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AQUATIC PLANT SPECIES DIVERSITY AND FLORISTIC QUALITY ASSESSMENT OF SAUGANY LAKE, INDIANA

Mitchell S. Alix and Robin W. Scribailo
Biology and Chemistry Section
Purdue University North Central
Westville, Indiana 46391

ABSTRACT: Floristic surveys of Saugany Lake were conducted during the growing seasons of 1996 through 1998 to determine the distribution and abundance of submerged, emergent, and free-floating aquatic plant species. Forty-nine species in 33 genera were identified from 24 families. The localities for each identified species were mapped. Each species was assigned an overall relative abundance rank based on a mean score which incorporated the total area covered by the species and its total number of occurrences. Plant families exhibiting the greatest diversity were the Potamogetonaceae (nine species), Cyperaceae (six species), and Lemnaceae (four species). Among the species collected, four are state-listed, and three are non-native. The floristic quality index (*I*) of the lake was 44, and the mean coefficient of conservatism ($\bar{C}$) was 6.6. These values indicate that the lake represents a natural community with high species richness. In addition to the floristic quality index and mean coefficient of conservatism, the attached checklist provides baseline data for future monitoring of the aquatic plant species of Saugany Lake.

KEYWORDS: Aquatic macrophytes, floristic quality assessment, Indiana flora, Saugany Lake, species diversity.

INTRODUCTION

Comprehensive floristic investigations of ponds, lakes, and streams in Indiana are rare despite concerns over eutrophication and the large number of aquatic vascular plant species listed as endangered, threatened, or rare in the State. Aquatic macrophytes are an integral component of aquatic ecosystems (Sculthorpe, 1967; Hutchinson, 1975; Carpenter and Lodge, 1986) although their importance in the maintenance of ecological integrity is seldom acknowledged (but see Scheffer and Jeppesen, 1998).

Assessments of the trophic status and integrity of deep-water habitats most commonly rely on surveys of planktonic organisms. Studies have shown that aquatic macrophytes are important determinants of zooplankton (Søndergaard and Moss, 1998), phytoplankton (Jeppesen, *et al.*, 1998), and macroinvertebrate diversity and abundance (Cyr and Downing, 1988; Ságová, *et al.*, 1993). The distribution of fish species is also often closely correlated with both invertebrate assemblages and submerged aquatic plant communities (Randall, *et al.*, 1996). If we are to better understand the functioning of lake ecosystems, more effort should be directed toward making detailed assessments of aquatic macrophyte communities in lakes of varying trophic status.

In this paper, we present a comprehensive inventory of the aquatic vegetation of Saugany Lake with specific reference to species richness, distribution, and abundance. An assessment of the floristic quality of the lake in terms of its native floral significance is also presented. No previous surveys of the aquatic plants of Saugany Lake were available, in part, because the lake does not have a public access. Information from this study will provide baseline data for future monitoring of one of Indiana's most pristine and finest lakes.

MATERIALS AND METHODS

Study Area. Saugany Lake, located in northeastern LaPorte County, Indiana (41°43′20″ N, 86°34′47″ W), is a relatively small, but rather deep, thermally stratified lake, occupying only 29.9 ha and having a maximum depth of 19.9 m (Figure 1). Like the majority of lakes in this region, Saugany Lake was formed during the Wisconsinan glacial period when a melting ice block left behind a depression on the outwash plain of the retreating glacier. This spring-fed lake is almost completely surrounded by homes. Limited information is available on the water quality of Saugany Lake since both the Indiana Department of Environmental Management and the Indiana Department of Natural Resources conduct only limited testing on private lakes. The watershed is small, and the lake has an outlet along its eastern shore which drains to Hudson Lake, the Kankakee River, and, eventually, the Mississippi River. An inlet to the northeast receives runoff from part of Interstate 80. Winter road salt intrusion in runoff from the toll road is a potential environmental concern for the lake. Physical data obtained from the Indiana Department of Environmental Management (undated) suggest that Saugany Lake is a Class One lake, indicating that it is rated as one of the least eutrophic lakes in Indiana. In 1995, the lake had a Secchi disk transparency of 5.9 m, a specific conductance of 416 µs/cm, and a pH of 7.5. The total alkalinity (expressed as ppm $CaCO_3$) for the lake was measured at 69.5. In contrast to lakes of similar size in LaPorte County, total nitrates (0.05 ppm) and total phosphates (0.04 ppm) are relatively low (G. White, pers. comm.).

