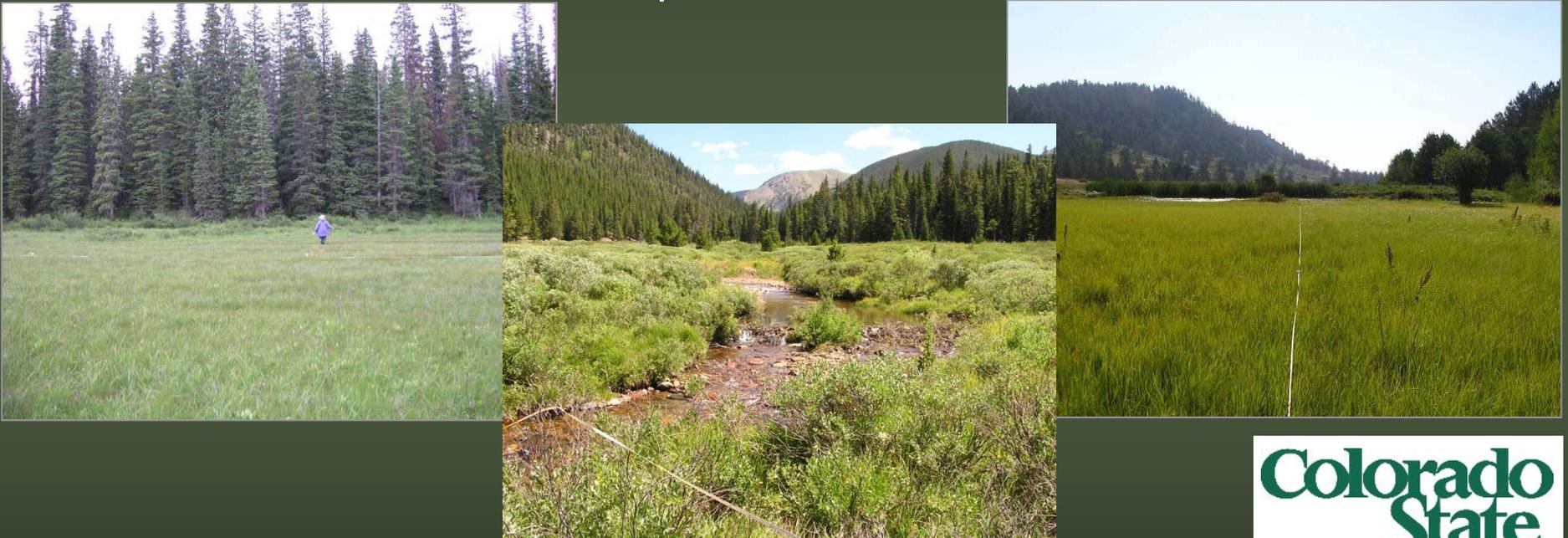


Vegetation Index of Biotic Integrity (VIBI) for Headwater Wetlands in Colorado

Seventh National Monitoring Conference
April 26, 2010



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Vegetation Index of Biotic Integrity (VIBI)

- Biotic integrity was defined by Karr and Dudley (1981)¹ as the ability of a resource to
"support and maintain a balanced adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitats within a region"



- An IBI is a collection of biological indicators (metrics) that reflect the condition of an area as compared to reference sites
- Originally developed using fish and benthic macroinvertebrates
- Recently adopted for wetlands. Colorado is 2nd in the West.

¹Karr, J.R. and D.R. Dudley (1981) Environmental Manager (5) 55-68

Why a Vegetation-based IBI?

1. Vegetation influences most wetland functions
2. Vegetation structure and composition provides habitat for other taxonomic groups
3. Vegetation is the primary vector of energy flow through wetland ecosystem
4. Strong correlations exist between wetland vegetation and water chemistry
5. Plants are the most conspicuous biological feature of wetland ecosystems
6. Vegetation integrates spatially and temporally variable human-induced impacts

Thus, vegetation is correlated to key factors of the chemical, physical, and biological integrity of a wetland

VIBI Development Process: 3 Phases

- Phase 1: 2004-2006
 - Determine appropriate wetland classification system
 - Select sample sites across disturbance gradient
 - Test sampling protocols
 - Conduct initial sampling (52 sites)
- Phase 2: 2006-2007
 - Complete development sampling (23 new sites)
 - Test and select vegetation metrics
 - Construct VIBI models, version 1.0
- Phase 3: 2007-2009
 - Conduct calibration sampling (38 new sites)
 - Test version 1.0 models with new data
 - Calibrate and adjust models to create version 2.0
- Funded by three EPA Region 8 Wetland Program Development Grants and support from Colorado Division of Wildlife
- Reports available on our website

