Wulfenia **15** (2008): 25–34

Wulfenia
Mitteilungen des
Kärntner Botanikzentrums
Klagenfurt

Floristic and ecological studies on the Nelson Mitigation Site, near Grantsburg, Burnett County, Wisconsin

Donald W. Davidson, Richard D. Gitar & Derek S. Anderson

Summary: The study area was approximately 80 hectares of restored mitigation wetlands. The site consisted of ten impoundment cells, representing shallow marsh, deep marsh, and wet meadow. The mitigation project was undertaken to offset any negative impacts of construction and expansion projects of Wisconsin State Highway 35. There was a total of 75 different species observed in the final year of monitoring in 1997. The goal of this project was to have at least 50% of the species meet the classification of obligate wetland (OBL) and/or facultative wetland (FACW). This objective was met in 1996 and 1997 with approximately 70% of the species observed falling into one of these two categories.

Keywords: wetland mitigation, wetland restoration, shallow and deep marsh, wetland ecology, flora of Wisconsin

The Wisconsin Department of Transportation (DOT), through its Bureau of Environmental Services and under the guidance and direction of John Jackson PhD, developed and implemented a statewide program of wetland mitigation banks throughout Wisconsin's major watersheds. Recognizing that construction of highways, airports and other transportation related facilities tends to impact the state's wetlands, the Department decided to offset these impacts through a coordinated effort featuring the restoration of previously drained wetlands and the construction of new wetlands in the respective watersheds where transportation impacts have occurred or likely will occur.

Region of Study

Wisconsin is located in the northern United States, between Lake Superior to the north, Lake Michigan to the east, and the Mississippi River to the west, with a total area of approximately 145,210 square kilometers. Glaciers have sculpted and shaped the landscape of the state and had a large role in the surficial geology of the region. In the north it scraped the tops of hills leaving rich earth deposits with approximately 15,000 small lakes.

Wisconsin was originally very rich in wetlands. However, many of these wetlands have been destroyed by development, including: urban development, farming, and the construction of highways. According to Curtis (1959), Maycock & Curtis (1960), and Cottam & Loucks (1965), all of the wetlands referred to in this study were found in this part of the state, prior to the time of settlement of Wisconsin in the 1800s.

In the case of the Nelson wetlands, the site was located near Grantsburg, Wisconsin on Crosstown Road, in the SE ¼ of Section 20, T38N, R18W, Burnett County. It was originally part of a poorly drained area of glacial deposition. The nearly level site consisted of hydric soils of peat and muck over mixed clay substrate. In some areas of the site, the water table was less than 0.6 meters below

the surface. The site of nearly 80 hectares was acquired and construction completed by September of 1994. This site was created to compensate loss of wetlands related to Wisconsin Department of Transportation development projects associated with State Highway 35.

Soils

The site has been classified by the Soil Conservation Service as a combination of Blomford variant loamy fine sand and Indus Loam. Both have clayey calcareous lacustrine sediments and both are hydric soils.

Climate

The climate of this region is continental. Based on weather data from Grantsburg, the mean annual precipitation is 80.7 cm, with August having the highest rainfall (11.5 cm). Mean annual temperature is 5.1° C with the hottest month being July (average 20.3° C), and the coldest January (-13.2° C). The growing season (frost free) ranges from 111 to 174, with the average being 142 day per year (Midwestern Regional Climate Center 2008).

Purpose of Study

Dr. Donald Davidson and Richard Gitar started studying wetland mitigation sites by invitation from District 8 of the Wisconsin Department of Transportation. They conducted an extensive series of surveys of the wetland mitigation sites in northwestern Wisconsin during the period of 1994 to 1999.

It has long been argued by various environmental regulatory agencies that constructed wetlands have less relative value than restored, previously converted wetlands, and that both are of less value to the natural and human environments than wetlands existing in their natural state. Therefore, compensatory replacement from mitigation bank sites may not provide true compensation for the functions of the lost wetland environments.