The soils surrounding Saugany Lake are primarily of two distinct types (Furr, 1982). Histosols and Aquolls comprise the soils of the north shore from site 9 to site 20 (Figure 1), whereas Riddles Loam is found along much of the southern shore. Histosols and Aquolls are deep, poorly drained soils in which black, decomposed organic material overlies sandy loams. Riddles Loams are soils that are well drained and that have formed in loamy glacial till. In general, the lake bottom is sandy; however, at the north end of the lake, the bottom is mucky with substantial organic matter accumulation in the marshy emergent zone.

Aquatic Plant Survey. Comprehensive surveys were conducted over a period of three years, spanning from 1996 through 1998. One survey was completed each year and consisted of bimonthly sampling of 24 sites (Figure 1) during the growing season. Like terrestrial ecosystems, aquatic plant communities exhib-

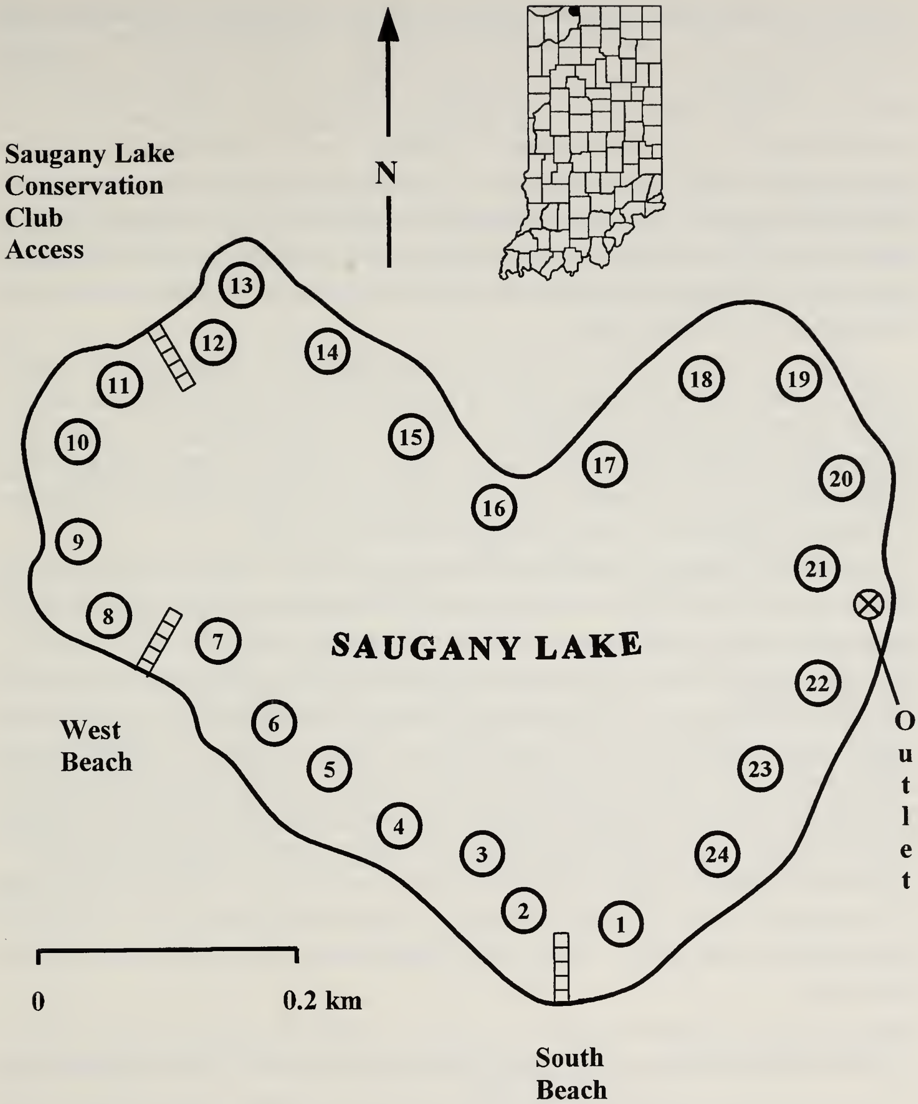

Figure 1. Map of Saugany Lake showing collection sites indicated by number.

it marked seasonality in species growth. Therefore, repetitive sampling minimizes temporal effects and ensures that the majority of species are not only sampled but can also be identified. Repetitive sampling is particularly necessary for aquatic plants where phenotypic plasticity in vegetative characters makes it essential that floral and fruit characters be present for positive identification (Sculthorpe, 1967). One-time sampling methods, which are often employed for aquatic vascular plants, can lead to a gross misrepresentation of both the abundance and species composition of aquatic plant communities.

