index of biotic integrity may help in the development of numeric nutrient criteria as well as help classify tiers of aquatic life uses for the Biological Condition Gradient (BCG) in Virginia.

Sampling is not time intensive (30-40 minutes per site) and VA DEQ biologists are already trained on collection protocols.

Contractor identification of algae communities is affordable; approximately $200 a sample for diatom identification from The Academy of Natural Sciences in Philadelphia.

By adding periphyton community structure as a tool to assess aquatic life use, VA DEQ will be able to detect nutrient over-enrichment in streams and rivers without costly and time consuming stressor analyses based on macroinvertebrate impairments.

Risks

Algal identification to the lowest taxonomic level requires trained phycologists. There are no phycologists currently employed by VA DEQ.

Resource Needs

Approximately $200 a sample for diatom identification from The Academy of Natural Sciences in Philadelphia (50-75 sites a year currently for ProbMon).

30-40 minutes per site for collection of algae.

Additional staff time would be required to analyze data, test new metrics and develop diatom multimetric index. (Approximately 300 DEQ staff hours per year, for a few years, split between workgroup of four people)

Suggested Solution

Develop an index of biotic integrity for algae (diatoms) that would accurately and cost effectively monitor streams and rivers for nutrient impairments, as well as, impairments caused by sedimentation, acidity, and metals.

Task/ Task Assignment

2011

- Create a VA DEQ algae (diatom) taxonomic database January 2011**– Workgroup and Biological Monitoring Coordinator (BMC)**
- Contact Academy of Natural Sciences to renew contract for increased diatom identification samples January 2011 **- BMC**
- Identify sites in ambient monitoring network where chemical data has already been collected and begin collecting algae there (approximately 20 sites per year) 2011 - 2012 - **Workgroup and BMC**

2013

- Form VA DEQ workgroup to create draft algal IBI during 2013, draft by December 2013**- Workgroup and BMC**

2014

- Assemble committee from The Academy of Natural Sciences, VCU and USEPA for peer review of algal IBI document March 2014 **– BMC**

Ongoing

- Continue algae collections at ProbMon sites **Ongoing –Regional Biologists**

References

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Wang, Y.K. and R.J. Stevenson. 2005. Development and evaluation of a diatom-based index of biotic integrity for the Interior Plateau Ecoregion, USA. JNABS 24(4):990-1008.

6. Training

Issue

Due to the small number of DEQ biologists, training needs are often not addressed by the typical classes offered by the agency. DEQ regional biologists have program specific training needs. The regionalized Biological Monitoring Program needs an avenue of communication to promote collaboration and increase the cohesiveness between the biologists.

Background

Each year, DEQ managers and staff are responsible for completing an Employee Development Plan (EDP) outlining the specific needs for the continued professional development of staff members. The biologist meetings are a good venue for determining the most useful specialized courses to request from training. The meetings also provide an avenue to conduct some of the specialized training required by the Biological Monitoring Program.

There are (as of 2008) 13 regional biologists who work solely within the boundaries of their respective regions. DEQ biologists are very knowledgeable about the types of streams that occur in their particular region and the impact of major stressors on those streams. However, this specialization has not been accompanied by a mechanism to familiarize biologists with the full diversity of Virginia streams and the varied, potential threats to stream health. A Biologist Exchange Initiative would provide such a mechanism by giving biologists from one region the opportunity to perform field and lab work with biologists from a different region. This form of cross-training would increase the knowledge base of every biologist; strengthen their ability to anticipate and solve problems; and improve the efficiency, reliability, and cohesiveness of the entire biomonitoring program.

Collecting and observing organisms in their natural habitat provide a critical opportunity to associate the organisms with the specific stressors affecting them. Certain stressors are localized or much more prevalent in certain regions. Examples include mining, fish farms, and heavy urbanization. Observing regionalized stressors would enable the biologist to recognize these stressors if/when the stressors appear in their home region. This would increase the overall efficacy of the group, identify potential improvements to the Biological SOP, and reinforce the efforts of the field audit program.

Opportunities/Risks

Opportunities

- Program specific training would increase the effectiveness and consistency of the biomonitoring program.
- Improved biologist collaboration will increase the likelihood of training courses which are tailored to meet the exact, specialized needs of the Biological Monitoring Program.
- Applicable training will ensure the program meets national/EPA standards and increases the likelihood of obtaining future funding to pursue program improvements.