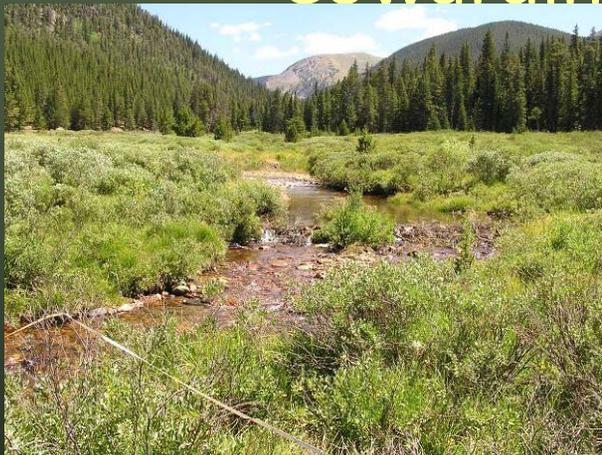


Wetland Classification System

- VIBI models discriminate “Signals” from “Noise”
- Classification constrains variation
- Which system to use?

HGM Class Ecological Systems

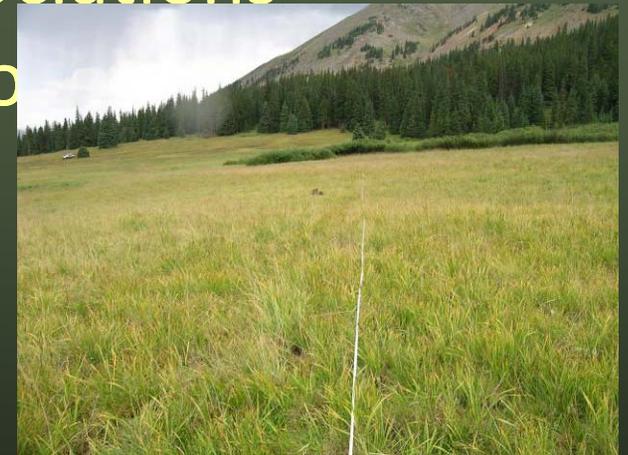
Cowardin Class Plant Associations



Riparian Shrublands



Fens



Wet Meadows

Sample Site Selection

- VIBI Development Sites (2004-06)

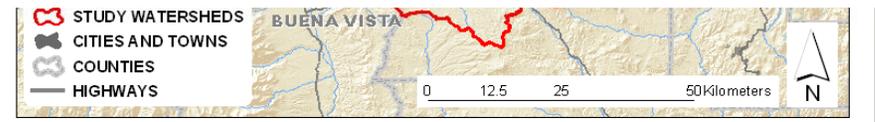
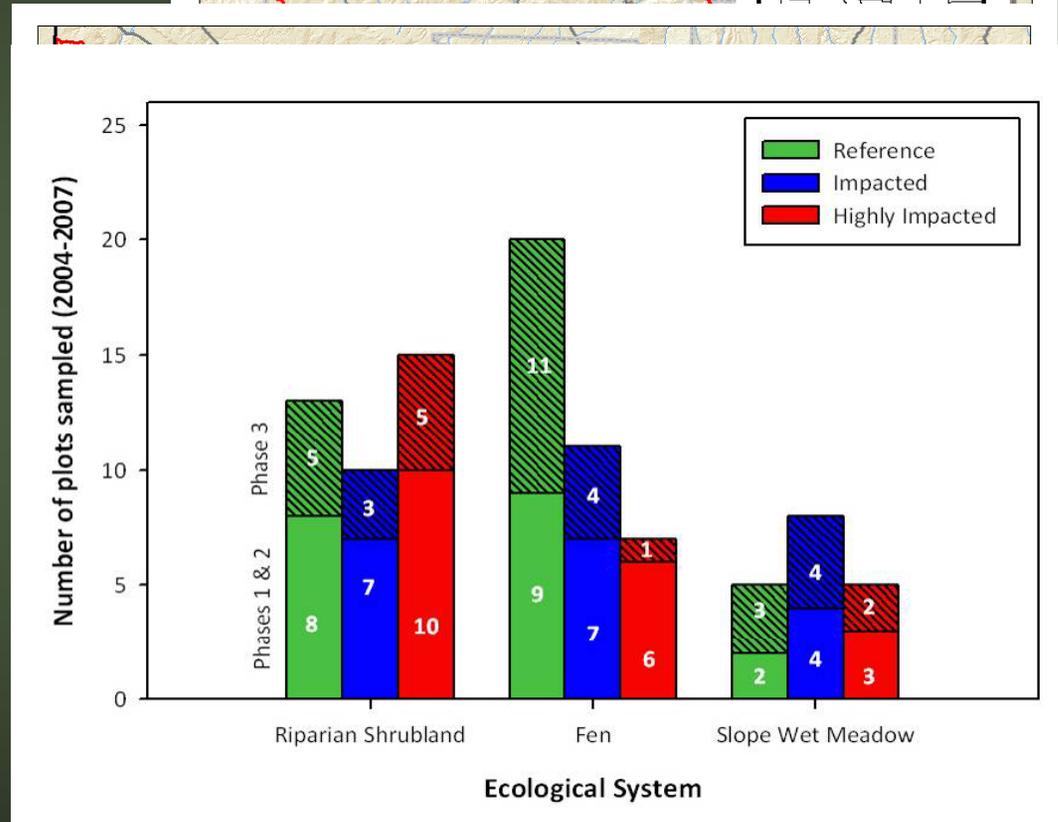
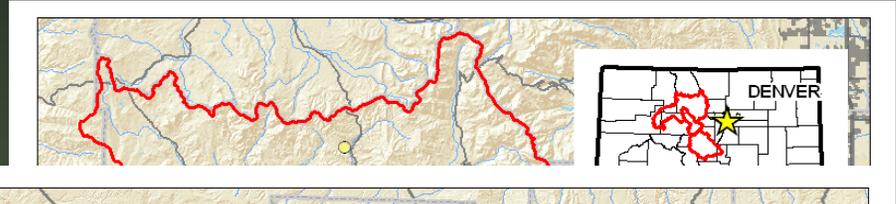
- Targeted sites
- Span disturbance gradient
- Central Colorado
- Park, Summit, Grand Counties
- 8,000-11,000 feet

