Final Report
May 2013
New Mexico Wetlands Ecological Indicators Project
Assistance Agreement No. CD #966558-01-0 E (FY2007)

(This project is Part E of a larger 2007 grant award to NMED Wetlands Program entitled "2007 New Mexico Wetlands Awards Project.")

Vegetation Patch Diversity on the Rio Santa Barbara (photo M. McGraw)

Project Goals and Objectives

New Mexico is in the process of developing rapid assessment methods (NMRAM) for various wetland subclasses throughout the state. There is a need to validate our landscape and rapid assessment methods using more detailed and intensive methods and indicators, to ensure that NMRAM is providing an accurate picture of wetland condition. Through this project, a Vegetation Index of Biotic Integrity (VIBI) for the mid-montane riverine subclass of wetlands is developed using current data collected from the Upper Rio Grande reference domain and legacy data collected from reference sites by the University of New Mexico (UNM) Natural Heritage Division of the Museum of Biology.

A VIBI focuses on plant indicators of ecosystem integrity that reflect stressors such as hydrological alteration, exotic species invasions, soils disturbance, and other human-

caused disturbance processes. A VIBI is made up of a suite of metrics derived from detailed quantitative field vegetation data that are scaled in such a way that the average overall score of the index ranges from 0.0 to 1.0 (poor to excellent condition). A VIBI score can be applied explicitly to rate and monitor ecosystem condition with respect to maintaining or restoring wetland integrity. It can then be used to evaluate the efficacy of semi-quantitative rapid assessment methods such as the NMRAM (Muldavin et al. 2011).

The final product for this project is the Final Report for **A Vegetation Index of Biotic Integrity for Montane Riverine Wetlands in the Upper Rio Grande Watershed of New Mexico** (Attachment) which includes a literature review, sampling design, a Floristic Quality Assessment Index and other vegetation indices that form the basis of the VIBI model, the VIBI based on a correlative sensitivity analysis with NMRAM metrics, an initial validation using legacy plot data from the Upper Rio Grande and an assessment of the VIBI as a tool for evaluating wetland ecological conditions in the context of a human disturbance gradient for the Upper Rio Grande watershed. The final results and analysis **(VIBI Final Report)** includes the use of legacy data in the analysis that was funded in part under another project - Task 8 of "Rapid Assessment of Wetlands in the Upper Rio Grande Watershed Phase 2" CD #966857-01-0B (FY2008).

The results of this project demonstrate the use of detailed vegetation data to assess the ecological condition of Mid-Montane Riverine wetlands. Wetlands restoration and management can then be improved to prevent disturbance and provide protection to suites of plants known to correlate with the lowest levels of human disturbance (reference sites). Vegetation suites provide habitat for other taxonomic groups such as birds and fish. In turn, the VIBI can also be used to improve management of wetlands based on vegetation attributes and habitat characteristics. VIBI is another important tool that improves the State's ability to protect, manage, restore and increase its wetlands resources.

