**1994-1995 Bad River Wetlands Protection**
**Wisconsin Coastal Management Program**

Bad River Band of Lake Superior Chippewa Indians

Final Report
1994 - 1995

Contract No. 85042-601.8

This report is a summary of the 1994-1995 programmatic accomplishments related to wetlands protection on the Bad River Reservation funded by the Wisconsin Coastal Management Program.



information regarding the Bad River Wetlands Protection Program, please contact the Natural Resources Department at (715) 682-7123.

**Project Background**

This project provided the Bad River Band with a GIS specialist, Mark Miller, and a wetland scientist, Jim Meeker, to coordinate the entry and analysis of several important data sets in the Band's existing geographic information system (GIS). These data sets are crucial in the development of the Band's Integrated Resources Management Plan (IRMP) and will benefit all Kakagon/Bad River Watershed Project cooperators. These data sets have increased the Band's understanding of the size and quantity of their wetlands, and will enable the Band to identify detrimental changes. This baseline data and knowledge will, in turn, improve land use and resource management decisions. The ultimate goal is to ensure the continued protection of the Kakagon and Bad River Sloughs. These sloughs are the ancestral home and cultural base of the Bad River Band. They are also designated as a National Natural Landmark, and comprise the largest and healthiest estuarine system in the Upper Great Lakes Basin. The sloughs sustain many rare species, regionally significant natural communities, important fisheries and wild rice beds, and other resources.

The Bad River Band would like to express its sincere appreciation to the Wisconsin Coastal Management Program (WCMP) for funding the 1994 - 1995 wetlands protection project. Support from programs such as WCMP enable the Band to build the expertise and resources needed to expand its capacity for self-management. Reaching this goal continues to be a demanding but rewarding challenge. We believe the Bad River Band has excelled in developing effective strategies for managing its resources, but we still have a long way to go. We hope WCMP recognizes the progress we have made and will continue to support the Band's research and monitoring efforts into the future so that they may become a model for other regional projects.

The following is a description of the projects accomplished under the 1994-1995 WCMP grant.

**Completed Project Tasks**

Wetland Community Inventory of the Kakagon, Band River and Honest John Lake Complex

This project resulted in a detailed cover type map and GIS layer depicting wetland vegetation in the Kakagon/Bad River Sloughs Conservation Area (Figure 1). The conservation area, which includes all reservation lands north of U.S. Highway 2, was defined several years ago to focus special management attention on the 10,000 acre wetland complex that is the heart of the cultural, spiritual, and economic values of the Bad River Band. While past research activities attempted to describe the wetland vegetation in a qualitative sense, this project was the first to provide a comprehensive inventory of all wetland communities.

We began the wetland delineation project by reviewing the Wisconsin Wetland Inventory (WWI). While this data provides a reasonable description of the general wetland categories present, it lacks the detailed categorization needed to monitor vegetation at the community level. We did, however, attempt to preserve much of the character of the WWI to facilitate comparisons with other projects (Table 1).

**Table 1: Comparison of Wetland Plant Community Classifications**

| Kakagon Complex | ACE Manual* | Wisconsin Wetland Inventory** |
|---|---|---|
| **1) Forested Communities** | | |
| Upland Deciduous | NA | NA |
| Upland Mixed | NA | NA |
| Upland Conifer | NA | NA |
| Lowland Conifer (Tamarack) | Conifer Bog | Forested, Needle-Leaf |
| Lowland Deciduous | Flood Plain Forsest? | Forested, Broad-leaf Decidous |
| | | |
| **2) Shrub Communities** | | |
| Alder | Alder | Scrub-Shrub, Broad Leaf Decid |
| Low Shrubs (eg Leather Leaf) | Open Bog | Scrub-Shrub, Broad Leaf Conf |
| Riverine | Shrub Carr? | Scrub-Shrub, Broad Leaf Decid |
| | | |
| **3)Sedge and Grass Communities** | | |
| Sedge Meadow | Sedge Meadow | Emergent/Wet Meadow, Narrow-leaf Persistent, Wet Soil |
| Wiregrass | Open Bog | Emergent/Wet Meadow, Narrow-leaf Persistent, Standing Water |
| with Sphagnum Moss | Open Bog | Emergent/Wet Meadow, Narrow-leaf Persistent, Standing Water |
| without Sphagnum Moss | Open Bog | Emergent/Wet Meadow, Narrow-leaf Persistent, Standing Water |
| | | |
| **4)Aquatic Plant Communities** | | |
| Aquatics | Shallow/Deep Marsh | Emergent/Wet Meadow Broad-Leaf persistent and non-persistent |

* *Wetland Plants and Plant Communities of Minnesota and Wisconsin*, Eggers and Reed
**Wisconsin Wetlands Inventory, DNR Bureau of Water Regulation and Zoning

Wetland communities were mapped from 1:9,000 scale color infrared photographs taken in Spring 1992. Vegetation boundaries were delineated on a mylar sheet placed over each photograph. The delineations were field checked by the wetland scientist and Natural Resources Department staff. Homogeneous areas were labeled with the appropriate classification code.

The delineations on each mylar sheet were transferred to a geometrically-registered base map using a zoom transfer scope to correct for distortions in the aerial imagery. The base map included WWI boundaries as a reference. Where boundaries coincided, the WWI delineation was retained; all other areas were updated from the mylar sheets.

The registered base map was digitized using PC ARC/INFO GIS software. The resulting digital data layer was carefully checked for accuracy and completeness. Each unique wetland area was assigned an attribute code corresponding to the new wetland community classification developed by the wetland scientist.

A report was written as an addition to the Bad River GIS User's Guide which describes the technical specifications of the data layer and the wetland classification system used (Appendix A). A final map (Figure 1) was created from this data layer which can be used for tribal resource planning.

Bad River Reservation-Wide Wetlands Inventory

At the beginning of our project year we received a digital version of the Wisconsin Wetland Inventory for areas covering the entire reservation (Figure 2). Our tribal Wetland Specialist has been using the data to assist with identifying jurisdictional wetland boundaries, and provide crucial information for identifying areas which are beneficial to the continued ecological functioning of the reservation's water resources. The data will also be used for invasive wetland plant modeling.

Wastewater Monitoring and Analysis

A major point source of pollution affecting the Bad River Slough and Honest John Lake is the New Odanah waste-water treatment lagoon. In addition to serving New Odanah, the largest community on the reservation, the lagoon also receives the wastewater of the casino. Twice a year and occasionally on an emergency basis, the lagoon is discharged directly into Denomie Creek, which feeds into both the slough and Honest John Lake. It is not clear how the stream and wetland system are assimilating the wastewater discharge.

With the help of the Natural Resources Department staff, the wetland scientist placed 16 periphyton samplers in strategic locations within the Bad River Slough and Honest John Lake. Periphyton samplers provide an effective and low-cost method to examine the effects of wastewater by measuring the amount of associated algae which develops throughout the year. At one month intervals, the samplers were removed and the dried weight of accumulated periphyton algae was recorded. An analysis of these measurements show a definite pulse of nutrient material entering the system early in the year, with higher concentrations found at the lake outlet in the latter part of the season (Figure 3). A complete copy of the report associated with this analysis can be found in Appendix B.

