Project Title

Wetland Indicator and Methods Evaluation at Arcadia Lake, a Protected Embayment of Lake Michigan

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Project Overview

At the selected study site where we collected some similar data in 1995, the project team evaluated wetland indicators and methods of data collection to cover all relevant metrics for Flora and Fauna, Physical Characteristics, and Landscape Measures categories, as directed by the Project Management Team. The information obtained was for the purpose of evaluating and developing final protocols for the wetland monitoring program. This report contains a description of the field methods tested, a tally of the number of person-days required for each method employed, and a recommendation for inclusion of the most appropriate methods into the final protocols. Data analyses were not included in this methods-testing study; however, much of the raw data collected during the study was provided to the Great Lakes Commission previously.

Study Site

Arcadia Lake is a protected embayment near Lake Michigan at the city of Arcadia, Michigan, which is approximately 18 km south of Frankfort. The lake is separated from Lake Michigan by dunes but is hydrologically connected by a channel. The hydrology of Arcadia Lake and its wetlands is determined by Lake Michigan water levels. The 170-ha wetland lies in a broad basin in the upstream portion of Arcadia Lake and downstream from the confluence of Bowens, Tondu, and Lucker creeks. The adjacent land is used for agriculture; the upstream watershed is agricultural, about 40% forested, and extends inland about 8 km. The wetland is separated from Arcadia Lake by a 1.0-km-long road crossing with two large culverts that restricts flow during high flow periods. The shallow open water adjacent to the crossing is sometimes slightly turbid. Surface sediments in the aquatic zone are largely decomposed peat, with some sand and silt. Numerous ditches were constructed through much of the wetland in an unsuccessful attempt to drain it for agriculture, and cattle are currently grazed in sedge/grass portions of the wetland.

Methods Testing

Flora and Fauna Indicators

Invertebrate Community Health. To reduce effort in sorting specimens from sediments and detritus, invertebrate communities were sampled using funnel traps in daily sets. Paired clear plastic funnels attached to collection vessels were mounted in vertical and horizontal positions from rods anchored in the sediments. Each of eight pairs of traps were set, moved, and sampled August 13-16, 2002 in association with one of eight fyke nets set for fish sampling, which were generally placed in submersed aquatic beds, short emergent marsh, and tall emergent marsh vegetation types in standing water. After a 24-h period, invertebrates were removed, placed in labeled jars with preservative, and returned to the laboratory for identification and enumeration. Funnel traps are most effective, however, in collecting zooplankton rather than macroinvertebrates. Therefore, we conducted additional sampling with standard D-frame dip nets with 0.5-mm mesh. In each major vegetation type with standing water, triplicate net sweeps were made through the water at the surface, in the middle of the water column, and above the sediment surface. Samples were placed in a white enamel pan and representative subsamples of 150 individuals collected, including both large and small, motile and non-motile, and sessile species. This sampling was conducted August 13-16, 2002 also. Identification of invertebrates from funnel traps and dip nets is being taken to the lowest practicable taxonomic level. In addition, adult caddisflies (Trichoptera) were sampled using ultraviolet blacklight traps placed in overnight sets at each site for two nights in mid-July, mid-August, and mid-September 2002. The traps consist of an Eveready 9450 flashlight containing an F6T5-BLB blacklight tube and a small plastic pan partially filled with 85% ethanol. Because of the low luminosity of the bulb and placement of the lights in locations with limited long-distance visibility, the traps draw insects from only a limited area within a wetland and generally will not draw insects from other habitats. Caddisflies from each collection were placed in jars, picked, sorted, and identified to species level.

Invertebrate sampling activities with dip nets and light traps involved two persons for a total of about 10 person-days, including travel. Sampling with funnel traps was coincidental with fyke net sampling of fish and required two persons for about one hour per day – 2 person-days total. If the fish sampling and funnel trap sampling were reduced from four to two sampling nights, the personnel requirements would be reduced. Picking and identification remain to be completed and require considerably more time.