- VIBI Calibration Sites (2007)

- Randomly selected sites
- Some targeted sites
- Central Colorado
- San Juan Mountains

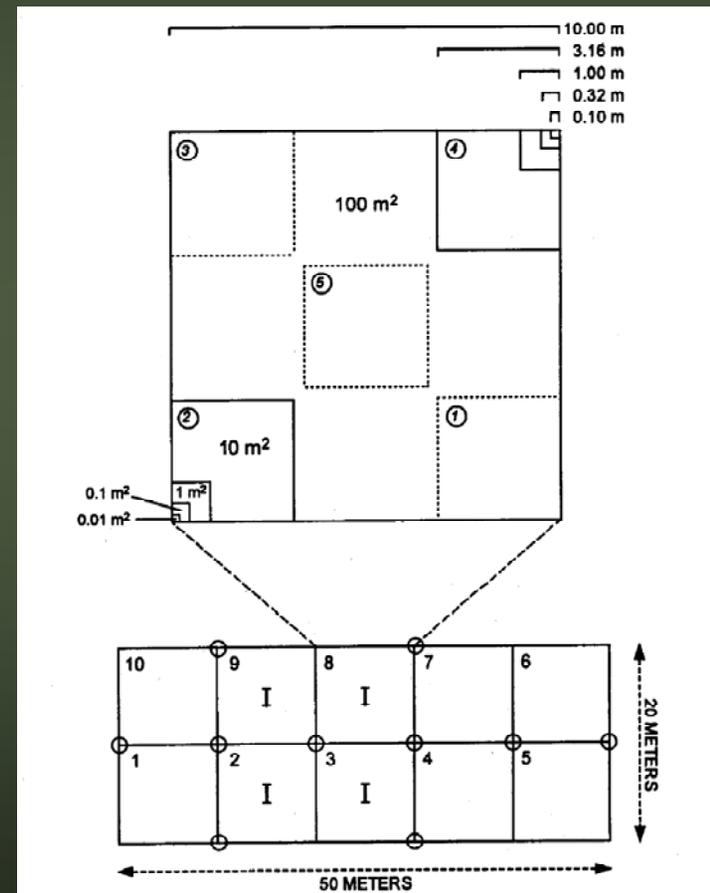
- 94 Total Sites

- 38 Riparian Shrublands
- 38 Fens
- 18 Wet Meadows



Vegetation Data Collection

- Plot methods adapted from Carolina Vegetation Survey (“Peet” Plot)¹
- 50 m x 20 m with 10 modules
- 4 “intensive” modules with nested subplots in two corners



¹Peet, R.K. et al. (1998) *Castanea*, 63: 262–274.

Human Disturbance Index

- Buffers

- Average Buffer Width
- Land Use in 100 m Buffer
- % Unfragmented Landscape within 1 km
- Riparian Corridor Continuity



- Hydrology

- Hydrological Alterations
- Upstream Surface Water Retention
- Upstream/Onsite Water Diversions/Additions
- Floodplain Interaction



- Physical/Chemical Disturbance

- Substrate/Soil Disturbance
- Onsite Land Use
- Cattail Dominance
- Toxics/Heavy Metals
- Algal Blooms
- Bank Stability
- Sediment/Turbidity

- Scale of 0.0 – 100.0

- Reference, Impacted, Highly Impacted

Data Analysis: Building the VIBI Models

- 133 Vegetation Metrics Tested by Ecological System
 - Floristic Quality Assessment (Mean C, FQI, AFQI, nativity, cover-weighted)
 - Lifeforms (tree/shrub/graminoid/forb)
 - Duration (annual/perennial/woody)
 - Genera/Families (*Carex*, *Salix*, Poaceae)
 - Wetland indicator status (% hydrophytes, mean wetland indicator)
 - Ground cover (bare ground, litter, bryophytes)

