



Wild Rice Monitoring and Abundance in the 1854 Ceded Territory (1998-2010)

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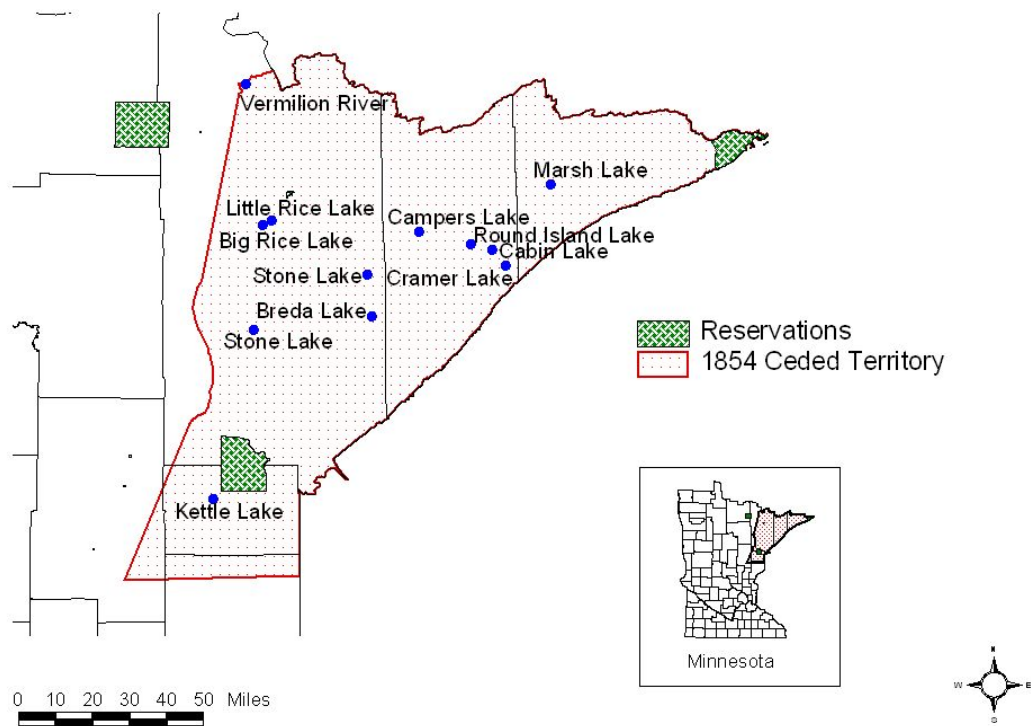
Technical Report 11-01
February 2011

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Introduction

In 1998, the 1854 Treaty Authority initiated a wild rice monitoring program on numerous lakes and rivers within the 1854 Ceded Territory in northeastern Minnesota. The 1854 Treaty Authority's monitoring program attempts to document wild rice abundance and determine trends in production on this group of waters. Monitoring activities have been completed on 12 different waters at some point (Figure 1), with seven lakes included each year from 1998 to 2010. The 2010 monitoring program included 10 lakes and rivers.



1854 Treaty Authority Biological Services Division

Figure 1: Wild Rice Waters Monitored by the 1854 Treaty Authority

In addition to the monitoring program, the 1854 Treaty Authority has also conducted a wild rice survey from 1996-2010. The purpose of the survey is to determine the presence/absence of wild rice and to collect general information on historic rice waters. The process has been coordinated with numerous partners including the Bois Forte, Grand Portage, and Fond du Lac reservations. A total of 192 lakes (or portions of lakes) and river stretches within the 1854 Ceded Territory has been surveyed over this period, with 28 surveys completed in 2010. Information has been entered into a geographic information system (GIS) database and will be expanded upon in future years. This information has also been incorporated into a Wild Rice Resource Guide developed by

the 1854 Treaty Authority. This guide lists waters in the 1854 Ceded Territory that contain wild rice, and attempts to provide information on locations where rice may be potentially harvested.

Methods

Wild rice monitoring occurred on 10 waters within the 1854 Ceded Territory in 2010.

Waters included:

Lake County - **Cabin, Campers, Cramer, Round Island lakes**

St. Louis County - **Big Rice, Breda, Little Rice, Stone lakes, Vermilion River**

Carlton County - **Kettle Lake**

These waters were included in past monitoring efforts, constitute a representative cross section of those surveyed (varying in size and geographic location), and are accessible for continued monitoring. Monitoring was conducted in a consistent manner so that acquired information will be comparable between waters and across years.

Water Depths

Water depths were measured approximately every two weeks throughout the summer beginning as soon as possible after ice out. A five-foot section of PVC pipe was marked in one-inch increments and embedded in each lake bottom to act as a depth gauge.

Changes in water depth were measured by recording gauge readings throughout the summer. Water depths were recorded at the same location as in previous years.

However, errors in comparisons across years are possible due to slight changes in gauge placement or to difficulty/judgment in measuring actual water depth at gauge location.

Water Temperature

Water temperatures were recorded in conjunction with depth readings. Temperatures were taken near the water surface.

Water Quality

Limited water quality measurements were taken periodically on each lake. Information gathered included pH, dissolved oxygen, conductivity, and total dissolved solids.

Measurements were taken near the water surface with field equipment (Accumet Portable AP5 pH meter, YSI Model 52 dissolved oxygen meter with YSI Model 5718 probe, Fisher Scientific digital conductivity meter). All instruments were calibrated and used according to manufacturer instructions. In addition, water sampling and analysis were conducted in 2007 to obtain baseline water quality information at the ten lakes/ivers included in the program.

Density/Acreage

Surveys to estimate wild rice density and crop size were conducted in late August or early September when the rice was standing and reaching maturity. Wild rice density was determined from sample plots with an area of 0.5 m² each. A square constructed from PVC piping (~0.71 m on a side) was used as a sampling grid. One corner of the grid was marked. The grid was placed over a portion of the rice bed and the number of rice stalks within it was counted and recorded. The plant nearest the marked corner was

measured further. Its height above the water was first recorded. The plant was then pulled and the distance from the top of the root to the water level was measured and the number of tillers was counted. From 1998-2004, density plots were done a minimum of 20 times per lake or river, and randomly only in areas determined to be rice beds. Beginning in 2005 (and in 2004 on Big Rice Lake), density plots were completed at sampling points based on a grid established for each lake or river. Due to the differences in size among the waters, grids ranged from 20 sampling points to 118 sampling points, and distances between sampling points ranged from approximately 100 m to 260 m. A GPS unit was used to navigate to all sampling points on the grid. (Density plots were completed only at odd numbered points at Big Rice Lake in 2010. On Big Rice Lake, plots will be completed only on even or odd numbered points each year, and will alternate across years. In an attempt to document abundance and distribution of pickerelweed, the number of stems of this emergent aquatic plant within the plots was also recorded on Big Rice Lake.)

Averages for number of stalks per 0.5 m² (and for plant height and water depth) were calculated only from sampling points within areas of wild rice. In other words, the average number of stalks reported is only for areas considered to be rice beds, not necessarily the lake as a whole.

Wild rice acreage on a lake was determined by first drawing rice beds on the lake map. A transparent grid was overlaid to determine percent of lake covered. Given the known area of the lake, the estimated acreage of wild rice coverage was then calculated. In both 2000 and 2001, the wild rice acreage on selected lakes was also determined through use of a Trimble TSC1 Asset Surveyor GPS unit. Results indicated that the drawing and grid technique is relatively accurate and provides a good estimate of wild rice acreage.

Abundance Index

An abundance index was developed for each water body monitored. This index is determined from the acreage and density of wild rice. The abundance index was calculated for each lake or river by multiplying the acreage of wild rice by the average number of stalks per 0.5 m² found in the rice beds.

Aerial Photos

The 1854 Treaty Authority has obtained aerial photographs of waters included in the monitoring program since 1999. In cooperation with the MN Department of Natural Resources and the Fond du Lac Band, aerial photographs were taken on 8/16/10, 8/17/10, and 8/25/10 on approximately 70 wild rice waters in the region, including those in the monitoring program. The 2010 season marked the fourth consecutive year of this coordinated effort. The 1854 Treaty Authority organized the photos and related survey data, and distributed the information to other agencies and interested parties. The coordinated effort at collecting information will be useful to further document wild rice abundance across years.

Results

Table 1: Wild Rice Density and Sample Plant Averages, 2010 (ranges included in parentheses)

Lake/River	Average # Stalks per 1/2 m ²	Average Numbers for Sample Plants	
		Height in inches	Water Depth in inches
Big Rice Lake	5 (0-32)	24 (12-40)	52 (19-68)
Breda Lake	48 (0-120)	30 (22-39)	24 (17-42)
Cabin Lake	51 (11-156)	21 (9-35)	26 (15-39)
Campers Lake	41 (11-93)	29 (17-47)	23 (15-30)
Cramer Lake	44 (0-157)	26 (14-51)	28 (13-46)
Kettle Lake	41 (11-96)	29 (14-45)	28 (18-40)
Little Rice Lake	6 (0-18)	24 (8-35)	37 (23-43)
Round Island Lake	49 (7-89)	26 (17-38)	31 (19-38)
Stone Lake	49 (25-93)	31 (24-39)	28 (22-37)
Vermilion River	22 (0-45)	24 (14-36)	23 (8-34)

Table 2: Wild Rice Acreage and Abundance Index, 2010

Lake/River	Water Acreage	Rice Acreage	2010	
			Average # Stalks per 1/2 m ²	Abundance Index
Big Rice Lake	1870	1010	5	5050
Breda Lake	137	90	48	4320
Cabin Lake	67	59	51	3009
Campers Lake	56	52	41	2132
Cramer Lake	62	43	44	1892
Kettle Lake	611	342	41	14022
Little Rice Lake	266	266	6	1596
Round Island Lake	54	46	49	2254
Stone Lake	230	83	49	4067
Vermilion River	303	206	22	4532
Totals:		2197		42874

Table 3: Wild Rice Acreage and Abundance Index, 1998-2010

Lake/River	Acres	1998			1999			2000			2001		
		Rice Acres	Avg # Stalks	Abund. Index	Rice Acres	Avg # Stalks	Abund. Index	Rice Acres	Avg # Stalks	Abund. Index	Rice Acres	Avg # Stalks	Abund. Index
Big Rice	1870	1421	56	79576	879	29	25491	1290	31	39990	1552	36	55872
Breda	137	125	89	11125	90	24	2160	98	54	5292	130	89	11570
Cabin	67	67	34	2278	54	27	1458	52	30	1560	63	37	2331
Campers	56	56	89	4984	4	6	24	56	57	3192	56	65	3640
Cramer	62	55	58	3190	48	27	1296	29	34	986	30	26	780
Kettle	611							415	33	13695	177	33	5841
Little Rice	266							245	18	4410	72	12	864
Marsh	69	52	76	3952	22	25	550	16	24	384	17	10	170
Round Island	54	50	82	4100	41	98	4018	23	33	759	38	50	1900
Stone	230	173	96	16608	145	29	4205	67	36	2412	85	86	7310
Stone (b)	137	18	66	1188									
Vermilion R.											61	23	1403
Totals:		2017		127001	1283		39202	2291		72680	2281		91681