At each of the study sites, emergent plants were sampled 1.0 m beyond the lake margin (*i.e.,* the water's edge) for a distance of approximately 20 m parallel to the shoreline to ensure that obligate wetland species directly associated with the perimeter of the lake were included in each survey. Because of shoreline development, very little habitat is available for the establishment of emergent vegetation with two exceptions — a small area on the west shore and one at the north end of the lake where more extensive wetlands have historically precluded development. In the majority of cases, this sampling method provided a representative picture of the emergent shoreline area, which often consisted of lawn down to the water's edge.

Aquatic plants of the littoral zone were sampled perpendicular to the shoreline out to the maximum depth of their distribution (typically 7.0 m) and parallel to the shoreline for a distance of 20 m, corresponding to the length of the shoreline sampled. The sample sites were not uniform in the distance they extended out from the shoreline due to variation in the depth contours of the lake. As a result, sample areas were not equivalent among sites.

Submersed, emergent, and free-floating macrophytes were collected by hand while wading in the shallow water along the lake margin. In areas having moderate depths, the sampling of submersed plant species was carried out by dredging the lake bottom with an extendable thatching rake from the side of a Jon boat. SCUBA was used to collect submersed aquatic plants in areas having a depth greater than 3.0 m. By employing multiple methods, a larger proportion of the lake could be comprehensively inventoried, and the likelihood of the majority of species being collected was greatly increased. The relative abundance for each species in the checklist was determined by modifying the ranking method outlined in Palmer, *et al.* (1995) to incorporate coverage area. A score was assigned to each species identified at a given site based on the amount of area covered by that species. The modified definitions for the categories of abundance are:

Rare (Score = 1):	Species that occupy up to 9% of the total area at a study site.
Infrequent (Score = 2):	Species that occupy between 10% and 19% of the total area at a study site.
Occasional (Score = 3):	Species that are neither abundant nor common but occupy between 20% and 49% of the total area at a study site.
Common (Score = 4):	Species that are not abundant but occupy between 50% and 74% of the total area at a study site.
Abundant (Score = 5):	Dominant species that occupy 75% or more of the total area at a study site or co-dominant species who together occupy 50% or more of the total area at a study site.

The relative abundance (A_r) of a given species in the entire lake was determined using:

$$A_r = \Sigma\ s / n$$

where the sum of all abundance scores for a given species ($\Sigma\ s$) is divided by the total number of occurrence sites for that species (n). The calculated relative abundance varies between 1 and 5, allowing the species to be placed into one of the above categories. This semi-quantitative method was used to assign macrophytic species to a specific relative abundance category for the lake based on overall occurrence and coverage area.

Floristic Quality Assessment. The lake's natural floristic quality was evaluated using Swink and Wilhelm's (1994) coefficient of conservatism (C). Swink and Wilhelm (1994) assigned each native plant species in the Chicago region a coefficient of conservation ranging from 0 to 10. However, no coefficients of conservatism were given to non-native species and native charophytes. Consequently, these species do not belong to a conservatism group, and they were excluded from the floristic quality assessment.

The C value reflects the probability that a plant will occur in an area which has remained relatively unaltered since presettlement times. Therefore, a C value of 0 is given to plant species that have little fidelity to a specific natural community, but a C value of 10 is given to plant species that are almost always restricted to that same natural community. The C values for all native aquatic vascular plants recorded from the lake have been included in the checklist (see p. 134).

Floristic quality is determined by calculating a mean coefficient of conservatism ($\bar{C}$):

$$\bar{C} = \Sigma\ C / N$$

where $\Sigma\ C$ is the sum of all the C values of the native aquatic vascular plants recorded from the lake, and N is the total number of species having C values. The floristic quality index (I) is then calculated as follows:

$$I = \bar{C}\sqrt{N}.$$

Taxonomy. Nomenclature follows Gleason and Cronquist (1991) for all taxa except the charophytes, which follow Daily's (1953) taxonomic treatment of the Characeae of Indiana with nomenclatural revisions where necessary. No attempt was made to identify specific forms or variants of any of the listed species. Voucher specimens of all species are deposited in the Aquatic Plant Herbarium of Purdue University North Central. Common names and collection numbers for each of the specimens are found in the checklist (see p. 134).

RESULTS AND DISCUSSION

The inventory of the aquatic macrophytes of Saugany Lake documented 49 species, including four (8.2%) state-listed species, three (6.1%) exotics, and two (4.1%) charophytes. The aquatic flora of the lake is composed of 24 families and 33 genera. Families having the greatest species richness were the Potamogetonaceae (9 species), Cyperaceae (6 species), and Lemnaceae (4 species). The percentage of monocotyledonous taxa (68.1%) was much larger than the percentage of dicotyledonous taxa (31.9%) in the total vascular flora (47 species). This difference is not surprising given that the aquatic flora is dominated by monocotyledonous families.