These botanical studies were undertaken to evaluate the short-term success (or failure) of colonization by wetland species, and to provide an initial benchmark for any future, long-term evaluation aimed at addressing the significance and relative value of such sites. Assuming that proper hydrology is achieved and maintained, hydrophytic vegetation should appear through succession. If these processes are successful, at least 50% of the species should be classified as obligate and facultative wetland species after completing the botanical meander searches (Reed 1998).

Methods

The monitoring of the site was done by determining the qualitative abundance of the vegetation, following Daubenmire (1959) canopy coverage methods. Using visual dominance, the plant and community types were recorded and compared with a plant species list which was adapted by Dr. John Jackson, Department of Transportation, Office of Environmental Analysis, in consultation with the Department of Natural Resources. Methods and guidelines established by Atkinson et al. (1993) and Wentworth et al. (1988) were used in assessment of the wetlands.

Monitoring began the first summer after the construction of the wetland cells in mid August of 1995. The ten impoundment cells represent the spectrum of shallow marsh, deep marsh, and

wet meadow. A meander search of each of the ten cells was conducted using the 'areal coverage meander search', a modification of the method described by Miller (1973). Each impoundment cell was viewed as a separate entity. The cell to be monitored was first viewed from the highest vantage point possible (usually one of the berms). From this position, the cell was categorized by its total plant species cover using a three point system as follows:

Closed: the plant species coverage is sufficient to occlude from view all or almost all the water and/or soil within the cell.

Semi-open: the plant species coverage is not sufficient to occlude from view all the water or soil within the cell. The cell has visible water and/or soil, and emergent plant species are present.

Open: all soil or water is visible within the cell and no emergent plant species are present.

Next, all plant species within the cell were identified and recorded. First the cell perimeter (transition zone between wetland and upland), and then the emergent zone (area between perimeter and open water, if it existed), and then the open water zone (if it existed) were surveyed. Any unknown species was collected and later identified in the John Thomson Herbarium, University of Wisconsin – Superior [SUWS]. After all plant species were recorded, each was rated by its relative cover within the cell using a five point system as follows:

Abundant (AB): the plant species has an areal coverage within the cell of 50% or greater, with regular occurrence.

Common (C): the plant species has an areal coverage within the cell between 10% and 50%, with regular occurrence.

Fairly Common (FC): the plant species has an areal coverage within the cell between 1% and 10%, with regular occurrence.

Occasional (O): the plant species has an areal coverage within the cell of less than 1%, but more than one individual or group was sighted within the cell.

Rare (R): the plant species has an areal coverage within the cell of less than 1%, and only one individual or group was sighted within the cell.

Finally, the wetland indicator status was assigned. This indicator referred to the likeliness that a plant would be found in a wetland or an upland habitat. The interpretation of each status level follows USDA (2008):

Obligate (OBL): occurs almost always under natural conditions in wetlands.

Facultative Wetland (FACW): usually occurs in wetlands, but occasionally found in non-wetland.

Facultative (FAC): equally likely to occur in wetlands or non-wetlands.

Facultative Upland (FACU): usually occurs in non-wetlands, but occasionally found on wetlands.

Obligate Upland (UPL): occurs almost always under natural conditions in non-wetland.

Results

In 1997, the dominant plant species observed in the cells include: *Potamogeton foliosus, Scirpus cyperinus, Echinochloa walteri, Lemna minor, Phalaris arundinacea, Polygonum lapathifolium, Carex* sp., and *Calamagrostis canadensis* (see Table 1 for the dominant species in each wetland cell). There was a total of 75 different species recorded in all of the wetland cells for the Nelson Mitigation Wetland in 1997. Of these, 32 (43%) were obligate – OBL, 20 (27%) were facultative wetland – FACW, 15 (20%) were facultative – FAC, 7 (9%) facultative upland – FACU and 1 (1%) was upland – UPL species according to Reed (1988). Table 2 lists the number of plants in each cell that fall into each of these wetland indicator categories, and Table 3 lists each species, its wetland indicator status, and the cell(s) it was observed in after the 1996 survey.

