



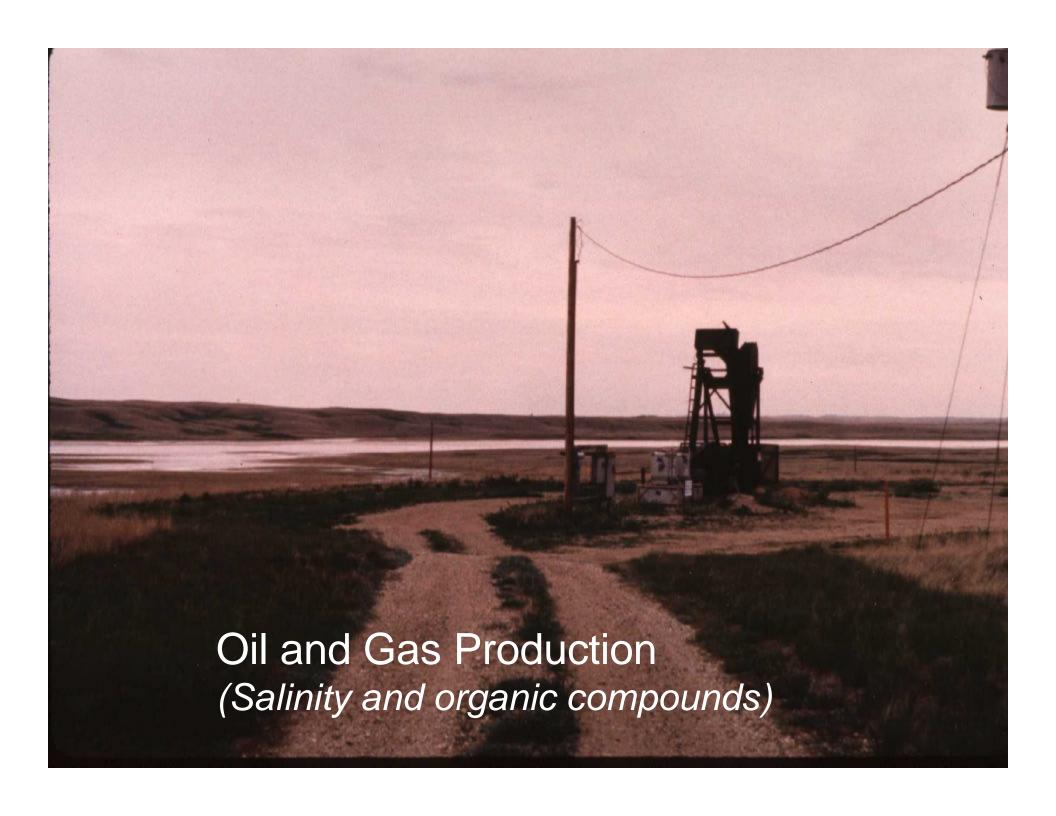
#### Wetland Bioassessments

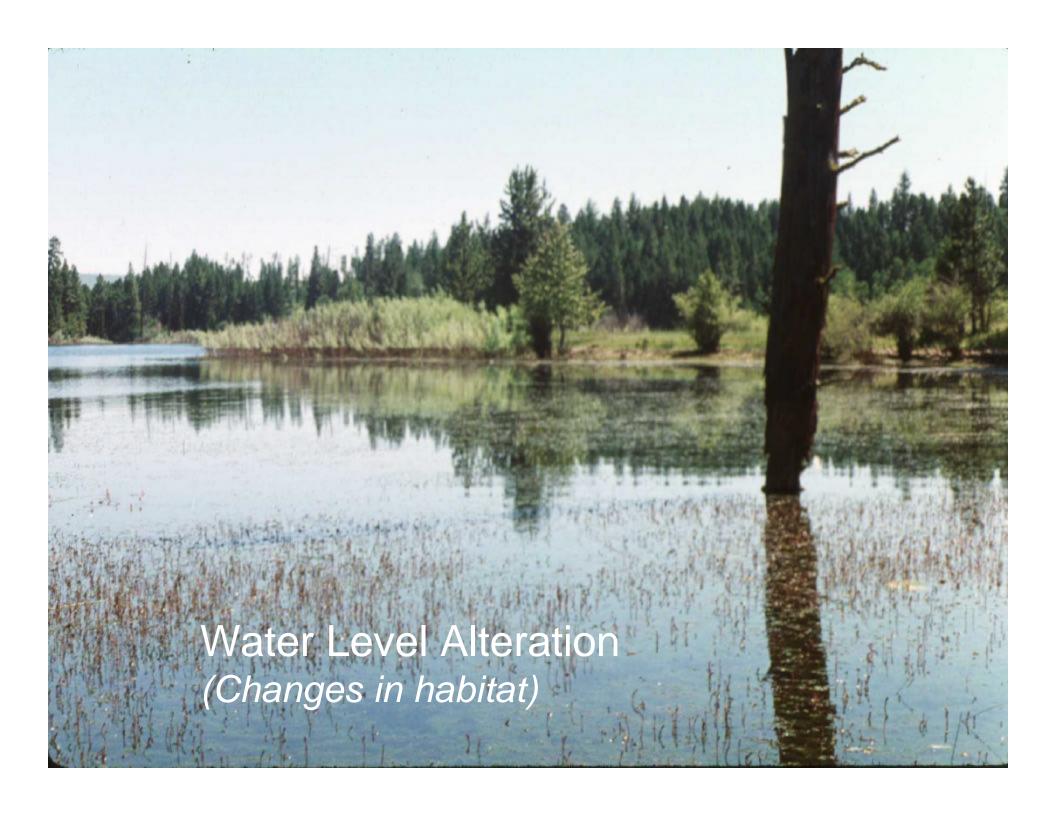
- Briefly present the approaches Montana has used to develop wetland biocriteria.
- Explain how Montana uses biological data to determine whether water quality standards are being achieved.
- Discuss the application of bioassessments to TMDL's.
- Provide an example of our assessment process.