The most abundant submerged monocotyledonous species are *Potamogeton praelongus* Wulfen and *P. zosterformis* Fern., the former being listed as state endangered (Indiana Natural Heritage Data Center, 2000). Other state-listed species include *Polygonum hydropiperoides* Michx., *Potamogeton pusillus* L., and *P. vaseyi* Robbins. The most common and widespread dicotyledonous species are *Nuphar advena* (Aiton) Aiton *f.*, *Nymphaea odorata* Aiton, *Utricularia vulgaris* L., and *Myriophyllum spicatum* L. (exotic). Other nonnative aquatic vascular plant species recorded from the lake include *Potamogeton crispus* L. and *Rumex crispus* L.

The least abundant species are emergent plants, such as sedges and grasses, commonly found growing on the shore or along the lake margin. These species illustrate one of two inherent problems with the methodology used to determine overall abundance. Emergent plants will always have lower scores because the amount of surface area represented by the emergent vegetation at a study site is only a fraction of the total surface area inventoried. The disparity is particularly great for the emergent aquatic plants at Saugany Lake because shoreline development is so extensive that there is very little habitat available for emergent vegetation. Homeowners prefer lawns down to the water's edge and no "weeds" in their beach areas. In addition, the elevation around the lake increases rapidly beyond the water's edge, making conditions too dry for emergent species outside of the immediate shoreline. As a result, emergent species are categorized as either rare or infrequent although they may be common at some sites.

Another problem with interpreting abundance values is that species that have high scores but only occur at a few locations are likely to be categorized as abundant or common, misleading the reader into believing that these species are widespread. To more clearly elucidate the status of each species, growth habit, type of habitat, and, in some cases, water depth have been recorded for each species in the checklist (see p. 134).

Despite inherent problems with this and similar methods, Palmer, *et al.* (1995) suggests that errors in the assignment of abundance rankings should be rare due to the breadth of the categories. Thus, a species exhibiting a two-category change in abundance ranking in a future study has probably undergone a highly significant change in its population size.

Table 1. The mean coefficient of conservatism and number of individual species per site.

Site	N	$\bar{C}$	Site	N	$\bar{C}$	Site	N	$\bar{C}$
1	11	7.3	9	34	7.2	17	11	6.7
2	4	8.5	10	18	6.6	18	26	6.4
3	11	7.4	11	14	6.4	19	21	7.0
4	8	7.6	12	15	7.8	20	12	7.4
5	5	6.6	13	16	7.1	21	9	6.4
6	6	6.2	14	12	7.4	22	4	8.3
7	13	7.2	15	15	5.8	23	7	7.8
8	17	7.5	16	14	6.8	24	13	7.3

Species richness varied among the sampling sites (Table 1). The number of individual taxa per site ranged from 34 (site 9) to 4 (sites 2 and 22). In most cases, sites located in less disturbed areas had a greater number of species than those sites where shoreline development is more extensive. The least disturbed sites are located within the extreme western and northeastern lobes (sites 9, 10, 18, and 19, respectively) of the lake, whereas the most disturbed sites are located along the southwestern and southeastern shores (sites 2 to 6 and 21 to 23, respectively) and are less diverse.

The overall $\bar{C}$ value for the lake was 6.6, indicating that the area is a mix of species having a range of C values. All sampling sites within the lake had values greater than 5.5, ranging from 5.8 to 8.3 (Table 1). The I value for the lake was 44.0, indicating that the lake is a highly important floristic remnant of natural vegetation that has not been severely impacted by human activities. According to Swink and Wilhelm (1994), areas having a $\bar{C}$ value of 3.5 or an I value of less than 35 are marginal quality habitats, whereas areas having a $\bar{C}$ value of 5.0 or an I value greater than or equal to 35 are high quality habitats and floristically important from a statewide perspective.

Floristic quality assessment has been most extensively applied in Michigan (Herman, *et al.*, 1996), the Chicago region (Wilhelm and Masters, 1995), Illinois (Taft, *et al.*, 1997), and northern Ohio (Andreas and Lichvar, 1995), and the results of these studies have upheld the value of these indices as indicators of ecosystem quality. Herman, *et al.*, (1996) suggest that the advantage of the floristic quality index is that it utilizes information about all of the native species in a community and does not rely solely on a suite of indicator species. The comprehensive nature of floristic quality assessment results in greater information about the habitat and its quality.

Unfortunately, obtaining adequate funding for this type of comprehensive inventory work is difficult. The rapid assessment surveys currently done for lakes and wetlands tend to be based on one-time inventories. In this study, a one-time survey would only have allowed the identification of a small percentage of the species present, primarily because the identifications would have been based on highly phenotypically plastic vegetative characters instead of flowering and fruiting material.