Fish Community Health. Fyke nets are very effective in sampling fish within wetland plant communities ranging from submersed and floating-leaf vegetation to short and tall emergent vegetation. Use of two frame sizes is necessary to allow nets to be placed in a variety of water depths. Use of two mesh sizes is necessary to enhance the ability to capture both large and small fish. On August 13-16, 2002, we used eight fyke nets (two of each frame size x mesh size) placed in the morning and retrieved the following morning. The nets were fished for two consecutive days then moved to a different location for two additional days. Nets with 91-cm x 91-cm frames and both 0.48-cm and 1.27-cm standard knotted mesh were placed facing the shore in water 1 m deep or greater with 6- to 15-m leads perpendicular to and reaching shore and 3-m wings extending to each side. Nets with 45-cm x 45-cm frames of both mesh sizes were placed similarly in water less than 1 m deep. After collection, all fish were anesthesized with MS-222 as needed, identified, counted, measured for length, and released. Occurrence of DELTs (deformities, eroded fins, lesions, and tumors) was noted also. Electrofishing was not possible because water levels were too low to allow access by boat electroshocker and sediments too soft to allow access by backpack electroshocker.

Fish community sampling required two persons for a total of 10 person-days, including travel. However, the effort could be reduced to 6 person-days if nets were not moved to different locations for sampling an additional 2 days, as was our practice.

Amphibian Diversity. The Marsh Monitoring Program operated by Bird Studies Canada (Port Rowan, Ontario) was used to conduct surveys for both wetland amphibian and bird communities. The protocols are based on the point-count method that incorporates fixed survey stations along a travel route. Weather- and temperature-sensitive amphibian data were collected by surveying calling species from fixed stations three times during the spring and early summer, with at least 15 days between surveys. A lengthened sampling season from April to early July enables nearly all of the 13 species of frogs and toads potentially present to be detected coincident with their breeding season. The surveys began one-half hour after sunset and ended before midnight. During 3-minute survey periods, all species heard within a semi-circle in front of the observer were mapped, and the intensity of calling activity was categorized as 1) individuals can be counted, calls not simultaneous; 2) calls distinguishable; some simultaneous calling; or 3) full chorus; calls continuous and overlapping.

The Marsh Monitoring Program protocols were used for sampling on April 18, May 20, and June 19, 2002. This effort required one person and 3 person-days including travel.

Bird Diversity and Abundance. Date- and time-sensitive bird data were collected by visual or auditory observation at fixed stations twice during the year between 20 May and 5 July, with at least ten days between surveys. During 10-minute survey periods, 30-second recordings of calls for Virginia Rail (*Rallus limicola* Vieillot), Sora (*Porzana carolina* L.), Least Bittern (*Ixobrychus exilis* Gmelin), Pied-billed Grebe (*Podilymbus podiceps* L.), and a combination of Common Moorhen (*Gallinula chloropus* L.) / American Coot (*Fulica americana* Gmelin) were broadcast with 30 seconds of silence between calls. Five minutes of calling was followed by five additional minutes of observation. Each bird observed was assigned to one of three categories: adults observed in contact with the sample area (not in flight), aerial foragers, and outside/fly-throughs.

The Marsh Monitoring Program protocols were also used for bird sampling on June 1 and June 28, 2002, requiring one person and 2 person-days of effort, including travel.

Plant Community Health. Color infrared aerial photographs at a nominal scale of 1:6000 were contracted for collection in July, with early return of the film. Major vegetation types clearly definable on the photographs, including submersed aquatic plant communities, were mapped in the field with photographs in hand. Intergrading, minor, and all invasive vegetation types were delineated also. These data can be compared to our 1995 data to track changes in areal extent of vegetation types, especially invasive types, through time. In early August, after mapping and ground-truthing were completed, we sampled twenty 1-m x 1-m quadrats in the dominant emergent vegetation type and the SAV or SAV/floating-leaf vegetation type according to a random or stratified random design. All taxa in each quadrat were identified to species, if possible, and estimates of percent cover were assigned to each taxa in the quadrats. All taxa identified during quadrat sampling were used to generate a species list, and can be evaluated for characteristics such as turbidity tolerance and invasiveness. We also collected data regarding attributes of physical habitat to assist in ecological interpretation of data; water depth at each quadrat location was most essential. A general floristic survey of at least 15 minutes in each vegetation type, including any elevation gradients within the wetland, was also conducted to assist in developing a more complete species list for use in FQI calculations.