It was found, that 40% (4 of 10 species observed) of the plants in Cell A were either obligate wetland (OBL). *Potamogeton foliosus* was the dominant species in this cell. Cell B had 50% (4 of 8 species observed) that were OBL. Once again, *Potamogeton foliosus* was the dominant species. 20% of the species (1 of 5) were found to be OBL in Cell C. Here, the dominant species was *Scirpus cyperinus*. Cell D had approximately 32% (4 of 13) of the species being OBL. There were three dominant species, *Echinochloa walteri, Lemna minor,* and *Phalaris arundinacea*. Approximately 27% (3 of 11 species) of Cell E had species that were OBL, with the dominant species being *Polygonum lapathifolium*. Cell F had 25% (2 of 8 species) that were OBL. *Carex* sp. was dominant in this cell. Cell G had about 15% of the species (2 of 13) that were obligate wetland species. The dominant species here was also *Carex* sp. Cell H had the lowest level of wetland obligate species at 10% (1 of 10). The dominant species in this cell was *Calamagrostis canadensis*. Cell I had approximately 33% (4 of 12 species) that were OBL, with the most dominant species being *Phalaris arundinacea*. The cell with the highest percentage of OBL species was Cell J with 64% (7 of 11 species). The dominant here was once again *Potamogeton foliosus*.

In 1996, there were 37 plant species recorded that did not return in 1997. However, this loss of species was off set by the addition of 37 species new to the site. All of the remaining 38 plant species have been recorded in at least two of the three monitoring years.

Wetland Cell Descriptions

Cell A

This cell was categorized as semi-open. It consists of mostly open standing water with all the wetland vegetation occurring from the first six inches of water outward to the wetland-upland transition zone. This situation also occurs along the shore of the island that is present in this cell. The most dominant plant species that occurs in this cell is *Potamogeton foliosus*. Four other species are also dominant. These species include *Alisma trivale*, *Hypericum* sp., *Phalaris arundinacea*, and *Carex brevior*.

Cell B

This cell was also categorized as semi-open. It is very similar in composition to Cell A, but it lacks an island. Like Cell A, this cell has *Potamogeton foliosus* as the dominant plant species. In addition, all four of the other dominants in Cell A were also dominant in this cell. However, Cell B also contains *Scripus cyperinus* as a dominant plant species.

Table 1: Dominant plant species in each cell in 1997.

Cell A	*Potamogeton foliosus*
Cell B	*Potamogeton foliosus*
Cell C	*Scirpus cyperinus*
Cell D	*Echinochloa walteri* *Lemna minor* *Phalaris arundinacea*
Cell E	*Polygonum lapathifolium*
Cell F	*Carex* sp.
Cell G	*Carex* sp.
Cell H	*Calamagrostis canadensis*
Cell I	*Phalaris arundinacea*
Cell J	*Potamogeton foliosus*

Table 2: Number of species by wetland indicator status for each wetland cell.

Indicator Status	Cell									
	A	B	C	D	E	F	G	H	I	J
OBL	4	4	1	4	3	2	2	1	4	7
FACW	3	3	3	5	3	4	5	5	4	2
FAC	2	0	1	2	3	1	4	3	2	1
FACU	1	0	0	2	1	1	2	1	2	1
UPL	0	1	0	0	1	0	0	0	0	0

Cell C

This cell was categorized as closed. No standing water, and very little soil saturation existed within the cell. The area of the cell that contained wetland plant species was dominated by *Scirpus cyperinus*. Although not as profuse, *Phalaris arundinacea* was also dominant. Additionally, *Carex brevior* was a semi-dominant plant species.

Cell D

This cell was categorized as semi-open. Much of this cell consisted of a long semi-winding channel. The most dominant plant species present within the cell was *Lemna minor*. This species covered nearly all open water areas in the cell. *Potamogeton foliosus* was the second most dominant, followed by *Phalaris arundinacea*, *Polygonum amphibium*, *Carex brevior*, and *Elytrigia repens*.