Lake/River	Acres	2002			2003			2004			2005		
		Rice Acres	Avg # Stalks	Abund. Index	Rice Acres	Avg # Stalks	Abund. Index	Rice Acres	Avg # Stalks	Abund. Index	Rice Acres	Avg # Stalks	Abund. Index
Big Rice	1870	1590	17	27030	1103	18	19854	1627	26	42302	1698	32	54336
Breda	137	132	53	6996	127	48	6096	133	70	9310	135	40	5400
Cabin	67	65	36	2340	62	43	2666	55	17	935	67	43	2881
Campers	56	47	24	1128	23	21	483	24	21	504	28	31	868
Cramer	62	32	38	1216	43	43	1849	32	39	1248	44	49	2156
Kettle	611	0	0	0	324	19	6156	360	15	5400	284	8	2272
Little Rice	266	114	16	1824	261	18	4698	263	19	4997	243	34	8262
Round Island	54	54	116	6264	49	79	3871	50	44	2200	53	204	10812
Stone	230	117	53	6201	122	39	4758	122	66	8052	151	37	5587
Vermilion R.	303	197	64	12608	176	37	6512	251	69	17319	234	44	10296
Totals:		2348		65607	2290		56943	2917		92267	2937		102870

Lake/River	Acres	2006			2007			2008			2009		
		Rice Acres	Avg # Stalks	Abund. Index	Rice Acres	Avg # Stalks	Abund. Index	Rice Acres	Avg # Stalks	Abund. Index	Rice Acres	Avg # Stalks	Abund. Index
Big Rice	1870	1462	8	11696	1103	8	8824	767	13	9971	935	4	3740
Breda	137	130	33	4290	115	30	3450	101	41	4141	123	46	5658
Cabin	67	50	38	1900	63	41	2583	31	22	682	60	14	840
Campers	56	39	31	1209	48	32	1536	50	39	1950	48	39	1872
Cramer	62	26	64	1664	42	30	1260	22	34	748	39	24	936
Kettle	611	396	19	7524	330	44	14520	79	30	2370	354	12	4248
Little Rice	266	266	8	2128	242	20	4840	37	15	555	245	4	980
Round Island	54	43	54	2322	41	25	1025	17	10	170	44	29	1276
Stone	230	83	17	1411	159	25	3975	92	28	2576	64	16	1024
Vermilion R.	303	255	101	25755	200	64	12800	258	76	19608	255	45	11475
Totals:		2750		59899	2343		54813	1454		42771	2167		32049

Table 3 (continued): Wild Rice Acreage and Abundance Index, 1998-2010

Lake/River	Acres	2010		
		Rice Acres	Avg # Stalks	Abund. Index
Big Rice	1870	1010	5	5050
Breda	137	90	48	4320
Cabin	67	59	51	3009
Campers	56	52	41	2132
Cramer	62	43	44	1892
Kettle	611	342	41	14022
Little Rice	266	266	6	1596
Round Island	54	46	49	2254
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Totals:		2197		42874

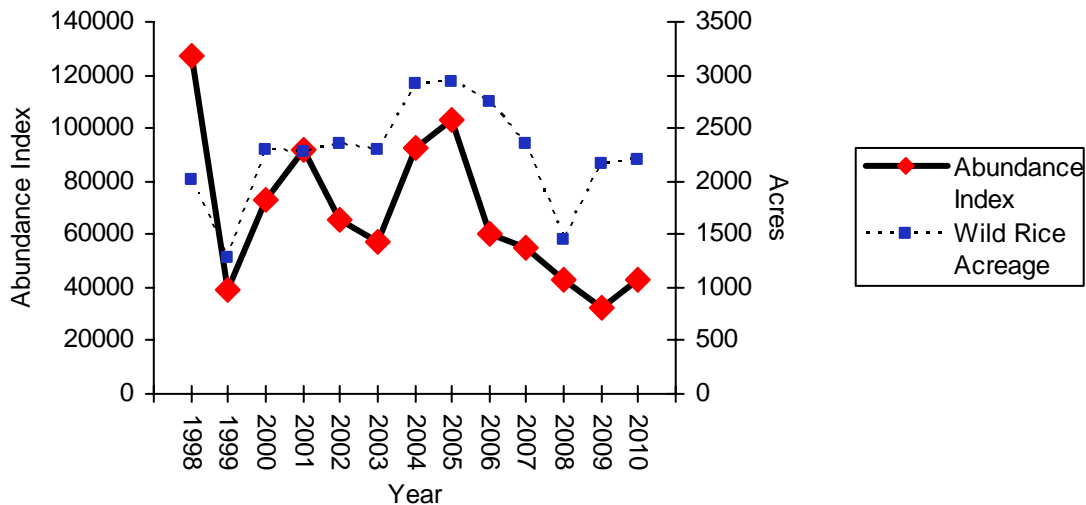


Figure 2: Total Abundance Index and Wild Rice Acreage on all Waters in Monitoring Program (1998-2010)

Please see Appendix A for data summaries, including water depths, for each lake or river monitored in 2010.

Discussion

Survey results (Table 1) indicated a wide range of densities (average number of stalks per 0.5 m²) sampled across the lakes. Wild rice stands were most dense on Cabin Lake (average of 51 stalks per sample plot), and least dense on Big Rice Lake (average of 5

stalks per sample plot) within areas considered to be rice beds. The average plant height above the water and water depth also varied across lakes.

Wild rice acreage and abundance index (Table 2) for lakes surveyed varied considerably. Abundance index will be most useful in comparing wild rice productivity across years for a given lake. Individual values will be less useful in making comparisons between waters due to the differences in lake sizes (acreage). The total abundance index and wild rice acreage will be helpful in evaluating the relative success of the crop on the group of waters as a whole on an annual basis.

A comparison of wild rice success from 1998 and 2010 can be made (Table 3, Figure 2). Across the waters monitored since 1998, the total wild rice acreage in 2010 was near the average over this time period. However, the total abundance index in 2010 was the fourth lowest over this time period, indicating poor rice density in beds across this group of waters as a whole. However, it should be noted that yearly total results are largely driven by rice production at Big Rice Lake due to the large acreage involved. In 2010, acreage and density of rice across Big Rice Lake was extremely poor, resulting in the second lowest abundance index recorded for the lake since beginning in 1998 and thus affecting total abundance index results. Omitting Big Rice Lake from the group, 2010 generally marked a fair year for wild rice on the other waters in the program, with crops ranging from poor to good.

A variety of interacting factors (water level, water quality, sediment nutrients, water flow, temperature, etc.) can affect wild rice production on a given lake. Because the weather is a driving force behind many of these factors, some information relating to 2010 should be noted. According to the National Weather Service, the winter of 2009-2010 was characterized by about average temperature and snowfall across the northeastern portion of Minnesota. Spring 2010 was warm, with March being the warmest on record in International Falls and the warmest since 1910 in Duluth. Duluth only reported a trace of snowfall in March. Ice-outs on area lakes occurred two to three weeks earlier than long-term averages, with some recording the earliest on record. Ice-outs in the region generally occurred during the last week of March and the first week of April. April 2010 was tied for the warmest on record in Duluth, and no snowfall was reported statewide. Due to dry conditions from little precipitation accompanied by the early snow melt, spring water levels were low across the region setting up favorable conditions for wild rice germination. Wild rice growth slowed in June due to wet and cool weather. Much of the region was characterized by above average precipitation in summer 2010, but some areas in extreme northern and northeastern Minnesota were near or even below normal. Wild rice crops were looking fair to good in many locations into August, but heavy rains and strong winds at the end of August and beginning of September caused poor conditions for wild rice maturation and ripening. Harvesters generally had poor success.

Big Rice Lake

Big Rice Lake contained a poor wild rice crop in 2010. The acreage and especially density of the stands were extremely low, resulting in the second lowest abundance index for the lake since the program began in 1998. Few good stands of rice were found in 2010. Pickerelweed continued to be distributed in many areas of the lake, and is potentially out-competing wild rice in some locations. Water levels in 2010 were high, increasing throughout the season and becoming the highest recorded under this program.

A field visit completed in September 2010 indicated a variety of beaver activity down the outlet, including an active dam on top of the rock weir. In 2008, the rock weir was adjusted to the approximately natural level as was originally found at the outlet before work was initiated there. Vegetation surveys of the lake have been conducted by MNDNR in 2001, 2003, 2004, 2006, 2007, and 2009. Due to interpretation of wild rice statutes by the MN Department of Natural Resources, the lake was not posted with opening dates for harvest in 2010. The MNDNR is working with partners to develop an updated management plan for the lake, with completion expected to occur in 2011.

Breda Lake

Breda Lake contained a fair wild rice crop in 2010. Although the acreage of wild rice was tied for the lowest observed since 1998, rice covered approximately two-thirds of the lake and density was moderate to good in many areas. Water levels in 2010 were low in the spring, increased through the middle of summer, and declined into the beginning of September. Water levels in summer 2010 were generally higher than a number of previous years, and beaver activity may be occurring on the outlet. Breda Lake is subjected to considerable water fluctuations during rain events. Some fluctuations in 2010 may not have been recorded with only periodic depth readings. Limited observations indicated one group of wild rice harvesters on 8/16/10 and four groups on 9/1/10. Ricers reported little success.

Cabin Lake

Cabin Lake contained a good wild rice crop in 2010. The acreage of wild rice on the lake has remained fairly stable each year since 1998. In 2010, wild rice stands had the highest density recorded, resulting in the highest abundance index for the lake since the monitoring program began. Wild rice covered most of the lake, and was moderate to good density in many areas. Water levels increased into June, decreased through the end of July, and then increased through the end of September. One group of wild rice harvesters was observed on 8/25/10 and one group on 9/10/10.

Campers Lake

Campers Lake contained a good wild rice crop in 2010. The crop was comparable to those found in the previous two years, and results indicated the highest abundance index since 2001. Wild rice covered most of the lake, with moderate to good density stands found over much of this area. Water levels fluctuated throughout the season, but did not bounce as high as seen in all previous years beginning in 1999. Campers Lake is subjected to considerable water fluctuations during rain events, and some extremes may not have been recorded with only periodic depth readings.