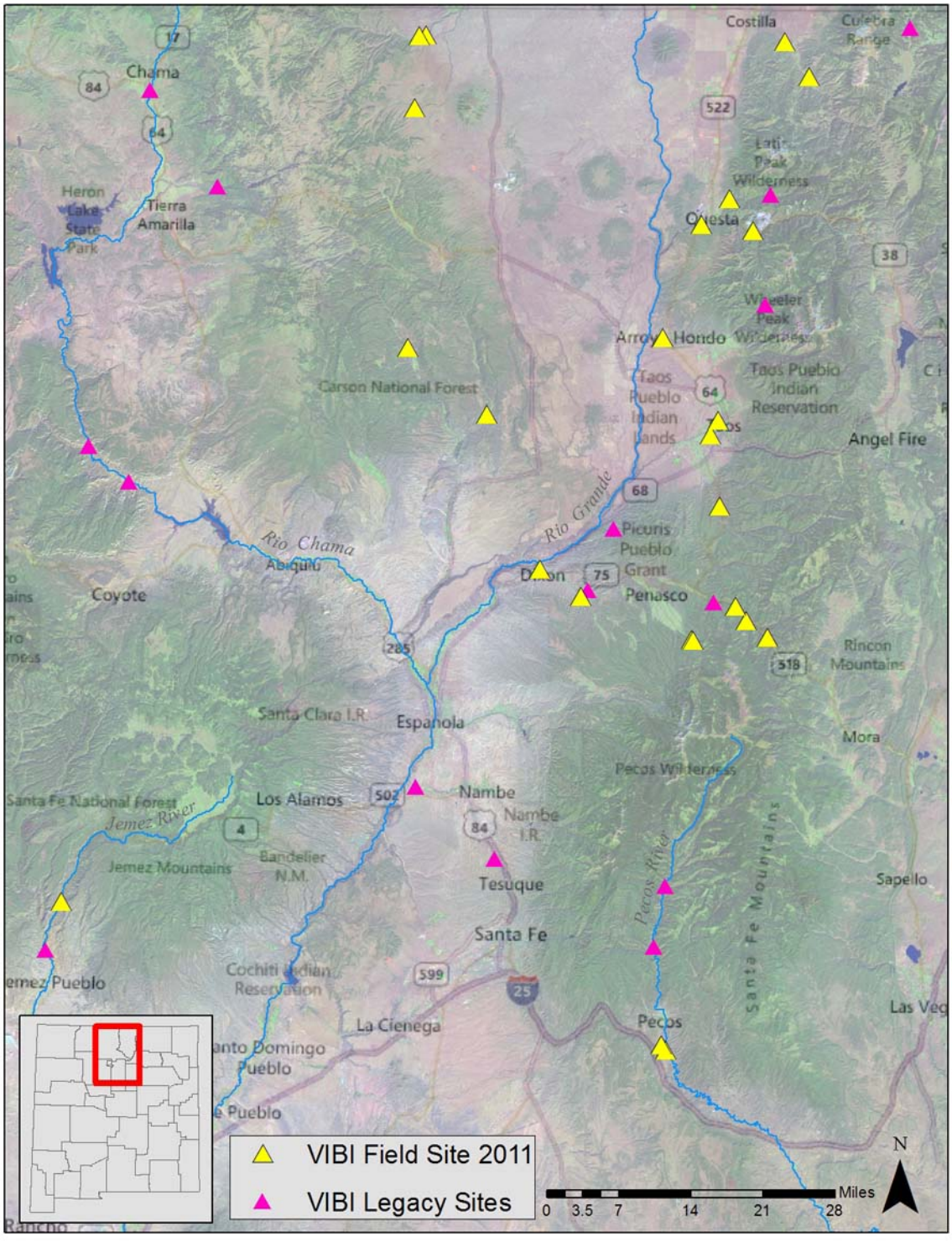
Project outcomes:

- A tool for evaluating the condition of a wetland in comparison to a level of human disturbance.
- A tool for establishing performance standards based on suites of plants.
- Metrics that identify reference standard wetlands in need of special protection.
- Development of a higher standard of performance for antidegradation (CWA Section 303) for rare and declining wetland subclasses.
- A tool for establishing a baseline of wetland condition based on an expected suite of plants for Mid-Montane Riverine Wetlands in New Mexico.

In combination with the use of NMRAM, the VIBI provides a more comprehensive evaluation of wetland condition. It helps to detect local, historic and cumulative effects of degradation in a wetland and will help sort out which types of human disturbance causes degradation of suites of plants. The VIBI helps to determine the correlation of plant suites and the discriminating power of individual plants to human disturbance gradients.

Project Location

The VIBI is being tested in the Upper Rio Grande Reference Domain in northern New Mexico (See map below). The results of this project have statewide application.