The locations of each periphyton sampler were recorded with the Band's Global Positioning System (GPS) to within 1 meter accuracy. These locations can be revisited in future years to provide an ongoing systematic method of monitoring wastewater discharge.

GIS System Development

The GIS Specialist provided technical support, field assistance, and training for each of the main and additional projects accomplished under this grant. All data layers were developed using rigorous cartographic techniques to ensure the highest quality data for the Band. To ensure proper use of the GIS system, all new datasets and specialized processing techniques were included in a Natural Resources Department GIS User Guide. An example of the Wetland Community data description is included in this report as Appendix A.

The GIS Specialist instructed the Natural Resources Department staff and wetland scientist in proper mapping techniques and GIS data entry and analysis. In addition to frequent hands-on assistance in the office, the GIS Specialist initiated a GIS training program at Northland College in Ashland, Wisconsin which is being attended by the Wetland Technician, the Forestry Aide, and the Tribe's newly hired Watershed Coordinator.

Staff members were also provided with individual instruction in the use of the Global Positioning System (GPS) receiver. The GIS Specialist wrote a guide to the GPS receiver for the Natural Resources Department.

**Additional Project Accomplishments**

Bad River Cadastral Overlay

The Bad River GIS program has continued work on producing a reservation-wide GIS parcel coverage which will be linked to county and tribal land records. To date, all parcel lines excluding government lots have been digitized. The next step will be to digitize government lots and tribally leased lands and link all records to county tax assessment role databases. The realty program has acquired new computers and a network which will facilitate intradepartmental use of the GIS system.

Corridor Land Cover Mapping

Three field assistants continued to map land cover across the reservation. The vegetation community types are based on those described in *Minnesota's Native Vegetation: A Key to Natural Communities*. Cover types are mapped from 1993 WDNR Forestry photos (B&W IR, nominal scale 1:15,840) and field checked for accuracy. Approximately one-third of the reservation was mapped in previous years, with an additional 28,000 acres mapped this summer. The Band's goal is to complete the project in the next year. This data is an important compliment to the forestry data provided by the Bureau of Indian Affairs. While the forestry data shows timber-related information on tribally-owned land, the new land cover data shows forest communities across the entire reservation, providing a crucial input to holistic resource management decisions.

Bad River 1930's Land Cover (Wisconsin Land Inventory)

The Band completed a GIS coverage based on the Wisconsin Land Inventory, a statewide land cover mapping project done in the late 1930's. This coverage provides information regarding the extent and type of forest, wetland, and agricultural lands existing at that time. Continuing analysis will show how these lands have changed compared to present day conditions. This information will be helpful to identify areas which are failing to regenerate, and areas which may have suffered long-term impacts from logging activity.

Surface and Groundwater Monitoring Program

With the assistance of the Water Resources Management Workshop from the University of Wisconsin-Madison, the Band determined site locations for both surface and groundwater monitoring. Water quality tests were made at each locations. Resulting parameters were recorded in a database and linked spatially to coordinates in the Band's GIS.

Wastewater Monitoring and Analysis

With the assistance of the Environmental Engineering graduate students from the University of Wisconsin-Madison, a review of wastewater treatment on the reservation was completed. The group provided a report to the Band detailing concerns over present wastewater management practices, methods for monitoring water quality, and recommendations for future improvements or additions.

Avian Diversity Census

A monitoring survey of avian diversity in the Bad River wetland corridor was completed. An avian census was also completed along the Bad River which is a part of a long-term monitoring program. An example of the results from this project is shown in Figure 4. Data from these projects were compiled and added to the GIS.

Loosestrife Survey

The Great Lakes Indian Fish and Wildlife Commission, in cooperation with the Bad River Natural Resources Department, completed a survey over the summer field season of loosestrife populations in the Bad River watershed using GPS. The results of this project were compiled into a database and incorporated into the GIS.

Global Positioning System (GPS)/Digitizing Table

The Band purchased a Trimble ProXL GPS which is capable of mapping features to within one-meter of their true ground position. The Natural Resources Department has initiated a project to map all forest roads within the reservation using the GPS. Staff members use trucks, ATV's, or mountain bikes depending on the terrain. The GPS has also been used experimentally to map wetland vegetation. The Bad River Wildlife Biologist has been using the GPS to record animal tracks which will provide the background information needed for a reservation-wide animal census.

The Band purchased an Altek 36" x 48" high precision digitizing table to assist with developing new GIS data sets. The table was used to digitize data for several projects this year, including the wetland community layer.