Cramer Lake

Cramer Lake contained a fair to good wild rice crop in 2010. The abundance index calculated for the lake was the third highest since 1998. A good wild rice stand was found in the northeastern portion of the lake. Water levels increased through the middle of June, declined into August to the lowest level seen since recording began in 2000, and then increased again through the end of September.

Kettle Lake

Kettle Lake contained a good wild rice crop in 2010. Wild rice was found over most of the open portions of the lake, with moderate to good density stands in many areas. The abundance index was the second highest since monitoring began in 2000. Water levels fluctuated in 2010 until a large increase at the end of August. One group of wild rice harvesters was observed on 8/27/10.

Little Rice Lake

Little Rice Lake contained a poor wild rice crop in 2010. Most of the lake was covered with sparse and scattered rice. Density in areas considered to be rice beds was the second lowest recorded since the monitoring program began, just slightly higher than 2009. Due to possible judgment differences each year in denoting beds in areas of sparse rice, the reported increased acreage from 2008 to 2009 is likely misleading. Water levels in 2010 generally increased through the season, and were high when compared to previous years. Some beaver activity on the outlet was seen from the air in September 2010, and further ground investigation and perhaps beaver management should be considerations.

Round Island Lake

Round Island Lake contained a fair to good wild rice crop in 2010. Moderate to good density stands covered approximately three-fourths of the lake, with sparse rice found elsewhere. After several years of beaver trapping and dam removal through a cooperative effort of the MN Department of Natural Resources and Ducks Unlimited, no work has been conducted from 2006 to 2010. Water levels remained stable and relatively high again in 2010, similar to the previous four years. Inspection of the outlet at the end of August showed a beaver dam with two to three feet of head. Observations of wild rice harvesters included one group on 8/23/10 and two groups on 9/10/10.

Stone Lake

Stone Lake contained a poor to fair wild rice crop in 2010. The abundance index calculated for the lake was the highest since 2005. Rice beds covered over one-third of the lake, with some stands having moderate or good density. The remainder of the lake contained areas of sparse rice. Water levels increased through the end of June, and then remained relatively stable through the remainder of the season. Three groups of wild rice harvesters were observed on 8/25/10.

Vermilion River

The Vermilion River contained a poor to fair wild rice crop in 2010. Stands of rice were found along the river channel in the stretch monitored (near Goldmine Resort), but the abundance index was the second lowest calculated since monitoring began in 2001. The density of the wild rice stands was the lowest recorded over this period. Only limited water depth readings were taken from April through August. It should also be noted that many water level readings from previous years were recorded from the MNDNR webpage, with direct readings taken by volunteers at the bridge in Buyck. Other water level data is available from a gauge near Crane Lake monitored by the U.S. Geological Survey. Three groups were observed checking or harvesting wild rice on 8/15/10, but the crop was still not ripe.

Summary

The 1854 Treaty Authority continued a wild rice monitoring program in 2010. The purpose of the program is to document wild rice abundance and trends production. In 2010, wild rice success across the 1854 Ceded Territory in northeastern Minnesota was generally fair to good. A variety of crop conditions were encountered. Fair or good crops were found on many of the waters included in the monitoring program, and also on many other lakes and rivers in the region. Big Rice Lake again stood out as a disappointment with a poor rice crop in 2010. Results from Big Rice affect regional totals and summary information. Across the group of waters monitored since 1998, the total wild rice acreage in 2010 was near the average over this period. However, the total abundance index was the fourth lowest recorded, indicating poorer density rice beds in general. An early spring with low water levels was favorable for wild rice growth, and the outlook for harvesters was good. However, wild rice harvesters generally reported poor success. Poor weather, including stretches of rain and wind at the end of August and into September, may have impacted plant development and likely also took any ripe rice. Data from subsequent years will be used to document wild rice abundance across time. The same waters will be monitored again in 2011 to obtain comparable information. The 1854 Treaty Authority plans to continue this survey on a yearly basis, and possibly expand upon the number of lakes and rivers included through recruitment of other cooperators.

Acknowledgments

The following individuals have provided assistance with the project:

Millard (Sonny) Myers - Executive Director, 1854 Treaty Authority
Andy Edwards - Resource Management Division Director, 1854 Treaty Authority
Nick Axtell - Environmental Specialist, 1854 Treaty Authority
Matt Weberg - Fish and Wildlife Technician, 1854 Treaty Authority
Sara Wroblewski - Fish and Wildlife Technician, 1854 Treaty Authority
Tom Enright - Fish and Wildlife Technician, 1854 Treaty Authority
Clay Rumph - Chief Conservation Officer, 1854 Treaty Authority
Ralph LaPlant - Conservation Officer, 1854 Treaty Authority
Leo Vidal - Conservation Officer, 1854 Treaty Authority
Mike Schrage - Wildlife Biologist, Fond du Lac Reservation
Peter David - Wildlife Biologist, Great Lakes Indian Fish & Wildlife Commission
Al Buchert - Regional Enforcement Aircraft Pilot, MN Dept. of Natural Resources

Appendix A
Data Summaries

Big Rice Lake

St. Louis County - township 60N, range 17W (DNR ID#: 69-0669 00)

**Table A-1: Wild Rice Density and Sample Plant Averages on Big Rice Lake
(ranges included in parentheses)**

Year	Average # Stalks per 1/2 sq. meter	Average Numbers for Sample Plants	
		Height in inches	Water Depth in inches
1998	56 (9-158)	25 (10-54)	27 (6-42)
1999	29 (4-84)	19 (3-40)	44 (18-57)
2000	31 (7-47)	33 (13-47)	34 (15-50)
2001	36 (7-118)	25 (10-37)	30 (13-40)
2002	17 (3-45)	28 (12-47)	43 (22-56)
2003	18 (3-63)	29 (15-47)	44 (25-58)
2004	26 (0-176)	26 (10-47)	28 (6-46)
2005	32 (0-137)	25 (9-47)	29 (13-42)
2006	8 (0-30)	24 (2-45)	21 (9-35)
2007	8 (0-66)	23 (10-35)	33 (0-47)
2008	13 (0-105)	16 (1-27)	34 (14-50)
2009	4 (0-17)	20 (9-35)	46 (25-59)
2010	5 (0-32)	24 (12-40)	52 (19-68)

Table A-2: Wild Rice Acreage and Abundance Index on Big Rice Lake

Year	Lake Acreage	% Rice Coverage	Rice Acreage	Average # Stalks per 1/2 sq. meter	Abundance Index
1998	1870	76	1421	56	79576
1999	1870	47	879	29	25491
2000	1870	69	1290	31	39990
2001	1870	83	1552	36	55872
2002	1870	85	1590	17	27030
2003	1870	59	1103	18	19854
2004	1870	87	1627	26	42302
2005	1870	91	1698	32	54336
2006	1870	78	1462	8	11696
2007	1870	59	1103	8	8824
2008	1870	41	767	13	9971
2009	1870	50	935	4	3740
2010	1870	54	1010	5	5050

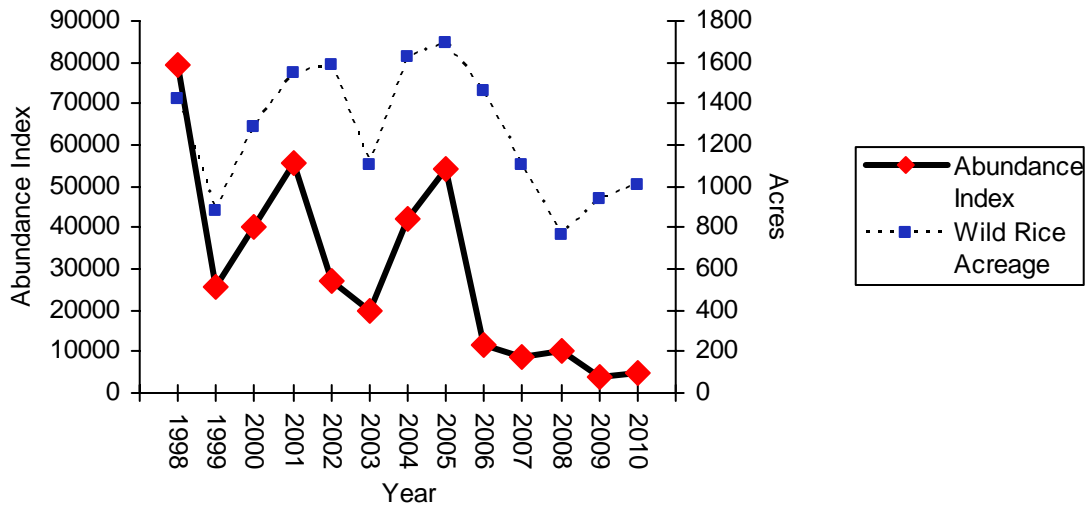


Figure A-1: Abundance Index and Wild Rice Acreage on Big Rice Lake (1998-2010)

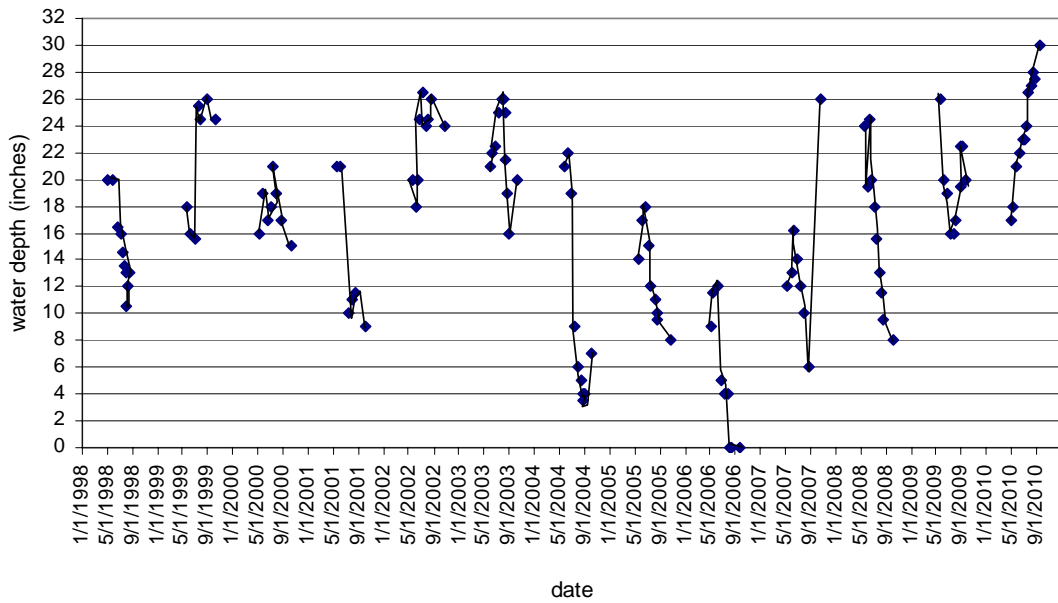


Figure A-2: Water Depth on Big Rice Lake (1998-2010)