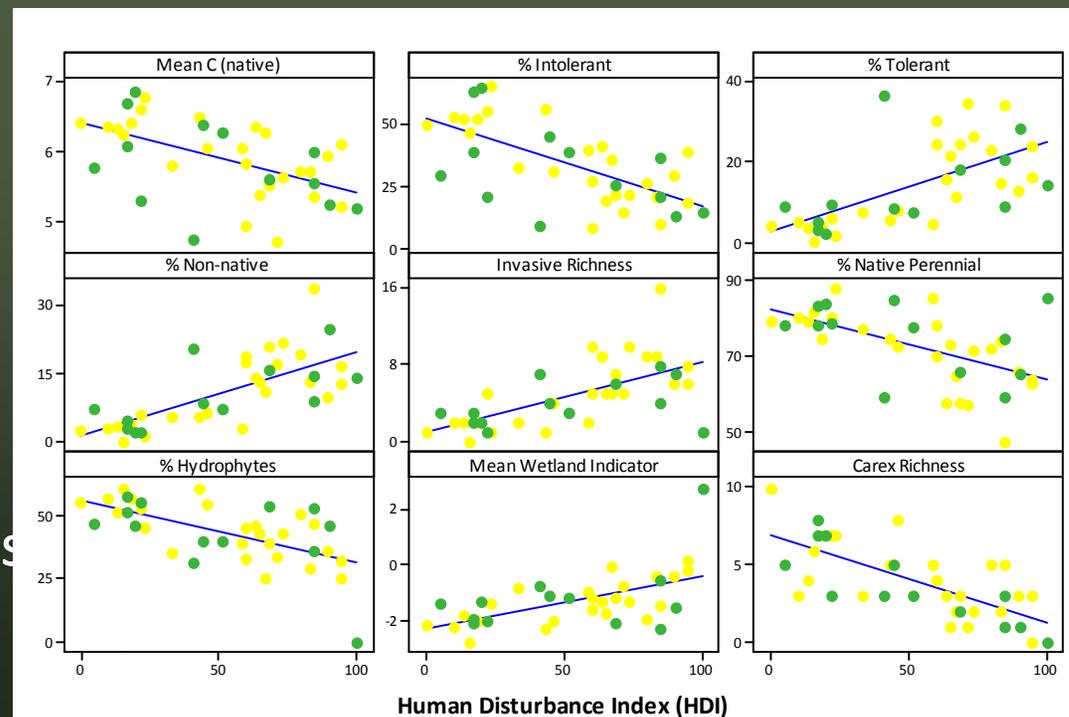
- Metric Selection Rules

- Correlation to disturbance (HDI)
- Discriminatory power
- Scope of detection
- Redundancy

