

Phase 5 - 2010 Wild Rice Enumeration Study

*Clam Lake Protection and Rehabilitation
District Lake Management Planning Project*

Siren, WI

DNR No. SPL-235-10
SEH No. CLAML 106825

February 2, 2011

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RE: Clam Lake Protection and Rehabilitation
District Lake Management Planning
Project
Phase 5 - 2010 Wild Rice Enumeration
Study
Siren, WI
DNR Project No. SPL-235-10
SEH No. CLAML 106825

Mr. Tom Stoffel
Clam Lakes Protection and Rehabilitation District
398 Queenan Avenue South
Lakeland, MN 55043

Dear Tom:

Please consider this report a final document for the Wild Rice Enumeration Project that was funded by a 2010 small-scale lake management planning grant awarded last year. With this document you should be able to close out this project and seek final reimbursement from the WDNR.

Sincerely,



Lake Scientist

DLB

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Phase 5 - 2010 Wild Rice Enumeration Study

Clam Lake Protection and Rehabilitation District Lake Management Planning Project
Siren, WI

Prepared for:
Clam Lakes Protection and Rehabilitation District
Siren, WI

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Lake Scientist

2/2/2011

Date

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Photographs
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Phase 5 - 2010 Wild Rice Enumeration Study

Clam Lake Protection and Rehabilitation District Lake Management Planning Project

Prepared for Clam Lakes Protection and Rehabilitation District

1.0 Introduction

Up until a few years ago Wild rice in the Clam Lakes system was considered to be one of the highest producing and best wild rice stands in northern Wisconsin. More than three hundred acres of wild rice was present just a few years ago. Since 2007, the rice beds saw significant decline leading to essentially no wild rice in 2009.

Sediment sampling was completed in 2009 to determine an estimate of the number of curly-leaf pondweed turions that were present in the sediment. Total turion density which was much less than predicted allowed additional sediment sampling to occur to look for the presence of wild rice seed. Sediment sampling and several 30-cm sediment cores were taken from the south end of Upper Clam Lake, the results of which were compared to similar sediment and core sampling done in Long Lake on the same day. Long Lake is just south and west of Upper Clam Lake and connected to it by a free-flowing stream. Wild rice production in Long Lake was exceptional in 2009. The results of this sediment sampling and subsequent enumeration of wild rice seed were startling and disturbing. Absolutely no wild rice seed was found in any sediment sample or sediment core taken from Upper Clam Lake. Abundant seed was found in the Long Lake samples.

Wild rice growth and production is often cyclical in nature, but seldom does the population crash so rapidly and so completely in only a couple of years unless some conditions in the body of water have changed drastically. Furthermore, even when rice does crash, there is usually enough seed remaining in the sediment to provide new growth in the following year, and often for years to come. There is not a lot of information available to determine how much wild rice seed is or should be present in the sediment beneath long standing rice beds. However, anecdotal evidence from DNR fish managers and Great Lakes Indian Fish and Wildlife Commission wild rice biologists believe that viable seed should remain and may actually last up to 20 or more years. The fact that this impromptu survey failed to identify any seed seemed unusual.

Adding to the disturbing nature of this finding was the fact that conditions on the Clam Lakes have rapidly deteriorated in the last three years or so. General aquatic vegetation growth is down considerably from previous years, the carp population appears to be exploding, and the water quality is worsening. The exploding carp population is supported by 2009 Carp survey work completed by the WDNR and Tribal Resources. A huge 4-yr age class of carp (43% of all carp captured and aged in the spring of 2009) was identified in the system. Point-intercept aquatic plant surveying completed as a part of the existing Lake Management Planning grant

showed a system dominated by only a couple of coarse, less palatable (to carp) plant species. According to the 2009 Plant Survey Report, total lake plant biomass was extremely low, and almost no intact, submergent plants were found.

A meeting to discuss 2009 findings on the Clam Lakes and what to do in 2010 was held on January 19, 2010 at the Tribal Resources Office in Hertel, WI. The local WDNR Fish Manager, Tribal Natural Resources Biologists, GLIFWC Biologists, Clam Lakes Protection and Rehabilitation District representatives, SEH, and others were in attendance. Additional carp study was completed in 2010 by both the WDNR and Tribal Resources. Tribal Resources also completed a more comprehensive wild rice survey of the system in 2010. A system of carp exclusion cages were set up by tribal and DNR resources in Upper Clam Lake in an attempt to determine what impact the carp may be having in the system. Several of the cages were seeded with rice.