Although the current authors agree with the concept of floristic quality assessment, we strongly believe that the presence of exotics, which are often invasive in aquatic habitats, should be considered in the calculation of *I*. The number of exotics in a community relates directly to the floristic quality of the site in question. The value of *I* should be dependent upon the total number of species (native + nonnative) with negative coefficients of conservatism being used for nonnative species. In situations where there are a large number of both native and nonnative species or a large number of nonnative species and a few highly conservative species, the exclusion of the nonnative component may result in an artificially inflated value of *I*.

Although the situation at Saugany Lake is a less pronounced example, if we assign a *C* value of -10 to the nonnative species, the value of *I* would drop from 44 to 38.2. Unlike other researchers (Swink and Wilhelm, 1994; Herman, *et al.*, 1996) using the coefficient of conservatism, we have included exotic species in our first conservatism group (Group A; Table 2) and in our calculation of the relative frequencies of species per group (Figure 2). This calculation is simply the number of species per conservatism group divided by the total number of aquatic vascular plant species present and is expressed as a percentage. The conservative species tend to have higher values of *C* (78% of the species have *C* values of 5 or higher, and 30% have a value of 8 or higher).

If the floristic quality index is to be used more extensively for the evaluation of lake quality, another issue must addressed — the assignment of coefficients of conservatism to charophytes. In the United States and the Midwest in particular, charophytes are a dominant component of the littoral zone of many lakes (Hutchinson, 1975). In Indiana, the charophytes are especially prevalent in marl lakes in the northeastern part of the State. Although many charophyte species exhibit an intermediate habitat fidelity, others are very sensitive to disturbance and show strong fidelity to more pristine lakes. The extensive literature on the ecology of charophytes (*e.g.*, Daily, 1953) should be used to derive conservatism coefficients for the species.

An interesting biotic factor that appears to have had an important impact on the distribution and abundance of aquatic plants in Saugany Lake is the introduction of the milfoil weevil *Euhrychiopsis leconteii* Dietz (the first county record for Indiana; Waltz, White, and Scribailo, 1997). The species occurs naturally in Wisconsin and has recently been reported from northeastern Illinois. Although the native host of the milfoil weevil is the northern water milfoil (*Myriophyllum sibiricum* = *M. exalbescens*), the weevil will preferentially feed upon Eurasian water milfoil (Sheldon and Creed, 1995).

In 1998, numerous weevils were found on Eurasian water milfoil plants at Saugany Lake, and extensive damage to plants' shoots was observed (Scribailo, Alix, and Barnes, pers. obs.). In the following year, aquatic plant surveys indicated a large-scale decline in the abundance of Eurasian water milfoil, particu-

Table 2. Conservatism groups for species collected from Saugany Lake. Groupings are based on Swink and Wilhelm's (1994) coefficient of conservatism (*C*) which indicates different degrees of habitat fidelity.

Group A: Nonnative and native species having a *C* value of 0 to 1 (low fidelity species)

Myriophyllum spicatum L.	*Typha angustifolia* L.
Potamogeton crispus L.	*Typha latifolia* L.
Rumex crispus L.	

Group B: Native species having a *C* value of 2 to 4

Alisma subcordatum Raf.	*Sagittaria latifolia* Willd.
Cyperus bipartitus Torr.	*Scirpus atrovirens* Willd.
Polygonum amphibium L.	

Group C: Native species having a *C* value of 5 to 7

Cephalanthus occidentalis L.	*Nymphaea odorata* Aiton
Ceratophyllum demersum L.	*Polygonum hydropiperoides* Michx.
Elodea canadensis Michx.	*Potamogeton foliosus* Raf.
Iris virginica L.	*Potamogeton pectinatus* L.
Juncus effusus L.	*Potamogeton pusillus* L.
Lemna minor L.	*Scirpus cyperinus* (L.) Kunth
Lemna trisulca L.	*Scirpus pungens* Vahl
Ludwigia palustris (L.) Elliott.	*Scirpus validus* Vahl
Lycopus americanus Muhl.	*Spirodela polyrhiza* (L.) Schleiden
Najas flexilis (Willd.) Rostkov & Schmidt	*Vallisneria americana* L.
Nuphar advena (Aiton)Aiton *f.*	*Wolffia columbiana* Karsten

Group D: Native species having a *C* value of 8 to 10 (high fidelity species)