To comply with agreed-upon sampling methodologies, additional vegetation sampling was conducted along transects placed perpendicular to the hydrological gradient. Along the transect, five randomly located quadrats, 0.5 meter square in area, were sampled for aquatic macrophytes in each vegetation zone. The starting point for each transect was randomly located, beginning within 25 meters of the upland edge of the wet meadow zone, with sampling points located 25 meters apart. The location of the sampling quadrat was based on a random bearing 1 to 9 meters from the sampling point. Percent cover was estimated for each plant species within the sample quadrat; coverage was also estimated for all species, emergent species, and floating and submergent species. Substrate, organic depth, water depth, and water clarity (using secchi disk) were recorded. Sampling was conducted in the wet meadow, emergent/submergent, and submergent zones.

Vegetation mapping and plant sampling were conducted during the week of August 13-16, 2002. Mapping required one person and 1 person-day. Quadrat sampling by the Albert method required two persons for a total of 2 person-days. Quadrat sampling of the major emergent community and SAV community by the Wilcox method required two persons for a total of 4 person-days but resulted in location and identification of more species. Additional vegetation types were also sampled, boosting the total for all plant sampling to 10 person-days, including travel.

Physical Characteristics

During the week if August 13-16, 2002, sediment flow and turbidity were at a minimum, and waters being very shallow, the bottom sediments were visible at most all locations. Light meters were deemed impractical.

Landscape Measures

Data for these indicators was obtained by evaluation of air photos and observations at the study site during the week of August 13-16, 2002 following site reconnaissance and making use of the GLC Site Attribute Data Sheet. Included were a general site description; evaluations of hydrologic alterations and landscape alterations (vegetation and substrate disturbances; proximity to navigable channels, recreational boating, and roadways; numbers of dwellings, industries, buildings, docks, parking lots, and boat launches; and percent hardened shoreline, eroding shoreline, and paved shoreline); adjacent habitat types, land-use classes, and construction/ structures; and degree and type of human activity.

With air photos in hand, this effort required one person and about 0.5 person-days.

<u>Methods Recommendations</u>

From past experience and the experiences gained during this methods evaluation, we suggest that the following options be considered for incorporation into the Consortium monitoring plan.

Invertebrate Community Health

Activity trap (funnel trap) and dip net methods collected quite different fauna. A combined total of 58 taxa were identified (25 for the activity trap sample and 38 for the dip net sample), with only 8 taxa common between the two methods. The activity trap taxa were dominated by crustaceans (15), while the dip net taxa was dominated by insects (27). Both sampling processes are affected by a variety of biases. Both methods are subject to placement or location bias, since placing the activity trap and selecting a site to dip are somewhat subjective. The use of activity traps faces a further placement bias in that the traps require a water depth of approximately one meter, whereas dip nets are effective at depths between 0.1 and 1 meter. Also, the taxa composition of a sample within an activity trap may be altered if a predator is entrained in the sample and forages on certain prey items in that sample. Weather conditions (moon phase, wind, etc.) may play a roll in the composition of an activity trap sample. In addition to the collection of amounts of detrital material that may hamper the field sorting process, the dip net method faces various human biases not mentioned above. The operators may be biased either for or against cryptically-patterned organisms, animals that move quickly as opposed to those that are more sessile, or animals about which they have more knowledge or interest. If the objective is to ascertain the relative abundances of the members present within wetland invertebrate communities, then the use of both types of sampling gear is appropriate. Together, they provided a more complete picture than the samples did separately. If the objective is to streamline the sample collection and sorting process in regard to metrics that respond to wetland degradation, then the dip net procedure is more applicable, since in our trial, this method collected more insect taxa than the activity trap, and numerous metrics relating insects with water and habitat quality have been proposed.