Location of VIBI data collection sites and VIBI legacy sites

Original Timeframe

A timeline was created for this project that began in November 2007 and was to be completed by December of 2011. The project was amended for a no cost extension, due to a reduction in SWQB staff and a hiring freeze, and also to change the Index of Biotic Integrity (IBI) from macroinvertebrates to vegetation. SWQB lost key Monitoring and Assessment Section staff that would have developed the macroinvertebrate IBI in-house. The Wetlands Program Coordinator took over as project lead and has more expertise in vegetation which would allow for completion of the project. The development of the VIBI was by a contractor (UNM, Natural Heritage Division of the Museum of Biology) selected through an RFP. The stated goals and objectives of the project remained the same, as well as some of the key project Tasks.

Partners Involved

The SWQB Wetlands Program partnered with UNM Natural Heritage to complete this project. Input on the coefficients of conservatism and on the development of the VIBI was provided by botanical experts Joanna Lemly from Colorado Natural Heritage Program, Joe Rocchio from Washington Natural Heritage Program, Bob Sivinski, currently a contract biologist but formerly the State Botanist from the New Mexico Department of Energy, Minerals and Natural Resources, Kelly Allred, coauthor of Flora Neomexicana and Tim Lowry, UNM Biology Department. The project was introduced and shared with stakeholders through a one-day training Botany Booster in November 2012, in which over 30 participants attended including state and federal agencies and tribes. A second Botany Booster will be held in the summer of 2013 under the Phase 2 portion of this project (Task 8 of CD#966857-01-0B (FY2008). In addition, during site selection and data collection, if anyone including landowners were interested, the assessment team and data collection team would share information about the project.

Funding

The original Federal amount was **$177,149.00** which was spent and **$60,950.00** match. The **final match amount** was **$$94,896.60 ($33,946.60 overmatched).** See semi-annual reports for details.

Major Project Highlights and Chronology

- Signatures on the Cooperative Agreement between NMED and EPA were completed on November 1, 2007. This project is Part E of a larger 2007 grant award to NMED Wetlands Program entitled “2007 New Mexico Wetlands Awards Project.”
- Shann Stringer of the Monitoring and Assessment Section was the Project Officer for this project. Shann Stringer participated on the Advisory Team for the development of the NMRAM for the Upper Rio Grande so that this project would be coordinated with NMRAM development.
- The Monitoring and Assessment Section Biological Assessment Team begins identifying and placing potential 12-digit -Hydrologic Unit Codes (HUC) (located

within the 8-digit HUCs in the Geographic Location section) along the Human Disturbance Gradient (Drake 2004, EPA 2005) in 2008.

- The development of a sampling plan for macroinvertebrates was started in early 2008 by Shann Stringer.
- Site Reconnaissance completed in September 2008. Human Disturbance Gradient GIS work was completed. Land Use/Land Cover calculations were completed in Feb. 2009.
- Calculation of match from water quality sampling WTUs is completed in early 2009.
- The Monitoring and Assessment Section acquires one compound microscope that is suitable for use for this project.
- Major staff changes including Shann Stringer taking another job in Texas, and a hiring freeze led to a delay in this project. Maryann McGraw has now taken over this project in spring 2009.
- The Ecological indicator for the IBI is changed from macroinvertebrates to vegetation in May 2009 and the revised workplan approved by EPA on August 28, 2009.
- Plant data collection suitable for making decisions regarding the design of this project is completed in September 2009 under the NMRAM URG project CD #966349-01-0A (F06).
- An RFP to hire a contractor to complete the Vegetation Index of Biotic Integrity (VIBI) was developed, and the RFP was advertised and released on March 10, 2010.
- An Interagency Agreement (IGA) with UNM Natural Heritage for the Development of a Wetlands Vegetation Index for Riverine Wetlands on the Upper Rio Grande was completed on December 29, 2010.
- The 2007 Wetlands Award Grant which includes this project as 966558-01-0E was awarded a no cost extension through December 2012 on September 13, 2011.
- A PQAPP for this project was approved by EPA on October 20, 2011.
- A set of potential data collection sites were identified based on the subclass, reference domain and level of disturbance. Forty-four sites were being considered.
- The study design for field data collection was completed and permission was obtained for data collection at 18 NMRAM sites and 6 new reference domain sites.
- VIBI data and supporting NMRAM data were collected for 24 sites (53 VIBI plots) in October 2011. The field data collection included vegetation plots, hydric soils descriptions, tree stand structure data and conducting the NMRAM at the new sites. The vegetation and stand structure data were then entered into the NHNM Ecology database.

