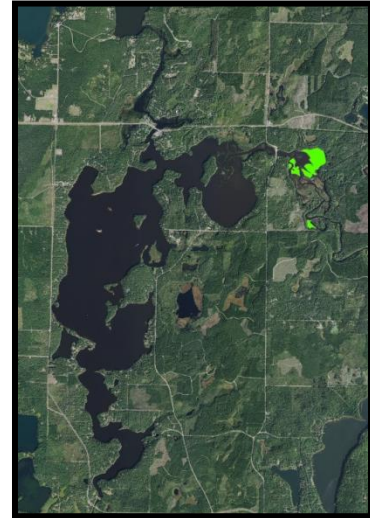


**Northern Wild Rice (*Zizania palustris*)
Bed Mapping Survey
Minong Flowage - WBIC: 2692900
Douglas County, Wisconsin**



Rice Uprooted by Flood Waters (Berg 2016)



Minong Flowage Aerial with 2016 Rice Beds

Project Initiated by:

The Minong Flowage Association, Lake Education and Planning Services, LLC, and the Wisconsin Department of Natural Resources



Scattered Surviving Rice East of Smith's Bridge (Berg 2016)

Survey Conducted by and Report Prepared by:

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July 30, 2016

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INTRODUCTION:

The Minong Flowage (WBIC 2692900) is a 1,564-acre eutrophic/mesotrophic stratified drainage lake located in north-central Washburn County and south-central Douglas County, Wisconsin in the Towns of Minong and Wascott (T42N R13W S13 SW NE). It reaches a maximum depth of 21.5ft near the dam on the far south end and has an average depth of approximately 9ft. The bottom is predominately sand and sandy muck in the south basin and organic muck in the northern bays. Water clarity is very poor to poor with Secchi disc readings averaging 4.1ft from 2001-2016 (WDNR 2016).

BACKGROUND AND STUDY RATIONALE:

Eurasian water-milfoil (*Myriophyllum spicatum*) (EWM) was first identified in the Minong Flowage in 2002. Since 2009, the Minong Flowage Association (MFA) under the direction of Lake Education and Planning Services, LLC (LEAPS) has been actively managing the infestation using herbicide treatments and manual removal as outlined in the flowage's Wisconsin Department of Natural Resources (WDNR) approved Aquatic Plant Management Plan (APMP). Unfortunately, despite this management, by 2012 EWM had spread to the Northern wild rice (*Zizania palustris*) beds along the river inlet channels, and it showed steady annual expansion both east and west of Smith's Bridge.

In April/May 2013, the flowage was drawn-down 5ft to perform maintenance on the dam. Due to a delay in finishing the repair/reconstruction, the flowage was not refilled until March/April 2014. Despite being subjected to extended desiccation over the summer of 2013, EWM managed to survive as tiny terrestrial rosettes that could quickly regrow once water levels rose (Figure 1). Fortunately, the extended period of freezing over the winter ultimately killed these terrestrial plants, and the rapid rise in water levels in the spring resulted in the elimination of the majority of EWM from the flowage – at least temporarily.

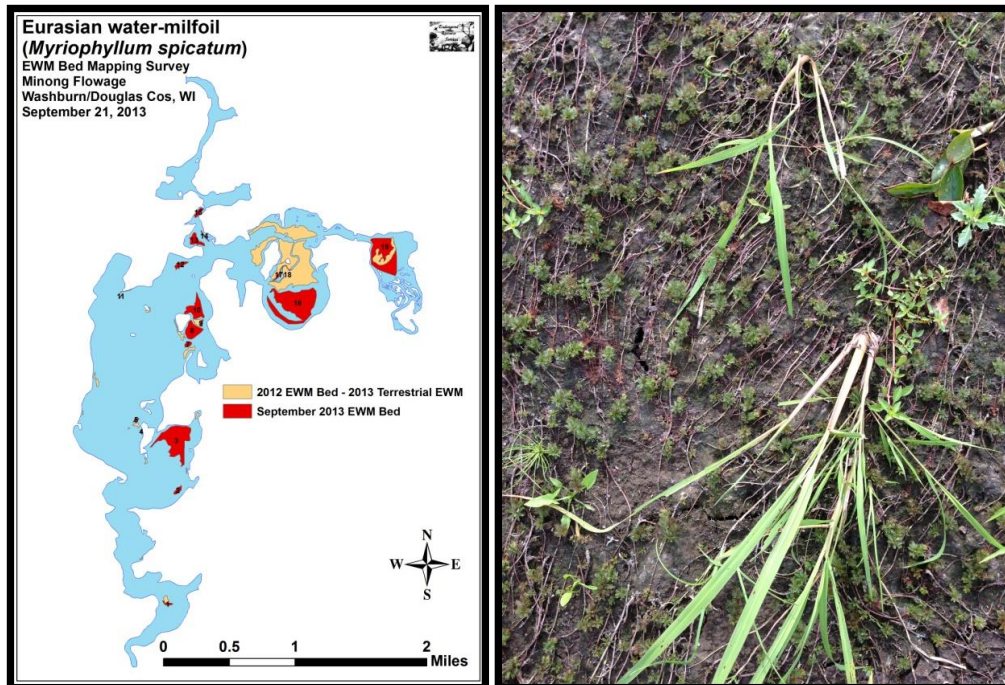
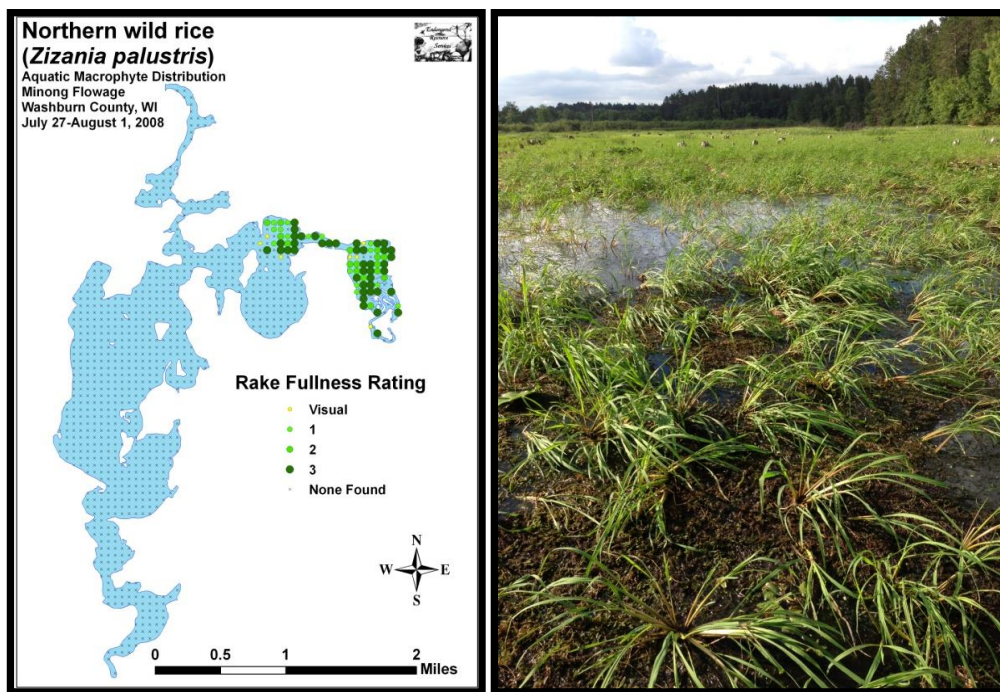