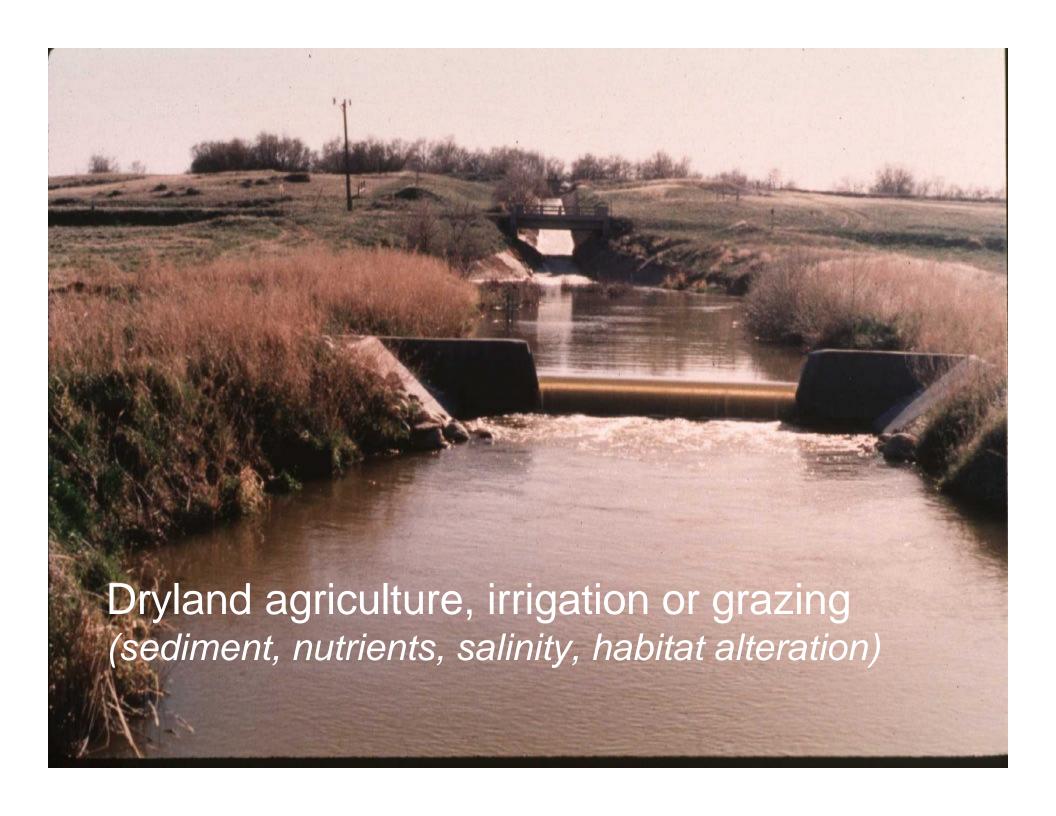


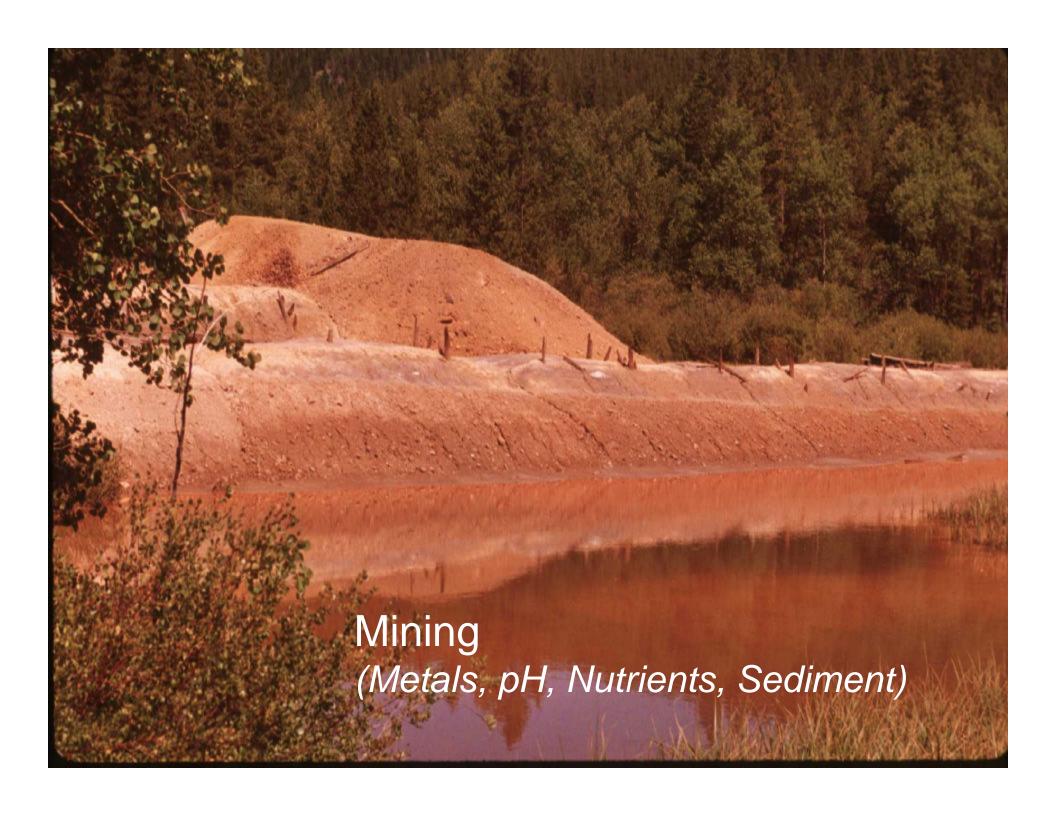
What type of impacts can wetland bioassessments detect?











#### 1993-94 Study Objectives

• Develop bioassessments tools that can detect human impacts to wetlands