Pecos VIBI sampling site with a cross-section set-up for conducting NMRAM.

Soil profile from VIBI vegetation plot

VIBI vegetation plot from which soil profile was taken.

- Plant Voucher Specimens collected in the Fall 2011 were frozen to kill pests and delivered to the UNM Herbarium for identification which was completed May 2012.
- An Amendment #1 to extend the term of the existing Intergovernmental Agreement (IGA) with UNM Natural Heritage for the Development of a Wetlands Vegetation Index for Riverine Wetlands on the Upper Rio Grande was completed on December 19, 2011 and extended the term to November 2012.
- IGA amendment #2 was completed in May 25, 2012 to include additional tasks funded through a 2008 grant (Task 8 of CD 966857-01-0B Rapid Assessment for New Mexico Wetlands Upper Rio Grande Phase 2.) The IGA extends the length of the contract until January 2013 to accommodate using legacy sites data in the VIBI analysis. The extended time and task was to be paid for under Task 8 of CD #966857-01-0B.
- An announcement about the VIBI was made to the NM Agency Wetlands Roundtable in February 2012.
- A draft plant species list was compiled for the reference domain from 2009 and 2011 surveys and also includes plant species from other sources including Colorado Natural Heritage Program, USDA PLANTS database, and federal and state stewards in May 2012.
- The legacy site data was included in the analysis in July 2012 and was paid for under CD # 96685701-0B.
- Assignment of the draft coefficients of conservatism to the species list (800 species) was sent to potential participating experts in September 2012.

- A literature review was completed and an annotated bibliography prepared for the Interim Final Report for this project in October 2012.
- An amendment to move funds between tasks was received from UNM Natural Heritage and approved by the Wetlands Program Coordinator. IGA Amendment #3 was developed and approved on January 22, 2013, to extend the term of the VIBI IGA with UNM Natural Heritage to July 31, 2013, to complete the project tasks. The remaining project Tasks 13 and part of Task 14 would be completed under *Task 8 Refine a Wetlands Vegetation Index of Biological Integrity of CD #966857-01-0B* (see Seventh Semi-Annual report Task 8 for CD #966857-01-0B Rapid Assessment for New Mexico Wetlands Upper Rio Grande Phase 2)) project.
- A one-day Botany Booster Training that included presentation of the VIBI was conducted in December 2012 as an outreach and technical transfer component of this project. About 30 agency, tribal and NGO participants representing USACE, NMDOT, EMNRD, Pueblo of Sandia, USFWS, Interstate Stream Commission, ranchers and private consultants attended.
- The multi-metric analysis was started in December 2012.
- An Interim Final Report for the first 13 Tasks was delivered to SWQB in January 2013 which completed the work under this Project. The remaining work under IGA contractor Task 13 and Task 14 were completed under CD # 96685701-0B funding.
- The Final Report was delivered to SWQB on September 24, 2013. The Final Report for this Project from the SWQB Wetlands Program was submitted to EPA on September 24, 2013.

List of Major Deliverables

- **Grant and Contract amendments.**
- **Botany Booster Training materials and sign-in sheets.**
- **Interim Final Report** "A Vegetation Index of Biotic Integrity for Montane Riverine Wetlands in the Upper Rio Grande Watershed of New Mexico."
- **Final Report** "A Vegetation Index of Biotic Integrity for Montane Riverine Wetlands in the Upper Rio Grande Watershed of New Mexico." (Attached)
- **Semi-Annual and Final Reports, Match reporting**

Lessons Learned

UNM Natural Heritage (E. Muldavin) had these comments about lessons learned from developing the VIBI.

1. The assigning the Coefficients of Conservatism can itself be a conservative process. There is a tendency by botanists to *not* assign species to the tails of the disturbance spectrum because of uncertainty of both the definition of the disturbance gradient and because ecological behaviors of many species is unknown. This may lead to a lower sensitivity of the subsequent floristic quality indices. A clear and as a quantitative as

possible a discussion of anthrogenic disturbance gradient is important, particularly in riparian ecosystems where natural disturbance is the norm.