- Metric and VIBI Scoring

- Each metric scaled from 0.0-10.0
- Metrics averaged for final VIBI Score

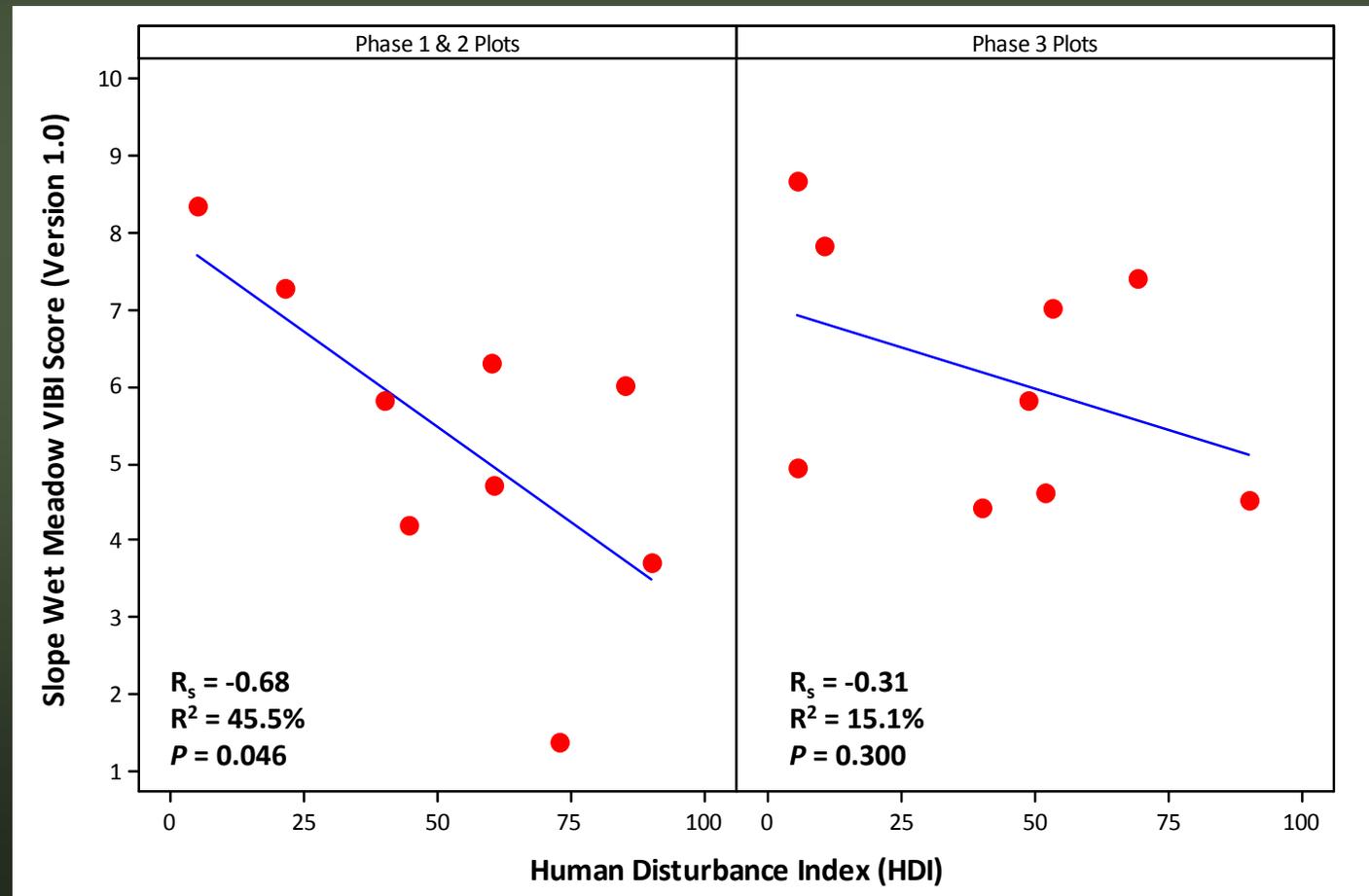
- Version 1.0 developed in Phase 1



Data Analysis: Calibrating VIBI Models

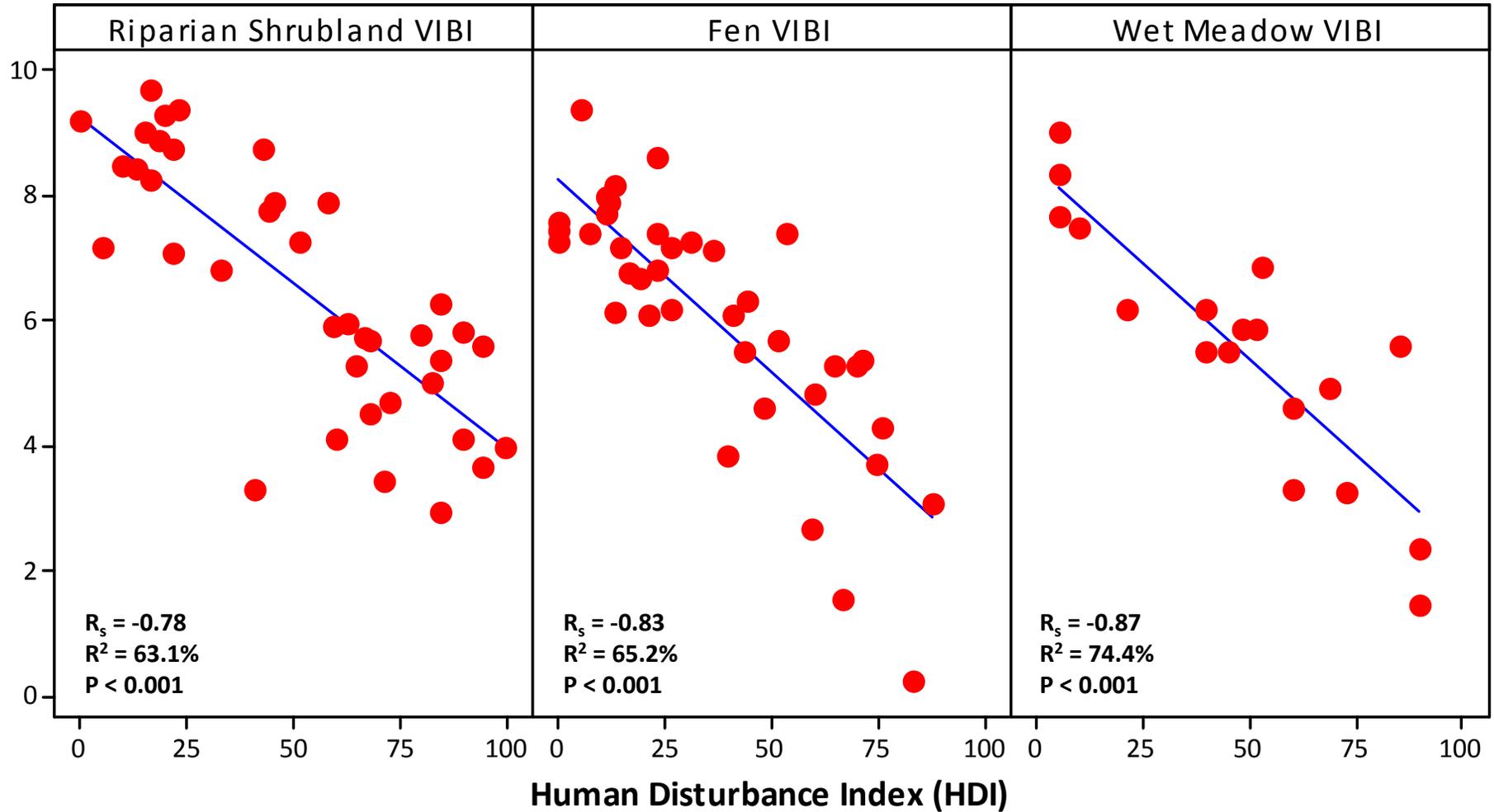
- Version 1.0 Models tested with Calibration Plots in Phase 3
 - If strength of correlations (R_s) differed by < 0.10 , considered validated
 - No model considered validated, all needed calibration
 - Re-ran metric selection process to identify metrics to retain, modify, replace