• Develop a classification system that can stratify the natural variability found in wetland biological communities

• Determine whether aquatic life uses were supported

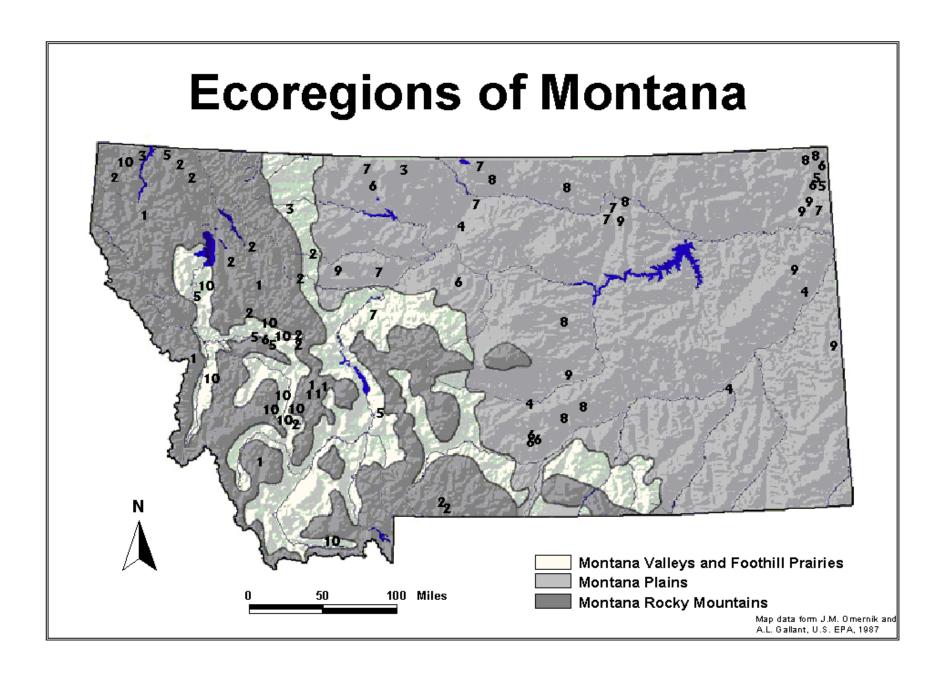
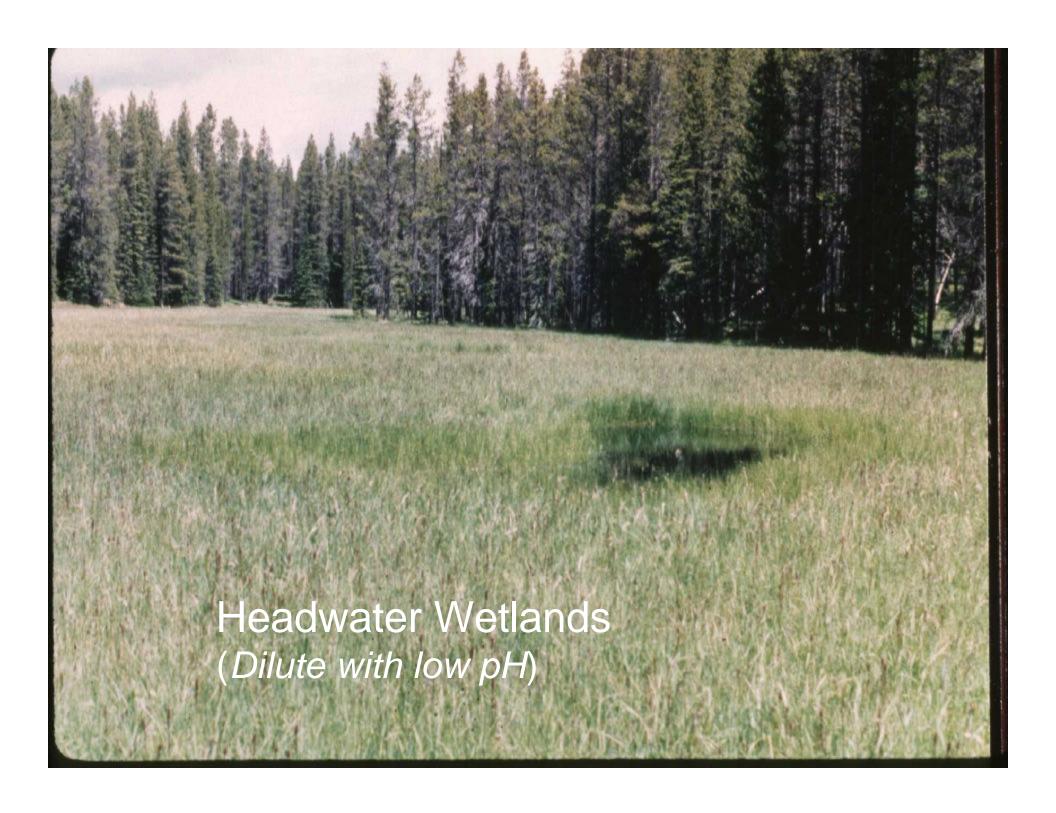
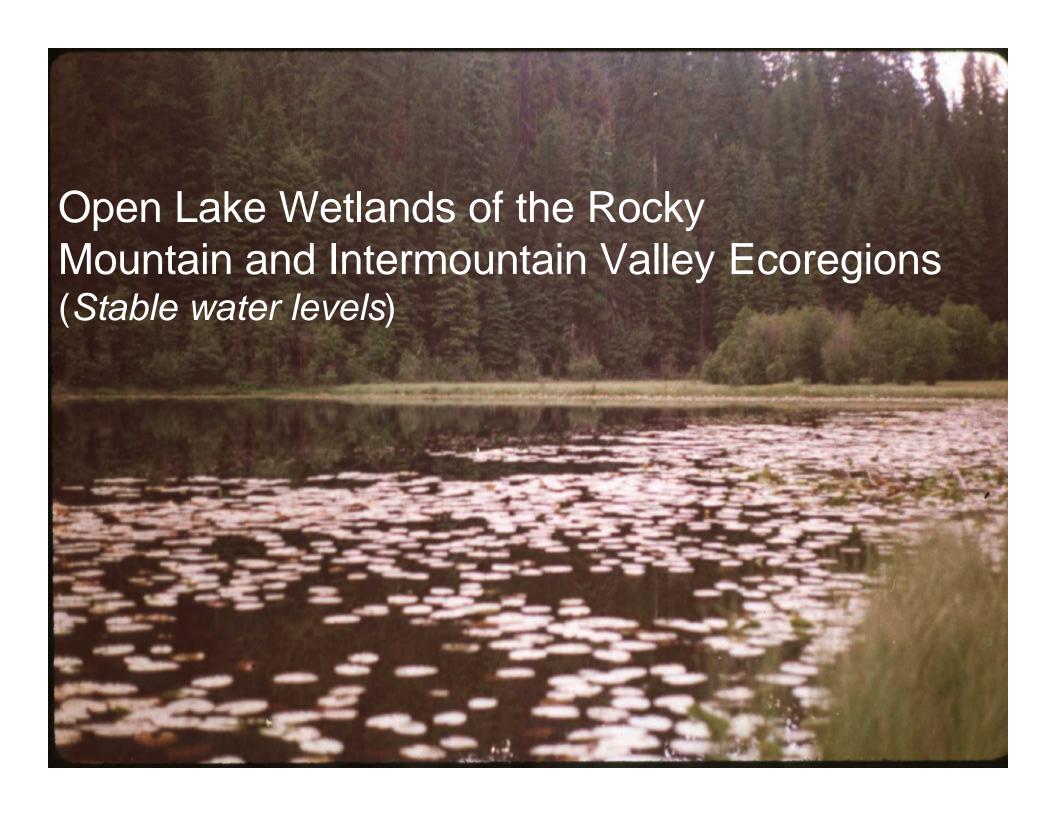
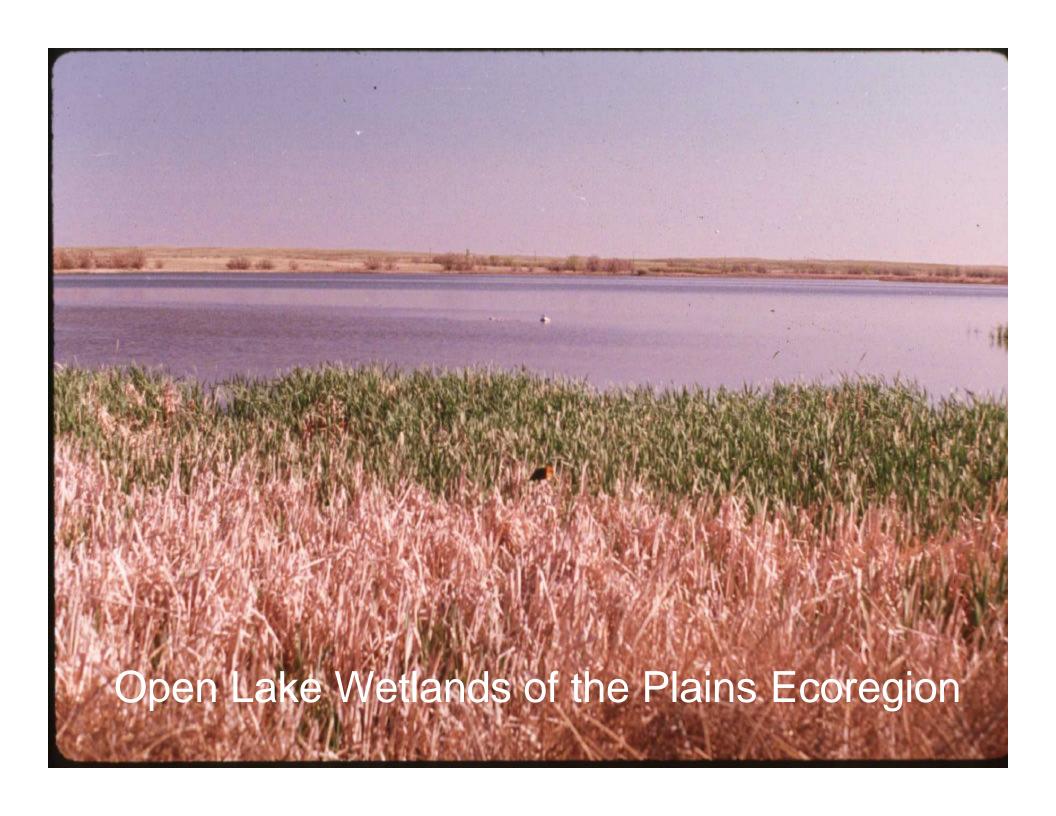