2. When analyzing relationships between VIBI indices and the underlying disturbance gradient represented by other metrics, using equivalent-scaled data would improve the analysis. That is, comparing FQA indices that are at a high level detail (Level 3) with more coarsely grained measures of the environment (level 2) may not have sufficient robustness to yield significant trends.

3. While increasing the number sites for sampling across a geographic domain is desirable, the tradeoff is in how much detailed sampling can be done at a site given project resources. In retrospect, placing more emphasis on individual but fewer sites might have yielded more finely honed details on the relationship of a VIBI to the underlying disturbance gradient.

What made the project successful?

This project is successful because it is the first Vegetation Index of Biotic Integrity for New Mexico and adds a useful and versatile tool for the management of wetland resources.

The VIBI correlated with some of our metrics that are being used for NMRAM. The VIBI metric with greatest number of significant correlations to NMRAM metrics was Mean C Graminoids All (native and non-native). Generally the higher the site scores on this metric (less anthropogenic disturbance), the higher the NMRAM score (the fewer the anthropogenic impacts). It was also one of the few to show a correlation with multiple abiotic NMRAM metrics. Mean C Grams Native also correlated with some of the same metrics as Mean C Graminoids All, but had a higher correlation with Land Use Index and was kept in the VIBI model for that reason. When grasses and forbs are considered together under Mean C Herbs All, comparatively strong correlations occurred with Relative Native Plant Community Composition (RNPCC) and Invasive Exotic Cover. Floristic Quality Index All (FQI All) also showed an affinity to Invasive Exotic Cover, but also a positive correlation to the overall Biotic Summary score and was kept for that reason (the only positive correlation among the set). Conversely, Non-Native Species Richness along with Mean C Shrubs All and Wetland Indicator Shrubs All were negatively correlated with Biotic Summary scores, perhaps reflecting the non-native components of each of those indices. The latter two were also inversely correlated to Native Riparian Tree Regeneration suggesting an interaction between shrubs and tree establishment. When all nine indices are combined into a final VIBI score, the strongest NMRAM elements of the underlying correlation matrix are what continue to be significant, i.e., Relative Native Plant Community Composition, Invasive Cover and the overall Biotic Summary score. (See Final Report for further discussion of these results.)

What made the project not so successful?

The project progressed slower than expected. In 2008, the SWQB lost key staff due to a hiring freeze and staff shortage. This project was delayed until reassignments could be made. In addition, the RFP process for hiring a contractor took about nine months to complete.

Technical Transfer

What information can you pass along to other agencies, cooperators or local landowners in other watersheds about this project?

The VIBI process can provide a useful tool for management of wetland resources on a finer scale when needed (See list under project outcomes.) There are a number of known caveats when using VIBI data to evaluate a wetland resource.

(From Andreas et al 2004) As with any tool, proper and appropriate use is of paramount importance.

- Caution should be used in comparing FQAI scores from different investigators or different studies unless it is determined that equivalent levels of floristic survey effort were used, especially for qualitative inventories.
- It is important that scores are compared within the same plant community type, in this case montane riverine wetlands. An intact plant community with a naturally high proportion of habitat specialists will score higher than an equally intact plant community that is naturally dominated by more generalist species.

EPA Feedback Loop

What would you suggest that EPA do differently to improve the process in regard to this project?

EPA was very supportive in all aspects of this project during the project period, especially allowing grant period extensions to complete high quality and meaningful work.

Future Activity Recommendations

- The VIBI should continue to be developed for wetland subclasses in New Mexico because of its usefulness and relative inexpensive cost compared to other IBIs.
- More work needs to be done on anthropogenic disturbance of wetlands and its affects locally, watershed wide and cumulatively.
- Trainings should be conducted in wetlands assessment methods to engage others in collecting needed wetlands data.
- All wetlands assessment data should be housed in a one-stop web-based accessible database.