Table 3: Nelson Wetland Species List 1996. The species found, indicator status, cells present, and occurrence (relative cover [AB = Abundant; C = Common; FC = Fairly Common; OC = Occasional; R = Rare]) within each cell. Parentheses '( )' in the indicator column denotes the most likely one (species not determined or listed in Reed 1988). Updated scientific names have been checked following Wetter et al. (2001).

Species	IND	A	B	C	D	E	F	G	H	I	J
Acer negundo	FACW										R
Achillea millefolium	FACU			OC							
Agrostis hyemalis	FAC						R		OC		
Agrostis stolonifera	FACW						OC		OC		
Alisma triviale	OBL	FC	FC		OC	OC	R	OC		OC	R
Ambrosia artemisifolia	FACU	OC	OC	OC		R			R		
Asclepias incarnata							R				
Aster sp.	FACW		R		R						
Calamagrostis canadensis	OBL								CO		
Callitriche sp.	(OBL)									R	
Campanula americana	FAC									OC	
Capsella bursa-pastoris									R		
Carex brevior	FAC	FC	FC	FC	FC	FC	FC	OC	FC	OC	FC
Carex lacustris	OBL						OC				
Carex pellita	(OBL)					OC	AB	OC	CO	OC	
Carex stipata	(FACW)	OC	OC			OC					
Carex sp.	(FACW)	OC	OC		OC			OC			
Chrysanthemum leucanthemum	(UPL)	OC									
Dryopteris sp.	(FACW)						OC				
Echinochloa crus-galli	FACW	OC	OC		OC	FC			OC	R	OC
Echinochloa walteri	OBL							OC			
Eleocharis ovata	OBL	OC			OC	FC		FC			
Eleocharis palustris			OC				FC		OC	FC	FC
Elytrigia repens	(FACU)	R			FC	FC	OC	OC	OC	OC	OC
Euthamia graminifolia	FACW	R									
Festuca rubra	FAC	OC	OC	OC	OC			OC			
Galium asprellum	OBL	R					OC				
Galium trifidum	FACW									OC	
Glyceria canadensis	OBL	OC	R			OC	OC	OC			
Glyceria grandis										OC	
Hypericum sp.	(FACW)	FC	FC		OC	CO	R	R			
Juncus arcticus	(OBL)	OC									
Juncus sp.	(FACW)	OC	OC		OC	OC	OC			R	R
Lemna minor	OBL	R			AB	OC		FC		FC	OC
Lycopus americana	OBL						R			OC	
Mentha arvensis	FACW						R				
Myriophyllum sp.	(OBL)	R								R	
Onoclea sensibilis	FACW						OC				
Phalaris arundinacea	FACW	FC	FC	CO	FC	FC	OC	OC	OC	FC	OC
Phleum pratense	FACU	OC	OC		OC	OC			FC	OC	OC
Poa sp.	(FAC)										OC

Species [Cont. tab. 3]	IND	A	B	C	D	E	F	G	H	I	J
Polygonum amphibium	OBL				FC	FC	OC			FC	OC
Polygonum hydropiper	OBL	OC	OC		OC	OC		OC	FC	FC	
Polygonum lapathifolium	FACW						OC		OC	OC	
Polygonum saggitatum	OBL	R					OC				
Polygonum sp.	(FACW)								OC		
Populus tremuloides	FAC								OC		
Populus sp.	(FAC)								OC		
Potamogeton foliosus	OBL	CO	CO		CO	FC		OC		OC	
Potamogeton natans	OBL	R	OC								
Potentilla norvegica	FAC			OC			R				
Ranunculus pensylvanicus	OBL				R		OC		OC		
Rorippa palustris	OBL									OC	R
Rudbeckia hirta	FACU	OC									
Rumex sp.	(FACW)	R									
Salix sp.	(FACW)	OC	OC		OC	OC		FC	R	FC	
Scirpus atrovirens	OBL										OC
Scirpus cyperinus	OBL	OC	FC	AB	OC	OC	FC	FC	OC	FC	FC
Scirpus heterochaetus											OC
Scirpus validus	OBL	OC	OC					OC			
Scutellaria galericulata	OBL									OC	
Setaria glauca										OC	
Sium suave	OBL				OC		R			R	
Solidago sp.	(FACU)						OC				
Sparganium chlorocarpum	OBL	OC			OC	OC		OC			
Spartina pectinata	FACW	R									
Sphagnum sp.	(OBL)	R									
Spiraea tomentosa	(FACW)						OC	OC			
Stachys palustris	OBL	OC			OC		R				
Trifolium arvense	(FACU)	R	R				R		R		
Trifolium pratense	FACU	R					OC		R		
Typha sp.	(OBL)	OC	OC		OC	OC	FC			FC	FC
Ulmus rubra	FAC									R	
Urtica dioica	FAC						R				
Veronicastrum virginicum	FAC	OC	OC				R				