Figure 1

# Wetland Communities of the Kakagon, Bad River and Honest John Lake Complex

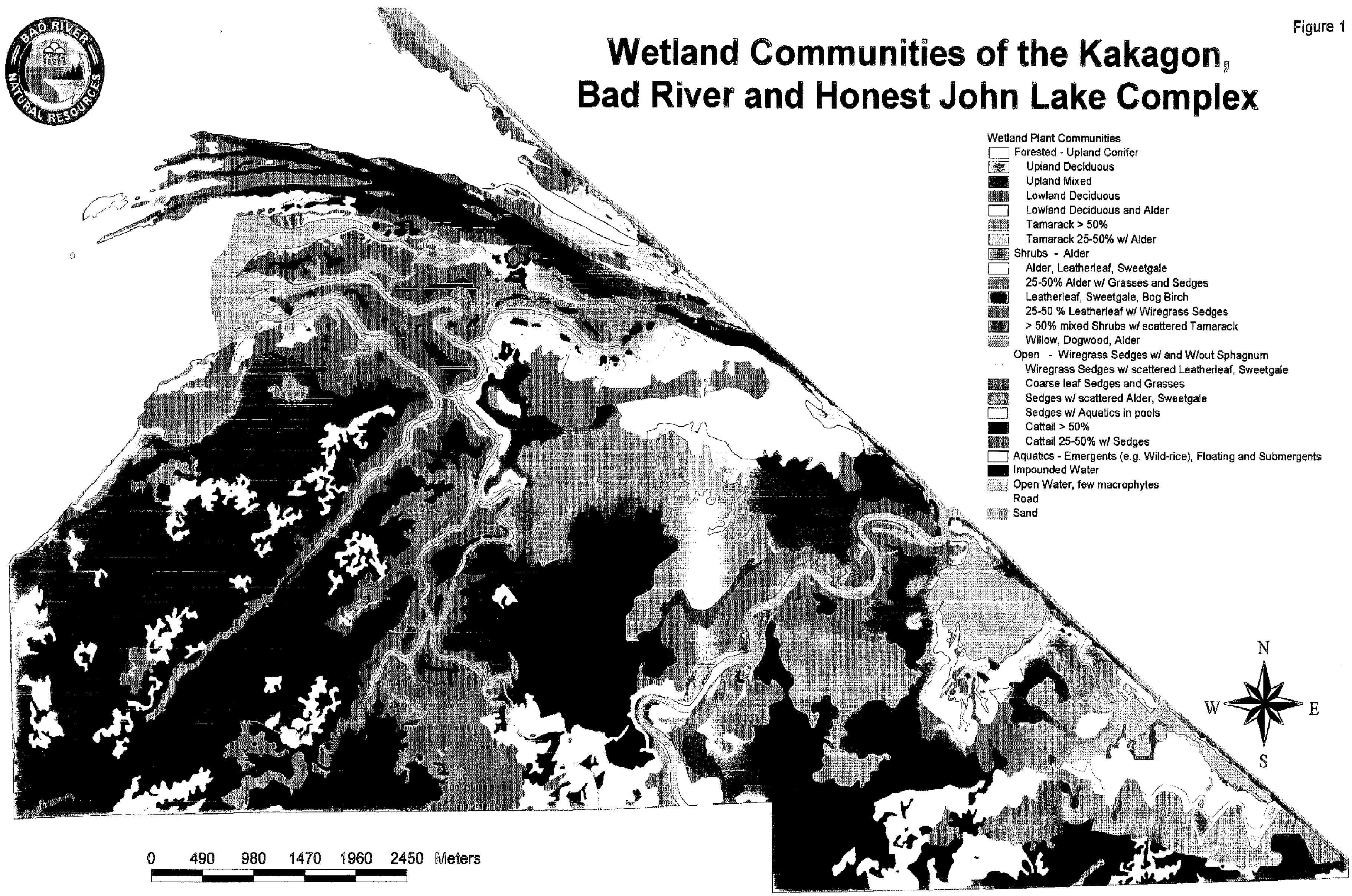


Figure 2

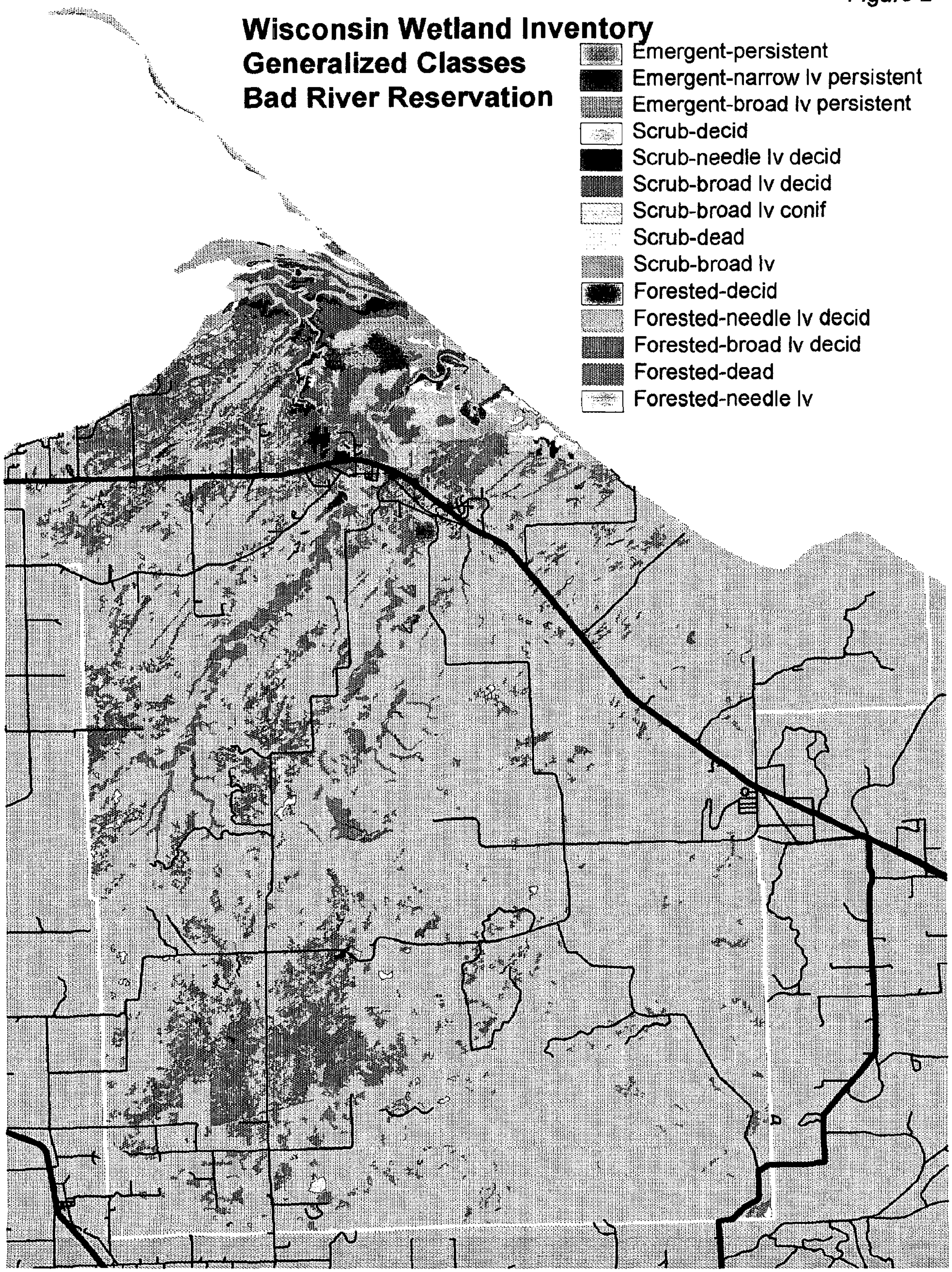
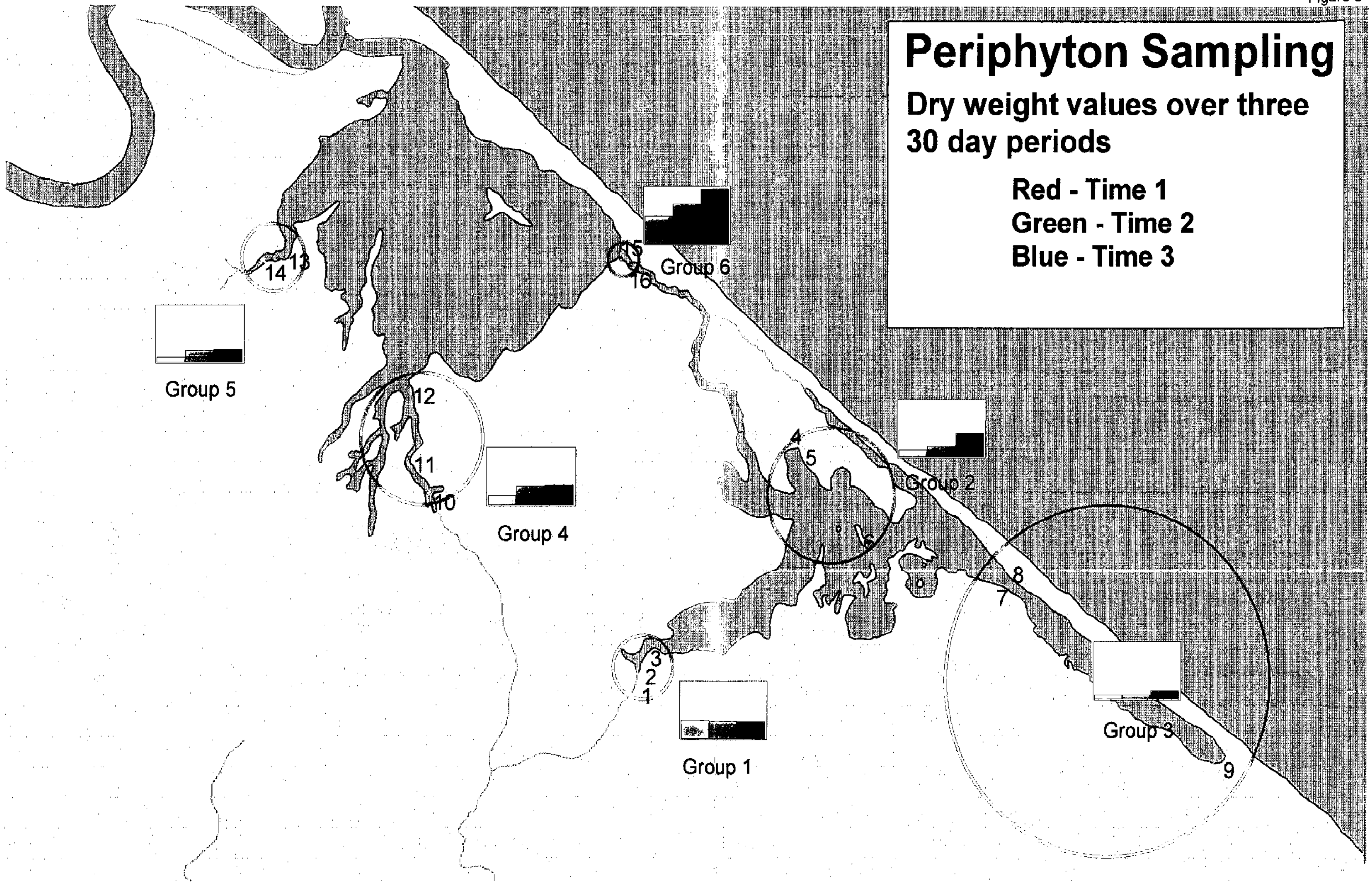
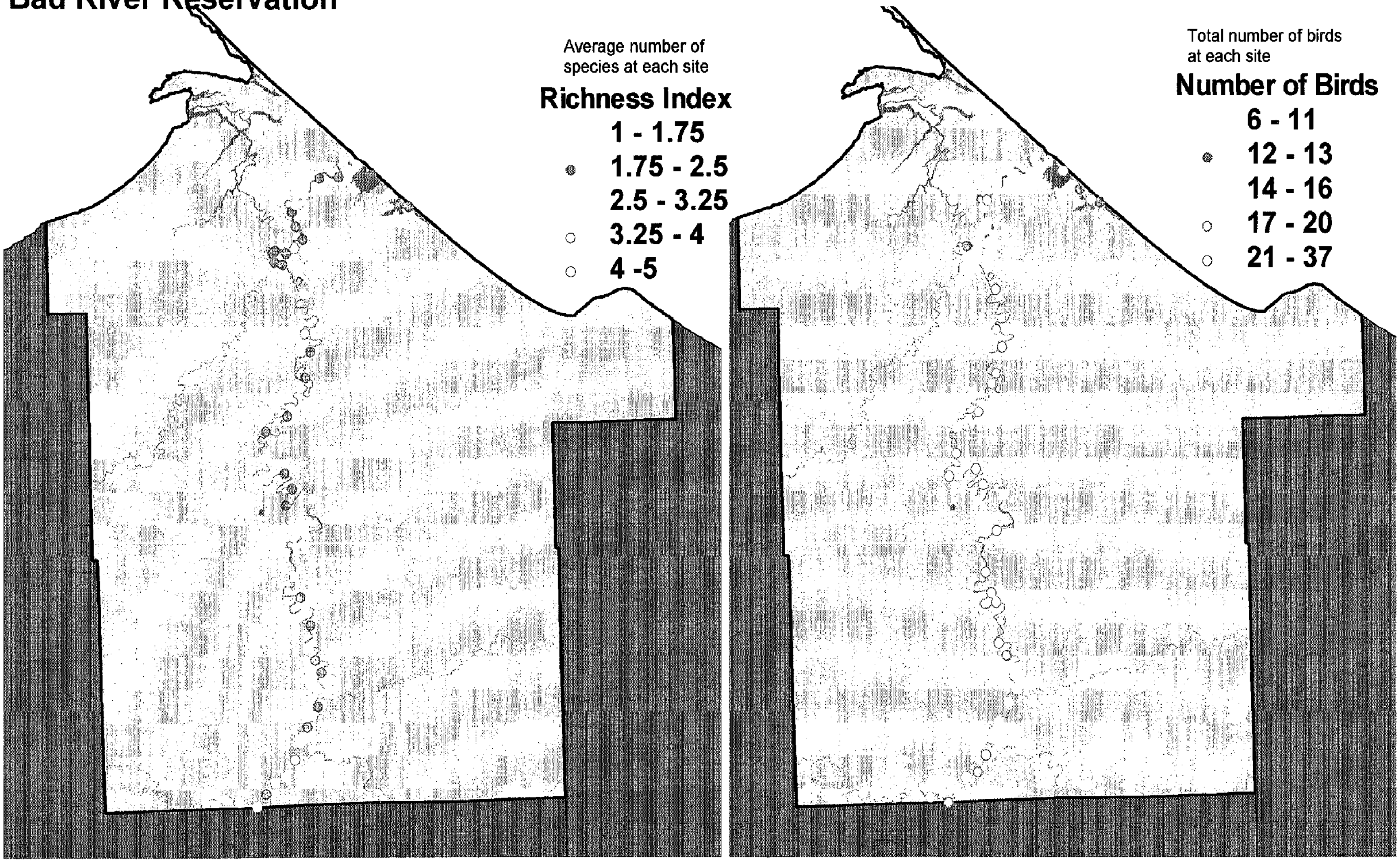

Wisconsin Wetland Inventory
Generalized Classes
Bad River Reservation
Emergent-persistent
Emergent-narrow lv persistent
Emergent-broad lv persistent
Scrub-decid
Scrub-needle lv decid
Scrub-broad lv decid
Scrub-broad lv conif
Scrub-dead
Scrub-broad lv
Forested-decid
Forested-needle lv decid
Forested-broad lv decid
Forested-dead
Forested-needle lv

Figure 3


Periphyton Sampling
Dry weight values over three
30 day periods
Red - Time 1
Green - Time 2
Blue - Time 3
Group 1
Group 2
Group 3
Group 4
Group 5
Group 6
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

# Neo-Tropical Bird Survey Results
# Bad River Reservation



**Appendix A**



| | | |
|---|---|---|
| newcode | latest class code | 8,c |
| digup | lateset date digitized | 8,c |
| upreason | reason for update | 2,c |
| minunit | min mapping unit | 2,n,0 |
| basedate | basemap date | 14,c |
| photodate | aerial photo date | 14,c |
| maptype | basemap type | 1,c |
| wet_id | USFWS wetland code | 11,n,0 |
| jimcode | coastal wetland code | 8,c |

**Codes**

The first four attributes are maintained by ARC/INFO. For more complete descriptions of attributes pls through wet_id, please refer to the WWI data dictionary included in this manual.