It was also determined that an expanded wild rice seed enumeration study should be completed in 2010 to cover more location in the two Clam Lakes, and to document wild rice seed present in other bodies of water with substantial rice beds for comparison purposes. SEH prepared a small-scale lake management grant application on behalf of the Clam Lakes Lake District in the spring of 2010. This report is the final summary of that project which was awarded and completed.

2.0 Completion of Tasks & Project Deliverables

SEH and our sub-contractor Freshwater Scientific Services (FSS) LLC completed the 2010 wild rice seed enumeration. A final Enumeration Report prepared by FSS is included with this document, and has been distributed to the WDNR, St. Croix Tribal Natural Resources Department, Burnett County, and others. All results, raw data, maps of sample sites, and reports are included on a data CD that accompanies this document.

3.0 Reimbursement of Small-scale Grant Project #SPL-235-10

This report should be considered a final summary for this small-scale lake management project and should be adequate in order to allow the completion of the reimbursement process once the Clam Lakes Protection and Rehabilitation District begins it.

Appendix A

Wild Rice Seed Enumeration Report: 2009-2010

Wild Rice Seed Enumeration Report: 2009-2010

Upper Clam Lake, Lower Clam Lake, Long Lake, and Clam River Flowage



*Prepared for SEH – September 2010
by James A. Johnson – Freshwater Scientific Services, LLC*

This project was conducted by James A. Johnson (Freshwater Scientific Services, LLC) under contract with Short Elliott Hendrickson Inc. (SEH).

Additional field support was provided by David Blumer (Lake Scientist, SEH) and Tony Havranek (Water Resources Manager, St. Croix Tribal Environmental Department). Additional historical and technical input was provided by Peter David (Great Lakes Indian Fish & Wildlife Commission), and Dr. Anthony Kern (Northland College – Ashland, WI).

Wild Rice Growth in Upper Clam Lake

Wild rice harvest records (Figure 2) show that Upper Clam Lake was a consistent high-quality source of wild rice from 1992 through 2006, with anecdotal accounts that this was also typical of most years prior to 1992. Historical images also indicate that the lake supported luxuriant growth of wild rice as recently as 2006 (Figure 3). However, the lake has experienced a dramatic decline in the extent and density of wild rice growth in subsequent years. This decline is also evident in the harvesting records, with no reported harvest of rice from the lake between 2007 and 2009.

Figure 2. Wild rice harvest data from Upper Clam Lake, Long Lake, and Briggs Lake: 1992-2009. Data provided by Peter David, Great Lakes Indian Fish & Wildlife Commission (GLIFWC).

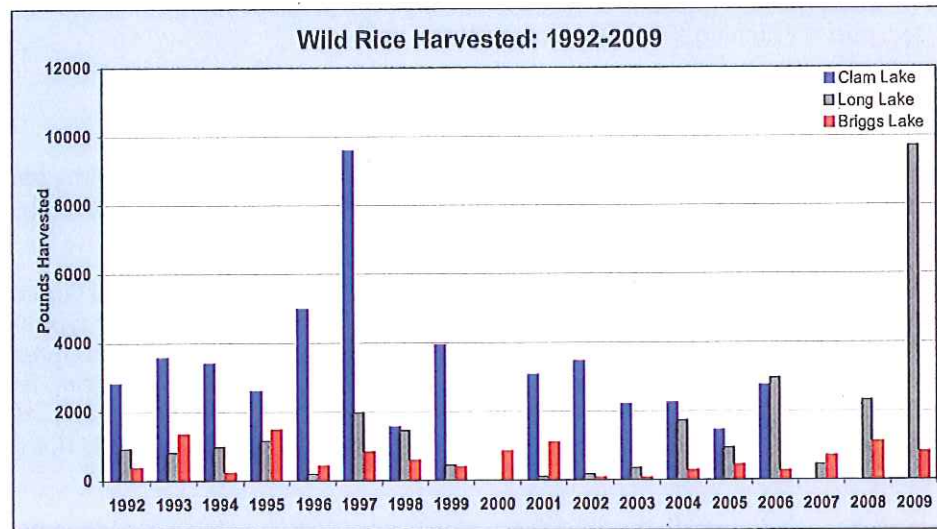
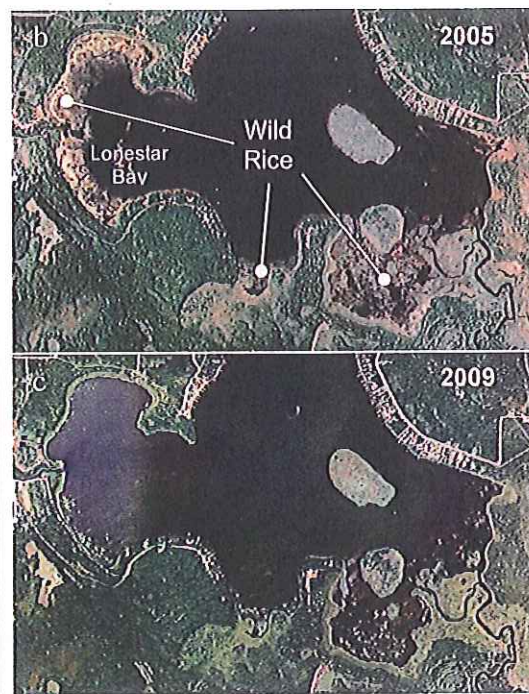