- Version 2.0 Developed
 - Details available in the Phase 3 report



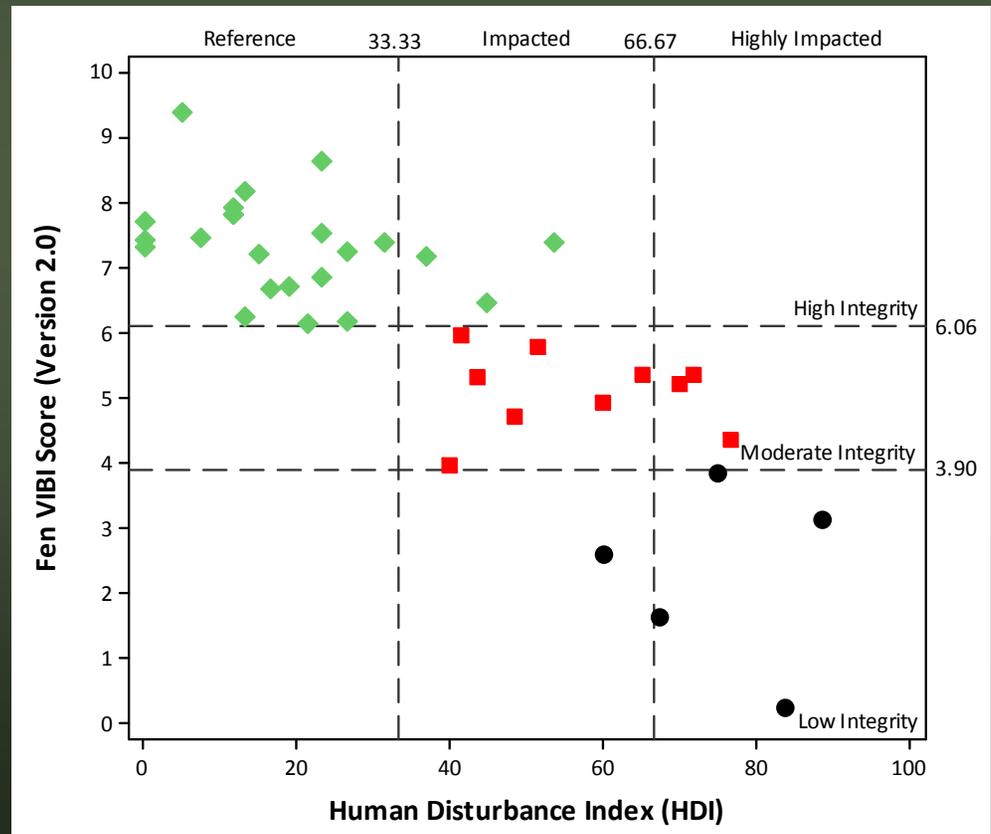
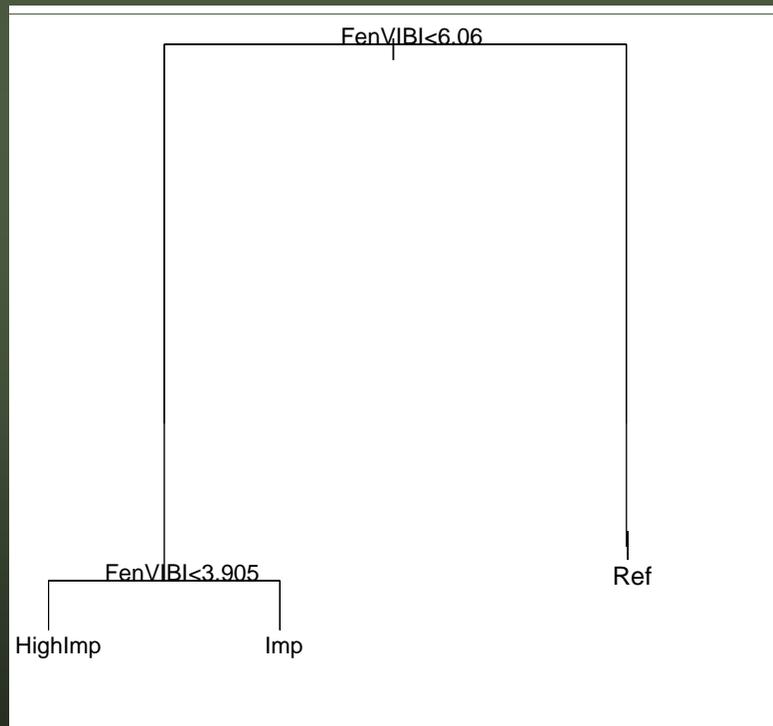
Metrics	Riparian VIBI	Fen VIBI	Wet Meadow VIBI
Mean C (native)	X	X	
cw FQI			X
% Intolerant species	X	X	
Intolerant species richness			X
% Tolerant species	X	X	
% Non-native species	X	X	
Total cover native species		X	X
Invasive species richness	X		
Total cover perennial species			X
% Native perennial species	X		
Native perennial species richness			X
% Native forb species			X
% Hydrophytes	X		
Total cover hydrophytes		X	X
Mean wetland indicator	X		
<i>Carex</i> species richness	X		
Relative cover <i>Poaceae</i>			X
Total cover bryophytes		X	
Total cover litter		X	
Total cover bare ground		X	X