Our past studies have shown that adult caddisflies may be a sensitive indicator of wetland quality, which is why we included this method in our evaluation. Very little time is required in the field for sample collection (placing and retrieving light traps). Compared to other invertebrate methods, the identification portion of data collection is relatively less time-consuming also. The drawback on use of this method, however, is the scarcity of taxonomic expertise capable of identifying adult caddisflies to species level accurately. Nevertheless, we recommend that this indicator be considered as an option in the Consortium monitoring plan.

Fish Community Health

The protocols that we used for fish sampling work very well. The rationale for placement of fyke nets with the leads staked on shore is that fish will move toward deeper water (and the net) when they approach the leads. Dr. John Brazner and colleagues at the U.S. Environmental

Protection Agency in Duluth have tested a variety of fyke net placement strategies. They concluded that two nets set with leads parallel to shore and facing each other were the most productive. While we do not argue with their results, it may be difficult to place such an arrangement unless the portion of the wetland to be sampled is fairly large. We would not contest selection of a net placement strategy that differs from the one we used; it is most important that all monitoring program practitioners be equipped with similar gear and apply them in the same manner. We are unable to comment on use of electrofishing because it was not possible at the site where we evaluated methods. We did not choose to use electrofishing in previous work for this very reason – it could not be employed in too many of our sites. Electrofishing also seems to be constrained by stands of emergent vegetation that make it difficult to approach in a boat and dense submersed, floating, and emergent vegetation that make it difficult to net fish that respond to the shocker. Most efforts that have used electrofishing have sampled only along the edge of the vegetation and may not have captured the full contingent of fish species present. On the other hand, some species are less prone to capture by a fyke net, so a combination of techniques might provide the best result. The question becomes one of standardizing methods and determining the level of effort and funding that must be applied vs. the completeness of data required.

Amphibian Diversity

We found the Marsh Monitoring Plan protocols to work efficiently. They are also standardized and in already in use. They should be incorporated into the Consortium monitoring program.

Bird Diversity and Abundance

We found the Marsh Monitoring Plan protocols to work efficiently. They are also standardized and in already in use. They should be incorporated into the Consortium monitoring program.

Plant Community Health

Although others chose not to incorporate interpretation of color infrared air photos into their methods evaluations, we maintain that this is a valuable tool for evaluating long-term changes in wetlands, especially those that are large. A plethora of journal articles making use of this method is testimony to its value. The air photos also provide easy and accurate evaluation of many landscape characteristics. We highly recommend that air photo interpretation be included in the monitoring program to assess changes in major vegetation types and invasive vegetation type over time using metrics such as *percent wetland in dominant emergent vegetation type* and *percent wetland in invasive vegetation types.*

We found the Albert method of sampling quadrats to be confusing and difficult to employ, likely as a result of our inexperience with it. The array of sampling quadrats at each sampling point was not difficult to contend with; however, the placement of sampling points at 25 m intervals resulted in the potential for quadrats surrounding one sampling point to fall into more than one vegetation type (e.g., the sampling point fell at the interface of sedge meadow and mud-flat communities). Although less time was required for sampling, the species list generated by this method did not contain as many taxa as the list generated by the other sampling design. If a similar level of effort had been employed (four person-days rather than two), the lists may have been comparable. The random survey for presence/absence was also critical in adding to the species list. The larger question to be answered, however, is what use will be made of the data collected. Species lists can be used for metrics such as *Floristic Quality Index (FQI), number of native taxa,* and *percent wetland obligate species*, but collection of quantitative data should be applicable to metrics requiring quantitative data. Our previous work indicated that s*um of mean percent cover of invasive taxa in dominant emergent vegetation type* and s*um of mean percent cover of turbidity-tolerant taxa in submersed aquatic vegetation type* were the useful quantitative metrics that could be derived from quadrat sampling. Our sampling protocol provided those data; any sampling design implemented for quantitative sampling of vegetation should be tied to appropriate quantitative metrics.

Landscape Measures

These data collection methods are fairly straightforward and should be incorporated into the monitoring program. We found, however, that time efficiency and accuracy were greatly enhanced by having air photos in hand.

Project Team

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