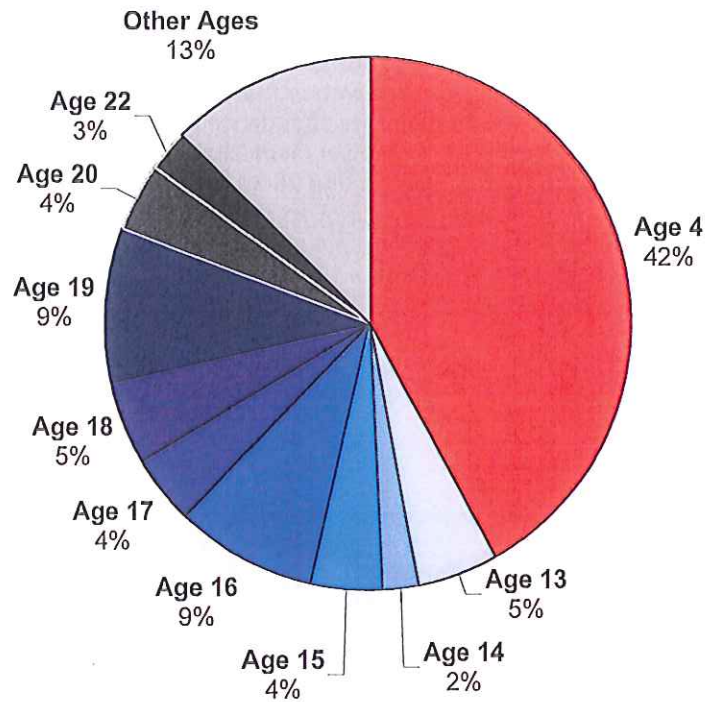
Figure 3. Historical photos of wild rice growth on Upper Clam Lake, WI; (a) luxuriant rice growth in 2006 (southwest shore of Lonestar Bay), (b) aerial image showing extent of wild rice growth in Upper Clam Lake in September 2005, and (c) Upper Clam Lake in September 2009 after the decline of wild rice.



Carp in Upper Clam Lake

Anecdotal reports from local residents suggested that the carp population in Upper Clam Lake had increased noticeably between 2000 and 2009 while the panfish population had declined over the same period. In 2009, staff from the St. Croix Tribal Environmental Department and Wisconsin DNR (Spooner, WI) captured approximately 300 carp in shallow areas of Upper Clam Lake using electrofishing equipment and determined the age of 140 individuals. Results indicated that over 40% of the captured carp were from a single year-class hatched in 2005 (Figure 4). Furthermore, a 2-year old gravid female carp was captured during the survey, suggesting that the large 4+ year-class of carp may have begun spawning in shallow areas of Upper Clam Lake as early as 2007 (the first year of major rice decline).

Figure 4. 2009 carp population age structure in Upper Clam Lake, WI. Age data provided by the Wisconsin DNR and the St. Croix Tribal Environmental Department. Fish age determined by evaluating scale annuli from 140 captured individuals.