Cell E

This cell was categorized as semi-open. This cell consists of mostly open water with a narrow water channel extending toward the west. The most dominant plant species in this cell was *Hypericum* sp. Seven other species were also dominant. These species were: *Echinochloa crus-gallii*, *Elytrigia repens*, *Eleocharis ovata*, *Polygonum amphibium*, *Carex brevior*, *Phalaris arundinacea*, and *Potamogeton foliosus*.

Cell F

This cell was categorized as semi-open. This cell consists of a small open water area near the spillway, with shallow marsh surrounding. The most dominant plant species was *Carex pellita*.

This species far exceeds the other species in the cell. The other lesser-dominant plant species included: *Scirpus cyperinus*, *Carex brevior*, and *Typha* sp.

Cell G

This cell was categorized as being semi-open. This cell consists of mostly open water with several stands of willows emerging from it. Many of these willows were expected to die (due to prolonged standing water) by the second year of monitoring. Some did, but not in the numbers anticipated. The dominant plant species (there was no single species more dominant than another) found in this cell were *Scirpus cyperinus*, *Eleocharis ovata*, *Lemna minor*, and *Salix* sp.

Cell H

This cell was categorized as closed. No open water existed within this cell, and the vegetation completely covered the soil. Two plant species were the most dominant within this cell. They were *Carex pellita* and *Calamagrostis canadensis*. Additionally, *Phleum pratense*, *Carex brevior*, and *Polygonum hydropiperoides* were also dominant. This last species covered the area of the cell where open water had pooled earlier in the growing season.

Cell I

This cell was categorized as being semi-open. This cell consisted of a combination of open water, mud flats, and shallow marsh. Many pre-existing trees that had once grown on the shore of the creek still survive in this cell. Seven plant species were dominant within the cell. However, non of these species were more dominant than the other. These species were *Scirpus cyperinus*, *Typha* sp., *Hypericum* sp., *Lemna minor*, *Phalaris arundinacea*, *Polygonum hydropiperoides*, and *Polygonum amphibium*.

Cell J

This cell was also categorized as being semi-open. This cell is situated on the west side of the berm, next to the road leading to the gate near cell I. This oval shaped cell is a combination of open water and shallow marsh. Five plant species share the dominant position in this cell. They are *Typha* sp., *Eleocharis palustris*, *Scirpus cyperinus*, *Carex brevior*, and *Festuca rubra*.

Discussion and Conclusion

The objective of this study was met in 1996, when more than 50% of the plant species observed were either obligate wetland species or facultative wetland species. In fact, 72% (54 of 75) of the observed species met this requirement. This satisfied the requirements set forth by the Wisconsin Department of Transportation for the process of creating a wetland. It was noticed that the first year after the construction of a wetland, the site is generally quite devoid of vegetation. In the following years, vegetation increases in both diversity and coverage. Results similar to those found at the Nelson Mitigation Site were also seen in the work at the Roy Johnson Mitigated Wetland (Davidson et al. 2006) and at the Kimmes-Tobin Mitigated Wetlands (Davidson et al. 2007).

The controlling requirement of a wetland's existence is the presence of hydrology, which in turn controls the presence or absence of hydrophytic vegetation. That hydrophytic vegetation dominates this site in broad diversity is a testament to the fact that the site was a wetland.