- Increased communication among staff may identify hidden knowledge already within the agency. Individual staff may be able to train and inform others in specialized areas of interest (in-house training).
- Enhance biologist knowledge of specific macroinvertebrate taxa uncommon or non-existent in the biologist home region.
- Experience stream habitats that do not occur in the biologist's home region. For example, low gradient, sandy bottom streams and swamps are not generally observed by the "western" biologists and mountain streams are not experienced by the "eastern" biologists.
- Increased knowledge of all types of Virginia streams would enable all biologists to make meaningful contributions during discussions of biomonitoring issues even if certain issues do not directly impact all regions. This additional input will improve decision making and implementation of the biomonitoring program.
- Increase biologist knowledge of different stressors to biological communities and stream habitat.
- Opportunity to learn and disseminate field and laboratory techniques developed by biologists in other regions.
- Increased level of communication among all regions will result in more timely flow of information and ideas among biologists.
- Reinforce the efforts of other DEQ biologist workgroups by providing exposure to region specific issues: ecological and anthropogenic.

Risks

- Potential lack of communication between staff and management during EDP development may lead to ineffective-training relative to the tasks biologists perform.
- Highly specialized training and certifications may lead to increased expenditures to maintain certifications.
- Inconsistent qualitative habitat assessments and improper stressor identification due to limited information exchange between regions.

Resource Needs

- A biologist exchange initiative would require a certain amount of additional staff time as summarized below:

Travel time for biologists moving between regions (average of 6 hours/biologist/year of their travel year)

Organizational and scheduling time to create a valuable experience for each participating biologist (approximately 2 hours/biologist/year of their travel year)

Some of the time spent in the field would be devoted to showing the visiting biologist specific streams of interest (approximately 8 hours/biologist/year of their travel year). Most of the field time would be spent engaged in normal biomonitoring activities such as probabilistic or TMDL monitoring which require at least two field staff members.

Lodging and per diem expenses would be the major direct financial costs associated with this program. Each biologist participating in the exchange program that year would spend an average of 3 days and 2 nights.

- Annual DEQ biologist meetings and the annual Mid-Atlantic Aquatic Biologist meeting at Cacapon must be fully funded to facilitate unique training opportunities by providing access to EPA and neighboring state biologists. This access will also enable DEQ to explore what neighboring states are doing to improve their biological monitoring programs.

- Schedule time during DEQ biologist meeting exclusively for training.

- Foster and maintain a good working relationship with academic institutions to provide specialized, science-based training. An on going relationship will enable the trainer to become more familiar with DEQ programs and provide the in depth, targeted training needed.

<u>Suggested Solutions</u>

- Establish and sustain a "training workgroup" among biologists to discuss the training needs of the program.

- Include training agenda items during biologist meeting
    - Discuss current training needs.
    - Discuss available training opportunities.
    - Deliver training – visual habitat assessment recalibration, SOP review, special topics, etc…

- The Biological Monitoring Coordinator will discuss the specialized training recommendations of the biologists with the WQMA Manager.
  WQMA Manager will discuss with the regional water quality managers, Water Division Manager, and DEQ training managers.

- Establish a Biologist Exchange Initiative in which every biologist has the opportunity to work for 2-3 days in at least one other DEQ region.

- Utilize the current DEQ training scheme (EDP/TCC) for generic training needs (team building, excel, communication, etc.) while developing specialized training within the department (genus level taxonomy, dendrology, statistics, etc.)

- Utilize the DEQ KC (Knowledge Center) as an online repository for training resources (taxonomy keys, field techniques, list of DEQ in-house training resources, etc). Published items in the public domain are not subject to copyright limitations if they are intended for knowledge sharing and not for material gain.

Task and Task Assignments

2009

- Develop training topic priorities, instructors, and preparation of courses throughout the year. Requested training opportunities are due to Biomonitoring Coordinator by February 1st (beginning 2009) to facilitate inclusion in the Agency Training Plan each year or development of specialized training not included in the Agency training plan – **Workgroup and BMC**
- Gain access to the DEQ KC as an authorized uploader of information to facilitate the exchange of training materials and information to the biologist group and the entire agency August 2009 **–BMC.**
- Initiate an agency wide, multimedia survey to discover hidden skills and knowledge to utilize for in-house training opportunities. The survey could be administered during EDP development November 2009 **– BMC and Workgroup**
- Attend meetings and/or conference calls held in June and December (beginning 2009) every year to discuss developing training opportunities, contracting instructors, and scheduling training events **– Biologists and BMC.**

2010

- Organize the Biologist Exchange Initiative, selection of regional destinations for each biologist, so it can be implemented in March 2010 **– Workgroup and Biological Monitoring Coordinator (BMC)**