Breda Lake

St. Louis County - township 56N, range 12W (DNR ID#: 69-0037 00)

**Table A-3: Wild Rice Density and Sample Plant Averages on Breda Lake
(ranges included in parentheses)**

Year	Average # Stalks per 1/2 sq. meter	Average Numbers for Sample Plants	
		Height in inches	Water Depth in inches
1998	89 (23-168)	30 (14-60)	17 (4-29)
1999	24 (2-56)	8 (1-20)	26 (19-36)
2000	54 (11-96)	32 (14-45)	25 (14-31)
2001	89 (11-199)	22 (8-46)	30 (18-37)
2002	53 (16-91)	25 (10-51)	26 (4-36)
2003	48 (11-109)	28 (12-49)	22 (4-31)
2004	70 (11-141)	24 (13-36)	21 (11-27)
2005	40 (5-93)	21 (10-40)	17 (7-29)
2006	33 (4-73)	22 (5-40)	19 (5-32)
2007	30 (1-71)	20 (4-42)	16 (6-23)
2008	41 (3-133)	24 (6-39)	17 (7-23)
2009	46 (18-111)	24 (14-34)	23 (13-32)
2010	48 (0-120)	30 (22-39)	24 (17-42)

Table A-4: Wild Rice Acreage and Abundance Index on Breda Lake

Year	Lake Acreage	% Rice Coverage	Rice Acreage	Average # Stalks per 1/2 sq. meter	Abundance Index
1998	137	91	125	89	11125
1999	137	66	90	24	2160
2000	137	72	98	54	5292
2001	137	95	130	89	11570
2002	137	96	132	53	6996
2003	137	93	127	48	6096
2004	137	97	133	70	9310
2005	137	99	135	40	5400
2006	137	95	130	33	4290
2007	137	84	115	30	3450
2008	137	74	101	41	4141
2009	137	90	123	46	5658
2010	137	66	90	48	4320

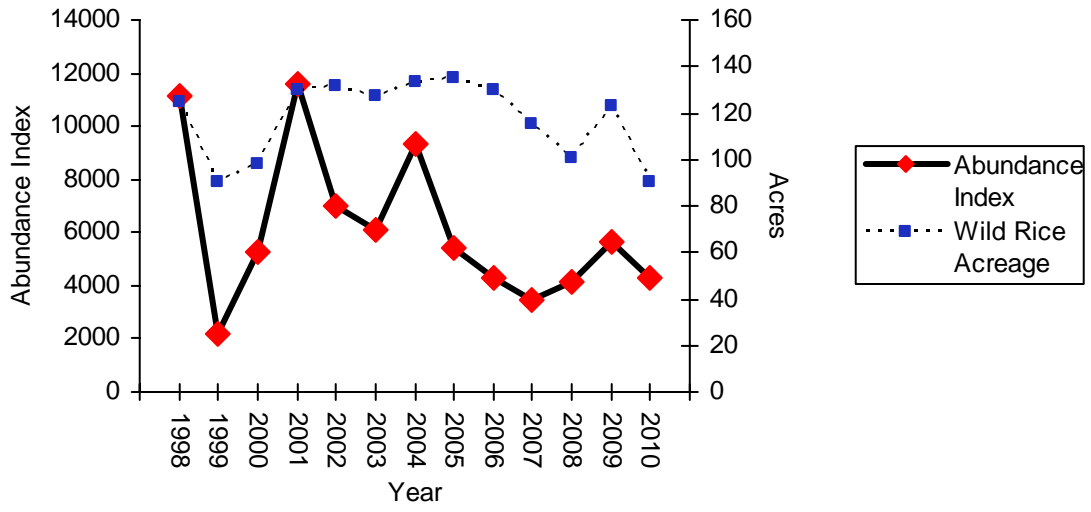


Figure A-3: Abundance Index and Wild Rice Acreage on Breda Lake (1998-2010)

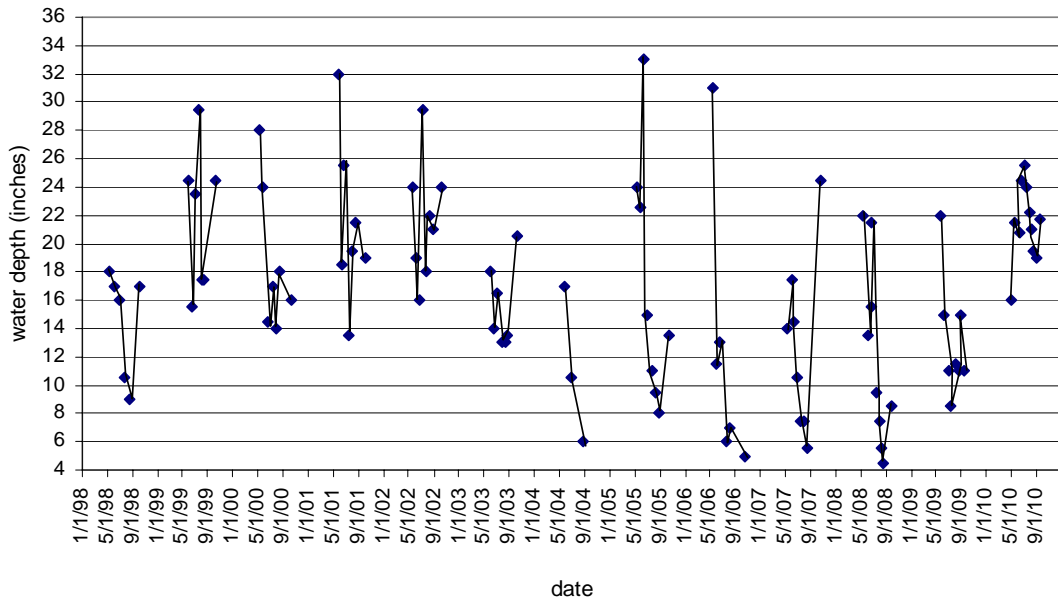


Figure A-4: Water Depth on Breda Lake (1998-2010)

Cabin Lake

Lake County - township 59N, range 7W (DNR ID#: 38-0260 00)

**Table A-5: Wild Rice Density and Sample Plant Averages on Cabin Lake
(ranges included in parentheses)**

Year	Average # Stalks per 1/2 sq. meter	Average Numbers for Sample Plants	
		Height in inches	Water Depth in inches
1998	34 (9-69)	21 (7-31)	21 (12-31)
1999	27 (10-48)	16 (9-29)	26 (10-39)
2000	30 (3-66)	19 (4-32)	26 (13-35)
2001	37 (8-142)	20 (15-30)	27 (14-36)
2002	36 (10-84)	20 (8-33)	26 (12-39)
2003	43 (10-118)	21 (9-49)	25 (4-43)
2004	17 (2-67)	17 (8-36)	23 (14-36)
2005	43 (9-139)	24 (8-39)	19 (3-31)
2006	38 (4-158)	22 (10-35)	17 (7-34)
2007	41 (2-118)	21 (6-35)	18 (3-35)
2008	22 (2-52)	18 (9-32)	14 (9-21)
2009	14 (3-33)	20 (8-29)	20 (5-35)
2010	51 (11-156)	21 (9-35)	26 (15-39)

Table A-6: Wild Rice Acreage and Abundance Index on Cabin Lake

Year	Lake Acreage	% Rice Coverage	Rice Acreage	Average # Stalks per 1/2 sq. meter	Abundance Index
1998	67	100	67	34	2278
1999	67	81	54	27	1458
2000	67	78	52	30	1560
2001	67	94	63	37	2331
2002	67	97	65	36	2340
2003	67	93	62	43	2666
2004	67	82	55	17	935
2005	67	100	67	43	2881
2006	67	74	50	38	1900
2007	67	94	63	41	2583
2008	67	47	31	22	682
2009	67	90	60	14	840
2010	67	88	59	51	3009

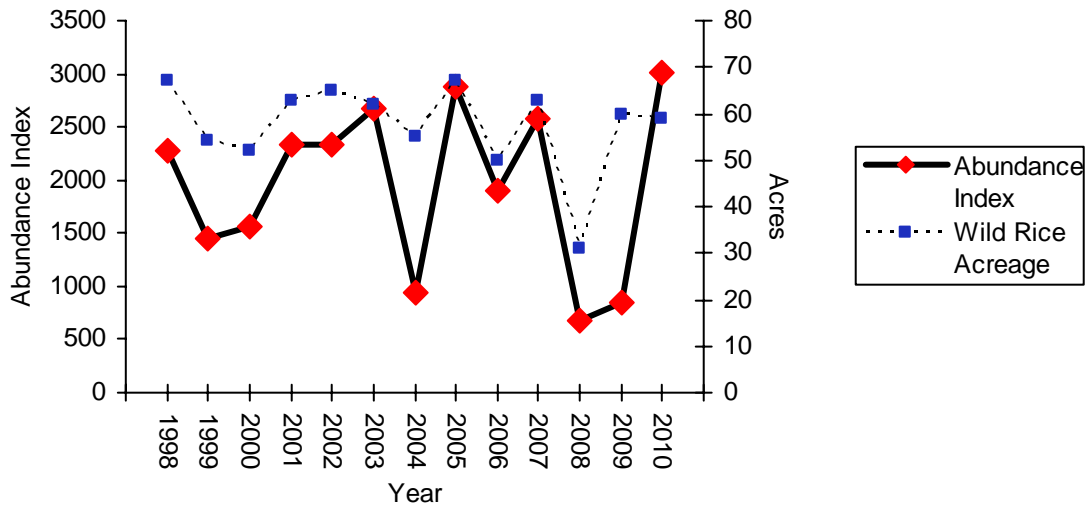


Figure A-5: Abundance Index and Wild Rice Acreage on Cabin Lake (1998-2010)