Figure 1: Sept. 2013 EWM Coverage/Terrestrial EWM Rosettes Bed 19

The drawdown also meant that the flowage’s wild rice beds in the north-central and eastern bays were subjected to these conditions (Figure 2). General concern about what impact this might have on the beds coupled with a desire to gather baseline information on the total acreage, density, and distribution of the rice post-drawdown prompted the WDNR (Pamela Toshner – personal communication) and the MFA to request an initial delineate of all rice beds on the flowage on August 17, 2014. That survey found that the rice survived the drawdown quite well, although submergent plants (including EWM) were almost entirely eliminated.

A fall Eurasian water-milfoil survey in 2015 showed EWM was rapidly recolonizing the rice beds. Because of this, in 2016, the WDNR and MFA requested a follow-up rice bed mapping survey. This report is the summary of that survey conducted on July 30, 2016.



**Figure 2: 2008 Wild Rice Density and Distribution/
2013 Rice and EWM East of Smith’s Bridge**

METHODS:

On July 30, 2016, we searched the entire visible littoral zone of the Minong Flowage for wild rice beds. Normally, a bed is defined as an area where wild rice makes up greater than 50% of all aquatic plants. However, as one of the goals of the survey was to document change since the last survey and because rice density can be extremely variable from year to year, this definition was expanded in both 2014 and 2016 to include all areas that supported continuous rice plants. Because of this broader definition, we also recorded the range and mean level of rice growth within each area using the WDNR’s standard 1-3 rake fullness scale (Figure 3), estimated its human harvest potential (none/low/moderate/high), and took representative pictures of the rice at each location.




Rating	Coverage	Description
1		A few plants on rake head
2		Rake head is about 1/2 full Can easily see top of rake head
3		Overflowing Cannot see top of rake head

Figure 3: Rake Fullness Ratings (UWEX 2010)

Using a Garmin 76CSX GPS unit, we recorded a string of waypoints that circled around the edges of the beds. These data were then mapped using ArcMap 9.3.1. We also used the WDNR's Forestry Tools Extension to determine the acreage of each bed to the nearest hundredth of an acre.

RESULTS AND DISCUSSION:

Northern Wild Rice Summary:

On July 11-12, 2016, more than a foot of rain fell within the Totagatic watershed and produced historic flooding. These flood waters caused the Colton Flowage Dam to fail sending a wall of water downstream into the Minong Flowage. We found that this event significantly altered the braided channels in the delta area where the river enters the flowage. We also noted that the majority of standing rice anywhere near the river channel was swept away, and the only surviving rice of significant density was in sheltered bays. Some late germinating individuals were still present in the channels, but they were just entering the floating-leaf stage at the time of our survey. With limited time left in the growing season, it seemed unlikely they would survive to set grain.

In August 2014, we mapped 16 beds with continuous wild rice plants that covered **87.08 acres** on either side of Smith's Bridge. They ranged in size from 0.18 acres (Bed 6) to 37.93 acres (Bed 12). Our 2016 survey found only four of these beds remained. They totaled **32.33 acres** with the smallest (Bed 9) being 0.73 acre and the biggest (Bed 12) covering 24.37 acres. Collectively, this was a nearly **63% decline in total distribution**.