Methods for Seed Enumeration

Sample Collection

In November 2009, we collected sediment samples at 13 locations on Upper Clam Lake and 10 locations on Long Lake. In April 2010, we collected samples at an additional 28 locations on Upper Clam Lake, 3 locations on Lower Clam Lake, 8 location on Long Lake, and 6 locations on the Clam River Flowage. All sample points were generated using desktop GIS software and randomly located within areas that had supported wild rice in previous years (Figure 6). In the field, we navigated to each sample point using a handheld GPS unit (Garmin 76), and collected a single sediment sample with a Ponar dredge (Wildlife Supply Company – Yulee, FL; basal area=225 cm²) (Figure 5). The dredge consistently sampled the top ten centimeters in the soft sediments of Upper Clam Lake, Lower Clam Lake, and Long Lake, and the top six to eight cm in the firmer sandy sediments of the Clam River Flowage. In addition to these dredge samples, we collected core samples at roughly one-third of the sites using a PVC suction corer (basal area=80 cm²) to determine the vertical distribution of seeds in lake sediments and to evaluate the abundance of seeds in deeper sediments (Figure 5). Core samples collected from Upper Clam Lake, Lower Clam Lake, and the Clam River Flowage were sectioned by depth stratum (0-5 cm, 5-10 cm, 10-20 cm, and 20-30 cm) while in the field, but core samples collected from Long Lake were extremely flocculent and not amenable to sectioning. Consequently, seed enumerations for Long Lake cores represent core totals and are not broken down into individual strata. Each sediment sample (dredge or core section) was sifted through a 1 mm mesh screen while in the field to remove fine silt. These sifted samples were then stored in sealed plastic bags at 5°C until they could be processed in the lab.

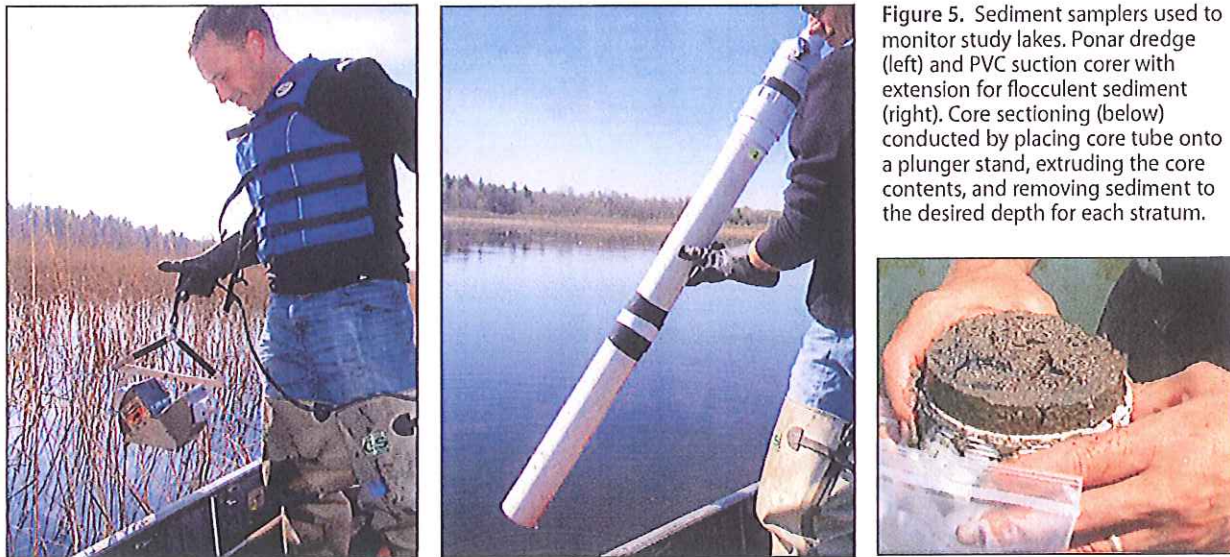
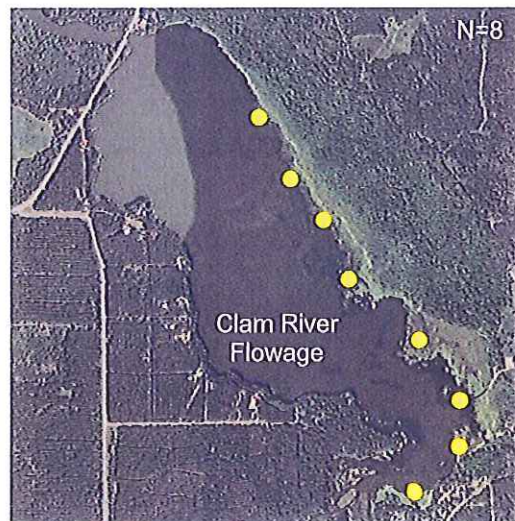


Figure 5. Sediment samplers used to monitor study lakes. Ponar dredge (left) and PVC suction corer with extension for flocculent sediment (right). Core sectioning (below) conducted by placing core tube onto a plunger stand, extruding the core contents, and removing sediment to the desired depth for each stratum.