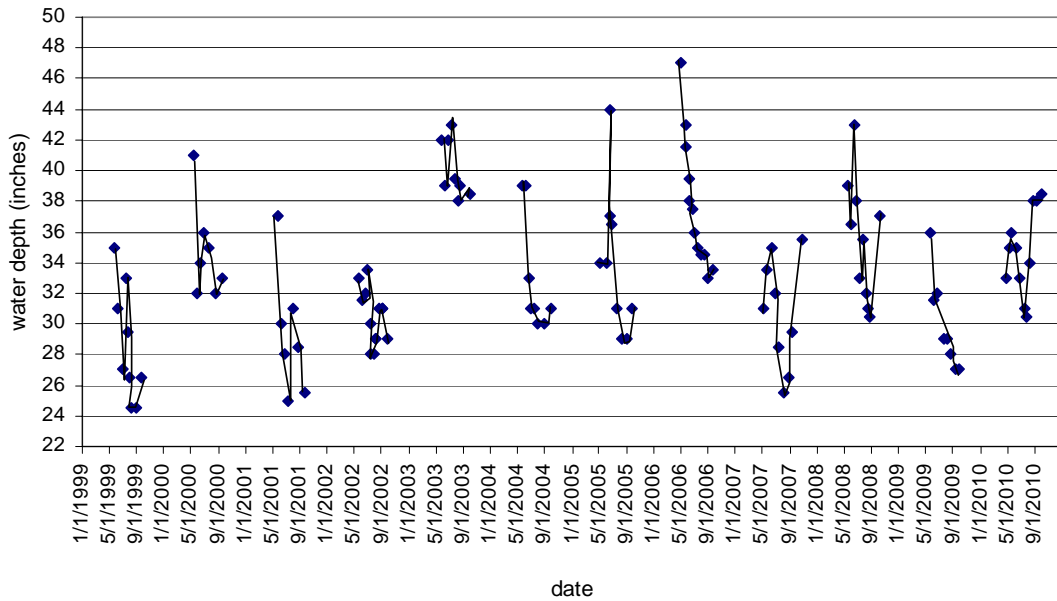


Figure A-6: Water Depth on Cabin Lake (1999-2010)

Campers Lake

Lake County - township 60N, range 10W (DNR ID#: 38-0679 00)

**Table A-7: Wild Rice Density and Sample Plant Averages on Campers Lake
(ranges included in parentheses)**

Year	Average # Stalks per 1/2 sq. meter	Average Numbers for Sample Plants	
		Height in inches	Water Depth in inches
1998	89 (29-151)	22 (8-48)	15 (8-24)
1999	6 (3-13)	2 (1-4)	14 (13-16)
2000	57 (8-134)	26 (6-40)	22 (17-34)
2001	65 (10-163)	16 (2-32)	28 (22-34)
2002	24 (6-81)	12 (9-25)	21 (20-30)
2003	21 (3-39)	21 (4-32)	21 (16-27)
2004	21 (9-46)	26 (15-40)	15 (9-20)
2005	31 (0-74)	27 (12-54)	10 (6-15)
2006	31 (0-121)	29 (12-46)	23 (15-32)
2007	32 (3-78)	26 (10-43)	12 (3-25)
2008	39 (2-76)	25 (10-52)	13 (4-26)
2009	39 (4-87)	15 (7-36)	27 (16-34)
2010	41 (11-93)	29 (17-47)	23 (15-30)

Table A-8: Wild Rice Acreage and Abundance Index on Campers Lake

Year	Lake Acreage	% Rice Coverage	Rice Acreage	Average # Stalks per 1/2 sq. meter	Abundance Index
1998	56	100	56	89	4984
1999	56	7	4	6	24
2000	56	100	56	57	3192
2001	56	100	56	65	3640
2002	56	84	47	24	1128
2003	56	41	23	21	483
2004	56	43	24	21	504
2005	56	50	28	31	868
2006	56	69	39	31	1209
2007	56	85	48	32	1536
2008	56	89	50	39	1950
2009	56	86	48	39	1872
2010	56	93	52	41	2132

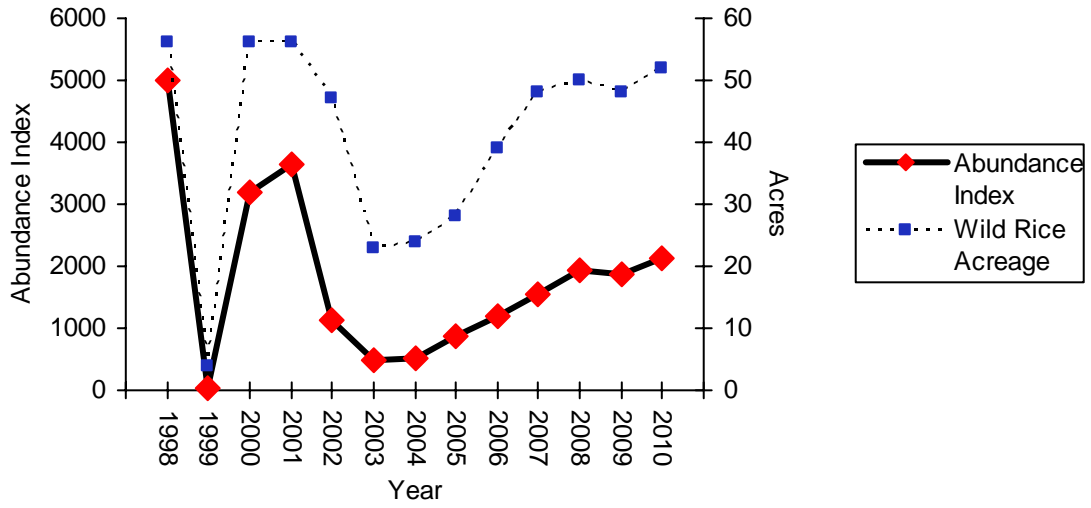


Figure A-7: Abundance Index and Wild Rice Acreage on Campers Lake (1998-2010)

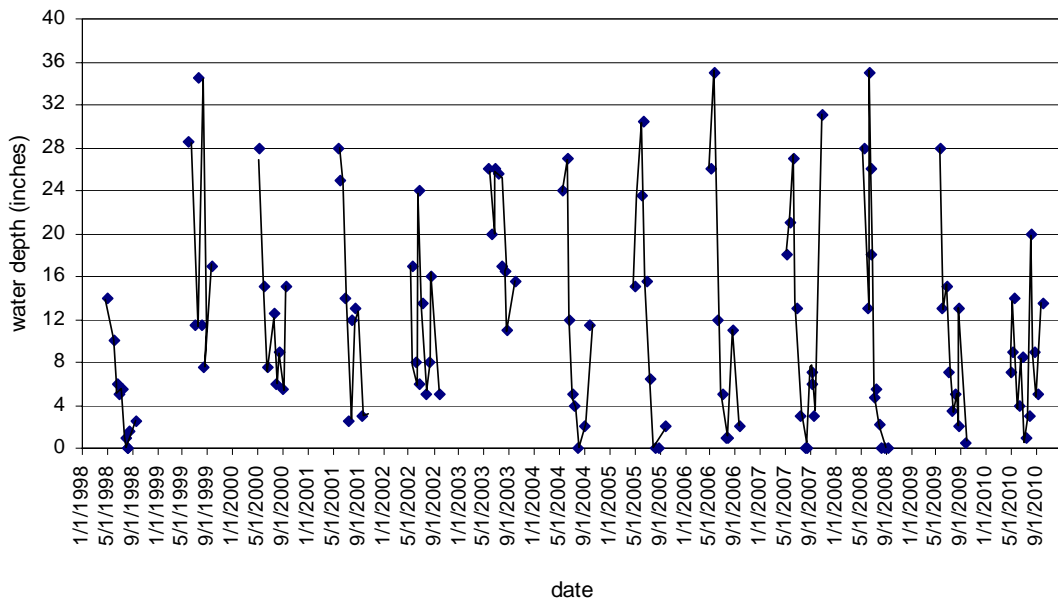


Figure A-8: Water Depth on Campers Lake (1998–2010)

Cramer Lake

Lake County - township 58N, range 6W (DNR ID#: 38-0014 00)

**Table A-9: Wild Rice Density and Sample Plant Averages on Cramer Lake
(ranges included in parentheses)**

Year	Average # Stalks per 1/2 sq. meter	Average Numbers for Sample Plants	
		Height in inches	Water Depth in inches
1998	58 (18-109)	23 (10-48)	28 (20-37)
1999	27 (2-83)	16 (2-24)	27 (14-39)
2000	34 (7-85)	32 (10-36)	25 (7-38)
2001	26 (9-44)	28 (16-48)	29 (16-40)
2002	38 (7-87)	21 (4-34)	26 (10-38)
2003	43 (3-97)	24 (11-41)	29 (17-40)
2004	39 (5-90)	21 (11-36)	29 (20-38)
2005	49 (9-141)	22 (12-33)	22 (10-36)
2006	64 (3-183)	29 (20-44)	23 (10-32)
2007	30 (0-104)	21 (12-29)	23 (11-31)
2008	34 (0-97)	27 (8-42)	20 (8-32)
2009	24 (0-76)	27 (17-41)	23 (10-33)
2010	44 (0-157)	26 (14-51)	28 (13-46)

Table A-10: Wild Rice Acreage and Abundance Index on Cramer Lake

Year	Lake Acreage	% Rice Coverage	Rice Acreage	Average # Stalks per 1/2 sq. meter	Abundance Index
1998	62	89	55	58	3190
1999	62	77	48	27	1296
2000	62	46	29	34	986
2001	62	49	30	26	780
2002	62	52	32	38	1216
2003	62	69	43	43	1849
2004	62	52	32	39	1248
2005	62	71	44	49	2156
2006	62	42	26	64	1664
2007	62	67	42	30	1260
2008	62	36	22	34	748
2009	62	63	39	24	936
2010	62	70	43	44	1892

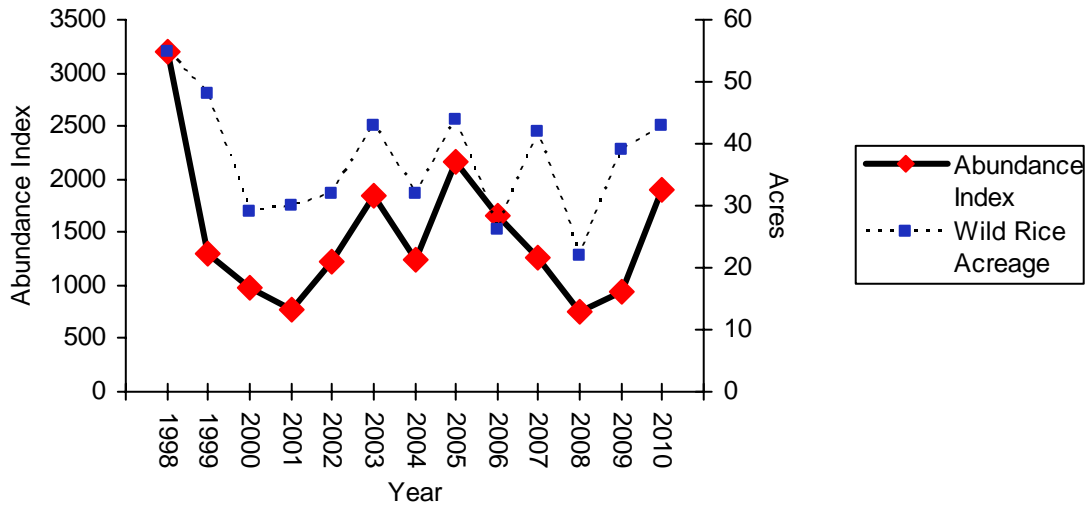


Figure A-9: Abundance Index and Wild Rice Acreage on Cramer Lake (1998-2010)