Brasenia schreberi J.F. Gmel.	*Potamogeton praelongus* Wulfen
Decodon verticillatus (L.) Elliott.	*Potamogeton vaseyi* Robbins
Eleocharis ovata (Roth) Roemer &Schultes	*Potamogeton zosteriformis* Fern.
Hydrocotyle umbellata L.	*Ranunculus longirostris* Godron
Peltandra virginica (L.) Schott & Endl.	*Sagittaria graminea* Michx.
Pontederia cordata L.	*Utricularia vulgaris* L.
Potamogeton amplifolius Tuckerman	*Zosterella dubia* (Jacq.) Small
Potamogeton gramineus L.	

larly in the southern half of Saugany Lake. At the same time, the state threatened species, *Potamogeton praelongus*, which had previously been rare, became one of the most dominant submerged macrophyte species. A recent analysis of lake data for States adjacent to Indiana has shown a similar correlation

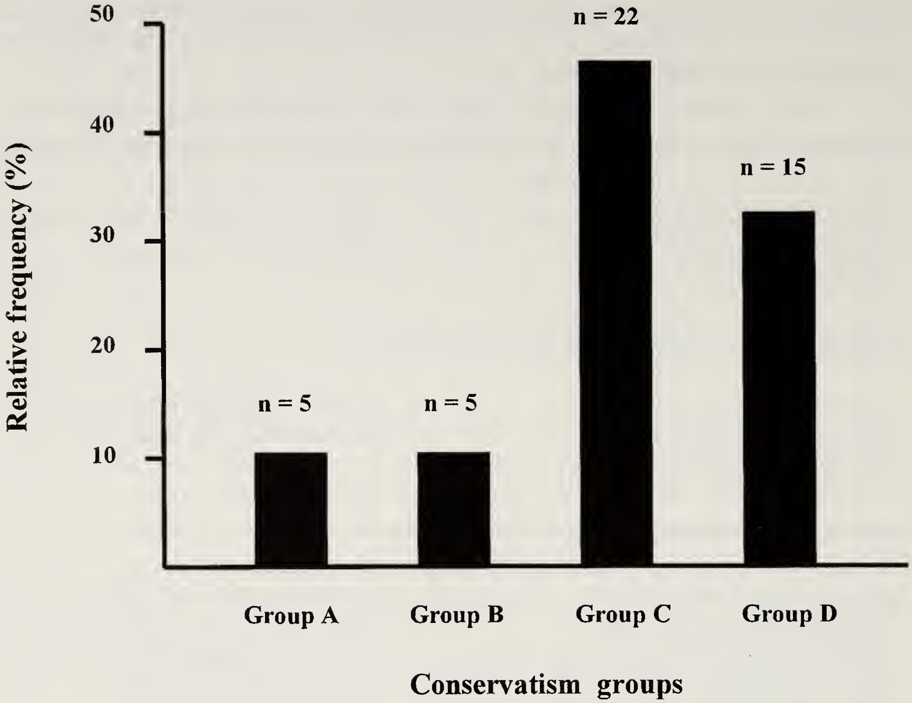

Figure 2. The relative frequency of species per conservatism group. Degree of fidelity increases across groups from left to right. See Table 1 for further explanation of conservatism.

between the distribution of the water milfoil weevil and lakes exhibiting a decline in Eurasian milfoil populations (Creed, 1998).

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CHECKLIST OF THE AQUATIC VASCULAR PLANTS AND CHAROPHYTES OF SAUGANY LAKE

In this annotated list of aquatic macrophytes collected from Saugany Lake, the taxa are arranged alphabetically by division, family, genus, and species, respectively. The common name, location(s) of occurrence, habit type, abundance ranking, and a brief description of the habitat are included for each species. When a species is considered endangered, threatened, or rare in Indiana, its State status (*SS*) is noted following the habitat description. A coefficient of conservatism (*C*) has been included for each native taxon. In addition, the collection number (CN) is appended for each species. All specimens were collected and identified by the authors.

DIVISION CHLOROPHYTA

Characeae — Muskgrass Family

Chara braunii Gmel.

Smooth muskgrass; 8, 13; submersed; rare in shallow water of the nearshore habitat and associated with marl to sandy substrate; CN = 48.

Chara zeylanica Willd.

Variable muskgrass; 3, 7-9, 13; submersed; occasional to common in both deep and shallow water habitats; CN = 49.

DIVISION MAGNOLIOPHYTA

Alismataceae — Water Plantain Family

Alisma subcordatum Raf.

Common water plantain; 6-8; emergent; rare along the lake margin and only found near the west beach sites; *C* = 4; CN = 19.

Sagittaria latifolia Willd.

Common arrowhead; 3; emergent; rare along the lake margin; *C* = 4; CN = 22.

Sagittaria graminea Michx.

Grass-leaved arrowhead; 7-9; emergent and submersed; rare along the lake margin and found in water up to 0.5 m deep near the west beach sites; *C* = 9; CN = 15.