Rice West of Smith's Bridge:

The 2014 survey found six areas with rice West of Smith's Bridge that totaled 23.81 acres (Figure 4) (Table 1). None of them were true beds or suitable for human harvest as rice densities were never greater than a rake fullness of 2 or averaged higher than a rake fullness of 1. Most plants had been cropped by geese, and it seemed unlikely that they would recover enough to set seed. Areas previously identified as having rice north of Bed 2 had only very widely scattered plants as this area was now dominated by Cattails (*Typha* spp.) and Ericaceous brush (Appendix I).

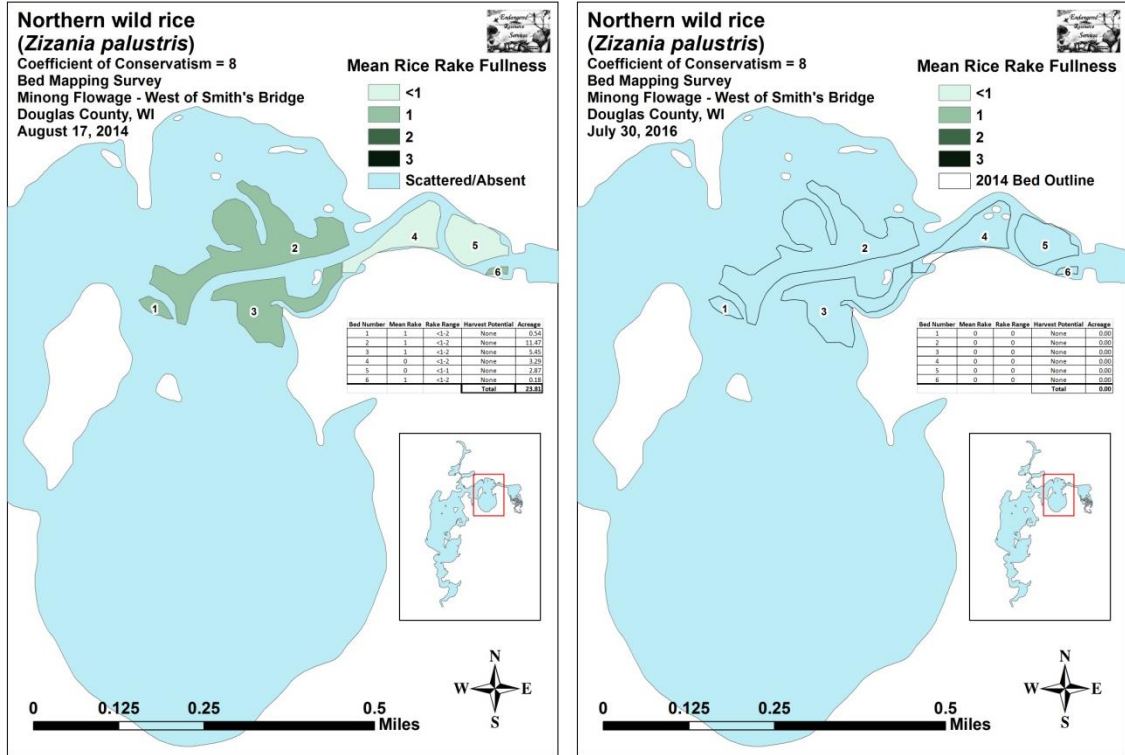
We found that the 2016 flood had completely eliminated the rice crop west of the bridge (Figure 4) (Table 2). In addition to the loss of rice, there were few surviving emergents of any kind along the channel. A natural pinch-point in the flowage, it appeared that strong currents had scoured the bottom throughout most of the former beds.

**Table 1: Wild Rice Bed Mapping Summary
West of Smith's Bridge - Minong Flowage, Douglas County
August 17, 2014**

Bed Number	Area in Acres	Rake Fullness Range	Mean Rake Fullness	Human Harvest Potential
1	0.54	<1-2	1	None
2	11.47	<1-2	1	None
3	5.45	<1-2	1	None
4	3.29	<1-2	0	None
5	2.87	<1-1	0	None
6	0.18	<1-2	1	None
Total Rice	23.81			

**Table 2: Wild Rice Bed Mapping Summary
West of Smith's Bridge - Minong Flowage, Douglas County
July 20, 2016**

Bed Number	Area in Acres	Rake Fullness Range	Mean Rake Fullness	Human Harvest Potential
1	0.00	0	0	None
2	0.00	0	0	None
3	0.00	0	0	None
4	0.00	0	0	None
5	0.00	0	0	None
6	0.00	0	0	None
Total Rice	0.00			



**Figure 4: Rice Beds West of Smith's Bridge
August 17, 2014 and July 30, 2016**

Rice East of Smith's Bridge:

In 2014, Beds 7-16 totaled 63.28 acres (Table 3). Covering much of the “delta” and extending up the Totagatic River, these areas have historically supported productive rice beds, but the densities we observed in 2014 were the greatest we had ever seen with the majority of the area having excellent potential for human harvest. When considering the entire area, only the beds nearest Smith's Bridge had mean rake fullness densities of <2 (Figure 5). We also noted that areas in the northeast bay of Bed 12 that had historically been mixed with large amounts of Pickerelweed (*Pontederia cordata*) were almost pure rice as the drawdown seemed to have nearly eliminated this species (Appendix II).