Acknowledgements

Thanks are extended to the Department of Transportation staff, including Gene MacDonald, Dan Peterson, Design Engineer Jim Rausch, Marc Hershfield, John Hoefer, Tom Michelsky, Dr. Sharon Ashworth and Dr. John Jackson. Thanks to Dr. Julius Ehrlenbach, Chancellor, UWS, and to Lori Gitar and Corey Gitar for their assistance. Special thanks to Dr. Mary Balcer, Chairman of the Biology and Earth Science for her ongoing support for the John Thomson Herbarium.

References

Atkinson R. B., Petty J. E., Smith E. & Cairns J. Jr. (1993): Use of created wetland delineation and weighted averages as a component of assessment. – Wetlands **13**(3): 185–193.

Cottam G. & Loucks O. (1965): Early vegetation of Wisconsin. – Madison, WI: University of Wisconsin – Extension, Geological and Natural History Survey.

Curtis J. (1959 [reprinted 1971]): Vegetation of Wisconsin. – Madison, WI: University of Wisconsin Press.

Davidson D. W., Gitar R. D. & Hlina P. (2006): Floristic and ecological studies on the Roy Johnson Mitigation Wetlands, Douglas County, Wisconsin. – Wulfenia **13**: 21–32.

Davidson D. W., Gitar R. D., Bajalii W. & Anderson D. (2007): Past and present landscapes and plant cover of the Kimmes-Tobin Mitigated Wetlands, Foxboro, Douglas County, Wisconsin. – Proceedings of the Transportation Research Board, National Academy of Sciences, Washington D. C.

Daubenmire R. F. (1959): Canopy coverage methods of vegetation analysis. – Northwest Science **33**: 43–64.

Federal Interagency Committee for Wetland Delineation (1989): Federal manual for identifying and delineating jurisdictional wetlands. – Cooperative Technical Publication: U.S. Army Corps of Engineers, U. S. Environmental Protection Agency, U. S. Fish and Wildlife Service, and the U. S. Department of Agriculture – Washington D. C.: Soil Conservation Service.

Gleason H. A. & Cronquist A. (1991): Manual of vascular plants of northeastern United States and adjacent Canada [2nd ed.]. – Bronx, New York: The New York Botanical Garden.

Maycock P. F. & Curtis J. T. (1960): The phytosociology of boreal conifer – hardwood forests of the Great Lakes region. – Ecological Monographs **30**(1): 1–35.

Midwestern Regional Climate Center (2008): Available [Online]: <http://mcc.sws.uiuc.edu>. Accessed 28 January 2008.

Miller J. B. (1973): Vegetation changes in shallow marsh wetlands under improving moisture regime. – Can. J. Bot. **51**: 1443–1457.

Reed P. B. (1988): National list of plant species that occur in wetlands: Wisconsin. – Washington: U.S. Fish and Wildlife Service, U.S. Department of the Interior.

United States Department of Agriculture (USDA), Natural Resources Conservation Service (2008): Wetland Indicator Status. – Available [Online]: <http://plants.usda.gov/wetinfo.html>. Accessed 5 February 2008.

Wentworth T. R., Johnson G. P. & Kologiski R. L. (1988): Designation of wetlands by weighted averages of vegetation data: a preliminary evaluation. – Water Resources Bulletin **24**(2): 389–396.

Wetter M. A., Cochrane T. S., Black M. R., Iltis H. H. & Berry P. E. (2001): Checklist of the vascular plants of Wisconsin. – Wisconsin Department of Natural Resources, Technical Bulletin Number **192**: 1–258.

Addresses of the authors:

Prof. Dr. Donald W. Davidson
Department of Biology and Earth Science
University of Wisconsin – Superior
Superior, Wisconsin 54880-4500
E-mail: ddavidso@uwsuper.edu

Richard D. Gitar
Director of Water Quality
Fond du Lac Tribal Reservation
12 Bianco Drive
Duluth, Minnesota 55808
E-mail: richardgitar@fdlrez.com

Derek S. Anderson
Department of Biology and Earth Science
University of Wisconsin – Superior
Superior, Wisconsin 54880-4500
E-mail: derekanderson06@gmail.com