Table 1. Comparison of Biocriteria and HGM Wetland Classes

Biocriteria Wetland Class	HGM Wetland Classes	Description
Headwater wetlands	Extensive peatland	High elevation wet meadow or bog
Riparian wetlands	Riverine	Flood plain
	Slope	Break in slope where groundwater is discharged(eg spring)
	Extensive peatland	Rich fen
Open lake wetland	Fringe	Shoreline of lacustrine
Closed basin wetland	Depressional	Pothole
	fringe	Large shallow reservoir or playa lake

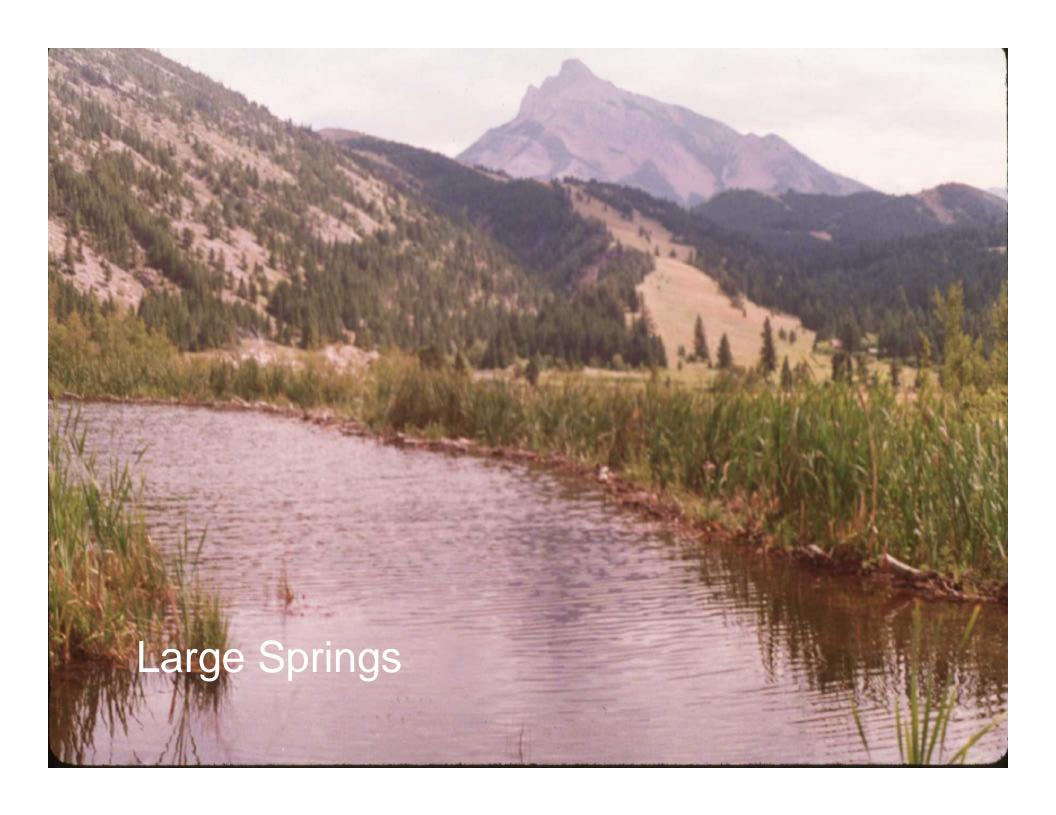




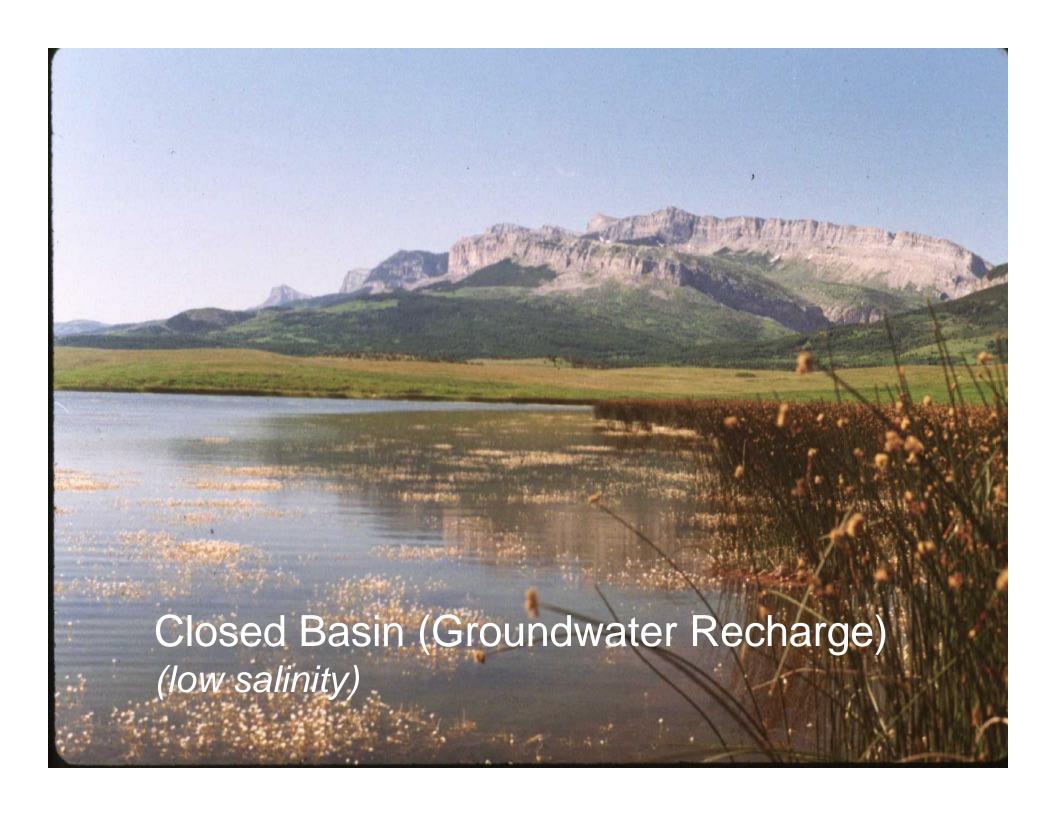


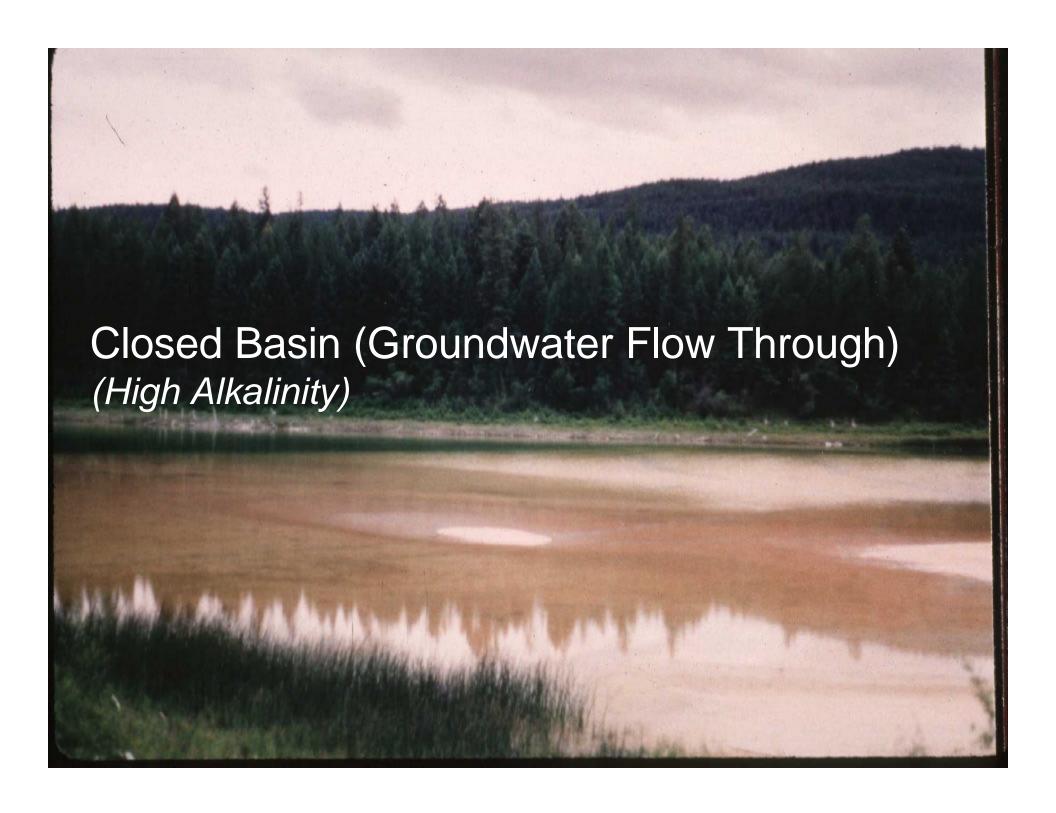


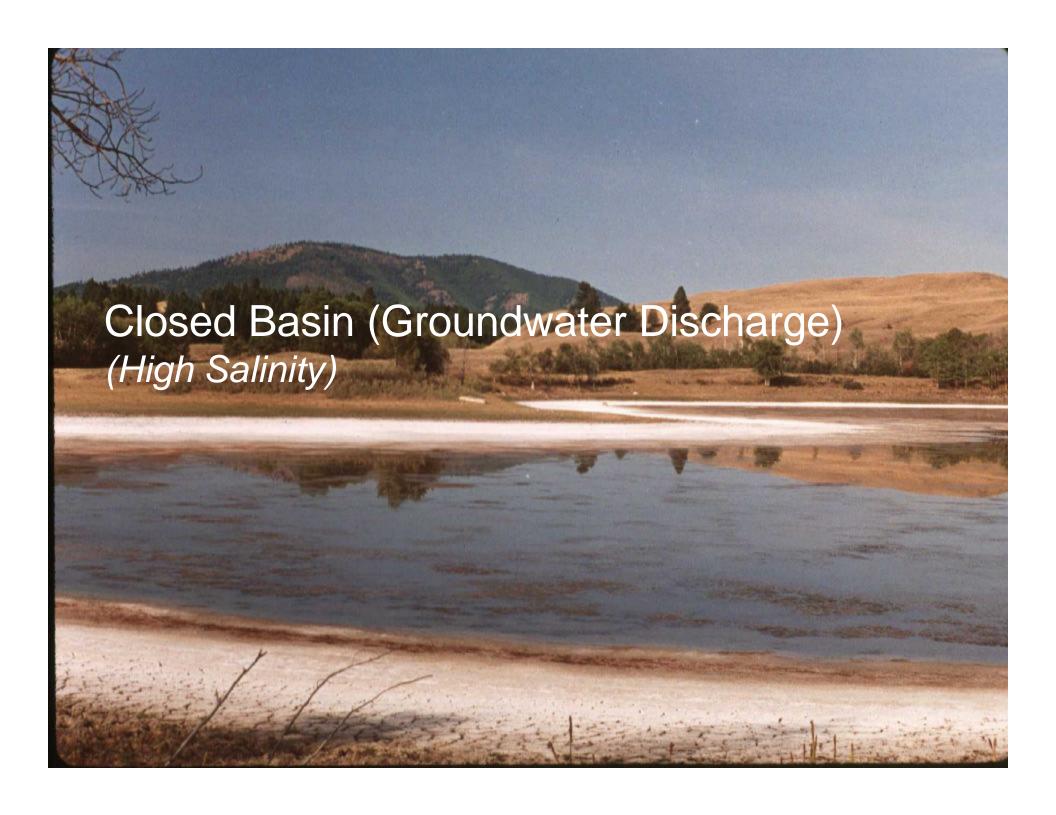


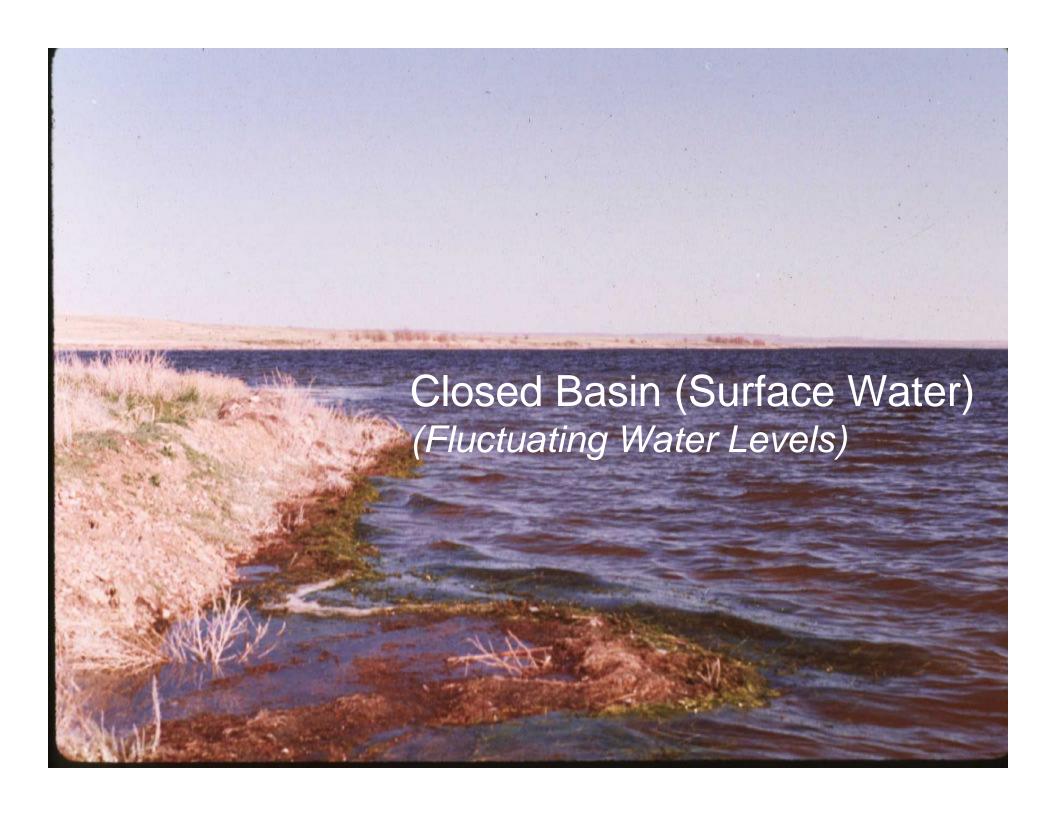


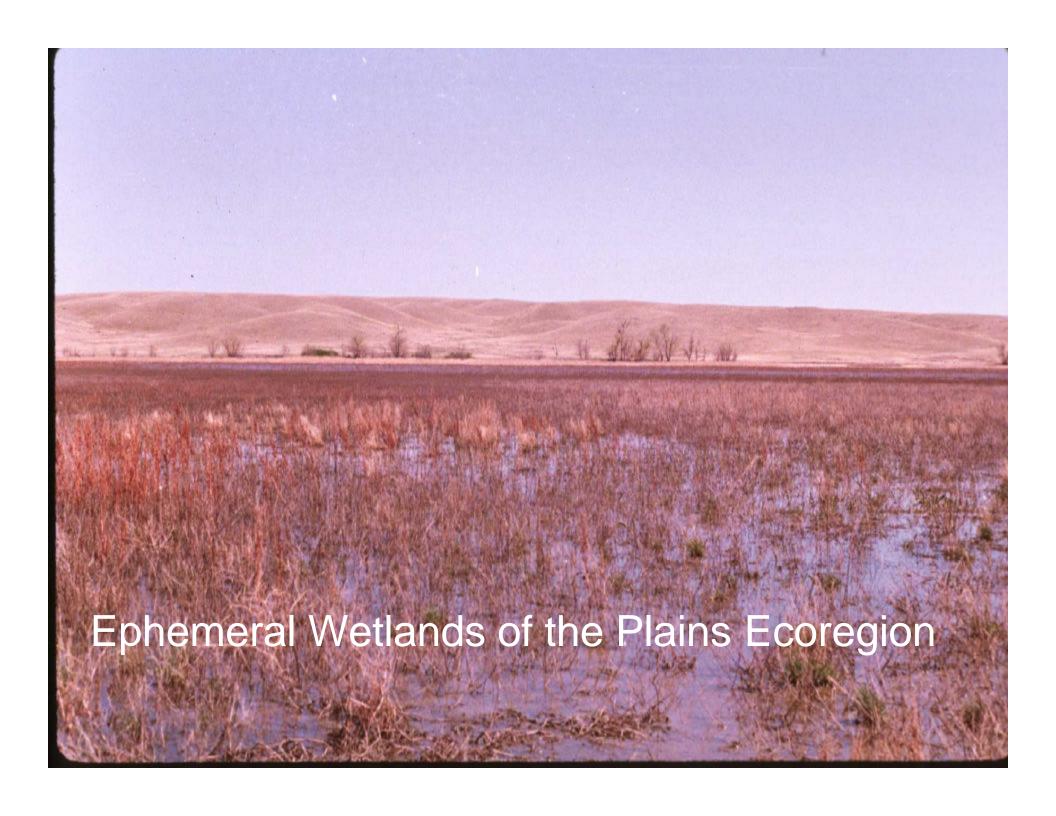




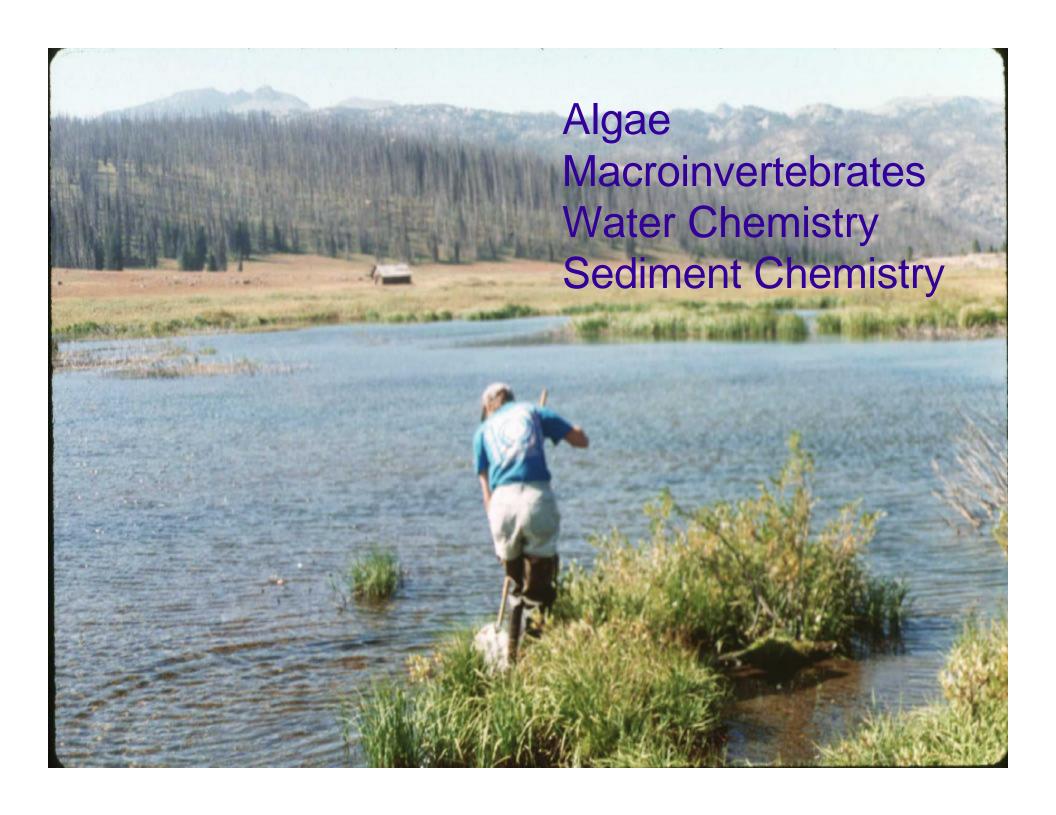


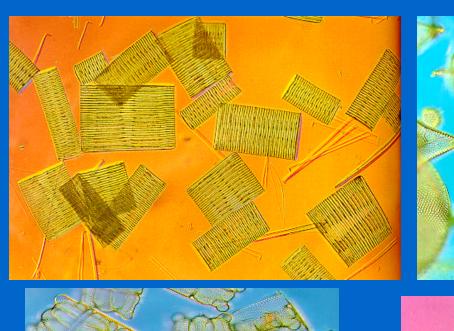




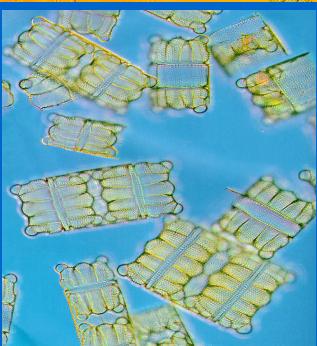


### Wetland Sampling Methods











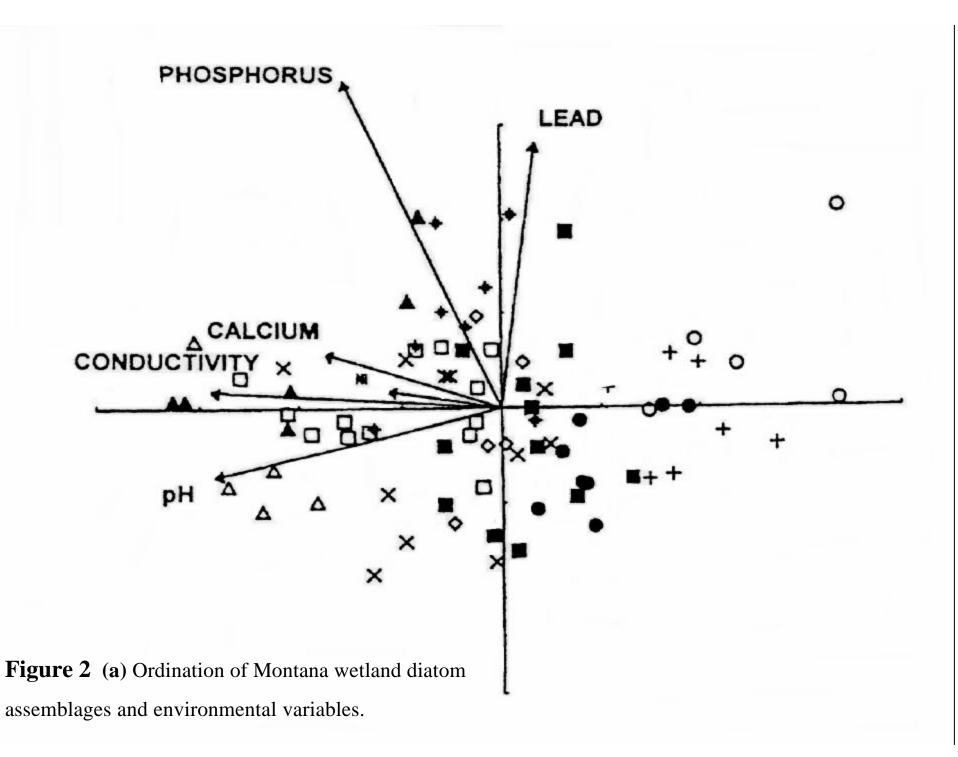
Algae (Diatoms)