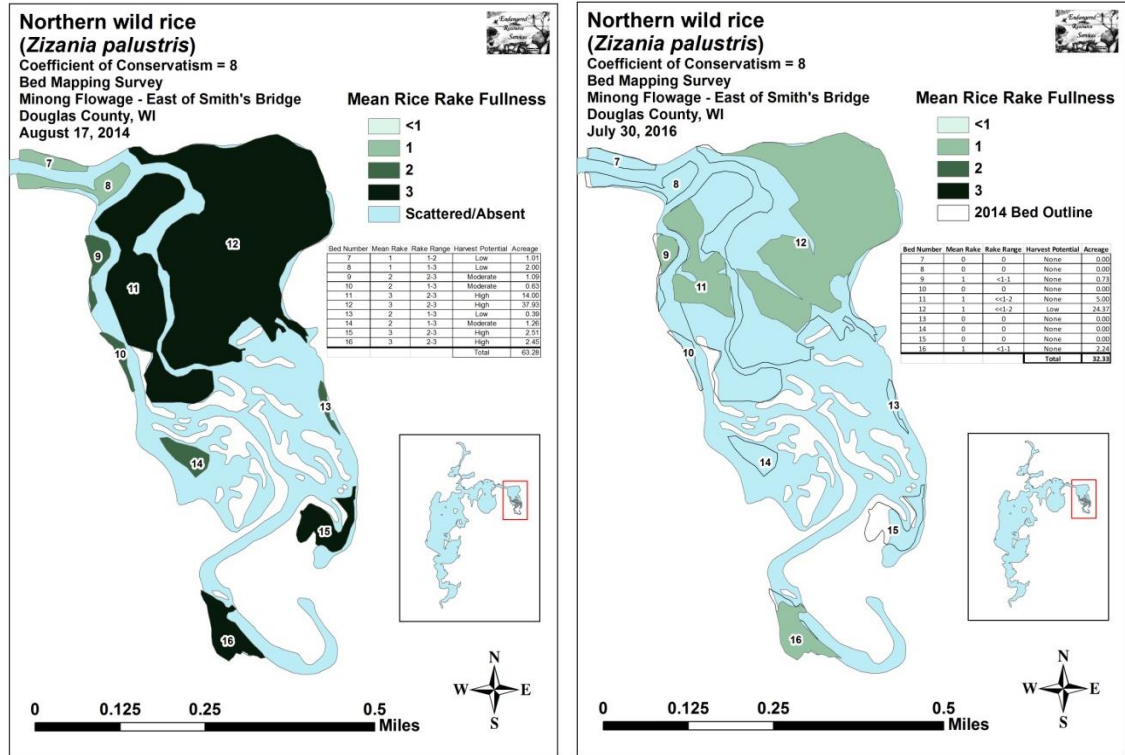
After the 2016 flood waters cut new channels in the delta and swept away the majority of standing rice, we found only four surviving beds totaling 32.33 acres (Table 4) (Figure 5). Of these, only Bed 12 had any human harvest potential. In addition to the rice, the flooding eliminated many other emergents leaving broad areas with few to no plants. This ecological void seemed to be benefitting Eurasian water-milfoil as it was actively fragmenting and appeared to be rapidly expanding on the west side of the delta in the area formerly dominated by rice in Bed 11.

**Table 3: Wild Rice Bed Mapping Summary
East of Smith's Bridge - Minong Flowage, Douglas County
August 17, 2014**

Bed Number	Area in Acres	Rake Fullness Range	Mean Rake Fullness	Human Harvest Potential
7	1.01	1-2	1	Low
8	2.00	1-3	1	Low
9	1.09	2-3	2	Moderate
10	0.63	1-3	2	Moderate
11	14.00	2-3	3	High
12	37.93	2-3	3	High
13	0.39	1-3	2	Low
14	1.26	1-3	2	Moderate
15	2.51	2-3	3	High
16	2.45	2-3	3	High
Total Rice	63.28			

**Table 4: Wild Rice Bed Mapping Summary
East of Smith's Bridge - Minong Flowage, Douglas County
July 30, 2016**

Bed Number	Area in Acres	Rake Fullness Range	Mean Rake Fullness	Human Harvest Potential
7	0.00	0	0	None
8	0.00	0	0	None
9	0.73	<1-1	1	None
10	0.00	0	0	None
11	5.00	<<1-2	1	None
12	24.37	<<1-2	1	Low
13	0.00	0	0	None
14	0.00	0	0	None
15	0.00	0	0	None
16	2.24	<1-1	1	None
Total Rice	32.33			



**Figure 5: Rice Beds East of Smith's Bridge
August 17, 2014 and July 30, 2016**

PAST AND PRESENT INDIVIDUAL BED DISCRPTIONS:

Minong Flowage West of Smith's Bridge:

Beds 1, 2, and 3 – In 2014, wild rice was present along the majority of the river channel west of Smith's Bridge prior to the channel splitting to the west and south near the islands. However, it occurred at low densities, and, technically, did not form true beds anywhere as Short-stemmed bur-reed (*Sparganium emersum*) and Northern manna grass (*Glyceria borealis*) tended to be the dominant plants in these areas (Figure 6). At that time, Eurasian water-milfoil was also relatively rare, and almost all EWM plants observed were located directly along the channel.