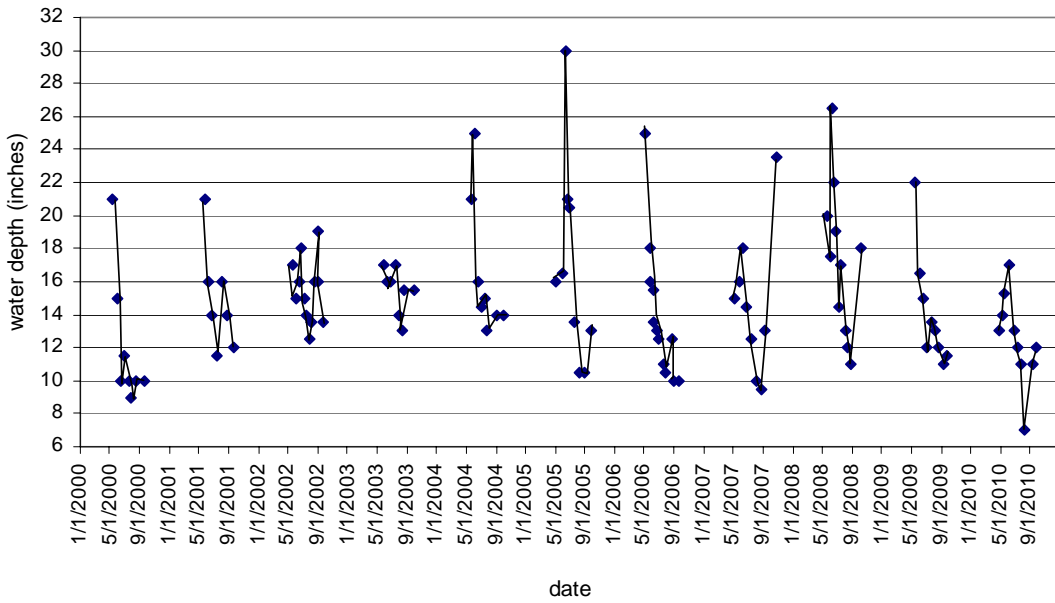


Figure A-10: Water Depth on Cramer Lake (2000-2010)

Kettle Lake

Carlton County - township 48N, range 19W (DNR ID#: 09-0049 00)

**Table A-11: Wild Rice Density and Sample Plant Averages on Kettle Lake
(ranges included in parentheses)**

Year	Average # Stalks per 1/2 sq. meter	Average Numbers for Sample Plants	
		Height in inches	Water Depth in inches
2000	33 (17-83)	26 (12-37)	42 (30-57)
2001	33 (13-73)	22 (2-41)	26 (18-41)
2002	0	NA	NA
2003	19 (3-89)	23 (9-47)	29 (15-47)
2004	15 (3-37)	20 (6-49)	26 (19-37)
2005	8 (3-24)	10 (5-21)	22 (11-37)
2006	19 (0-43)	33 (18-52)	15 (8-31)
2007	44 (8-104)	33 (16-51)	16 (4-35)
2008	30 (6-74)	25 (17-33)	11 (5-21)
2009	12 (2-45)	20 (8-32)	38 (30-46)
2010	41 (11-96)	29 (14-45)	28 (18-40)

Table A-12: Wild Rice Acreage and Abundance Index on Kettle Lake

Year	Lake Acreage	% Rice Coverage	Rice Acreage	Average # Stalks per 1/2 sq. meter	Abundance Index
2000	611	68	415	33	13695
2001	611	29	177	33	5841
2002	611	0	0	0	0
2003	611	53	324	19	6156
2004	611	59	360	15	5400
2005	611	46	284	8	2272
2006	611	65	396	19	7524
2007	611	54	330	44	14520
2008	611	13	79	30	2370
2009	611	58	354	12	4248
2010	611	56	342	41	14022

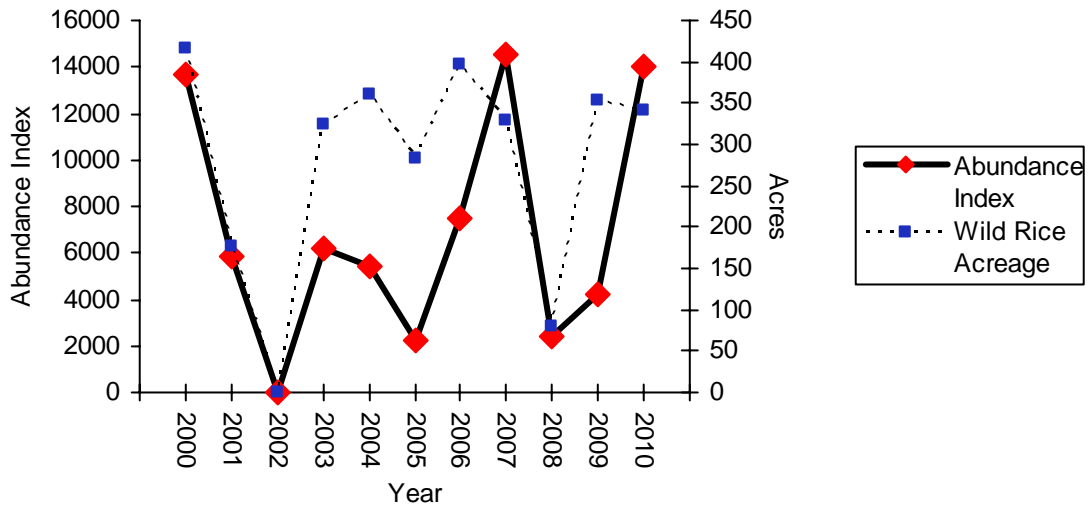


Figure A-11: Abundance Index and Wild Rice Acreage on Kettle Lake (2000-2010)

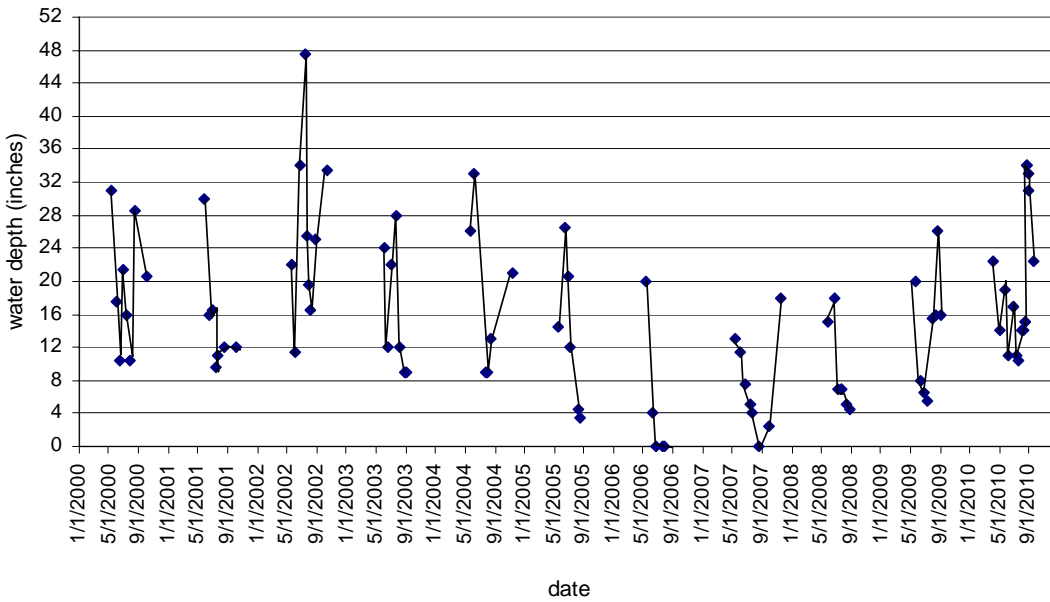


Figure A-12: Water Depth on Kettle Lake (2000-2010)

Little Rice Lake

St. Louis County - township 60N, range 17W (DNR ID#: 69-0612 00)

**Table A-13: Wild Rice Density and Sample Plant Averages on Little Rice Lake
(ranges included in parentheses)**

Year	Average # Stalks per 1/2 sq. meter	Average Numbers for Sample Plants	
		Height in inches	Water Depth in inches
2000	18 (7-44)	29 (17-52)	33 (27-39)
2001	12 (5-18)	17 (7-30)	19 (15-24)
2002	16 (1-52)	21 (12-36)	20 (14-25)
2003	18 (0-57)	26 (1-46)	16 (17-30)
2004	19 (4-41)	24 (11-34)	17 (13-23)
2005	34 (9-65)	21 (10-50)	16 (8-25)
2006	8 (0-22)	18 (3-34)	14 (8-17)
2007	20 (5-49)	28 (17-41)	11 (4-16)
2008	15 (2-62)	22 (12-31)	17 (10-28)
2009	4 (0-9)	19 (3-29)	27 (16-31)
2010	6 (0-18)	24 (8-35)	37 (23-43)

Table A-14: Wild Rice Acreage and Abundance Index on Little Rice Lake

Year	Lake Acreage	% Rice Coverage	Rice Acreage	Average # Stalks per 1/2 sq. meter	Abundance Index
2000	266	92	245	18	4410
2001	266	27	72	12	864
2002	266	43	114	16	1824
2003	266	98	261	18	4698
2004	266	99	263	19	4997
2005	266	91	243	34	8262
2006	266	100	266	8	2128
2007	266	91	242	20	4840
2008	266	14	37	15	555
2009	266	92	245	4	980
2010	266	100	266	6	1596