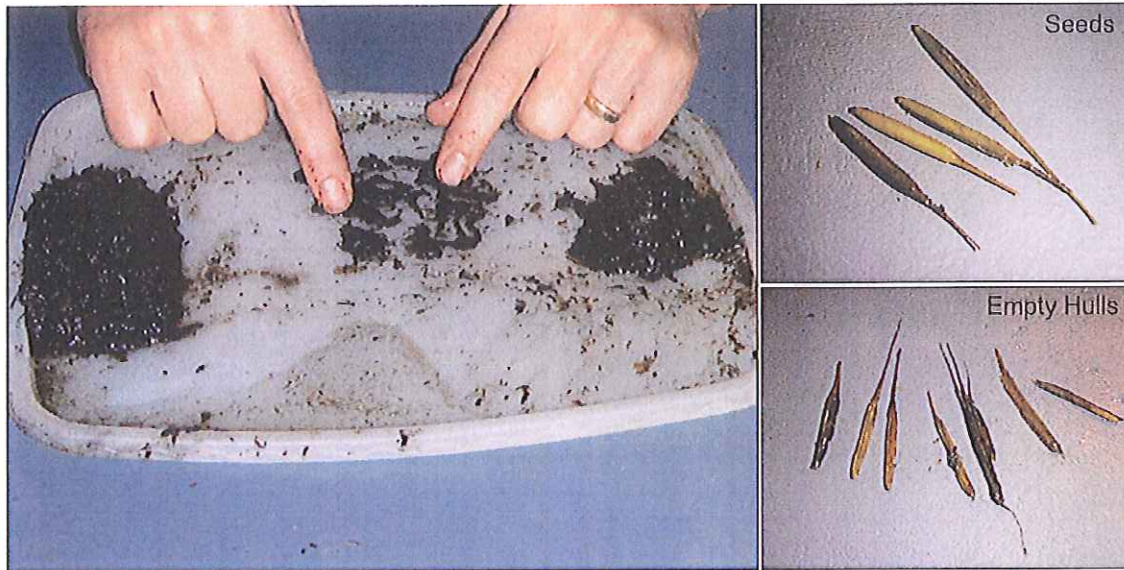
Figure 6. Locations sampled (yellow dots) in November 2009 and April 2010 in the four study lakes, with aerial imagery (taken in early September of 2009) to show positions of points relative to rice beds in each lake.



Sample Processing

Each sifted sample was manually sorted and all identifiable wild rice seeds and empty seed hulls were enumerated (Figure 7). Seed hulls that were flattened, papery, and easily bent were assumed to be empty and non-viable. After sorting, the total number of identified seeds and empty hulls were recorded for each sample.

Figure 7. Manual processing of sifted sediment sample (left) to identify and enumerate wild rice seeds (top right) and empty seed hulls (bottom right).



Results

Wild rice seed counts from Ponar dredge samples indicated that the abundance of seeds in the top ten centimeters of Upper Clam Lake (0 seeds/m²) was significantly lower (t-test, unequal variances; P<0.05) than in Long Lake (250 ±43 seeds/m²; mean±SE) or the Clam River Flowage (80 ±32 seeds/m²). Similarly, the abundance of seeds in core samples (full core enumeration) from Upper Clam Lake (11 ±11 seeds/m²) was lower than in Long Lake (170 ±105 seeds/m²) or the Clam River Flowage (63 ±63 seeds/m²). However, given the small number of core samples, these differences were not statistically significant (P>0.25). Average seed abundance for each site is presented in Figures 8-10 (average of Ponar dredge and core samples for each site)

In addition to seeds, we found empty seed hulls in the sediment samples. These hulls may be remnants of seeds that had sprouted in previous years, flowers that were not pollinated, seeds that were eaten by insects, or developing seeds that were knocked into the water before reaching maturity. The abundance of these empty hulls was generally much higher than the abundance of seeds in both dredge and core samples from all study lakes (Table 1), with hulls being uniformly distributed throughout the sectioned cores (Table 2). Moreover, the abundance of empty hulls in Upper Clam Lake was not statistically different than the abundance of hulls found in lakes that supported substantial beds of rice in 2009 (P=0.13 to 0.31 for Ponar samples; P=0.27 to 0.82 for core samples). This suggests that these hulls can persist for years after being deposited.