Figure 6: Low Density Rice in Beds 1 and 3 – 8/17/14

In 2016, Beds 1-3 had been completely taken over by EWM (Figure 7). The only emergents remaining were Common yellow lake sedge (*Carex utriculata*), Pickerelweed, Cattails, and some scattered Softstem bulrush (*Schoenoplectus tabernaemontani*) and Common bur-reeds (*Sparganium eurycarpum*) along the sheltered edges of what had been Beds 2 and 3.



**Figure 7: Canopied EWM in Former Rice Bed 3 Facing Southeast
7/30/16**

Beds 4, 5, and 6 – These three shallow sand flats just west of the bridge were historically dominated by rice, albeit at low densities. Following the drawdown, we noted that, although rice plants were still scattered throughout, the area had largely been taken over by Northern manna grass. In 2016, the area was completely scoured, and we found no vegetation of any kind – emergent or submergent (Figure 8).



Figure 8: Bed 4 Facing Northwest 8/17/14 – Bed 5 Facing East 7/30/16

Minong Flowage East of Smith's Bridge:

Beds 7 and 8 – In 2014, the two beds just east of the bridge on either side of the channel were the poorest in the area; however, there were still significant amounts of rice in these nearly pure stands. The 2016 survey found that, like Beds 1-5 west of the bridge, these areas were scoured clear of all emergent and submergent vegetation (Figure 9).



**Figure 9: Bed 8 Facing Smith's Bridge 8/17/14 -
From Smith's Bridge Facing East 7/30/16**

Beds 9 and 10 – These two small beds lined the western shoreline of the western channel and were reasonably dense in 2014. Despite their size, they offered at least some human harvest potential. This was not the case in 2016 when we found Bed 10 had been completely scoured away and Bed 9 had only scattered surviving rice plants. We also noted that EWM was now established throughout much of the bed (Figure 10).



Figure 10: Scattered Rice with Interspersed EWM Plants - 7/30/16

Bed 11 – This area was the second biggest bed on the flowage in 2014, and the majority was a solid rake fullness of 3 making it ideal for human harvest (Figure 11). The bed still retained some rice in 2016, but it was low density and of generally poor quality (Figure 12). We also noted that EWM was present throughout with the western edge of the rice being bordered by a solid canopied mat of EWM.



Figure 11: Dense Rice in the Center of Bed 11 – 8/17/14



Figure 12: Low Density Rice with EWM in Bed 11 - 7/30/16

Bed 12 – Bed 12 dominated the area east of the main river channel in 2014. Following the drawdown, all the secondary channels had silted in making the entire area a continuous rice bed of varying density. On the northwest and north ends of the bed, we found the rice to be especially patchy in 2014 (Figure 13). In 2016, these low density areas were mostly swept away by the floods with only a few scattered plants left along the northern border. An apparent outwash area during the flooding, we also found large numbers of uprooted and rotting rice plants in this area (Figure 14). We also noted there were a few scattered late-germinating rice individuals that were just reaching the floating-leaf stage. Further to the east, the sheltered northeast bay seemed to have weathered the flood better than any other area as there were still some patches of moderately dense rice (Figure 15).



Figure 13: Northwest and Northern Shorelines of Bed 12 – 8/17/14



Figure 14: Uprooted Clumps and Scattered Floating-leaf Stage Rice Northwest and Northern Shorelines of Bed 12 – 7/30/16



**Figure 15: North End of Bed 12 Facing Northeast and Southeast
7/30/16**

In 2014, the bed became increasingly dense to the south (Figure 16) with the majority of the central and southern thirds of the bed being so monotypic and dense that poling through with a canoe at harvest time would have been difficult, but extremely productive. On the southern boundary of the bed, rice plants rapidly declined in density before being replaced entirely by other emergents (primarily horsetail, bulrushes, and bur-reeds). Just north of this southern boundary, and extending all the way to the east, rice continued to be dense and nearly monotypic before abruptly becoming more fragmented at the eastern river channel entrance. In 2016, the southern boundary of the bed was full of uprooted dead rice, and the majority of what remained had been heavily cropped by geese (Figure 17).



Figure 16: Bed 12 Facing Southeast and South - 8/17/14



Figure 17: Southern Edge of Bed 12 in 2014 (left) and 2016 (right)

Bed 13 – In 2014, we found scattered clusters of rice throughout the braided channels entering the Minong Flowage’s east side. However, Bed 13 was the only location where plants were continuous and dense enough to be considered a bed. Like the rest of the channels entering the flowage, these areas were all scoured clear by the flood in 2016.

Bed 14 – In 2014, most of the rice in this area was growing over soft sandy muck in water <1ft deep making it essentially impossible to pole or wade along the north border. Following the 2016 flood, the entire channel was blocked by trees making the whole area inaccessible. Scanning the channel with binoculars showed no surviving rice anywhere.

Beds 15 and 16 – The sloughs with scattered spring-fed pools found just south of the braided channels that enter the Minong Flowage had dense rice in 2014 that was essentially inaccessible; at least at its core. The 2016 survey found a new channel had scoured through Bed 15, and it removed essentially all rice in the area (Figures 18 and 19). Bed 16 was at least partially sheltered from the flood waters and did have some surviving rice albeit at very low levels (Figure 20).