**Coastal wetland codes (jimcode):**

| | |
|---|---|
| Forested - Upland Conifer | UC |
| Upland Deciduous | U |
| Upland Mixed | UM |
| Lowland Deciduous | LD |
| Lowland Deciduous and Alder | LD/AL |
| Tamarack > 50% | TM |
| Tamarack 25-50% w/ Alder | TM/SH |
| Shrubs - Alder | AL |
| Alder, Leatherleaf, Sweetgale | AL/MY |
| 25-50% Alder w/ Grasses and Sedges | AL/SM |
| Leatherleaf, Sweetgale, Bog Birch | MY |
| 25-50 % Leatherleaf w/ Wiregrass Sedges | MY/LA |
| > 50% mixed Shrubs w/ scattered Tamarack | SH/TM |
| Willow, Dogwood, Alder | RS |
| Open - Wiregrass Sedges w/ and W/out Sphagnum | LA |
| Wiregrass Sedges w/scatt. Leatherleaf, Sweetgale | LA/MY |
| Coarse leaf Sedges and Grasses | SM |
| Sedges w/ scattered Alder , Sweetgale | SM/SH |
| Sedges w/ Aquatics in pools | SM/EM |
| Cattail > 50% | TY |
| Cattail 25-50% w/ Sedges | TY/SM |
| Aquatics | AQ |
| Impounded Water | OW/IN |
| Open Water, few macrophytes | W |
| Road | ROAD |
| Sand | SAND |

**Appendix B**

# An initial study of the aquatic productivity of Honest John Lake and Bad River Sloughs using time integrating sampling devices

Submitted by

James E. Meeker

and

Dale G. Soltis

November 1995

# AQUATIC PRODUCTIVITY SAMPLING  Meeker and Soltis

## Study overview

The Bad River Sloughs and Honest John Lake are a unique and important aquatic resource within the Bad River Reservation. These waters are characterized by a rich and diverse assemblage of aquatic macrophytes surrounded by a mosaic of wetland communities and very little shoreline development. Within this picture of timeless beauty are indications of the pressures of modern society. At the mouth of Denomie Creek are large floating mats of filamentous algae, one sign of nutrient enrichment. Given enough time and an expanding human population, the nutrient contributions from the Denomie watershed, if not curtailed, could adversely affect the overall quality of the receiving waters.

The determination of the effects and extent of nutrient enrichment of an aquatic system over time can be accomplished by various means. Measurements of water chemistry, such as dissolved oxygen, nutrient concentrations, dissolved solids, etc. is often prohibitively costly and labor intensive as many measurements over a long time period are necessary to characterize the problems. It is particularly difficult to assess the affects of intermittent perturbations by this means. One needs to be present at the time of a discharge in order to measure the parameters of interest. A more cost effective way to assess nutrient enrichment over time, is to monitor algal productivity. The object of this study was to develop and test the efficacy of a monitoring system which could be employed over many years to determine changes in periphytic algal concentrations, an indirect measure of nutrient availability.

## Methods

The primary goals in the design of a sampling device were that it be inexpensive to produce, be easy to use, allow for modifications, and accommodate the testing of several substrate types on which algae can grow. Figure 1. illustrates the device. It is basically a "T" shaped assembly of CPVC pipe that holds a .1 square meter (total surface area) piece of plexiglass on one side and a like-sized piece of fiberglass screening (pre-weighed to 0.001 g.) on the other side. The substrate types were chosen to test the extent of algal colonization on the different surfaces.

Sixteen sites were chosen, nine in Honest John Lake and seven in the Bad River Sloughs. These sites were then combined into six groups for data analysis (fig. 2). Each group was chosen to illustrate the productivity levels of general representative geographical locations within the two lake systems including suspected enriched areas and more isolated locations. Three replicate sampling devices were placed at each site and were submerged to a depth of approximately 25-35 cm. from the top cross bar and left in place for three time periods of approximately four weeks each. These periods are listed below:

| Bad River Sloughs | Honest John Lake |
|---|---|
| 1) 6/16-7/13 | 1) 6/14-7/14 |
| 2) 7/13-8/11 | 2) 7/14-8/8 |
| 3) 8/11-9/15 | 3) 8/8-9/13 |

At the end of each time period the devices were lifted and the substrates removed and picked clean of invertebrates, if any. The colonized plexiglass was placed in one gallon sized "ziploc" plastic bags, and the screens were rolled and covered with aluminum foil. The samples were then placed in a cooler chilled with ice packs. Clean substrates were then added to the device and submerged again. After the day's field work was completed, the samples were taken to the lab where the screens were removed from the foil and placed in a plant drier for desiccation. The algae colonized on the plexiglass were scraped with a straight-edge plastic scraper and rinsed with tap water into a vacuum funnel onto pre weighed 11cm fiber filter paper. The filtered samples were then folded and placed into the desiccator with the screens and dried for at least 24 hours in an airflow at 43 degrees centigrade. At this time the samples were weighed on an AND FX-200 electronic scale to the milligram (+/- .003 g.).

## Results and Discussion

The following is a synthesis of the raw data summarized in Appendix 1. As the sampling periods are of unequal duration, daily averages for each period were calculated and then used to standardize each period length to thirty days. Overall there was a good correlation with the trends of algal biomass weight between the two different substrate types (fig. 3). Although the biomass on the screens was greater than that of the plexiglass, the change over time was very similar. This relationship indicates that the extent of algal colonization on the two dissimilar substrate types reflects a response of algal growth to environmental conditions and is not an artifact of the substrates themselves.

Figure four represents a summary of the changes in periphytic biomass over time within each of the six geographic groups as measured from the plexiglass substrate. Figure five summarizes the biomass as found on the screens. The numbers within the graphs (figs. 4 and 5) indicate those geographic groups which are statistically different from the others within a time period. Since the screen samplers were not employed at the beginning of the season the following discussion will refer to the plexiglass results for period one.

It was surprising to find that the channel area between the two lakes exhibited the greatest amount and the largest increases over time of algal biomass as compared with the other groups. It was noted in the field that submersed plants such as *Myriophyllum* just outside the channel were covered with periphytic algal growth. The apparently high nutrient availability within this area is understandable from the standpoint that this channel area is the direct outflow for all of the Honest John Lake system, as well as receiving nutrient inputs from the Sloughs, particularly during seiche events. In addition, the shallow water depth at the channel mouth may allow a mixing of the sediments into the water column due to wave activity.

Honest John Lake at Denomie had the next highest amount of algal growth while the remaining groups exhibited relatively low weights which were not significantly dissimilar. Denomie Creek at Honest John Lake is the suspected primary point source of nutrients into the two lake systems. This possibility is evident by the occurrence of large floating mats of filamentous algae there. Sampling devices at this location during the first sampling period, contained approximately twice as much algal biomass as the remaining areas. As the season progressed the periphytic growth remained relatively constant (slight decrease) on the samplers at Denomie Creek while increases occurred at the other sites until the systems became more or less homogenous by mid summer (with the exception of the channel area). A probable explanation is that nutrient inputs from the Denomie watershed enter at Honest John and are then dispersed throughout the system over the course of the summer.