Apiaceae — Carrot Family

Hydrocotyle umbellata L.

Water pennywort; 3, 11, 12; floating-leaved; rare along the lake margin and found in water up to 0.5 m deep; *C* = 10; CN = 2.

Araceae — Arum Family

Peltandra virginica (L.) Schott & Endl.
Arrow arum; 8, 9, 14, 17-19; emergent; occasional to common along the lake margin and in shallow water, locally abundant in the undisturbed marsh at the north outlet; *C* = 10; CN = 14.

Cabombaceae — Water Shield Family

Brasenia schreberi J.F. Gmel.
Water shield; 9, 14-16, 18, 19; floating-leaved; common in deep water of the nearshore habitat in the northern portion of the lake and typically forming a zone at the outer and deeper margins of *Nuphar* stands; *C* = 10; CN = 23.

Ceratophyllaceae — Hornwort Family

Ceratophyllum demersum L.
Common coontail; 4, 7, 9-11, 18, 19; submersed; common in shallow and deep-water habitats and appears to be more prevalent on mucky substrates in the northern portions of the lake; *C* = 5; CN = 9.

Cyperaceae — Sedge Family

Cyperus bipartitus Torr.
Brook nut sedge; 9, 14, 15, 20, 21; emergent; rare to infrequent, found growing on the sandy shore; *C* = 4; CN = 38.

Eleocharis ovata (Roth) Roemer & Schultes

Blunt spike rush; 9, 12, 13; emergent; rare, found growing on the shore; *C* = 10; CN = 44.

Scirpus atrovirens Willd.
Black bulrush; 6, 10, 11, 18; emergent; rare, found growing in small patches on the shore; *C* = 4; CN = 20.

Scirpus cyperinus (L.) Kunth
Wool grass; 9, 15, 18; emergent; rare along the lake margin, but perhaps more common than observed, particularly in the marsh to the north; *C* = 6; CN = 17.

Scirpus pungens Vahl
Common threesquare; 15, 16; emergent; rare, found only on the north shore of the lake; *C* = 5; CN = 18.

Scirpus validus Vahl
Softstem bulrush; 15-18; emergent; rare along the lake margin, but perhaps more common than observed; *C* = 5; CN = 43.

Haloragaceae — Water Milfoil Family

Myriophyllum spicatum L.
European water milfoil; 1, 7, 9-12, 15, 17-20, 22-24; submersed; abundant and widespread throughout the lake where it has become a nuisance; CN = 11.

Hydrocharitaceae — Frog's Bit Family

Elodea canadensis Michx.
Common water weed; 9, 14, 18-21, 24; submersed; occasional to common in water up to 2.5 m deep; *C* = 5; CN = 30.

Vallisneria americana L.
Eel grass; 1, 7-9, 12, 14, 17-21, 24; submersed; common in water up to 2.5 m deep; *C* = 7; CN = 16.

Iridaceae — Iris Family

Iris virginica L.
Southern blue flag; 5; emergent; rare along the sandy lake margin; *C* = 5; CN = 24.

Juncaceae — Rush Family

Juncus effusus L.
Soft rush; 14, 17, 18; emergent; rare along the lake margin; *C* = 7; CN = 41.

Lamiaceae — Mint Family

Lycopus americanus Muhl.
American water horehound; 9,13-15; emergent; rare, primarily found along the lake margin just west of the conservation club; *C* = 5; CN = 32.

Lemnaceae — Duckweed Family

Lemna minor L.
Lesser duckweed; 9, 10, 13, 15, 23, 24; floating; occasional to common in nearshore habitats and closely associated with water lily stands; *C* = 5; CN = 28.

Lemna trisulca L.
Forked duckweed; 7, 9, 13, 20; floating, rare, found just beneath the water's surface along the lake margin; *C* = 7; CN = 50.

Spirodela polyrhiza (L.) Schleiden
Greater duckweed; 9, 10, 13, 15, 23, 24; floating; occasional to common in nearshore habitats and closely associated to water lily stands; *C* = 7; CN = 27.

Wolffia columbiana Karsten
Watermeal; 9, 10, 13, 15, 23, 24; floating, occasional to common, found along the lake margin usually behind water lily stands; *C* = 7; CN = 29.

Lentibulariaceae — Bladderwort Family

Utricularia vulgaris L.
Common badderwort; 1, 3, 5, 8-13, 18-20, 24; submersed; common and widespread throughout the lake; *C* = 9; CN = 13.

Lythraceae — Loosestrife Family

Decodon verticillatus (L.) Elliott.
Water willow; 8-11, 14; emergent; occasional and most commonly found along the lake margin of the west shore; *C* = 8; CN = 47.