Figure 18: Eastern Edge of Bed 15 Facing South - 8/17/14 and 7/30/16



Figure 18: Northwest Corner of Bed 15 - 8/17/14 and 7/30/16



Figure 20: Bed 16 Facing South - 8/17/14 and 7/30/16

LITERATURE CITED

UWEX Lakes Program. [online]. 2010. Aquatic Plant Management in Wisconsin. Available from <http://www.uwsp.edu/cnr-ap/UWEXLakes/Pages/ecology/aquaticplants/default.aspx> (2016, November).

WDNR. [online]. 2016. Citizen Monitoring Lake Water Quality Database. Available from <http://dnr.wi.gov/lakes/CLMN/Station.aspx?id=663099> (2016, November).

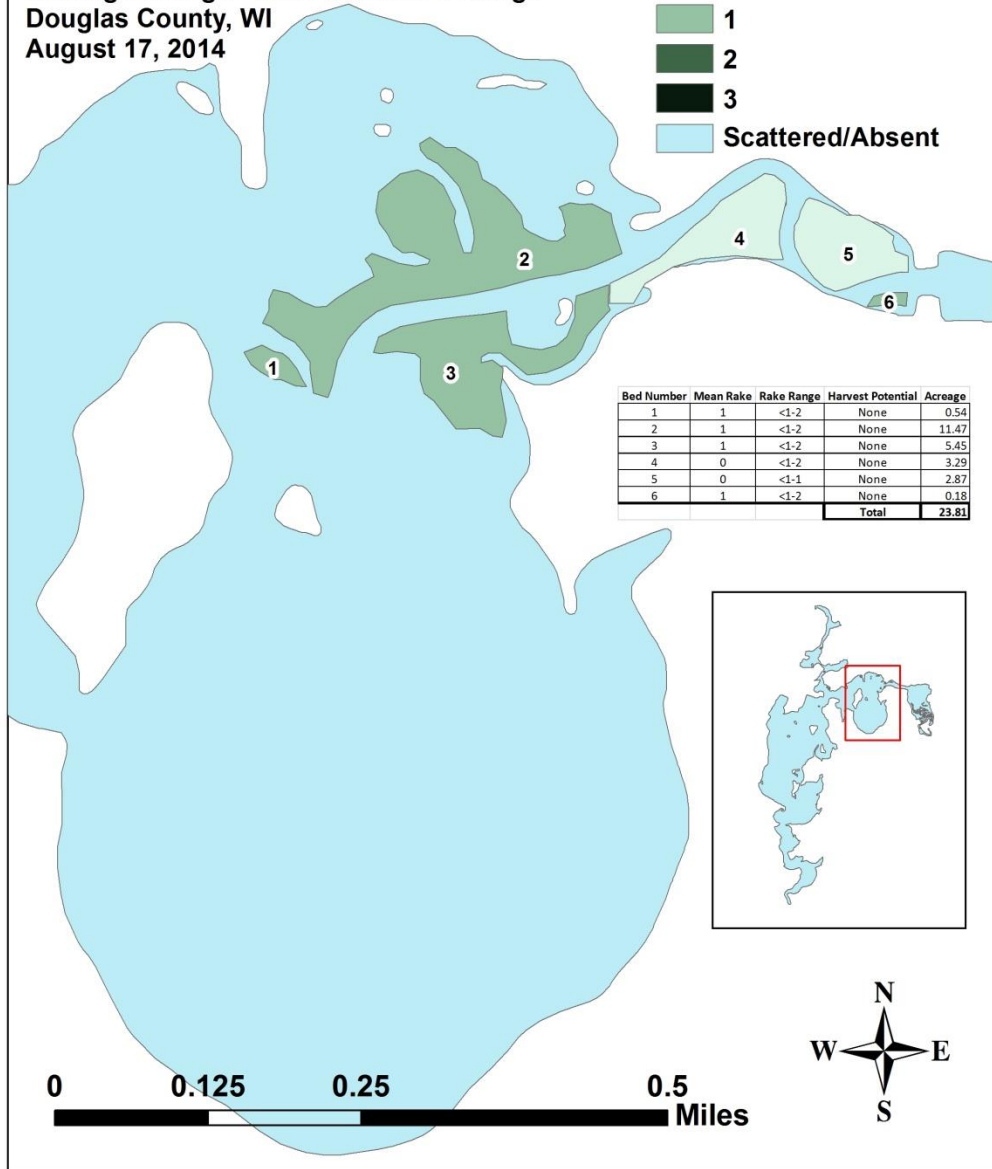
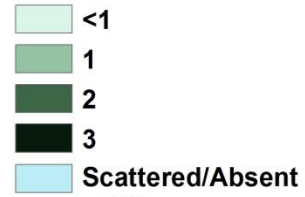
Appendix I: 2014 and 2016 Wild Rice Beds West of Smith's Bridge

**Northern wild rice
(*Zizania palustris*)**

Coefficient of Conservatism = 8
 Bed Mapping Survey
 Minong Flowage - West of Smith's Bridge
 Douglas County, WI
 August 17, 2014



Mean Rice Rake Fullness



Bed Number	Mean Rake	Rake Range	Harvest Potential	Acreage
1	1	<1-2	None	0.54
2	1	<1-2	None	11.47
3	1	<1-2	None	5.45
4	0	<1-2	None	3.29
5	0	<1-1	None	2.87
6	1	<1-2	None	0.18
Total				23.81