It is interesting to note that the Honest John east group had some of the lowest biomass weights when compared within the other groups. This area is geographically isolated from the effects of the Denomie watershed and the nutrient concentrations are influenced primarily by groundwater influxes from the surrounding peatlands. The low biomass values in this area supports the contention that the remainder of the Honest John system is experiencing nutrient concentrations that do not reflect "normal" background levels.

## Recommendations and critique of the devices

The biomass values from each of the three devices within a site showed good similarity. It was noted in the field that when a particular device had significantly less growth than the other two at a site, that device was usually located in an area with more surrounding macrophytes (fig. 6). This reduction of colonization was probably due to shading of light by the macrophytes and/or competition for nutrients in the water column. Another problem encountered was the presence of invertebrates on the substrates, particularly snails. While the numbers of invertebrates was relatively small, their presence indicated that they had been grazing. The amount of material lost to predation was probably relatively little and would become even less significant with a sufficient number of replicate samplers.

Overall we feel that the devices are viable tools for assessing the extent and differences of periphytic algal biomass within aquatic systems. As the devices are inexpensive to use they would be particularly useful as indicators of changing trends in aquatic productivity over the course of many years. The present experiment showed relatively good replicability within sites and an ability to show trends between sites over the course of the growing season. The technique could be refined for future use with the following recommendations:

1) "Fine tune" the devices by comparison with standard measures of productivity for one season. It would be instructive to compare biomass values on the devices with estimates based on planktonic chlorophyll assessments. In addition, the collection of nutrient data for a season would further illustrate the viability of the present technique.

2) Keep the devices clear of macrophytes.

3) Begin sampling earlier in the season. It is possible that the devices at Denomie Creek in Honest John Lake would have had greater algal colonization if sampling had commenced in late April or early May during spring runoff.

4) Monitor yearly weather fluctuations. If this technique is to be refined and used over the course of years, then annual variations such as percent sunlight, heating degree days and water temperature measurements should be accounted for when making annual comparisons of algal biomass.

5) Establish more sites within the Bad River Sloughs and perhaps extend to the Kakagon system. Monitoring devices located near the center and northwest shore would help characterize this lake.

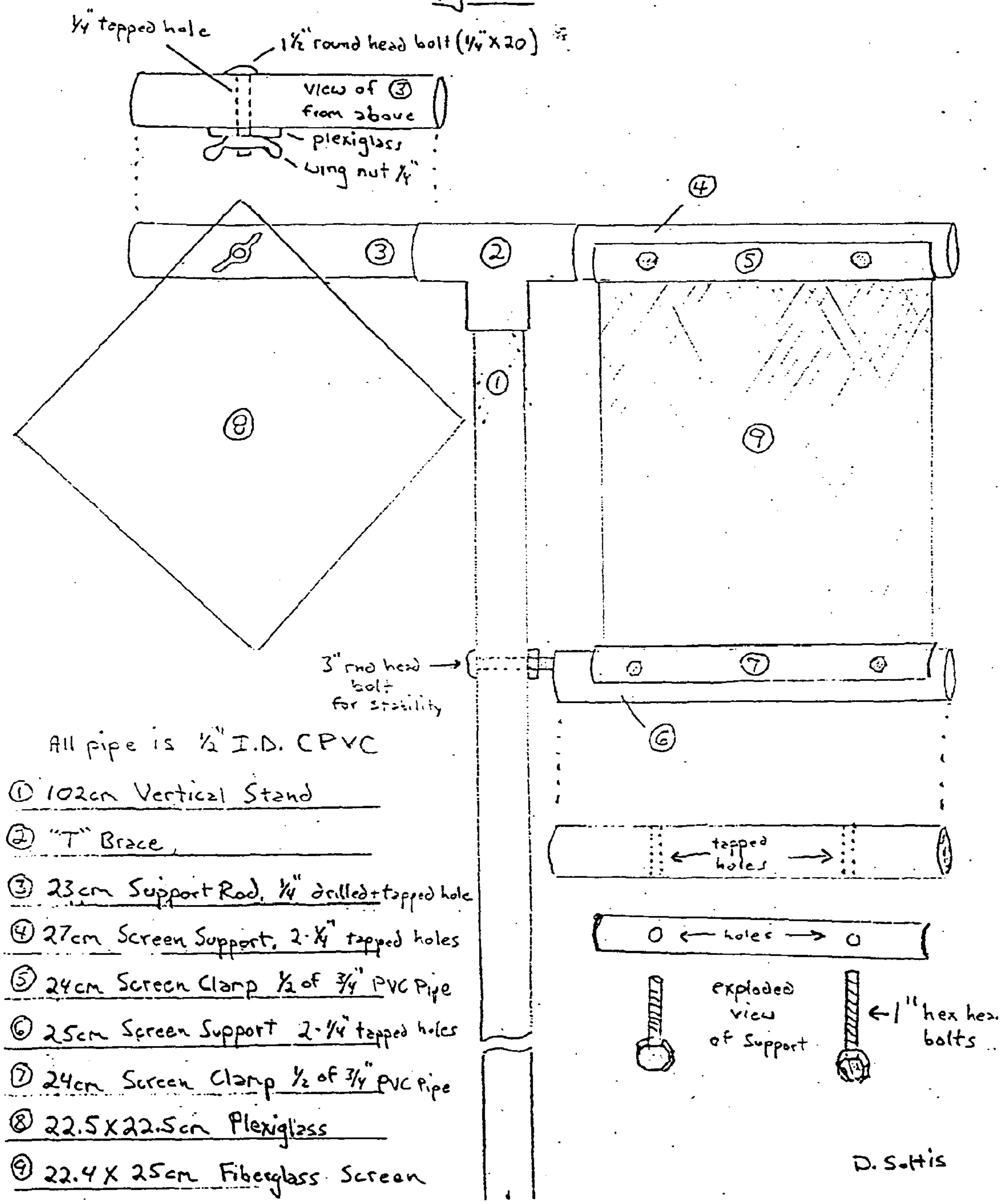
6) Utilize one substrate type. As there was good correlation in biomass between the two substrates, the use of either by itself should give similar results. Processing the screens for desiccation was much less time consuming and required less equipment than the plexiglass samples. Therefore, using only screens would speed the process up. In addition, the three devices at a site could hold six screens, giving a greater number of replicates of one substrate type for each site.

7) Monitor periphytic algal species composition. While not directly related to the goals of this experiment, the monitoring of any changes within the major taxa of periphytic growth over the course of years would be a valuable tool for assessing environmental changes in conjunction with the biomass.

**Appendix B**

Periphyton Sampler

Figure 1.