Final Calibrated VIBI 2.0 Models



Condition Classes Based on VIBI Scores

- Condition Classes Threshold Developed
 - Instead of arbitrary breaks in VIBI Scores
 - CART Models used to find thresholds
 - Thresholds will improve with more data



VIBI Uses and Applications

- Assessment/monitoring
 - Assess wetland condition
 - Monitor effectiveness of wetland protection projects
 - Monitor effectiveness of wetland management practices
- Assessing water quality
 - Report status/condition of waters as required by Section 305b of CWA
- Identification of impaired “waters”
 - As required by Section 303(d) of CWA (i.e. TMDL)
- Define wetland tiered aquatic life uses
- Prioritization of potential mitigation, restoration & conservation sites
- Characterize reference conditions
- Calibrate Level 1 & 2 wetland assessment tools

Rio Grande Headwaters Pilot Project

Project Partners:

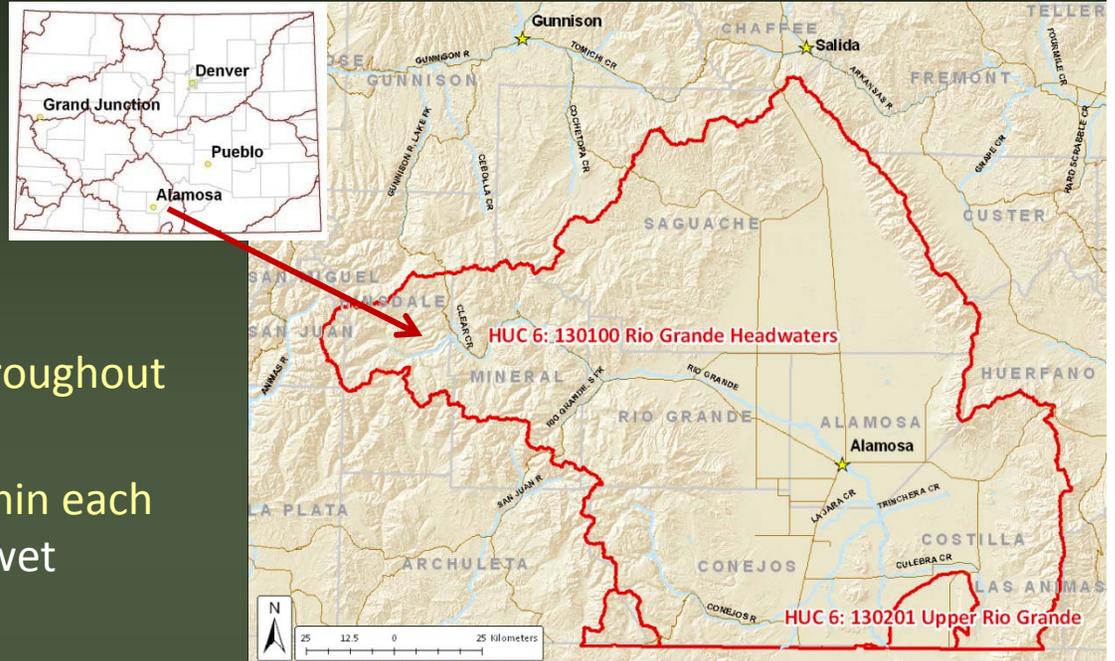
- CNHP, CDOW Wetlands Program
- Funded by EPA Reg 8, Rio Grande NF