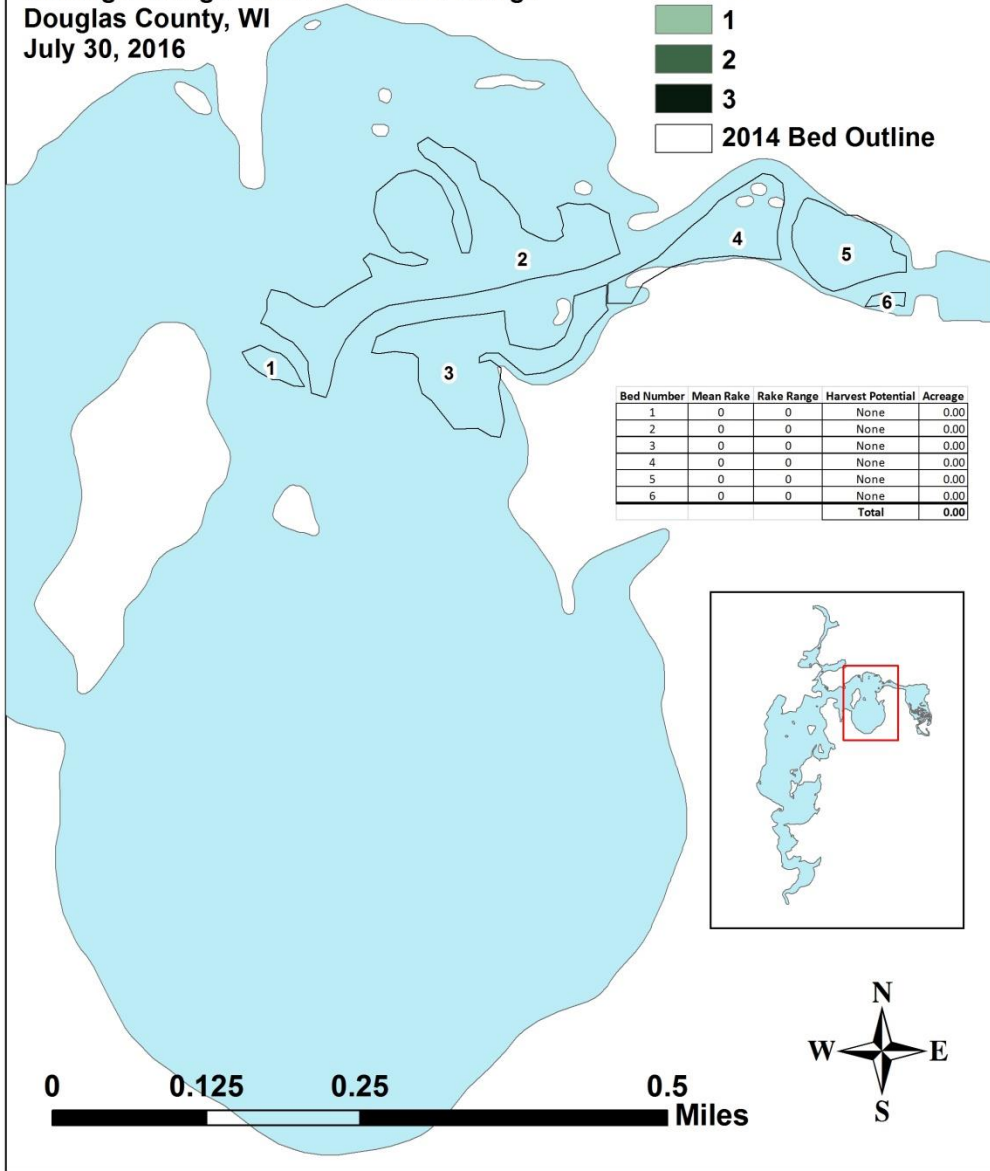
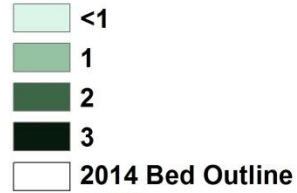


**Northern wild rice
(*Zizania palustris*)**

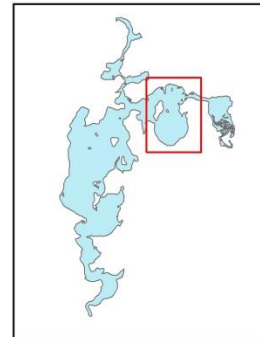
Coefficient of Conservatism = 8
 Bed Mapping Survey
 Minong Flowage - West of Smith's Bridge
 Douglas County, WI
 July 30, 2016



Mean Rice Rake Fullness



Bed Number	Mean Rake	Rake Range	Harvest Potential	Acreage
1	0	0	None	0.00
2	0	0	None	0.00
3	0	0	None	0.00
4	0	0	None	0.00
5	0	0	None	0.00
6	0	0	None	0.00
Total				0.00