Table 1. Abundance of wild rice seeds and hulls (#/m²) in Ponar and core samples collected from study lakes (mean ±SE). Samples collected using

	Ponar Samples* (#/m ²)			Core Samples** (#/m ²)		
	Samples	Seeds/m ²	Hulls/m ²	Samples	Seeds/m ²	Hulls/m ²
Upper Clam Lake	47	0	340 ±56	11	11 ±11	860 ±214
Lower Clam Lake	3	0	60 ±15	1	125	125
Clam River Flowage	8	80 ±32	800 ±264	2	63 ±63	2200 ±563
Long Lake	18	250 ±43	470 ±108	3	170 ±105	960 ±331

* Petite Ponar, basal area=225 cm²; sampled sediment depth was ≈10 cm in soft sediment, ≈6 to 8 cm in firmer sediments

** PVC suction corer, basal area=80 cm², sampled sediment depth = 0.4 to 1.5m, full core counts (all strata) reported

Table 2. Abundance of wild rice seeds and hulls (#/m²) in collected sediment core samples (mean ±SE); broken down by depth stratum for sectioned cores. Samples collected using a PVC suction corer; basal area=80 cm²

Sediment Stratum (cm)	Wild Rice Seeds (#/m ²)				Empty Hulls (#/m ²)			
	Upper Clam (N=11)	Lower Clam (N=1)	Clam River Flowage (N=2)	Long** (N=3)	Upper Clam (N=11)	Lower Clam (N=1)	Clam River Flowage (N=2)	Long** (N=3)
Full Core	11 ±11	125	63 ±63	170 ±105	860 ±214	125	2200 ±563	960 ±331
0-5	0	0	0	-	130 ±34	0	} 940 ±63	-
5-10	0	0	0	-	250 ±73	0		-
10-20	11 ±11	125	0	-	300 ±102	125	900 ±375	-
20-30*	0	0	63 ±63	-	400 ±194	0	400 ±250	-

* Strata deeper than 30 cm were not analyzed for lakes with firmer sediments (Upper Clam, Lower Clam, and Clam River Flowage)

** Long Lake sediments were very flocculent and not amenable to sectioning; deeper cores (150 cm) collected to prevent sample loss