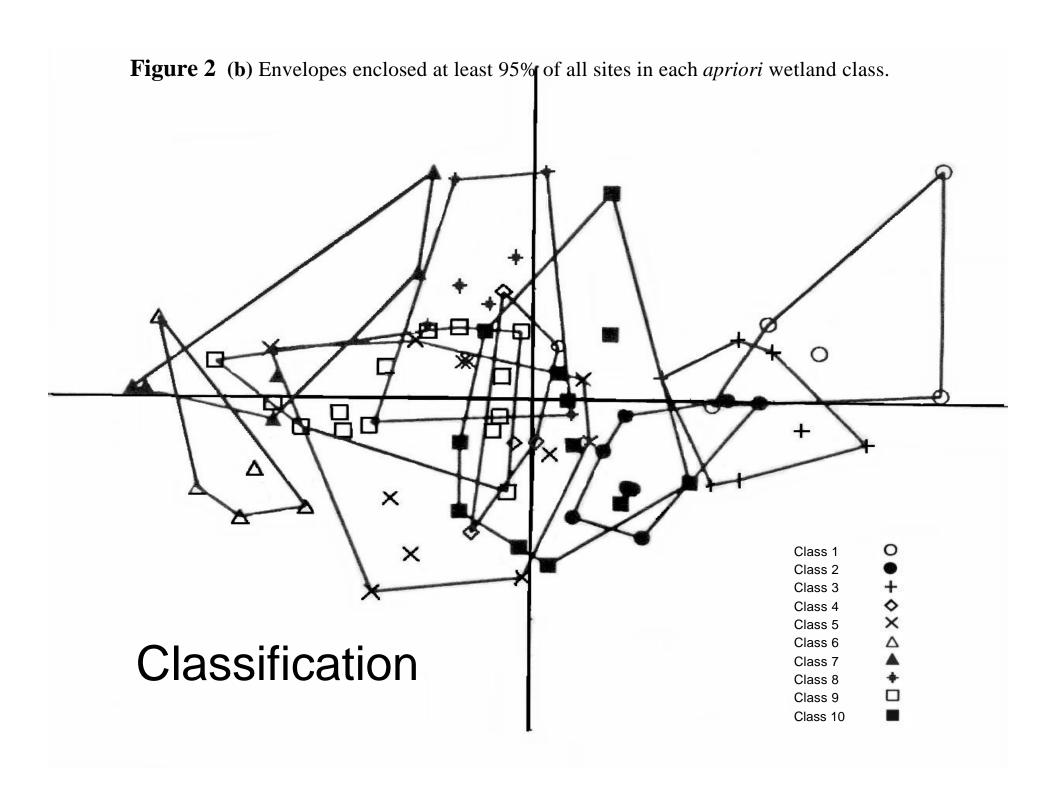


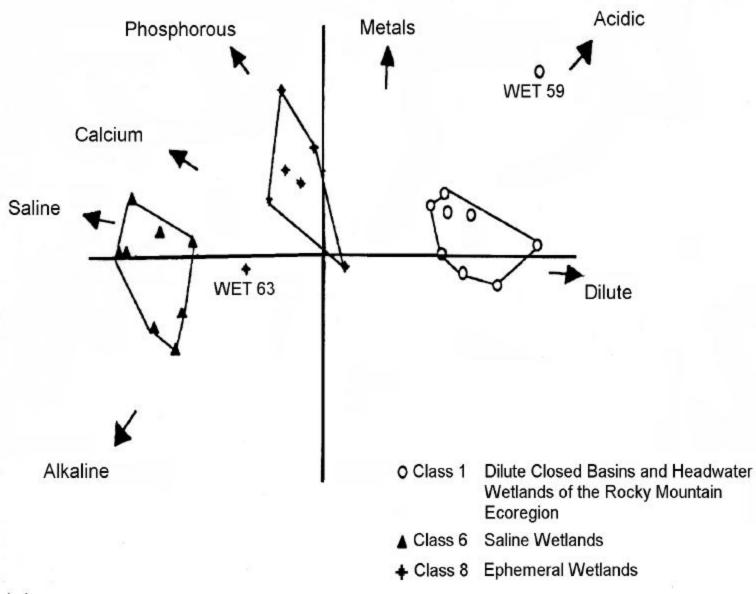




## How did we analyze the algae data?





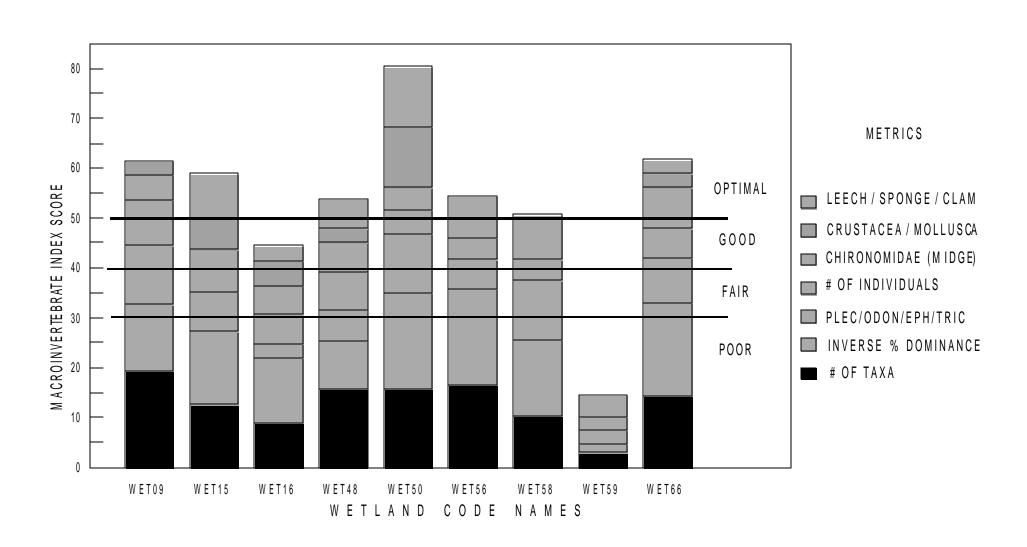


(a)

# How did we analyze the macroinvertebrate Data?

Proposed Metrics	Theorized Direction of Change in Presence of Stressor
Number of Taxa	decrease
Percent Dominance Percent 1 Dominant Taxon Percent 2 Dominant Taxa Percent 5 Dominant Taxa POET Number of Individuals	increase increase increase increase decrease decrease
Chironomidae  Number of Chironomidae Taxa  Percent Chironomidae Taxa  Percent Orthocladiinae/Chironomidae	decrease decrease increase decrease
Crustacea/Mollusca  Number of Crustacea & Mullusca Taxa  Percent Crustacea & Mullusca Taxa  Leech/Sponge/Clam	decrease decrease increase decrease

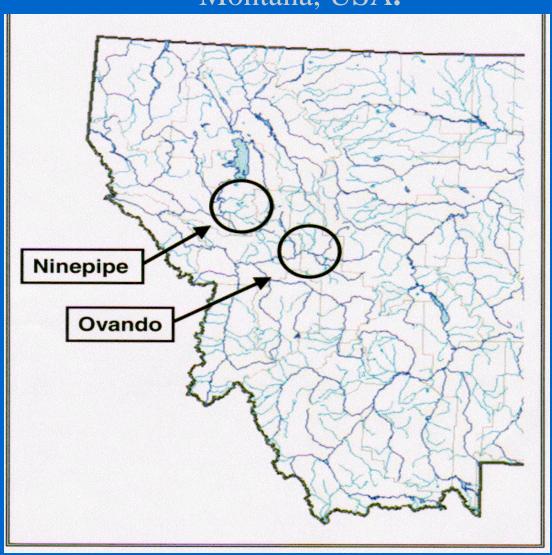
Class 1 Dilute Closed Basins and Headwater Wetlands of the Rocky Mountain Ecoregion.



#### Additional Research

- Cici Borth (Montana State University)
  - Vegetation (1997-1998)
- Vicki Ludden (University of Montana)
  - Macroinvertebrates (1999-2000)

**Figure 1.** Relative location of study sites within western Montana, USA.



**Figure 4.** Illustration of two wetland types typical of the Intermontane Prairie Potholes.

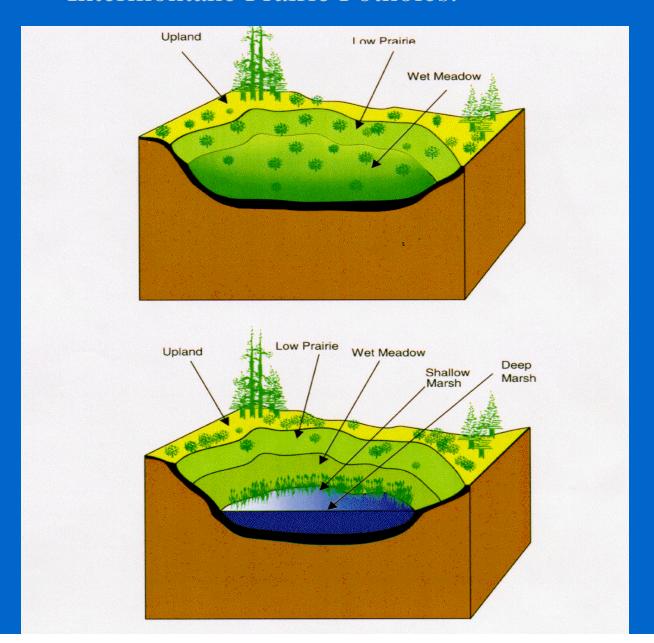
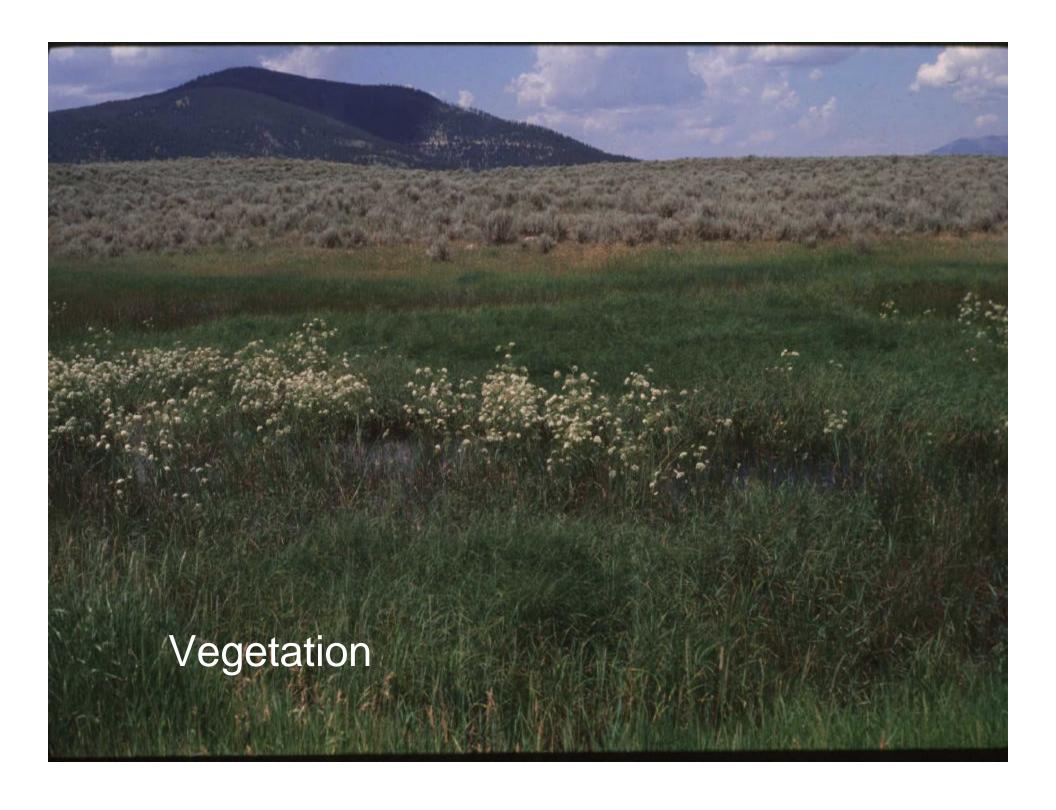


Table 13. The Effectiveness Levels of Each Metric Tested.