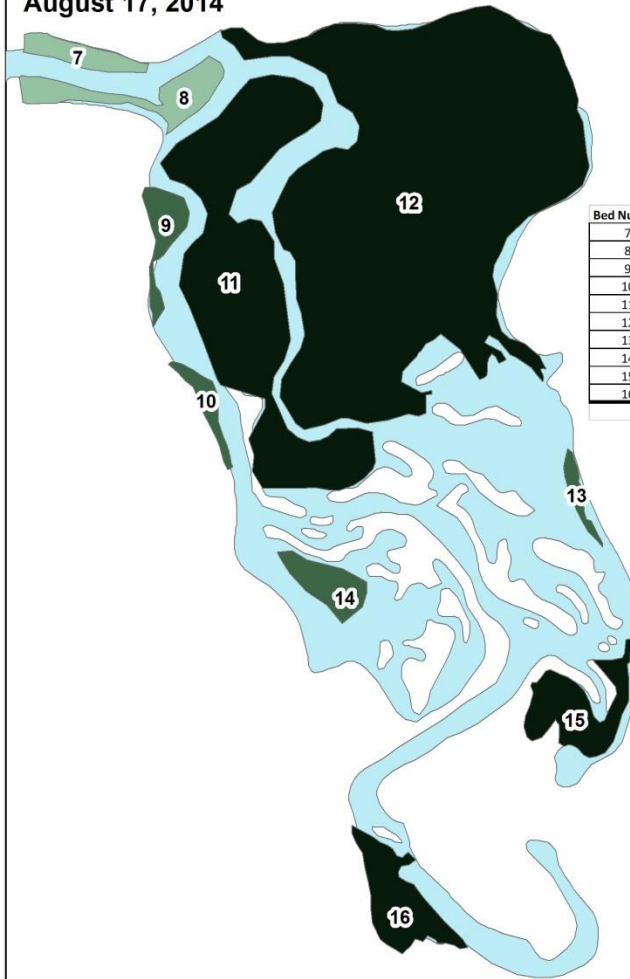
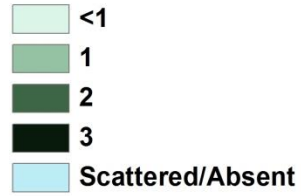


Appendix II: 2014 and 2016 Wild Rice Beds East of Smith's Bridge

**Northern wild rice
(*Zizania palustris*)**
 Coefficient of Conservatism = 8
 Bed Mapping Survey
 Minong Flowage - East of Smith's Bridge
 Douglas County, WI
 August 17, 2014



Mean Rice Rake Fullness



Bed Number	Mean Rake	Rake Range	Harvest Potential	Acreage
7	1	1-2	Low	1.01
8	1	1-3	Low	2.00
9	2	2-3	Moderate	1.09
10	2	1-3	Moderate	0.63
11	3	2-3	High	14.00
12	3	2-3	High	37.93
13	2	1-3	Low	0.39
14	2	1-3	Moderate	1.26
15	3	2-3	High	2.51
16	3	2-3	High	2.45
Total				63.28

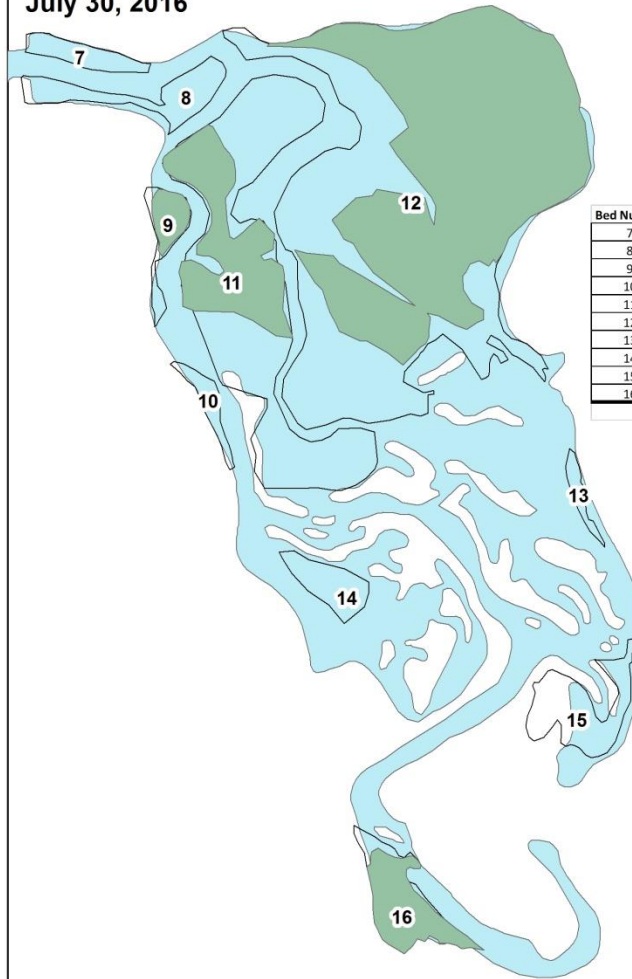
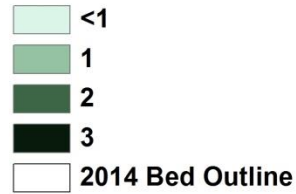


**Northern wild rice
(*Zizania palustris*)**

Coefficient of Conservatism = 8
 Bed Mapping Survey
 Minong Flowage - East of Smith's Bridge
 Douglas County, WI
 July 30, 2016



Mean Rice Rake Fullness



Bed Number	Mean Rake	Rake Range	Harvest Potential	Acreage
7	0	0	None	0.00
8	0	0	None	0.00
9	1	<1-1	None	0.73
10	0	0	None	0.00
11	1	<<1-2	None	5.00
12	1	<<1-2	Low	24.37
13	0	0	None	0.00
14	0	0	None	0.00
15	0	0	None	0.00
16	1	<1-1	None	2.24
Total				32.33