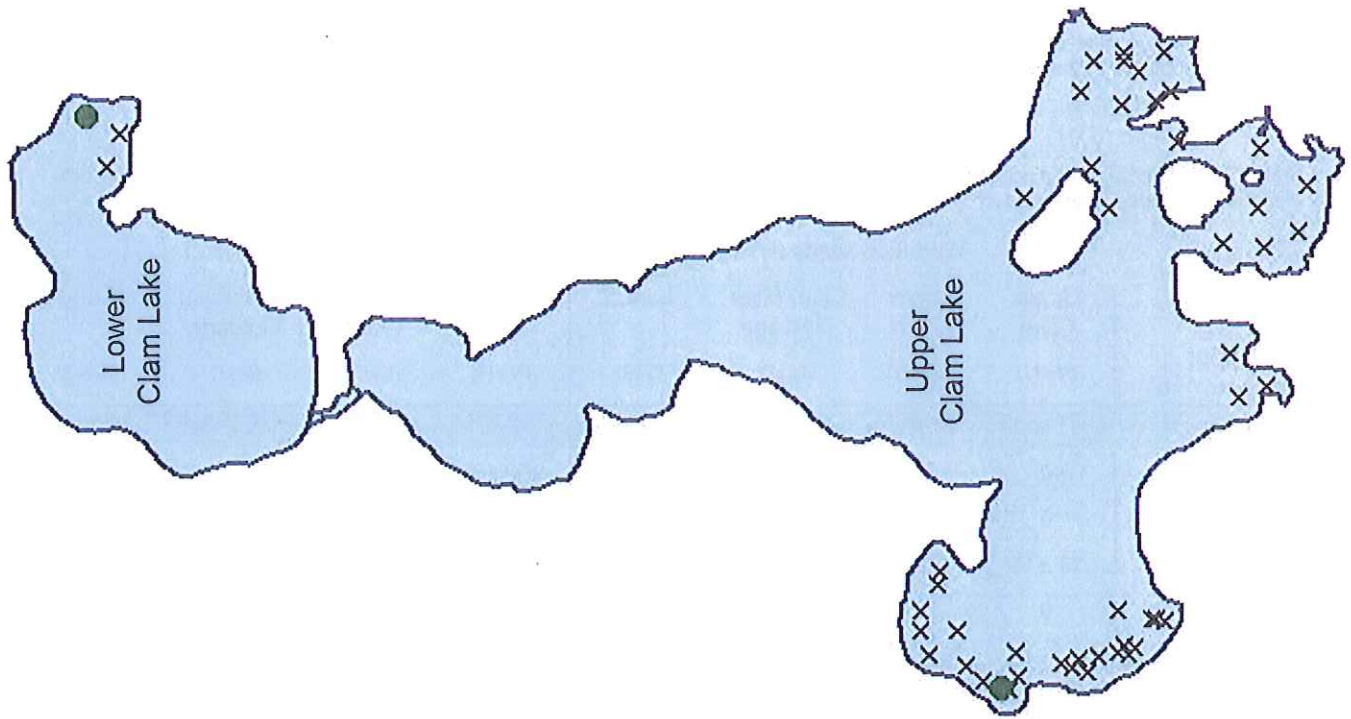


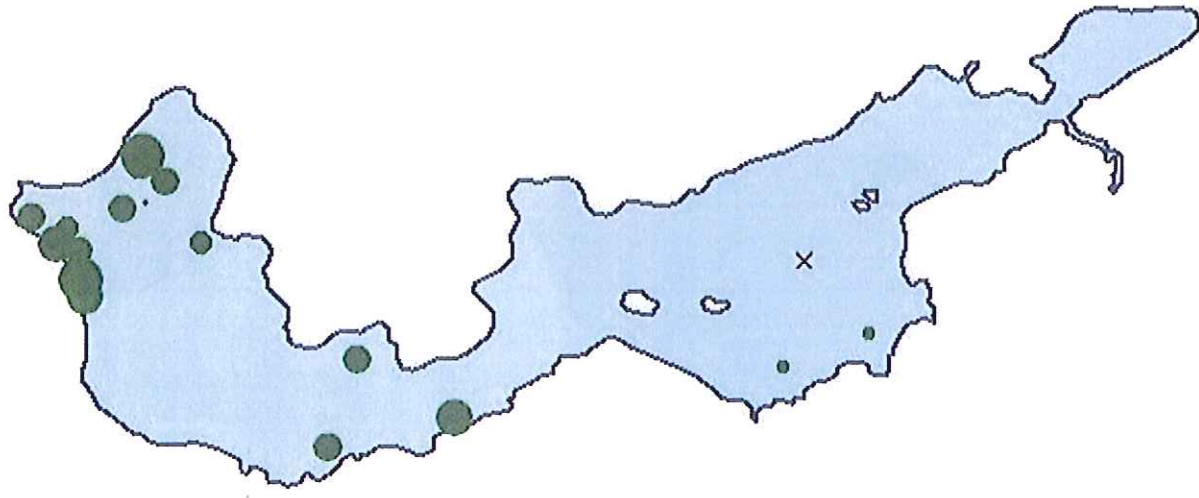
Figure 8. Abundance of wild rice seeds ($\#/m^2$) in sediments of Upper and Lower Clam Lake (Ponar dredge (N=47) and core samples (N=11)). Samples collected November 2009 and April 2010. Note that all encountered seeds were found in the 10-20 cm stratum of core samples; no seeds were found in Ponar dredge samples (0-10 cm) collected from Upper or Lower Clam Lake.

Upper and Lower Clam Lakes 2009-2010

Wild Rice Seed Enumeration

- X No seeds found
- < 50 seeds/ m^2
- 50-100
- 100-200
- 200-300
- 300-500
- 500-1000

Figure 9. Abundance of wild rice seeds in sediments of Long Lake (combination of Ponar dredge (N=18) and core samples (N=3)). Samples collected November 2009 and April 2010.