**Appendix B**

| Geographic Location | Device # | Site Location |
|---|---|---|
| Honest John Denomie | 1-9 | Denomie Outlet |
| Honest John West | 10-15 | NW Bay |
| | 16-18 | Island |
| Honest John East | 19-24 | Narrows |
| | 24-27 | SE Bay |
| Bad River Sloughs Denomie | 28-36 | Denomie Outlet |
| Bad River Sloughs West | 37-42 | West Bay |
| Connecting Channel | 43-48 | Channel |

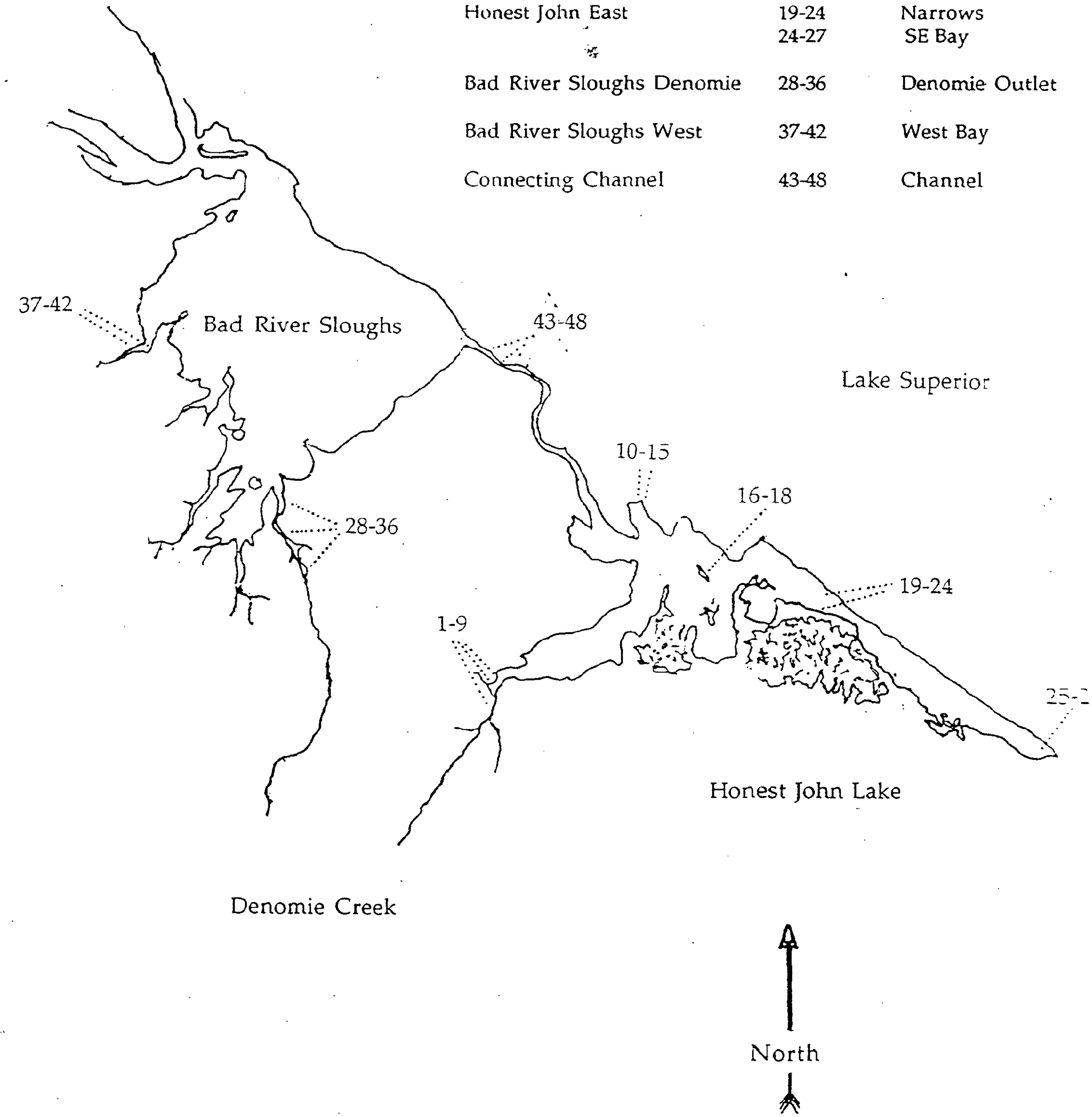
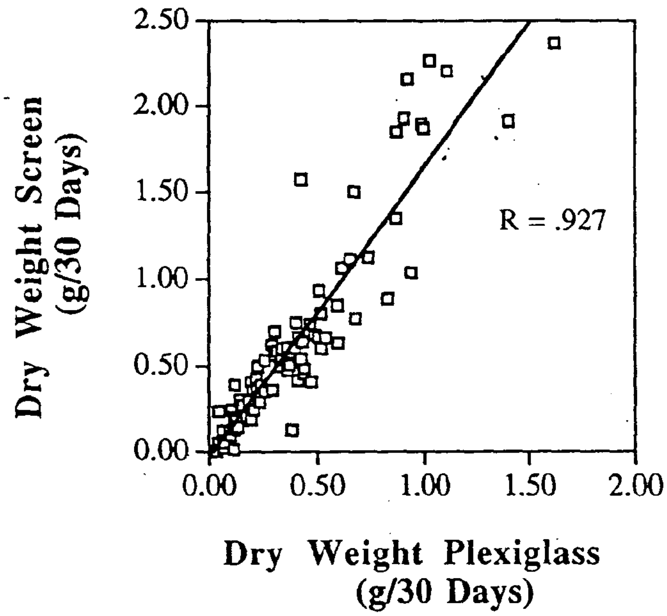