Najadaceae — Water Nymph Family

Najas flexilis (Willd.) Rostkov & Schmidt
Slender naiad; 1, 3, 8, 9, 13, 24; submersed; occasional, but perhaps more common than observed; *C* = 6; CN = 6.

Nymphaeaceae — Water Lily Family

Nuphar advena (Aiton)Aiton *f.*
Yellow water lily; 6-13, 16-20; floating-leaved; common and widespread throughout the lake; *C* = 7; CN = 26.

Nymphaea odorata Aiton
White water lily; 3, 5-13, 16-20, 22, 24; floating-leaved; common and widespread throughout the lake; *C* = 7; CN = 39.

Onagraceae — Evening Primrose Family

Ludwigia palustris (L.) Elliott.
Marsh purslane; 1, 5, 8; submersed; rare, found in shallow water along the lake margin; *C* = 5; CN = 33.

Polygonaceae — Smartweed Family

Polygonum amphibium L.
Water smartweed; 9-11, 15, 16, 18; emergent; uncommon, occasionally found along the lake margin and in water up to 1.0 m deep; *C* = 4; CN = 35.

Polygonum hydropiperoides Michx.
Mild water pepper; 7-9, 11-13, 18; emergent; uncommon, found along the lake margin; *SS* = *E*; *C* = 7; CN = 37.

Rumex crispus L.
Curly dock; 13; emergent; rare, but perhaps more common than observed, found along the lake margin; CN = 42.

Pontederiaceae — Water Hyacinth Family

Pontederia cordata L.
Pickerel weed; 4, 8, 9, 14, 16, 20, 23; emergent; common in nearshore habitats and along the lake margin; *C* = 10; CN = 10.

Zosterella dubia (Jacq.) Small
Water star grass; 1, 9, 10, 18-22, 24; submersed; common in nearshore habitats and along the lake margin; *C* = 8; CN = 1.

Potamogetonaceae — Pondweed Family

Potamogeton amplifolius Tuckerman
Large-leaved pondweed; 9, 10, 19; submersed and having the heterophyllous condition; rare, found in water up to 1.0 m deep; *C* = 10; CN = 36.

Potamogeton crispus L.
Curly pondweed; 1, 4, 18, 19, 21; submersed; occasional, found in nearshore habitats; CN = 8.

Potamogeton foliosus Raf.
Leafy pondweed; 9, 19; submersed; rare, found along the shallows of the lake margin; *C* = 7; CN = 25.

Potamogeton gramineus L.
Variable pondweed; 2-4, 6-8, 12, 16, 18-21; submersed and having the heterophyllous condition; abundant and widespread throughout the lake, found in water up to 2.0 m deep; *C* = 8; CN = 5.

Potamogeton pectinatus L.
Sago pondweed; 1, 3, 4, 16, 18, 19; submersed; rare to occasional, found in the nearshore habitats; *C* = 5; CN = 4.

Potamogeton praelongus Wulfen
White-stemmed pondweed; 1-4, 7, 9, 10, 12, 15-24; submersed; abundant and widespread throughout the lake, found in water up to 3.5 m deep; this species appears to be the most abundant vascular plant species in nearshore habitats; *SS* = *E*; *C* = 10; CN = 3.

Potamogeton pusillus L.
Slender pondweed; 3-6, 9, 12-16, 18, 19; submersed; common and widespread; *SS* = *R*; *C* = 7; CN = 12.

Potamogeton vaseyi Robbins
Vasey's pondweed; 9; submersed and having the heterophyllous condition; rare, the population consisted of 23 individuals; *SS* = *E*; *C* = 10; CN = 31.

Potamogeton zosteriformis Fern.
Flat-stemmed pondweed; 1-4, 7-14, 16, 18, 19, 21, 23, 24; submersed; abundant and widespread, found throughout the nearshore habitats; *C* = 8; CN = 40.

Ranunculaceae — Buttercup Family

Ranunculus longirostris Godron
White water crowfoot; 1, 2, 8-12, 16-19, 24; submersed; common, found throughout the lake; *C* = 8; CN = 7.

Rubiaceae — Madder Family

Cephalanthus occidentalis L.
Buttonbush; 9-12, 15, 17, 18; emergent; occasional to common, found along undisturbed portions of the lake margin; *C* = 5; CN = 34.

Typhaceae — Cattail Family

Typha angustifolia L.
Narrow-leaved cattail; 14-19; emergent; rare to occasional, primarily found along the northern shoreline, one large stand at site 15; *C* = 1; CN = 45.

Typha latifolia L.
Common cattail; 9-12, 18, 19, 21; emergent; occasional, found along the lake margin; *C* = 1; CN = 46.