<b>Effectiveness</b>	<u>Metric</u>			
***	<ul><li>Shannon-Weiner</li></ul>	<ul><li>Percent Diptera</li></ul>		
High	Diversity Index	<ul><li>Percent Tanytarsini</li></ul>		
	<ul><li>Total Taxa Richness</li></ul>	<ul><li>Percent Tanytarsini of Chironomidae</li></ul>		
	<ul><li>Crustacea and Mollusca</li></ul>	<ul><li>Percent Pelecypoda</li></ul>		
	Taxa	<ul><li>Percent Trichoptera</li></ul>		
	■ EPT Taxa	<ul><li>Percent Odonata</li></ul>		
	<ul><li>POET Taxa</li></ul>	<ul><li>Percent Shredders</li></ul>		
	<ul><li>Odonata Taxa</li></ul>	<ul> <li>Percent Coenagrionidae of Odonata</li> </ul>		
	<ul><li>Diptera Taxa</li></ul>	<ul><li>Ratio of POET to POET and</li></ul>		
	<ul><li>Chironomidae Taxa</li></ul>	Chironomidae		
	<ul><li>Mollusca Taxa</li></ul>	<ul><li>Percent Odonata and Trichoptera</li></ul>		
	<ul><li>Odonata and Trichoptera</li></ul>			
	Taxa			



#### Candidate Vegetation Metrics

- % Annuals
- % Perennials
- % Non-Natives
- % Moss
- % Spp. With Persistent Litter

- % Agropyeon Spp.
- % Juncus Balticus
- % Typha Latifolia
- Species Richness,
   Vascular Plants

## Application of Wetland Biological Assessments

#### Wetland Bioassessments



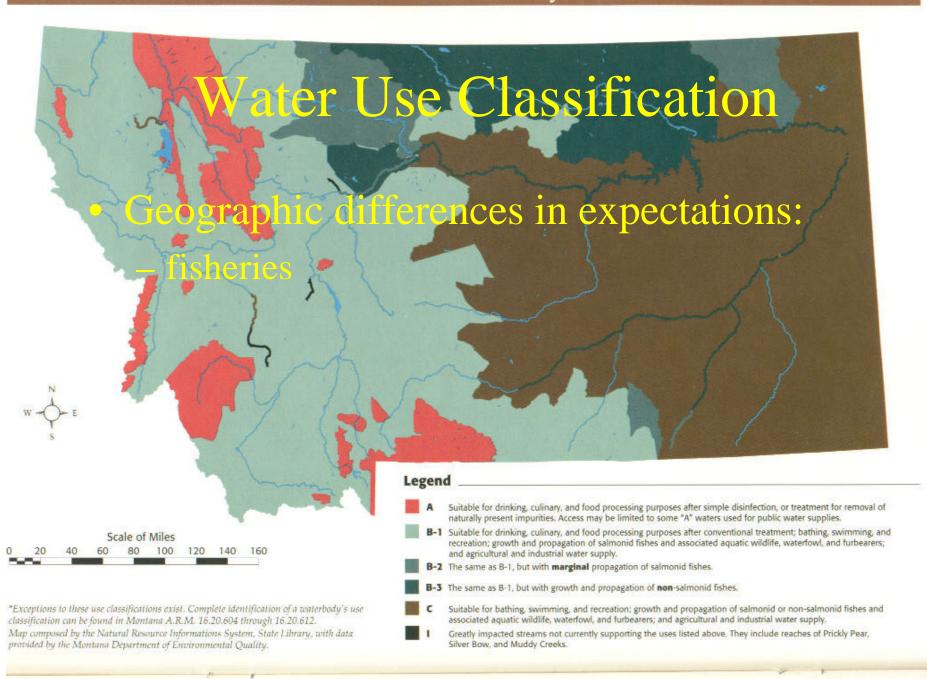
- Are water quality standards being achieved and are aquatic life and wildlife beneficial uses fully supported?
- What should the goals be for restoration (e.g. TMDL biological targets)?
- Are restoration goals that were developed to protect aquatic life being achieved?

• How are biological assessments used to determine if Montana's water quality standards are being achieved?

#### Water Quality Standards

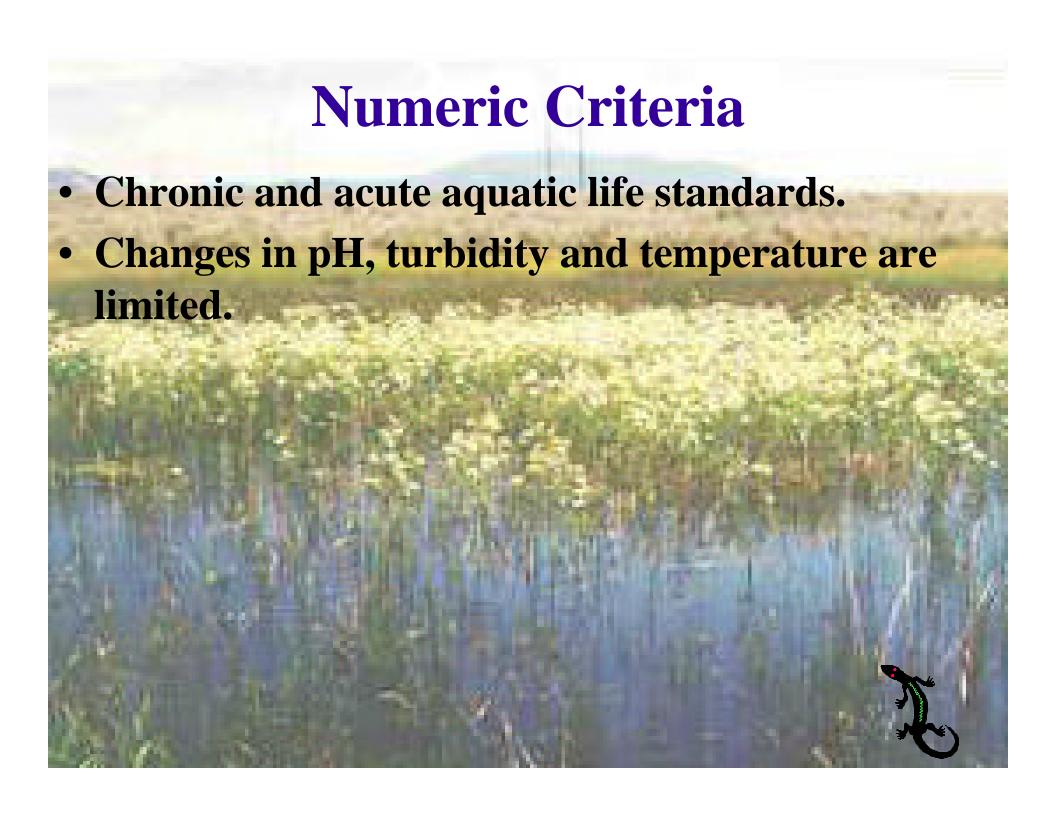
- Clean Water Act (Section 101(a))
  - restore and maintain the chemical, physical and biological integrity of the Nation's waters.
- Designates beneficial uses for all surface water, *including wetlands*.
- Nondegradation
  - Existing uses of state waters must be maintained and protected

#### Montana Surface Water Quality Classifications\*



#### Wetland Beneficial Uses

- Aquatic Life Use Support
  - Waters are suitable for the growth and propagation of fish and associated aquatic life, waterfowl and furbearers.
  - Bioassessments are very useful for assessing aquatic life beneficial uses because they are a direct measure of the health of aquatic communities.



#### **Narrative Criteria**



- No increases are allowed above *naturally* occurring concentrations of sediment, settleable solids, floating solids, etc. which are *harmful*, *detrimental*, *or injurious to birds*, *fish or other wildlife*.
- Prohibition of *undesirable* aquatic life.
- *Pollution* resulting from non-point sources, including agriculture, construction, logging, and other practices must be minimized.
- **Bioassessments** are often used to determine if narrative criteria are achieved.

• How are biological assessments being used by Montana's TMDL Program?



• Technically, a TMDL is the total amount of a pollutant, per day, (including a margin of safety) that a waterbody may receive from any source (point, non-point, or natural background) without exceeding the *State water quality* standards.



Practically, a TMDL is a water quality restoration plan that is developed to <u>protect</u> <u>beneficial uses</u> which has quantifiable goals or endpoints.

# Application of Biological Assessments in the TMDL Program

#### Detecting impairment

- Direct measure of aquatic life use
- Interpretation of the biological data helps identify probable sources and causes of impairment

#### • TMDL (restoration) plan

- Establish targets or restoration goals
- Effectiveness monitoring

## 303(d) List:

List of impaired water bodies that require a TMDL (restoration) plan

Currently eight wetlands are on our 303(d) list

#### Montana Water Quality Act

(amended 1997)

- There was a TMDL lawsuit in 1996
- Legislature was concerned about the credibility of our 303(d) list.
- By 1 Oct 1999....shall revise the list....remove any water that lacks sufficient credible data to support its listing.
- .... may modify the list only if there is sufficient credible data.....

#### **303(d)** List

 Nearly 900 waters were on Montana's 303(d) list before it was revised

 approximately 50% of the waters were determined to have insufficient data and needed to be reassessed  How are biological data considered when making Montana's 303(d) listing decisions and what is sufficient credible data?

#### Sufficient Credible Data

"....chemical, physical, or biological monitoring data, alone or in combination with narrative information, that supports ..... whether a water is achieving compliance with applicable water quality standards."

....Must use all readily available data.