**Figure 2**

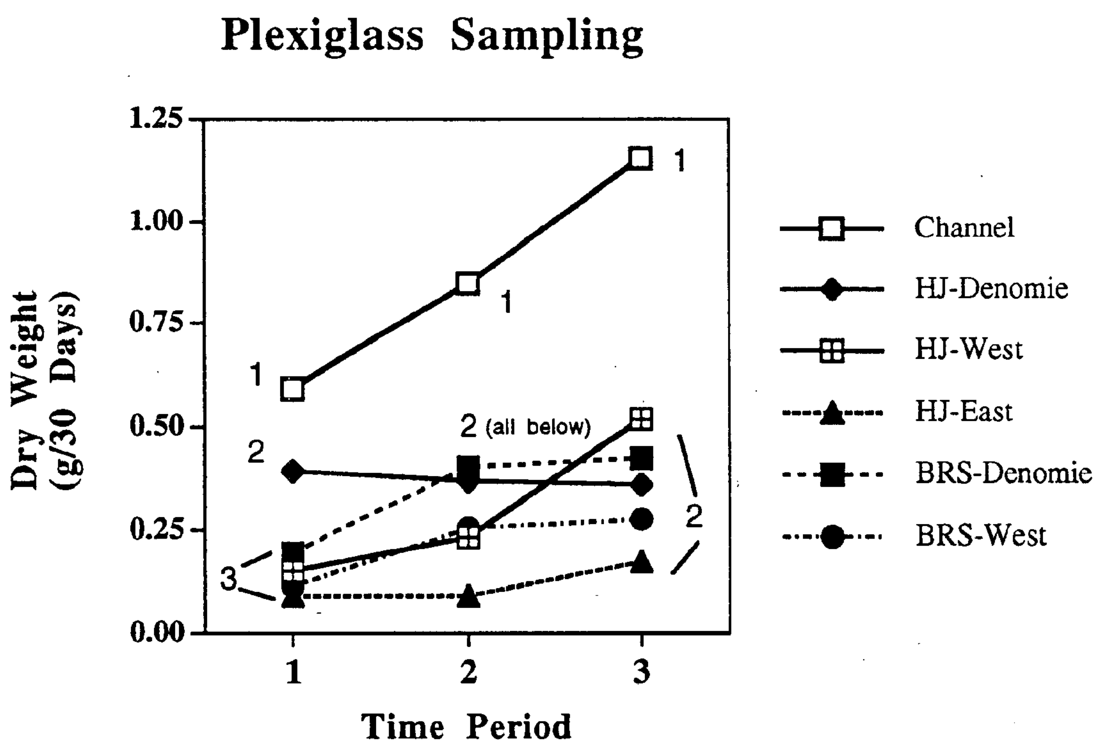
## Figure 3

**Correlation between screen and plexiglass sampling (compared in time periods 2 and 3 only - screens were not employed in time period 1)**



Appendix B

## Figure 4



Appendix B

Figure 5

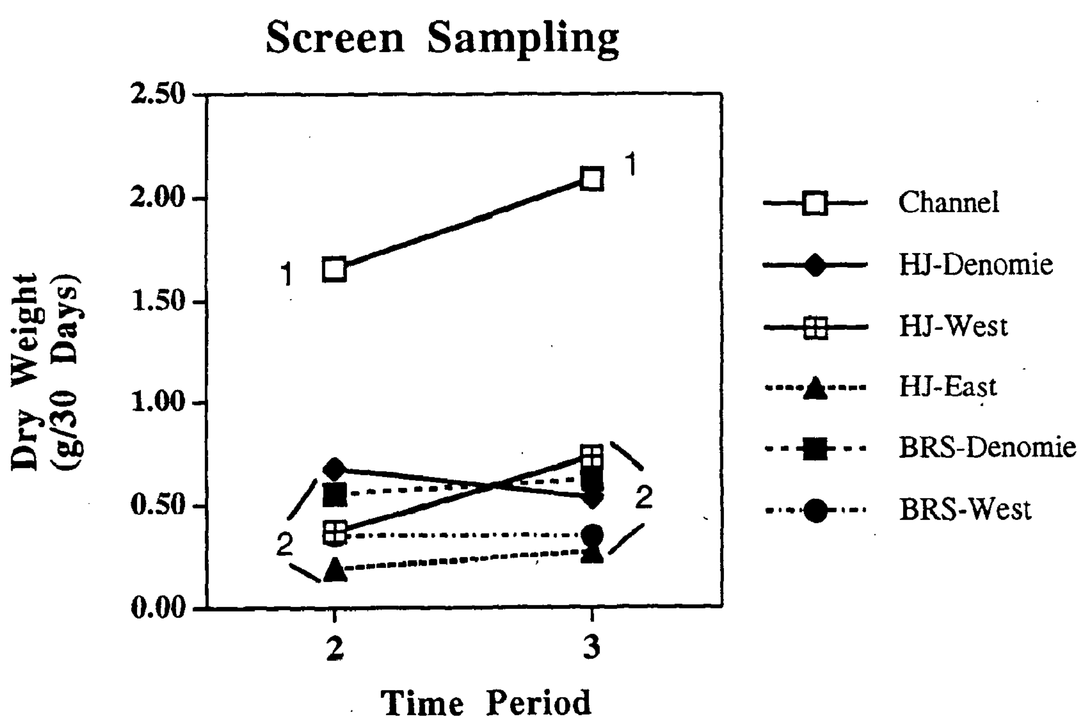
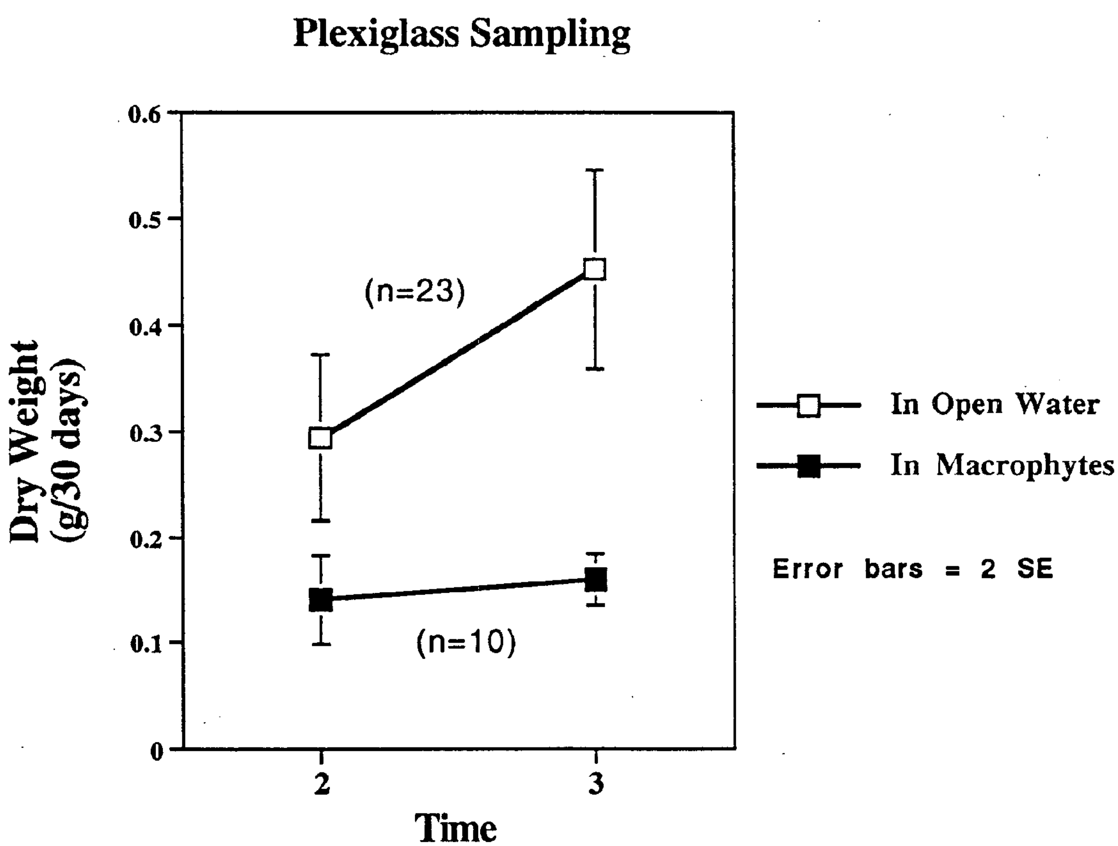


Figure 6


Plexiglass Sampling
0.6
0.5
0.4
0.3
0.2
0.1
0
Dry Weight
(g/30 days)
(n=23)
(n=10)
2
3
Time
In Open Water
In Macrophytes
Error bars = 2 SE