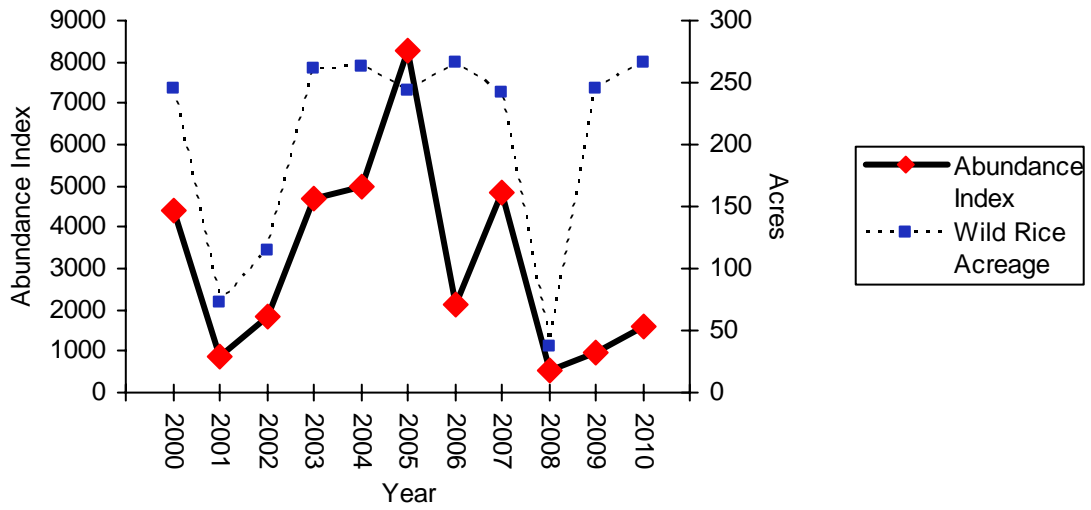


Figure A-13: Abundance Index and Wild Rice Acreage on Little Rice Lake (2000-2010)

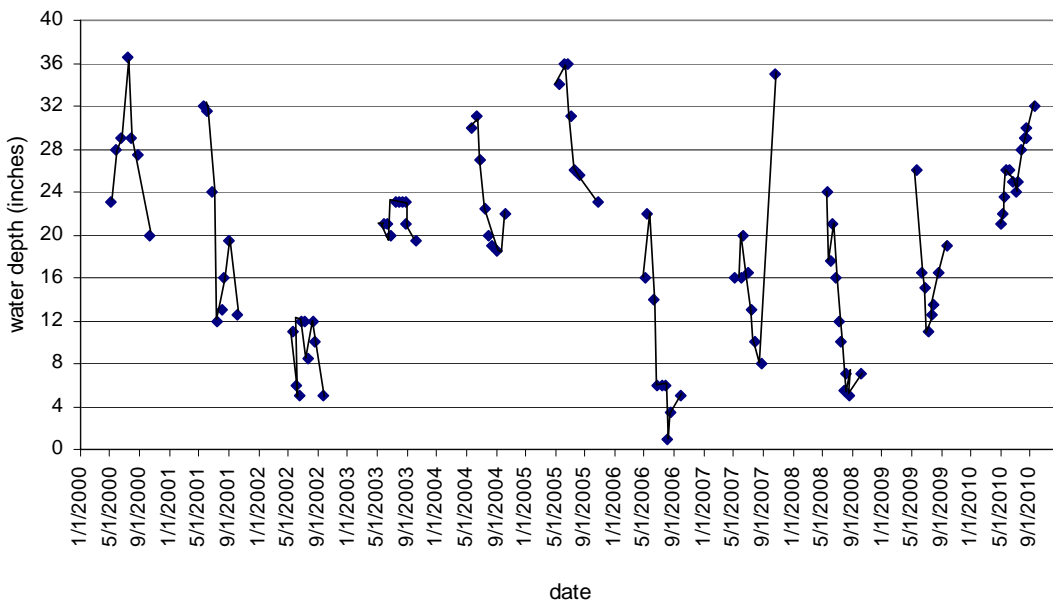


Figure A-14: Water Depth on Little Rice Lake (2000-2010)

Round Island Lake

Lake County - township 59N, range 8W (DNR ID#: 38-0417 00)

Table A-15: Wild Rice Density and Sample Plant Averages on Round Island Lake (ranges included in parentheses)

Year	Average # Stalks per 1/2 sq. meter	Average Numbers for Sample Plants	
		Height in inches	Water Depth in inches
1998	82 (31-175)	19 (6-34)	6 (3-16)
1999	98 (10-168)	12 (6-23)	24 (17-37)
2000	33 (3-87)	19 (4-34)	24 (16-38)
2001	50 (20-117)	27 (12-43)	27 (16-39)
2002	116 (38-313)	32 (4-49)	12 (2-24)
2003	79 (22-173)	18 (6-31)	26 (15-34)
2004	44 (18-78)	30 (15-42)	10 (5-15)
2005	204 (46-393)	23 (13-32)	8 (2-17)
2006	54 (0-176)	16 (1-30)	26 (17-35)
2007	25 (0-62)	15 (9-21)	27 (10-37)
2008	10 (0-20)	20 (1-29)	28 (22-32)
2009	29 (3-59)	20 (9-34)	35 (30-44)
2010	49 (7-89)	26 (17-38)	31 (19-38)

Table A-16: Wild Rice Acreage and Abundance Index on Round Island Lake

Year	Lake Acreage	% Rice Coverage	Rice Acreage	Average # Stalks per 1/2 sq. meter	Abundance Index
1998	54	93	50	82	4100
1999	54	76	41	98	4018
2000	54	43	23	33	759
2001	54	70	38	50	1900
2002	54	100	54	116	6264
2003	54	90	49	79	3871
2004	54	93	50	44	2200
2005	54	98	53	204	10812
2006	54	80	43	54	2322
2007	54	75	41	25	1025
2008	54	31	17	10	170
2009	54	81	44	29	1276
2010	54	85	46	49	2254

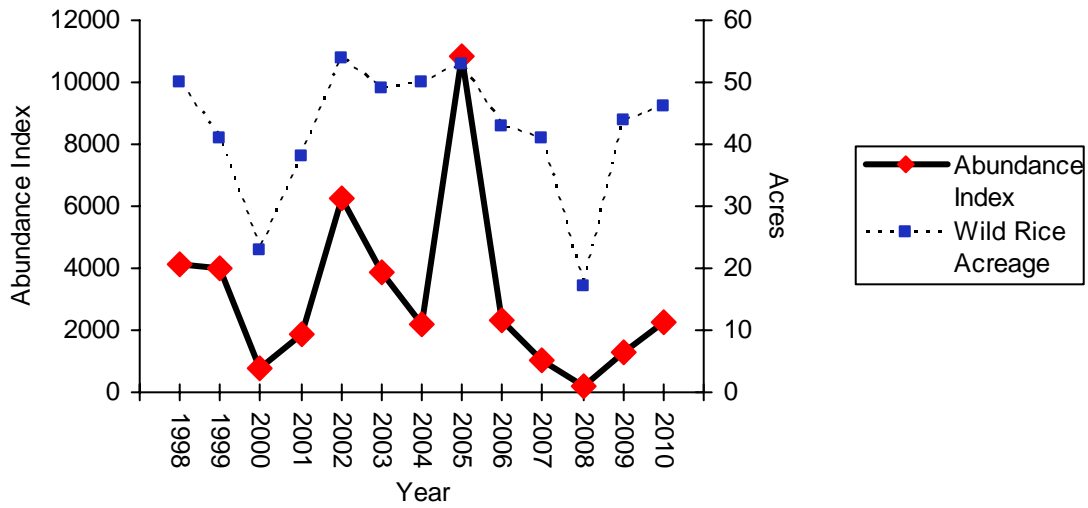


Figure A-15: Abundance Index and Wild Rice Acreage on Round Island Lake (1998-2010)

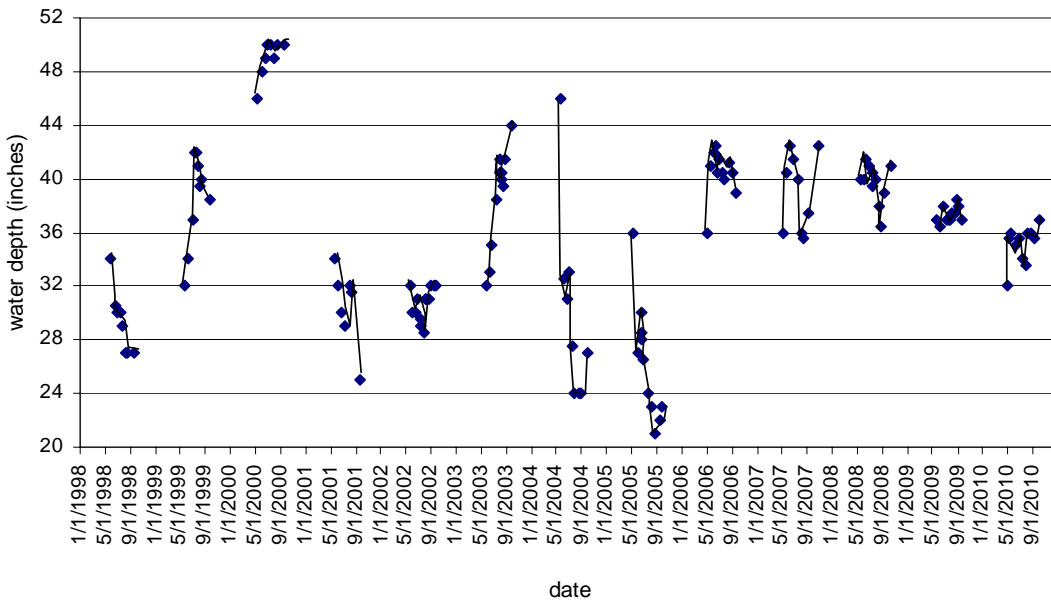


Figure A-16: Water Depth on Round Island Lake (1998-2010)

Stone Lake

St. Louis County - township 58N, range 12W (DNR ID#: 69-0046 00)

**Table A-17: Wild Rice Density and Sample Plant Averages on Stone Lake
(ranges included in parentheses)**

Year	Average # Stalks per 1/2 sq. meter	Average Numbers for Sample Plants	
		Height in inches	Water Depth in inches
1998	96 (23-203)	30 (13-53)	23 (11-38)
1999	29 (4-60)	15 (2-31)	27 (16-39)
2000	36 (13-52)	25 (9-38)	35 (31-41)
2001	86 (32-272)	31 (11-55)	26 (16-38)
2002	53 (10-247)	24 (10-35)	36 (30-53)
2003	39 (2-64)	24 (10-40)	33 (24-45)
2004	66 (9-144)	25 (10-34)	23 (14-34)
2005	37 (7-73)	19 (11-29)	22 (9-36)
2006	17 (3-39)	24 (12-36)	15 (12-29)
2007	25 (1-111)	22 (10-41)	21 (6-48)
2008	28 (11-51)	18 (10-33)	21 (4-40)
2009	16 (1-57)	15 (5-34)	20 (15-30)
2010	49 (25-93)	31 (24-39)	28 (22-37)