Project Objectives:

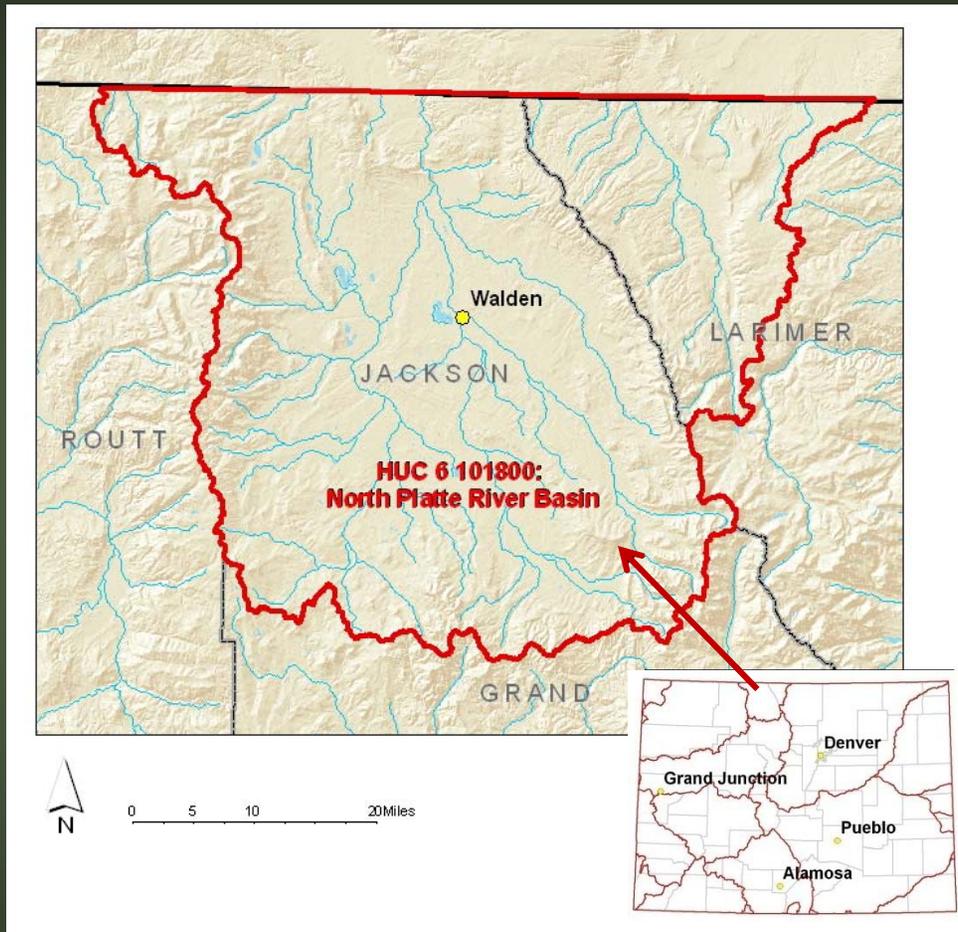
1. Compile spatial data on wetlands throughout the basin
2. Quantify proportion of wetlands within each major wetland type: riparian areas, wet meadows, fens, playas, marshes
3. Within each wetland type, quantify proportion of wetlands within four major condition classes: excellent, good, fair, poor
4. Use the information to drive protection and conservation action by the Colorado Division of Wildlife.

Project Timeline:

- 2008 to 2011
- Three seasons of field data collection



North Platte Basinwide Wetland Profile



Project Partners:

- CNHP, CDOW, CSU Statistics Dept
- Funded by EPA Region 8

Project Objectives:

1. Compile existing spatial data for wetlands
2. Conduct a statistically valid survey of wetland condition
3. Model the distribution of wetland condition throughout the basin
4. Determine optimal metrics for measuring key habitat features for wildlife

Project Timeline

- 2009 to 2011
- Two seasons of field data collection



Acknowledgements

- Joe Rocchio, Washington State Natural Heritage Program
- Jill Minter, Brent Truskoski, Rich Sumner, U.S. EPA
- Bill Gooseman, Diane Gansauer, Paula Nicholas, CDOW
- John Mack, Ohio EPA
- Shawn DeKeyser, NDSU
- Marc Jones, MT NHP
- Brad Johnson, CSU
- Rich McEldowney, PBS&J
- USFS, Summit County, SAIC
- Landowners
- Amy Jacobs, Delaware DNREC
- CNHP Staff and Field Crew Members

Questions?