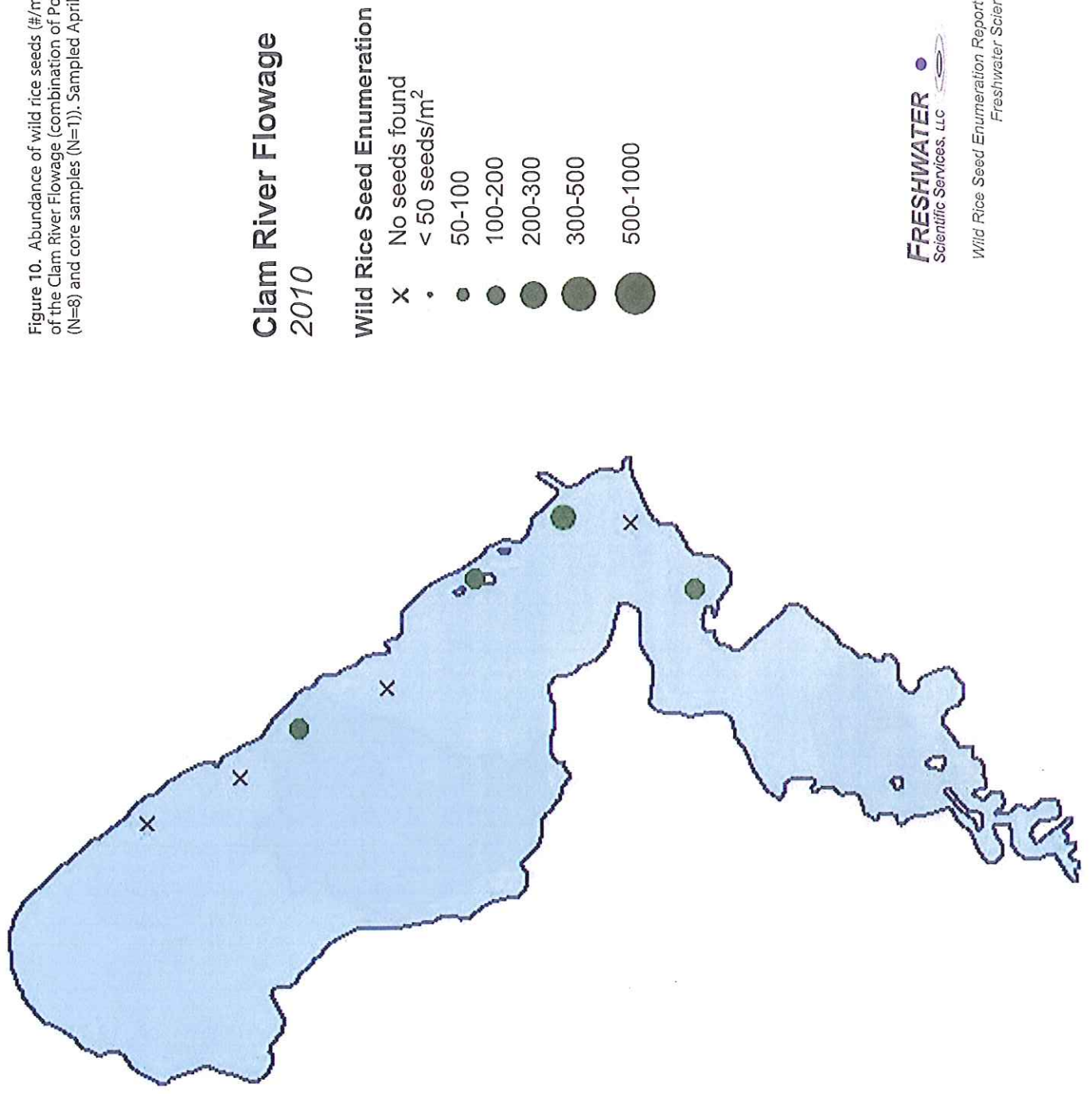


Long Lake 2009-2010

Wild Rice Seed Enumeration

- X No seeds found
- <math>< 50</math> seeds/m²
- 50-100
- 100-200
- 200-300
- 300-500
- 500-1000

Figure 10. Abundance of wild rice seeds (#/m²) in sediments of the Clam River Flowage (combination of Ponar dredge (N=8) and core samples (N=1)). Sampled April 2010.



Discussion

The abundance of wild rice seeds in the sediments of Upper Clam Lake appeared to be greatly reduced relative to the seed abundance observed in Long Lake and the Clam River Flowage. The fact that very few seeds were found in the sediments of Upper Clam Lake, with no seeds found in the top ten centimeters of sediment, suggests that reseeding will likely be needed (in addition to carp removal) to restore wild rice growth in Upper Clam Lake. However, any reseeding should use seed collected from a nearby source (ideally from remnant stands in Upper Clam Lake) to preserve the genetic strain of rice that has flourished in Upper Clam Lake in past years. Based upon a personal discussion with Dr. Anthony Kern (Northland College - Ashland, WI), this strain of rice may be uniquely adapted to the conditions in the lake. In 2010, some remnant stands of wild rice grew to maturity in shallow isolated bays of Upper Clam Lake (Figure 11). Although these stands were generally sparse, measures should be taken to protect them from carp so they may serve as founder colonies and a source of seed for future restoration of the rice beds.



Figure 11. Remnant stand of sparse wild rice in the shallow southern bay of Upper Clam Lake (August 2010)

References

- Moyle, J. B. 1944. Wild rice in Minnesota. *Journal of Wildlife Management*. 8: 177-184.
- Walker, R. D., J. Pastor, and B. W. Dewey. 2006. Effects of wild rice (*Zizania palustris*) straw on biomass and seed production in northern Minnesota. *Canadian Journal of Botany*. 84: 1019-1024.