#### **Sufficient Credible Data** Categories for making ALUS **Determinations**

• Chemistry (e.g., Toxins)



• Physical/Habitat

• Biology



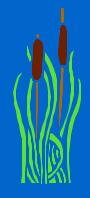
# Chemistry Data



Field Measurements

- Water Column Grab Samples
- Sediment or Tissue Samples
- Toxicity Tests

## Physical/Habitat Data



 Visual assessment of riparian and habitat conditions

Functional assessment

Watershed assessment

#### Biological Data



Macroinvertebrates

Algae

Vegetation

Fish and Wildlife populations

• How does Montana decide when there is a sufficient amount of data and information to make an ALUS determination?

### **Evaluate Data for:**

- Technical Rigor of Methods
- Coverage /Quantity
- Quality
- Applicability to Present Conditions

# Scoring Example: Biological Data

				Data
Score	Methods	Data Quantity	Data Quality	Currency
				Data no
	Visual		Unknown or	relevant; may
	observation;	Limited	low; no	have been
	no reference		specialist	significant
1				changes
			Low to	Data older
	1 group; use	Single time or	moderate;	than ideal;
	reference	single site	some specialist	likely still
2			guidance	accurate
	1 or more		Moderate;	
		Target sites; 1	specialist	Recent data
	groups; use reference	season	makes	Necent data
3	reference		assessment	
	2 or more		High; all work	
	groups; use	Broad Coverage	done by	Current data
4	reference		specialist	

# **Sufficient Credible Data for Making ALUS Determinations**

- All available data are evaluated.
- Data are usually required from at least two data categories
- Minimum score of 6 required out of 12
- Data that scores 1 are not considered
- Assessments based on *reference condition* are generally scored higher.

• How is reference condition determined for making biological assessments?

#### **Reference Condition**

- Reference condition is the condition of a water body capable of supporting all of its present and future beneficial uses when all reasonable land, soil, and water conservation practices have been applied.
- used to interpret *narrative* water quality criteria
- used to interpret *numeric* criteria that limit how much a parameter can change from what would be naturally occurring.

#### **Reference Condition**

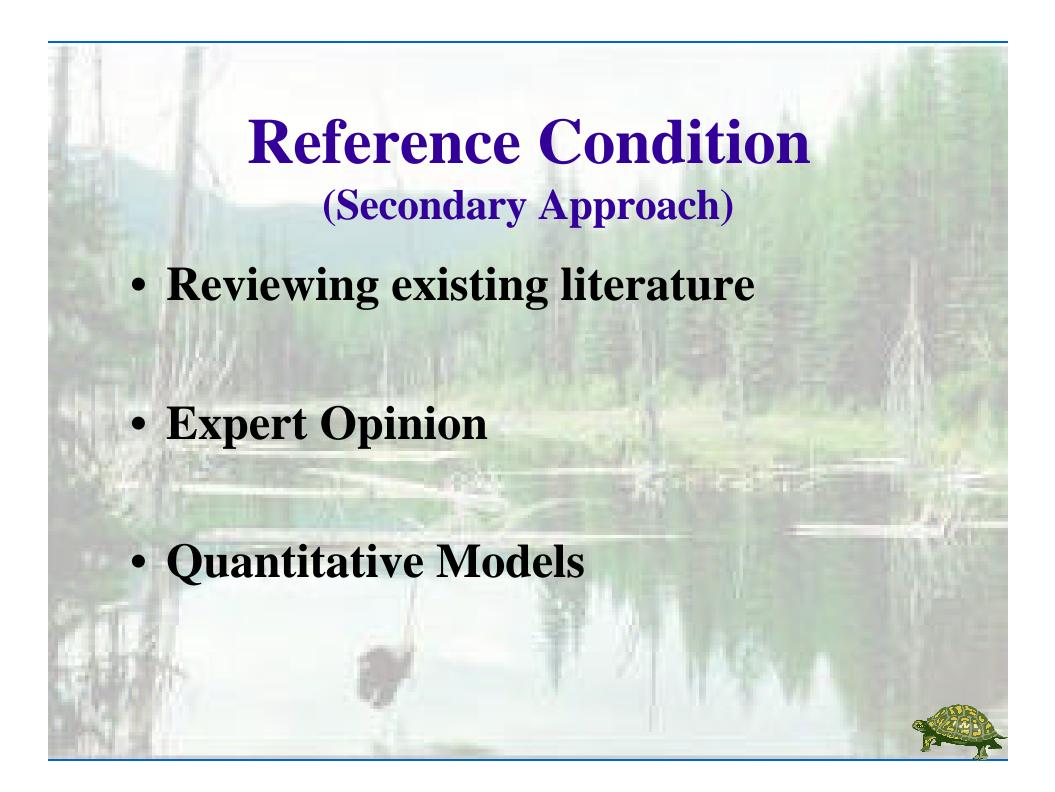
(Primary Approach)

 Collecting baseline data from minimally impaired water bodies within the same region having similar geology, hydrology and morphology

Evaluating historical data



Using internal references or a paired watershed approach



• How does Montana make aquatic life use support determinations?

## Assessment Process

- Gather & Organize Data
- Evaluate Data Quantity & Quality
- Beneficial Use Support Determination

# Aquatic life Use-Support Decision Tables

• Decision tables are used by the reviewer to link beneficial use-support determinations to water quality standards

- Numeric water quality criteria are used for most chemical parameters
- Narrative water quality criteria are linked to decisions involving habitat, sediment, nutrients and biological data.

# Aquatic Life Use Support Determination

Overwhelming Evidence Test

• Independent Evidence Test

Weight of Evidence Test

## Assessment Process (continued)

#### • Use Support:

Full

Threatened

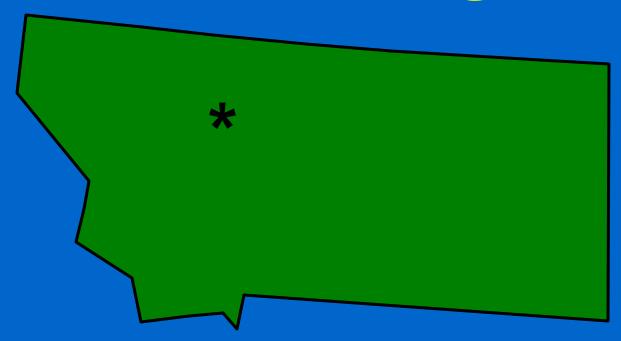
**Partial** 

Not Supporting

#### Application of Results

- 305(b) Statewide WQ Database
- 303(d) Impaired Waters List

# Case Study Benton Lake National Wildlife Refuge



#### Benton Lake National Wildlife Refuge

- 5,600 acre saline marsh created by a glacier
- Established in 1929 to provide habitat for up to 100,000 ducks, 40,000 geese and 5000 swans
- Currently receives a large portion of its water from irrigation drainage
- The marsh is currently divided into separate units that are periodically flooded.
- Because there is no surface outlet, salts and contaminants are concentrated in the water.

### Benton Lake National Wildlife Refuge

(Example of Sufficient Credible Data)

- Chemistry (Score 3 of 4)
  - water column, sediment, and tissue data
- Physical/habitat (Score 2 of 4)
  - Visual habitat assessment with photo documentation and interpretations
- **Biology** (Score 3 of 4)
  - Macroinvertebrate and algae bioassessment
  - Substantial amount of waterfowl population data
- Total Score = 8 (Sufficient Credible Data)



#### Benton Lake National Wildlife Refuge

(Example of Aquatic Life Use-Support Determination)

#### • Chemistry

- High nitrates in water column
- High selenium in sediment and tissue

#### Physical/Habitat



- Saline seeps were found along wetlands
- intensive agriculture occurs within watershed
- Water levels intensively managed to control salinity

#### Biology

Algae biocriteria indicates moderate impairment
 Macroinvertebrates indicate slight impairment

# Benton Lake NWR 303(d) listing

- Weight-of-Evidence Test
  - Chemistry and biology data indicate impairment
  - Physical/habitat data identifies probable sources
- Partial Support of Aquatic Life Use
- Probable Causes of Impairment
  - nitrogen, selenium, salinity, noxious algae
- Probable sources of impairment
  - agriculture



# Possible TMDL Targets for Benton Lake NWR

- Selenium concentrations is tissue
- Salinity
- nitrogen loading
- Algae biocriteria
- Algae biomass
- Saline seeps

## TMDL Plan

- Improve water management within the wetland complex
- Encourage less intensive agricultural practices within the surrounding watershed.
- Encourage landowners to take some of their agricultural land out of production (Conservation Reserve Program)

# Summary

- Biological assessments directly measure impacts to the aquatic life communities.
- Physical/habitat and chemistry data often provide valuable information concerning the probable causes and sources of impairment.
- Therefore, Montana DEQ is emphasizing a holistic approach for making ALUS determinations which usually entails consideration of data from *at least* two data categories.

# **Final Thoughts**

- The TMDL process provides a useful tool for addressing constraints to biological integrity.
- We feel that Load-based TMDL targets that are solely based on pollutants are often not practicable approaches for protecting wetland water quality.
- Therefore, we also use biological and physical/habitat TMDL targets for determining when aquatic life uses are fully supported and water quality standards are being achieved.

## Final Thoughts (continued)

- Stream aquatic life communities and geomorphology are affected when adjacent wetlands are altered.
- Wetland aquatic life communities that are adjacent to streams are often affected by changes in stream water quality and geomorphology.
- Therefore, we believe that an integrated approach should be used to assess the ecological integrity of the entire stream/wetland complex, which includes the use of biocriteria in combination with a habitat, landscape and/or functional assessment.

# Montana DEQ Web Page

Http://www.deq.state.mt.us/ppa/mdm/

• Water Quality Assessment Process and Methods

Wetland Biocriteria Development