Table A-18: Wild Rice Acreage and Abundance Index on Stone Lake

Year	Lake Acreage	% Rice Coverage	Rice Acreage	Average # Stalks per 1/2 sq. meter	Abundance Index
1998	230	75	173	96	16608
1999	230	63	145	29	4205
2000	230	29	67	36	2412
2001	230	37	85	86	7310
2002	230	51	117	53	6201
2003	230	53	122	39	4758
2004	230	53	122	66	8052
2005	230	66	151	37	5587
2006	230	36	83	17	1411
2007	230	69	159	25	3975
2008	230	40	92	28	2576
2009	230	28	64	16	1024
2010	230	36	83	49	4067

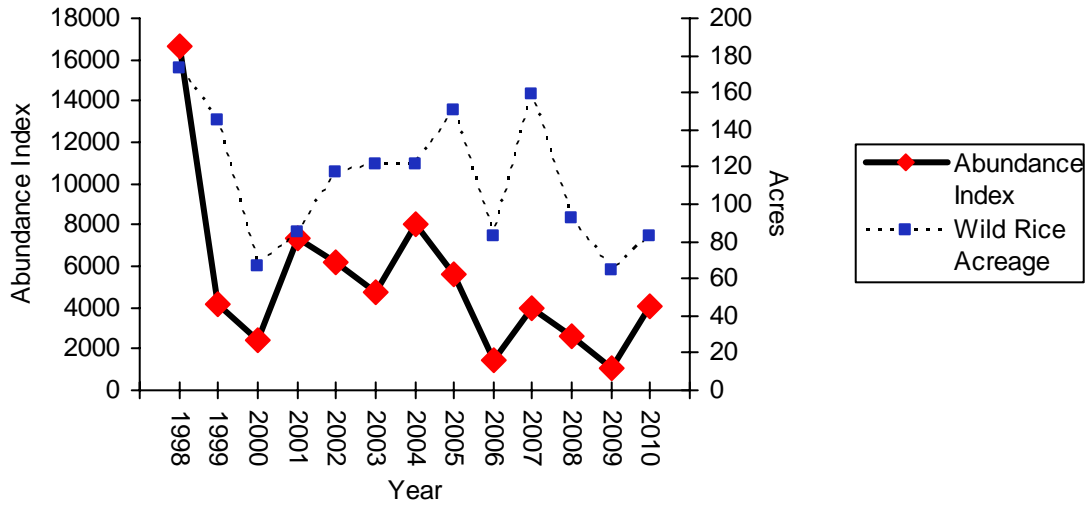


Figure A-17: Abundance Index and Wild Rice Acreage on Stone Lake (1998-2010)

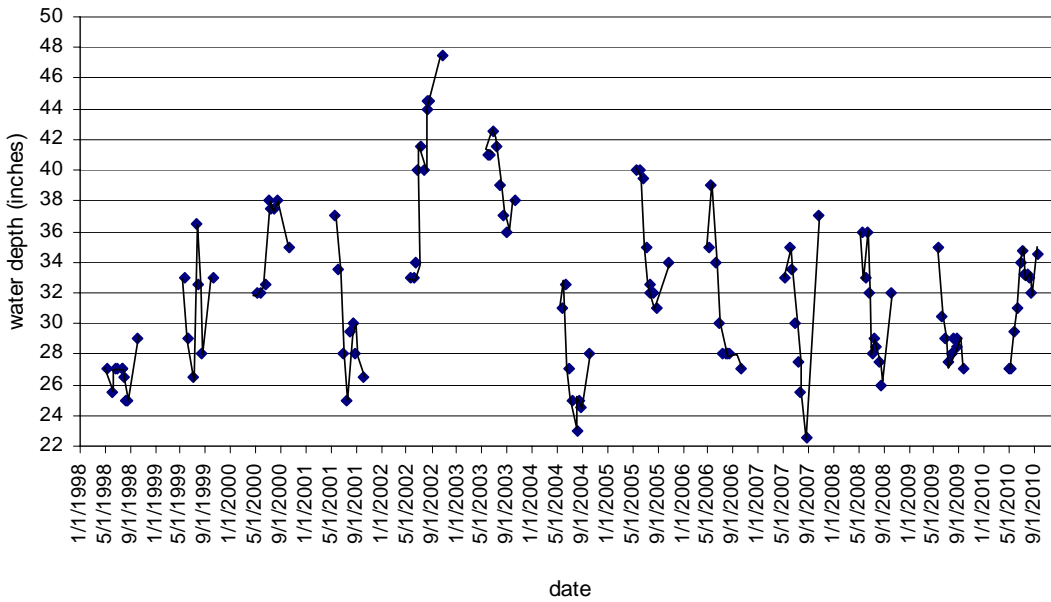


Figure A-18: Water Depth on Stone Lake (1998-2010)

Vermilion River

St. Louis County - township 67N, range 17-18W (DNR ID#: 69-0613 00)

**Table A-19: Wild Rice Density and Sample Plant Averages on Vermilion River
(ranges included in parentheses)**

Year	Average # Stalks per 1/2 sq. meter	Average Numbers for Sample Plants	
		Height in inches	Water Depth in inches
2001	23 (4-54)	17 (7-34)	44 (32-49)
2002	64 (32-97)	38 (23-61)	27 (15-37)
2003	37 (15-64)	25 (10-38)	17 (5-33)
2004	69 (6-111)	31 (6-67)	20 (10-33)
2005	44 (3-97)	25 (5-54)	18 (8-31)
2006	101 (26-205)	47 (32-62)	14 (0-33)
2007	64 (5-125)	33 (15-56)	11 (2-24)
2008	76 (17-154)	30 (7-47)	26 (11-38)
2009	45 (9-83)	32 (17-53)	22 (6-36)
2010	22 (0-45)	24 (14-36)	23 (8-34)

Table A-20: Wild Rice Acreage and Abundance Index on Vermilion River

Year	River Acreage	% Rice Coverage	Rice Acreage	Average # Stalks	Abundance
				per 1/2 sq. meter	Index
2001	303	20	61	23	1403
2002	303	65	197	64	12608
2003	303	58	176	37	6512
2004	303	83	251	69	17319
2005	303	77	234	44	10296
2006	303	84	255	101	25755
2007	303	66	200	64	12800
2008	303	85	258	76	19608
2009	303	84	255	45	11475
2010	303	68	206	22	4532

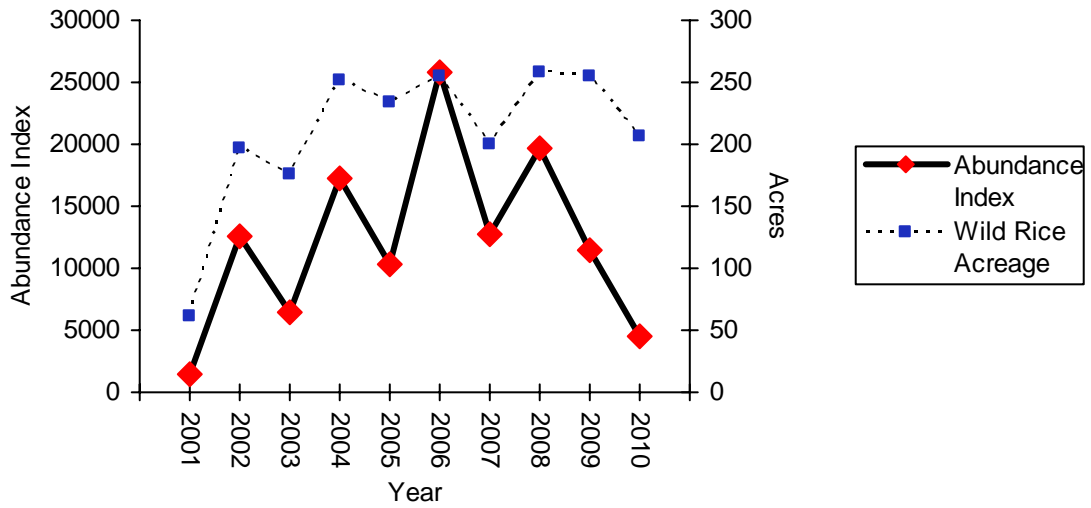


Figure A-19: Abundance Index and Wild Rice Acreage on Vermilion River (2001-2010)

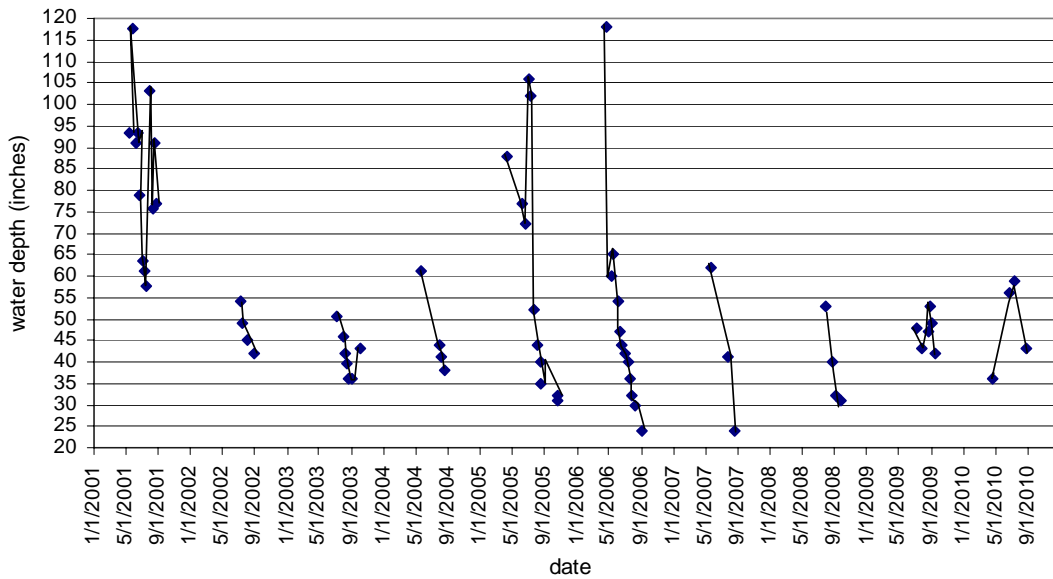


Figure A-20: Water Depth on Vermilion River (2001-2010)*
 *recorded at bridge in Buyck, some readings from MNDNR webpage